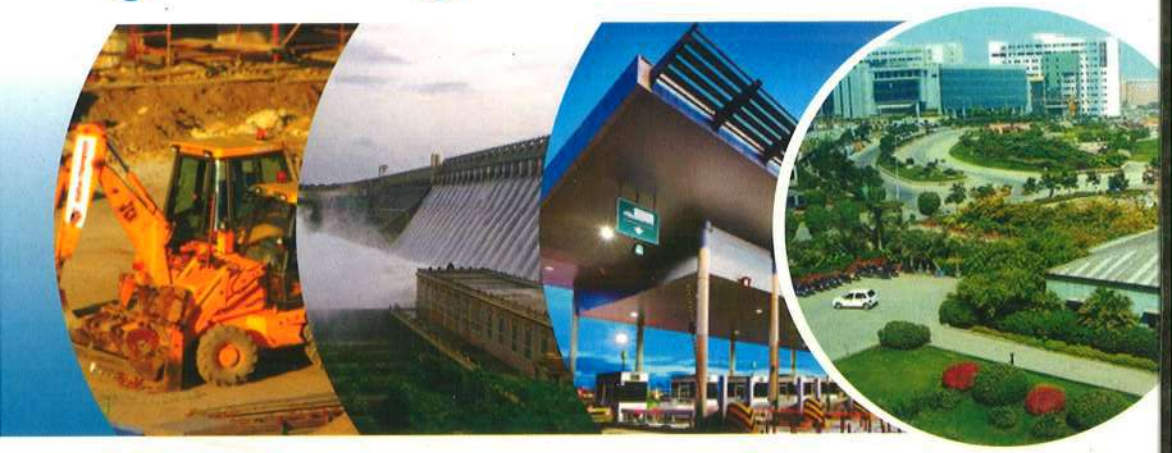
Padala Rama Reddi

The Andhra Pradesh Detailed Standard Specifications and General Principles of Engineering Contracts



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THE
ANDHRA PRADESH
DETAILED STANDARD SPECIFICATIONS
AND
General Principles of Engineering Contracts

By

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With a Foreword By
Hon'ble Justice Alladi Kuppuswamy
Chief Justice (Retd.), High Court of A.P.

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THE ANDHRA PRADESH

DETAILED STANDARD SPECIFICATIONS & General Principles of Engineering Contracts

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FOREWORD

I am glad to learn that Sri Padala Rama Reddi has compiled the Andhra Pradesh Public Works Code which is being brought out in three volumes containing the A.P. Public Works Department Code, A.P. Public Works Accounts Code and the A.P. Detailed Standard Specifications respectively.

He has been responsible in the past for getting published a number of Codes and Manuals like the Andhra Pradesh Education Code, Andhra Pradesh Civil Services Code, Andhra Pradesh Co-operative Law Manual and Andhra Pradesh Gram Panchayats Manual, etc.

These three volumes will be welcome additions to such publications. The Contractors and their Engineers on the one hand and the Departmental Officers and Engineers on the other are equally interested in having an upto date compilation of the various rules, executive instructions, case law, etc., relating to a number of matters connected with public works. In the absence of a complete code containing the rules and instructions it will be practically impossible to carry out any undertaking relating to public works. The authors have taken immense pains to collect all the material.

I have no doubt that these volumes will be extremely useful not only to the Contractors and their Engineers as well as the Departmental Officers but also to the Lawyers who assist the Contractors and Department and who have also to appear sometimes before the Arbitrators and the Courts in proceedings arising out of arbitration.

ALLADI KUPPUSWAMI

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PRELIMINARY SPECIFICATIONS

A. — Preface

P.S. 1. Intent and reference to Andhra Pradesh Standard Specifications :— It is intended by these Andhra Pradesh Standard Specifications to describe—

(a) the character of the materials to be used;

(b) the method of execution of work; and

(c) the contractor's responsibilities and liabilities to the Public, Government, and his workmen and general contract conditions which are to be accepted by every contractor who executes work entrusted to him by the Public Works Department of Andhra Pradesh.

Whenever the term "*Standard Specification*" or the abbreviation "*A.P.S.S.*" is used in estimates or contract documents, it shall refer to the relevant specification in the Andhra Pradesh Standard Specifications book and its addenda volume.

P.S. 2. Applicability of the Andhra Pradesh Standard Specifications :—It shall be unnecessary to include in any contract documents a specification for any item of work which is defined in the tender notice or in the contract schedule of work to be done, by a standard specification number. The fact that the item is defined as standard specification shall mean that the contractor is to execute the work according to such standard specification, modified as may be necessary by an addendum specification for that particular item of work.

This preliminary specification shall apply to all agreements entered into by contractors with the Public Works Department and shall form an inseparable condition of contract, and it shall not be necessary to append a copy of the same to agreement.

P.S. 3. Contractor to sign in the Divisional or the Sub-Divisional copy of the A.P.S.S. :—Every contractor who executes work for the Public Works Department shall carefully study the standard specification for all items of work which are included in the schedule for work to be done as standard specifications and his obligations under the "Preliminary Specification" which apply to all agreements, and he shall sign in the Divisional office copy of the A.P.D.S.S. (or the Sub-Divisional copy if so arranged by the Executive Engineer) as evidence that he understands clearly the conditions of contract governing his agreement and accepts the same.

It shall not be necessary for the contractor to sign the Divisional office copy of the A.P.S.S. for every contract awarded to him, but his signature there in will be evidence that he accepts the conditions of contract (which includes the standard specifications) as detailed in the A.P.D.S.S. for every contract into which he enters. I shall also be the contractor's responsibility by frequent perusal of the Divisional office (or the Sub-Divisional office) copy to become conversant with sanctioned alterations or additions made to the A.P.S.S. as soon as they are made. A separate volume of addenda to the A.P.D.S.S. will be maintained in each Division (or Sub-

Division office as the case may be) in which will be entered all sanctioned corrections and additions. This must also be studied and signed by every contractor before executing an agreement. Interleaving correction slips will not be made for this purpose. The contractor should purchase a book of the A.P.D.S.S. for his reference while executing work.

P.S. 4. Term "Specification" apart from "Standard Specification" :—Whenever the term "*Specification*" is used in contract documents apart from "Standard Specification", it shall mean the specification or plan prepared for the particular item referred to in the document, for the instruction of the contractor in executing that item of work.

P.S. 5. Sub-Specifications :—Works of a similar nature having many common clauses in their specifications are grouped under one specification number with a "General", preface thereto, and the sub-specifications are therefore given an alphabetical affix.

P.S. 6. Additions and alterations to the standard specifications In the A.P.S.S.:—Which do not involve legal implications will be approved by the Chief Engineer (General) in consultation with the other Chief Engineers. Additions and alterations to the preliminary specifications and standard forms in the A.P.S.S. will be approved by the Government.

P.S. 7. Powers of Superintending Engineers and Executive Engineers to supplement or alter the A.P.S.S. :—Superintending and Executive Engineers may alter the standard specifications for any particular contract, which is within their respective powers of sanction —, when such alteration is found necessary, by attachment of a correction sheet to the contract form, bearing the standard specification number, the corrections, and the signature of the Superintending or the Executive Engineer, as the case may be, together with the signature of the contractor. Similarly, additional specifications for items for which there are no standard specifications will be made by attachment to the contract documents of addendum specification sheets bearing the signature of the Superintending or the Executive Engineer as the case may be and the signature of the contractor.

P.S. 8. Definition of terms :—Wherever the words defined in this clause or pronouns used in their stead occur in contract documents (which includes the A.P.S.S.), they shall have the meanings here given.

(a) *Executive Engineer* :—Wherever the term Executive Engineer is used, it shall be understood to refer the Executive Engineer for the time being in charge of the concerned work under execution or such other departmental assistants or subordinates to whom the Executive Engineer may have delegated certain duties, acting severally within the scope of the particular duty entrusted to them.

(b) No delegation by Executive Engineer, Superintending Engineer or higher authority which affects agreement. it is, however, to be distinctly understood that the Executive Engineer or the Superintending Engineer or the higher authority who is vested with the powers of acceptance of the particular agreement under reference will make no delegation of powers to such assistant or subordinates which in any way affects the agreement and its contracts condition when such agreement is to be or has been accepted by the Executive Engineer or by the other higher

authority respectively. The duties of such assistants or subordinates will be solely duties of supervision to ensure compliance with contract conditions.

(c) ***Contractor*** :—Wherever the term "Contractor" is used, it shall be understood to refer to the particular person, firm or corporation with whom an agreement has been made by the Executive Engineer or higher authority as the case may be, for executing work defined in the concerned agreement, and for purposes of instructions regarding compliance with contract conditions, it shall include the contractor's authorized agent, who is maintained on the work by the contractor. When two or more contractors are engaged on installation or construction work in the same vicinity, the Executive Engineer shall be authorized to direct the manner in which each shall conduct the work so far as it affects other contractors.

Note :—The terms Sub-Divisional Officer, Assistant Engineer, Executive Engineer, Superintending Engineer and Chief Engineer used in the following clauses shall, where the context so requires, be construed as including officers of the corresponding grade in the Highways Department.

P.S. 9. Evidence of Experience :—Tenderers shall, if required, present satisfactory evidence to the Executive Engineer that they have been regularly engaged in constructing such works as they propose to execute and that they are fully prepared with the necessary capital, machinery and materials to begin the work promptly and to conduct it as required by the A.P.S.S. and the other specifications for the particular work tendered for, in the event of their tender being accepted.

P.S. 10. Legal address — Notices :—Tenderers should gave in their tender, their place of residence and postal address. The delivering at the above named place or posting in a post box regularly maintained by the Post Office Department or sending by letter registered for acknowledgement of any notice, letter or other communication to the contractor shall be deemed sufficient service thereof upon the contractor in writing as may be changed at any time by an instrument executed by the contractor, and delivered to the Executive Engineer.

Nothing contained in the agreement and its contract conditions shall be deemed to preclude or render inoperative the service of any notice, letter, or other communication upon the contractor personally.

B. — Statement of approximate quantities in Schedule A

PS. 11. Quantities approximate and contractor to verify the nature and amount of work :—The quantities mentioned in tender notices and given in agreement (Schedule A) are worked out from the relevant drawings in Public Works Department Office and may or may not be the actuals required for execution. The Executive Engineer does not expressly or by implication agree that the actual amount of work to be done will correspond therewith but reserves the right to increase or decrease the quantity of any class or portion of the work as he deems necessary. Provided there is no change in the over all scope of the work.

(Amended by G.O.Ms.No. 1007, Tr. Roads & Blds. (c) Dept., Dt. 5-11-1976)

Tenderers must satisfy themselves by a personal examination of the site of the proposed work, by examination of the plans and specifications and by other

means as they prefer as to the accuracy and sufficiency of the statement of quantities and all conditions affecting the work and shall not at any time after the submission of their tender, dispute or complain of such statement of qualities, not assert that there was any misunderstanding in regard to the nature or amount of the work to be done nor in consequence apply for extension of time for completion beyond the agreement date.

P.S. 12. Approximate not to mean deviation from drawings and specifications:—The declaration of the approximate nature of the statement of quantities in Schedule A does not, however, in any way imply that the quantities will be increased for departure by the contractor from strict compliance with sanctioned drawings and specifications to suit his own given convenience or reduce
costs.

P.S. 13. To compare tenders :—The quantities in Schedule A are for a uniform comparison of lump-sum tenders.

C. — Drawings and Specifications

P.S. 14. Purpose :—The contract drawings if any read together with the contract specification are intended to show and explain the manner of executing the work and to indicate the type and class of material to be used.

P.S. 15. Conformance :—(a) The works shall be carried out in accordance with the directions and to the reasonable satisfaction of the Executive Engineer, in accordance with the drawings and specifications which form part of the contract and in accordance with such further drawings, details and instructions, supplementing or explaining the same as may from time to time be given by the Executive Engineer.

(b) If the work shown on any such further drawings or details, or other work necessary to comply with any such instructions, directions or explanations, be in the opinion of the contractor, of a nature which the schedule rate in the contract does not legitimately cover, he shall before proceeding with such work, give notice in writing to this effect to the Executive Engineer. In the event of the Executive Engineer and the contractor failing to agree as to whether or not there is any excess rate to be fixed and the Executive Engineer deciding that the contractor is to carry out the said work, the contractor shall accordingly do so, and the question whether or not there is any excess, and if so the amount thereof, shall, failing agreement, be settled by an arbitrator as provided in the arbitration clause, unless the subject is one which is left to the sole discretion of the Executive Engineer under the clauses of his preliminary specification, and the contractor shall be paid accordingly.

(c) It shall be the responsibility of the contractor to give timely notice to the Executive Engineer, regarding anything shown on the drawings and not mentioned in the specifications, or mentioned in the specifications and not shown on the drawings, or any error or discrepancy in drawings or specifications and obtain his orders thereon Figured dimensions are to be taken and not those obtained from scaling the drawings. In any discrepancy between drawings and specifications, the latter shall prevail. In any such case or in case any feature of the work is not

fully described and set forth in the drawings and specifications, the contractor shall forthwith apply to the Executive Engineer for such further instructions, drawings, or specifications as he requires, it being understood that the subject is to be dealt with under building procedure of best modern practice. The Executive Engineer will furnish the further instructions, drawings, or specifications, if in his opinion, they are required by competent workmen, for the proper execution of the work.

P.S. 16. Variations by way of modifications, omissions or additions :- (a) For all modifications, omissions from or additions to the drawings and specifications, the Executive Engineer will issue revised plans, or written instructions or both and no modification, omission or addition shall be made unless so authorized and directed by the Executive Engineer in writing.

(b) The Executive Engineer shall have the privilege of ordering modifications, omissions or additions at any time before the completion of the work and such orders shall not operate to annul those portions of the specifications with which said changes do not conflict.

P.S. 17. Copies of drawings and specifications :—One copy of the available drawings and specifications for (apart from the A.P.S.S. a copy of which the contractor should purchase for his reference) shall be furnished free of cost to the contractor for his own use. Such copies and copies of supplementary details furnished by the Executive Engineer shall be kept on the work until the completion thereof, and the Executive Engineer shall at all times have access to them.

P.S. 18. Signed drawings — No authority to the contractor :—No signed drawing shall be taken as in itself an order for variation, unless either it is entered in the agreement schedule of drawings under proper attestation of the contractor and the Executive Engineer, or unless it has been sent to the contractor by the Executive Engineer, with a covering letter confirm that the drawing is an authority for variation for the contract under reference.

P.S. 19. Finished sizes :—The whole of the specified or figured dimensions or drawings are to be finished sizes, after dressing or planning or cutting, subject however to the condition that, unless marked “nett,” 1.5 mm will be allowed for planning for each planed finished surface of wood-work, when the contractor is permitted to use carefully sawed market size cut scantlings. This allowance will only be permitted in the case of Sections 15mm thick or over. The figure dimensions of masonry walls and reinforced concrete are exclusive of the thickness of plaster or skirtings or cement or wall linings, unless otherwise specifically stated.

D. — Materials and Workmanship

P.S. 20. To be the best quality :—All materials, articles and workmanship shall be the best of their respective kinds for the class of work described in the contract specification and schedule, materials being obtained from sources approved by the Executive Engineer. The word “best”, as used in these specifications shall mean, that in the opinion of the Executive Engineer there is no superior quality of material or finish or articles on the market and that there is no better class of workmanship available for the nature of the particular item described in the contract schedule. The contractor shall, upon the request of the. Executive Engineer, furnish him with the vouchers to prove that the materials are such as are specified.

Samples of materials shall be furnished at the contractor's expense to the Executive Engineer when called for in the tender notice or ordered to be furnished by the Executive Engineer prior to execution of any work.

P.S. 21. Conventions for proportions :—Wherever the proportions are written by figures without further descriptions and there the meaning is otherwise clear as to which figures is intended to apply to each material, then the usual conventions will be understood to apply

For example :

1:2 means 1 lime (or cement in accordance with the context) and 2 sand.

1:2:4 means 1 lime (or cement in accordance with the context), 2 sand, and 4 broken stone (or other aggregate in accordance with the context).

P.S. 22. Measurement and mixing :—In the case of loose materials such as lime, sand, cement broken stone, surki, mortar, etc., the proportions demanded by the specifications must be measured in properly constructed measuring boxes, or in such other manner as shall be instructed by the Executive Engineer. Measurement is not to be done in loose heaps when intimate mixtures such as mortar, concrete, etc., are to be formed. The mixing must always be done on closely constructed platforms so that there will be no leakage of any of the materials through the floor of the platform and also so that no foreign material can be incorporated during the mixing. These platforms must be approved by the Executive Engineer. The cost of such measuring boxes and platforms and all the work referred to herein shall be borne by the contractor.

P.S. 23. Data :—The materials and labour utilized in the execution work by the contractor shall not be less than that given in the A.P.P.W.D. standard data for the relevant item.

P.S. 24. Lay-out of material stacks :—The contractor shall deposit materials for the purpose of the work on such parts only of the ground as may be approved by the Executive Engineer. He shall submit, for the approval of the Executive Engineer, before starting work, a detailed site survey clearly indicating positions and areas where materials shall be stacked and sheds built.

P.S. 25. Source of purchase of materials and stores :—The Executive Engineer shall, during the progress of the work, have power to cause the contractor to purchase and use such materials, or supplies from Government brick-fields, stores or other sources as may be specified in the contract, for the purposes therein specified.

P.S. 26. Contractor liable for materials supplied by the Government :— The contractor shall be responsible for all materials and other articles and things which may be supplied by Government from the time he takes delivery thereof and shall use them only for the purposes of this contract and shall make good any loss, damage, wastage or undue wear and tear that may take place from whatever cause and pay to Government, for such loss, damage, wastage or undue wear and tear such sum as the Executive Engineer may determine.

P.S. 27. Test inspection and rejection of defective materials and work :— (a) The contractor shall provide proper facilities at all times, for the testing

of materials and inspection of the work by the Executive Engineer and the Executive Engineer shall accordingly also have access at all times to the place of storage or manufacture where materials are being made for use under the contract to determine that manufacture is proceeding in accordance with the drawings and specifications.

(b) The contractor shall, upon demand, also forward for the Executive Engineer's inspection, test certificates supplied by the vendors, when he is purchasing consignments of cement, steel and other materials in respect of which such certificates are usually available.

(c) The Executive Engineer shall have power to reject at any stage, any work which he considers to be defective in quality of material or workmanship and he shall not be debarred from rejecting wrought materials by reason of his having previously passed them in an unworked condition. Any portion of the work or materials rejected or pronounced to be inferior or not in accordance with the drawings and specifications, shall be taken down and removed from the work-site at the contractor's expense, within 24 hours after written instructions to that effect have been given by the Executive Engineer. Replacement shall at once be made in accordance with the specifications and drawings, at the contractor's expense.

In case of default on the part of the contractor to carry out such orders, the Executive Engineer shall have power to employ and pay other persons to carry out the orders at the contractor's risk and all expenses consequent thereon and incidental thereto shall be borne by the Contractor.

In lieu of rejecting work not done in accordance with the contract, the Executive Engineer may allow such work to remain, and in that case shall make such allowance for the difference in value, as in his opinion may be reasonable.

(d) ***Works opened for inspections*** :—The contractor shall at the request of the Executive Engineer, within such time as the Executive Engineer shall name, open for inspection any work covered up; and should the contractor refuse or neglect to comply with such a request, the Executive Engineer may employ workmen to open the same. If the said work has been covered up in contravention of the Executive Engineer's instructions, or if on being opened up, it be found not in accordance with the drawings and specifications or the written instructions of the Executive Engineer the expenses of opening it and covering it up again, whether done by the contractor or such workmen, shall be borne by, or recovered from the contractor. If the work has not been covered up in contravention of such instructions, or if on being opened up it be found to be in accordance with the drawings and specifications or the written instructions of the Executive Engineer, then the expenses aforesaid shall be borne by Government and shall be added to the contract sum, provided always that in the case of foundations, or any other urgent work so opened up and requiring immediate attention, the Executive Engineer shall, within reasonable time after the receipt of a notice from the contractor that the work has been so opened, make or cause the inspection thereof to be made and at the expiration of such time if such inspection shall not have been made, the contractor may cover up the, same and shall not be required to open it up again for inspection except at the expense of Government.

P.S. 28. Defects, shrinkage, etc., after completion :—Any defects, shrinkage or other faults which may appear within six months from the completion of the works arising, in the opinion of the Executive Engineer, from faulty materials or workmanship not in accordance with the drawings and specifications or the instructions of the Executive Engineer, shall, upon the directions in writing of the Executive Engineer and within such reasonable time shall as be specified therein, be amended and made good by the contractor at his own cost, unless the Executive Engineer shall decide that the contractor ought to be paid for the same at the rates agreed or such reduced or other rates as the Executive Engineer may fix and in case of default, the Executive Engineer may employ and pay other persons to amend and make good such defects, shrinkage or other faults or damage and all expenses consequent thereon and incidental thereto shall be borne by the contractor.

[In the event of Government taking over portions of the works as and when they are completed, the liability of the contractor shall be limited to the period of six months from the date of taking over the portion or portions of the work, provided that the portion or portions taken over has no connection with the remaining portions of the main work and is independent of it].

[Subs. by G.O.Ms.No. 1007, Tr., R. & B.(Cl) Dept., Dt. 5-11-1976]

P.S. 29. Executive Engineer's decision :—To prevent disputes and litigation, it shall be accepted as in inseparable part of the contract that in matters regarding materials, workmanship, removal of improper work, interpretation of the contract drawings and contract specifications, mode of procedure, and the carrying out of the work, the decision of the Executive Engineer shall be final and binding on the contractor, and in any technical question which may arise touching the contract, the Executive Engineer's decision shall be final and conclusive.

[In the case of any difference between Executive Engineer and contractor on matters regarding materials, workmanship, removal of improper work, interpretation of contract drawings and contract specifications, mode of procedure and the carrying out of work, the contractor shall have a right of appeal to the next higher authority viz., the Superintending Engineer of the Circle, and the decision of the latter shall be final and conclusive].

[Added by G.O.Ms.No. 1007, Tr.,Rds., & Blds. (Cl) Dept., Dt. 5-11-1976]

P.S.30. Dismissal of Workmen :—The contractor shall, on the request of the Executive Engineer, immediately dismiss from the works any person employed thereon who may, in the opinion of the Executive Engineer, be incompetent or misconduct himself, and such person shall not be again employed on the works without the written permission of the Executive Engineer, but the contractor may appeal to the Superintending Engineer of the Circle against such dismissal.

P.S. 31. Contractor's maistri or agent and Contractor's staff :—The contractor shall, in his own absence keep constantly on the works a competent maistri or agent, and any directions or explanations given by the Executive Engineer or his representatives to such maistri or agent shall be held to have been given to the contractor.

The contractor shall further provide all staff which is necessary for the supervision, execution and measurement of the work to ensure full compliance with the terms of the contract.

P.S. 32. Government maistries or agents :—The Government may be represented on the works by an agent, clerk of the works, or maistri who is not borne on the official list of officers and subordinates of the Public Works Department. He (if appointed) shall, in the absence of the Executive Engineer, furnish the contractor with the Executive Engineer's or his representative's instructions and directions as to the progress and execution of the works and the contractor shall duly comply with such instructions and directions and shall, on the written requisition of the maistri, clerk of works or agent, stay the further progress of any portion of the works which in his judgment is being constructed with unsound or improper materials or workmanship, until the opinion and determination of the Executive Engineer shall be obtained thereon, but such maistri, clerk of works or agent, is to have no power whatever to order any extra works or deviation from the specifications and drawings.

E. — Included in the Contract Rates

The items mentioned in this Section 'E' are to be provided by the contractor and are therefore to be allowed for in his contract rates for the various items of work in the contract schedule, notwithstanding any contrary manual procedure claimed by the contractor, unless there are definite superseding instructions in the specifications relating to the contract in question.

P.S. 33. Defining Contract Schedule Rates :—The rate entered in a contract schedule for any class of work shall be for finished work in site and shall include all contingent expenses whether direct construction expenses involved in the building in place in accordance with the drawings and specifications, or whether they be expenses imposed by an outside authority such as a local body Such contingent expenses shall not entitle the contractor to claim an extra in respect thereof.

P.S. 34. Carriage :—(a) Rates for finished work shall always include the cost of conveyance and all leads, lifts, loading, unloading and stacking in the manner and at the place ordered by the officer in immediate charge of the work, unless circumstances necessitate provisions for a separate schedule item, in which case such will be specified in the tender notice or schedule. When materials are supplied by Government, the place of supply shall be specified in the Descriptive Specification Sheet mentioned in the Tender Notice and no extra payment will be stacking. If the place of supply is not so specified, the parties intending to tender should obtain the information from the Executive Engineer before tendering. Otherwise, the absence of information in regard to place of supply will not entitle the contract to any extra payment.

(b) Whether the term "carriage" or "conveyance" is used in a schedule item, it shall, in the absence of other schedule provision or modifying description in the specification, be taken to include all leads, lifts, loading, unloading and stacking in uniform stacks to the satisfaction, of the Executive Engineer, with careful attention to close packing in the case of materials which are to be measured in stacks as a basis of payment for finished work.

Note :—In the case of important leads and lifts as may occur in River Conservancy and other such works, where lifts over flood banks and long leads

may be involved, it is usual to make separate schedule item provision with a specification defined the exact work to be done for each tendered rate.

Payment for carriage will ordinarily be by bulk or weight at a mileage rate between specified places and on the basis of the method adopted in the standard schedule of rates for carriage of materials. The distance will be measured by the nearest practicable and cheapest route, whether metalled or unmettalled road or cart- track.

(c) When carts or vehicles of any sort are engaged by the day, the quantity of material to be converted, the distance to be travelled and the number of trips to be made shall, if he considers it necessary, be fixed by the Executive Engineer.

(d) The contractor is responsible for making good all loss in transporting material entrusted to him or his agents, whether caused by wastage, breakage, theft, or any other cause.

(e) No payment shall, in any case, be made for the return trip with carts empty. Where there are loads also for the return trip, the agreement rates should allow for the reduced cost thereby on each set of materials so conveyed..

P.S. 35. Construction Plant :—The contractor shall include in his tendered price, and shall provide and install all necessary construction plant and shall use such methods and appliances for the performance of all the operations connected with the work embraced under the contract as will secure a satisfactory quality of work and rate of progress which, in the opinion of the Executive Engineer, will ensure the completion of the work within the time specified. If at any time before the commencement, or during the progress of the work, or any part of it, such methods or appliances appear to the Executive Engineer to be insufficient or inappropriate for securing the quality of the work required, or the said rate of progress, he may order the contractors to increase their efficiency, or to improve their character, and the contractor shall comply with such orders; but the failure of the Executive Engineer to demand such increase of efficiency or improvement shall not relieve the contractor from his obligation to secure the quality of work and the rate of progress required by the contract, and the contractor alone shall be responsible for the efficiency and safety of his plant, appliances and methods.

[If the department intends to supply any tools and plant to the contractor on hire, the details of such tools and plant, the hire charges leviable and the terms of hiring them should invariably be specified in the tender schedules and in the agreement, and the same should not be varied during the contract period. If, however, the department is not able to supply any of the tools and plant indicated in the agreement, the contractor shall claim no compensation but can only claim reasonable extension of contract tine. If any other tools and plant, that are available with the department but are no indicated in the agreement, are supplied to the contractor during the course of the work, the hire charges and conditions of hire prevailing in the department at the time of actual supply shall be applicable].

[Subs. by G.O.Ms.No. 1007, Tr., R&B (C) Dept., Dt. 5-11.1976]

P.S. 36. Scaffolding instructions :—All requisite scaffolding shall be provided at the contractor’s expense and shall be double, i.e., it must have two sets of upright supports. Care must be taken to ensure the safety of the workpeople and

the contractor must comply with such instructions as the Executive Engineer may issue to ensure such safety. The contractor will be entirely responsible for any damage or injuries to persons or property resulting from ill-erected scaffolding, defective la4ders, or - otherwise arising out of his default in this respect.

P.S. 37. Temporary instructions :—The contractor shall erect and maintain at his own cost temporary weather-proof sheds at such places and in a manner approved by the Executive Engineer for keeping materials under cover. The contractor shall also provide and maintain at his own expense such temporary fences, guards, bridges and roads as may be necessary for the execution of his contract work or for safeguarding or accommodating the public. If the Executive Engineer shall order any departure from any arrangements made by the contractor, the contractor shall comply with such orders as the Executive Engineer may issue to safeguard or accommodate the public. Sheds for housing workmen shall be provided at the contractor's expense, if in the opinion of the Executive Engineer such are necessary or desirable.

P.S. 38. Water and lighting :—The contractor shall pay fees and provide water and light as required from Municipal mains or other sources, and shall pay all charges therefor (including storage tanks, meters, etc.) for the use of the works and workmen, unless otherwise arranged and decided on, in writing, with the Executive Engineer. The water for the works shall be, so far as practicable, free from earthy, vegetable, or organic matter, and from salts or other substances likely to interfere with the setting of mortar or otherwise prove harmful to the work.

P.S. 39. Latrines for Work-people :—The contractor shall provide and erect, prior to the commencement of work, sufficient latrines for the use of the work people, male and female, and shall keep the same disinfected and clear at all time during progress of the works, and shall remove the same, disinfect the ground and make good all damage on the completion of the work.

P.S. 40. Sun protection, keeping dry and pumping :—The contractor shall at his own expense arrange all requisite protection of the work and materials against sun or rain effects and shall keep all portions of the work free from water to the satisfaction of the Executive Engineer and shall use his own plant for the purpose, unless otherwise specifically provided in the contract specifications.

P.S. 41. Tools and seigniorage :—The contractor shall, unless otherwise specially stated in the tender notice and subsequently on this basis in the contract be responsible for the payment wherever payable of all import duties, tolls, octroi duties, seigniorages, quarry fees, etc., on all materials and articles that he may use.

The contractor shall be solely responsible for the payment of sales tax under the provisions of the Andhra Pradesh General Sales Tax Act, as in force for the time being and the rates for the various items of work shall remain unaffected by any change that may be made from time to time in the rate at which such tax is payable.

Notwithstanding anything contained in Section 10 of the Indian Tariff Act of 1894 the rates for items involving the use or supply of articles obtained by the contractor from outside India shall remain unaffected by any charges that may be introduced in the Customs duties.

Note :—For works carried out on behalf of the Government of India seigniorage fees, etc., referred to in this clause will have to be levied in every case.

P.S. 42. Setting out works :—The contractor shall be responsible-for the correct setting out of all works, providing at his own cost all labour3 materials and staff required for so doing.

P.S. 43. Cleaning up during progress and for delivery :—All rubbish shall be burnt or removed from the site as it accumulates. All floors, stairs, landings, doors, windows, surface and soil drains shall be cleaned down and put in a thoroughly complete, clean, sound and workman like state to the satisfaction of the Executive Engineer before the work is finally handed over, all rubbish and surplus materials not required by the Executive Engineer having first been removed by the contractor. The contractor shall give notice in writing to the Executive Engineer when the work is so ready to be handed over, and shall be responsible for its maintenance until it is taken over by the Executive Engineer.

[The Executive Engineer should take over the work within one month of such notice from the contractor, if the work has been satisfactorily completed in terms of the agreement].

[Added by G.O.Ms.No. 1007, Tr., Roads and Blds. (Cl) Dept., Dt. 5-1 1-1 976]

F. — Responsibilities and Liabilities of the Contractor

Explanation :—This section sets forth some responsibilities which the contractor shall assume in addition to those mentioned in other sections of this "Preliminary Specifications" under every contract which he enters into, with the Andhra Pradesh Public Works Department and he should therefore calculate his unit prices for schedule items of work accordingly.

P.S. 44. Observance of Laws — Local regulations and notices — Attachments:—The contractor shall conform to the regulations and bye-laws of any local authority and/or of any water or lighting companies with whose systems the structure is proposed to be connected and shall, before making any variations from the drawings or specifications that may be necessitated by so conforming, give to the Executive Engineer written notice, specifying the variations proposed to be made and the reasons for making them, and apply for instructions thereon. In case the contractor shall not receive such instructions within seven days, he shall proceed with the work, conforming to the provision; regulation or bye-law in question; and any variations in the drawings or specifications so necessitated shall be dealt with under clause 63. The contractor shall give all notices required by the said Acts, regulations or bye-laws and pay all fees in connection therewith, unless otherwise arranged and deciding on in writing with the Executive Engineer. He shall also ensure that no attachments are made against materials or work forming part of or for the use of the contract. In every case referred to in this clause the contractor shall protect and indemnify Government against any claim or liability arising from or based on the violation of any such law, ordinance, regulation, order, decree, or attachment whether by himself or by his employees.

P.S. 45. Accidents — Hoarding, Lightings, Observations — Watchmen :—
(a) When excavations have been made or obstacles have been put in public
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through fares or in places where there is any likelihood of accidents, the contractors shall comply with any requirement of law on the subject, and shall provide suitable hoarding, lighting and watchmen as necessary.

[(b) it shall be the Contractor's sole responsibility to protect the Public and his employees against accident from any cause and he shall indemnify Government against any claims for damages for injury to person or property, resulting from any such accidents, and shall where the provisions of the Workmen's Compensation Act, 1923, apply, take steps to properly insure against any claims 3hereunder. The contractor shall execute the 'Indemnity pond' in the prescribed form noted below for the payment of claims coming under (a) Workmen's Compensation Act, 1923, (b) Minimum Wages Act, 1948, (c) Payment of Wages Act, 1936, (d) Contract Labour (Regulation and Abolition) Act, 1970 and all other such Acts in force and that may be enacted from time to time during the currency of the agreement.

The following Indemnity Bond is to be executed by the Contractor while entering into an agreement in respect of contract Works:

Indemnity Bond

Name of the Works:

Agreement No.

I, ……. Contractor, s/o ……..
Aged …….. Resident of ……
do hereby bind myself to pay all the claims which may come (a) under Workmen's Compensation Act, 1923, with any statutory modification thereof and rules thereunder or otherwise for or in respect of any damage or compensation payable in connection with any accident or injury sustained, (b) under Minimum Wages Act, 194, (c) under Payment of Wages Act, 1936, (d) under the Contract Labour (Regulation and Abolition) Act, 1970 by any workmen engaged for the performance of the business relating to the above contract i.e. ……
……
failing such payment of claims of workmen engaged in the above work I abide in accepting for the recovery of such claims affected from any of my assets with the Department.] (Subs. by G.O.Ms. No. 85, TR & B (B.I.(2) Dept. Dt. 12-2-1986)

(c) On the occurrence of an accident which results in the death of any of the workmen employed by the contractor or which is so serious as to be likely to result in the death of any such workmen, the contractor shall, within 24 hours of the happening of such accident, intimate in writing to the concerned Section Officer of the Public Works Department, the fact of such accident. The contractor shall indemnify Government against all loss or damage sustained by Government resulting directly or indirectly from his failure to give intimation in the manner aforesaid including the penalties or fines if any payable by Government as a consequence of Government's failure to give notice under the Workmen's Compensation Act or otherwise confirm to the provisions of the said Act in regard to such accident.

(d) In the event of an accident in respect of which compensation may become payable under the Workmen's Compensation Act, VIII of 1923 whether by the contractor or by the Government as principal it shall be lawful for the

Executive Engineer to retain out of monies due and payable to the contractor such sums of money as may, in the opinion of the said Executive Engineer, be sufficient to meet such liability. The opinion of the Executive Engineer shall be final in regard to all matters arising under this clause.

P.S. 46. Blasting :—Blasting executed by contractors in connection with Government works shall be carried out in the manner described under "Blasting operations - Instructions to contractors" of the A.P.S.S.

P.S. 47: Protection of adjoining and existing premises :—The contractor is to protect the whole of the adjoining and, where necessary, the existing premises, and all works and all fittings to all buildings on and adjoining the site against structural and decorative damage caused by the execution of these works and make good in all respects all such damage done or occurring to the same, and leave such reinstatement in perfect order. He is also to make good any damage done in the execution of the work to existing public or private footways or roadways.

P.S. 48. Permit other Workmen — Co-operation — Afford facilities :— The Executive Engineer shall have full empower to send workmen upon the premises to execute fittings and other works not included in the contract, for whose operations the contractor is to afford every reasonable facility during ordinary working hours, provided that such operations shall be carried on in such a manner as not to impede the progress of the work included in the contract, but the contractor is not to be responsible for any damage which may happen to or to be occasioned by any such fittings or other works, provided he complies with the Executive Engineer's Instructions in connection therewith, and provided that the damage is not caused by himself or his workmen.

The contractor shall, to all times, co-operate, assist, attend on, and afford facilities for such specialist as may be employed by the Executive Engineer or other works in connection with the building, allowing them, free of charge, the use of all plant, light and water installed in the works. The contractor shall also cause such special work or protect it as instructed to avoid injury during progress of the works. For failure so to protect, the contract or must make good any damage caused.

P.S. 49. Holes for water service, gas, electrical and sanitary fittings :— The contractor shall leave all holes in masonry and floors for the insertion of water services, gas and electrical connections and sanitary fittings in the exact positions indicated by the Executive Engineer during the progress of the work. These holes must be properly built up, in a workman like manner, at the contractor's cost, as soon as the fittings have been installed, in cases where the installations are made during the construction of the building and where, in the opinion of the Executive Engineer, delays in settlement of accounts will not thereby occur.

P.S. 50. Contractor's risk and Insurance :—The work executed by the contractor under the contract shall be maintained at the contractor's risk until the work is taken over by the Executive Engineer. The contractor shall accordingly arrange his own insurance against fire and other usual risks during such period unless otherwise specified:

Provided however that the contractor shall not be liable for all or any loss or damage occasioned by or arising out of acts of God, and in particular unprecedented

flood, volcanic eruption, earthquake or other convulsion of nature, invasion, the act of foreign enemies hostilities or warlike operations (before or after declaration of war) rebellion, military or usurped power.

P.S. 51. Holidays :—No work shall be done on Sundays without the written permission of the Executive Engineer or of the officer in charge of the work, and the contractor shall comply with the provisions of the Factories Act, in and so far as the same are applicable.

G.—Miscellaneous

P.S. 52. Sand and gravel :—The contractor shall not make any excavation upon the site for the purpose of obtaining gravel, sand or soil other than that shown on or implied by the drawings, except with the previous permission of the Executive Engineer.

P.S. 53. Old curiosities :—All old curiosities, relics, coins, minerals, etc., found in excavating or pulling down, shall be the property of the Government and be handed over to the Executive Engineer. Should any ancient masonry, or other old work of interest be opened up, the Executive Engineer's attention shall be called to the same before demolition or removal.

P.S. 54. Assignment or sub-letting :—The contractor shall not, without the written consent of the Executive Engineer) assign the contract nor sublet any portion of the same. Ordinarily no sub-letting will be permitted, but in case such should be permitted by the Executive Engineer, it shall in no way free the contractor from any of his responsibilities under any clause of his Preliminary Specification or of the "Articles of Agreement".

P.S. 55. Specialists :—The Executive Engineer shall, during the progress of the work, have power to select, nominate or recommend tradesmen or specialists to supply material or execute such portion of the work as he may consider desirable in the interests of the Government.

[**P.S. 56. Ratification of the orders of the Executive Engineer** :—Should the acceptance of the tender be beyond the authorized powers of the Executive Engineer ad laid down in the Public Works Department Code, the orders and decision of such Executive Engineer with regard to extension of time for completing the contract or the termination of the contract or of the employment of specialists for certain portions of the work as described in the previous clause will be subject to the ratification of the higher authority who entered into the agreement].

[Amended by G.O.Ms.No. 1007, Tr. Roads & Buildings (C) Dept., Dt. 5-11-1976]

P.S. 57. Order book :—An order book shall be kept at the Public Works Department office on the site of the work. As far as possible, all orders regarding the work are to be entered in this book. All entries shall be signed and dated by the Public Works Department Officer in direct charge of the work and by the contractor or by his representative. In important cases, the Executive Engineer or the Superintending Engineer will countersign the entries which have been made. The order book shall not be removed from the work, except with the written permission of the Executive Engineer.

H. — Date of commencement, completion, delays, extensions, suspension of work and forfeiture

P.S. 58. Date of commencement and completion:— On notification of possession of the site (or premises) being given to the contractor by letter registered for acknowledgement as provided in paragraph 10 *Supra*, he shall forthwith begin the work, shall regularly and continuously proceed with them, and shall complete the same (except for painting or other work which, in the opinion of the Executive Engineer, it may be desirable to delay) by the date of completion as defined in "Articles of Agreement", subject, nevertheless, to the provisions of extension of time mentioned in the next clause. The contractor shall under no circumstances be entitled to claim any damages from Government if he incurs any expense or liabilities to payment under the contract before the date of commencement defined above. The contractor shall have the right to withdraw from the contract and obtain refund of his security deposit is such intimation of handling over the site is delayed more than two months from the date of acceptance of the agreement by competent authority.

P.S. 59. Delays and extension of time :—No claim for compensation on account of delays or hindrances to the work from any cause whatever shall lie, except, as hereinafter defined. Reasonable extension of time will be allowed by the Executive Engineer or by the officer competent to sanction the extension for unavoidable delays, such as may result from causes, which, in the opinion of the Executive Engineer, are undoubtedly beyond the control of the contractor. The Executive Engineer shall assess the period of delay or hindrance caused by and written instructions issued by him, at twenty five per cent in excess of the actual working period so lost.

In the event of the Executive Engineer failing to issue necessary instructions and thereby causing delay and hindrance to the contractor, the latter shall have the right to claim an assessment of such delay by the Superintending Engineer of the Circle whose decision will be final and binding. The contractor shall lodge in writing with the Executive Engineer a statement of claim for any delay or hindrance referred to above, within fourteen days from its commencement, otherwise no extension of time will be allowed.

Whenever authorized alterations or additions made during the progress of the work are of such a nature in the opinion of the Executive Engineer as to justify an extension of time in consequence thereof, such extension will be granted in writing by the Executive Engineer or other competent authority when ordering such alterations of additions.

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JUDGMENT

P.S. 59. BARS A CLAIM FOR COMPENSATION ON ACCOUNT OF ANY DELAYS CAUSED BY THE DEPARTMENT

The Hon'ble Mr. Justice Jeevan Reddy

and

The Hon'ble Mr. Justice Neeladri Rao

1989 (2) ALT 372 (D.B.)

[C.M.A.No. 684/85 & C.R.P. 1581/85, Dt. 24-3-1989]

State of A.P. *Petitioner.*

vs.

M/s. Associated Engineering Enterprises, Hyderabad. *Respondent.*

Judgment

(Judgment of the Bench delivered by Jeevan Reddy, J.)

1. The appeal and the Civil Revision Petition arise from a common judgment and order of the learned Subordinate Judge, Rajahmundry, marking the award a rule of the Court and dismissing the petition filed by the appellant — State for setting aside the award.

2. An agreement was entered into between the State of Andhra Pradesh and the respondent-contractor for execution of the work of constructing approaches the rail-cum-road bridge across Godavari, at Rajahmundry. The agreement is dated 17-6-1970, and the value of the work is Rs. 70,29,925/-. A period of 42 months was stipulated for completing the work, i.e., on or before 21-12-1973. The respondent actually completed the work by 10-12-1974, after the period of contract was extended twice. The first letter of the contractor requesting for extension was addressed on 17-12-1973. Extension was granted upto 31-5-1974. By another letter, dated 22-7-1974 the contractor requested another extension till the end of August, 1974. It was granted subject to imposition of penalty of Rs. 50/- per day, after 1-9-1974.

3. After the work was completed, disputes arose between the parties with respect to the amount payable to the respondent. They were referred to the sole arbitration of the Superintending Engineer, R & B, Cuddapah Circle, in accordance with the agreement. The arbitrator made his award on 25-3-1981. Apart from interest and costs, the respondent had preferred eight claims. The arbitrator awarded some or other amount under each claim. Claim No. 9 related to interest. The arbitrator awarded interest as the rate of 15% per annum from the date of award, till the date of payment. So far as costs are concerned (claim No. 10), he directed the parties to bear their own costs.

4. The award is a non-speaking one. It does not give reasons for the several amounts awarded under each of the claims. It reads as follows:—

> "Now, I, Sri P. Vishnu Rao, Superintending Engineer, (R&B), Cuddapah Circle, Cuddapah, having taken upon myself the burden of reference and having examined and considered the statements of parties and arguments produced before me and having heard the parties, do hereby make and publish this day my award in writing of and concerning the matter referred to me.
>
> **Claim No. 1** :—This includes:
>
> (a) Compensation for delay in handing over site on Kovvur side involving Rs. 1,61,790.93 towards escalation in price index and Rs. 1,65,

150-00 towards establishment and over-head charges. Total Rs. 3,26,940.93, and (b) Compensation by way of reimbursement for extra expenditure incurred to an extent of Rs. 14,330-00 for removal and re-erection of the sheds, fencing etc., of railway contractors, Rs. 2,000-00 for removal of caving in earth and forming temporary roads, and Rs. 30,000-00 towards compensation paid to owners of buildings, huts, etc., in the area dismantling the same on Rajahmundry side.

Award :—I award the respondents shall pay to the claimants Rs. 2,81,800-00 (Rupees two lath eighty one thousand eight hundred only) towards this claim.

Claim No. 2 :—This includes:

(a) Rs. 45,000-00 towards refund of recovery made, and

(b) Rs. 38,000-00 towards reimbursement of expenditure incurred regarding load testing. Total Rs. 83,000-00.

Award :—I award that the respondents shall pay to the claimants under (a) and (b), a total sum of Rs. 83,000-00 (Rupees eighty three thousand only) towards this claim.

Claim No. 3 :—this comprises of Rs. 22,441-00 towards cost of excavation of excess depth in foundations of Rajahmundry.

Award :—I award that the respondents shall pay the claimants Rs. 22,441-00 towards the claim. (Rupees twenty two thousand four hundred forty one only).

Claim No. 4 :—This comprises of Rs. 2,000-00 being the cost of expenditure incurred for the footpath slab extension and coaxial centering.

Award :—I award that the respondents shall pay the claimants Rs. 2,000-00 (Rupees two thousand only) towards this claim.

Claim No.5 :—This comprises of Rs. 32,050-00 being payment to be made for conveyance of excess earth to embankment.

Award :—I award that the respondents shall pay the claimants Rs. 32,050-00 (Rupees thirty two thousand and fifty only) towards this claim.

Claim No. 6 :—This comprises of waiver of refund of fines imposed to an extent of Rs. 13,500-00.

Award :—I award that the respondents shall pay claimants Rs. 13,500-00 (Rupees thirteen thousand five hundred only) towards this claim.

Claim No. 7 :—This comprises of Rs. 2,000-00 being the refund of fine imposed for absence of Site Engineer on Rajahmundry side.

Award :—I award that the respondents shall pay the claimants Rs. 2,000-00 (Rupees two thousand only) towards this claim.

Claim No. 8 :—This comprises of Rs. 72,645-42 towards refund of recovery made for excess steel consumed.

Award :—I award that the respondents shall pay the claimants Rs. 72,64542 (Rupees seventy two thousand six hundred and forty five and paise forty two only) towards the claim.

Claim No.9 :—This comprises of Rs. 1,32,359-00 towards interest on amounts claimed and disputed.

Award :—This claim is rejected. However, after careful consideration of all the factors the claimants are awarded interest on the awarded amounts from the date of this award, i.e., 25th March, 1981 till the date of payment of 15% (fifteen per cent) per annum.

Claim No. 10 :—This refers to costs of the claimants in these proceedings.

Award :—Each party to the reference shall bear their costs. The claimants shall bear the cost of the stamp-paper for this award of Rs. 200-00 (Rupees two hundred only).

This award is made, signed and published by me on this, the twenty fifth day of March, one thousand nine hundred eighty one".

O.S.No. 119/1981 was filed by the respondent contractor to make the award a rule of the Court. The state filed O.P.No. 51/1981 to set aside the award under Section 30 of the Arbitration Act. No evidence was adduced by either party before the learned Subordinate Judge. After hearing the parties, the learned Subordinate Judge, as stated above, made the award a rule of the Court, and dismissed the petition filed by the State for setting it aside. The result is that the award in favour of the respondent in a sum of Rs. 5,09,436-42 Ps. with interest thereon at 15% per annum from the date of award, i.e., 25-3-1981, till the date of payment or decree, is affirmed. The present appeal and Civil Revision Petition are directed against the said judgment.

5. The learned Addl. Advocate-General, appearing for the State, disputed the validity and legality of the award in so far as claims Nos. 1, 8 and 9 are concerned. He did not dispute the amounts awarded under other claims.

6. The respondent claimed a total sum of Rs. 3,73,270-93 Ps., under claim No. 1, which was divided into two sub-heads. They are:

(a) compensation for delay in handling over site on Kovvur side involving Rs. 1,61,790-93 Ps. towards escalation in price index and Rs. 1,65,150-00 towards establishment and over-head charges, making a total of Rs.
3,26,940-93 Ps.

(b) compensation by way of reimbursement for extra expenditure incurred to an extent of Rs. 14,330-00 for removal and re-erection of sheds, fencing etc., of railway contractors;

Rs. 2,000-00 for removal of caving in earth and forming temporary roads; and

Rs. 30,000-00 towards compensation paid to owners of buildings, huts, etc., in the area dismantling the same on Rajahmundry side.

The arbitrator awarded a total sum of Rs. 2,81,800-00 under the claim without specifying the amount under each of sub-heads or each of the items under each sub-bead. Claim No. 8 is in a sum of Rs. 72,645-42. The respondent claimed refund of this amount which was recovered from him towards excess steel consumed by him. The arbitrator allowed the claim in full. Claim No. 9 pertains to grant of interest from the date of the award till the date of realization.

7. For the sake of convenience we may take up claim No. 9 first. Following the principle of the decision of the Supreme Court in *Executive Engineer (Irrigation) Galimala vs. Abnaduta Jena* (AIR 1988, SC, 1520), it has been held by two Benches of this Court in (i) C.M.A.No. 292/1938 disposed of on 15-11-1988 (consisting of Jeevan Reddy & Y. Bhaskar Rao, JJ.) and (ii) C.M.A.No. 993/1984 and batch, disposed of on 17-3-1989 (consisting of Jeevan Reddy & V. Neeladri Rao, JJ.), that the arbitrator has no power in law to award interest even for the period subsequent to the date of award. In this case, the arbitrator has not awarded interest for the period prior to the date of reference, nor has he awarded interest for the period the dispute was pending before him. He has awarded interest only from the date of the award. Since the reference to arbitration in this case is governed by Chapter II, i.e., without the intervention of the Court, the arbitrator was not competent to award the said interest. It must, accordingly, he held that the award of interest is incompetent and to that extent the award suffers from an error apparent on the face of the record. The awards is liable to be set aside to the extent it allows claim No.9.

8. We shall next take up claim No. 8. The respondent's claim in this behalf is to the following effect: According to the agreement, the steel required for the work was to be supplied by the department at a recovery rate of Rs. 877-00 per Metric Tonne. The agreement provided a margin of 5% wastage over the requirements as per schedule. Any excess quantity of steel used over and above the said 5% wastage margin was to be charged at the market value plus 10%, or the supply rate, whichever is higher. By the time the work was completed, the respondent utilized 1550-251 Metric tonnes of steel. The quantity actually used on the work was 1439-174 Metric Tonnes, accounting for an excess issue of 1111-077 Metric Tonnes. The excess thus worked out to 6.93%. For the excess wastage the Government recovered an amount of Rs. 72,645-42 Ps. This recovery was protested by the respondent, who set out his case in his letter, dated 26-2-1975. According to him 110-235 Metric Tonnes of steel was used for bolts and frames of the centering erected for execution of RCC items and that it cannot be treated as wastage. The wastage actually comes to 0-842 Metric Tonnes, which is negligible. However, the Government neither responded to this representation nor did it refund the amount recovered. The respondent, therefore, claimed refund of this amount.

9. In their counter the Govt. disputed the respondent's claim. They denied that the steel used for bolts and frames of the entering erected for RCC items is a *bona fide* use of the steel supplied by the Government. If any such material is required the contractor has to procure his own steel therefor. The matter was indeed considered by the Government, which refused to accept any wastage beyond 5%.

10. Condition 5.0.4 of the relevant Section of the agreement reads as follows:-

"**5.0. 4** :—Cement and steel will be supplied in sufficient quantity as when required as is consistent with the out turn of the work. In case of non- availability of these materials, the contractors shall make their own arrangements at their own cost. The department shall not be held liable for any loss that is likely to be caused to the contractor on account of delay in supply. In case of delay the contractor shall be eligible only for suitable extension of time. The scrap or cut pieces of steel left over shall not be taken back by the department. The loss, if any, on account of these scrap or cut pieces shall be borne by the contractor. The recovery of steel supplied by the Department shall be made for the quantities issued. The rates to be quoted by the contractor shall be for the supply and fabrication of steel including probable wastage upto 5% over the requirement as per schedule.

Recovery for any excess quantity used over 5% wastage, shall be made at the market value plus 10% or supply rate whichever is higher. The contractor shall get binding wire required for use on the work at his own cost ....".

The preceding conditions in the same Section says that the cement, steel, and bitumen required for the work shall be supplied by the department at the specified rates, and that the cost thereof shall be recovered from the contractor's bills and other dues. The contractor was obligated to use the material exclusively for the purpose of the work, and to make good any loss, damage, or wastage that may take place from whatever cause. Condition 5.0.5 states that "the recovery of steel supplied by the Department shall be made for the quantities issued". It says further that "the scrap or cut pieces of steel left over shall not be taken back by the Department" and that "the loss, if any, on account of these scrap or cut pieces shall be borne by the contractor". It also provides that recovery for any excess quantity used over and above 5% wastage shall be made at the rates specified. Now, in the case before us there was no dispute as to the quantity issued. The only dispute was whether the steel used for bolts and frames of the centring erected for execution of RCC items should be treated as wastage, or should be treated as having been utilized for the purpose of the work. In the absence of any specific provision in the agreement that steel used for bolts and frames shall not be treated as steel used for the purpose of the work, we are unable to say that the arbitrator was not competent to allow the said claim of the contractor. In the absence of any specific provision in that behalf it was open to the arbitrator to decide the issue taking an overall view of the several terms and conditions of the agreement. We are, therefore, unable to say that the arbitrator acted contrary to, or outside the terms of contract in allowing the said claim.

11. We shall not take up the main dispute between the parties. It centres round claim No. 1. The respondent contractor's claim under claim No. 1, stated briefly, is this: Though the site for the approach on Rajahmundry side was handed over well in time there was abnormal delay in handing over the site on Kovvur side. The respondent addressed several letters to the appropriate authorities in this behalf, but to no effect. These was a delay ranging between two months to 26 months in handing over the piers. The particulars of delays and the compensation claimed by the respondent-contractor are the following:-

Compensation Particulars

	Location	*Date on which site is to be handed over*	*Date on which site is actually handed over*	*Delay*	*Difference in price index in points*	*Difference in cost Rs.*
(a)	K23 to K12	22-6-1970	End of 12/1970	6 months	12(7.7%)	11,057.80
	K11	6/71	8/71	2 months	9(4.89%)	7,022.40
	K10	6/71	10/71	4 months	14(7.4%)	10,627.00
	K9	6/71	1/72	6 months	13(6.9%)	9,909.00
	K8	6/71	4/72	10 months	19(9.79%)	14,059.30
	K1 to K3	1/72	1/72 to complete foundations and 5/73 to do substructure & superstructure.	17 months	34(15.31%)	21,987.00
	K4 & K3	1/72	9/73	21 months	39(17.18%)	24,672.00
	K5 & K6	1/72	10/73	22 months	45(19.3%)	27,716.00
	K7	1/72	2/74	26 months	60(24.19%)	34,739.00
(b)	ADD 5% for Establishment and Overheads on Rs.33,03,000/-					1,65,150.00
(c)	ADD for removing and re-erecting sheds, fencing, etc., of Railway contractors as per Annexure I.					14,330.00
(d)	ADD for removing caves in earth and forming Temporary Road					2,000.00
(e)	ADD compensation paid to owners of buildings, huts, etc., in the area and dismantling the same on the Rajahmundry side.					30,000.00
					Rs.	3,73,270.00
						OR
					Rs.	3,73,271.00

The Government disputed the respondent's claim. It relied upon the letters of the respondent, dated 23-1-1970 and 13-3-1970, and the letter of the Chief Engineer, dated 8-3-1970 in this behalf. Under these letters the time for delivering the sites/piers was postponed. It was also stated that because of the said delay, the period of contract will be extended by six months. The Government's contention, therefore, is that there is no basis of claiming any compensation on account of the delays in handling over the sites. It submitted that there were several delays on the part of the contractor in carrying out the work, and that he did not keep up to the schedule of work. Since no compensation was contemplated either by the

agreement or by the letters aforesaid, it submitted, the contractor cannot claim any compensation. Reliance was placed upon Section 55 of the Contract Act, and the several terms and conditions of the agreement, including Clauses 58 and 59 of the A.P. Detailed Standard Specifications (APDDS). It denied that the contractor paid any moneys to the owners of the structures, as claimed by him, and submitted that he is not, therefore entitled, to any compensation on that account also.

12. The agreement entered into between the parties contained, *inter alia*, clauses 4 and 5, which read :—

> "(4) Time shall be considered as of the essence of the agreement and the Contractor hereby agrees to commence the work as soon as the agreement is accepted by the competent authority as defined by the Madras Public Works Department Code and the site (or premises) is handed over to him as provided for in the said conditions and agrees to complete the work within (42) Forty two months from the date of such handling over of he site (or premises) and to show progress as defined in the tabular statement, "Rate of progress" below, subject nevertheless to the provisions for extension of time contained in Clause 59 of the Standard Preliminary Specification.
>
> (5) The said condition shall be read and construed as forming part of this agreement and the parties hereto will respectively abide by and submit themselves to the conditions and stipulations and perform the agreements on their parts, respectively……..".

The 'Preliminary Specifications' mentioned, in APDSS constitute the terms of agreement between the parties, Clause 58 of Preliminary Specifications says that on notification of possession or the site being given to the contractor, he shall begin the work forthwith and shall regularly and continuously proceed with the work and complete the same as provided in the agreement subject, nevertheless, to provision of extension of time, mentioned in the next clause. Clause 59, which is relevant for our purposes, reads thus:—

"59. Delays and extension of time :—x x x"

Clause 60 says that time shall be considered the essence of the contract, and if the contractor is guilty of delay in commencing or carrying on the work and fails to improve inspite of notice, it shall be lawful for the Executive Engineer to determine the contract, which shall entail forfeiture of security deposit and other amounts. It shall open to the Government to have the balance of the work carried out by another contractor at the risk and cost of the contractor.

13. Before proceeding further, it would be appropriate to refer to certain other relevant material. In his letter, dated 23-1-1970 the respondent-contractor wrote to the Superintending Engineer, Eluru, stating *inter alia* : "12. We agree that compensation need not be paid if the delay in handling over the site occupied by the Railway is not more than 3 months". It is clear that certain portions of the site which were to be handed over to the respondent were occupied by the railway in connection with its own work; the agreement between the parties was that as soon as the Railway vacated its occupation, the site shall be handed over to the contractor within three months. The next letter is dated 8-3-70 from the Chief

Engineer, PWD, Hyderabad, to the respondent, in which it was stated, *inter alia*, "12. (a) : In your letter reference (3) cited (reference is to the respondent's letter, dated 23-1-1970 referred to above), you have agreed for not claiming any compensation for the delay in handing over site at piers 14 to 21 on Kovvur side beyond middle of 71" if the delay is not more than 3 months. You are informed that the last 6 spans can be handed over in the beginning of 1972 …… This letter is rather ambiguous. It speaks of delivery of piers 14 to 21 "beyond middle of 1971". Suffice it to note that as soon as the Railways delivered possession of the said sites, they were to be handed over to the contractor within three months.

14. The third letter is dated 13-3-1970 from the respondent to the Chief Engineer. In this letter it was stated, *inter alia*, "(12)(a) : We note that the site for piers 14 to 21 on Kovvur side will be handed over ii3 the beginning of 1972. Since there is a delay of 6 months in handing over the site, the time of completion of the work on Kovvur side will have to be extended by 6 months …… " This letter shows that the site for piers 14 to 21 on Kovvur side was to be delivered in the beginning of 1972, which meant a delay of six months over the time agreed earlier, and in lieu thereof it was agreed that the period of contract shall be extended by six months.

15. Now, the contention of Sri P. Ramchandra Reddy, learned council for the respondent-contractor, is that in as much as admittedly, there was delay in the handing over the sites on Kovvur side, the cost of work went up and the contractor is entitled to be compensated therefor. According to him, the consumer price-index went up by 24.19% between June, 1971 and February, 1974. It is on this basis that he claimed Rs. 1,61,790/- by way of compensation. To this he added establishment and overhead charges calculated at the rate of 5% of the total cost of Viaduct on Kovvur side. Some other minor claims were also made. Mr. Ramachandra Reddy says, because of the delay in handing over the site, the period of contract had to be extended, which meant extra cost to the respondent, and it must be paid for by the Government which is responsible for the delay. The contention of the learned Addl. Advocate-General, on the other hand, is that no such compensation is contemplated, or provided for, either by the contract, or by the correspondence between the parties. Indeed, the letter of the respondent, dated 13-3-1970 clearly speaks of extension of the period of contract by six months in lieu of the delay in handing over the site for piers 14 to 21. Even if there is any delay in handing over the site, no claim for compensation can be made since any such claim is barred b Clause 59 of the APDSS. It is also submitted that the contract does not provide for any such compensation, and hence the arbitrator, who had to operate within the four-corners of the contract, had no power to award any compensation on this account.

16. The first aspect to be noticed in this behalf is that the contractor did not choose to terminate the contract on account of the Government's delay in handing over the sites. He requested for, and agreed to extension of the period of contract, and completed the work. It is not the respondent's case that while agreeing to extension of the period of contract he put the Government on notice of his intention to claim compensation on that account. Section 55 of the Contract Act reads thus :—

> ***"55. Effect of failure o perform at fixed time, in contract in which time is essential*** :—When a party to a contract promises to do a certain thing at or before a specified time, or certain things at or before specified times, and fails to do any such thing at or before the specified time, the contract, or so much of it as has not been performed, becomes voidable at the option of the promise, if the intention of the parties was that time should be of the essence of the contract.
>
> If it was not the intention of the parties that time should be of the essence of the contract, the contract does not become voidable by the failure to do such thing at or before the specified time; but the promisee is entitled to compensation from the promisor for any loss occasioned, to him by such failure.
>
> If, in case of a contract voidable on account of the promisor's failure to perform his promise at the agreed, the promisee accepts performance of such promise at any time other than that agreed, the promisee cannot claim compensation for any loss occasioned by the non-performance of the promise at the time agreed, unless, at the time of such acceptance, he gives notice to the promisor of his intention to do so".

According to this Section it was open to the respondent to avoid the contract on account of the Government's breach of promise to deliver the sites at a particular time ; but, he did not choose to do so, and accepted the delivery of sites. at a time other than what was agreed upon between them earlier. If so, he is precluded from claiming compensation for any loss occasioned by such delay, unless,, of course, at the time of such delayed acceptance of the sites, he had given note to the Government of his intention to claim compensation on that account. It must be remembered that this provision of law was specifically referred to, and relied upon in the counter filed by the Government to the respondent's claim before the arbitrator. But, it is not brought to our notice that the contractor bad given such a notice (contemplated by the last sentence in Section 55). We must make it clear that we are not entering into the merits of the decision of the arbitrator. What we are saying is that such a claim for compensation is barred by law, except in a particular specified situation—and inasmuch as such a particular specified situation is not present in this case, the claim for compensation is barred. It is well settled that an arbitrator, while making his award, has to act in accordance with law of the land, except in a case where a specific question of law is referred for his decision.

17. Even apart from Section 55, we are of the opinion that the arbitrator had no power to award compensation as claimed by the respondent. Clause 59 of the APDSS specifically bars such a claim. We have set out the clause in full hereinbefore. The meaning of the said clause was considered by a Bench of this Court—of which one of us (Jeevan Reddy, 3.) was a member—in A.A.O. No. 677/ 81 & C.R.P.No. 385/1982 disposed of on 19-4-82. It was held:

> "Coming to Clause 59 of the preliminary specifications of "APDSS", it provides that neither party to the contractor shall claim compensation on account of delays or hindrances to work from any cause whatever". That

the delays and hindrances contemplated by Clause 59 include the stoppage, hindrances and delays on the part of the department as well, is clear from the following sentence in this first part of the said clause, viz., "the Executive Engineer shall assess the period of delay or hindrances caused by any written instructions issued by him, at 25% in excess of the actual work period so lost". Indeed, the second para of the clause also contemplates delays and hindrances being caused on account of the failure of the Executive Engineer to issue necessary instructions. In such a case, the contractor has a right to claim the assessment of such delay by the Superintending Engineer of the Circle, whose decision is declared to be final and binding on the parties. But, any such claim has to be lodged in writing to the Executive Engineer within fourteen days of the commencement of such delay, or hindrances, as the case may be. We find it difficult, therefore, to say that Clause 59 has no application to the present case. The words "from any cause whatever", occurring Clause 59, are wide enough to take in delays and hindrance of all types, caused by the department, or arising from other reasons, as the case may be. Thus, by virtue of Clause 59, the contractor is precluded from claiming any compensation on account of delays or hindrances arising from any cause whatever, including those arising on account of the acts or omissions of the departmental authorities …….".

In this context, we must refer to two conflicting decisions of this Court, though they are not strictly relevant in the facts of this case. Since they are relied upon by the parties before us, It would be appropriate to refer to them briefly. In these cases the question arose whether a contractor is entitled to claim escalation charges on account of delay on the part of the Government in handing over the site. The first decision is in *Chief Engineer, Panchayatraj Department vs. B. Balaiah*, (1985 (1), APU 224). The Bench held that inasmuch as the contract between the parties does not provide for payment of escalation charges, awarding an amount on account of escalation charges is in excess of the arbitrator's jurisdiction, and is void. In the later decision of another Bench, in *State of A.P. vs. S. Shivaraj Reddy*, (988(2), APLJ 465), a different view was taken. The claim in this case pertained to the work done beyond the contract period. The Court held that the contract or must be paid as per the standard specification rates, for the reason that the Government had defaulted in handing over the site at the time agreed. It was held that such a claim is not barred by Clause 59 of APDSS. When the decision of this Court in C.M.A. No. 677/8 1 and C.R.P. No. 385/82, dated 19- 4-1982 was brought to the notice of this Bench, it distinguished the same holding that was a case where the claim was for compensation, whereas in the case before them the claim was not for compensation, but for payment as per the standard specification rates for the reason that the site was not handed over to the contractor at the agreed time. This is what the Bench said:

"In our view Section 59 has no application. It pertain to compensation. In the present case, we are concerned with the rates for the work done. The contractor is not claiming any compensation for loss or damage or loss of profit which he would have made but for the delay committed by the department. What is asked for here is that beyond the contractual date he must be paid as per the standard specification rates as the site was not handed

over in time due to the fault of the department itself. We do not think P.S. 59 has any application at all. The decision of the Division Bench referred to by the learned Government Pleader has as relevance in the present context. In this Division Bench case, the contractor having agreed for reduction of rates and executing the final agreement, demanded escalation of rates complaining that the department committed delays and defaults. The Government relied upon Clause 59 and Foot Note 7 of Schedule 'A' which prohibited payment of rates at the enhanced rates even during the extended period. The Division Bench negatived the claim of the contractor on the ground that the Foot Note 7 is clear to the effect that the agreed rate should prevail even during the extended period of the agreement. The judgment of the Division Bench was more based on the specific prohibition contained in Foot Note 7 of Schedule 'A' of the agreement therein. There is no such clause in the present agreement. It is not a case of escalation of rates. Here the major portion of the site was handed over beyond the period of agreement during which period the cost of labour and other materials have gone up. Without the site was impossible for the contractor to complete the work and what the Arbitrators have done is only to permit the contractor to claim the rates prevalent as per the S.S.Rs. in force. In our view, it is not prohibited either under the APDSS Rules or by any clause in the agreement ……..".

We must clarify that, so far as the case before us is concerned the claim of the respondent-contractor is not for escalation of rates, nor is it a claim for payment of rates as per the standard specification rates in force for the period beyond the originally agreed contract period. If so, the decision in *State of A.P. vs. S. Shivaraj Reddy (3 Supra)* has no application herein. In the case before us, the claim is a pure and simple claim for compensation. The amount claimed has been worked out on the basis of the rise in consumer price-index, and also on account of establishment and overhead charges. It would, therefore, be a case squarely governed by the principle of the decision in A.A.O. No. 677/81 & C.R.P. No. 385/82, dated 19-4-1982.

18. The learned Addl. Advocate-General also relied upon the decision of the Supreme Court in *Continental Construction Co., Ltd. vs. State of M.P.,* (1988 (3), SCC 82 ; AIR 1988, SC 1166). In that. case the contract was entered into between the State of Madhya Pradesh and the applicant before the Supreme Court, for construction of a bund. The work could not be completed within the stipulated time because of the delays on the part of the State in allotment of work and discharge of its obligations under the contract. On account of this, the appellant incurred unforseen extra expenditure, which claim was referred to arbitration. The State denied that there was any delay on its part. Apart from that, it submitted that the appellant's claim was barred by Clause 3.3.15 of the contract, which read: "3.3.15: Clause 15 *: Time limit for a unforeseen claims* : Under no circumstances whatever shall the contractor be entitled to any compensation from Government on any account unless the contractor shall have submitted claim in writing to the Engineer-in-charge within one month of the cause of such claim occurring …… ". The contractor did not avoid the contract on the ground of delays or defaults on the part of the State. He contemplated the work. On these facts, the Supreme Court held:

> "The arbitrator misconducted himself in allowing the claim without deciding the objection of the State. In view of the specific clauses, the appellant was not legally entitled to claim for extra cost. The decision of this Court in *Seth Thawardas vs. Union of India* (AIR 1955, SC 468) is of no avail on this point. If no specific question of law is referred, the decision of the arbitrator on that question is not final however much it may be within his jurisdiction, and indeed essential for him to decide the question incidentally. The arbitrator is not a conciliator and cannot ignore the law or misapply it in order to do so what he thinks is just and reasonable. The arbitrator is a tribunal selected by the parties to decide their disputes according to law and so is bound to follow and apply the law, and if he does not, he can be set right by the Court provided his error appears on the face of the award. In this case, the contractor having contracted he cannot go back to the agreement simply because it does not suit him to abide by it. The decision of this Court in *M/s. Alopi Prasad vs. Union of India* (AIR 1960, SC 588) may be examined. There it was observed that a contract is not frustrated merely because the circumstances in which the contract was made, altered. The Contract Act does not enable a party to a contractor to ignore the express covenants thereof, and the claim payment of consideration for performance of the contract at rates different from the stipulated rates, on some vogue plea of equity. The parties to an executory contract are often faced, in the course of carrying it out, with a turn of events which they did not at all anticipate, a wholly abnormal rise or fall in prices, a sudden depreciation of currency, an unexpected obstacle to execution, or the like. There is no general liberty reserved to the Courts to absolve a party from liability to perform his part of the contract merely because on account of an uncontemplated turn of events, the performance of the contract may become onerous …….. ".

When it was argued by the appellant that since the Award was a non- speaking Award and no mistake of law was apparent on the face of the record, the Supreme Court repelled the same holding that "this being a general question, in our opinion, the District Judge rightly examined the question and found that the appellant was not entitled to claim for extra cost in view of the terms of the contract and the arbitrator misdirected himself by not considering this objection of the State before giving the award...". Reference was also made to the decision of the Privy Council in *Champsey Bhara & Co. vs. Jivraj Ballo Spinning & Weaving Co. Ltd.* (AIR 1923, SC 6), where it was held that the award of an arbitrator can be set aside on the ground of ah error apparent on the face of the record only where the error is apparent either on the face of the award or from any document incorporated in it. After referring to several authorities, the Supreme Court held that" the District Judge was entitled to examine the contract in order to find out the legality of the claim of the appellant regarding extra cost towards rise in price of material and labour", and observed further, "as was pointed out by the learned District Judge, Cls. 2.16 and 2.4 stipulated that the contractor had to complete the work inspite of rise in prices of materials and also rise in labour charges at the rates stipulated in the contract. There was a clear finding of the arbitrator that the contract was not rendered ineffective in terms of Section 56 of the Contract Act due to abnormal

rise in prices of material and labour. This being so and the contractor having completed the work, it was not open to him to claim extra cost towards rise in prices of material and labour. The arbitrator misconducted himself in not deciding this specific objection raised by the State regarding the legality of extra claim of the appellant ……..".

19. Applying the principal of the above decision to the facts of the case before us, it must be held that Clause 59 bars a claim for compensation on account of any delays or hindrances caused by the department. In such a case, the contractor is entitled only to extension of the period of contract. Indeed, such an extension was asked for, and granted on more than one occasion. (The penalty levied for completing the work beyond the extended period of contract has been waived in this case). The contract was not avoided by the contractor, but he chose to complete the work within the extended time. In such a case, the claim for compensation is clearly barred by Clause 59 of the APDSS which is, admittedly, a term of the agreement between the parties.

20. Mr. P. Ramachandra Reddy, learned counsel for the respondent- contractor, however, relied upon certain decisions as laying down a contrary proposition, to which we should now refer. The first decision relied upon is in *P.M Paul vs. Union of India*, (1989(1), Scale 221). In this case, the appellant-contractor urged that there was delay on the part of the respondent-Government in handing over the site, and that, on that account, he has incurred extra cost which he must be reimbursed. His claim was rejected, as also his request to refer the same to arbitration. Thereupon, it is said, the appellant-contractor abandoned the work. The dispute was thereafter referred to the arbitrator. One of the claims put forward by the appellant-contractor and allowed by the arbitrator related to the loss caused to the contractor due to increase in prices of material, cost of labour and transport during the extended period of contract. The respondent-State submitted that no such claim is contemplated, or provided for, by the agreement between the parties and hence the arbitrator was not competent to allow the said claim. The Supreme Court observed that the dispute referred to the arbitrator, *inter alia* was as to who is responsible for delay and what are the repercussions of the delay in completion of the work and how to apportion the consequences of such responsibility. It was observed: "After discussing the evidence and the submissions the arbitrator found that it was evident that there was escalation and, therefore, he came to the conclusion that it was reasonable to allow 20% of the compensation under Claim 1; he has accordingly allowed the same. This was a matter which was within the jurisdiction of the arbitrator and hence, the arbitrator has not misconducted himself in awarding the amount as he has done Once it was found that the-arbitrator had jurisdiction to find that there was delay in execution-of the contract due to the conduct of the respondent, the respondent, was liable for consequence of the delay, namely, increase in prices. Therefore, the arbitrator had jurisdiction to go into this question. He has gone into that question and has awarded as he did. Claim 1 is not outside the purview of the contractor. It arises as an incident of the contract and the arbitrator has jurisdiction ……". It must, however, be noticed that in this case the contract did not contain a clause like contained in Clause 59 of the APDSS. Where a similar clause was found as in the case *Continental Construction Co. Ltd. vs. State of Madhya Pradesh (4 Supra)* the Supreme Court held clearly

that the arbitrator had no jurisdiction. It must be noted that the award in this case was a speaking/reasoned award.

21. Mr. Ramachandra Reddy placed strong reliance upon the decision of the Supreme Court in *M/s. Sudarsan Trading Co. vs. The Government of Kerala & another*, (1989 (1), Scale 395) Three questions were considered in this case, namely, (i) when is an award a speaking award; (ii) in the case of a non-speaking award, how and to what extent can the Court go to determine whether there is an error apparent on the face of the award; and (iii) to what extent can the Court examine the contract between the parties which is not incorporated or referred to in the award? We are not concerned with the first question in this case. The second and third questions are, however, relevant. On the second question arising before it, the Supreme Court referred to the decision of the Privy Council in *Champsey Bhara & Co. vs. Jivraj Balloo Spinning & Weaving Co. Ltd. (5 Supra)* and held that an award can be set aside on the ground of an error apparent on the face of the award only where the award, or any document incorporated therein contain some legal proposition which constitutes the basis of the award, and which is erroneous. It was observed that in the case of a non-speaking award it is not open to the Court to probe the mental process of the arbitrator and speculate as to what impelled the arbitrator to arrive at the conclusion which he did. In this connection, the Court referred to its earlier decision in *M/s. Alopi Parshad vs. Union of India*, (AIR 1960, SC 588), wherein it was held that an award can be set aside on the ground of an error apparent on the face of it, when the reasons given for the decision either in the award or in any document incorporated in it, are based upon a legal proposition which is erroneous. The other principle enunciated in the said decision to the effect that "an award which ignores express terms of the contract, is bad" was also affirmed. It was pointed out that the ground of "error apparent on the face of the award" is distinct from the ground that the arbitrator exceed his jurisdiction. It was pointed out that while in the latter case the Court can look into the arbitration agreement to determine whether the arbitrator exceed his jurisdiction, in the former case the Court must confine its attention only to the award and to any other document or material incorporated therein. It was held that for determining whether there is an error apparent on the face of the award the Court has no jurisdiction to look beyond the award and the documents, if any, incorporated therein. Now, in the case before us the question is not whether the award suffers from an error apparent on its face, but whether the arbitrator has exceeded his jurisdiction in awarding compensation when the agreement specifically prohibits the same. In such a case, it is open to the Court to look to the terms of the agreement between the parties.

22. Mr. P. Ramchandra Reddy also relied upon the decisions of the Supreme Court in *State of Orissa vs. M/s. Lall Brothers* (AIR 1988, SC 2018) and *Neelkantan & Brothers Construction vs. Superintending Engineer, National Highways, Salem*, (AIR 1988, SC 2045) but which, in our opinion, are not quite relevant to the issue before us. In the first case it was held that a non-reasoned Award, which awards a lumpsum without specifying the amount awarded under each claim/count is still good between the parties. It is not open to the Court it was held to set it aside by speculating as to the reasons which must have impelled the arbitrator to

come to the conclusion which he did, nor is it permissible for the purpose to establish by a process of inference and argument that the arbitrator he committed some mistake in arriving at his conclusion. In the second case, it was held that a non-reasoned award which contains no legal proposition which can be said to constitute the basis of the award cannot be interfered with by the Court.

23. We are, therefore, of the opinion that the decisions relied upon by Mr. Ramachandra Reddy do not lay down the proposition that where an award is questioned on the ground that the arbitrator had no jurisdiction to entertain a claim by virtue of the terms of the contract the court is precluded from looking to the terms of the contract. On the contrary such a power is expressly recognized in one of the decision cited, viz., *Sudarsan Trading Company vs. The Government of Kerala & another (7 supra)*. Further, as held by the Supreme Court in *Continental Construction Co., Ltd. vs. State of Madhya Pradesh (4 supra)*, where the argument bars a particular claim, the arbitrator has no jurisdiction to award any amount towards such a claim, and that any such award would be incompetent and void.

24. There is yet another objection to the competency of the arbitrator to award any amount under claim No. i, in this case. A would be evident from the claim of the respondent-contractor (extracted herein before), the claim for compensation pertains (except in this case of one pier/K7) to the period of contract. The period of contract stipulated in the agreement expired on 21- 12-1973. Out of 9 items, mentioned in the Table (containing particulars of compensation), 8 items pertain to the original period of contract itself. Moreover, in the case, it was agreed between the parties even before the formal agreement was executed that the period of contract shall be extended by six months, which is evident from the respondent's letter, dated 13-3-70 referred to above. (The formal contract was executed in this case on 17-6-70). It must, therefore, be assumed that in this case the period of contract expired on 21-6-74. In any event, even if we take the original period of contract, the claim for compensation to a very major extent pertains to the original period of contract. The question is whether any claim for compensation is permissible for the original period of contract? It was held by a Bench of this Court of which one of us (Jeevan Reddy, 3.) was a member in A.A.O.No. 786/1986, dated 1-12- 1988, that such a claim is not permissible by virtue of Clause 59 of the APDSS. We may also mention that in this decision the Bench distinguished another decision of this Court in *State of Andhra Pradesh vs. R. V. Rajaram*, (1988(1), APLJ 536), where the contractor's claim on account of statutory increase in the minimum wages and other categories of labour was allowed by the arbitrator and upheld by the Court. We need not, whoever, refer to the facts and principles of the said decision since in the case before us the claim is not similar to the one in the said case. As already stated, in the case before us the claim is squarely one for compensation which is worked out on two bases, viz., (i) rise in consumer's price-index, and (ii) establishment and overhead charges and a large portion of the claim pertains to the original period of contract itself.

25. We may also state that it is not possible for us to apportion the amount awarded for the original period of contract and the amount awarded for the extended period, even assuming that the arbitrator was competent to make such an award for the extended period of contract.

26. For the above reasons, we are of the opinion that the arbitrator exceeded his jurisdiction in awarding the amount of Rs. 2,81,800/- under claim No. 1. The award of the said amount is liable to be deleted from the Award.

27. Accordingly, the Civil Miscellaneous Appeal and the Civil Revision Petition are allowed in part, the amount awarded by the arbitrator under claim No. 1 shall be deleted. It is also held that the arbitrator had no power, in law to award interest for the period commencing from the date of Award till the date of decree of the Civil Court. However, the respondent-contractor shall be entitled to interest from the date of the decree (i.e., from 19-2-1985) at the rate of 15% per annum till realization. We are awarding interest at the rate of 15% per annum since that happens to be the rate which was adopted by the arbitrator in the Award. There shall be no order as to costs.

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JUDGMENT

CLAIM FOR COMPENSATION — WAWER OF RIGHT (P.S. 59) BY THE DEPARTMENT

1996 (3) ALT 53 (D.B.)

The Hon'ble Mr. Justice P. Venkatarama Reddy

and

The Hon'ble Mr. Justice G. Bikshapathy

M. Gangareddy *Petitioner*.

vs.

State of A.P. *Respondent*.

Judgment

(Judgment of the Bench delivered by Venkatarama Reddy, J.)

Held:

In *Prasad and Company's* case [1995 (3) ALT 537], the Division Bench, of which one of us (Venkatarama Reddi, J.) was a member, held that escalation over and above the agreed rates during the currency of the agreement period was clearly barred by P.S. 59 of APDSS. In *Ramalinga Reddy 's* case (1994 (5) SCALE 67), the Supreme Court had gone a step further and held that the claim for the payment of extra rate even for the workdone beyond the agreement period was unsustainable in the light of the specific prohibition contained in Clause 59. However, it is not discernible from the Judgment whether the prolongation of the contract was for reasons attributable to the contractor or on account of breach of contractual obligations by the employer as in the instant case. Be that as it may, even assuming that Clause 59 would have in the normal course come in the way of the petitioner claiming escalation in rates for the work done beyond the contractual period, the special facts and circumstances of this case stand apart and do not attract the bar of Clause 59. We agree with the learned counsel for the contractor that the immunity conferred by the exclusionary clause 59 must be deemed to have been waived and the Department is estopped from taking shelter under it. (Para 8)

On the facts of the case, it can be reasonably said that there was waiver f the right to enforce Clause 59. Alternatively, we hold that the arbitrator's finding that there was an assurance to pay the extra rates cannot be said to be perverse or vitiated by an error of law apparent on the face of the award. The assurance may not be direct or express but it is possible to take the view that there was an implied promise to pay the extra rates for the work done beyond the agreement period notwithstanding Clause 59. The promise had emanated from a competent officer who signed the agreement itself. If the view taken by the arbitrator is reasonably possible or plausible, we cannot interfere with the award on the ground of error apparent on the face of the award. We, therefore, uphold the award in regard to Claim No. 1 (e) and the learned Additional Judge, City Civil Court was justified in confirming the award to this item. (Para 11)

Further see also *S.E., Irrigation and another vs. M/s. Progressive Engineering Co. Hyd and others, 1997 (2) ALT 701 (D.B.)*

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JUDGMENT

PROHIBITION OF PAYMENT OF ANY AMOUNT OVER AND ABOVE THE CONTRACTUAL RATE IS APPLICABLE TO COMPENSATION BUT NOT IN THE RATES FOR THE WORK DONE

It was held by a Division Bench of A.P. High Court, in *State of A.P. vs. S.S. Reddy*, reported in 1988(2), A.P.L.J., pages 465 to 469, consisting of Mrs. Justice Amareswari and Bhaskar Rao, J., that Clause 59 pertains to compensation. If the present case, we are concerned with the rates for the work done. The Contractor is not claiming any compensation for loss or damage or loss of profit which he would have made but for the delay committed by the department. What is asked for here is that beyond the contractual date he must be paid as per the standard specification rates as the site was not handed over in time due to the fault of the department itself. We do not think P.S. 59 has any application at all." (Para 9)

"The major portion of the site was handed over beyond the period of agreement during which period the cost of labour and other materials have gone up. Without the site it was impossible for the contractor to complete the work and what the Arbitrators have done is only permit the contractor to claim the rates prevalent as per the S.S. Rs. in force. In our view, it is not prohibited either under the A.P.D.S.S. Rules or by and clause in the agreement". (Para 9)

LAPSE ON THE PART OF THE DEPARTMENT IN NOT HANDING OVER THE SITE TO THE CONTRACTOR TN FULL AT A TIME - CONTRACTOR IS ENTITLED TO BE PAID AT THE STANDARD SCHEDULE OF RATES TN FORCE

Held :—After the lapse of more than 2 years from the stipulated date of completion namely, 13-11-1979, extension of time was granted by the department upto September, 1982. This clearly shows that there was lapse on the part of the department in not handing over the site to the Contractor in full at a time, since

there is an increase in the cost of labour, material and machinery during the period beyond the agreement, the claimants are entitled to be paid at the standard schedule of rates in force. (Para 12)

JUDGEMENT

(Judgment of the Bench delivered by Amareswari, J.)

1. These three appeals arise out of a common order of the IInd Additional Judge, City Civil Court, Hyderabad, dated 27-12-1983. The matter arises under arbitration proceedings.

2. O.S.No. 1557 of 1982 is filed under Sections 14 and 17 of the Arbitration Act for making the award the rule of the Court and O.P.No. 377 of 1983 is filed under Sections 30 and 33 of the Indian Arbitration Act for setting aside the award.

3. The Executive Engineer, Roads and Buildings Department entered into an agreement with Shivraj Reddy, (3rd defendant in O.S.No. 1557 of 1982) on 14-7-1978 formation including metalling and Block topping of inner ring road at Uppal junction. As disputes arose between the parties, the matter was referred to a panel of Arbitrator as per the terms of the agreement. The Contractor made as many as 7 claims. The Arbitrators allowed Claims 1(a) and 1(b) and rejected the other claims by their award, dated 13-9-1982, Ex. A-i. Thereafter, the Arbitrators filed O.S.No.l557 of 1982 for making the award the rule of the Court. The award is contested by the 1st and 2nd defendants.

4. The Contractor filed a written statement that the award should be made the rule of the Court. The trial Court, after considering the material on record made the award the rule of the Court and dismissed the O.P. filed by the 1st and 2nd defendants to set aside the award.

5. Aggrieved thereby, the State preferred two appeals C.M.A. Nos. 470 and 471 of 1984 and Contractor preferred one C.M.A. No. 820 of 1984. The main contention of the appellant-Government is that the Arbitrators exceeded their jurisdiction in accepting claims 1(a) and 1(b) and the trial Court should have set aside the award to that extent.

6. In this case tenders were invited for the work in early 1977. Tenders were made by the 3rd defendant on 2-5-1977 and the final agreement was concluded on 14-10-1978. On 27-11-1978 the Department instead of handing over the entire site in one stretch, only a portion was handed over to the Contractor with an assurance that the remaining portion will be handed over shortly. The remaining site was handed over in bits on 23-7-1980 and on 11-12-1981. That was more than 2 years from the stipulated date of completion on 26-11-1979. The Contractor made a claim under head 1(a) for the work done upto the period of agreed date of completion namely, 26-11-1979 for payment at the rates agreed to in Schedule ‘A’ and for quantities of work done beyond the agreed date of 26-11.1979 upto 31-12-1981 at the standard specification rates in force during the period of execution plus over all tender percentage amounting to Rs. 2,43,800/-. The Arbitrators accepted the claim of the Contractor in this regard and granted rates as originally agreed for the work done upto the period of originally agreed date of completion

and for the work done thereafter at the standard specification rates in force during the period of execution of further work beyond the date of completion pins over all accepted percentage.

7. The main submission of Miss. V. Lakshmi Devi, the learned Counsel for the appellant is that Clause 59 of the Andhra Pradesh Detailed Standard Specification Rules prohibits payment of any amount over and above the contractual rate. In support of this contention, she relied upon a decision of the Division Bench of this Court in C.M.A. No.677 of 1981 and C.R.P. No.385 of 1982, dated 19-4- 1982.

8. P.S. 59 of the Andhra Pradesh Detailed Standard Specifications is as follows:—

"P.s. 59. Delays and extension of time :—x x x "

9. In our view P.S. 59 has no application. It pertains to compensation. In the present case, we are concerned with the rates for the work done. The Contractor is not claiming any compensation for loss or damage or loss of profit which he would have made but for the delay committed by the department. What is asked for here is that beyond the contractual date he must be paid as per the standard specification rates as the site was not handed over in time due to the fault of the department itself. We do not think P.S. 59 has any application at all. The decision of the Division Bench referred to by the learned Government Pleader has no relevance in the present context. In this Division Bench case, the contractor having agreed for reduction of rates and executing the final agreement, demanded escalation of rates complaining that the department committed delays and defaults. The Government relied upon Clause 59 and Foot Note 7 of Schedule 'A' which prohibited payment of rates at the enhanced rates even during the extended period. The Division Bench negatived the claim of the Contractor on the ground that the Foot Note 7 is clear to the effect that the agreed rate should prevail even during the extended period of the agreement. The judgment of the Division Bench was more based on the specific prohibition contained in Foot Note 7 of Schedule 'A' of the agreement therein. There is no such clause in the present agreement. It is not a case of escalation of rates. Here the major portion of the site was handed over beyond the period of agreement during which period the cost of labour and other materials have gone up. Without the site it was impossible for the contractor to complete the work and what the Arbitrators have done is only to permit the contractor to claim the rates prevalent as per the S.S.Rs. in force. In our view, it is not prohibited either under the APDSS Rules or by any clause in the agreement.

10. In *Chellappan vs. Kerala State Electricity Board*, (2) AIR 1975, Supreme Court, Page 230, it was held that the award can be set aside only when it is vitiated by an error of law apparent on the face of the record.

11. In *Jeevarai Bai vs. Chintamani Rao*, (3) AIR 1965, Supreme Court, Page 214, it was held that the Courts cannot interfere with the decision of the Arbitrators on the ground that a different conclusion is possible. The adjudication by the Arbitrators must be considered as binding for he is a Tribunal selected by the parties.

12. As per the agreement, the work has to be completed within 12 months from the date of handing over the site. A portion of the site was handed over on 27-11-1978 and the remaining portion in bits on 23-7-1980 and 16-12-1981. After the lapse of more than 2 years from the stipulated date of completion namely, 30-11-1979, extension of time was granted by the department upto September, 1982. This clearly shows that there was a lapse on the part of the department in not handing over the site to the Contractor in full at a time, since there is an increase in the cost of labour, material and machinery during the period beyond the agreement, the claimants are entitled to be paid at the standard schedule of rates in force. The award of the arbitrators is just and reasonable and it is not vitiated by an error of law apparent on the face of the record.

13. In the result, the appeals preferred by the State dismissed with costs.

14. In C.M.A.No. 820 of 1984 preferred by the Contractor, it is contented that the decree is not in accordance with the award passed by the Arbitrators. We find substance in this connection. While the judgment said that the award is made the rule of the Court, the decree refers to only one relief viz., that the contractor should be paid at the standard schedule of rates in force from December, 1979 to June, 1980, July, 1980 to June, 1981 and July, 1981 to September, 1982 plus the accepted over all tender percentage. The decree does not refer to Claim No. 1(a) which was allowed by the Arbitrators namely that for the work done upto the period of original agreed rate of completion, the Contractor is entitled at the rates agreed to in Schedule 'A' including the work done in excess of the quantities in Schedule 'A'. Claim 1(b) which was also allowed by the Arbitrators says that the Contractor is entitled for payment at the S.S.Rs. in force for the work done beyond the original agreed date of completion during the period of execution of further work plus over all accepted tender percentage. Hence the decree of the lower Court is modified in terms of the award to the following effect:—

(1) The defendants 1 and 2 shall pay the contractor, 3rd defendant at he agreed rates in Schedule 'A' including the work done in excess of the quantities in Schedule 'A'

(2) The defendants 1 and 2 shall pay defendant No. 3 Contractor at the standard schedule of rates-in force for the further work done beyond the originally stipulated date of completion i.e., 30-11-1979 till the date of completion plus the accepted over all tender percentage; and

(3) The amount deposited by the Department and withdrawn by the contractor shall be adjusted in the final payment.

C.M.A. No. 820 of 1984 is allowed. No costs.

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JUDGMENT

CERTAIN CLAUSES OF P.S. 59 ARE ARBITRARY AND UNJUST

HON 'BLE SRI JUSTICE K RAMASWAMY

W.P.No. 9797 of 1983, dated 25-1-1988 (Reported in 1988 (1) A.L.T. 461

V. Raghunadha Rao *Petitioner*

vs.

State of A.P. and others *Respondents*

Held :—The execution of the Government contracts has constitutional flavour emanating from Articles 298 and 299 of the Constitution. Public law element imposes limitation of imports and obligation upon the State's executive power to conform to rule of law. It cannot compel a citizen or person to forego the constitutional or statutory rights as a condition to grant contracts. The conditions! covenants must satisfy the rigour of Article 14 unless they are otherwise constitutionally authorized. Thereby the imposition of the unconstitutional conditions is ultravires the executive power of the State. (Para 13)

Unless sufficient long time is given between the date of unilateral calling of the tenders and the last date to submit tender, clause 11 remains to be a mere paper statement affording no adequate opportunity to the intending contractor. Paragraph 2 of Clause II by itself cannot be declared to be *perse* arbitrary but on a given facts and circumstances and it has to be tested with reference to the timelag and relief given to the parties. (Para 41)

Limiting or self-relieving obligations on the part of the State are self- exculpatory and breeding source to extra-constitutional behaviour. Omission to recompose a contractor of the damages or loss suffered due to inaction, non- performance or under performance or substantial unilateral variation of the terms of the contract are obnoxious to justness, fairness, or reasonableness offending Article 14. Thus considered, the opening part of first sub-clause of clause 59 and the supplementary specifications (relieving the liability of the State) are arbitrary, unreasonable, unjust, unfair, and unconscionable. (Para 42).

The Executive Engineer and the Superintending Engineer are the subordinates to the State. Their decision shall not be made final and conclusive but must be left to a decision, though may be raised at a later stage by an independent authority, viz., the Court or an independent arbitrator or panel of arbitrators. No one shall be a Judge of his own cause. Clause 29 of the specifications is not arbitrary but the exclusion of the decisions of the authorities mentioned thereunder (Executive Engineer and Superintending Engineer) from the purview of arbitration under Clause 73 is invalid offending Articles 14 and 21. In matters relating to Government contracts fair procedure is that the disputes shall be referred to an independent arbitrator or panel of arbitrators of "their known integrity". The procedure provided in Clause 73 to refer to an arbitrator or a body of official arbitrators is an unfair procedure offending Article 21. (Paras 44 and 48)

Under Clause 62(b) power has been given to deduct part amounts pending execution of the contract. It is an interim measure. Therefore it is not arbitrary. (Para 49)

The decision only applies to the petitioner's contract and to the contracts to be executed hereinafter. (Para 50)

P.S. 60. Delays in commencement or progress or neglect of work and forfeiture of earnest money, security deposit and withheld amounts :—(a) Time shall be considered as of the essence of the contract. If, at any time the Executive Engineer shall be of the opinion that contractor is delaying commencement of the work or violating any of the provisions of the contract or is neglecting or delaying the progress of the work as defined by the tabular statement "Rate of progress" in the "Articles of agreement", he shall so advise the contractor in writing and at the same time, demand compliance. If the contractor neglects to comply with such demand within seven days after receipt of such notice, it shall then, or at any time thereafter, be lawful for the Executive Engineer to determine the contract, which determination shall carry with it the forfeiture of the Security deposit and the total of the amount withheld under Clause 68 below, together with the value of such work as may have been executed and not paid for, or such proportion of such total sums, as shah be assessed by the Executive Engineer.

[However, any authority higher in rank than the Executive Engineer may, in his absolute discretion, waive or modify any penalty or forfeiture imposed by the Executive Engineer, under the provisions of the clause].

[Added by G.O.Ms.No. 1007, Tr.Roads & Blds.(C1) Dept., Dt. 5-11-1976]

[(b) If, however, the Executive Engineer notwithstanding the failure of the contractor to comply with the demand referred to in sub-clause (a) of this clause or failure to maintain the "Rate of Progress" specified in the "Articles of Agreement" plus any extension of time that may have been allowed to the contractor as defined in Clause 59, shall permit the contractor to proceed with the whole or part and continue and complete the whole or such part of the work, such permission shall not be deemed to be a waiver in any respect by the Executive Engineer of the right of forfeiture under this clause:

Provided however that any such forfeiture under this sub-clause shall not exceed 5 per cent of the total of the contract amount:

Provided however that any authority higher in rank than the Executive Engineer may in his absolute discretion waive or modify any penalty or forfeiture imposed by the Executive Engineer under the provisions of this clause].

[Amended by Memo No. 972, Codn./74-5, P.W.D., Dt. 18-9-1974]

(c) It shall be a further right of the Executive Engineer, under this clause, at any time the "Rate of Progress" in the agreement is not maintained, to give any part of the work to any other contractor at his discretion, in order to maintain the "Rae of progress" upon the completion of that part of the work that is withdrawn. the Executive Engineer shall certify the amount of expenditure incurred by the department for getting it completed by another contractor or contractors. Should the amount so certified be less than the amount which would have been due to the contractor on the completion of that part of the work by him, the difference shall not be paid to the contractor. [Should, however the former exceed the latter, the difference shall be recovered from the contractor by the Government, provided however that such a recovery shall not exceed 5% of the total contract amount.

[Subs. by G.O.Ms.No. 140, Tr.R & B(B. III), Dept., Dt. 1-7-1992]

[***Note*** :—The contractor who makes a standing security deposit of Rs. 1,00,000 (Rs. one lakh) with the Chief Engineer under whom he wishes to tender

for works is eligible for concessional rates of Earnest money deposit and retention from bills. However, for the purpose of forfeiture under the above clause, security deposit will be reckoned at the normal rate, assuming that there is no standing security and not at the concessional rate].

[Amended by G.O.Ms.No. 471, Tr., R.&B. (C) Dept., Dt. 7-10-1983]

Clarification

Execution of Balance work after determination of Contract under Clause 60(c) of P.S. to A.P.D.S.S.

[Memo.No. 1778/C1/78-18, Tr.&R.B. (CI) Dept.. Dt. 10-8-1981]

Clarification has been made as to the mode of execution of balance Work and the rate of which it may let out.

It is clarified that the Executive Engineer should have the right to allot the balance work on nomination to any other contractor at his description in order to maintain the rate and progress. No tenders need be invited so long as the Executive Engineer can get the balance work executed satisfactorily at the rate in the agreement of the original contractor. If the Executive Engineer is, however unable to find a contractor to execute the balance work at the original agreement rate, he shall call for tenders at short notice and obtain realistic rates. If the work so covered out and completed by the other contractor or contractors involves any extra cost, the difference shall be received from the original contractor under Clause 60(c) aforesaid provided, however, that such recovery shall not exceed 5% of the total finished contract amount.

P.S. 61. Suspension of the works by the Contractor :—If, the contractor (except on account of any legal restraint not occasioned by his own wilful act or default or orders from Government preventing the continuance of act or default or orders from Government preventing the continuance of the extension of time has been sanctioned by competent authority) shall suspend the works, or sublet the work or a portion thereof without sanction of the Executive Engineer, or in the opinion of the Executive Engineer, shall neglect or fail to proceed with due diligence in the performance of his part of the contract as laid down in the schedule rate of progress, or if he shall continue to default or repeat such default in the respects mentioned in Clause 27 the Executive Engineer shall have power to give notice in writing to the contractor requiring that the works be proceeded with in accordance with the terms of the contract. Such notice shall not be unreasonable, or vexatiously given, and must signify' that it purports to be a notice under the provisions of this clause, and must specify that act or default on the part of the contractor upon which it is based. After such notice shall have been given, the contractor shall not be at liberty to remove from the site or the works, or from the ground contiguous thereto, any plant or materials belonging to him, which shall have been placed thereon for the purpose of the work; and Government shall have a lien upon all such plant and materials, to subsist from the date of such notice being given until the notice shall have been complied with. The Government shall have power to post watchmen at the site of the works and or the ground contiguous thereto in order to prevent the removal of any plant or materials upon which the Government shall have a lien. If the contractor shall fail, for fourteen days after such notice has been given, to comply with the same to the satisfaction of the Executive Engineer as certified by him in writing, Government may enter upon and take possession of the works and

site, and of all such plant and materials thereon (or any ground contiguous thereto) and all such plant and materials as above mentioned shall thereupon be at the disposal of Government absolutely, for the purpose of completing the work.

If Government shall exercise the above power to enter upon the works and take possession of the works, plant and materials they may engage any other person to complete the works, and exclude the contractor, his agents and servants from entry upon or access to the same, except that the contractor or any person nominated by him may have access at all reasonable times to inspect, survey and measure the works already executed by him. And Government shall thereupon take such steps as they may consider necessary for completing the works without undue delay or expense, using for that purpose the plant and materials above mentioned and obtain such additional plant and materials as the Executive Engineer shall decide is necessary for the due prosecution and competition of the work. Upon the completion of the works, the Executive Engineer shall certify the amount of the expenses properly incurred consequent on, and incidental to, the default of the contractor as aforesaid and in having the works completed by other persons having credited the contractor with the value of the materials utilized as aforesaid. Should the amount so certified be less than the amount which would have been due to the contractor on the completion of the works by him the difference shall not be paid to the contractor by Government; should the amount of the former exceed the latter, the difference shall be paid by the contractor to Government. Government shall not be liable to make any payment to the contractor on account of the use of such plant for the completion of the works under the provisions hereinbefore contained. Government may at any time give notice in writing to the contractor to remove any of his plant or materials from the site and not required for completion of the works. If such plant and or materials are not removed within fourteen days after notice shall have been so given Government may remove and sell the same, holding the proceeds less the cost of removal and sale, to the credit of the contractor.

In case Government shall exercise the power contained in this clause and shall complete the works by any other person as therein provided, the Executive Engineer, after instituting such inquiries as he may deem fit, with or without notice to the contractor, shall certify what amount (if any) had at the time of the Government exercising such power as aforesaid, been reasonably earned or would reasonably accrue to the contractor in respect of work then actually done by him in the premises and such certificate shall be final and binding on the contractor.

Notwithstanding anything contained in Clause 50 above, when possession of the work and site is taken by Government in exercise of the power contained in this clause the portion of the work actually completed by the contractor in the premises shall be maintained by Government as the risk and expense of the contractor until the whole of the work is completed by other agency and possession thereof taken by Government.

I. — Particulars of Payment

P.S. 62. Payment on lump-sum basis or by final measurement or unit prices:—(a) Payment for the work done by the contractor will be made on the basis of the measurements recorded in the measurement books or level field books

by an officer not below the rank of the Supervisor and check measured by an officer not below the rank of an Assistant Engineer. The measurements will be recorded at the various stages of the work, while it is in progress, for the proper assessment of the quantities of work, done and also after the work is completed or when the contract is determined. The contractor or his authorized agent shall be present at the recording of each set of measurement and check measurement and accept them, then and there, so as to avoid disputes at a later stage. The set of measurements and check measurements may also be taken by the Department even in the absence of the contractor or his authorized agent, three days after the issue of a notice to the later, in writing of such intention by the department.

[Subs. by G.O.Ms.No. 1007, Tr., Roads & Blds. (C1) Dept., Dt. 5-11-1976]

(b) In cases of over-payment or wrong payment made, if any, to the contractor due to wrong interpretation of the provisions of the contract, the Andhra Pradesh Standard Specification or otherwise, such unauthorized payment will be deducted in the subsequent bills or final bill of the work, or failing that, from the bills under any other contract with the Government or at any time thereafter, from his security deposits available with the department.

[Subs. by G0.Ms.No. 1007, Tr., Roads & Blds. (Cl) Dept., Dt. 5-11-1976]

(c) It shall be accepted as a condition of the contract that a payment of the final bill to the contractor less the withheld amount and his acceptance thereof shall constitute a full and absolute release of Government from all further claims by the contractor under the contract.

P.S. 63. Payment for additions and deductions for omissions:- The contractor is bound to execute all supplemental items that are found essential, incidental and inevitable during the execution of the work, at the rates to be worked out as detailed below

[(a) For all items of work in excess of the quantities shown in Schedule A of the tender the rates payable for such items shall be either the tender rates or the standard schedule of rates for the items plus or minus the overall tender percentage accepted by the competent authority whichever is less.

(b) For items directly deducible from similar items in the agreement, the rates shall be derived by adding to or subtracting from the agreement rate of such similar item, the cost of difference in quantity of material or labour between the new items and the similar items in the agreement, worked out with reference to the Schedule of rates adopted in the sanctioned estimate plus or minus the over all tender percentage].

[Subs. by G.O.Ms.No. 1007, Tr., Roads & Blds. (C) Dept., Dt. 5-11-1976]

(c) For new items which do not correspond to any items in the agreement, the rates shall be the standard schedule rate plus or minus the overall tender percentage.

The terms ‘standard schedule of rates’ used in the above sub-clauses (a), (b) & (c) means the schedule of rates on which the sanctioned estimate was prepared.

(d) In the event of the Executive Engineer and the Contractor failing to agree on a rate for such additional work, the Executive Engineer may, at his opinion either :—

(i) employ other parties to carry out the additional work in the same manner as provided for under Clause 48, or

(ii) the contractor shall execute the work upon written orders from the Executive Engineer and the cost of labour and materials plus 10 per cent thereon shall be allowed therefor, provided that the vouchers for the labour and materials employed shall have been delivered to the Executive Engineer or his representative within seven days after such work shall have been completed. If the Executive Engineer considers that payment for such work on the basis of the vouchers presented is unduly high, he shall make payment in accordance with such valuation as he considers fair and reasonable and his decision to the matter shall be final, if the amount involved in additional payment is Rs. 1,000 or less, for each occasion on which such additional works shall have been authorized. If such amount exceeds Rs. 1,000, the contractor shall have the right to submit the matter to arbitration under the provisions of the arbitration Clause 73.

(e) If, in the opinion of the Executive Engineer, a rate for the additional work is not capable of being properly arrived at prior to execution of work, or if the work is not capable of being properly measured, then the cost and payment thereof shall be dealt with as provided for in the preceding sub-clause (d)(ii).

P.s. 64. No payment for unsanctioned extras :—It shall be distinctly understood that no payment whatever will be made to the contractor for variations by way of extras in cases where such variations have been made without the written sanction of the Executive Engineer.

P.S. 65. Accounts, receipts and vouchers :—The contractor shall at any time, upon the request of the Executive Engineer furnish him with all invoices, accounts, receipts and other vouchers that he may require in connection with the contract.

P.S. 66. Fraud, wilful neglect or default :—No final or other certificate of payment of completion, acceptance or settlement of account shall, in any circumstances, relieve the contractor from his liability for any fraud or wilful neglect or default in the execution of the contract or any wilful or unauthorized deviations from the drawings, specifications, instructions and directions for the time being binding upon him.

P.S. 67. Unfixed materials :—No payment or advance will be made for unfixed materials when the rates are for finished work in site.

P.S. 68. Payments and certificates :—Payment will be made to the contractor under the certificate to be issued at reasonably frequent intervals by the Executive Engineer or by the sub-divisional officer. Within fourteen days of the date of each certificate, an intermediate payment will be made by the Executive Engineer or the sub-divisional officer of a sum equal to 92 ½ per cent (96 ½ % in the case of contractors who have lodged the standing security deposit of [Rs. 1,00,000) (Rs. 1-00 lakh)] of the value of work, as so certified and the balance of 7½ percent, (3½% in the case of contractors who have the standing security deposit) will be withheld and retained as a security for the due fulfilment of the contractor. Under the certificate to be issued by the Executive Engineer or the Sub-

Divisional Officer on the completion of the entire works the contractor will receive the final payment of all the moneys due or payable to him under or by virtue of the contractor except earnest money deposit retained as security and a sum equal to 2 ½ % of the total value of the work done, provided there is no recovery from or forfeiture by the contractor to be made under Clause 60. The amount withheld from the final bill will be retained under "deposits" and paid to the contractor together with the earnest money deposit retained as security after a period of six months as all defects shall have been made good according to the true intent and meaning thereof. However in the case of works like conveyance of materials, supply of materials, slit clearance where the fixation of observation period is not necessary, the deposit amount could be refunded after the work is completed in accordance with the terms of the agreement.

[Subs. by G.O.Ms.No. 471, Tr., Roads & Blds. (Cl) Dept., Dt. 7-10-1983]

No certificate of the Executive Engineer or the Sub-Divisional Officer shall be considered conclusive evidence as to the sufficiency of any work or materials or correctness of measurements to which it relates, nor shall it relieve the contractor from his liability to make good defects as provided by the contractor. The contractor, when applying for a certificate, shall prepare a sufficiently detailed bill, based on the original figures of quantities and rates in the contract (Schedule A) to the satisfaction of the Executive Engineer, to enable the Executive Engineer or the Sub-Divisional Officer to check the claim and issue the certificate. The certificate as to such of the claims mentioned in the application as are allowed by the Executive Engineer or the Sub-Divisional Officer shall be issued within fourteen days of the application. No application for a certificate shall be made within fourteen days of a previous application.

In calculating the amount of each item due to contractor in every bill submitted for payment under this contract, fractions of below five paise shall be omitted and five paise or over shall be reckoned as ten paise. In calculating the total on each bill amounting to Rs. 25 or more under this contract, fractions of less than half rupee shall be disregarded and half a rupee and over shall be reckoned as one rupee.

[The above clause will not apply to contracts entered into for designing, manufacture, supply, erection, testing, etc. (mechanical contracts) where special conditions are incorporated providing for retention of 10% of the contract value for twelve months after the payment upto 90% on erection and testing].

[Inserted by G.O.Ms.No. 416, T., R. & B. (C) Dept., Dt. 27-12-1980]

P.S. 69. Interest on money due to the contractor :—(a) No omission by the Executive Engineer or the Sub-Divisional Officer to pay the amount due upon certificates shall vitiate or make void the contract, nor shall the contractor be entitled to interest upon any guarantee fund or payments in arrear, nor upon any balance which may, on the final settlement of his accounts, be found to be due to him.

(b) Whenever the withheld amount reaches Rs. 1,000 or a multiple thereof, the contractor may, at his option, deposit with Executive Engineer Rs. 1,000 or a multiple thereof, in any of the forms of interest bearing securities recognized for

the purpose by the Andhra Pradesh Public Works Accounts Code and subject to the provisions therein contained, in which case in the equivalent withheld amount shall be paid to him forthwith. The contractor will be permitted to exercise the option in this clause, subject only to the condition that the rate of progress contained in the Articles of Agreement is properly maintained.

JUDGMENT

CANNOT BE CONSTRUED AS A TOTAL PROHIBITION OF PAYMENT OF INTEREST

1989(1) ALT 195

The Hon 'ble Mr. Justice P. Kodandaramayya

Appeal No. 932 of 1986 and Memo. of Cross Objections, Dt. 5-2-1988

A.P.S.R.T.C. rep. by its General Manager
(Now re-designated as Managing Director)
Mushirabad, Hyderabad and others *Appellant*

vs.

P. Ramanareddi *Respondent*

Judgement

The Andhra Pradesh State Road Transport Corporation represented by its Managing Director, the first defendant and its officers, defendants 2 and 3, are the appellants in this appeal. The suit is laid for recovery of Rs. 81,018-93 Ps. towards the work done for the Corporation for constructing a building and bus stand at Srikalahasthi, Chittoor District.

2. The plaintiff case in short is that the plaintiff entered into an agreement Ex. A-i on 19-11-1978 and the work was completed on 22-5-1980 and the amount due to him under the work done by him and the deposits refundable to him were not paid even after 22-11-1980, six months' period stipulated under the contract and with the details given in the plaint the suit claim is made with interest. The defence is that the plaintiff failed to comply with the terms of the contract and for recovery of amount due for two items 37 and 38 a separate suit was filed, by the plaintiff and the plaintiff refused to sign the final bill and declined to accept the estimate-made by them and he is entitled to Rs. 21,401-48 Ps., towards the work done and Rs. 30,531/- towards deposits and a sum of Rs. 49,082-22 Ps., has to be adjusted from the bills and hence he is entitled to only a sum of Rs. 2,850-25 Ps.

3. On this controversy, very strangely, the Court below framed a solitary issue, whether the plaintiff is entitled to recover suit amount, from the defendants as prayed for. This can hardly be described as a satisfactory method of framing issues. No doubt it discussed the evidence in respect of each item claimed by the defendant for being adjusted but took the view that the claim of the defendant constitutes set-off and in as much as the Court-fee is not paid no claim can be sustained even in respect of the items found due to the defendant which are liable to be deducted from the bill. However, in view of the admission made by the

defendants that a sum of Rs. 51,922-48 Ps., is due negativing the claim of the plaintiff for Rs. 49,082-22 Ps., decreed the suit for the said sum with interest at 12% p.a. from 22-1-1980 upto the filing of the suit and also granted interest on Rs. 7 1,653-02 Ps., at 6% per annum from the date of the suit till the date of realization. Against this decree and judgment the present appeal is filed.

4. The learned counsel for the appellants, Sri K. Harinath, argued three questions before me.

1. The view of the trial Court that the deductions sought from the bill payable to the plaintiff constitute set off is incorrect and no Court-fee need be paid and the claim of the defendants for adjustment of these items must be examined on merits.

2. Awarding of interest at 12% per annum from 22-1-1980 the date of completion of contract is illegal and further awarding interest on interest is illegal.

3. He also canvassed the correctness of the finding of the trial Court on the items claimed by the defendants.

5. It is true as per Section 8 of the Andhra Pradesh Court-fees and Suits Valuation Act, 1956 (Act VII of 1956) a written statement pleading a set-off or counter-claim shall be chargeable with fee in the same manner as plaint. It is necessary to examine whether the present claim of deduction made by the defendants constitutes set-off. A perusal of Ex. A-i shows the items supplied by the Corporation such as cement, steel and other material had to be deducted in order to arrive at the total bill payable. They are virtually in the nature of payments in kind. But they are not sums of money payable to the defendants under the terms of the contract. If the total sum payable has to be arrived at on the adjustment of these amounts, it does not amount to set-off and no Court-fee need be payable. I may usefully refer to the following dicta of the Supreme Court in this regard reported in *M/s. Lakshmichand & Baichand vs. State of Andhra Pradesh*, (1986(2), APLJ 45). No doubt in that case the question of Court-fee did not arise. It is also a case where some amounts were deducted by the Government for the work done while upholding the right of set-off. While dealing with the right of the defendant to claim set-off in the execution proceedings under Order XXI, Rule 18 of the C.P.C., the Supreme Court observed as follows with reference to Clause 68 of the contract which enables final payment to be made to the contractor after taking into account the amount which had been received by him earlier. They described such amount and the process of deduction as adjustment. The passage runs thus

> "So far as the first claim to adjustment is concerned, t1ie matter is covered by Clause 68 of the contract. What was awarded to the contractor under the decree was an amount relating to a part only of the work entrusted to him. The contract was still in the process of execution. Any amount claimed by him for such work was subject to a final settlement of account on the preparation of the final bill. The right to payment depended on the terms of the contract. Any payment made while the contract was still being worked out was in the nature of a provisional payment. It is always subject to adjustment against amounts found due against the contractor on preparation

> of the final bill. Such adjustment was implied in the very terms of the contract. Therefore, in regard to the adjustment claimed by the State Government on the first count the High Court is right in our opinion, in holding that the amount claimed by the State Government as determined on arbitration, was entitled to set off against the decretal amount claimed by the contractor and that payment of the decretal amount was to be subject to such adjustment."

6. Though in this case the finding is in respect of set-off, the passage is relied upon very rightly by the learned counsel to show that it is really in the nature of adjustment. No doubt the Court is not concerned with reference to the Court fee payable but only substantive right of set-off. It is necessary to remember that even if adjustment is made if a dispute is raised about the right to adjustment, the Court may have to examine it. It is not as if the adjustment pleaded will be accepted automatically or it must be one which is indisputable. We are concerned with the problem of payment of Court-fee. The Court is bound to make any enquiry and adjudicate the rights of the parties irrespective of the plea raised by the plaintiff whether it is set-off or adjustment, but if it is an adjustment, no Court-fee need be payable.

7. This view is fairly settled and there are decided judicial opinions on this question. We have got a similar provision under the Central Court-fee Act, 1870. In Schedule I, Item 1 which enjoins payment of Court-fee on plaint, written statement pleading a set-off or counter-claim. Courts have examined this provision and ruled that when the plea raised is only an adjustment or payment no Court fee need be payable. It is necessary to distinguish set-off from adjustment. A Full Bench of this Court in *Boganandam Seshaiah vs. Budhi Veerabadrayya*, (AIR 1972, A.P. 134; 1971(2), ALT 227 F.B.) defined set-off in the following terms

> "The principle of set-off may be defined as the extinction of debts of which two persons are reciprocal debtors to one another, by the credits of which they are reciprocally creditors to one another."

8. Stroud's Judicial Dictionary defines set-off as

> **"(A) A legal set-off is** : "where there are mutual debts between the plaintiff and defendant, or if either party sue or be sued as executor or administrator....one debt may be set against the other".

The author relying on a dicta of Brett L.J., also says, "set-off' and "counter-claim" confer definite and independent remedies upon a defendant against the plaintiff. Thus it is seen, 'set-off' is a claim that arises under the same transaction which confers a right to recover the same as an independent debt, but an adjustment or payment in respect of the amount due to the plaintiff has extinguished the debt as the defendant is not claiming any right to recover the amount but only seeking to establish that the claim of the plaintiff cannot be arrived at without reference to the payment or adjustment already made.

9. It is unnecessary to multiply the authority on this question. A Division Bench of the Orissa High Court in *The Tata iron and Steel Co.Ltd. vs. R.N. Gupta*, (AIR 1963, Orissa 174), arising under the Central Court-fee Act rightly took the view holding that:

> "A plea of satisfaction or extinguishment of a debt or a claim, set up merely by way of defence is very different. A plea of payment necessarily refers to a satisfaction or extinguishment of a debt effected prior to the stage of the defence, whereas a plea of set-off is in the nature of a cross-claim and in effect it prays for a satisfaction, or extinguishment of a claim, to be made in the future 'after the date' when the plea has been set up. If it were held to be merely a plea regarding adjustment of accounts and no more, no Court-Fee would be payable on the amount mentioned in such a plea".

10. The above case also noticed earlier judgments in support of this view. Hence I am clearly of opinion that the payment of adjustment is not set-off as the defendant has no independent right to recover the amount without settling the claim of the plaintiff. It is not a cross-claim though arising under the same transaction as in the case of set-off.

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11. Applying this principle to the facts of this case, it is clear Ex. A-1 envisages that the Corporation should supply cement, steel and other material and the price must be deducted in the bills payable to the plaintiff. The defendant has no right to recover as a cross-claim though arising under the same transaction. He cannot plead that the plaintiff must refund these amounts and he will pay the amount due to the plaintiff. On the other hand, the amount paid by him should go towards the deduction of the claim made by the plaintiff and hence in the absence of a right to recover as an independent debt due from the plaintiff it clearly constitutes an adjustment or payment. Accordingly I am of the opinion that the Court below misdirected itself in thinking that these deductions that have to be made by the Corporation are in the nature of counter-claim and Court-fee requires to be paid.

12. Fortunately the Court below alternatively examined each item claimed by the defendant and rejected all the items except two items. But at the end of the judgment it held that in view of the non-payment of Court-fee no claim made by the defendant can be examined and hence I have new no examine the claim of the defendant on merits as I hold that no Court-fee need be paid.

13. Now I shall deal with the merits of the case.

14. The defendant claimed as many as 8 items to be deducted out of the amounts admitted by him due to the plaintiff. The first item is cement supplied

to the plaintiff. The defendant's counsel made two alternative submissions. (1) The Court below decreed only the amount admitted by the defendant i.e., Rs.51,932-43 Ps., but did not deduct even 6.25 metric tons of cement admittedly deducted by the plaintiff in his plaint while arriving at the total sum payable to him. Secondly the value of cement is not 125 bags as claimed by the plaintiff, but it must be 267 bags. This is refuted by the learned counsel for the plaintiff stating no doubt the plaintiff deducted 6.25 metric tons of cement in the plaint but on that basis total amount arrived at Rs.81,080-93 Ps. Unless the Court examine these items and reject a part of the claim as untenable, the mere deduction shown in the plaint at Rs.2,875-00 Ps., cannot constitute an admission. The alternative argument was answered by him saying though the plaintiff deducted 6.25 metric tons on the basis of his calculation, he claimed some illegal deductions made in the bill at Rs. 4,761-00 and that was accepted by the trial Court in which event the claim for 267 bags of cement or the statement in the plaint for 6.25 metric tons is not fatal and the total amount must be rejected. I am inclined to accept the submission on behalf of the plaintiff. No doubt the plaintiff on the method of calculation arrived at sought to deduct 6.25 metric tons i.e., 125 bags but the Court did not examine the correctness of the figure arrived by the plaintiff at Rs. 81,082-93 Ps. but proceeded to decree the suit claim on the basis of the admission made by him. In view of the fact the plaintiff has claimed Rs. 4,761/- and the interest payable therein respect of the excess cement already used, he might have shown the deduction for Rs. 6,25 Metric Tons or 125 bags. Both the counsel did not take me to details of calculation adopted either by the plaintiff or the defendant. The defendant's counsel contended that the statement in the plaint constitutes an admission whereas the plaintiff's counsel contended that when the Court rejected the plaintiff's method of calculation the statement of deducting a portion of the cement used by him cannot constitute an admission. In fact the Court also accepted the plea of the plaintiff in this regard and said that DW-2 stated that the cost of 3866 bags of cement given to the plaintiff was recovered by 11th bill itself and it also held that no evidence has been produced to show that the plaintiff did not spend the cement of 3724 bags as per the measurement in M.Book. The contention of the learned counsel for the defendant is that though the plaintiff has used all 3991 bags his claim for the entire thing is illegal as the estimated amount is less. The relevant clause in the agreement Ex. A-1 shows that the plaintiff is entitled to use the cement required and hence the Court below also recorded a finding that no evidence has been produced to show that the plaintiff did not use the cement issued from the 1st bill to the 11th bill or subsequently except stating that the measurements were noted in the M Book. Hence I am of the opinion that no separate deduction towards the cement is warranted in view of the finding arrived at by the trial Court.

15. The trial Court on the question of steel, recorded a finding that the defendants are entitled to recover cost of excess steel 3.52 metric tons at Rs. 2,500-00 per metric ton i.e., Rs. 8,800-00. It also held that a sum of Rs. 800-00 can be claimed by the defendant for non engagement of technical agents. On these two items the learned counsel for the plaintiff contended that if the Court-fee is paid, his claim can be allowed. But he did not say how the finding is incorrect. In view of the fact that I have taken the view that the Court-fee need not be paid, these two items must be allowed as deduction towards the bill payable to the plaintiff.

16. The Court below also held seigniorage charge of Rs. 3,884-00 and also Income-Tax of Rs. 428-00 cannot be deducted. When we look to the relevant clause 22 it not only enables the defendant-Corporation to deduct that amount if it actually paid on behalf of the plaintiff or if any outstanding income or other dues. If the plaintiff failed to produce Income-tax clearance certificate, the Corporation is not entitled to deduct them in the absence of any proof of payment made by them on behalf of the plaintiff.

17. The last item is damages claimed by them at Rs.16,130-84 Ps. The learned counsel for the defendant vehemently argued that admittedly the plaintiff let out certain items in the contract without performing them and they have to get it done by some other person and the damages incurred by them must be allowed to be recovered from the bill payable to the plaintiff. I must say there is no specific clause in the agreement enabling the Corporation to deduct any amount towards damages. It is admitted by the defendant that it is only under general law of damages. Assuming that the Corporation has a right, I am clearly of the view that no one connected with the work entrusted was examined. The actual amount spent is not forthcoming. But the learned counsel for the defendant argued that this item was not disputed. I must say it is clearly an untenable contention. What was urged by the defendant is that at the instance of the Corporation's Engineer he released certain items to the third parties. On the other hand he is disputing the plaintiff's statement that the defendant committed default. The fact that he released certain items for being entrusted to third parties does not mean that be admitted the claim of the defendants. I must hold that in the absence of any evidence of actual loss, - the claim for damages at Rs. 16,130-84 Ps. is clearly untenable. In the result out of the total amount found due and admitted by the defendant at Rs. 51,922-48 Ps. the two sums i.e., Rs. 8,800-00 and Rs.. 800-00 totalling Rs. 9,600-00 are liable to be deducted and the plaintiff is entitled to the said amount.

18. On the question of interest I took the assistance of Sri J. Prabhakar and I place on record of my appreciation for his able assistance to the Court. The argument of the learned counsel is two fold. Under Clause 69 of the Andhra Pradesh Detailed Standard Specifications which is made applicable to the contract in question, no interest is payable. In view of that prohibition the decree regarding payment of interest is unsustainable. Secondly even assuming that Clause 69 is not a bear or inapplicable for a claiming interest as stated in the plaint, the provisions of the Interest Act, 1839 are not attracted to the facts of the case. On the first part of the argument, he relied on the judgment of this Court in *Koppisetti Venkateswara Rao vs. Superintending Engineer, P.H. East Circle* (1986 (2), ALT 547), wherein Ramaswamy, 3., held that Clause 69 bars the claim for interest. Sri Prabhakar brought to my notice the judgement of another single Judge, Amareshwari, 3., who took a contrary view. In view of the judgement of the Supreme Court in *Hyderabad Municipal Corporation vs. M. Krishnaswami Mudaliar* (AIR 1985, SC 607) and *State of Rajasthan vs. Raghubir Singh* (AIR 1979, SC 852), 1 cannot give effect to this agreement. Before I draw support from these two cases it is necessary to refer to Clauses 68 and 69 of the Andhra Pradesh Detailed Standard Specifications. The first paragraph of Clause 68 reads as follows:

> **"68. Payments and certificates** :—Payment will be made to the contractor under the certificate to be issued at reasonably frequent intervals

by the Executive Engineer or by the Sub-divisional Officer. Within fourteen days of the date of each certificate, an intermediate payment will be made by the Executive Engineer or the sub-divisional officer of a sum equal to 92 ½ % (96 ½ % in the case of contractors who have lodged the standing security deposit of [Rs. 1,00,000) (Rs. 1-00 lakh)] of the value of work, as so certified and the balance of 7 ½ percent, (3 ½ % in the case of contractors who have the standing security deposit) will be with-held and retained as a security for the due fulfilments of the contractor. Under the certificate to be issued by the Executive Engineer or the Sub-divisional Officer on the completion of the entire works the contractors will receive the final payment of all the moneys due or payable to him under or by virtue of the contractor except earnest money Deposit retained as security and a sum equal to 2 ½ % of the total value of the work done, provided there is no recover from or forfeiture by the contractor to be made under Clause 60. The amount withheld from the final bill will be retained under "deposits" and paid to the contractor together with the earnest money deposit retained as Security after a period of six months as all defects shall have been made good according to the true intent and meaning thereof. However in the case of works like conveyance of materials supply of materials, slit clearance where the fixation of observation period is not necessary, the deposit amount could be refunded after the work is completed in accordance with the terms of the agreement. [Subs. by G.O.Ms.No. 471, Tr., R. & Bldgs. (C), Dept., Dt. 7-10-1983]

19. Clause 69 reads as follows:

"69. Interest on money due to the contractor :—(a) No omission by the Executive Engineer or the sub-divisional officer to pay the amount due upon certificates shall vitiate or make void the contract, nor shall the contractor be entitled to interest upon any guarantee found or payments in arrear, nor upon any balance which may, on the final settlement of his accounts, be found to be due to him.

(b) Wherever the withheld amount reaches Rs. 1,000 or a multiple thereof, the contractor may, at his option, deposit with Executive Engineer Rs. 1,000 or a multiple thereof in any or the forms of interest bearing securities recognized for the purpose by the Andhra Pradesh Public Works Accounts Code and subject to the provisions therein contained in which case in the equivalent withheld amount shall be paid to him forthwith. The contractor will be permitted to exercise the option in this clause, subject only to the condition that the rate of progress contained in the Articles of Agreement is properly maintained".

20. A close reading of these two clauses discloses that in respect of each bill and after obtaining the certificate an amount of 3 ½ % or 7 ½ %, as the case may be, can be withheld. Further even after completion of the entire work, the contractor cannot receive the earnest money deposit and also a sum equivalent to 2 ½ % of the total value of the work done, and that will be payable only at the end of 6 months which is considered to be observation period. By a reading of this clause we can easily follow the ambit of Clause 69 which envisages that no claim for interest can be entertained in respect of payment of arrears or final settlement be

found to be due to the contractor. The balance of 3 ½ % or 7 ½ % that may be retained in respect of each bill even after the completion of the work constitutes payment in arrears and the earnest money deposit and also 2 ½ % of the total value of the work done is the balance due on the final settlement of the amount found due to him. So the scope of Clause 69 is to retain these sums even though the work was done completely. This is exactly what was held in *Hyd. Municipal Corporation's* case *(supra)* when a similar clause was relied on to deny the claim of interest. The clause relied on by the Supreme Court judgment is identical. It read thus

> "The contractor shall not be entitled to interest, upon any payment in arrears or upon any balance which may on final settlement of his accounts be found due to him".

Considering the scope and effect of this clause, it was observed:

> "In our view the reliance on this clause is of no avail to the appellant for the simple reason that this clause will be applicable provided the work was completed according to the specifications and the time schedule fixed in the original contract".

Thus it is clear that notwithstanding the completion of the work as per the specifications, the terms of the contract contemplates retention of the sum without paying them immediately. In view of the liability of the contracting party to pay the amount immediately on completion of the work, this clause contemplates retention of the money even though the work is completed and it specifically negatives the claim for interest on any such arrears due or on any amount deposited with the Department as earnest money deposit or sum equal to 2 ½ % of the total value of the work done till the expiry of the period of six months. Similarly in *State of Rajasthan vs. Raghubir Singh*, (AIR 1979, SC 852), the clause relied on to negative the claim of interest reads thus

> "Neither the earnest money deposit nor the withheld amount shall bear any interest".

It was observed that:

> "This sentence far from supporting the case of the appellant appears to support the case of the plaintiff. The reference to "the withheld amounts" is to the amounts representing five percent of the running bills. The provision that the contractor is not entitled to interest on these withheld amounts appears to imply that interest is claimable on other amounts due to the contractor".

21. Thus it is clear that this Clause 69 is intended to really prevent any claim for interest during the running period when final bills is not settled and also in respect of earnest money deposit on the sum equal to 2 ½ % of the total value of the work done till the expiry of the period of six months. This six months' period is called 'observation period' ; so that the Department can see whether the work was done satisfactorily or not. Clause 69 cannot be construed as a total prohibition, but it operates a limited period of six months from the date of the completion of the work and hence I negative this contention that Clause 69 is a bar to claim interest.

22. It is fairly well settled that the claim for interest can either be under the agreement, or under the usage of trade having force of law, or under the provisions of substantive law or under the provisions of the Interest Act, 1839 or when the Court exercises equitable jurisdiction as envisaged in the proviso to Sec. 1 of the said Act. Vide *Vithaldass vs. Rup Chand*, (AIR 1967, SC 188). So far as the requirement of Interest Act is concerned, the Supreme Court in *Thawardas vs. Union of India*, (AIR 1955, SC 468) laid down five conditions :

1. the interest is not payable under any other law,

2. there must be a debt or a sum certain,

3. it must be payable at a certain time or otherwise,

4. these debts or sums must be payable by virtue of some written instrument,

5. there must have been 34emand in writing stating that interest will be demanded from the date of the demand.

23. The learned counsel for the defendant on the strength of this dicta urged that the contract in question is such that no definite sum is due till it is settled by the parties or by the Court and the claim of interest can only be made after the decree is passed. Though the Interest Act 22 of 1839 is repealed by Act 14 of 1978, we are concerned with the previous Act as substantive rights cannot be affected by the repeal of the Act as Sec. 6 of the General Clauses Act is made applicable. The learned counsel relied on a judgment of the Division Bench of the Madras High Court in *Sri Rajah Ravu Venkta Kumaramahipati Surya Rao Bahadur Garu vs. Ballapragada Pallamraju*, (XL MU 18 ; 1921, Mad. 76). There the claim for interest by a contractor who undertook a building contract was negatived on the ground that no certain sum is due payable within the time as contemplated under Section 1 of the Act apart from the infirmity in that case of want of notice. It is necessary to refer the clause in that case.

> "The contract provides that, "all work done by the contractor shall be paid for by the Rajah according to the rates herein specified within a reasonable time after it has been inspected and finally approved and passed".

In that view it was held that the said provision is not one for payment of sum certain or for the payment of such sum on certain date. I cannot give effect to the submission of the learned counsel on the strength of this case. We have already noticed Clauses 68 and 69 of the Andhra Pradesh Detailed Standard Specifications. There is a clear obligation on the part of the authority to pass the bill and also make payment and finally pay entire amount within six months after the completion of the work. "A sum certain" within the meaning of Section 1 does not mean the sum must be calculated sum. It is enough it is capable of being calculated. Let us look to Section 1 of the Interest Act.

> **"Power of the Court to allow interest** :—It is, therefore hereby enacted that, upon all debts or sums certain payable at a certain time or otherwise, the Court before which such debts or sums may be recovered may,

if it shall think fit, allow interest to the creditor at a rate not exceeding the current rate of interest from the time when such debts or sums certain were payable, if such debts or sums be payable otherwise, than from the time when demand of payment shall have been made in writing, so as to such demand shall give notice to the debtor that interest will be claimed from the date of such demand until the terms of payment; provided that interest shall be payable in all cases in which it is now payable by law".

24. It is true this provision envisages as held by the Supreme Court that sum must be a certain sum and it is payable within a certain time and a demand thereof is made. It is no doubt made payable under the contract which is an instrument within the meaning of the Act. The word 'certain sum' occurring in the Act does not mean sum actually calculated or ascertained sum. A sum (which) is capable of being ascertained is sufficient to attract the section. Once the bill is prepared as per the measurements it is capable of being ascertained. It is not a case where it depends upon the consent of the parties as envisaged in 1921, Madras, 76 as a matter of objective verification ascertainable and capable of being ascertained. Regarding time factor also it is payable on certain times as the right of retaining the amount beyond six months after the completion of the work is not envisaged on the terms of the contract and the liability to pay entire sum arises on the expiry of six months' period after completion of contract, and hence I am satisfied that all the requirements of 'sum certain' and 'payable before certain time' and 'making the demand' were satisfied. The plaintiff issued a notice under Ex. A-3 making the demand and no reply was given to him. The fact that lesser amount was found due is not a ground for rejecting the claim for interest. Once a sum is certain and payable at a particular time and demand is made for that, the requirement of Section 1 of the Interest Act are satisfied irrespective of the fact that Court came to a different conclusion about the actual amounts payable. Hence I am clearly of the opinion that the interest is payable from 22-4-1982 till the date o the suit. Regarding the rate once I hold Section 1 is attracted it is the current rate of interest. The current rate of interest was considered by Courts as a fair and reasonable rate in the absence of special circumstances. Hence I am of the opinion that 12% interest from the date of demand till the suit is just and proper. The suit is filed on 2-2-1984 and pending to suit till the date of decree and from the date of decree till the date of payment the plaintiff is entitled to only 6% interest as that period is governed by Section 34, C.P.C.

25. In the result, the decree of the trial Court is modified directing that from a sum of Rs. 51,932-48 Ps. a sum of Rs. 8, 925-00 should be deducted. The plaintiff is entitled to interest at 12% p.a. from 22-4-1982 till 2-2-1984 on Rs. 43,007-48Ps. and on the same amount he is entitled to interest at 6% per annum from the date of suit till the date of decree and from the date of decree till the date of realization.

26. The appeal is allowed in part as indicated above with proportionate costs. The cross-objections are not substantiated. Hence they are accordingly dismissed.

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Case law

Interest pendente lite

In *Executive Engineer (Irrigation) vs. Abhaduta Jena* , (1988) 1 SCC 418 it was held that the arbitrator to whom the reference is made without the intervention of the Court, does not have jurisdiction to award interest pendente lite.

A Constitution Bench in Secretary, *Irrigation Dept., Govt. of Orissa vs. G. C. Roy*, (1992) 1 SCC 508, AIR 1992 SC 732 overruling Abhaduta Jena case held:

"The arbitrator acted with jurisdiction in awarding pendente lite interest to the contractor-respondent when the agreement was silent as to award of interest.

Where the agreement between the parties does riot prohibit grant of interest and where a party claims interest and that dispute (along, with the claim for principal amount or independently) is referred to the arbitrator, he shall have the power to award interest *pendente lite*. This is for the reason that in such a case it must be presumed that interest was an implied term of the agreement between the parties and therefore when the parties refer all their disputes or refer the dispute as to interest as such to the arbitrator, he shall have the power to award interest. This does not mean that in every case the arbitrator should necessarily award interest *pendente lite*. It is a matter within his discretion to be exercised in the light of all the facts and circumstances of the case, keeping the ends of justice in view.

The following principles emerge:

(1) A person deprived of the use of money to which he is legitimately entitled has a right to be compensated for the deprivation, call it, by any name. It may be called interest, compensation or damages. This basic consideration is as valid for the period the dispute is pending before the arbitrator as it is for the period prior to the arbitrator entering upon the reference. This is the principle of S. 34, Civil Procedure Code and there is no reason or principle to hold otherwise in the case of arbitrator.

(ii) An arbitrator is an alternative forum for resolution of disputes arising between the parties. If so, he must have the power to decide all the disputes or differences arising between the parties. If the arbitrator has no power to award interest *pendente lite*, the party claiming it would have to approach the Court for that purpose, even though he may have obtained satisfaction in respect of other claims from the arbitrator. This would lead to multiplicity of proceedings.

(iii) An arbitrator is the creature of an agreement. It, is open to the parties to confer upon him such powers and prescribe such procedure for him to follow, as they think, fit, so long as they are not opposed to law. (The proviso to S. 41 and S. 3 of Arbitration Act illustrate this point). All the same, the agreement must be in conformity with law. The arbitrator must also act and make his award in accordance with the general law of the land and the agreement.

(iv) Over the years, the English and Indian Courts have acted on the assumption that where the agreement does not prohibit and a party to the reference makes a claim for interest, the arbitrator must have the power to award interest *pendente lite*.

(v) Interest *pendente lite* is not a matter of substantive law, like interest for the period anterior to reference (pre-reference period). For, doing complete justice between the parties, such power has always been inferred.

The decision in *Abhaduta Jena* case does not lay down good law on this aspect. However, the present decision shall only be prospective in operation, which means that this decision shall not entitle any party, nor shall it empower any Court to reopen proceedings which have already become final. In other words, the law declared herein shall apply only to pending proceedings."

See also M. Ganga Reddy vs. State of A.P., 1996 (3) ALT 53 (DB)

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P.S. 70. Acceptance of final measurements :—The contractor agrees that before payment of the final bill shall be made on the contract, he will sign and deliver to the Executive Engineer either in the measurement book or otherwise demanded, a valid release and discharge from any and all claims and demands whatsoever for all matters arising out of, are connected with the contract; provided that nothing in this clause shall discharge or release the contractor from his liabilities under the contract. He shall also produce a certificate from the income tax authorities that all income tax payable by him up-to-date has been duly paid in the case of contracts the value of which is over Rs. 10,000. It is further expressly agreed that Executive Engineer in supplying the final measurement certificate, need not be found by the preceding measurements and payments. The final measurements, if any, of the Executive Engineer shall be final, conclusive and binding on the contractor.

P.S. 71. Recovery of money from contractor in certain cases :—In every case which provision is made for recovery of money from the contractor, Government shall be entitled to retain or deduct the amount thereof from any moneys that may be due or may be due or may become due to the contractor under these presents and/or under any other extract or contracts or any other account whatsoever.

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JUDGMENT

CLAIM BY CONTRACTOR FOR CERTAIN AMOUNT

1988 (1) ALT 736

The Hon 'ble Mr. Justice M.N. Rao

C. Raghava Reddy *Petitioner*

vs.

Superintending Engineer, Irrigation
Circle No. 3, Nizamabad & another. *Respondent*

Order

1. The petitioner is a recognized Class I contractor. His tender for construction of Masonry Blocks of spill way at left flank from Blocks 7 to 14 of Singoor Project was accepted by the Superintending Engineer, ID., Irrigation Circle-3, Nizamabad, the first respondent herein and an agreement was entered into on 5-9-1983 for execution of the said work costing about Rs. 1,21,59,459/-. The agreement contemplated completion of the work within eight months from the date of handing over of the site. The site was handed over on 14.11-1983 and the work was to be completed by 23-5-1985. It so happened that due to various reasons, the work could not be completed some of the main reasons, according to the petitioner, are delay on the part of the Geologist to approve the foundations, short supply of cement by the Department, deposit of heavy silt and slush beyond the contemplation of the parties and out-break of cholera in the area affecting the supply of labour, etc. The petitioner applied for extension of time for 4 months from 23-5-1985. The Department granted extension of time only upto 30-6-1985 and subsequently went on extending the contract period. The petitioner requested the Department to grant enhanced rates in view of the steep escalation in the cost of material and labour after the expiry of the original contract period. The Department did not agree. The petitioner, therefore, stopped work from 4-1-1986.

2. The agreement provides for arbitration of disputes that arise under the contract. The petitioner, therefore, filed O.S.No. 3 of 1986 in the Court of the Subordinate Judge, Medak under Section 20 of the Arbitration Act for appointment of sole arbitrator. The Executive Engineer, Singoor Project Division-2, the second respondent herein, addressed all the Executive Engineers of Irrigation Department asking them to send him (Executive Engineer) all the amounts payable to the petitioner under different bills pertaining to different agreements. The petitioner, therefore, filed I.A.No. 106 of 1986 in O.S.No. 3 of 1986 seeking injunction restraining the respondents from stopping payments of bills or any other amounts payable to him in respect of other contracts carried out by him. He contended that he was entitled to get an amount of Rs. 33 lakhs from the Department and the alleged claim of the Department in respect of the work in question for Rs. 12,58,300/- was totally incorrect. The Civil Court, after hearing both sides, granted status quo. That order was questioned by the petitioner in C.M.A. No. 1137 of 1986 in this Court. The C.M.A. was dismissed by this Court taking the view that under Section 41(b) read with Second Schedule of the Arbitration Act, an injunction restraining the Government from withholding payments to the petitioner in respect of other contracts is not permissible since the injunction cannot be said to be for the purpose of and in relation to the proceedings before the Court.

3. The petitioner is seeking a, writ of *Mandamus* declaring that the action of the respondents in seeking to withhold the amounts payable to him for the works executed under agreements other than the agreement No. 10/83 is illegal and unconstitutional.

4. Sri V.R. Reddy, learned counsel for the petitioner, relying upon a decision in *M/s. Lakshmichand & Baichand vs. State of A.P.,* (AIR 1980, SC 20), contends that unless the amount due from him is determined the respondents cannot take action to withhold payments to him in respect of the other contracts carried

out. by him. On the other hand, the learned Government Pleader relying upon Cl. 71—of the Andhra Pradesh Standard Specifications which reads

> "***71. Recovery of money from contractor in certain cases*** :—In every case in which provision is made for recovery of money from the contractor, Government shall be entitled to retain or deduct the amount thereof from any moneys that may be due or may become due to the contractor under these presents and/or under any other extract or contracts or any other account whatsoever".

which formed part of the contract, contends that the Government is entitled to retain or deduct the amounts from any moneys that may be due or may become due to the contractor on any other account.

5. The question that fell for consideration before the Supreme Court *Lakshmichand & Baichand vs. State of A.P., (1 supra)* is similar to the one that has now arisen in this case. Dealing with the contentions based on C. 71, the Supreme Court observed:

> "In regard to the claim to adjustment on the second count the position is more controversial. The claim is founded in the doctrine of equitable set off but we do not find evidence before us to bring the case within the operation of the doctrine. It is not a case where cross demands rise out of the same transaction or the demands are so connected in their nature and circumstances that they can be looked upon as part of one transaction. Nor can assistance be derived from Clause 71. The benefit of that provision can be claimed only if the amount sought to be retained is an ascertained, sum, an amount which can be readily adjusted against the amount payable under the other contract. Here, the amount sought to be adjusted has yet to be determined as a liability against the contractor. It has been disputed by the appellant. Accordingly Clause 71 cannot be invoked".

The reasoning fully applies to the case on hand. Merely because the Government have specified that a sum of Rs. 12,58,300/- was due from the petitioner, it would not become a sum ascertained. In order to become an ascertained sum, there must be determination. There was no determination in the present case. The petitioner wants the matter to be decided by the arbitrator, his claim is that he is entitled for Rs. 33 lakhs from the Government in respect of the contract in question and he is disputing that claim of the Government that in respect of the very same contract, a sum of Rs. 12,58,300/. was due from him. In the circumstances, invocation of Clause 71 is illegal.

6. For the foregoing reasons, the writ petition is allowed. A *Mandamus* will issue directing the second respondent not to withhold the amounts payable to the petitioner for the works executed under the agreements other than the agreement No. 10/83. There shall be no order as to costs. Advocate's fee Rs. 250/-.

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P.S. 72. Contractor dying, becoming insolvent, insane, or imprisoned :—In the event of the death or insanity or insolvency or imprisonment of the contractor or where the contractor being a partnership or firm becomes dissolved

or being corporation goes into liquidation, voluntary or otherwise, the contract may, at the option of the Executive Engineer, be terminated by notice in writing posted at the site of the works and advertised in one issue of the local District Gazette, and all accepted and acceptance works shall forthwith be measured up and paid for at the rates provided in the contract schedule where such apply, or otherwise, by the most recent schedule of rates of the division approved by competent authority, to the person or persons entitled to receive and give a discharge for the payment.

J. — Arbitration and Claims of Contractors on Arbitration Cases

P.S. 73. Arbitration :—In case of any dispute or difference between the parties to the contract either during the progress or after the completion of the works or after the determination, abandonment, or breach of the contract, as to the interpretation of the contract, or as to any matter or thing arising there under except as to the matters left to the sole discretion of the Executive Engineer under clauses 20, 22, 27 (C), 29, 36, 37 and 40 of the Preliminary Specifications or as to the withholding by the Executive Engineer or payment of any bill to which the contractor may claim to be entitled, then either party shall forthwith give to the other notice of such dispute or difference, and such dispute or difference shall be and is hereby referred to the arbitration of the Superintending Engineer of the nominated circle mentioned in the "Articles of Agreement" (hereinafter called the "Arbitrator") and the award or such Arbitrator shall be final and binding of the parties unless contested by either party in a Court of law. Provided however that in cases where the Executive Engineer has entered into the contract on behalf of the Governor, the dispute or difference shall, in the first instant, be referred by or through the Executive Engineer to the Superintending Engineers of the Circle, in which the work lies and his decision thereon obtained before referring such dispute or difference to arbitration under this clause. Progress of the work shall not be suspended or delayed on account of the reference of any dispute or difference to the Superintending Engineer of the circle in which the work lies or to arbitration under this clause. The decision of the Executive Engineer or the Superintending Engineer of the Circle in which the work lies, as the case may be on such dispute or difference shall be conclusive until reversed by the Superintending Engineer or the arbitrator. Either party may within a period, which shall be fixed by the arbitrator, file before the arbitrator a statement of the case and also all 'the documents relating to or having a bearing on the case. The arbitrator shall set that the award is passed, if reasonably possible, within a period of four months from the date of his entering upon the reference, but if any extension of that period is considered by him to be necessary, either *suo moto* or on the application of either party to the reference, the parties hereby agree and consent to such extension as the arbitrator may from time to time consider reasonably necessary, and any such extension shall forthwith be communicated by him in writing to each of the parties hereto. The arbitrator shall not be bound to observe the ordinary rules of procedure applicable to trials before Judicial tribunals not to hear to receive formal evidence but may pass on award on the documents or statements of the case filed by both the parties under or on personal inspection. The arbitrator shall have power to view the subject matter of the dispute with or without the parties or their agents. The arbitrator shall also have power to open up, review and revise any Certificate, opinion, decision, requisition or notice, save in regard to the matters expressly excepted and to determine all

matters in dispute which shall be submitted to him, and of which notice shall have been given as aforesaid, in the same manner as if no such certificate, opinion, decision, requisition or notice had been given upon every any such reference the costs of any incidental to the reference and award respectively shall be in the discretion of the arbitrator, subject to the condition that the amount of such cost to be divided to either party shall not in respect of, i.e., monitory claim exceed the percentage set out below of any such award irrespective of the actual fees, Costs and expenses incurred by either party; provided that where a monitory claim is disallowed in full, the said percentage shall be calculated on the amount of the claim. The arbitrator may determine the amount of the costs to be awarded or direct the same to be taxed as between solicitor and client or a party and shall direct by whom and to whom and in what manner the same shall be borne and paid.

The percentage above referred to in this clause is 5 per cent on any such monitory award which does not exceeds Rs. 10,000, 3 per cent on the next Rs.40,000 or any part thereof, 2 per cent on the next Rs.50,000 or any part thereof and I per cent on any excess over Rs. 1,00,000

Provided that Government shall not be liable to any claim in respect of any such dispute or difference until liabilities, and the amount referred to is decided by the arbitrator ;

Provided that payment to the contractor based on the arbitration award shall be made only after acceptance of the award by the Chief Engineer if the value of the award is less than Rs. 20,000/- be and the Government if the value is Rs. 20,000 above.

Note 1 :—*Arbitration awards whose value is below Rs. 20,000:*

The Chief Engineer is authorized to accept arbitration awards below Rs. 20,000 in value. The Chief Engineer shall make a review of the arbitration award within 15 days of service of the notice of the making of the awards in consultation with the local counsel and if in his opinion the award has to be contested, he shall file an application in the Court Within 30 days of service of the notice of making of the award for the filing of the award and take steps to contest the award.

If, for any reason, the Chief Engineer considers it in advisable to act according to the advice of the local counsel, he shall refer the matter to the Government for examination within 15 days of the service of the notice of making of the award.

Arbitration Awards whose value is Rs 20,000 or above:

The Chief Engineer shall make a review of the arbitration awards whose value is Rs. 20,000 and above and submit a report to the Government within 10 days of service of the notice of the making of the award. In such case a summary of the case, a copy of the agreement for the work, the facts pressed before the arbitrator by the parties along with the recommendations of the Chief Engineer, should be furnished to the Government for all appreciation of the case. The Government will then take a decision in consultation with the law department whether the award should be accepted or not and communicate the same within 25 days of service of the notice of making of the award so as to enable the Chief Engineer either to take action on the basis of the award or to file an application

in the Court within 30 days of service of the notice of the making of the award for filing of the award and for contesting it.

Note 2 :—Applications of contractors seeking arbitration should bear a Court fee stamp as per clause 10(K) of Schedule (II) to the Andhra Pradesh Court Fees and Suits Valuation Act, 1956 but no stamp duty need be levied.

The awards passed by arbitrators shall be made on stamped paper the value of which should according to the value of claim to which the award relates as per Article 12 of Schedule I-A to the Indian Stamp Act.

If the aggrieved party goes to a Court of law challenging the award, he should pay the necessary Court fee.

[***Note 3*** :—Except as otherwise provided in the contract any disputes and differences arising out of or relating to the Contract shall be referred to adjudication as follows :

I. (i) Settlement of all Claims upto Rs. 50,000/- in value by way of Arbitration to be referred as follows :

(a) Claims upto Rs. 10,000/- in value,	Superintending Engineer of another Circle in the Dept.
(b) Claims above Rs. 10,000/- and upto Rs. 50,000/- in value	Another Chief Engineer of same Department.

The arbitration proceedings will be conducted in accordance with the provisions of the Arbitration Act, 1940 as amended from time to time. The Arbitrator shall invariably give reasons in the award.

II. Settlement of all Claims above Rs. 50,000/- in value:

All Claims above Rs. 50,000/- in value shall be decided by the Civil Court of competent jurisdiction by way of a regular suit and not by arbitration.

A reference for adjudication under this Clause shall be made by either party to the Contract within six months from the date of intimating the Contractor of the preparation of final bill or his having accepted payment.

The relevant Clauses of Andhra Pradesh Detailed Standard Specifications stand modified to the extent provided in this Clause].

[Added by G.O.Ms.No. 158, Tr. & B. (B. III), Dt. 13-7-1992]

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JUDGMENT

SPECIFIC ELIMINATION OF ARBITRATION CLAUSE CLAUSE 73 WOULD BE INOPERATIVE

AIR 1989, Kerala 241

V. Siva Ramannair and N. Fathima Beevi, JJ.

M/s. Leo Construction Contractors *Appellant*

vs.

Government of Kerala *Respondent*

Sivaraman Nair, J. :—The appellant is the Managing Partner of a registered firm of contractors. He had filed O.S.No. 411 of 1981 under Sec. 20 of the Arbitration Act. That suit was dismissed on the finding that the contract which the appellant had entered into with the respondents did not provide for reference to the arbitrator. Hence this appeal.

2. The appellant had submitted a tender for construction of a building for the Government Secondary School, Quilandy, consequent on the acceptance of his tender, he executed an agreement on 18-11-1978 with the second respondent. According to the appellant, Cl. 14 of the Form of Tender and Cls. 24, 24(a) and 44 of Form No. 83 were expressly made part of the agreement. These clauses were to the effect, that in case of any dispute or difference that may arise in the working of the contract, the same should be referred to arbitration before the Government Arbitrator, at the instance of either party. Several disputes arose between the parties regarding execution of the work. It was because his request for referring the dispute to the Arbitrator was not allowed that he filed O.S.No. 411 of 1981.

3. In their written statement, the respondents submitted that condition No. 14 of the Form of Tender and Cls. 24 and 24(a) of Form No. 83 had been specifically eliminated from the contract and the dispute could not be referred for Arbitration. Reference was also made to Ext. B2 Government Order, Dt. 8-5-197 8 to the effect that arbitration would be restricted only to works the estimated P.A.C. of which was Rs. 2 laths and below. They also contended that Art. 3 of the Agreement was deleted and the appellant had endorsed such deletion. Consequence of such deletion, read in conjunction with Ext. B2 Government Order, and the removal of Cls. 24 and 24(a) of Form No.83 was said to be to shut out Arbitration in the instant case, since, admittedly, the estimated amount of contract exceeded Rs. 2 lakhs by over Rs. 2,40,000/-.

4. The trial Court considered the question whether the disputes were liable to be referred for Arbitration under the terms of the contract. The trial Court found that Cl. 44 has the only effect of incorporating general conditions forming part of the contract documents and that general Cl. 73 in Madras Detailed Standard Specifications which necessarily formed part of the notice inviting tender and therefore of the agreement could not survive the deletion of Cls. 3,24 and 24(a), which related specifically to arbitration. Those clauses were scored off. The trial Court also found that in the light of the specific deletion of Cls. 24 and 24(a), it was not reasonable to hold that Cl. 14 of the Tender Form was incorporated in the agreement by virtue of the provisions of Cl. in Form No. 83. The Court held further that the appellant having signed Form No. 83, from which Cl. 24 & 24(a) relating to Arbitration were deleted, could not be heard to seek arbitration in spite of such deletion. Appellant submits, that Cl. 44 of Form No. 83 and Cl. 14 of the tender notice do survive and such survival in the contract willingly entered into between the parties do provide for a reference of dispute arising out of the contract to the Government Arbitrator.

5. The very question as to whether the provision for arbitration as contained in the Madras Detailed Standard Specifications, which are corporated as terms of the contract, would enable a contractor to claim reference of disputes for arbitration notwithstanding the deletion of clauses similar to Cls. 3, 24 and 24(a) had come up for consideration before this Court in a number of decisions. *State of Kerala vs. Joseph*, 1983, Ker. LT 583, a Division Bench of this Court held, that incorporation of the terms of M.D.S.S. had the effect of providing for arbitration of disputes notwithstanding the specific deletion of arbitration clauses in the agreement. A different view was taken in M.F.A. No. 158 of 1984. In yet another decision, *State of Kerala vs. Siby Varghese*, 1987 (1), Ker. LT 860, another Division Bench adopted a slightly different view. In that decision, it was held in unmistakable terms that the M.D.S.S. served an entirely different area and would not supply or supplement provisions dealing with arbitration. A Full Bench of this Court considered the divergetice of views expressed in the above decisions in the judgment in M.F.A. Nos. 586 and 789 of 1987, 1988 (2), Ker. LT 768 ; (AIR 1989, Ker. 61) (FB), and held that C1.73 of the M.D.S.S., which was to be read as part of the contract, was not meant to render the deletion of Cls. 3, 24 and 24(a) of the contract ineffective. The Full Bench, therefore, held that the effect of the deletion of those clauses was that not only the arbitration clause, but the entire arbitration process itself was consciously annihilated. The Full Bench also referred to G.O.Ms.No. 53/ 78/PW&E, Dt. 8-5-1978 (Ext. B2) and held, that the order unmistakably indicated the intention of the Government to do away with the provision for arbitration in contracts, the P.A.C. of which was more than Rs. 2 lakhs. The Full Bench concluded, that a situation in which Cls. 3 and 24 were deliberately and consciously struck down, the entire arbitration provisions collapsed. We are bound by the decision and have necessarily to dismiss this appeal.

6. We have to come to the said conclusion for yet another reason also. Art. 299 of the Constitution of India deals with contracts made in the exercise of the executive power of the Union or of a State. It provides for the manner in which the contract shall be expressed to be made and executed on behalf of the President or the Governor. A contract which does not comply with Art. 299 of the Constitution is not enforceable against the executive Government. Art. 299 of the Constitution, dealing with the executive power of the Union or a State in respect of contracts is in the following terms

> "***299. Contracts*** :—(1) All contracts made in the exercise of the executive power of the Union or of a State shall be expressed to be made by the President, or by the Governor of the State, as the case may be, and all such contracts and all assurances of property made in the exercise of that power shall be executed on behalf of the President or the Governor by such persons and in such manner as he may direct or authorize".

Ext. B2 is an order of the executive Government and is expressed in the name of the Governor as required by Art. 166 of the Constitution of India. That clearly and unmistakably indicated that no contract with the Executive Government, comprehended by Art. 299 of the Constitution of India, shall contain a provision for arbitration if the estimated PAC was more than Rs. 2 lakhs. Even assuming that Cl.73 of the M.D.S.S. should be read as part of the Form of contract, the

existence of that condition which is contrary to the expressed intention of the executive Government will be inoperative, because it will be contrary to the direction which the Governor is competent to issue under Art.299 of the Constitution of India. A provision of a contract which is contrary to the stipulations contained in directions issued by the Governor under the above Article cannot be enforced against the executive Government.

7. Counsel for the appellant submitted that though the appellant had countersigned the deletion of Cl. 3, he had not countersigned deletion of Cls. 24 and (a) of the agreement. He submitted further, that according to Cl. 44 of the agreement, Cl. 14 of Form No. 84 which provides for arbitration should be read into the contract. He, therefore, submits that the finding of the trial Court is unsustainable. We have perused the agreement, the tender notice and Cl. 14 of Form No. 84 dealing with specifications. What we find is that Form No. 84 is not part of the tender notice and cannot therefore be read into the contract by virtue of the provisions contained in Cl. 44 of the agreement.

8. In addition to the reasons stated by the Full Bench in the decision referred to above, we hold that a provision for arbitration would not survive the promulgation of Ext. B2 Order by the Governor in relation to the manner in which contracts shall be executed on behalf of the executive Government. A term in a contract contrary to the directions issued by the Governor is incapable of enforcement against the executive Government.

The appeal is, therefore, devoid of merits and is hereby dismissed. The parties will suffer their respective costs.

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Claims of Contractors on Arbitration Cases

Claims of contractor on Arbitration cases — revised procedure — Orders — Issued.

[G.O.Ms.No. 430, irrigation (irr. V) Dept., Dt. 24-10-1983]

Ref :—G.O.Ms.No. 876, PW., Dt. 31-7-1975.

Order :—In the G.O. read above, orders were issued introducing the system of arbitration by a Panel of Arbitrators as detailed below:

	Value of amount	*Panel of Arbitrations*
1.	Claims upto Rs.20,000/- in value.	Superintending Engineer of another Circle.
2.	Claims of Rs.20,000/- above upto Rs.1.00 lakh.	1. Superintending Engineer of another Circle. 2. Directors of Accounts/Dy.Chief Accounts Officer. 3. Chief Engineer.

3.	Claims of Rs.1.00 lakh above.	1. Chief Engineer. 2. Representative of the Finance and Planning Dept. to be nominated and 3. Director of Accounts or Dy.Chief Accounts Officer.

2. The question of the revising the above procedure has been receiving the attention of Govt. for some time past. The Govt. after careful consideration of various aspects of issues involved direct the procedure be revised as follows:

	Value of amount	*Panel of Arbitrations*
1.	Claims upto Rs.10,000/-	Superintending Engineer of another Circle in the same Department.
2.	Claims above 10,000/- and upto Rs.50,000/-	(a) Another Chief Engineer of the same Department. (b) Where there is only one Chief Engineer, in the Dept., the Chief Engineer will submit proposals to Govt. in the Administrative Dept., for nomination of another Chief Engineers as Arbitrator by Govt.
3.	x x x	x x x

3. All claims above Rs. 50,000/- shall be decided by a Civil Court of competent jurisdiction by way of a regular suit.]

(Amended by G.O.Ms.No. 160, Irrigation & CAD (PW) Dept., Dt. 1-6-1987)

4. Claim means all claims in that contract.

5. The orders referred to in paras 2 and 3 above shall be applicable to all the agreements entered into by Government from the date of issue of this order and will be applicable to all the Engineering Department, in the State Govt. referred in para (6) *Supra*.

6. The Engineer-in-Chief is requested to submit necessary suitable draft amendments to the codal provisions wherever necessary including amendment to the A.P.D.S.S. urgently.

7. Government also direct that pending amendments to the codal provisions and A.P.D.S.S. referred to in para (5) above, the Chief Engineers/Superintending Engineers of Irrigation Department, and the Chief Engineers of other Departments, i.e., Panchayat Raj, Roads and Buildings and Public Health Depts., Chief Engineer (Electrical) are hereby directed to take necessary action in regard to incorporation of the revised procedure referred to in paras 2 and 3 above in all the future agreements to be entered into with the contractors with immediate effect.

Claims of contractor on Arbitration cases — revised procedure — Orders— Issued.

[G. O.Ms.No. 20. Irrigation & CAD (PW) Dept, Dt. 31-1-1989]

Order :—x x x x x

Except as otherwise provided in the contract, all disputes and differences arising out of or relating to the contract shall be referred to adjudication as follows :—

(1) (i) Settlement of all claims upto Rs. 50,000/- in value and below by way of arbitration to be referred as follows :—

(a) Claims upto Rs. 10,000/-	Superintending Engineer of another Circle, in the same Department.
(b) Claims above, 10,000/- and upto Rs. 50,000/-.	Another Chief Engineer of the same Department.

The arbitration proceedings will be conducted in accordance with the provisions of the Arbitration Act, is to be prepared from time to time. The Arbitrator shall invariably give reasons in the award.

(ii) Settlement of all claims above Rs. 50,000/- in value :—All claims above Rs. 50,000/- in value shall be decided by a Civil Court of competent jurisdiction by way of a regular suit and not by arbitration.

———

Claims of Contractors on Arbitration cases — Revised procedure — Orders — Issued — Nomination of Chief Engineers in Irrigation and Projects in respect of claims above Rs. 10,000/- upto Rs. 50,000/- orders — Issued.

[G. O.Ms.No. 456, irrigation (V) Department, Dt. 10-11-1983]

Ref :—G.O.Ms.No. 430, Irrigation, dated 24-10-1983.

Order :—In the G.O. read above, orders have been issued prescribing the revised procedure on claims of contractors on Arbitration cases.

2. In of the orders issued in the GO. read above, Govt. direct that

I. In respect of claims upto Rs. 10,000/- the Engineer-in-Chief shall nominate another Superintending Engineer of a circle as Arbitrator.

II. In respect of claims above Rs. 10,000/- upto Rs. 50,000/- the following Chief Engineers are nominated as Arbitrators as indicated in columns (2) below:

	Name of the Unit *(1)*	*Arbitrator* *(2)*
1.	Chief Engineer, Major Irrigation	Chief Engineer, Sriramsagar Project.
2.	Chief Engineer, Medium and Minor Irrigation.	Chief Engineer, Srisailam Project.

3.	Chief Engineer, Nagarjunasagar Project (Dam, Right & Left Canals).	Chief Engineer, Medium & Minor Irrigation.
4.	Chief Engineer, Srisailam Project.	Chief Engineer, Major Irrigation.
5.	Chief Engineer, Sriramsagar project.	Chief Engineer, Nagarjunasagar Project.
6.	Telugu Ganga Project (Including Somasila Project)	Engineer-in-Chief.

———

ARBITRATION AWARDS — STAMP DUTY

Arbitration awards bearing Cost of stamped papers — Clarification.

[Memo.No. 176, - Codn/75-1, P. W.D., Dt. 5-3-1975]

An extract of item 12 in Schedule 1-A to the Indian Stamp Act is printed below:

	Description of instrument *(1)*	*Proper Stamp Duty* *(2)*
12.	Award	
	(a) Where the amount does not exceed Rs.1,000/-	3%
	(b) Where the amount exceeds Rs.1,000/- but does not exceed Rs.5,000/-	50 Rs.
	and for every additional Rs.1,000/- or part thereof in excess of Rs.5,000/-	2 Rs. subject to a maximum of Rs.200/-

———

STANDARD SPECIFICATIONS

THE ANDHRA PRADESH
STANDARD SPECIFICATIONS
SECTION 1
STANDARD SPECIFICATIONS FOR MATERIALS

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SECTION 1

STANDARD SPECIFICATIONS FOR MATERIALS

Specification No. 101

General

101.1. Stacking of Materials :—Materials normally measured in stack are rough stone of all kinds, broken stone and broken brick of all the grades, moorum, sand, quarry rubbish, surki and lime; (Vide instructions in clause 22 of Standard Preliminary Specifications where the method of measurement for the purpose of mixing for certain materials is defined).

101.1.1. Stacks shall be formed to regular shape and uniform cross section.

101.1.2. Materials shall be stacked on even ground which permits correct and ready measurements from external inspection of the stack. Stacking shall not be done in flood zones or in water logged areas.

101.1.3. Rough stone which is to be measured in stacks shall be packed so closely as to give minimum quantity of voids possible, without actual dressing of stone to fit interstices.

101.1.4. In cases where improper stacking is done by the contractor, the Executive Engineer shall have the right to either reject the stacks partly or completed and take action as provided for vide Clause 27(c) of the Standard Preliminary Specifications in the case of rejected materials or he may order complete restacking of the materials to specification at the contractor's expense, or he may make an appropriate deduction towards improper stacking with its attendant excess quantity of voids as he may decide in each case.

101.1.5. Unless otherwise specified templates shall be provided to the sizes and dimensions of the stone as may be specified at the contractor's expense. The contractor shall make necessary allowance while stacking to ensure that the specified stack dimensions are manufactured at the time of measurement and check-measurement.

101.1.6. For road works aggregates obtained from different sources or for different purposes or of different sizes shall be stacked separately.

101.1.6.1. The road materials shall be stacked entirely clear of the carriage way, shoulders and the side drains, and as far as possible well behind the line of avenue trees. The stacking shall be done on one side (left side) only unless unavoidable.

101.1.6.2. Different materials required for each 200 metres length of road shall be stacked as per the estimated quantities. Stacking shall begin at the point farthest from the quarry and progress towards the quarry along with road.

101.1.6.3. Stacking of materials on tops of high embankments, deep narrow cuttings and decks of bridges and culverts shall be avoided. Where unavoidable

103.2.2. The aggregate shall be well graded and shall pass in any direction through 40 mm. IS : Sieve for ordinary concrete and through 20 mm. IS : Sieve for Madras Terrace Roofing Concrete or such other size as may be specified *vide* Standard Specification for broken stone coarse aggregate for concrete regarding gauge.

103.2.3. Aggregate shall be screened over 4.75 mm. IS : Sieve to remove rubbish and dust.

103.3. Stacking :

103.3.1. Broken brick shall be collected in regular stacks on a hard surface or platform so as to prevent admixture of clay, dust, vegetable and other foreign matter.

103.3.2. The stacks of material shall be nearer to the place of use.

103.3.3. The stacks shall be completely formed throughout with well formed slopes and to the given dimensions.

103.3.4. Broken brick shall be handled the least number of times before being used in concrete.

103.4. Method of test for determination of water absorption of aggregate :

103.4.1. *Apparatus* :—The apparatus shall consist of a balance of capacity not less than kg. readable and accurate to 0.5 gramme.

103.4.2. *Sample* :—A sample of not less than 3,000 gm. of the aggregate shall be tested.

103.4.3. *Procedure for 24 hours cold water immersion test* :

103.4.3.1. The sample shall be screened on 10 mm. IS : Sieve and washed to remove finer particles and dust. This sample shall be dried in a ventilated even at a temperature between 100°C and 110°C till a constant weight is obtained (W1) and cooled approximately to room temperature.

103.4.3.2. The dried and cooled sample shall then be placed in a suitable vested and covered with distilled water at a temperature between 22°C and 32°C and kept immersed for 24 hours. Air entrapped in and bubbles on the surface of the aggregate shall be removed, as the appear, by gentle agitation with a rod.

103.4.3.3. The sample shall then be taken from the water and any water visible on the surface shall be rapidly removed by means of a damp cloth. The surface dried sample shall then be immediately weighed (W2).

103.4.3.4. The percentage of water absorption of aggregate shall be calculated as follows :

Water absorption percentage by weight : $\frac{W_2 - W_1}{W_1} \times 1000$

Where W_2 = Weight in grams of the sample after 24 hours of immersion in cold water.

W_1 = Weight in grams of the dry sample.

103.5. Method of test for determination of water soluble matter of aggregate :

103.5.1. About 100 grams of the representative sample shall be air dried and ground, to pass 150 micron IS : Sieve. The material shall be stored in an air tight bottle.

103.5.2. Twenty-five grams of the sample shall be weighed and transferred to a 500 ml. beaker. 100 ml. of cold distilled water shall be added and the contents stirred frequently for three hours. It shall be decanted (through a No.42 watman filter paper or equivalent) into a 500 ml. graduated flask. the filtrate shall be refiltered if necessary. The filter paper along with the sample retained on it shall be returned to the breaker. 250 ml. distilled water shall be added and extraction continued for another one and a half hours. The material on the filter paper shall be washed three times with cold distilled water and filtered. The filtrate and the washing shall be added to the first filtrate in the 500 ml. flask and made upto the mark using distilled water. The flask shall be shaken well and 200 ml. pipetted out, to a weighed platinum dish (or porcelain dish, glazed inside and outside). The contents of the dish shall be evaporated to dryness and heated to constant weight at 105°C to 110°C.

103.5.3. *Result* :—The percentage weight of the soluble salt shall be calculated as follows :

Soluble salts, percent by weight = 10 W. Where : W = Weight in grams of the dried material on the dish.

Specification No.104

Surki

104.1. Manufacture :

104.1.1. The surki shall be obtained by calcining processed clay of approved quality and at suitable temperature and grinding the resulting product to the required fineness.

104.1.2. The clay shall be prepared with suitable additions of water into a plastic mass weeding out gritty material, pebbles, sticks, etc.

(The method of manufacture of surki currently practised in India, is to burn clay after moulding it into bricks or balls and then to powder it.)

104.1.3. The clay thus prepared shall be burnt at the temperature suitable to the type of clay used in the manufacture. The exact degree of burning for each clay shall be determined after making necessary experiments with samples prepared at different temperatures and ground to specified fineness.

104.1.4. The burnt clay shall be pulverized to the fineness specified in clause 104.2.2.

104.2. Quality :

104.2.1. It shall be clean and free from admixture of foreign matter.

104.2.2. The material shall be ground to an impalpable dust and shall pass through 75 microns or 0.075 mm IS : Sieve unless other size is prescribed by the Executive Engineer.

104.2.3. The soluble salt content shall not exceed 3 percent by weight.

104.3. Tests :

104.3.1. When three mortar cubes with a mix comprising one part of lime surki mixture (1 part hydrated lime and 2 parts of surki by weight blended intimately) and 3 parts of standard sand by weight, when prepared cured and tested in accordance with IS : 1727-1967 shall give an average compressive strength not less than 40kg./cm.

104.3.2. Three mortar cubes with a mix comprising one part of cement surki mixture (4 parts of ordinary cement and 1 part of surki by weight blended intimately) and 3 parts of standard sand by weight, when prepared, cured and tested in accordance with IS : 1727-1967 shall satisfy the following requirements of average compressive strength.

(a) At the age of 28 days : Not less than 80% of the strength of the corresponding plain cement sand mortar cube prepared with one part cement and three parts of standard sand and crued, at the age of 28 days.

(b) At the age of 20 days : Not less than the strength of the same (Cement Surki sand mix at the age of 28 days).

104.4. Delivery :

104.4.1. Surki may be specified in bags (gunny, multiply paper or cloth) bearing the manufacturer's name or registered trade mark. The gross weight of each bag shall be 50 kg.

104.4.2. When supplied in bags the permissible tolerance on the weight of surki shall be plus or minus 42.5 per cent per bag with an overall tolerance of plus or minus 40.5 per cent per wagon load of 20 to 25 tonnes.

104.5. Storage :

104.5.1. Surki shall be stored on a hard surface or platform so as to prevent the admixture of clay, dust, vegetable and other foreign matter and shall be protected from rain and dampness.

Specification No.105

Fly Ash

105.1. General :—Fly-ash is a finely divided residue resulting from the combustion of pulverized coal and is transported by the flue gases from where it is collected. It can be used as puzzolona, as an admixture for concrete or as fine aggregate for mortar and concrete and shall conform to the following specifications :

(1) IS : 3812-Part-I-1966 Specification for "Fly ash–for use as puzzolona".

(2) IS : 3812-Part-II-1966 Specification for "Fly ash–for use as admixture for Concrete".

(3) IS : 3812-Part-III-1966 Specification for "Fly ash–for use as Fine aggregate for Mortar and Concrete".

105.2. Storage :—Fly ash shall be stored in such a manner as to permit easy access for proper inspection and identification of each consignment.

105.3. Delivery :—Supplies of fly-ash may be made in bulk or in bags as mutually agreed to between the purchaser and the supplier.

105.4. Measurement and rate :—Fly ash shall be measured in tonnes correct 0.01 of a tonne and paid per tonne.

Specification No. 106

Rough Stones for Dry Packed Revetments and Approns

106.1. Source :—The stone shall be supplied from the quarries specified.

106.2. Quality :—The stone shall be of approved quality, sound, hard, dense and durable, free from segregation, seams, cracks, weathered portions and other structural defects or imperfections tending to affect their soundness and strength. Stone shall generally be freshly quarried with sharp edges and clean faces. They shall be free from rounded, worn or weathered surfaces or skin or coating.

106.3. Size :

106.3.1. The sizes of the stone to be used for various thicknesses of revetments shall be as follows :—

Unless otherwise specified, for revetments upto 450 mm. thickness of the length of the stones shall be equal to the revetment thickness. For revetment over 450 mm. thick at least 50% of the stones shall be 450 mm. long. No stone shall have any dimension less than 150 mm. or less than 50% of the maximum dimension of the stone.

106.3.2. The minimum volumes of the individual stones used for various thickness of revetments shall be as follows :

Thickness of revetment	*Volume of stones*
300 mm.	0.015 cu.m.
450 mm.	0.030 cu.m.
600 mm.	0.045 cu.m.

106.4. Stacking :—Stacking shall be done n conformity with clauses 101 to 101.3 and at the location specified or ordered by the Executive Engineer.

106.5. Sample :—Sample of stones to be used in the work shall be got approved by the Executive Engineer before the work is started.

106.6. Measurement & Rate :—Rough stones shall be measured from well formed stacks with minimum voids.

All liner measurements shall be in metres correct to 0.01 of a metre and volumes worked out in cubic metres correct to 0.01 of a cu.m.

106.7. Rate :—The unit rate shall be per cu.m.

Specification No. 107

Stone for Masonry

107.1. Source :—The stone of the required quality shall be obtained from the quarries specified.

107.2. Types :—The common types of natural stones which are generally used are granite and other igneous rocks, lime stone (including marble), and stone and laterite, etc., and shall be free from defects like decay, cavities, cracks, flaws, sand, holes, soft seams, veins, patches of soft or loose materials or any other deleterious materials like iron oxide, organic impurities, etc. They shall be free from rounded, worn or weathered surfaces or skin or coating which prevents the adherence of mortar.

107.3. Quality :—All stones used shall be clean of uniform colour and texture, strong, hard and durable as indicated in clause 107.4.1.

107.4. Tests :

107.4.1. *Strength* :—The strength of stones shall be adequate to carry the load imposed. The crushing strength of stone is given in Table 107-A.

TABLE 107-A

Crushing strength of stones as determined in accordance with IS : 1121-1974

Sl.No. (1)	*Type of stone* (2)	*Minimum crushing strength kg/cm²* (3)
(i)	Granite	1,000
(ii)	Basalt	400
(iii)	Lime stone (Except very soft stone)	200
(iv)	Sand stone	300
(v)	Marble	500
(vi)	Laterite	30

107.4.2. *Water Absorption* :—The percentage of water absorption shall generally not exceed 5 per cent by weight as determined in accordance with IS : 1124-1974.

107.5. Measurement :—This shall conform to clause 106.6.

107.6. Rate :—This shall conform to clause 106.7.

Specification No. 108

Coarse Aggregate for Concrete

108.1. Terminology :

108.1.1. *Coarse Aggregate* :—Aggregate almost all of which is retained on a 4.75 mm. size sieve.

108.1.2. *Nominal size of Coarse Aggregate* :—The size then which only a small specified percentage of aggregate is larger.

108.1.3. *Single sized Coarse Aggregate* :—Aggregate most of which is close to the nominal size.

108.1.4. *Graded size Coarse Aggregate* :—Aggregate with sizes well distributed between the nominal size and lower limit for coarse aggregate.

108.2. General :

108.2.1. *Source* :—The aggregate shall be obtained from the quarries specified. Samples of aggregate shall be furnished to the Executive Engineer for prior approval.

108.2.2. Broken stone shall, unless otherwise specified, consist of hard, sharp, angular pieces, broken to specified sizes. Flaky and weathered stones shall not be used.

108.2.3. The coarse aggregate shall be free from all dust and dirt and washed to ensure that all faces are perfectly clean.

108.2.4. Aggregate shall not contain any harmful material such as iron pyrites, coal, mica, shale or similar laminated material, clay, alkali, soft fragments, sea shells, organic impurities, etc., in such quantity as to affect the strength or durability of the concrete and in addition to the above, for reinforced concrete any material which might attack the reinforcement.

Table 108-A

Nominal size and Corresponding grading for single size and graded aggregates

IS : Sieve Designation	*Percentage passing by weight for single size aggregate of nominal size*				
	63mm	*40mm*	*20mm*	*16mm*	*12.5.mm*
(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*
80 mm.	100	—	—	—	—
63 mm.	85-100	100	—	—	—
40 mm.	0-30	85-100	100	—	—
20 mm.	0-5	0-20	85-100	100	—
16 mm.	—	—	—	85-100	100
12.5 mm.	—	—	—	—	15-100

(1)	(2)	(3)	(4)	(5)	(6)
10 mm.	0-5	0-5	0-20	0-30	0-45
4.75 mm.	—	—	0-5	0-5	0-10
2.36 mm.	—	—	—	—	—

IS : Sieve Designation	*Percentage passing by weight for graded size aggregate of nominal size*				
	63mm	*40mm*	*20mm*	*16mm*	*12.5.mm*
(1)	*(7)*	*(8)*	*(9)*	*(10)*	*(11)*
80 mm.	—	100	—	—	—
63 mm.	—	—	—	—	—
40 mm.	—	95-100	100	—	—
20 mm.	—	30-70	95-100	100	100
16 mm.	—	—	—	90-100	—
12.5. mm.	100	—	—	—	90-100
10 mm.	85-100	10-35	25-55	30-70	40-85
4.75 mm.	0-20	0-5	0-10	0-10	0-10
2.36 mm.	0-5	—	—	—	—

Table 108-B

Sizes of Coarse Aggregates for use in mass concrete

Class and Size	*IS Sieve Designation*	*Percentage passing by weight*
(1)	*(2)*	*(3)*
Very large 150 to 80 mm.	160 mm.	90-100
	80 mm.	0-10
Large 80 to 40 mm.	80 mm.	90-100
	40 mm.	0-10
Medium 40 to 20 mm.	40 mm.	90-100
	20 mm.	0-10
Small 20 to 4.75 mm.	20 mm.	90-100
	4.75 mm.	0-5

108.2.5. Aggregates which are chemically reactive with the alkalies of cement are harmful as cracking of concrete may take place and shall be rejected.

108.2.6. The broken stone used for a work, which is likely to be subjected to or open to the action of fire must not be lime stone or of a nature liable to disintegrate or become calcined under high temperature. Flint is liable to disintegrate under the action of fire and shall not therefore be used.

108.2.7. Quartz has such a smooth surface that adhesion of the mortar thereto is poor and is therefore not normally suitable as an aggregate unless specifically passed after laboratory test.

108.3. Sizes and Grading :

108.3.1. Unless otherwise specified, nominal sizes and corresponding grading for single size and graded aggregate for plain and reinforced concrete shall be as given in Table 108-A. For mass concrete work the sizes and grading shall be as given in Table 108-B.

108.3.2. For reinforced concrete the nominal maximum size of the aggregate shall be 20mm. Unless otherwise specified. For heavily reinforced concrete members the nominal maximum size of the aggregate shall usually be restricted to 5mm. less than the minimum clear distance between the main bar or 5mm. less than the minimum cover to the reinforcement, whichever is smaller. Where the reinforcement is widely spaced the nominal maximum size may be as great as or greater than the minimum cover.

108.4. Mechanical properties :—Mechanical properties of aggregates regarding crushing value, impact value, abrasion value and soundness shall unless otherwise specified conform to the requirements of IS : 383-1970.

108.5. Testing :—Tests where required shall be carried out in accordance with IS : 2386-1963.

108.6. Stacking :—The relevant clauses of 101 shall apply.

108.7. Measurement :—All linear measurements shall be in metres correct to 0.01 of a metre. Volume shall be worked out in cu.m. correct to 0.01 of a cu.m.

108.8. Rate :—The unit rate shall be per cu.m.

Specification No. 109

Marble

109.1. Classification :—The marble shall generally be classified either as white or coloured. A combination of different colour shall be as per Appendix A of IS : 1130-1969 or may be specified.

109.2. General Requirements :—To the extent possible the marble shall be free any foreign matter and cracks.

109.3. Sizes :—

109.3.1. *Slabs* :—The marble slabs shall be of specified dimensions.

109.3.2. *Tiles* :—The tiles shall be in the form of specified dimension.

109.4. Workmanship :—The marble slabs and tiles shall be supplied with one of following finishes :

(a) Sand and/or abrasive finish.

(b) Hone finish.

109.5. Physical Properties :

109.5.1. The physical properties of marble for slabs and tiles shall conform to the requirements given in col. 3 of the following table when tested in accordance with the standard procedure given in the corresponding ISI Codes.

Table 109-A

Physical Properties of Marble

Sl.No. (1)	*Characteristic* (2)	*Requirement* (3)	*Method of test* (4)
I.	Moisture absorption after 24 hours immersion in cold water	Max. 0.4.% by weight	IS : 1124-1974.
II.	Hardness	Min. 3	Mohs. Scales.
III.	Specific Gravity	Min. 2.5	IS : 1122-1974.

109.6. Handling of Stacking :—Marble slabs and tiles shall be handled with great care and stacked neatly, without damaging their shapes and finish.

109.7. Measurement :—All linear measurements shall be in metres correct to 0.01 of a metre. Areas shall be worked out in sq. m. correct to 0.01 of a sq.m.

109.8. Rate :—Marble slabs and tiles shall be paid per sq.m. specifying the thickness.

Specification No. 110

Sand

110.1. Terminology :

110.1.1. *Sand* :—Granular material (passing 10mm. sieve and almost entirely passing, 4.75 mm. sieve and predominantly retained on 75 micron sieve) resulting from natural disintegration and abrasion of rock or processing of completely friable and stone.

110.1.2. *Natural Sand* :—Fine aggregate resulting from natural disintegration of rock which has been deposited by streams or glacial agencies.

110.1.3. *Crushed Stone Sand* :—Fine aggregate produced by crushing hard stone.

110.1.4. *Coarse Sand* :—The fineness modulus of coarse sand shall not be less than 2.5.

110.1.5. *Fine Sand* :—The fineness modulus of fine sand shall not be less than 1.0.

110.1.6. *Fineness Modulus* :—Anemperial factor obtained by adding total

percentages of a sample of the aggregates retained on each of the following series of sieves divided by 100.

The sieves used are 150 microns, 300 microns, 600 microns, 1.18 mm., 2.36 mm., 4.75 mm., 10 mm., 20 mm., 40 mm., and larger increasing in the ratio of 2 to 1.

110.1.7. *Bulking of Sand* :—Increase in bulk volume of a quantity of sand in moist condition over the volume of the same quantity of sand when completely inundated.

110.1.8. *Bulking Factor* :—Ratio of volume of moist sand and the volume of sand when completely inundated.

110.2. Source :—Sand shall be obtained from the source defined in the descriptive specification sheet.

110.3. Quality of Sand (General) :

110.3.1. Sand to be used shall be composed of hard Silicious material. It shall be clean, sharp and angular type.

110.3.2. Sand required for various purposes shall conform to the gradings given in Table 110-A, 110-B and 110-C, and the grading of which falls outside the specified limits due to excess or deficiency of coarse or fine particles may be processed to comply with the standard by screening through a suitable sieve and/ or blending with the required quantities of suitable sizes of sand particles. Any deviation may be left to the discretion of the Executive Engineer based on practical experience with the use of local material.

The various sizes of particles of sand shall be uniformly distributed throughout the mass.

The required grading may often be obtained by screening and/or by blending together either natural sands or crushed stone screenings which are unsuitable.

110.3.3. *Deleterious Materials* :—The sand shall be durable and free from adherent coatings and organic matter and shall not contain any appreciable amount of clay balls or pellets.

110.3.4. The sand shall not contain any harmful impurities, such as iron pyrites, alkalies, salts, coal, mica, shale or similar laminated or other materials in such form or in such quantities as to adversely affect hardening, strength and durability of concrete or mortar for plaster or cause corrosion of Metals.

110.3.5. Sand which is chemically reactive with alkalies of cement is harmful as cracking for of concrete may take place shall be prohibited.

110.3.6. Unless found satisfactory as a result of further tests as may be specified by the Executive Engineer or unless evidence of such performance is offered which is satisfactory to him the maximum quantities of clay, fine silt in, fine dust and organic impurities in sand shall not exceed the following limits determined in accordance with IS : 2386 (Part-II)-1963.

(a)	Clay, Fine silt and Fine dust.	
	1. In natural sand or crushed gravel sand	Not more than 4% by weight
	2. In crushed stone sand	Not more than 10% by weight
(b)	Organic impurities	Below that indicated by comparison with standard solution or with clause No. 3.

In particular cases crushed stone sand with even higher proportions of fine dust than specified above may be satisfactory and the limit so permitted will however be specified by the Executive Engineer.

110.3.7. The sand shall be screened before use. If the sand brought to site is dirty, it must be washed clean in water.

110.3.8. Fine drift sand or sea sand or sand containing saline impurities shall on no account be used except with the express approval of the Executive Engineer who will instruct the contractor regarding the treatment to be given to sand before use (at the contractor's expense). In case the sea sand has to be used the same shall be taken from the upper reaches of the beach where the salt has been washed out by rains.

110.3.9. *Bulkage Allowance* :—When measuring sand due allowance shall be made for bulkage from moisture as explained in clause 110.5. below.

110.4. Determination of silt content (Field test) :—The percentage of silt content may be determined as given below :—

A sample of sand to be tested shall be placed without drying in 200 ml. measuring cylinder. The size of sample shall be such that it fills the cylinder upto 100 ml. mark. Clean water shall be added over it upto 150 ml. mark. The mixture shall then be shaken vigorously and the contents allowed to setile for 3 hours. The height of silt visible as settled layer above the sand shall be expressed as percentage of the height of the sand below.

110.5. Determination of bulkage allowance of sand (Field method) :

110.5.1. *Object* :—This test covers the procedure of determining in the field, the amount of surface moisture or bulkage in fine aggregates by displacement in water.

110.5.2. *General* :—Sand brought on to the site may contain an amount of moisture which will cause it, when loosely filled into a container, to occupy a larger column than it would occupy when dry. If sand is measured loose (wet) it is necessary to add more volume of sand (based on bulkage) in order that the amount of sand put into the concrete may be the amount intended for the proposed nominal mix.

110.5.3. *Procedure* :

110.5.3.1. The procedure adopted depends on the fact that the volume of inundated sand is the same when dry.

110.5.3.2. In a 250 ml. measuring cylinder pour the damp sand (Consolidating by shaking until it reaches the 200 ml. mark. Then fill the cylinder with water and stir the sand well. (The water shall be sufficient to submerge the sand completely). It will be seen that the sand surface is now below its original level. Suppose the surface is at the mark Y ml. The percentage of bulking of the sand due to moisture shall be calculated from the formula.

$$\text{Percentage bulking} = \frac{110\ (200-y)}{y}$$

110.5.3.3. The percentage of bulkage of sand shall be rounded off to the nearest whole number.

110.6. Stacking :

110.6.1. This shall conform to clauses 103.3.1. to 103.3.3.

110.6.2. The relevant clauses of S.S. : 103 shall also apply.

110.7. Sand for Masonry :

110.7.1. *Quality* :—This shall conform to clause 110.3.

110.7.2. *Grading* :—The particle size distribution of sand to be used in mortars for masonry work shall be within the limits specified in Table 110-A.

Table 110-A

Requirements of grading for sands for masonry work

IS : Sieve Designation.	*Percentage by weight passing IS : Sive*
4.75 mm.	100
2.36 mm.	90-100
1.18 mm.	70-100
600 micron	40-100
300 -Do-	5-70
150 -Do-	0-15

110.8. Sand for Plastering :—

110.8.1. *Quality* :—This shall conform to clause 110.3.

110.8.2. *Grading* :—

110.8.2.1. For the purpose of indicating the suitability for use, the sand is classified as Class 'A' and Class 'B' in accordance with the limits of grading. Class 'A' sands shall be used generally for plaster work but when they are not available Class 'B' sands may be used.

110.8.2.2. The grading of sand for internal wall and ceiling plaster shall be within the limits specified in Table 110-B.

Table 110-B

Requirements of grading for sands for internal wall and ceiling plastering

IS : Sieve Designation	*Percentage by weight passing IS : Sieve*	
	Class A	*Class B*
2.36 mm.	98-100 for uncer coats	98-100 for under coats
	100 for finishing coats	100 for finishing coats
1.18 mm.	80-95 for under coats	80-100 for under coats
	95-100 for finishing coats	95-100 for finishing coats
600 microns	30-85	30-95
300 microns	5-50	5-56
150 microns	0-10	0-15

110.8.2.3. The grading of sand for external plaster coats and renderings shall be within the limits specified in Table 110-C.

Table 110-C

Requirements of grading for sands for external plastering and renderings

IS : Sieve Designation	*Percentage by weight passing IS : Sieve*	
	Class A	*Class B*
4.75 mm	100	100
2.36 mm	90-100	90-100
1.18 mm	70-100	70-100
600 microns	40-85	40-95
300 Do.	5-50	10-65
150 Do.	0-10	0-15

110.9. Sand for Cement Concrete (Plain and Reinforced)

110.9.1. *Quality* :—This shall be as per clause 110.3.

110.9.2. *Grading* :—The grading of sand is classified into four grading zones in which sand becomes progressively finer from grading Zone I to grading Zone IV as in Table 110-D.

Table 110-D

Natural of crushed stone sands percentage passing for

IS : Sieve Designation (1)	*Grading Zone I* (2)	*Grading Zone II* (3)	*Grading Zone III* (4)	*Grading Zone IV* (5)
10 mm.	100	100	100	100
4.75 mm.	99-100	90-100	90-100	95-100
2.36 mm.	60-95	75-100	85-100	95-100
1.18 mm.	30-70	55-90	75-100	90-100
600 microns	15-34	35-59	60-79	80-100
300 -do-	5-20	8-30	12-40	15-50
150 -do-	0-10	0-10	0-10	0-15

110.9.2.1. For crushed stone sands, the permissible limit on 150 microns IS : Sive is increased to 20 percent.

110.9.2.2. Sand complying with requirements of any grading Zone in Table—110-D above is suitable for concrete, but the quality of concrete produced will depend upon a number of factor including proportions.

110.9.2.3. Where concrete of high strength and good durability is required, sand conforming to any one of the four grading zones may be used, but the concrete mix shall be properly designed. As sand grading becomes progressively fine that is, from grading Zone I to IV, the ratio of sand to coarse aggregates shall be progressively reduced. The most suitable sand to coarse aggregates ratio to be used for any particular mix will, however, depends upon the actual grading of particles shape and surface texture of both sand and coarse aggregates and will be specified in the schedule.

110.9.2.4. Sand conforming to grading Zone IV shall not be used in reinforced concrete unless tests have been made to ascertain the suitability of proposed mix proportions.

110.10. Measurement :—This shall conform to clause 108.7.

110.11. Rate :—This shall conform to clause 108.1.

Specification No. 111

Lime

111.1. Terminology :

111.1.1. *Quick Lime* :—The calcined material, (the major part of which is calcium oxide in a natural association with a relatively smaller amount of magnesium oxide) capable of slacking with water.

111.1.2. *Lump Lime* :—Quick lime as it comes from the kiln.

111.1.3. *Hydrated Lime* :—A dry power obtained by treating quick lime with water enough to satisfy its chemical affinity for water under the condition of its hydration. It essentially consists of calcium hydroxide and some magnesium hydroxide.

111.1.4. *Hydraulic Lime* :—Lime containing small quantities of silica and alumina and/or iron oxide which are in chemical combination with some of the calcium oxide contents giving a putty or mortar which has the property of setting and hardening under water. Hydraulic limes are classified as eminently hydraulic and semi-hydraulic limes as mentioned in clause 3.1 of IS : 712-1973.

111.1.5. *Fat Lime* :—The lime which has high calcium oxide content and is dependent for setting and hardening solely on the absorption of carbon-di-oxide from the atmosphere.

111.2. Classification :

111.2.1. *Limes shall be classified as below* :

Class A :—Eminently hydraulic limes used for structural purposes.

Class B :—Semi-hydraulic limes used for mortar for masonry work.

Class C :—Fat limes used mainly for finishing coat in plastering, white washing and with suitable admixture such as surki, or any other pozzolanic material to produce artificial hydraulic mortar.

Class D :—Magnesium lime used for finishing coat in plastering, white washing, etc.

Class E :—Kunkar lime used for masonry mortars.

[Please See Next Pages for **Table 111-A and Table 111-B]**

111.2.2. Class "A" shall be supplied as hydrated lime only. Class "B" and Class "C" limes shall be supplied both as quick lime and hydrated lime. Class "D" lime shall be supplied as quick lime and hydrated lime. Class "E" lime shall be supplied as hydrated lime only.

111.3. Chemical Requirements :—Building limes are classified in 111.2 shall comply with chemical requirements specified in Table 111-A when tested in accordance with the methods prescribed in IS:712-1973.

111.4. Physical Requirements :—Building limes shall comply with the physical requirements specified in Table 111-B when tested in accordance with the methods prescribed in IS : 712-1973.

111.5. Sampling :—

1115.1. *Quick lime* :—In the case of quick lime the limits of physical and chemical requirements specified in clauses 111.3 and 111.4 shall apply when the samples are taken at the point of loading at the manufacturer's works. If the samples are taken at any other point then the limits of these requirements shall be subject to the agreement between the Contractor and the Government.

111.5.1.2. *Hydrated Limes* :—In the case of Hyderabad limes the samples shall be taken at the point of delivery.

TABLE III-A
Chemical Requirements

Sl. No.	Type of Test		*Requirements for building limes*							
			Class A		Class B	Class C		Class D		Class E
			Hydrated	Quick	Hydrated	Quick	Hydrated	Quick	Hydrated	
(1)	(2)		(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
(i)	Calcium and magnesium, oxides per cent	Min.	60	70	70	85	85	85	85	25
(ii)	Magnesium oxides per cent	Max.	5	5	5	5	5	—	—	5
		Min.	—	—	—	—	—	5	5	—
(iii)	Silica, alumina and feric oxide, per cent	Min.	25	15	15	—	—	—	—	—
(iv)	Un-hydrated oxides, per cent	Max.	—	—	—	—	—	8	8	—
(v)	Insoluble residue in hydrochloric acid less the silica percent,	Max.	2	3	2	—	—	—	—	—
(vi)	Insoluble matter in Sodium carbonate solution, per cent	Max.	5	5	5	5	5	5	5	5
(vii)	Loss on ignition, per cent			5 for large lump, 7 for lime other than large lump.	—	5 for large lump, 7 for lime other than large lump.	—	5 for large lump, 7 for lime other than large lump.	—	5
(viii)	Carbondioxide, percent	Max.	5	5	5	5	5	5	5	—
(ix)	Cementation value	Min.	0.6	0.3	0.3	—	—	—	—	—
		Max.	—	0.6	0.6	—	—	—	—	—

TABLE III-B

Physical Requirements

Sl. No.	Type of Test	*Requirements for building limes*								
		Class A	Class B		Class C		Class D		Class E	Methods of test Ref.
		Hydrated	Quick	Hydrated	Quick	Hydrated	Quick	Hydrated	Hydrated	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
(i)	Fineness	Shall leave no residue on 2.36mm. IS : Sieve, not more than 5 percent on 850-micron IS : Sieve and the fraction passing through 850-micron IS : Sieve shall leave not more than 10 per cent (of this fra tion) on 300-micron IS : Sieve	—	Shall leave no residue on 2.36mm IS : Sieve, not more than 5 percent on 850-micron IS : Sieve and the fraction passing through 850-micron IS : Sieve shall leave not more than 10 per cent (of this fraction) on 300 micron IS : Sieve	—	Shall leave no residue on 850 micron IS : Sieve, not more than 5 percent on 300 micron IS : Sieve and the fraction passing through 300-micron IS : Sieve shall leave not more than 10 per cent (of this fraction) on 212 micron IS : Sieve	—	Shall leave no residue 850micron IS : Sieve, not more than 5% on 300 micron IS : Sieve and the fraction passing through 300 micron IS : Sieve shall leave not more than 10% (of this fraction) on 212 micron IS : Sieve	Shall leave no residue 2.36 mm. IS : Sieve, not more than 5% on 850 micron IS : Sieve and the fraction passing through 850 micron IS : Sieve shall leave not more than 10% (of this fraction) on 300 micron IS : Sieve	IS : 6932 (Part IV) 1923

(ii)	Residue on slaking (on the basis of quick lime taken), Max. percent by weight	—	10 on 850-micron IS : Sieve	—	5 on 850-micron IS : Sieve, the fraction passing through this sieve when further passing through 300 micron IS : Sieve shall leave residue 5	—	5 on 850 micron IS : Sieve, the fracting passing through this sieve when further passing through 300 micron IS : Sieve shall leave residue 5	—	—	IS : 6932 (Part III) 1973.
(iii)	Setting time	—	In the putty of standard consistency as per IS : 6932 (Part-VIII)-1973 initial set shall take place in not less than 2 hrs. and final set within 48 hrs.	—	—	—	—	—	In the putty of standard consistency as per IS : 6932 (Part VIII) initial set shall take place in not less than 2 hrs. and final set within 48 hrs.	IS : 4031 1968
(iv)	Compressive Strength Minimum.	17.5kg./cm² after 14 days and 28kg./cm² after 28 days shall, however, show an increase over that at 14 days	—	12.5. kg./cm² afters 14 days and 17.5 kg./cm² at 28 days shall, however, show an increase over that at 14 days	—	—	—	—	10.5 kg./cm² after 14 days and 17.5 kg./cm² after 28 days shall however show an increase over that at 14 days.	IS:6932 (Part VII) 1973.

(v)	Transverse Strength	Modulu so rupture not less than 10.5 kg./cm2 at 28 days	—	Modulus of rupture not leass than 7 kg./cm² at 28 days	—	—	—	—	Modulus of rupture not less than 7 kg./cm² at 28 days	IS:6932 (Part VII)
(vi)	Work-ability	—	—	—	Shall require not less than 12 bumps to attain an average spread of 190mm. from an initial spread of 100mm. on the flow table	Shall require not less than 10 bumps to attain an average spread of 190mm. from an initial spread of 110mm. on the flow table	Shall require not less than 12 bumps to attain an average spread of 190mm. from an initials spread of 110mm. on the flow table	Shall require not less than 10 bumps to attain an average spread of 190mm. from an initial spread of 110mm. on the flow table	—	IS : 6932 (Part-VIII) 1973.
(vii)	Volume Yield	—	—	—	1.7ml. per gram or as agreed to between the purchaser and the supplier	—	1.4ml. per gram or as agreed to between the purchaser and the supplier	—	—	IS : 6932 (Part IV) 1973
(viii)	Soundness	The Le Chatlier moulds shall not exhibit more than	—	The Le Chatlier moulds shall not exhibit more than	—	—	—	—	The Le Chatlier moulds shall not exhibit more than	IS : 6932 (Part IX) 1973

		10 mm. expansaion		10 mm. expansion				10mm. expansion		
(ix)	Popping and pitting	*	—	—	—	Shall not exhibit any disintegration popping or pitting on the surface	—	Shall not exhibit any disintegration popping or pitting on the surface	—	IS : 6932 (Part IX) 1973

Note :—The sign (*) means no requirements of the tests.

111.5.2. *Procedure of Sampling* :—The sampling shall be done in accordance with the procedure laid down in IS : 712-1973. The samples shall be kept properly sealed until tested.

111.5.2.1. *General* :—Sampling shall be carried out as quickly as possible so that the material does not deteriorate. The total time occupied in mixing (and if necessary quartering down) the composite samples and the preparation (where necessary) of the final samples from this shall not exceed two hours. The final samples shall be three in number and shall be placed immediately in clean, dry, air-tight containers. When testing is not to be carried out once the samples shall be enclosed marked and sealed to the satisfaction of the Executive Engineer, paying special attention to the air-tightness of the containers. Tools and containers shall be of material free from rust and shall be alkali resistant.

111.5.2.2. *Samples of quick lime* :—Three final samples each of not less than 20 shall be taken as provided under clause 111.5.2.2 (a) for lump quick lime and under clause 111.5.2.2 (b) for powdered quick lime.

(a) ***Lump Quick Lime*** :—An initial sample shall first be taken from which the final samples to be tested shall be obtained by quartering. This initial sample shall not be less than 3 kg. per tonne of material sampled and shall be taken as follows :—

(i) *In Bulk* :—When the lump lime is loose approximately equal portions shall be drawn from as many different positions as possible, corresponding to not less than two selected places for every 3cu.m. so as to be fair by representative of the materials.

(ii) *In packages* :—With lump lime in bags, barrels or other packages the initial sample shall be made up by approximately equal portions taken from not less than one package for every tonne. Where the number of packages is less than 20, the sample shall be drawn from at least three or half the number of packages whichever is chose at random.

Sufficient material shall be taken from each package sample to produce a total initial sample of at least 3kg. per tonne of material the sample is supposed to represent. Samples shall not be taken from broken packages.

In either of the cases (i) or (ii) above the initial samples shall be broken down to pass through 12.5 mm. IS : Sieve. This shall be collected and thoroughly mixed on a clean dry surface preferably on a steel plate of atleast 5 mm. thickness and then reduced to about 20 kg. by coning and quartering.

20 kgs. may be necessary when all the tests are to be carried out. If not the sample may be broken further to below 5mm. and reduced to the required quantity for the tests.

(b) ***Powdered quick lime*** :—Sufficient materials for the sample or samples shall be taken direct in approximately equal portions from different positions corresponding to every 3 cu.m. of the stock when the lime is loose or from one package from every ten packages when the lime is not loose or where the number of packages is less than 20 from at least three or half the number of packages

whichever is less choosen at random. The quantity of material drawn shall be not less than 1.5 kg. per tonne of material to be represented by the sample.

111.5.2.3. *Sampling Hydrated Lime* :—The final samples each, of not less than 5 kg. be taken direct in the same manner as described under 111.5.2.2 (b) for powdered quick lime.

111.5.2.4. *Materials for tests and chemical analysis* :—At the time and place at which the tests and chemical analysis are to be carried out the sample taken as described under clause 111.2.2 shall be crushed to pass through the 2.36 mm. IS : Sieve thoroughly mixed and slightly more quantity of lime than is sufficient for conducting the tests taken in such a manner to be as representative as possible. In the case of lump quick lime quartering shall be carried out.

From the material finally choosen a small quantity from the sample shall be ground and rejected in order to ensure absence of contamination in the grinding equipment. Then about 100 gms. of the sample shall be ground with as little exposure to air and water vapour as possible to pass through 300 micron IS : Sieve and placed in a small air-tight container.

111.5.3. *Facilities for sampling and identifying* :—The contractor shall afford every facility and provide all labour and material for taking and packing samples for testing and for subsequently identifying samples.

111.6. Stacking and Storage :—

111.6.1. Stacking shall conform to clauses 103.3.1 to 103.3.3.

111.6.2. Lime shall suitably be stored in such a manner as to permit of easy access for proper inspection to protect it from dampness and to minimise warehouse deterioration.

111.6.3. The lime at work site shall be suitably protected from weather action.

111.6.4. Lime shall not be stacked against the walls of the shed.

111.6.5. Quick lime shall as far as possible be stacked soon after it is received. Storage of unslaked, fat or semi-hydraulic lime is not desirable as lime deteriorates by absorption of moisture from atmosphere.

111.6.6. Lime which has perished or which has been damaged by dampness rain or intermixture of dirt or which has become partially air-slaked shall on no account be used on the works and shall be removed at once from the site.

111.7. Measurement :—This shall conform to clause 110.10.

111.8. Rate :—This shall conform to clause 108.8.

Specification No. 112

Portland Cement

112.1. Portland cement shall conform to IS : 269-1967 which covers the following types :—(a) Ordinary portland cement for general use; (b) Rapid hardening portland cement for use where high early strength is required; (c) Low

heat portland cement for use where low heat of hydration is required as in mass concrete for dams.

112.2. Unless otherwise specified "cement" shall mean ordinary portland cement.

112.3. Cement shall be produced as fresh as possible after manufacture direct from manufacturers or from authorised dealers. The suppliers shall furnish a test certificate where required.

112.4. The cement shall be procured either in bulk or in bags bearing the manufacturers name or his registered trade mark.

112.5. The net weight of each bag shall be 50 kg. The permissible tolerance on the weight of cement supplied in bags shall be + 2.5% per bag, with an over all tolerance of + 0.5% per wagon load of 20 tonnes or more.

112.6. Storage :

112.6.1. Cement bags shall be stored in dry, weather proof godowns. Adequate precautions shall be taken to ensure stacking of cement bags in such a way as to keep them about 150 mm. to 200 mm. clear above floor and 250 mm. to 300 mm. clear of walls.

112.6.2. The height of the stack shall not be ordinarily be more than 10 bags and in no case more than 15 bags (except for very short periods) to prevent the possibility of lumping up under pressure. Cement bags shall be stacked in a manner to facilitate their removal and use in the order in which they are received.

112.6.3. Cement shall be stored at the work site in such a manner as to prevent deterioration due to moisture.

112.6.4. Cement which has become caked or otherwise damaged by getting wet or for any other reason shall on no account be used on the works.

112.6.5. When the cement has been stored for prolonged periods or when deterioration is suspected it shall be used only after it is tested for conformity with standard specification.

112.7. Testing :—All tests when required shall be conducted in accordance with IS : 4031-1968 and IS : 4032-1968.

112.8. Measurement & Rate :—This shall conform to clause 105.4.

Specification No. 113

Lime Mortar

113.1. Materials :—Slaked lime, sand and water to be used shall conform to SS : 111-110 and 129 respectively.

113.2. Mix Proportions :

113.2.1. The mortar shall be mixed in the proportions noted in Table 113-A below or such other proportions as may be defined in the relevant schedule item for the various items of the work.

Table 113-A

Mix proportions for lime mortar by volume

Item of work (1)	*Lime* (2)	*Class of lime suitable* (3)	*Sand* (4)
Mortar for concrete	1	All limes except fat lime	2
Mortar for masonry (Brick or stone)	1	All limes except fat lime	2
Mortar for plastering 1st coat	1	All limes except fat lime	2
Mortar for plastering 2nd coat	1	All limes except fat lime	1½
Mortar for plastering 3rd coat (sebara)	Lime Only	All limes can be used	No. Sand
Mortar for pointing	1	All limes except fat lime	1½
Mortar for terracing work	1	All limes except fat lime	1½
Brick on edge	1	All limes except fat lime	1½
Flat tiles	1	All limes except fat lime	1½
Plastering Top and Bottom		As above for plastering	

113.3. Preparation of lime mortar :

113.3.1. *Grinding* :

113.3.1.1. If lime is supplied in the form of quick lime it shall first be slacked to give dry hydrated lime.

113.3.1.2. Dry hydrated lime shall be ground to the required consistancy of a stiff paste with necessary water and then the specified proportion of sand added to it. This mix shall then ground again to the required consistency of a stiff paste with necessary water. Excess water shall be avoided.

113.3.1.3. The preparation of mortar as above for use in masonry works shall be retained for a day's requirement only.

113.3.1.4. When an animal drawn mortar mill is used for grinding, the mortar is to be ground for not less than 100 revolutions. In the case of a machine driven mill the grinding lime shall not be less than 20 minutes or until sand and lime gets thoroughly mixed.

112.3.1.5. The mortar shall be raked up continuously during the process particularly in the angles of the mill.

112.3.1.6. Every precaution shall be taken to ensure that the pressure on the mortar is not so high that sand particles in the mortar get powdered to an appreciable extent.

113.3.2. Partly set and dried mortar shall not be retempered for use and shall be removed from the site.

113.4. Stacking of storage :—All lime mortar after grinding shall be kept damp and shall never be allowed to go dry. This may be ensured by covering the

ground mortar with wet sacks or by any other suitable means. It shall always be protected from sun and rain.

113.5. Time for use :

113.5.1. All mortar shall be used as soon as possible after grinding Mortar shall not be used after more than 24 hours of grinding in case of hydraulic lime, 72 hours in the case of semi-hydraulic lime and 7 days in the case of fat limes. After expiry of the aforesaid periods all mortar shall be removed from the site of work.

Specification No. 114

Surki Mortar

114.1. Materials :—Lime, Surki, Sand and Water to be used shall conform to S.Ss. 104, 110, 111 and 129 respectively.

114.2. Proportions :

114.2.1. Surki mortar shall be mixed in the proportions noted below or such other proportions as may be defined in the relevant schedule item for the Various items of work.

Table 114-A

Proportions for Surki mortar by volume

Item of work (1)	*Lime (B & C Types of lime)* (2)	*Surki* (3)	*Sand* (4)
Concrete	1	½	1½
Masonry (Brick or stone)	1	½	1½
Pointing	1	½	1

114.2.2. Quantities of materials and labour required for various items of work shall be as given in the standard data and relevant specification.

114.3. Preparation of Surki Mortar :—

114.3.1. Surki, lime and sand shall be measured out in suitable sized boxes one over the other in proper proportions.

114.3.2. The method of mixing and grinding, etc., as described in the standard specification for "Lime Mortar" vide clause 113.3 shall be followed with the exception that the mortar being hydraulic shall be used within 24 hours after being mixed.

114.3.3. Any mortar which has not been made use of within the about limit of time or which has set and hardened shall be considered unfit for use and recovered forthwith from the site of work.

114.4. Stacking and Storage :—This shall confirm to clause 113.4.

Specification No. 115

Cement Mortar

115.1. Materials :—Cement, sand and water to be used shall conform to S.Ss. : 112,110 and 129 respectively.

115.2. Proportions :

115.2.1. Cement mortar shall be mixed in the proportions noted below or such other proportions may be defined in the relevant schedule item for the various items of work.

Table 115-A

Proportions of Cemend and Sand by volume

	Item of work (1)	*Cement* (2)	*Sand* (3)
1.	Mortar for masonry	1	5
2.	Mortar for masonry	1	6
3.	Mortar for Plastering	1	4
4.	Mortar for Pointing	1	3

115.2.2. If specified part of the cement may be replaced by approved pozzalona such as surki conforming to SS : 104 and fly ash conforming SS : 105.

115.3. Preparation of cement mortar :

115.3.1. The portland cement shall be measured by weight, 1440 kg. being taken as 1 cubic metre and sand measured in suitable sized measuring boxes. A bag of cement weighing 50 kg. may be taken as 0.035 cu.m.

115.3.2. *Mixing in Mechanical Mixer* :

115.3.2.1. Mixing shall be done preferably in a mechanical mixer. In such case the cement and sand in the specified proportions shall be mixed dry thoroughly in the mixer operated manually or by power.

115.3.2.2. Water shall then be added gradually and wet mixing continued atleast for 3 minutes. Care shall be taken not to add more water than that required to bring the mortar to the required working consistency.

115.3.2.3. Mixer shall be cleaned with water each time before suspending the work.

115.3.3. *Hand Mixing* :

115.3.3.1. The measured quantity of sand shall be spread over a platform and the cement uniformly spread over the sand. The cement and sand shall then be mixed over dry three times to obtain uniform colour.

115.3.3.2. The quantity of dry mix which can be used within 30 minutes shall be taken and the required quantity of water to give a workable consistency shall be added while the mortar is thoroughly mixed for atleast 5 minutes.

115.4. Time of use :

115.4.1. Cement mortar shall be used as soon as possible after mixing and before it has begun to set and in any case within 30 minutes after the water is added to the dry mixture.

115.4.2. Mortar unused for more than 30 minutes shall be rejected and removed from the site of work.

Specification No.116

Cement Lime Mortar

116.1. Materials :—Cement, lime, sand and water to be used shall conform to S.Ss : 110, 111, 112 and 129 respectively.

116.2. Proportions :—The cement lime and sand shall be taken in the proportions of (1 : 1 : 6) or (1 : 1 : 7) or (1 : 2 : 9) (Cement : Lime : Sand) by volume or as may be specified in the relevant schedule item.

116.3. Preparation of Cement Lime Mortar :—The sand and lime shall be measured by volume in suitable measuring boxes. Cement shall be measured by weight 1440kg. being taken as equivalent to one cubic metre or a 50kg. bag taken as equivalent to 0.035 cu.m.

116.4. Lime (Sand) mortar of the required proportions shall be prepared as per S.S. 113. The specified quantity of cement shall then be added to the lime mortar and thoroughly mixed either by hand or by a mechanical mixer. If necessary additional quantity of water shall be added during the final mixing to bring the mortar to a workable consistency.

116.5. Time of use :—Cement lime mortar shall be used as soon as possible after mixing and before it has begun to set and in any case within one hour after the addition of cement.

116.5.1. Mortar which has set or remained unused for more than one hour after addition of cement shall be rejected and removed from site.

Specification No. 117

Sebara Putty (Lime Putty)

117.1. Materials :

117.1.1. *Lime* :—Pure fat lime conforming to S.S. : 112 shall be used.

117.1.2. *Water* :—Water shall conform to S.S. : 129.

117.2. Preparation :—Lime shall be slaked and mixed with sufficient water to form a thick paste. It shall be reduced to a fine paste by grinding. It shall then be passed through a fine sieve (3mm. IS : Sieve) to remove all unslaked particles and foreign matter and allowed to mellow under water for atleast 10 days in a slaking tank. The surplus water on the top shall be allowed to run off. Lime putty so formed shall be kept wet till it is completely used. It can be stored without deteriorating for 15 days, provided it is protected from drying out.

Specification No. 118

Pan Tiles

118.1. General Requirements :—Tiles shall be made from well prepared clay and well burnt to give a uniform texture and colour and they shall be free from twists, cracks and particles of stone.

118.2. Size and Shape :—Tiles shall be about 225mm. long, 140mm. wide at the large end, 125mm. at small end and 10mm. thick and they may be segmental or semicular in shape.

118.3. Water Absorption :—After 24 hours immersion in water, absorption by weight shall not exceed 20% of the dry weight of the tile.

118.4. Measurement & Rate :—Tiles shall be counted in full numbers and paid per hundred.

Specification No. 119

Burnt Clay Flat Terracing Tiles

119.1. General Requirements :—Flat tiles shall be made from fine, well weathered or well prepared clay and shall be uniformly well burnt. They shall have even texture and shall be free from twists, bends, cracks and particles of stone.

119.2. Sizes :—The sizes of terracing tiles and tolerances shall normally be as under.

(a) Size 150mm. x 150mm. x 12.50mm.

(b) Tolerances : Lenght and width : plus or minus 5mm. Thickness plus or minus 2mm.

119.3. Water Absorption :—The water absorption shall be 24% when immersed completely in clean water at 24° for 24 hours.

119.4. Flexural Strength :—The modulus of rupture in bending when tested in accordance S : 2690-(Part-I)-1975 and IS : 2690-(Part-II)-1975, shall not be less than 10kg./cm.

119.5. Measurement & Rate :—This shall conform to clause 118.4.

Specification No. 120

Clay Roofing Tiles, Mangalore Pattern

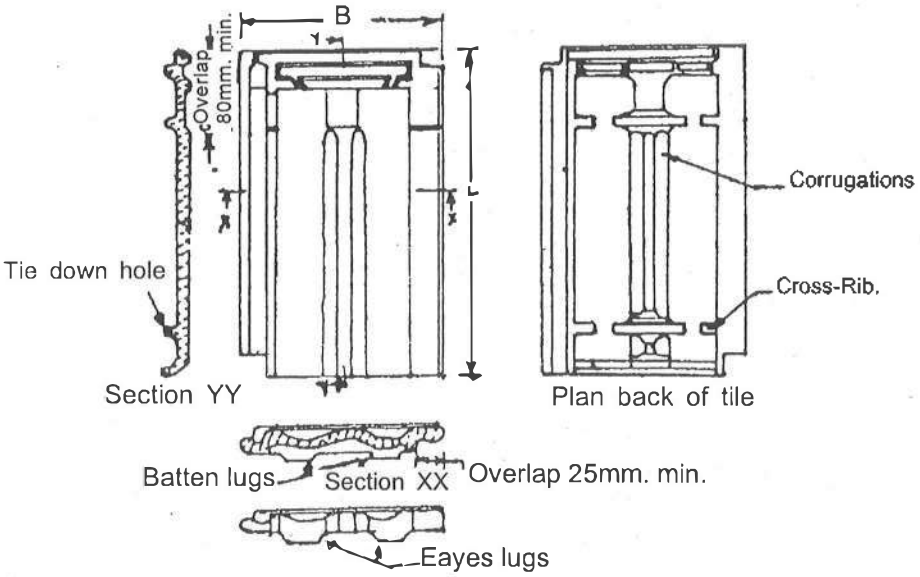
120.1. Terminology :

120.1.1. *Mangalore pattern roofing tiles* :—These are machine pressed, burnt clay roofing tiles suitable for laying on, sloping roofs by means of nibs which catch on reepers or battens and overlap similar tile at the lower end on the sides.

120.1.2. *Ridge titles* :—The machine pressed burnt clay tiles of 'V' shape are suitable or use on roof ridges in conjunction with Mangalore pattern tiles.

120.1.3. *Ventilating tiles* :—These shall be similar to the roofing tiles as prescribed in clause 120.1.1 except for a suitable shielded opening for ventilation.

120.1.4. *Ceiling tiles* :—A machine pressed, burnt clay tiles for use as ceiling under the Mangalore pattern tiled roof.



[Fig. 120.1]

TYPICAL DETAILS OF MANGALORE TILE

120.2. General Requirements :—Roofing tiles Mangalore pattern and specials in clause 120.1 shall be of two classes namely class "AA" and Class "A" on conformity with IS : Specifications with characteristics specified in Table 120-A and 120-B.

Table 120-A

Classification of Roofing tiles

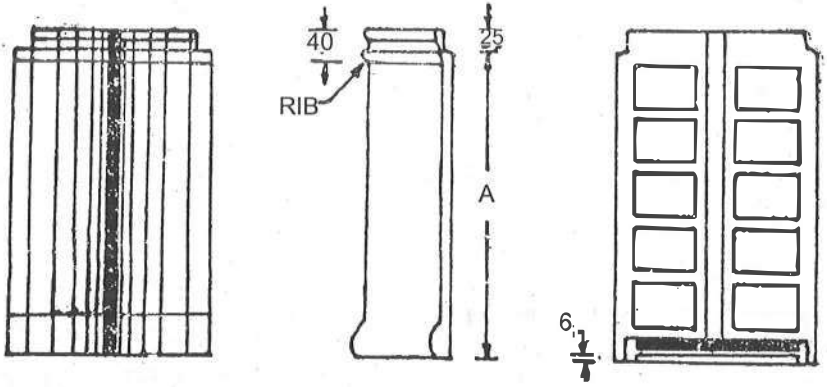
Sl. No. (1)	*Characteristics* (2)	*Requirement*	
		Class "AA" (3)	*Class "A"* (4)
(i)	Water absorption, percent Max.	16	24
(ii)	Breaking load, Kg. Min.		
	(a) Average	102	82
	(b) Individual	91	68

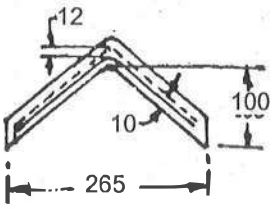
Table 120-B

Classification of Ridge and Ceiling tiles

Sl. No.	*Characteristics*		*Requirement*	
			Class "AA"	*Class "A"*
(i)	Water absorption, percent (for ridge and ceiling tiles)	Max.	19	14
(ii)	Breaking strength (for ridge tiles only) Kg.	Min.		
	(a) Average		1.5	1.10
	(b) Individual		1.15	0.95

120.2.1. The roofing tiles shall conform to IS : 654-1972 and ridge and ceiling shall conform to IS : 1464-1973.





[Fig. 120.2]

All dimensions in mm.

RIDGE TILE

120.3. Shape, Dimensions and Tolerances :

120.3.1. The typical shapes of Mangalore pattern roofing tiles, ridge and ceiling tiles are shown in figures 120-1 to 120-3.

120.3.2. The sizes of roofing and ridge tiles in accordance with relevant Indian Standard are given in Table below :

Table 120-C

Sizes of Mangalore pattern roofing tiles

Sl.No. (1)	*Overall length in mm.* (2)	*Overall width in mm.* (3)
(i)	*410*	*235*
(ii)	*420*	*250*
(iii)	*425*	*260*

Table 120-D

Sizes of ridge tiles

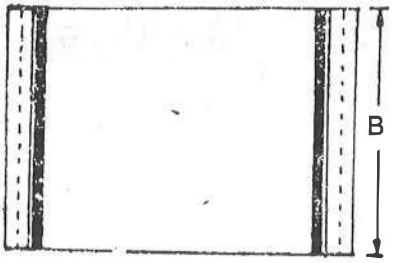
Sl.No. (1)	*Length in mm.* (2)	*Overall width in mm.* (3)
(i)	*375*	*265*
(ii)	*400*	*265*
(iii)	*435*	*265*

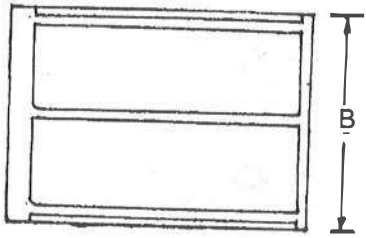
120.3.3. *Tolerances* :—The following tolerances may be permitted in the dimensions of Mangalore pattern roofing tiles.

CEILING TILE

Fig. 120.3

All dimensions in mm.





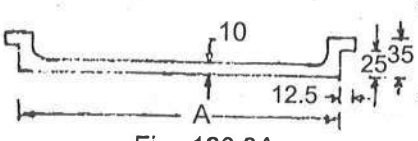


Fig. 120.3A

Double lug type

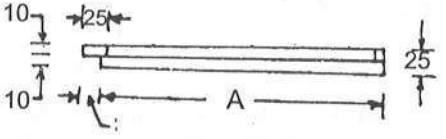


Fig. 120.3B

Single lug type

Dimensions	*Toleances*
Effective length	plus or minus 6 mm.
Effective width	plus or minus 3 mm.

120.3.3.1. The tolerances on the length, width, and height of ridge tiles shall be plus or minus 5mm. respectively.

120.4. Tests :—The tiles and specials shall comply with the tests laid in the relevant Indian Standard and if required a test certificate to this effect from an approved laboratory shall be furnished by the supplier.

120.5. Measurement & Rate :—Tiles and specials shall be counted if full number and paid per hundred.

Specification No. 121

Glazed Tiles

121.1. Qualities :

121.1.1. The tiles shall be covered by a glaze on the top and the under side. The edges shall be free from glaze in order that the tiles may adhere properly to the base.

121.1.2. The glaze shall be uniform in quality and free from welts, ships, craze, specks, crawlings or other imperfections visible from a distance of one metre.

121.1.3. The glazed tiles shall be white or coloured.

121.2. Size and Shape of Tiles :

121.2.1. The tiles shall generally be square and of two nominal sizes i.e., 149 x 149mm. or 99 x 99mm. with a thickness of 5, 6 or 7 mm.

121.2.2. The specials such as covers internal and external angles, beads, cornices and corner pieces shall be of specified sizes.

Table 121-A

Dimensions of fittings for glazed tiles

Sl. No.	*Fitting*	*Length L mm.*	*Height H mm.*	*Width W mm.*	*Radius of rounding at mm. corners*
(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*
(i)	Cove base	Same as for corresponding tiles	Same as for corresponding tiles	—	25.00
(ii)	Round edge	Do.	Do.	—	10.00
(iii)	Corner cups	25,31,37	—	—	—

(iv)	Angles galzed	Same as for corresponding tiles	—	25,31,37	—
(v)	Ridges	Do.	—	50	—
(vi)	Legs	—	25,31,37	25,31,37	—
(vii)	Cornice	150	23	50	—
(viii)	Capping beads	150	—	12	—

121.3. The tiles shall be true to shape and conform to the performance requirements of IS : 777-1970 as revised from time to time and the supplier shall submit a certificate if required with respect to the quality of tiles and detailed therein.

121.4. Measurements & Rate :—This shall conform to clause 120.5.

Specification No. 122

Bitumen felts for water proofing and damp proofing

122.1. Classification :—Bitumen felts shall be classified as follows depending upon the type of base used in their manufacture and the uses for which the felts are suited in accordance with IS : 1322-1970.

(a) Fibre base.

Type 1 : Saturated felt for underlay.

Type 2 : Self-finished felt (for water proofing) - Grade 1.

Self-finished felt (for water proofing) - Grade 2.

Self-finished felt (for damp proofing) - Grade 3.

(b) Hessian base.

Type 3 : Self-finished felt (for water proofing) - Grade 1.

Self-finished felt (for damp proofing) - Grade 2.

122.2. Dimensions :

122.2.1. Unless specified otherwise bitumen felts shall be supplied in widths of 0.9m. and 1.00m. The length of felts shall be such that each roll shall be adequate to cover an area specified below taking into account the necessary overlaps.

Type of felt		*Area covered*
Type 1	—	40 sq.m.
Type 2, Grades 1 & 2	—	20 sq.m.
Type 3, Grade 1	—	10 sq.m.
Type 2, Grade 3	—	10 sq.m.
Type 3, Grade 2	—	10 sq.m.

122.3. Tests :

122.3.1. Bitumen felts shall comply with the tests specified in IS : 1322-1970 and if required a test certificate to this effect from an approved laboratory shall be furnished by the supplier.

122.4. Packing :

122.4.1. Unless specified otherwise, bitumen felts shall be packed in rolls according to the approved (trade) practice. No roll shall contain more than two pieces. The number of rolls containing more than two pieces in any one delivery shall not exceed 3 per cent of the rolls in that delivery.

Specification No. 123

Cuddapah/Shahabad Slabs

123.1. Quality :

123.1.1. The slabs shall have an even surface without any viens, cracks or flaws and shall be of uniform colour.

123.1.2. Earthy and flaky slabs shall be rejected.

123.1.3. Slabs shall be either up-polished or polished on face.

123.2. Dimensions :

123.2.1. The slabs shall be rectangular or square and generally of the sizes given in the table or of any other sizes specified in the relevant schedule item.

Table 123-A

Standard Sizes of Slabs

Length in mm	*Breadth in mm*	*Thickness in mm*	*Tolerances in mm.*
190, 50, 295, 395	195	15, 25, 30	(a) Plus or minus 5mm. on dimensions more than 195mm.
295, 395, 495	295	15, 25, 30, 40, 50	(b) Plus or minus 2mm. on dimensions less than 95mm.
395, 495, 695	395	15, 25, 30, 40, 50	
495, 595, 795	495	15, 25, 30, 40, 50	
595, 795, 895	595	30, 40, 50	
795, 895, 1195	795	30, 40, 50, 60, 70	
895, 1195, 1495	895	50, 60, 70	
1195, 1495	1195	50, 60, 70, 80, 95	
1495	1495	50, 60, 70, 80, 95	

123.3. Sample :—Before supply the contractor shall submit the samples to the Executive Engineer for approval.

123.4. Measurement :—All linear measurements shall be in metres correct to 0.01 of a metre. Areas shall be worked out in sq.m correct to 0.01 of sq.m. They shall be differentiated by their lenghts, widths and thickness.

123.5. Rate :—The unit rate shall be per sq.m.

Specification No. 124

Galvanized Steel Sheets (Plain or Corrugated)

124.1. General :—Plain and corrugated galvanized steel sheets shall conform to the requirements of IS : 277-1969.

124.2. Classification :—Galvanized steel sheets (Plain or corrugated) produced by hot dip process are classified as follows :—

Class 1 : Extra heavy coating of Zinc, nominal 750 g/m^2

Class 2 : Heavy coating zinc nominal 600 g/m^2

Class 4 : Medium coating of zinc nominal 450 g/m^2

Class 4 : Light coating of zinc nominal 375 g/m^2

124.3. Dimensions :

124.3.1. *Sizes* :—Galvanized steel sheets (Plain or Corrugated) shall generally be of the sizes given in the following table :

Table 124-A

Sizes of Galvanized Steel Sheets (Plain or Corrugated)

Length in metres	*Width (mm.)*	
	Plain	*Corrugated*
1.8 | 2.2 | 2.5 | 2.8 | 3.2. | 3.6.	750 mm or 900 mm	660 mm or 800 mm

124.3.2. *Thickness* :—The thickness of sheets shall generally be 0.63, 0.80, 1.00, 1.25 or 1.60 mm.

124.4. Marking :

124.4.1. Every sheet shall be legibly marked with manufacturer's name or trade mark. The top sheet be each bundle shall, in addition, be marked with type of coating, lenght width, thickness and the number of corrugations in the case of corrugated sheets.

124.5. Stacking and Storage :

124.5.1. Sheets shall be handled and stored in such a manner as not to damage them in any way.

124.5.2. These sheets shall be stacked on wooden battens laid on firm and level ground.

124.5.3. It shall be protected from atmospheric actions such as rain, sun, moisture, etc., to avoid deteriorations.

124.6. Measurement :—This shall conform to clause 123.4. They shall be differentiated by their types of coating and the number of corrugations.

124.7. Rate :—This shall conform to clause 123.5.

Specification No. 125

Un-reinforced Corrugated Asbestos Cement Sheets

125.1. General :

125.1.1. Un-reinforced corrugated asbestos cement sheets shall conform to the requirements of IS : 459-1970.

125.2. Classification :

125.2.1. The sheets are classified as corrugated or semi-corrugated according to the size and form of corrugations.

125.3. Dimensions and Tolerances :

125.3.1. *Dimensions* :—The corrugated sheets shall be and conform to the linear dimensions specified in Tables 125-A and 125-B.

Table 125-A

Dimensions of Corrugated Asbestos Cement Sheets

Pitch of Corrugation	*Depth of Curragation*	*Overall Width*	*Effective Width*	*Nominal thickness of sheet*	*Length of sheet*
P mm.	D mm.	B mm.	C mm.	T mm.	A mm.
(1)	(2)	(3)	(4)	(5)	(6)
146	48	1050	1010	6	1.5, 1.75, 2, 2.5
146	48	1050	1010	7	2.51, 3

Table 125-B

Dimensions of semi-corrugated Asbestos Cement Sheets

Pitch of Corrugation	*Depth of Curragation*	*Overall Width*	*Effective Width*	*Nominal thickness of sheet*	*Length of sheet*
P mm.	D mm.	B mm.	C mm.	T mm.	A mm.
(1)	(2)	(3)	(4)	(5)	(6)
338	45	1100	1014	6	1.5, 1.75, 2.25
338	45	1100	1014	7	2.5, 2.75, 3

125.3.2. *Tolerance* :

125.3.2.1. *Tolerance on length and width* :—Corrugated and semi-corrugated sheets shall not vary from the dimensions for length and width specified in the Tables 125-A and 125-B by more than plus or minus 6mm.

125.3.2.2. *Tolerance on thickness* :—No tolerance is permitted in thickness. For the purposes of measuring thickness, a sliding gauge having a blade not more than 25mm. long and approximately 3mm. thick may be used.

125.4. Freedom from defects :—The sheets when delivered shall be free from visible defects that impair appearance or serviceability and shall have been manufactured at least four weeks before despatch. The surface of the sheets shall be of uniform texture and have neatly trimmed edges.

125.5. Stacking and Storage :—Roofing sheets shall be handled and stored in such a manner as not to damage them in any way. These sheets shall be stacked on wooden battens laid on firm and level ground. They shall be stored and stacked as per manufacturer's instructions. They shall be stored relatively nearer to the place of use.

125.6. Measurement :—This shall conform to clause 123.4. They shall also be differentiated by the number of corrugations.

125.7. Rate :—This shall conform to clause 123.5.

Specification No. 126

Steel for Reinforcement

126.1. Quality :—The various types of steel shall conform to relevant Indian Standard Specifications as follows :

Table 126-A

Types of Sheets

Sl.No.	*Types of Steel*	*Relevant IS No.*
1.	Cold twisted steel bars for concrete reinforcement	IS : 1786-1966
2.	Hot roled mild steel and medium tensile steel deformed bars for concrete reinforcement	IS : 1139-1966
3.	Hand drawn steel wire fabric for concrete reinforcement	IS : 1566-1967
4.	High tensile steel bars used in prestressed concrete	IS : 2090-1962
5.	Indented wire for prestressed concrete	IS : 6003-1970
6.	Mild steel and medium tensile steel bars for concrete reinforcement	IS : 432–Part-I–1966
7.	Hard drawn steel wire	IS : 432–Part-II–1966
8.	Plain hard drawn steel wire for prestressed concrete	IS : 1785–Part-I–1966 IS : 1785–Part-II–1967
9.	Uncoated stress relieved strand for prestressed concrete	IS : 6006-1970
10.	Mild steel binding wire	IS : 280-1972

126.2. All the reinforcement shall be clean and free from dust, oil paint, grease, mill scale or rust at the time of placing.

126.3. Storage :—

126.3.1. Reinforcement steel and binding wire shall be stored above ground surface upon platform, skids or other supports protected as far as practicable from surface deterioration by direct contact with undesirable elements or by exposure to conditions producing rust and corrosion. Bars shall be so supported as to avoid distoration and saging of long lengths. All reinforcement of same designation shall be stacked separately and distinctly marked.

126.4. Measurement :—Reinforcement steel and binding wire shall be measured by length or by weight. Linear measurements shall be in metres correct to 0.01 of a metre. Standard weights/metre lenghts of the reinforcement steel diameter wire shall be adopted as per IS weight/shall be measured in tonnes and kgs. correct to 0.1 of a kg.

126.5. Rates :—The unit rate shall be per tonne for steel and per kg. of binding wire.

Specification No. 127

Steel for Structural Work

127.1. Materials :

127.1.1. *Structural Steel* :—Unless otherwise specified structural steel shall conform to IS : 226-1975 "Structural Steel Standard Quality" and IS : 2062-1969 for "Fusion Welding Quality".

127.1.2. *Rivet Steel* :—All rivet steel shall conform to IS :1148-1973 and IS : 1149-1973.

127.1.3. *Steel for bolts and nuts* :—All bolts and nuts shall conform to IS : 1367-1967.

127.1.4. *Washers* :—Plain washers shall be made of steel conforming IS : 226-1975.

127.1.5. Dimensions, forms, weight and tolerances of all rolled steel and other members shall conform to relevant IS or shall be as specified. The finished material shall be free from cracks, surface flaws, laminations and rough jagged and imperfect edges and all other harmful defects and shall have a smooth uniform finish. The section shall be supplied/to/specified lenghts, smoothly cut to the required dimensions.

127.1.6. *Tolerance* :—Unless otherwise specified the permissible tolerances shall be in accordance with IS : 1852-1973.

127.2. Straightening :—All deformed structural material shall be properly straightened by methods which are not injurious, prior to being laid off, punched or otherwise worked in the shop. Steel with kinks and bends shall be rejected.

127.3. Storage :—Structural steel shall be stored above surface of the ground upon platforms, skids or other suitable supports to avoid distortion of sections in long lenghts and shall be protected as far as practicable from surface deterioration by direct contact with harmful elements or exposure to conditions producing rust and corrosion. It shall be so stored and handled that the material is not subjected to excessive stresses and damage.

127.4. Tests :—The structural steel shall comply with the tests laid down in the relevant IS : Specification and if required a test certificate to this effect from an approved laboratory shall be furnished by the supplier.

127.5. Measurement :—The linear measurements shall be in metres correct to 0.01. of a metre. Standard weight per metre length of specified section shall be adopted as per IS weights shall be calculated in tonnes and kgs. correct to 0.10 of a kg.

127.6. Rate :—The unit rate shall be per tonne for steel sections and per kg. for rivets, bolts, washers, etc.

Specification No. 128

Asbestos Cement Flat Sheets

128.1. General :

128.1.1. Asbestos cement flat sheets shall conform to IS : 2096-1966.

128.2. Classification :

128.2.1. Asbestos cement flat sheets shall be classified according to the unit bending stresses as below :

(a) *Compressed sheets* :—Sheets which give a minimum unit bending stress of 225 kg./cm.^{2} having a density exceeding 1.6 kg./dm^3.

(b) *Uncompressed sheets* :—Sheets which give a minimum unit bending stress of 160 kg./cm.^{3} having a density exceeding 1.2 kg./dm.^{3}.

128.3. Dimensions and Tolerances :

128.3.1. *Dimensions* :

128.3.1. The nominal thickness of asbestos cement flat sheet shall be 5,6,8,10 and 15 mm.

128.3.1.2. The nominal lenghts and widths of the asbestos cement flat sheets shall be specified below :

Lenght mm.	*Width* mm.
2400	2400
1800	1800
1200	1200

128.3.2. *Tolerances* :

128.3.2.1. *Tolerance on thickness* :—The actual thickness measured shall not vary from the nominal thickness specified in clause 128.3.1.1 by more than plus or minus 5 per cent.

128.1.2.2. *Tolerance on length and width* :—Asbestos cement flat sheets shall not vary from the nominal dimensions for length and width specified in clause 128.3.1.2 by more than plus or minus 5 mm.

128.4. Freedom from defects :—The sheets when delivered shall be free from visible defects that impair appearance or serviceability. The surfaces of the sheets shall be of uniform texture and shall have atleast one smooth surface. They shall be, flat, rectangular and shall have neatly trimmed, straight and regular edges and shall be square at the corners.

128.5. Stacking and Storage :—The sheets shall be handled and stored in such a manner as not to damage them in any way. These sheets shall be stacked no wooden battens laid on firm and level ground. They shall be stored and stacked as per the manufacturer's instructions. They shall be stored as near the place of work as possible.

128.6. Measurements :—This shall conform to clause 123.4 except that they shall differentiated by their thickness only.

128.7. Rate :—This shall conform to clause 123.5.

Specification No. 129

Water

129.1. Water used for mixing mortar or concrete and for curing shall be clean and free from injurious amounts of deleterious materials such as oils, acids,

alkalies, salts, slit and organic matter, etc., and material which may cause discolouration. It shall be free from suspended impurities.

129.2. Where contains any sugar or an excess of acid, alkali or salt the Executive Engineer may refuse to permit its use. As a guide, the following concentrations represent maximum permissible values.

(a) To neutralise 200 ml. sample it shall not require more than 2 ml.of 0.1 normal Na OH.

(b) To neutralise 200 ml. sample it shall not require more than 10 ml. of 0.1 normal HCl.

(c) Percentage of solids should not exceed the following :

Organic	—	0.02 per cent.
Inorganic	—	0.30 per cent.
Sulphates	—	0.05 per cent.
Alkali chlorides	—	0.10 per cent.

129.3. If required by the Executive Engineer the water shall be tested by comparison with distilled water. Comparison shall be made by means of standard cement tests for soundness, time of setting and mortar strenght as specified in IS : 269-1967. Any indication of unsoundness, change in time of setting by 30 minutes or more decrease of more than 10% in strength of mortar prepared with water samples when compared with the result obtained with mortar prepared with distilled water shall be sufficient cause for rejection of water tested.

129.4. Containers for transport, storage and handling of water shall be clean.

129.5. Potable water is generally considered satisfactory.

129.6. Where permitted sea water not containing more than 3 per cent of chloride salts may be used for curing only.

Specification No. 130

Teak Wood

130.1. Quality :—The teak used for various works shall be durable and of good quality. It shall be well seasoned, free from decay, rot harmful fungi and insect attacks.

130.1.1. *Wood other than poles and ballies* :—The teak wood shall be uniform in texture straight in fibre, free from flaws, shakes, warps cups, springs, twists, bends or large loose or dead cluster knots or defects of any other kind. It shall be free from spongy, brittle, flaky, brashy condition sap wood and borer holes.

130.1.2. *Knots* :—The diametre of knots shall not be more than 25mm. and aggregate area of all the knots shall not exceed 1 per cent of the area of the piece.

130.1.3. *Poles or posts* :—Natural felled teak without any possessing. They shall be classified according to the mild girth or mid diametre or according to the

girth or diametre at top and bottom excluding bark in each case. These shall be free from large and dead knots, cracks and wooden borer infection.

130.1.4. Logs or rounds shall be square or rectangular.

130.1.5. *Scantlings* :—Sawn timber other than planks and reepers.

130.1.6. *Planks* :—Scantlings with thickness less than 50mm. and width more than 50mm.

130.1.7. *Battens or reepers* :—Scantlings with thickness and width less than 50 mm.

130.2. Sawing :—All scantlings, planks, battens or repeers shall be swan in straight lines, planes, uniform thickness, of full measurements from end to end and shall be swan in the direction of the grain. They shall be swan with sufficient margin as to secure specified dimensions, lines and planes after being wrought.

130.3. Stacking :—As soon as the foundations of a building are laid all necessary timber scantlings shall be brought to site and stacked properly. They shall be kept under cover and allowed to remain till required.

130.4. Measurement :

130.4.1. All linear measurements shall be in metres correct to 0.01 of a metre. Volumes shall be worked out in cubic metres correct to 0.01 of a cubic metre.

130.4.2. Poles or posts shall be measured in running metres and differentiated by their girth or diametre and lengths.

130.4.3. Battens or reepers shall be measured in running metres and differentiated by their widths, thickness and lenghts.

130.4.4. Planks, logs or rounds and scantlings shall be measured in metres and volume worked out as per clause, 130.4.1 shall be differentiated by their lengths. Planks shall also be differentiated by their widths and thickness.

130.5. Rate :—The unit rate shall be per running metre or per cubic metre as the case may be.

Specification No. 131

Bamboos

131.1. Quality :—Bamboos shall be free from attacks of weevils, not older than about two to three years and well seasoned.

131.2. Classification :—The bamboos are classified as follows :

(a) First Class

(b) Second Class

(c) Third Class

(d) Reepers.

131.3. Sizes :—The sizes of the above classes of Bamboos shall conform to the sizes given in the Table 131-A.

Table 131-A

Sizes of Bamboos

Class (1)	*Diametre* (2)	*Length* (3)
First Class	Over 150 mm	3.5 to 4.5 metres
Second Class	Over 125 mm	3.5 to 4.5 metres
Third Class	Over 100 mm	3.5. to 4.5 metres
Reepers	10 to 25 mm	3 to 4 metres

131.4. Measurement :—The diametre shall be measured at mid length of each bamboo.

Specification No. 132

Ballies

132.1. Materials :

132.1.1. Ballies shall be round, reasonably straight, without bark (except in the case of casurina) and without defects such as large and dead knots, holes, rots, splits, cracks, wooden borer infection, etc.

132.2. Quality :—Unless otherwise specified ballies shall be from the following species of wood :

Teak, Casurina, Eucalyptus, Chennagi, Sirmanu (Tirman) Billudi Nallamaddi, Sal.

132.3. Tolerances :—The tolerances shown in Table 132-A may be permitted.

Table 132-A

Sl. No.	*Length*	*Mean diametre or diametre at the middle*	*Tolerance in diametre at the thinner end*
1.	Ballies not exceeding 3m. length	Not less than the specified diametre	The diametre at the thinner end shall not be less than the specified diametre by more than 10mm.
2.	Ballies exceeding 3m. length	Not less than the specified diametre	The diametre at the thinner end shall not be less than the specified diametre by more than 20mm.

132.4. Measurement :—The ballies shall be measured in running metres, correct to 0.01 of a metre and shall be differentiated by their diameters and lenghts.

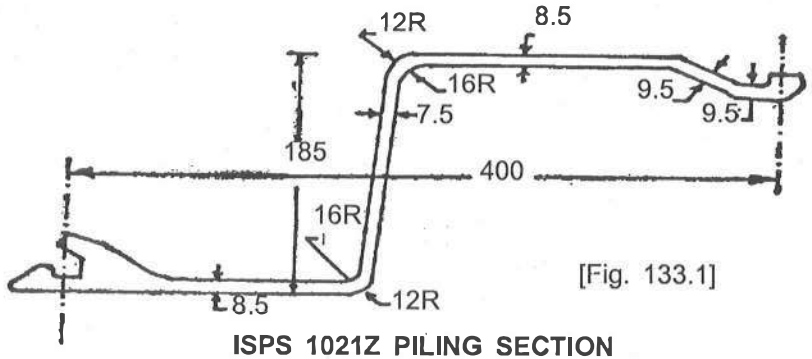
132.5. Rate :—The unit rate for payment shall be per running metre.

Specification No. 133

Steel Sheet Piling Sections

133.1. Scope :

133.1.1. Steel sheet piling shall be used in coffer dam constructions, protective works and for river training works.



[Fig. 133.1]

ISPS 1021Z PILING SECTION

133.2. Material :

133.2.1. Piling sections shall be made from steel of any one grade confirming to IS : 226-1975 "Specification for Structural Steel (Standard Quality)" IS : 961-1975 "Specification for High Tensile Structural Steel, or IS : 2062-1969" specification for Structural Steel (Fusion welding quality)".

133.2.2. Where steel is required in copper bearing quality, the copper contents shall be between 0.20 and 0.35 per cent.

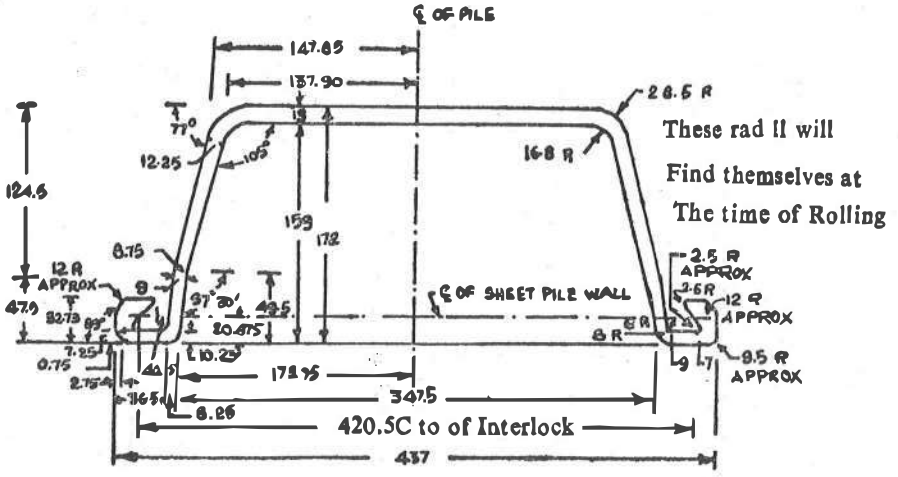


FIG. 188-2

All dimensions in mm

Isps 1625 U piling section

133.3. Designation :

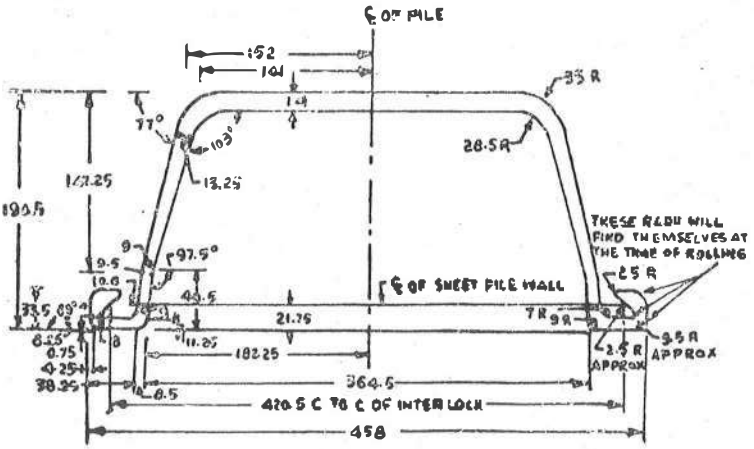


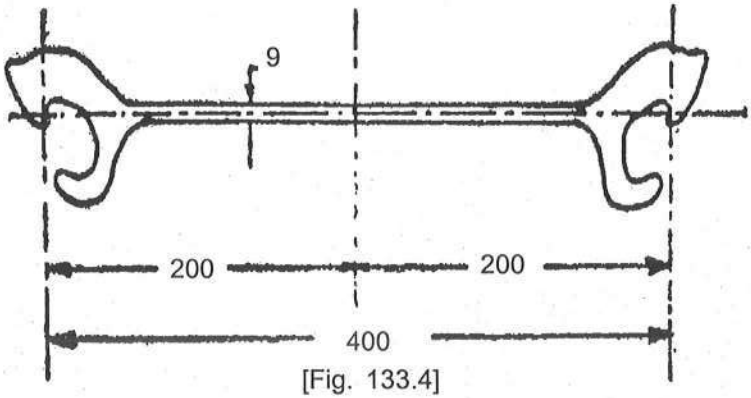
FIG. 133.3

ISPS 2222 U PILING SECTION

133.3.1. Steel sheet piling sections shall be designated with the letters ISPS followed by the section modulus per metre of wall in cm.^{3} and letters symbols Z,U and F which denote Z-type, U-type and Flat-type sections respectively.

133.4. Dimensions :—

133.4.1. The nominal dimensions of the steel sheet piling sections shall be as given in Figs. 133-1, 133-2, 133-3 and 133-4.



[Fig. 133.4]

All Dimensions in mm.

ISPS 100F PILING SECTION

Approximate calculated sectional properties based on the nominal dimensions are given in Table 133-A.

Table 133-A

Geometrical properties of Indian Standard Sheet Piling Sections

Sl. No.	Desig-nation	Weight per m. of wall kgs.	Weight per sq.m. of wall kgs.	Section modules per m of wall cm^3	Moment of inertia per m. cm^4	Secl. area per m of wall cm^2	Peri-metre per m of wall cm.	c-c dis-tance of joints cm.
ISPS	1,021Z	49.25	123.12	1,021	9,448.5	157	233	400.0
ISPS	1,625U	65.37	162.40	1,625	24,563	207	308	402.5
ISPS	2,222U	82.70	195.70	2,222	38,219	249	331	420.5
ISPS	100F	55.20	138.00	100	428.0	176	104	400.0

133.4.2. *Tolerances* :

133.4.2.1. *Dimensional Tolerances* :—Dimensional tolerances of the profile of the piling sections shall be as agreed to between the purchaser and the manufacturer.

133.4.2.2. *Weight Tolerances* :—The weight tolerances shall be +4 per cent and –2.5 per cent.

133.4.2.3. *Length Tolerances* :—The sections shall be supplied in lenghts between 9m. and 13.4m. subject to a tolerances +75 mm. and –50mm. Any specific length may be ordered subject to mutual agreement between the purchaser and the manufacturer.

133.5. Marking :

133.5.1. Piling sections shall be marked with the following details :

(a) Manufacturer's identification mark,

(b) Designation, and

(c) Colour code to identify grade of steel as per IS : 2049-1963.

133.5.2. The material may also be marked with I.S.I. Certification mark.

133.6. Measurement :—Steel sheet piling sections shall be weighed in tonnes correct to 0.01 of tonne.

133.7. Rate :—The unit rate for payment shall be per tonne.

Specification No. 134

Bitumen Emulsions for Roads (Anionic Type)

134.1. Scope :—Bitumen emulsions are generally used in road construction and maintenance such as soil stabilisation, grouting, tack coating, resurfacing, seal coatings, premixing and in various other special circumstances where cold application of bitumen is required.

134.2. Terminology :

134.2.1. *Bitumen Emulsion (Anionic)* :—An emulsion in which the anion of the emulsifier is at the interface with the bitumen particle. An emulsion in which the particles are negatively charged and the aqueous phase is alkaline.

134.3. Types and uses :

134.3.1. Emulsified bitumen shall be of the following three types and shall conform to IS : 3117-1965.

(a) Rapid setting type (R.S.), used for penetration and surface treatment.

(b) Medium setting type (M.S.), used for mixing with coarse aggregate.

(c) Slow setting type (S.S.), used for mixing with fine aggregate.

These types shall not be used in temperatures below 5°C as their utility is likely to be impaired.

134.4. Requirements :

134.4.1. Bitumen emulsion shall be homogenious and shall show no undispensed bitumen after thorough mixing within 90 days after manufacture.

134.5. Handling :—As damage is likely to occur during the unloading of bitumen drums from railway wagons and from lorries in case of transit by road from the rail road great care shall be exercised in the handling of bitumen drums during these operations. As far as possible unloading of bitumen drums shall be done with the help of wooden skids on which they can be rolled from the wagons or lorries on to the ground safely. In case skids are not used the drums may be unloaded on a mattress of straw packed in gunny bags.

134.6. Storage :—Each consignment shall be kept separate until the material has been accepted. Drums containing different grades shall be kept in separate lots and never intermingled and shall be stored in such a manner as to permit easy access for proper inspection and identification of each consignment and in a suitable place that will not damage the containers whereby leakage of bitumen or instrusion of water and other foreign matter may be caused.

The presence of pockets of water in bitumen gives rise to frothing during heating.

Bitumen drums shall not be stored in low lying areas where in rain water is likely to collect around the drums and leak into the drums creating pockets of water inside the bitumen.

As a further precaution against intrusion of water the bitumen drums shall be stacked with the drums lying on either side (and not end on) so that any rain water that falls on them will be quickly drained off.

134.7. Sampling :

134.7.1. For the purpose of testing the size of the sample and the sampling procedure from drums and bulk supply shall be as described in IS : 1201-1958 subject to the following :

(a) *From drums* :—The contents of drum which the sample is to be taken shall be thoroughly mixed by rolling the container to and fro for a period of two or three minutes successively in opposite directions, allowing at least five revolutions of the container in each direction and then up ending the container through two revolutions, first in one direction and then in the opposite direction.

(b) *From Bulk* :—Where practicable bulk deliveries of bitumen emulsion shall be agitated by forced circulation or air agitation, be one sampling.

134.7.2. The sample of bitumen emulsion shall be drawn within 24 hours after delivery and tested within 7 days from the date of drawing unless otherwise specified.

134.8. Testing :—Tests where necessary shall be conducted as detailed in IS : 3117-1965.

134.9. Marking :

134.9.1. Each container shall be legibly and indelibly marked with the following :—

(a) Manufacturer's name and/or distinguishing trade mark, if any;

(b) Date of manufacture;

(c) Type and grade ;

(d) Batch number; and

(e) Date of expiry.

134.10. Measurement :—Where supply of bituminous material is required to be paid for separately, it shall be weighed in terms correct to 0.01 of a tonne.

134.11. Rate :—The unit rate for payment shall be per tonne.

Specification No. 135

Cutback Bitumen

135.1. Scope :—Cutback bitumen is generally used in road works.

135.2. Terminology :

135.2.1. *Cutback bitumen* :—Bitumen, the viscosity of which has been reduced by a volatile dilutent.

135.3. Types and Grades :

135.3.1. This shall conform to IS : 217-1961 and shall be of three types namely :

(a) *Rapid Curing (Rc)* :—Cutback bitumen is classified on the basis of initial viscosity into six grades i.e., Rc-0, Rc-1, Rc-2, Rc-3, Rc-4 and Rc-5.

(b) *Medium Curing (Mc)* :—Cutback bitumen is classified on the basis of initial viscosity into six grades i.e., Mc-0, Mc-1, Mc-2, Mc-3, Mc-4 and Mc-5.

(c) *Slow Curing (Sc)* :—Cutback bitumen is classified on the basis of initial viscosity into six grades i.e., Sc-0, Sc-1, Sc-2, Sc-3, Sc-4 and Sc-5.

135.4. Requirements :

135.4.1. Penetration at 25°C,100g, 5 sec. in 1/100 cms. shall be as under for the different grades of materials :

(a) For all the six rapid curing (Rc) grades i.e., Rc-0, Rc-1, Rc-2, Rc-3, Rc-4 and Rc-5, the penetration shall be from 80 to 120.

(b) For all the six medium curing (Mc) grades, i.e., Mc-0, Mc-1, Mc-2, Mc-3, Mc-4, Mc-5, the penetration shall be from 120 to 300.

135.4.2. Cutback bitumen shall not be heated beyond the flash point.

135.4.2.1. For rapid curing (Rc) cutback bitumen of grades i.e., Rc-2, Rc-5 the flash points is 26°C.

135.4.2.2. For medium curing (Mc) cutback bitumen the flash point is given for different grades as under : 38°C for Mc-0 to Mc-1, 65°C for Mc-2 to Mc-5.

135.4.2.3. For slow curing (Sc) cutback bitumen the flash point is given for different grades as under :

65°C for Sc-0 to Sc-1, 79°C for Sc-2, 93°C for Sc-3, 107°C for Sc-4 and 121°C for Sc-5.

135.5. Handling :

135.5.1. This shall conform to clause 134.5

135.6. Storage :

135.6.1. This shall conform to clause 134.6.

135.7. **Sampling** :

135.7.1. *Lot* :—In any consignment all the containers for cutback bitumen of the same category and grade and from the same batch of manufacture shall be grouped together to constitute a lot.

135.7.2. The number of containers to be selected at random from the lot shall depend upon the size of the lot and shall be in accordance with Table 135-A.

Table 135-A

Number of the containers to be selected

Sl.No. (1)	*Lot Size* (2)	*No. of containers* (3)
1.	Upto 50	2
2.	51 to 100	3
3.	101 to 200	4

(1)	(2)	(3)
4.	201 to 300	5
5.	301 to 500	7
6.	501 and above	10

135.7.3. From each of the containers selected as in the table above, an average sample (representative of the material in the container) shall be drawn in accordance with the methods prescribed in IS : 1201-1958 taking all the precautions mentioned therein. All these samples from individual containers shall be stored separately.

135.8. Testing :—Tests where necessary shall be conducted as detailed in IS : 217-1961.

135.9. Marking :

135.9.1. This shall conform to clause 134.9.

135.10. Measurement :—This shall conform to clause 134.10.

135.11. Rate :—This shall conform to clause 134.11.

Specification No. 136

Paving Bitumen

136.1. Scope :—Paving bitumen is used for road ways, air fields, etc.

136.2. Grades :—Paving bitumen shall be classified into five grades according to their penetrations as specified in IS : 73-1961.

136.3. Requirement :—

136.3.1. *Ash* :—No mineral matter other than that naturally contained in the material shall be present.

136.3.2. The material shall be homogenous and shall not foam when heated to 175°C.

136.3.3. Paving bitumen shall not be heated beyond the flash point.

136.3.3.1. For paving bitumen of all the five grades (i.e., S. 35 to S. 200) the flash point is 175°C.

136.3.4. Penetration at 25°C, 100 g., 5 Sec. in 1./100 cms. shall be as under for the different grades of materials (as per IS : 73-1961 Table-II).

Grade of material	*Penatration*
(1) S 35	30 to 40
(2) S 45	40 to 50
(3) S 65	60 to 70
(4) S 90	80 to 100
(5) S 200	175 to 225

136.4. Handling :—This shall conform to clause 134.5.

136.5. Storage :—This shall conform to clause 134.6.

136.6. Sampling :—This shall conform to clause 135.7.

136.7. Testing :—Tests where necessary shall be conducted as detailed in IS : 73-1961.

136.8. Marking :—This shall conform to clause 134.9.

136.9. Measurement :—This shall conform to clause 134.10.

136.10. Rate :—This shall conform to clause 134.11.

Specification No. 137

Coal Tar Pitch

137.1. Scope :—This specification covers the range of four grades of coal tar pitch from soft to hard consistencies with softening points verying from 45°C to 92°C intended for the production of water proofing protective and binding compounds employed in, masonry, steel, timber and concrete structures and also for the preparation of roofing felts.

137.2. Terminology :

137.2.1. *Coaltar pitch* :—The black or dark brown solid or semi-solid fusible and agglomerative residue remaining after partial evaporation or fractional distillation of Coal tars.

137.3. Grades :—Coal tar pitch shall be classified into the following four grades:

(a) Soft pitch.

(b) Soft medium pitch

(c) Hard medium pitch.

(d) Hard pitch.

They shall conform to the requirements given in Table I to IS : 216-1961.

137.4. Handling :—This shall conform to clause 134.5.

137.5. Storage :—This shall conform to clause 134.6.

137.6. Sampling :—This shall conform to clause 136.7.

137.7. Testing :—Tests where necessary shall be conducted as detailed in IS : 216-1961.

137.8. Marking :—This shall conform to clause 134.9.

137.9. Measurement :—This shall conform to clause 134.10.

137.10. Rate :—This shall conform to clause 134.11.

Specification No. 138

Moorum

138.1. Quality :—The moorum shall be composed of well graded coarse siliceous grains sharp and gritty to touch and free from dirt and other deleterious matter. It shall not contain lumps larger than 20 mm. and the fines (passing through 75 microns IS sieve) shall not exceed 10%.

The liquid limit (L.L) and Plasticly Index (P.I.) of moorum for various uses shall be as follows :

		L.L.	P.I.
(a)	Filler material in W.B.M. roads	—33	Not more than 4 to 9
(b)	Filler material in surface treated W.B.M. roads	—20	Not more than 6
(c)	Sub base for roads	—20	Not more than 6
(d)	Backing for revetments	—20	Not more than 6

138.2. Stacking :—This shall conform to S.S. : 101.

138.3. Measurement :—All linear measurements shall be in metres correct to 0.01 of a metre. Volumes shall be worked out in cubic metres, correct to 0.01 of a cubic metre.

138.4. Rate :—The unit rate for payment shall be per cubic metres. This shall include the cost, conveyance and stacking, etc.

SECTION 2

STANDARD SPECIFICATIONS FOR CLEARING SITE, DISMANTLING OF BUILDINGS AND OTHER STRUCTURES AND BLASTING

Sl. No.	*Specification No.*	*Name of Specification*	*Page Nos.*
1.	201	Clearing Site	162
2.	202	Dismantling of Building and other Structures	166
3.	203	Blasting	167

Specification No. 201

Clearing Site

201.1. The area described or shown on the relevant site shall be cleared of all obstructions, loose stones and rubbish of all kinds. If big size stones or boulders are met with they shall be broken, burnt or blasted, removed and stacked as specified.

201.2. All brush wood shall be cleared and the roots entirely removed.

201.3. No trees are to be cut down and removed without the instructions of the Executive Engineer. The roots of those which are cut down, shall be removed upto a depth of 600mm. below ground level or 150mm. below formation level whichever is lower.

201.4. Trees to be preserved shall be defined in the schedule.

201.5. The products of the clearing are to be collected in such a place and manner as may be ordered by the Executive Engineer and the ground shall be left in a perfectly clean condition. All products of the clearing shall be the property of the Government and shall be disposed of, as the Executive Engineer may direct.

201.6. Ant hills are to be completely dug out and queen ants destroyed.

201.7. All holes or hollows whether originally existing or produced by digging up of roots shall be carefully filled up with earth well rammed and levelled off as may be directed.

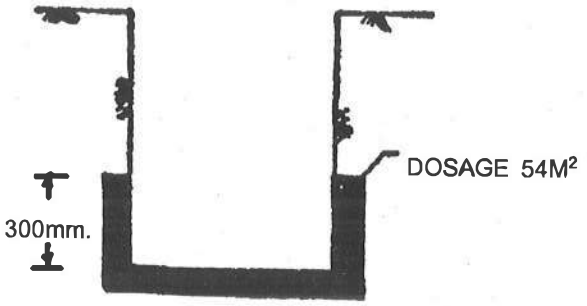
201.8. All Temples, Mosques, Churches, Historical monuments, Tombs etc., shall be safeguarded.

201.9. Anti-termite Treatment :

201.9.1. *General* :—Anti-termite treatment before construction and during early stages of construction, where required, shall be done generally in accordance with IS : 6313-Part-II-1971.

201.9.2. *Chemical used* :—The various chemicals that may be used, the relevant IS : Specification for the same and their usual concentrations as water-emulsions for soil treatment are given in Table 201-A.

TREATMENT OF TRENCH BOTTOM AND SIDES



[Fig. 201.1]

TABLE 201-A

Sl. No.	*Particlars of Chemicals*		*Concentration by weight per cent*
1.	Dialdrin emulsifiable concentrates	(IS : 105401962)	0.50
2.	Aldrin emulsifiable concentrates	(IS : 1307-1958)	0.50
3.	Reptachlor emulsifiable concentrates	(IS : 6439-1972)	0.50
4.	Chlordance emulsifiable concentrates	(IS : 2682-1966)	1.00

201.9.3. *Site Preparation* :

201.9.3.1. All stumps, logs and roots shall be removed from the building site. Sub-floor arears shall be kept free from all debris.

201.9.3.2. On clays and other heavy soils where penetration is likely to be slow and on sloping sites where run off of the treating solution is likely to occur, the surface of the soil shall be scarified to a depth of at least 75 mm.

201.9.3.3. On loose, sandy or porous soils where loss of treating solution through excessive percolation is likely to occur, preliminary moistening of the soil shall be restored to.

201.9.3.4. All concrete from work, levelling pegs, timber off-cuts and other builder's debris shall be removed from the area to be treated.

201.9.4. *Treatment* :

201.9.4.1. Any of the chemical emulsions listed in Table 201-A shall be applied uniformly and at the prescribed rate at the various stages of the treatment. A watering can or a suitable sprayer shall be used to secure uniform distribution of the chemical over the whole area.

201.9.4.2. The chemical barrier shall be complete and continuous under the whole of the structure to be protected.

201.9.4.3. Soil treatment shall be started when the foundation excavations are ready for laying foundations. Laying of the foundation shall start when the chemical emulsion has been absorbed by the soil and the surface is quite dry.

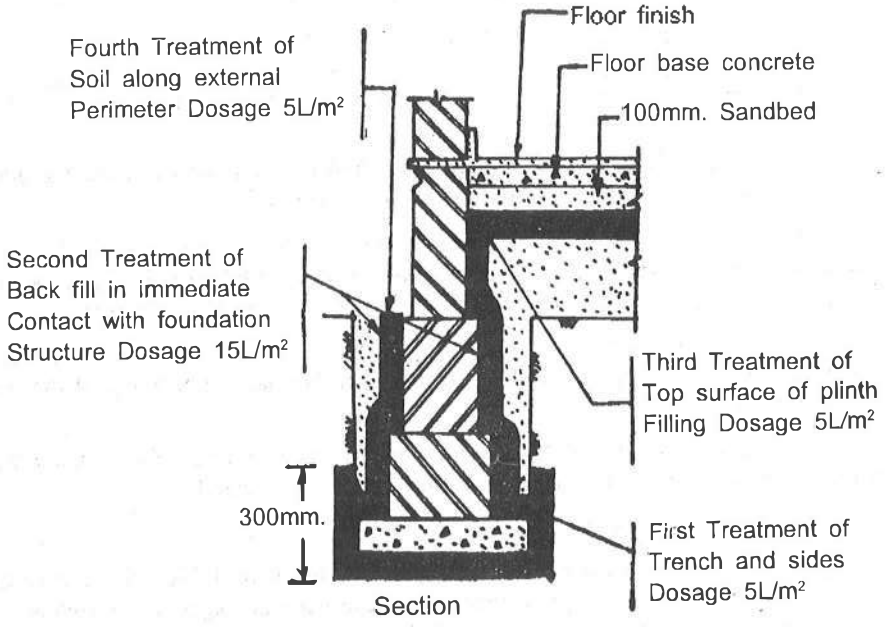
201.9.4.4. Treatment shall not be carried out when it is raining or when the soil is water-logged. In the event of water-logging the water shall be pumped out and the chemical emulsion applied when the soil is rendered absorbent.

201.9.4.5. Once formed, treated soil barriers shall not be disturbed, if disturbed by chance immediate steps shall be taken to restore continuity.

201.9.4.6. If termite mounds are found within the plinth area these shall be broken open and any one of the emulsions listed in Table 201-A, in half the concentration shown therein shall be poured into these mounds at the rate of about 4 litres/m^3 of the mound volume.

201.9.4.7. Details of the treatment of foundation and basement excavations and backfills together with the disease of the emulsions to be applied are given in Figs. 201-1, 201-2 and 201-3. Treatment of the backfill shall proceed layer by layer as laid. Care shall be taken to ensure adequate treatment of the soil in immediate contact with the vertical masonry surfaces. Where necessary shallow holes or trenches shall be made in the fill along the vertical faces and the chemical emulsion applied through them to thoroughly soak the soil.

TREATMENT FOR LOAD BEARING WALLED STRUCTURE



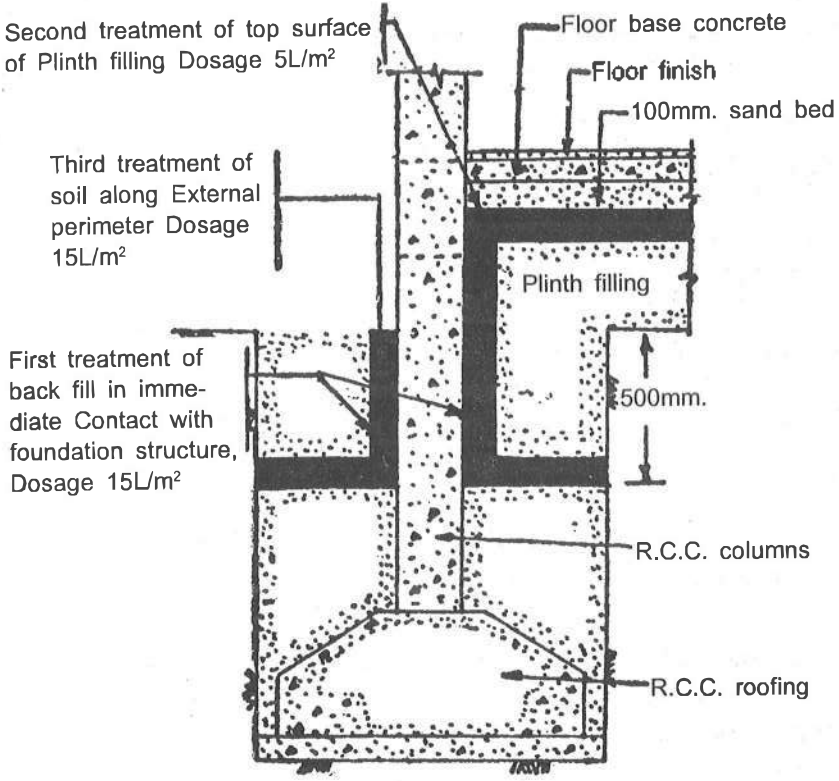
[Fig. 201.2]

201.9.4.8. The soil around pipes, conduits and under expansion joints shall be treated carefully.

201.9.4.9. After the building is complete, holes shall be made with a steel rod to a depth of 300mm. and at intervals of about 150mm. in the soil along the

external perimeter of the building and these holes filled with the chemical emulsion at the rate of 15 litres/m^2 of the perimeter wall.

TREATMENT FOR R.C. FRAMED STRUCTURE WITH COLUMNS AND PLINTH BEAMS



[Fig. 201.3]

201.9.5. *Safety Precautions* :

201.9.5.1. All the chemical concentrates specified are poisonous and hazardous to health, when absorbed through the skin, inhaled as vapour or swallowed. Prolonged exposure to dilute emulsions shall also be avoided. Workers shall wear clean clothing and shall wash thoroughly with soap and water specially before eating or smoking. In the event of severe contamination, clothing shall be removed at once and the skin washed with soap and water. If the chemicals splash into the eyes they shall be flushed with plenty of water and immediate medical assistance given. In case of poisoning suitable remedial measures shall be taken in accordance with IS : 4015-Part-I-1967 and IS : 4015-Part-II-1967.

201.9.5.2. All containers of the chemical concentrates shall be clearly labelled, securely closed and carefully stored, out of reach of children and domestic animals.

201.9.5.3. The chemical concentrates are oil solutions and present a fire hazard. Open flames shall not be allowed during mixture.

201.9.5.4. Care shall be taken in the application of these chemicals to see that they are not allowed to contaminate wells or springs which serve as sources of drinking water.

201.10. Measurement :—All linear measurements shall be in metres, correct to 0.01 of a metre. All areas shall be worked out in square metres, correct to 0.01 of a square metre. All volumes shall be worked out in cubic metres, correct to 0.01 of a cubic metre.

201.11. Rate :

201.11.1. The unit rate shall be per 10 square metres. Cutting and uprooting of trees having girth of 500mm. and above as measured one metre above ground level shall however be paid for separately.

201.11.2. Big boulders of more than 300mm. diameter in any direction and rocks removed by breaking, burning or blasting shall be paid for separately per cum. When pre-measurements are not directly possible the quantities may be arrived at by measuring the compactly formed stacks of the removed stones, duly deducting 40% of the volume to allow for the voids.

201.11.3. Anti-termite treatment shall be paid for separately.

Specification No. 202

Dismantling of Buildings and Other Structures

202.1. The buildings or other structures defined in the schedule and handed over shall be dismantled down to ground level or to bottom of foundations as may be specified in the schedule.

202.2. Precautions :

202.2.1. Necessary propping, shoring and underpinning shall be provided for the safety of the adjoining work or property, which is to be left intact, before dismantling is taken up and the work shall be carried out in such a way that no damage is caused to the adjoining work or property.

202.2.2. Wherever required temporary enclosures or partitions shall also be provided.

202.2.3. Necessary precautions shall be taken to keep the dust nuisance down as and where necessary.

202.2.4. Dismantling shall be commenced in a systematic manner. All materials which are likely to be damaged by dropping from roofs, walls etc., shall be carefully dismantled first. The dismantled articles shall be passed by hand where necessary lower to the ground and not thrown.

202.2.5. Where fixing is done by nails, screws, bolts, rivets, etc., dismantling shall be done by taking out the fixtures with proper tools and not by treating or ripping off.

202.2.6. All materials obtained from dismantling shall be the property of the Government. Any serviceable materials obtained during dismantling shall be separated out and stacked or stored properly as directed by the Executive Engineer. All unserviceable materials, rubbish, etc., shall be disposed off as directed by the Executive Engineer.

202.3. In case of damage, the responsibility for making good of such a damage shall solely rest with the contractor, alternatively, the value of materials broken or damaged shall be recovered from the contractor.

202.4. All necessary precautions shall be taken to safeguard all human life etc., and in case of accidents the contractor shall be solely responsible for all compensation claims arising under the relevant State or Central Acts.

202.5. All work shall be measured before the dismantling is started.

202.6. Unless otherwise specified, the measurements and units for payment shall be the same as those adopted for the construction.

Specification No. 203

Blasting

203.1. Scope :—This specification lays down the requirements for blasting and related drilling operations in locations other than mines.

203.2. Terminology :—

203.2.1. *Blasting cap* :—A shell closed at one end and containing a charge of detonating compound which is ignited from a spark.

203.2.2. *Detonator* :—The term shall include igniters, blasting caps, electric blasting caps or other similar devices used to explode commercial explosives.

203.2.3. *Electric blasting Caps* :—A shell containing a charge of detonating compound which is ignited by an electric current from two projecting insulated leg wires.

203.2.4. *Explosive* :—Any mixture or chemical compound which is capable of producing an explosion by its own energy like black powder, dynamite, nitroglycerine compounds and fulminate.

203.2.5. *Magazine* :— Any building or other structure used for the storage of explosives.

203.2.6. *Missed hole* :— A drilled hole containing an explosive charge that failed to explode.

203.2.7. *Permanent blasting wires* :—Those wires between the firing switches, for use in blasting, where the power source is an electric circuit.

203.2.8. *Primer* :—A explosive catridge with a detonator or ingiting agent inserted therein.

203.2.9. *Safety fuse* :—A medium manufactured especially for firing explosive charges, that conveys a flame at a uniform rate.

203.2.10. *Stemming* :—Material used for confining a charge of explosives in a hole or to cover explosives in mudcapping.

203.3. General :

203.3.1. Blasting operations, when considered necessary shall be resorted to only with the written permission of the Executive Engineer. Prior inspection shall be carried out for the safety and stability of the public and property. Blasting operations in the proximity of over head power lines, communication lines, utility lines or other structures shall not be carried on until the operator or the owner or both of such lines have been notified and precautionary measures deemed necessary have been taken.

203.3.2. All the relevant Central, State and Local Laws and Rules and Regulations, if any, framed thereunder passing to the acquisition, transport, storage, handling and use of explosives shall be strictly complied with. The provisions detailed herein are supplementary to the above laws, Rules and Regulations, etc., and are applicable except where they conflict with the afore-mentioned laws, etc., from time to time. Further the Executive Engineer may issue modifications, alterations and new instructions from time to time.

203.3.3. Trained workmen who are thoroughly acquainted with the details of handling explosives and blasting operations shall be employed by the Blasting Contractor. The blasting operations shall be supervised by a competent and experienced supervisor of the contractor.

203.3.4. Blasting in unrestricted areas shall be carried out during fixed hours every day or on fixed days in the week. This information shall be amply publicized and the following precautions observed.

(a) On the project-sites, where regular blasting operations are carried out, daily blasting hours shall be clearly painted on the sign boards on all the roads approaching in that area.

(b) Road closing barriers shall be provided to close the traffic on these roads, at least 400 meters away from where the firing is to take place.

(c) Red flags shall be prominently displayed 200 metres away all around the area to be blasted and proper precautions for safety of persons taken by clearing all the persons from the flagged area at least 10 minutes before firing.

(d) A loud warning siren or bugle shall precede the beginning of the firing. Completion of the firing shall be followed by loud all-clear sirens or bugle. The warning and all-clear signals shall be clearly distinguishable and the workmen shall be thoroughly made familiar with these signals.

203.3.5. The contractor shall be responsible for the safe custody and proper accounting of the explosive materials. The Executive Engineer shall have access to check the Contractor's store of explosive and his accounts. In case of any accountable shortage or unsatisfactory account, the contractor shall be liable for penal action.

203.3.6. No explosives shall be abandoned. They shall be disposed off or destroyed strictly in accordance with the approved methods. The contractor shall

be solely responsible for damages to property and any accidents which may occur to workmen or any other persons due to any or all the operations connected with storing and handling or use of explosives and blasting.

203.4. Materials, tools and equipment :—The black powder explosives, detonators, fuses, tamping materials, electrical firing equipment is used, tools for drilling holes and tamping shall be subject to the approval of the Executive Engineer. The Executive Engineer may specify the type of explosives to be allowed in special cases. The fuse to be used in wet locations shall be sufficiently water resistant as to be unaffected when immersed in water for 30 minutes. The rates of burning of the fuse be uniform and definitely known to permit such a safe length being cut as will permit sufficient time to the firer to reach a place of safety before explosion takes place. It shall not be more than 600mm. per minute. The length of a fuse shall not be less than 1200mm. Detonators shall be capable of giving effective blasting of the explosives. The blasting powder, explosives, detonators, fuses, etc., shall be fresh and not damaged due to dampness, moisture or any other cause. They shall be inspected before use and the damaged articles discarded totally and removed immediately.

203.5. Procurement :—All blasting materials shall be procured only from standard firms or licensed dealers.

203.6. Transportation :

203.6.1. In cases where explosives are required to be transported and stored at site, relevant clauses of Explosives Rules, 1940 or as amended subsequently shall be complied with.

203.6.2. Where the magazines are located near the construction site and blasting operations continue daily, actual requirements of explosives shall be drawn from the magazine and transported to the site. Any left-overs shall be returned to the magazine each time after the blast. In case of work at scattered places and for a small duration portable magazines shall be used and kept within a fence in a safe place and properly guarded. Detonators and other explosives for blasting shall be transported to site of work in original containers or in separate securely locked non-metallic containers and shall not be carried loose or mixed with other materials.

203.6.3. For carrying a small quantity (approximately 5 kg. of explosives) specially designed insulated containers may be used. These containers shall be constructed of finished wood not less than 50mm. thick or plastic not less than 6mm. thick or pressed fibre not less than 10mm. thick. There shall be not metal parts (not even nails, bolts, screws, etc.) and the container shall be water proof and provided with a lid. The container shall be provided with a suitable non-conductive carrying device, such as rubber, leather or canvas handle or strap.

203.6.4. Vehicles to be used for transporting explosives shall be in good working condition and shall have a tight wooden or non-sparking metal (copper, brass and the like) floor, with sides and ends high enough to prevent the explosive from falling of the vehicle. In open-bodied vehicles, the explosives shall be covered with a water proof and fire-resistant tarpaulin. Electrical wiring in vehicles shall be fully insulated so as to prevent the chances of short circuiting and at least two

fire extinguishers of Carbon tetrachloride type shall be carried. The vehicle shall be properly, marked so as to give adequate warning to the public in regard to the nature of cargo. No metals except approved metal truck bodies shall be allowed to come in contact with cases of explosives.

203.6.5. Loading and unloading of explosives shall be done carefully.

203.6.6. Explosive and detonators or blasting caps shall not be permitted to be transported in the same vehicle. Metal flammable or corrosive substances shall not be transported with explosives. As far as possible transportation of any other material with explosives shall be prohibited.

203.6.7. No unauthorised persons shall be allowed in the vehicle carrying explosives.

203.6.8. Smoking shall be prohibited in the vehicle carrying explosive.

203.7. Storage :

203.7.1. Storage of explosives is regulated by the Indian Explosives Act and provisions there under shall be strictly observed. The magazine for storage of explosives shall be built to the designs and specifications of the Explosives Department and located at the approved site.

203.7.2. Explosives shall be stored only in a magazine which is clean, dry, well-ventilated, reasonably cool, correct located, substantially constructed, bullet and fire resistant and securely locked.

203.7.3. Precautions against lightning shall be provided in accordance with the Indian Electricity Act and the Indian Explosives Act.

203.7.4. The following shall be hung in the lobby of the magazine :

(a) A copy of rules both in English and in the language with which the workers concerned are familiar.

(b) A statement of up-to-date stock in the Magazine.

(c) A certificate showing the last date of testing of the lightning conductor.

(d) A notice that smoking is strictly prohibited.

203.7.5. Blasting caps, electric blasting caps or primers shall not be stored in the same box, container or room with other explosives.

203.7.6. Explosives, fuse or fuse lighter shall not be stored in a damp or wet place or near oil, gasoline, cleaning solutions or solvents or near radiators, steam pipes or other sources of heat.

203.7.7. No sparking metal or sparking metal tools shall be stored in an explosives magazine. Persons entering the magazine shall put on magazine shoes, which shall be provided at the magazine for the purpose.

203.7.8. Smoking shall not be permitted with in the fencing around the explosive magazine, nor matches, open lights or other fire or flame shall be allowed near the magazine. Warning notices to this effect shall be displayed at conspicuous places.

203.7.9. Oily cotton rag waste, and articles liable to spontaneous ignition shall not be allowed inside the magazine.

203.7.10. If nitroglycerine from deteriorated explosives has leaked down on the floor of the explosives magazine, the floor shall be desensitized by washing thoroughly with an agent obtained before hand from the supplier of the explosives. For this purpose, desensitizing agents and the instructions for using them shall always be obtained along with the supply of nitroglycerine.

203.7.11. No leaves, grass, brush or debris of any kind shall be allowed to accumulate with 8m. of an explosives magazine.

203.7.12. The magazine shall on no account be opened during a thunderstorm or when one is expected and no person shall remain in the vicinity of the magazine during such periods.

203.8. Handling :

203.8.1. Any package containing explosives shall not be dragged, dropped or handled roughly. The explosives packages shall be opened only at a safe distance and properly shielded from the packages of explosives in build storage.

203.8.2. Sparking metal tools shall not be used to open wooden or fibre board cases of explosives.

203.8.3. The covers of the explosive cases or packages shall be replaced every time soon after taking out part of the contents as long as any explosives are left in them.

203.8.4. Explosives shall not be placed where they may be exposed to flame, excessive heat, sparks or impact.

203.8.5. Smoking shall not be permitted nor matches, open lights, fire, flame or any other device capable of producing sparks or flame shall be carried while handling or using explosives.

203.8.6. Explosives shall not be carried in the pockets by any person.

203.8.7. No person shall handle, use or be near explosives during the approach or progress of a thunderstorm. All persons shall retire to a place of safety.

203.8.8. Children and unauthorised or unnecessary persons shall not be present where explosives are being handled or used.

203.8.9. Nothing shall be inserted in the open end of blasting cap except fuses.

203.8.10. No persons shall strike, tamper with or attempt to remove or investigate the contents of a blasting cap or an electric blasting cap or attempt to pull out the crimped safety fuse out of a blasting cap.

203.8.11. Primers shall not be madeup in a magazine or near excessive quantity of explosiveness or in excess of immediate needs.

203.8.12. No attempt shall be made to reclaim or use fuses, blasting caps or electric blasting caps or any other explosives which may have been water soaked even if they have been dried out. The manufacturer shall be consulted.

203.8.13. No attempt shall be made to soften hard-set explosives by heating over a fire or by rolling the explosives on the ground.

203.8.14. Deteriorated or damaged explosives or blasting equipment shall not be used, but shall be disposed and destroyed as per approved methods.

203.9. Drilling :—

203.9.1. Before planning the drilling operations for blasting purposes, nature of startum and the over burden shall necessarily be examined to avoid possibilities of land slides after blasting.

203.9.2. The face of rock shall be carefully examined before drilling to determine the possible presence of unfired explosives. No attempt shall be made to drill at a site if undetonated explosives are suspected.

203.9.3. The position of all holes to be drilled shall be marked out with circles in white paint. The bore holes shall be jumped or drilled in the rock face. A bore hole near another hole loaded with explosives shall be sprung.

203.9.4. The charge holes shall be drilled to required depths in suitable places. The bore holes shall be carefully checked for length, presence of water, dust, etc., with a wooden tamping pole or a measuring tape before loading.

203.9.5. A bore hole shall not be loaded with explosives after springing (enlarging the hole with explosives) or upon completion of drilling without making sure that it is cool and that it does not contain any hot metal, burning or smouldering material. Temperatures in excess of 65°C are dangerous.

203.9.6. Surplus explosives shall not be stacked near working areas during loading.

203.9.7. No loose materials such as tools, drilling implements, etc., shall be left on the rock surfaces to be blasted.

203.10. Loading :

203.10.1. *Loading with black powder* :—Blasting shall normally be done with black powder. When blasting is done with powder, the fuse cut to the required length shall be inserted into the hole and the powder dropped in. The powder shall be gently tamped with wooden or copper rods with rounded ends. The powder shall then be covered with tamping material (clay) which shall be tamped lightly but firmly.

203.10.2. *Loading with high explosives* :

203.10.2.1. High explosives shall only be used in special cases with the written permission of the Executive Engineer. When blasting is done with dynamite and other high explosives, dynamite cartridges are prepared by inserting the required cut end of a fuse into detonator and finishing it with nippers at the open end. The detonators shall be gently pushed into the primer leaving one-third of the copper tube exposed outside. No force shall be used for inserting a blasting cap or an electric blasting cap into the explosives. The cap shall be inserted in a hole made with a pricker designed for the purpose. A hitch of the electric blasting cap leading wire shall be made on the primer cartridge so as to prevent pulling out of the electric

blasting cap from the explosive charge. The paper of the cartridge is then closed up and securely bound with wire or twine. The primer shall be housed into the explosive. Bore holes shall be of such size that the cartridge can easily pass down. The holes shall be cleared of all debris and the explosive inserted. No force shall be used for inserting cartridges or any explosives into a bore hole or passing any obstruction in a bore hole. The space for above 200mm. the charge is then gently filled with dry clay pressed home and the rest of tamping is formed of any convenient material gently packed with a wooden rammer. The primer cartridge shall be on the top. Care shall be taken so that the electric blasting cap leading wire or the length of the fuse does not get damaged during loading of the charge.

203.10.2.2. Explosive cartridge shall not be cut nor explosive removed from the cartridge for use.

203.10.2.3. No attempt shall be made to slit, drop, deform or abuse the primer.

203.10.2.4. Blasting caps or electric blasting caps shall not be connected to detonating fuses except by methods recommended by the manufacturers of caps.

203.10.2.5. Kinking or injuring of fuse or electric blasting cap wires shall be avoided, when tamping.

203.10.2.6. Metallic devices of any kind shall not be used in tampering. Wooden tamping tools with no exposed metal parts except non-sparking metal connectors for jointed poles shall be used. Violent tamping shall be avoided. Primer shall not be tamped.

203.10.2.7. Care shall be taken to confine the explosiveness in the bore hole with sand, earth, clay or other suitable stemming material.

203.11. Firing :—

203.11.1. *General* :—Firing may be done either with safety fuses or by electrical ignition. The blasting site shall not be approached within 5 minutes of firing to permit toxic gases to disperse. After the blast the contractor's Supervisor shall inspect the work and satisfy himself that all the charged holes have been exploded before workmen are permitted to approach the site. All holes loaded in a shift shall be fired in the same shift.

203.11.2. *Firing with safety fuse* :—The number of holes to be loaded and fired at one time shall in no case be more than the limit fixed by the Executive Engineer. The safety fuses of the charged holes shall be ignited in the presence of a competent and experienced Supervisor of the contractor who shall see that all the fuses are properly ignited. The firer after igniting the fuses shall run to a place of safety which is generally dictated by the burning time of the fuses. Utmost care shall be taken to count the number of loud reports to ensure that all the shorts have fired.

203.11.3. **Electrical firing** :

203.11.3.1. Only the Supervisor incharge shall possess the key of the firing apparatus and he shall keep it always himself.

203.11.3.2. Special apparatus shall be used as a source of current for the blasting operations. Power lines shall not be tapped for the purpose.

203.11.3.3. The detonators shall be checked before use.

203.11.3.4. For blasts in series, only detonators of the same manufacture and of the same group of electrical resistance shall be used.

203.11.3.5. Such of the electrical lines as could constitute danger for the work of changing shall be removed from the site. The firing cable shall have a proper insulating cover so as to avoid short circuit due to contact with water, metallic parts or rock.

203.11.3.6. The use of earth as a return line shall not be permitted.

203.11.3.7. The firing cable shall be connected to the source of current only when no-body is in the area of blasting.

203.11.3.8. Before firing, the circuit shall be checked by a suitable apparatus.

203.11.3.9. After firing whether with or without an actual blast the contact between the firing cable and the source of current shall be cut off before any people are allowed to leave the shelters.

203.11.4. During storms charging with electrical detonators shall be suspended. The charges already placed in the holes shall be blasted as quickly as possible, but taking all the safety precautions and giving necessary warning signals. If this is not possible, the site shall be abandoned till the storm has passed.

203.12. Misfired Holes :

203.12.1. In the event of misfire, the holes shall be approached with great care by the blasting Supervisor. When a safety fuse is used, no person shall be allowed to approach the misfired hole for atleast 30 minutes. In any case, a careful inspection for any remains of undetonated explosives shall be made after firing the shots. All misfired short holes shall be cross marked with red paint. No other person than those duly authorised shall approach the holes and one of the following operations shall be performed in respect of each of the misfired holes.

(a) If the misfire is due to a faulty cable or faulty electrical connection, the defect shall be remedied and the shot fired.

(b) The stemming shall be floated out by use of water or air jet from a hole until the hole has been opened to within 600mm. of the charge of half the depth of the stemming, where upon water shall be syphoned or pumped out and then a fresh (new) charge placed carefully.

(c) A new hole shall be drilled 600mm. away from the old bore and parallel to it and about 300mm. less in depth and the new hole charged and duly fired. The missed hole shall also explode along with the new one.

203.12.2. A careful search shall be made of unexploded material in the debris of the second charge.

203.12.3. Before leaving the work the blasting Supervisor of the Contractor of one shift shall inform in writing the blasting Supervisor of the contractor of the

next shift of any cases of misfire and shall point out the holes denoted by red cross and also state the action, if any, to be taken in the matter.

203.13. Measurement :—This shall conform to clause 201.10.

Pre-measurements shall be taken and got check measured before blasting operations are started. When pre-measurements are not directly possible, the quantities may be arrived at by measuring compactly formed stacks of blasted rock or boulders duly deducting 40% or higher percentage towards boids as may be directed by the Executive Engineer.

203.14. Rate :—The unit rate shall be per cu.m.

SECTION 3

STANDARD SPECIFICATIONS FOR EARTH WORK

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Specification No. 301

Excavation and Forming Uncompacted Banks

3.1. Scope :—This specification applies to excavation of canals, drains, etc., wh the excavated soil need not be formed or laid into uniform layers and also wh breaking clods, ramming and neat sectioning of the bank are not required.

3.2. Excavation :

3.2.1. Drain or canal sections shall be excavated as specified or as directed the Executive Engineer. Both the inner edges of the bank shall be neatly aid symetrically to the centre line of the channel. They shall as far as possible be straig in straight reaches and smoothly curved on bends. All gangways, pathways d landings shall be such that they fall within the canal section so that final dresg of slope shall consist of cutting only and not filling.

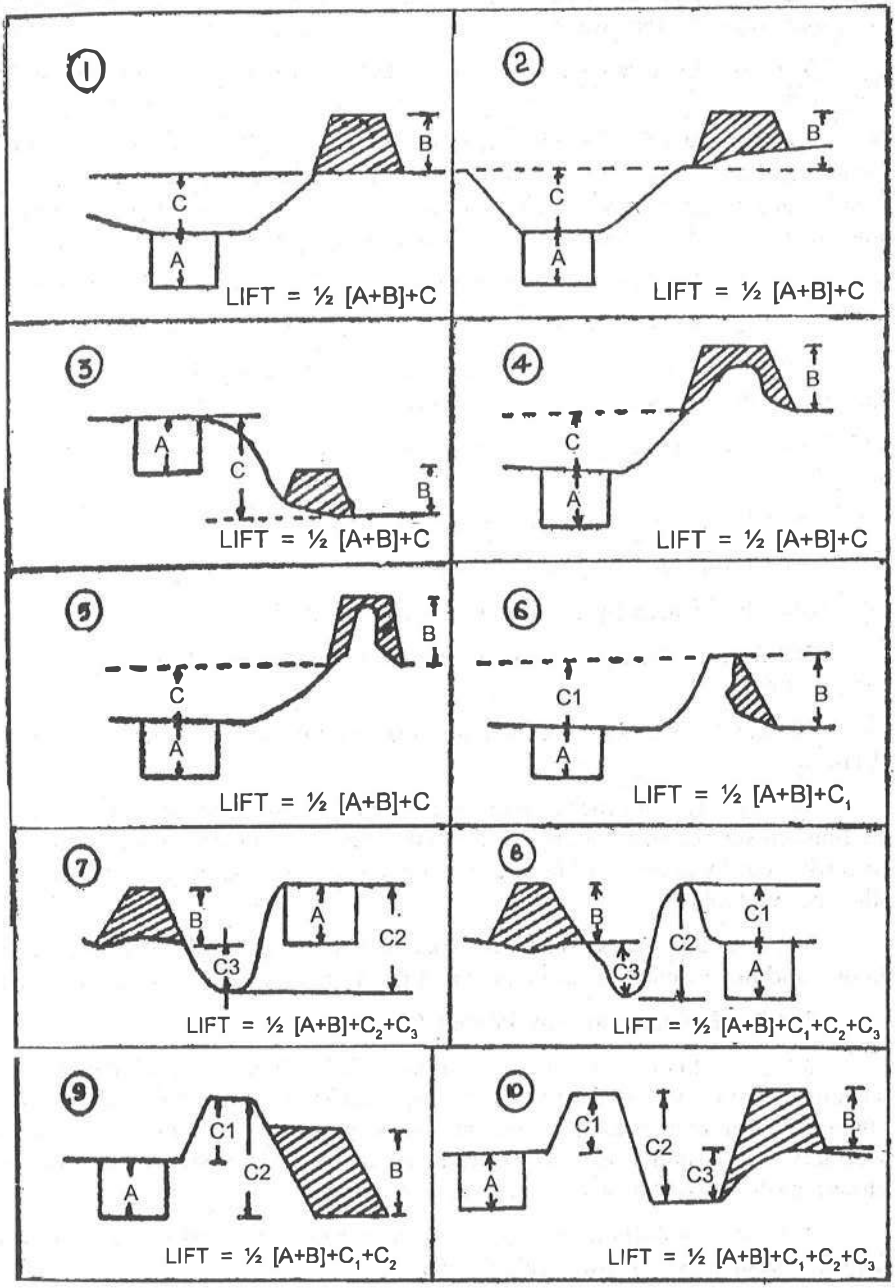
301.2. Suitable arrangements shall be provided to divert surface drainage clear of th excavation during the work. Sump pits may be excavated at suitable place and h water thus collected may be pumped out or let into a nearby valley.

301.3. In case ground water table is met during excavation adequate meaures shl be taken for dewatering. The method adopted to dewater depends

upon the type of sub-soil strata met with and the quantity of ground to be removed to keep the sub-soil water table below the level of the excavation.

All Dimensions in Metres

[Fig. 301.1. 1 to 10]



301.2.4. If there is a continuous spring of water a sub-drain with sumps at intervals may be provided. Excavation shall be done from down-stream side to up-stream side so as to facilitate easy drainage to the nearest natural drainage course.

301.2.5. In case of canals to be lined sub-soil water shall not be allowed to accumulate in the canal bed and the dewatering arrangements shall be so organised as to deal with the rain water also.

301.2.6. Excavation may be carried out by manual labour or by suitable machinery.

301.2.7. While excavating in rocky strata above the lining in case of lined sections and above the F.S.L. in case of unlined sections, the rock may be allowed to stand at the slope shown in the relevant drawings and no finishing is required other than removal of rock masses which are loose and are liable to fall.

301.2.8. Boulders which may interfere with the work shall be removed.

301.2.9. *Rock Excavation* :

301.2.9.1. Rock excavation shall be carried out by any of the following methods as may be specified by the Executive Engineer.

(a) Excavation by hand with suitable rock wedges, hammers, steel bars, picks, etc. ;

(b) Excavation by pneumatic or other power tools ;

(c) Excavation by blasting; and

(d) Excavation by any other approved method.

301.2.9.2. During rock excavation over hangs or unsafe slopers shall not be permitted.

301.2.9.3. Blasting when required shall be done in accordance with SS 203 "Blasting".

301.2.9.3.1. In order to minimise over break and loosening of material at the finished surface final cutting for the last 450mm. to 600mm. in hard rock shall be carried out by controller blasting or trimming or with the help of pneumatic or other power tools.

301.2.9.3.2. Unless otherwise specified the over break shall not exceed 75mm. and the estimates shall be prepared taking into account this over breakage.

301.3. Forming unconsolidated Banks :

301.3.1. Spoil from the excavation shall be deposited on banks to such sections as are shown on the relevant plans, specified or ordered by the Executive Engineer. Ramming, breaking clods and smooth surface sectioning shall not be necessary but a spoil bank with a neatly aligned toe, even slopes and even top surface shall be formed as the depositing proceeds.

301.3.2. Deduction from the earthwork rate as decided by the Executive Engineer shall be made for careless deposition.

301.4. Measurement :—All linear measurement shall be in metres correct to 0.01 of a metre and volumes worked out in cubic metre correct to 0.01 of a cubic metre.

301.4.1. All original works shall be measured by levels, except for foundations for buildings and trenches for pipe lines, etc., for which the quantities shall be worked out by pit measurements.

301.4.2. Repair works such as slit clearance in canals and distributaries, raising of the standards of tanks, canals and distributaries and widening of road formations and any other works as may be directed by the Executive Engineer shall be measured by levels.

301.4.3. Earthwork for repair works such as filling up of gullies and pot holes and making up of berms of roads and any other works as directed by the Executive Engineer shall be calculated by pit measurements.

301.4.4. Earthwork for emergent repair works such as forming of ring bunds for restoring the breached portions of tanks, canals and distributaries, etc., and for closing breaches on roads shall be calculated by pit measurements.

301.4.5. Where pit measurements are taken they shall be checked with the help of thandoos which shall be left for the purpose and maintained until the check-measurements of the work are completed. Wherever pit measurements are taken deductions shall be duly made for boulders, vegetation, thandoos which are not made use of and for losses of earth in transit.

301.4.6. The mode of taking measurements and making payments, that is, whether by levels or by pit measurements shall be incorporated in the tender schedules and the agreement bonds.

301.4.7. Where payments are made with reference to levels, the L.F. Books, the section sheets (in which the levels are plotted) and the calculation sheets shall be treated as adjuncts to the measurement books.

301.4.8. For embankment works which are to be paid, based on levels the rate shall be worked out taking into account the field density, the proctor's density and shrinkage, etc.

301.4.9. Wherever soils harder than those contemplated in the original sanctioned estimate are met with during actual execution in excavation works on account of which excess over the original sanctioned estimate is involved, the levels shall be test-checked by the Executive Engineer.

301.5. Rate :

301.5.1. The unit rate shall be per 10 cubic metres and shall include the initial rate for excavating, dressing, bed and sides to exact sections of working plans, conveyance and depositing to the requirements of this specification, inclusive of 10 metres of initial lead and 2 metres of initial lift, providing and forming model sections, lock spittings, strings and stakes as may be considered necessary by the Executive Engineer to guide the contractor in excavating in depositing. Extra leads

and lifts shall be paid for separately when the material is conveyed by head loads. When conveyance charges are paid for transporting the material, no separate charge for extra leads and lifts shall be paid.

301.5.1.1. *Leads and Lifts* :

(i) "*Lead*" is the horizontal distance between the central line of the pit cross section and the central line of the bank which is formed with the excavated earthy. "Earth lead" by head-load will be the "lead" as above defined less an initial lead of ten metres. For every extra lead of ten metres or part thereof payment will be made at the contact schedule rate.

(ii) "*Lift*" is the vertical distance obtained by adding up, A, B and C where :

(A) = half the depth of pit actually excavated ;

(B) = half the maximum height of the bank formed with the excavated earth over existing ground or bank; and

(C) = the difference between the top level of pit actually excavated and the level above which the bank is formed.

Figures 301-1 1 to 10 illustrate the method to calculate the value of C in different circumstances (on page 177).

"Extra lift" by head load will be the sum of A, B and C as above defined less an initial lift of two metres. For every "extra lift" of one metre or part thereof payment will be made at the contract schedule rate.

301.5.2. In case of rock the rate shall be per cubic metre. The rate shall include the permissible over breakage of 75 mm. When measurement is not directly possible from the sections, it may be arrived at by measuring compactly formed stacks of the excavated rock. Deduction of 40 percent or higher percentage as may be directed by the Executive Engineer shall be made to allow for the voids.

301.5.3. Excavation in earthwork beyond the sections shown on the plans shall not be measured for payment. In the case of rock-excavation also the overbreakage of 75mm. referred to clause 301.5.2 shall not be measured for payment and therefore the contractor while quoting his rate for rock excavation has to take into account the permissible over breakage of 75mm.

301.5.4. *Dewatering* :—Unless specially provided for as a separate item in the contracts, the excavation rate shall include baling or pumping out all water which may accumulate in the excavation during the progress of the work either from seepage, springs or rain and divertion of surface flows if any by bunding or other means.

Specification No. 302

Embankments Compacted by other than Power Driven Equipment

302.1. Scope :—This specification applies to low embankments of canals and drains, flood banks, tank bunds and road embankments including reforming of breached embankments, etc., which have to be compacted by methods other than power driven equipment.

302.2. Selection and Demarcation of borrow area :—This shall conform to clause 303.2.

302.3. Borrowing of soils :—This shall conform to clause 303.3.

302.4. Forming embankments :—This shall conform to clause 303.6 except that instead of using power driven rollers, ordinary rollers drawn either by bullocks or by manual labour and or including tamping with wooden and iron rammers, shall be adopted for compaction. Thickness of layers shall not exceed 150mm. before compaction. Layer shall be compacted to atleast 90% proctor's density unless otherwise specified. Any loose soil shall be removed by trimming and bringing the embankment to the required section.

302.5. Tests :—This shall conform to clause 303.8.

302.6. Measurement :—This shall conform to clause 303.9.

302.7. Rate :—This shall conform to clause 303.10.

Specification No. 303

Embankments Compacted by Power Driven Equipment

303.1. Scope :—This specification applies to earthdams, embankments to canals and drains, flood banks, tank bunds and road embankments including reforming or breached embankments etc., when compacted with power driven equipment.

303.2. Selection and Demarcation of Borrow Areas :

303.2.1. *Investigation* :

303.2.1.1. *Trial pits* :—To ascertain the suitability of soils for embankment purposes, soil samples shall be taken by excavating trial pits not only in the borrow area at specified locations so as to cover the whole area; but also from soils got from foundations, or any other excavations. Generally the dimensions of the trial pits shall be one metre by one metre upto about 1½ metres depth and for deeper pits proper slopes shall be given (so that the soil may not slip in) either by excavating in steps or by excavating in slopes. The bottom section of the pit shall not be more than one metre by one metre.

In soils where the pit walls do not safely stand by themselves, shoring, strutting or cribbing etc., shall be resorted to. The excavated earth from the trial pits shall be thrown at a minimum distance of 2 metres from the top edge.

303.2.1.2. *Sampling* :—Representative soil samples in required quantities shall be collected from the trial pits and shall be clearly identified by the trial pit number and the levels at which the samples are taken. Undisturbed samples where required shall be collected in accordance with the procedure laid down in IS : 2132-1972 "Code of Practice for thin walled tube sampling of soils".

303.2.1.3. *Testing & Selection of suitable soils* :—The soil samples collected as above shall be tested in accordance with the relevant Indian Standards for the following properties to assess their suitability for embankments :

(a) Grain size analysis.

(b) Aterburg's limits.

(c) Shrinkage limit.

(d) Optimum Moisture content.

(e) Proctor's density.

(f) Shear strength at optimum moisture content and 100% saturation.

(g) Permeability at Proctor's Density.

Additional tests shall be conducted where so required.

303.2.2. *Demarcation of selected borrow areas* :—The whole area used for borrowing soils shall be clearly demarcated by means of pegs or boundary stones.

303.2.3. *Private land* :— The contractor shall not enter on patta or private lands to excavate pits until formal arrangements have been made with the patta-holder or owner either directly by the Public Works Department or through the Revenue Department. In these cases the contractor shall be instructed regarding the maximum depth of pits to be excavated. The rate to be paid for such earth shall be settled in writing with the owner in consultation with the revenue authorities. Unless otherwise specified, the cost of such earth shall be paid for by Government and shall not be included by the contractor in his earthwork unit rate. Contractors shall be personally responsible for all damage that they may cause to private property in the execution of their work.

303.3. Borrowing of Soils :

303.3.1. When sufficient quantities of soils are not available in the demarcated borrow areas they shall be borrowed from elsewhere. In this case the selection of new borrow areas shall be done on the same principles as for the original borrow areas.

303.3.2. *Borrow Pits* :

303.3.2.1. The borrow pits shall not normally be more than 25m. in length, 10m. in width and 1½m. in depth. A clear spacing of one metre between each pit shall be left out. Each pit shall be clearly peg marked and number tags of the pits shall be maintained.

303.3.2.2. In the case of earth dams unless otherwise specified the borrow pits shall not be located within a distance of 10 times the height of the embankment on the up-stream side and two times the height of the embankment on the down-stream side.

303.3.2.3. The depth of the pits shall be so regulated that their bottom does not cut the hydraulic gradient line having a slope of 4 : 1 from the top edge of the embankment.

303.3.2.4. In no case the pits shall be located within 5m. from the toe of the embankment. If there are old pits in the borrow area the new pits shall be located one metre away from them.

303.4. Excavation :—Excavation of borrow soils shall be done either (a) by manual labour or (b) by mechanical methods using earth moving machinery.

303.4.1. *Excavation of Borrow pits by Manual Labour* :

303.4.1.1. While excavation borrow pits, ramps and steps shall be left of the easy carrying of the soils to the top.

303.4.1.2. Whenever so required thandoos of sufficient size as specified by the Executive Engineer shall be left during the excavation at regular intervals so as to permit the proper and correct measurement of the earth work excavation with reference to the ground levels before and after excavation. These thandoos shall be retained as they are until the final measurements of the work done are taken and check measured.

303.4.1.3. *Drainage* :—The bottom of the borrow pits shall be excavated level and the individual borrow pits shall be inter connected with a drain so as to drain off the accumulating rain water into the natural stream or valley course.

303.4.2. *Excavation with earth moving equipment* :—The earth moving machinery to be used shall be selected depending upon the nature of the work involved.

303.5. *Moisture control at borrow areas* :—The moisture content of the borrow soil shall be determined by laboratory tests. If the moisture content is less than the optimum moisture content for the required compaction, then the balance water requirement shall, where possible be added during excavation. If the moisture content is more than the optimum moisture content for the required compaction then the borrowed soils shall be spread over the embankment in layers of 100mm. to 250mm. thickness and allowed to dry until the moisture content comes down to the optimum moisture content.

303.6. Forming of Embankment :

303.6.1. The toes of the slopes on each side of the banks shall be lock spitted and marked at about 20m. intervals. Profiles of the slopes shall be marked at about 50m. part in straight reaches and at about 25m. apart in curves. This profile shall include suitable allowance for settlement where necessary and for trimming of loose soils from the edges after compaction of the embankment.

303.6.2. *Preparation of Sub-Grade* :

303.6.2.1. Clearing site shall confrons S.S. : 201.

303.6.2.2. *Stripping* :

303.6.2.2.1. Top soil where it contains vegetable matter, grass or shrub roots or loose unsuitable soils, etc., shall be stripped to a minimum depth of 150mm. or to a greater depth where so specified.

303.6.2.3. *Scarification* :— The surface on which the embankment is laid shall be loosened or scarified by means of a plough or ripper or any other method to the satisfaction of the Executive Engineer.

303.6.2.4. *Sloping ground* :— On sloping ground, benching shall be done with a little slope towards the inside of the benching so as to give a good grip to the embankment soil with the subgrade. Unless otherwise specified benches shall be 450mm. x 450mm.

303.6.2.5. *Exposed rock* :— Where rock is met with it shall be benched or otherwise treated as specified by the Executive Engineer.

303.6.2.6. Unless otherwise specified boulders shall be broken if necessary and removed.

303.6.3. *Junctions* :

303.6.3.1. The junctions between the old and the new embankments shall be benched to a slope of 4 : 1 to ensure proper bond.

303.6.4. *Spreading of Soils* :

303.6.4.1. No stones, cobbles having maximum dimension of more than 100mm. size shall be placed in the earth fill. All clods which can not get crushed shall be broken into smaller pieces.

303.6.4.2. *Thickness of horizontal layers* :— An earth used for embankment or cut off trenches where so provided shall be spread in horizontal layers of 100mm. to 250 mm. before compaction depending upon the type of equipment used.

303.6.4.3. *Zonal sections* :—In Zonal sections the selected and approved soils shall be spread to the required widths. All the Zones shall be tackled simultaneously and the difference in level between zone to zone shall not be more than 150 mm.

303.6.4.4. On resuming work each day or after an interval of a few days or when work is not done in continuity, the previous layer shall be well raked and water sprinkled over it before the fresh layer is laid and compacted.

303.6.5. *Moisture content* :—The moisture content in soil for embankment and for filling of cut off trenches shall be determined by tests in accordance with IS : 2720. If the moisture content is below the optimum moisture content for the given compaction, then necessary water shall be added by sprinkling and the oil shall be compacted. If the moisture content of the soil is more than the optimum moisture content then it shall be allowed to dry down to the optimum moisture content and then compacted. The moisture content shall be uniform throughout the layer of material and ploughing, disking, harrowing or other methods of mixing may be acquired of obtain uniform distribution.

303.6.6. *Compaction* :—Compaction shall be achieved by the use of smooth wheeled rollers, pneumatic type rollers, sheep's foot rollers, vibrating plates programmers, power rammers and such other equipment as shall be specified. The number of passes of different types of rollers to be used shall be determined by testing the density of the compacted soils at site after taking trial compaction for specified passes of the rollers. The number of passes shall be those at which the required compaction is achieved as determined by necessary tests for each type of soils. Rolling shall commence at edges and progress towards centre longitudinally. Each pass of the roller shall overlap not less than one third of the track width made in the preceding pass. Density tests shall be made on each compacted layer and unless otherwise specified dry density attained shall not less than 98% of the maximum dry density (standard proctor) for the type of materials used. The earth moving machinery shall not be allowed to pass over a compacted portion of the

embankment beyond a certain limit by varying the hauling routes and ramps, thus ensuring that over compaction does not take place in any particular reach.

303.6.7. *Special precautions* :—During construction a small transverse slopes from centre towards the edges shall be given and further in the reach where the earth dam is being raised, the work will be tackled in continuous horizontal layers, to avoid pools of water and concentration flow of water during rains, which will cause dangerous scours and rain gullies.

Special precautions shall also be taken while rolling the spread soil near structures, conduits, sluice barrels, filters and rock toes etc., as detailed below :

303.6.7.1. *Near Structures* :—The roller shall not operate within one metre of exterior walls of the structures. The portion of the embankment where the roller is not permitted shall be compacted to the required density by such other means as specified by the Executive Engineer.

303.6.7.2. *Around the conduits and sluice barrels* :—The earth shall be rolled evenly on both sides of the conduits, sluice barrels etc., so that there is equal pressure on the sluice or conduits from both the sides. Rolling shall be permitted over conduits and sluice barrels only after providing the specified cushion of earth over them. This cushion of earth shall be compacted to the required density by such other means as specified by the Executive Engineer.

303.6.7.3. *At junctions with embankment* :—Compaction at the junctions shall be done carefully by taking the roller well over the benched slope of the embankment. In case the whole length of the embankment is not formed simultaneously and a portion of the reach is formed, the slope of the bending surface between the previously compacted portions of the embankment and materials to be placed in each zone shall not be steeper than 4 : 1.

303.6.7.4. *In zonal sections* :—In Zonal sections the required compaction for each zone shall be achieved by regulating the number of passes of the order in the different zones in accordance with clause 303.6.6 and the level of any zone shall not exceed the level of the adjacent zone by more than 150 mm.

303.6.7.5. *In cut off trenches* :—Rolling shall be done along the cut off trench and the roller shall be taken close to the sides of the trench. In cases where the compaction by rollers is not possible, compaction to the required density shall be achieved by such other means as specified by the Executive Engineer.

303.6.7.6. *Reforming or breached embankments* :—The breach shall be cleared of all water, sand, stones, soft mud, slush, vegetable mould, trees, etc., if any found in the bed and sides of breach. The junction between old and new banks shall be joggled and stepped for proper keying and sloped towards the old embankment to prevent slipping into the breached site.

303.7. Trimming of Loose Soils after Compaction from sides and ends :— While marking out the embankment an extra provision of 600mm. shall be made on either sides so that the roller may be taken as close as possible to the extreme edges. Later the extra 600mm. width shall be neatly trimmed and the trimmed material shall be permitted for reuse in the embankment at higher elevations.

303.8. Tests :—Quality control tests shall be regularly carried out to determine the suitability of the soils used for the embankment and to control the moisture content and ensure that the density as specified in the relevant clauses has been attained. The number and frequency of such tests shall be as may be instructed by the Executive Engineer. All tests shall be done in accordance with the relevant Indian Standards.

303.9. Measurement :

303.9.1. All original works as well as repair works shall be measured as per the relevant clauses 301.4.1 to 301.4.9.

303.9.2. The works shall be done to the construction profile shown in the drawings. Wherever the work is defective and is not as per the construction profile due to any reasons, natural or otherwise, it shall be rectified by the contractor at his own cost. Any extra earth work done for the trimming of the sides and ends of the embankments as required in clause 303.6.7.6 shall not be measured separately and the unit rate for earth work shall include these operation.

303.9.3. Removal of roots extending upto 150mm. below stripping level shall not be paid for separately.

303.10. Rate :

303.10.1. The rate for the embankment shall be for each 10cu.m. of the compacted section including borrowing soils, transporting, spreading, watering, compaction, trimming the sides and ends of the embankments.

303.10.2. Water, if available within the initial lead of ½ K.M. shall not be paid for separately.

303.10.3. The rate shall include conveyance of water and earth within initial leads and lifts. Conveyance over the initial leads and lifts shall be paid for separately.

303.10.4. The following items of work shall be included in the rate for embankment and shall not be paid for :

(a) marking out ;

(b) forming thandoos and their removal after check measurement ;

(c) forming and removal of steps, ramps, benching, battering beyond the finished profile ;

(d) formation of temporary drains for diversion of surface flows, baling of seepage water and such other temporary arrangements, unless otherwise provided for separately.

Specification No. 304

Clay Blankets

304.1. Scope :—Clay blankets are made from impervious soils and are used on the beds of reservoirs or in channels or canals to reduce seepage.

304.2. Requirements :—The material used for these purposes, shall be impermeable, free from excessive shrinkage and swelling, shall resist erosion and

have adequate stability. As far as possible, G.C. or S.C. materials shall be used. When satisfactorily soils are not available, the surface shall be protected with a blanket of stable gravelly soils if so instructed by the Executive Engineer.

304.3. Laying :—The clay blanket shall be laid and compacted to a length and depth as specified and as instructed by the Executive Engineer.

304.4. Measurement :—Dimensions shall be measured to the nearest 0.01 metre and volume worked out to the nearest 0.01 cu.m.

304.5. Rate :—The rate for clay blanket shall be for a unit of 10 cu.m. and shall include all operations of quarrying, transporting, laying, watering, compaction, etc., complete. The rate shall include conveyance of water and earth within initials leads and lifts. Conveyance over the initial leads and lifts shall be paid for separately.

Specification No. 305

Filters

305.1. Scope :—This specification covers filters used for internal drainage namely, filter blankets, horizontal and inclined filter drains, longitudinal and transverse and filters around rock toe and under revetment and riprap, etc.

305.2. Filter Materials :

305.2.1. The filter materials shall consist of clean, sound and well graded sand and crushed rock. The materials shall be free from debris, organic matter and other deleterious matter. It shall be ensured that the surface over which the filter is laid has been well consolidated to not less than 95% of the proctor's density.

305.2.2. For earth dams upto thirty metres height filter materials in contact with earth or foundation soil shall be of any available clean, well graded sand having maximum size of 6 mm. This shall be over laid with well graded, hard, durable coarse aggregate of maximum size 20mm. Over this a layer of hard durable well graded coarse aggregate of maximum size 25mm. in contact with rock fill/ riprap shall be used.

305.2.3. The thickness of each filter layer shall be not less than 300 mm.

305.2.4. Where the height of earth dam is more than thirty metres, the gradation of the filter layers shall be more elaborately fixed based on extensive laboratory studies and shall be specified in the special specifications for the project works.

305.3. Placing of filter :—The foundation shall be cleared and stripped in accordance with Specification 338, before laying the bottom layer of filter material. Filter material shall be laid in layer in 150mm. and compacted to 70% relative density by the required number of passes of crawler type tractors or any other approved method. Water as found necessary shall be sprinkled before compaction. Care shall be taken to ensure that materials of different layers do not get mixed, both at the time of placing and during compaction. Extreme care shall be taken when placing materials to obtain a fill free from lenses, layers and streaks of segregated materials. In the case of horizontal filters, after being compacted,

earthfill material shall be laid over it in layers of 150mm. and compacted as directed by the Executive Engineer. Sheep foot roller shall not be used till earthfill has been laid and compacted to a thickness of 600mm. over the filter blanket. However, the construction of earthfill in the initial 600mm. thickness shall be subject the same quality control regarding moisture content and dry density as for the rest of the embankment. In the case of inclined filters, the filter shall be raised along with adjoining embankment layers and shall be properly compacted by suitable means. In order to avoid contamination of the filters with adjoining earthfill material, the top of the filter shall be kept slightly higher than the adjacent embankment level and any contaminated portion shall be scraped and removed before adding the new layer.

305.4. Measurement :—All linear measurements shall be in metres, correct to 0.01 of a metre. Volumes shall be worked out to the nearest 0.01 cu.m.

305.5. Rate :—Unit rate for this item shall be per one cu.m.

Specification No. 306

Rockfill in Toe of Embankment

306.1. Materials :—Rockfill shall consist of sound, durable and well graded broken rock obtained from approved excavation for the work and/or from approved quarries and shall be approved prior to being transported to the area of deposition. The materials shall range in size from 75mm. to 450mm. However, no load shall contain more than 15 per cent by volume or rock fragments smaller than 75mm. in size. All brush roots, or other perishable material shall be removed from rockfill during the spreading.

306.2. Placing :—The rockfill shall be placed and packed to obtain a stable, well graded and free draining fill. The smaller rock fragments shall be placed adjacent to the filter of embankment and the large rock fragments near the outer edge of the fill. The rock fill shall be placed and roughly levelled in layers not greater than one metre in thickness. The interstices shall be well filled with spawls and chips and tightly wedged to ensure firm packing. Rock toe shall be laid true to specified line and grade.Contamination of the rock with finer materials from any other zones shall be avoided.

306.3. Measurement :—All linear measurement shall be in metres, correct to 0.01m. Volume shall be worked out to nearest 0.01 cu.m.

306.4. Rate :—The unit rate for this item shall be per one cu.m.

Specification No. 307

Turfing

307.1. Materials :—Sods of grass which form a thick short turf shall be used.

307.2. Preparation of Bed :

307.2.1. All areas to be turfed shall be trimmed or filled to the profile required so that the finished work after laying the sods shall be the required line and grade.

307.2.2. The areas to be sodded shall be free from stones, roots, or other undesirable foreign material.

307.2.3. The soil on the area to be sodded shall be loosened and raked to a depth of not less than 25mm. All clods and lumps shall be broken to provide a uniform texture.

307.2.4. The prepared bed shall be moistened adequately to permit the sods to adhere properly.

307.3. Sodding :—The sods shall be cut in rectangular shape 80 to 100mm. thick and laid so that their edges are is close contract and then welded by gently ramming till they form a level and compact mat.

307.4. Watering :—Sods shall be thoroughly watered immediately after placing. They shall be kept thoroughly wet for a period of at least seven days after laying and shall be maintained in a satisfactory wet condition for a period of thirty days thereafter.

307.5. Rate :

307.5.1. The rate for turfing shall be for a unit of 10 sq.m. of sod in place and shall include preparation of the bed, supply and laying of the sods, watering and maintenance for the specified period.

307.5.2. Earthwork for trimming or filling to the required profile shall be paid for separately.

Specification No. 308

Excavation of Foundations

308.1. Excavation :

308.1.1. Excavation for foundations shall be to the exact dimensions as specified or as directed by the Executive Engineer.

308.1.2. In firm soil, the sides of the excavation shall be kept vertical upto a depth of 2 metres and for a greater depth, the excavation shall be widened by allowing steps of 500mm. on either side at every 2 metres depth. Where the soil is soft, loose or slushy, the width and depth of the steps shall be suitably altered or the sides sloped or shored up as directed by the Executive Engineer. It shall be the responsibility of the contractor to take complete instructions in writing from the Executive Engineer regarding the stepping, sloping or shoring to be done for excavations deeper than 2 metres.

308.1.3. The bed of the excavation shall be dressed level and rendered firm by watering and tamping. Any soft pockets occurring in the excavated bed shall be dug out and filled with concrete of the same mix as the foundation concrete or as may be directed by the Executive Engineer. If by the contractor's mistake, the excavation is made to a depth greater than that specified or as required by the Executive Engineer, the excess depth shall be made good with concrete of the same proportion at the cost of the contractor.

308.1.4. The foundation excavation shall be inspected and passed by the Executive Engineer, before the concrete is laid.

308.1.5. *Excavation in Rock* :

308.1.5.1. Excavation in rock shall be carried out by crow bars, pick taxes, chisels or pneumatic drills, etc. Unless permitted, blasting shall not be restored to. Where blasting is permitted the final section of excavation shall be obtained by chiselling.

308.2. Disposal of excavated material :

308.2.1. Excavated materials shall not be placed within one metre of the edge of the excavation or half the depth of the excavation whichever is more or a greater distance as prescribed by the Executive Engineer. All materials excavated shall be the property of Government. Materials suitable and useful for back-filling or other use shall be stacked separately as directed by the Executive Engineer.

308.3. Protection :

308.3.1. Near towns and all busy localities foundation excavation shall be properly fenced and marked within red lights at night to avoid accidents. Adequate protective measures shall be taken to see that the foundation excavation does not effect or damage the adjoining structures. The contractor shall be entirely responsible for any accidents, injury to life and damage to property caused by his negligence.

308.4. Measurement :

308.4.1. The dimensions of the excavation shall be measured to the nearest 0.01m. and volumes worked out to the nearest 0.01 cu.m.

308.4.2. The measurements for the foundation excavation shall be made according to the sections shown on the drawing or to such other sections including stepping and sloping back as authorised by the Executive Engineer.

308.4.3. In the case of excavation in rock, when measurement is not directly possible from sections, it may be arrived at by measuring compacitly formed stacks of the excavated rock as per clause 301.5.2.

308.5. Rate :

308.5.1. The rate for earthwork shall be for a unit of 10 cu.m. The rate for excavation in rock shall be for a unit of 1 cu.m.

308.5.2. The rate for excavation shall include the following and no extra payment shall be made.

(a) Site clearance, such as clearing of shrubs, brushwood, under growth and small trees not exceeding 300mm. in girth, measured at one metre above ground.

(b) Making out.

(c) Initial lead of 10 metres and initial lift of 2 metres.

(d) Forming temporary steps at sides of deep trenches.

(e) Removing slips and blows during excavation.

(f) Fencing, protection and other safety measures as specified in clause 308.3.

(g) All dewatering required during excavation, unless provided for separately in the agreement.

(h) All shoring, sheeting, planking and strutting etc., unless provided for separately in the agreement.

Specification No. 309

Filling in Foundations

309.1. Earth used for back filling shall be free from salts, organic or other deleterious matter. Unless otherwise directed by the Executive Engineer, G.C. or S.C. material shall be used. All clods of earth shall be either well powdered or removed.

309.2. As soon as the construction of the foundation has been completed and measured, the space all around the foundation shall be cleared of all debris and filled with earth in layers not exceeding 150mm., each layer being watered and well compacted before the succeeding layer is laid, care being taken not to disturb the constructed foundation. The backfill shall be brought to the original ground surface.

309.2.1. On completion of the structure, the ground shall be carefully dressed with a gentle outward slope for a distance of 3 metres, all round the structure, unless otherwise specified or directed by the Executive Engineer.

309.3. Rate :

309.3.1. The unit rate shall be per 10cu.m., and shall include spreading in layers not exceeding 150mm. in depth, watering, compaction, levelling and surface dressing all round.

Specification No. 310

Filling in Basement

310.1. The earth or sand for filling in basement shall be of approved quality and free from salts, organic or other deleterious matter.

310.1.1. Expansive soils shall not be used. Also sea sand shall not be used unless specifically permitted by the Executive Engineer. Where so permitted the top 300mm. of the filling shall consist of approved earth or sand.

310.2. The surface to receive the filling shall be first cleared, free from all roots, vegetation or spoil and wetted.

310.2.1. Filling shall be done in layers not exceeding 150mm., each layer being watered and compacted before the succeeding layer is laid, care being taken not to disturb the structure. The finished level of the filling shall be to the bottom of the base concrete of the flooring.

310.3. Rate :

310.3.1. The unit rate shall be per 10 cu.m. and shall include the cost of all the operations described above.

Specification No. 311

Well Sinking for Fondations

311.1. General :

311.1.1. Well foundation generally consist of steining of masonry (brick or stone with or without reinforcement) or concrete (plain or reinforced) provided with a curb at the bottom which is sunk to the required depth by dredging. The well is then plugged at the bottom with concrete, filled with sand and provided with a concrete cap at the top.

311.2. Excavation :

311.2.1. If the river bed is dry, open excavation shall be carried to a depth just above the water level or to such depth as may be specified before the curb is laid. Open excavation shall conform to SS : 308.

311.2.2. Where it is necessary to sink foundation wells in standing water, unless otherwise specified by the Executive Engineer, an island of sand or earth shall be formed before laying the curb. The island shall extend at least 3 metres beyond the outer periphery of the wells to be sunk. The material forming the island shall be free from all stones and other hard materials which are liable to impede the sinking of the well and shall be brought up atleast 500mm. above the water level. The sides of the island shall be adequately protected from erosion.

311.3. Curb :

311.3.1. The curb shall be made of reinforced concrete with a cutting edge provided where necessary with a steel shoe.

311.3.2. The curb shall be laid truly in position and level.

311.3.3. Cement concrete for the curb shall be of the grade not less than M 150. The concreting of the curb shall be done in one continuous operation.

311.4. Steining :

311.4.1. Cement concrete for steining shall be of grade not less than M 100. Where bricks are used for steining they shall have a strength not less a than 75 Kg./cm^2. The mortar for brick or stone masonry shall be of cement mortar (1:3).

311.4.2. The steining shall be built in one straight line from bottom to top. In no case shall it be built in plumb at intermediate stage when the well is titled.

311.4.3. The steining shall be built in true shape both on the inner and outer edges.

311.4.4. The height of the steining built at any stage shall be such that the well does not loose stability.

311.5. Sinking :

311.5.1. Sinking shall be commenced only after the steining is cured atleast for 48 hours.

311.5.2. The sinking of the well shall proceed uniformly so that the well does not go out of position or out of plumb beyond the specified tolerance.

311.5.3. Dredging may be done manually or mechanically.

311.5.4. Kentledge or sinking load shall be placed in an orderly and safe manner so that it shall not interfere with dredging or damage the steining of the well.

311.5.5. Wells shall not be dewatered during sinking without the specific permission of the Executive Engineer.

311.5.6. Water jetting may be used where necessary to facilitate sinking.

311.5.7. Blasting may be resorted to only with the specific permission of the Executive Engineer. Where so permitted light charges placed below the level of the cutting edge and fired under water shall be used so as not to damage the steining.

311.5.8. As sinking proceeds a record of the different kinds of soil penetrated by the well shall be kept by preserving suitable soil samples. Necessary *insitu* tests may be conducted where so required.

311.5.8.1. Suitable gauges shall be painted on the outside of the well steining to provide a continuous indication of the depths cast or sunk.

311.5.9. All precautions shall be taken against possible damage to the foundations of structures in the vicinity of the wells prior to commencement of dredging of the material from inside of the well.

311.5.9.1. Careful watch shall be kept during sinking and any tilts developed shall be immediately attended to. Whenever the well shows a tendency for tilting, adequate preventive measures shall be taken by shifting the kentledge, controlling the dredging, jetting or by any other approved means.

311.5.9.2. Blasting shall not be permitted before 24 hours have elapsed since the last course of masonry or concrete has been laid.

311.6. Bottom Plugging :

311.6.1. The bottom of the well shall be cleaned of all loose and unwanted material before plugging is started.

311.6.2. The method adopted for concreting shall be such that sound concrete is obtained. In any method adopted the concrete shall be placed at the bottom and shall in no case be dropped from a height. The methods used may be tremie, prepakt concrete or concreting by skip boxes. The concrete in all cases shall be evenly distributed on the base.

311.6.3. The concreting shall be done in one continuous operation to the required thickness if there are two or more dredged holes, plugging shall preferably be done simultaneously and to equal height in all the dredge holes.

311.6.4. No flow of water shall be permitted through the concrete till it is set.

311.6.5. Concrete used for the bottom plugging shall not be of a grade lower than M 100. The well shall not be dewatered or the concrete otherwise disturbed for atleast 14 days after it is laid.

311.7. Sand filling :—Sand for filling shall be clean and free from earth, clay, clods, rods, boulders, etc.

311.8. Top Plug :

311.8.1. After filling the well with sand upto the required height, the top plug of the specified thickness shall be laid over it using cement concrete not leaner than (1: 4 : 8).

311.9. Measurement :—This shall conform to clause 305.4.

311.10. Rate :

311.10.1. Earth-work for open excavation shall be paid for as per SS : 308. All structural steel work shall be paid for in accordance with SS: 1103. All R.C.C. work shall be paid for in accordance with SS : 403 and all plain concrete work shall be paid as per SS : 402. All masonry work shall be paid for in accordance with SS : 501 and SS : 601. Sand filling shall be paid for at the unit rate of 10 cu.m. and shall include all the operations as described in clause 311.7.

311.10.2. *Sinking* :

311.10.2.1. Sinking shall be measured correct to 0.01 of a metre from the initial position of the cutting edge of the curb of its final position. The unit rate for sinking well shall be per metre and shall be inclusive of, formation of island where necessary, dredging, dewatering where permitted, supplying and placing kentledge on the top of well and removing the same, jetting, blasting where necessary, supplying and use of all necessary stagings and scaffoldings, tools, plants, requirement and other incidental works to sink the well to the specified levels. It shall also include the use of divers for removal of obstacles from under the cutting edge of the well. The level of cutting edge of the curb at the time of casting shall be recorded and signed by the contractor in token of his acceptance.

311.10.2.2. Any extra sinking done beyond the specified level for the purposes of correcting the tilt or shift shall not be paid for.

Specification No. 312

Well Sinking for Water Supply

312.1. General :—Wells sunk for water supply generally consist of steining of masonry (brick or stone or sand cement blocks with or without reinforcement), concrete (plain or reinforced) provided with a curb at bottom which is sunk to the required depth by dredging. The well is then provided with a plug at the bottom either of graded coarse sand and gravel pebbles to admit bottom infiltration.

312.2. Excavation :—This shall conform to clause 311.2.

312.3. Curb :—This shall conform to clause 311.3.

312.4. Steining :— This shall conform to clause 311.4. Where specified sand cement blocks (4 : 1) mix, can be used for steining in place of brick or stone. Weep-holes 6mm. x 50mm. shall be provided in sand cement blocks to a specified level in the steining, where side infiltration is required. Weep-holes shall be provided with a slope towards the outside of the well steining.

312.5. Sinking :—This shall be as per Cl. 311.5.

312.6. Bottom plug :—The well shall be plugged with graded coarse sand or gravel of approved size to admit bottom infiltration. Sand gravel (pebbles) shall be carefully lowered into the well in gunny bags and evenly distributed on the base.

312.6.1. Where bottom infiltration is not required as in the case of collecting wells and pump wells, concrete plug shall be provided as per clause 311.6.

312.7. Measurement :—This shall conform to clause 305.4.

312.8. Rate :—This shall conform to clause 311.9.

Specification No. 313

R.C.C. Precast and Cast-in-situ Pile Foundations

313.1. Scope :—This specification is for the construction of reinforced concrete load bearing piles which transmit the weight of the structure to the soil by resistance developed at the toe of the piles by friction along their surfaces or by both. The piles may be of any of the following types :

(a) Precast piles, driven by hammer and/or Jetting.

(b) *Driven cast-in-situ piles* :—The piles may be formed by filling a light mandril driven steel shell with contract. Alternatively a steel casing may be driven which is later replaced by concrete by withdrawing it after concrete is formed.

(c) *Bored cast-in-situ piles* :—The piles may be formed with or without a casing by excavating or boring a hole in the ground and subsequently filling it with concrete.

(d) *Under reamed piles* :—Two types of under reamed piles that is single and double under reamed piles are in common use.

313.2. Materials :

313.2.1. *Reinforced cement concrete* :—Reinforced cement concrete shall conform to SS : 403.

313.2.1.1. The grade of concrete shall be as follows :

	Situation	*Grade of concrete*
(a)	For head driving (where driving stress exceeds 100 kg./cm^2)	Not less than M 200
(b)	For easy driving (where the driving stress is less than 100 kg./cm^2)	Not less than M 150
(c)	For cast insitu piles	Not less than M 150
(d)	For under water construction	The mix for concrete shall have 10% more cement than what is used for normal situations.

313.2.1.2. The shape and cross section of the pile shall be as specified.

313.3. Precast piles :

313.3.1. Care shall be taken at all stages of transportation and handling to ensure that the piles are not damaged or cracked. During handling piles shall be supported at the appropriate lifting points provided for the purpose. If the piles are put down temporarily after being lifted, they shall be placed on trestles or blocks located at the lifting points.

313.3.2. Piles shall be stored on firm ground free from liability to unequal settlement under the weight of the stack of piles. The piles shall be placed on supports which are truly level and spaced so as to avoid undue bending in the piles. The support shall be located vertically one above the other. Spaces shall be left round the piles to enable them to be lifted without difficulty. The order of stacking shall be such that the older piles can be withdrawn for driving without disturbing the new piles. Separate stacks shall be provided for different lengths of piles. Wherever curing is needed during storage, arrangements shall be made to enable the piles to be watered.

313.4. Before the operation of handling and driving the piles, the minimum periods required for various operations counted from the time of casting shall be as follows :

	Type of cement used in casting the piles	*Minimum period from the time of casting*			
		Strike side shutters	*End of wet curing*	*Lift from casting bed*	*Drive*
(a)	Ordinary portland Cement	24 hrs.	7 days	10 days	28 days
(b)	Rapid hardenning portland Cement	12 hrs.	7 days	7 days	10 days

313.5. Control of pile Driving :

313.5.1. *Protection of pile Head* :— The head of precast concrete pile shall be protected with packing of resistant material, care being taken to ensure that it is evenly spread on the piles and is held securely in place. If a drop hammer or single acting hammer is used, a helmet shall be placed on the head of the pile and provided with a block of hard wood or other material not thicker than the width of the pile.

313.5.2. *Selection of pile Hammer* :—The pile shall be driven by any type of hammers, provided they penetrate to the prescribed depth or attain the specified resistance without being damaged. The weight of the hammer shall be atleast half that of the pile and shall also be sufficient to ensure a final penetration of not less than 2.5mm. per blow. Unless rock has been reached within a single acting or drop hammer the stroke shall normally not exceed 1.35mm. for R.C.C. piles. A heavier hammer shall be preferred to limit the drop or stroke. Continued driving long after the pile has almost ceased to penetrate shall be avoided.

313.5.3. *Jetting* :—Wherever necessary, jetting of piles by air or water to facilitate driving may be carried out with the permission of the Executive Engineer.

313.5.4. The driving of a number of piles in loose sand shall proceed outwards from he centre as otherwise, it may be difficult to drive the inner piles to the same depth as the others. However, in the case of soft clay soils, the driving shall proceed from outside to inside so that the soil is restrained from flowing out during the driving operations.

313.5.5. If there is a major variation between the depths at which adjacent foundation piles in a group meet refusal, a boring shall be made nearby to ascertain the cause of this difference. If the boring shows that the soil contains pockets of highly compressive material below the level of the shorter pile it shall be necessary to enforce penetration of all the piles to a level below the bottom of the zone which shows such pockets.

313.5.6. *Defective piles* :

313.5.6.1. Piles that are defective shall be pulled out and replaced. However, where defective piles are permitted to be left in place, additional piles shall be driven as directed by the Executive Engineer.

313.5.6.2. Levels shall be taken on each pile after driving and again after all the piles are driven. Piles which are found to have risen up shall be redriven to the original depth or resistance, unless redriving tests on the adjacent piles show this to be unnecessary.

313.5.7. *Driving tolerance* :—Unless otherwise specified, the maximum shift in portion shall not exceed 75mm. at the level of the bottom of the pile cap and the pile shall not deviate by more than 2% (above 1°) from the specified inclination.

313.6. Cast-in-situ piles :

313.6.1. Where bored cast *insitu* piles are used in soils liable to flow, the bottom of the casing shall be kept for enough in advance of the boring tool to prevent the entry of soil into the casing, thus preventing the formation of cavities and settlements in the adjoining ground. The water level in the tube shall be maintained at the natural ground water level until the tube is sealed. The joints of the casing shall be made as tight as possible to minimise inflow of water or leakages of air, where compressed air is employed to facilitate concreting. Before concreting, where the use of compressed air is unnecessary, the bottom of the boring shall be plugged and dried, as far as possible. If concrete is placed in precast concrete tubes or consists of precast sections, these shall be free from cracks or other damages before being installed.

313.6.2. *Reinforcement* :—Any reinforcement used shall be made into cages and well wired to withstand handling without damage. The bars shall be so spaced as not to impede the placing of the concrete and the lateral ties or spiral binding shall not be closer than 150mm. centre to centre. Care shall be taken to preserve correct cover and alignment of reinforcement, throughout the whole operation of

placing the concrete. The displacement or distortion of reinforcement during the operation shall be avoided.

313.6.3. *Concreting* :

313.6.3.1. Concrete shall be so placed as to fill the entire volume of the tube or bore without the formation of voids caused by faulty vibration or entrapped air.

313.6.3.2. Concrete shall not be placed through water, but in unavoidable circumstances it shall be done with necessary precautions under the approval of the Executive Engineer.

313.6.3.3. In silty clays and other soils there will be a tendency to cause 'waisting' in the concrete deposited and suitable precautions shall be taken against this by proper compaction of the concrete during placement.

313.6.3.4. In the case of concreting inside tubes which are subsequently withdrawn, the concrete shall be placed in sufficient quantity to ensure that during the withdrawal of the tubes a sufficient head of concrete is maintained to prevent than inflow of soil and water.

313.7. Under reamed piles :

313.7.1. Under reamed piles shall be used as follows :

(a) Single under reamed piles for foundations of lighter structures upto two storeys.

(b) Double under reamed piles for foundations of heavier structure, in shallow as well as in deep layers of expansive soils.

313.7.2. The length of piles will depend on the depth of stable zone of soil and the piles shall be taken at least 500mm. into it. Uniform diameter piles in expansive soils shall however be taken down sufficiently deep into the firm soil strata so as to develop the required anchorage against uplift.

313.7.3. Diameter of piles shall be not less than 200mm.

313.7.4. Diameter of the under-reamed portions of piles shall normally be two to two and a half times the diameter of the shaft and shall not be more than three times the diameter of the shaft.

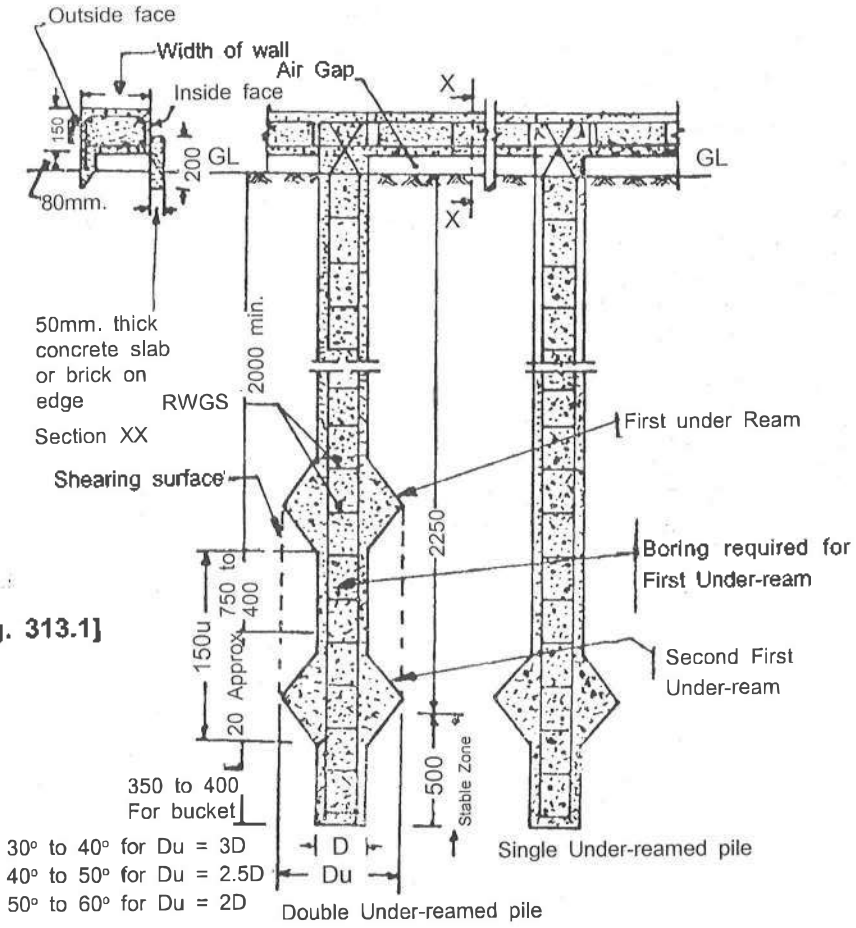
313.7.5. Piles shall be provided at all the junctions of walls and at intermediate points where necessary.

313.7.6. The spacing of under-reamed piles shall normally be kept a minimum of twice the under-reamed diameter for normal leading.

313.7.7. In double under-reamed piles the vertical spacing between the two under reamings may also be kept equal to one and a half times the under-reamed diameter. (See Fig. 313-1)

313.7.8. *Capping Beams* :

313.7.8.1. The capping beams shall be kept a minimum of 80mm. clear of the ground.



[Fig. 313.1]

All Dimensions in Millimetres

TYPICAL DETAILS OF UNDER-REAMED PILE

313.7.8.2. The minimum depth of the capping beams shall be kept as 150mm. and it shall not normally exceed 200 mm.

313.7.9. *Constructions* :

313.7.9.1. Bore holes shall be made by earth augers. In case of manual boring an auger boring guide shall be used to keep the bores vertical or to the desired inclination and in position.

313.7.9.2. After the bore is made to the required depth, enlarging of the base shall be carried out by means of an under reaming tool.

313.7.9.3. For double under-reamed piles, boring shall first be made to a depth as required for the first under-reaming. After completing the first under-reaming, the bore shall be further extended by augering to the full depth and then the second under-reaming done.

313.8. Measurement :—A linear measurement shall be in metres, correct to 0.01 of a metre, according to the different diametres of the piles.

313.9. Rate :—The unit rate shall be per running metre.

For precast piles the payment for driving shall be made separately.

For cast-in-situ piles, the rate shall include both the cost of pile and driving.

For different diametres, different rate per running metre shall be paid for.

SECTION 4

STANDARD SPECIFICATIONS FOR CONCRETES

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Specification No. 401

Lime Concrete and Surki Concrete

401.1. The concrete shall consist of graded aggregate of clean broken stone or verified or hard well burnt broken brick mixed with matrix or either lime mortar or surki mortar as may be specified. The broken brick, broken stone, lime mortar and surki mortar shall comply with the Standard Specifications 103, 108, 113 and 114 respectively. Unless otherwise specified the maximum size of the aggregate shall be 40mm.

401.2. Proportions :—The quantity of mortar shall be 40 per cent of the gross volume of the aggregate. For the maximum size of the course aggregate other than 40mm. the quantity of mortar shall be as specified by the Executive Engineer.

401.3. Mixing :—Concrete shall be mixed on a level platform of slabs, bricks or wood of such dimensions as the Executive Engineer may direct. The platform shall have tight and close joints so that there shall be no leakage of water or mortar through it and the mixing tool shall not strike the joints while in operation. The aggregate shall be first washed clean and thoroughly wetted. The measured quantity shall be placed to an even thickness on the platform covering not more than half the length of the platform. Measured quantity of mortar in the proper proportion noted above shall then be evenly spread over the aggregate and the whole thoroughly mixed using just sufficient water (applied with a spinkler) to enable the mortar to adhere to each piece of the aggregate by turning it over several times and gradually transferring it to the vacant half of the platform until all particles of aggregate are covered with mortar. Suitable measuring boxes shall be used for both the aggregate and the mortar. When it is necessary to give great fluidity to the concrete this shall be effected by adding water to the mortar and on no account by adding water to the mixed concrete. No more concrete shall be mixed than can be laid in position on the same day of mixing and excess if any shall be removed at once from the site.

401.4. Laying :

401.4.1. After the bed for the concrete is properly prepared and wetted, the concrete shall be laid carefully in position in layers not exceeding 150 mm. It shall never be thrown from a height, but gently laid along with a basket in such a way that the aggregate does not separate from the mortar. Each layer shall be well rammed until the mortar creams to the surface. If this does not take place completely the top of each layer shall be grouted with thin mortar. No water shall be added during ramming but the surface of each completed layer shall be watered and well scored with the point of a trowel or were brush before the next layer is added. No ramming shall be done after the concrete has begun to set. Not less than two men arranged over the width of the concrete with a lateral space of not more than half a metre per man, shall do the ramming, moving forward and backward and in unison.

401.4.2. In case of foundations sufficient labour and materials shall be employed to lay the concrete bedding layer by layer simultaneously over the whole foundations. When this is not practicable unfinished layers of concrete shall break joint. Such break joints wherever they occur shall be rough and fresh mortar shall be applied to a thickness of about 12 mm to ensure proper bond before laying new concrete.

401.4.3. When concrete is laid against from work the joints of the from work shall be sufficiently right to prevent the leakage of mortar.

401.4.4. *Laying concrete under water* :—For laying under water or in wet conditions, lime concrete, using class "A" lime or surki concrete shall only be used. When concrete is to be laid in wet locations the Executive Engineer shall decide whether the excavation is to be kept free of water while the concrete laying is in progress or whether the concrete is to be laid under water. If the concrete is to be laid under water it shall be simply tipped into place by means of a basket or box containing it, the concrete being gently overturned when it reaches the bottom and no tamping or ramming shall be done until the concrete surface rises above water level, and even then the surface shall be tamped gently so as not to squeeze out the mortar. When pumping is done care must be taken that it is not done in a manner to permit any disturbance or leakage or suction of mortar from the concrete.

401.5. Curing :—The concrete shall be kept wet after each days work and shall be cured for a period of not less than 10 days or such other period of time as the Executive Engineer may decide, either by ponding, frequent sprinkling or by any other means.

401.6. No masonry shall be built upon concrete within three days after its laying.

401.7. Measurement :—All linear measurements shall be in metres, correct to 0.01 of a metre. Volumes shall be worked out in cubic metres, correct to 0.01 of a cubic metre.

401.8. Rate :—The unit rate for payment shall be per cubic metre. The rate shall include all necessary from work and the cost of all materials, mixing,

conveying, placing, compacting, curing, tools and all appliances required for laying the concrete in position. It shall also include the cost of bailing out water and pumping for keeping the excavation free of water unless otherwise specified. Extra leads and lifts shall be paid for separately. Where tests are specified by the Department the cost of testing shall be borne by the department, except where the materials have failed in which case the cost of tests shall be borne by the contractor or supplier in addition to the rejection of such materials from usage on the works.

Specification No. 402

Cement concrete for Plain and Reinforced work

402.1. Terminology :

402.1.1. *Controlled Concrete* :—Concrete for which the mix has been proportioned on the basis of trial mix based on preliminary tests.

402.1.2. *Ordinary Concrete* :—Concrete for which a nominal mix has been used without preliminary tests.

402.1.3. *Preliminary test* :— A test conducted in a laboratory on a trial mix with the object of designing a concrete mix before actual concreting operations or for determining the necessary adjustments during execution.

402.1.4. *Works test* :— A test conducted either on the field or in a laboratory on specimens made on the site out of concrete being used on the works.

402.1.5. *Proportioning* :— The determination of the mutual proportions of cement, aggregates, water and admixtures if any required to attain the desired workability, strength and any other special characteristics.

402.1.6. *Grade of Concrete* :— The letter M (Standing for 'mix') followed by a number indicating the specified 28-day works cube compressive strength of the mix expressed in Kg./cu.m^2.

402.2. Materials :

402.2.1. *Coarse aggregate* :—The aggregate of specified maximum size shall be graded and shall comply with SS : 108.

402.2.2. *Sand* :—This shall conform to SS : 110.

402.2.3. *Cement* :—Cement to be used, shall conform to the SS : 112.

402.2.4. *Water* :—Water used for both mixing and curing shall be fresh, clean and free from injurious amounts of deleterious materials. Potable waters are generally considered satisfactory for mixing and curing concrete.

402.2.5. *Admixtures* :—When specified only approved admixtures shall be used strictly in accordance with the Executive Engineer's instructions. Calcium chloride shall not be used for reinforced concrete.

402.3. Grades of Concrete :—The concrete shall be of seven grades designated as M 100, M 150, M 200, M 250, M 300, M 350 and M 400.

402.4. Strength Requirements of concrete :

402.4.1. Where ordinary portland cement conforming to SS : 112 is used the 28-day compressive strength requirements for various grades of concrete shall be as given in Table 402-A.

Table 402-A

Strength requirements of concrete (All values in Kg./cm²)

Grades of Concrete	*Compressive strength of 150mm. cubes at 28 days after mixing*	
	Preliminary test (minimum)	*Works test (minimum)*
M 100	135	100
M 150	200	150
M 200	260	200
M 250	320	250
M 300	380	300
M 350	440	350
M 400	500	400

Where rapid hardening portland cement is used the specified strength shall be attained at 7 days instead of at 28 days. Where other cements are used the Executive Engineer shall specify the corresponding requirements, preferably on the basis of preliminary tests.

402.4.2. The strength requirements specified in Table 402-A shall apply to both controlled and ordinary concrete. Preliminary tests need not however to be made in the case of ordinary concrete.

402.4.3. In order to get a relatively quicker idea of the quality of concrete optional works tests on beams for modulus of rapture at 72+2 hours or at 7 days, or compressive strength tests at 7 days may be carried out in addition to 28-day compressive strength tests. In all cases a 28-day compressive strength specified in Table 402-A shall alone be the criterion for acceptance or rejection of the concrete. If however, from tests carried in a particular job over a reasonably long period it has been established to the satisfaction of the Executive Engineer that a suitable ratio is got between the 28-day compressive strength and the modulus of rupture at 72 plus or minus 2 hours or 7 days or compressive strength at 7 days than in such cases compression strength at 7 days may be accepted. The Executive Engineer may suitably relax the frequency of 28-day compressive strength tests specified in Table 402-D provided the expected strength values at the specified early age are consistently met. For this purpose the values given in Table 402-B may be taken for general guidance in the case of concrete made with the ordinary portland cement.

Table 402-B

Optional works test requirements of concrete, (All values in kg./cm.) (All tests conducted in accordance with IS : 516-1959)

Grade of concrete	Compressive strength on 150mm. cubes at 7 days Minimum	Modulus of ruptures by Beams test, Minimum	
		at 72 plus or minus 2 hrs.	at 7 days
M 100	70	12	17
M 150	100	15	21
M 200	135	17	24
M 250	170	19	27
M 300	200	21	30
M 350	235	23	32
M 400	270	25	34

402.4.4. Where the strength of a concrete mix as indicated by tests lies in between the strength for any two grades specified in Table 402-A, such concrete shall be classified for all purposes as a concrete belonging to the lower of the two grades between which its strength lies.

402.5. Proportioning and works control :

402.5.1. *Controlled concrete* :—As far as possible controlled concrete shall be used on all concrete works requiring a concrete of grade higher than M 200. Controlled concrete for use in plain and reinforced concrete shall be of grade M 100, M 150, M 200, M 250, M 300, M 350 and M 400.

402.5.1.1. The concrete mix shall be designed to have an average strength corresponding to the values specified for preliminary tests in Table 402-A. The proportions chosen shall be such that the concrete is of adequate workability for the conditions prevailing in the work in question and can be properly compacted with the means available. The maximum total quantity of aggregate by weight per 50kg. of cement shall not exceed 450kg. except where otherwise specifically permitted by the Executive Engineer.

402.5.1.2. Except where it can be shown to the satisfaction of the Executive Engineer, that supply of properly graded aggregate of uniform quality can be maintained over the period of work, the grading of aggregate shall be controlled by obtaining the coarse aggregate in different sizes and blending them in the proper proportions when required. The different sizes shall be stacked in separate stock piles. The materials shall be stock piled preferably one week before use. The grading of coarse and fine aggregates shall be checked as frequently as possible the frequency for a given job being determined by the Executive Engineer to ensure that the suppliers are maintaining the grading in conformity with that of the samples used in the preliminary test.

402.5.1.3. In proportioning concrete the quantity of both cement and aggregate shall be determined by weight. Where the weight of cement is determined by accepting the manufacturer's weight per bag a reasonable number of bags shall be weighed separately to check the net weight. When loose cement is weighted at the site it shall be weighed separately from the aggregates. Water shall be either measured by volume in calibrated tanks or weighed. All measuring equipment shall be maintained in a clean serviceable condition and their accuracy periodically checked.

402.5.1.4. It is most important to maintain the water cement ratio constant at its correct value. To this end determination of moisture content of both fine and coarse aggregates shall be made as frequently as possible, the frequency for a given job being determined by the Executive Engineer according to the weather conditions. The amount of the water added shall be adjusted to compensate for any observed variations in the moisture content. The moisture content in the aggregates shall be determined as specified in IS : 2386 (Part-III)-1963. To allow for the variation in weight of aggregates due to variation in their moisture contents suitable adjustments in the weights of aggregates shall also be made.

402.5.1.5. No substitution in materials used on the work or alterations in the established proportions except as permitted in clause 402.5.1.4. shall be made without additional tests to show that the quality and strength of concrete are satisfactory.

402.5.1.6. Workability of concrete shall be checked at frequent intervals. The slump test as described under clause 402.9.1 may be adopted for this purpose. Table 402-C gives suitable slumps for various conditions.

Table 402-C

Sl. No.	*Type of work*	***Slumps***	
		when vibrators are used	*when vibrators are not used*
A.	**Plain Concrete.**		
1.	Mass concrete in foundations, footings, retaining walls and pavements, etc.	10mm. to 25mm	50mm. to 75mm.
2.	Sections less than 75mm. thickness.	25mm. to 40mm.	75mm. to 100mm.
B.	**Reinforced Concrete.**		
1.	Mass concrete in foundations, footings and retaining walls, etc.	10mm. to 25mm.	75mm. to 100mm.
2.	Beams, slabs and columns etc., with normal amounts of reinforcement.	25mm. to 40mm.	100mm. to 125mm.
3.	Thin sections or section with congested reinforcement.	40mm. to 50mm.	125mm. to 150mm.

402.5.2. *Ordinary Concrete* :—When the use of controlled concrete is not considered practicable ordinary concrete may be used. The use of ordinary concrete shall however be restricted to grades M100, M150 and M200. The proportions for ordinary concrete shall be in accordance with Table 402-D.

Table 402-D

(Concrete mix Proportions)

Ordinary Concrete

Grade of concrete (1)	*Maximum total quantity of dry aggregates by volume per 50kg. of cement to be taken as the sum of the individual volumes of fine and coarse aggregate Litres* (2)	*Proportion of fine aggregate to coarse aggregate* (3)	*Maximum quantity of water per 50kg. cement Litres* (4)
M 100	300	Generally (1 : 2) for fine aggregate to coarse aggregate by volume but subject to an upperlimit of (1 : 1½) and a lower limit of (1 : 3)	34
M 150	220		32
M 200	160		30

402.5.2.1. The proportions of the aggregates shall be adjusted from upper limits to lower limits progressively as the grading of the fine aggregate becomes finer and the maximum size of coarse aggregate becomes larger. *Example* : For an average grading of fine aggregate the proportions shall be (1 : 1½), (1 : 2) and (1 : 3) for the maximum aggregate size of 10mm., 20mm. and 40mm. respectively.

402.5.2.2. M100, M150 and M200 of ordinary concrete correspond approximately to (1 : 3 : 6), (1 : 2 : 4), and (1 : 1½ : 3) nominal mixes currently used in the country.

402.5.2.3. In proportioning concrete the quantity of cement shall be determined by weight. The quantities of fine and coarse aggregates may be determined by Volume but these shall also preferably be determined by weight. In the later case the weight shall be determined from the volume specified in Table 402-D and the weight per litre of the proportioned by aggregates. If the aggregate is moist and volume batch is adopted allowance shall be made for bulking which shall be determined as follows: In a 250ml. measuring cylinder pour the damp sand and consolidate it dry shaking until it reaches the 200ml. mark. Then fill the cylinder with water and stir the sand well. The water shall be sufficient to submerge the sand completely. It may be seen that the sand surface is now below its original levels. Suppose the surface is at the mark 'Y' ml. The percentage of bulking of the sand due to moisture shall be calculated from the formula.

$$\text{Percentage bulking} = (200/y - 1) \times 100$$

402.5.2.3.1. The water cement ratios shall not be more than those specified in Table 402-D. Excess water reduces the strength of concrete and shall be avoided. The quantity required shall be carefully observed from time to time and reliable data worked out for guidance as the work proceeds. The cement content of the mix specified in Table 402-D for any nominal mix may be increased if the quantity of water in a mix has to be increased to overcome the difficulties of placement and compaction, so that the water cement ratio specified in Table 402-D is not exceeded.

402.5.2.3.2. In the case of vibrated concrete, the limit specified may be suitably reduced to avoid segregation.

402.5.2.3.3. The quantity of water used in the concrete mix for reinforced concrete work shall be just sufficient to produce a dense concrete of adequate workability which will surround and properly grip all the reinforcement. Workability of concrete shall be controlled by maintaining a water cement ratio that is found to give a concrete which by just sufficiently wet to be placed and compacted without difficulty with the means available.

402.5.2.4. Workability shall be controlled by direct measurement of water content with due allowance for any surface moisture in the coarse and fine aggregates. Clause 402.9.1 and Table 402-E give details of the slump test and recommended slumps for various conditions.

402.5.2.5. Allowances shall be made for surface water present in the aggregate when computing the water content. Surface water shall be determined by one of the field methods described in IS : 2386 (Part III)-1963. In the absence of exact data in the amount of surface water may be estimated from the values given in Table 402-E.

Table 402-F

Surface water carried by average aggregate

Aggregate	*Approximate quantity of surface water (litres per cubic meter)*
Very wet sand	120
Moderately wet sand	80
Moist sand	40
*Moist gravel or crushed rock	20 to 40

**Coarser the aggregate, less the water it will carry.*

402.5.2.6. If ordinary concrete made in accordance with the proportions given for a particular grade does not yield the specified strength due to proper quantities of materials not being available such concrete shall be classified as belonging to the appropriate lower grade. Ordinary concrete proportioned for a given grade in accordance with Table 402-D, shall not however be placed in a higher grade on the ground that the test strengths are higher than the minimum specified. No such interpolations shall be permitted.

402.6. Mixing :

402.6.1. *Machine mixing* :—Concrete shall normally be mixed in a mechanical mixer. Mixing shall be continued until there is a uniform distribution of materials and the mass is uniform in colour and consistency, but in no case shall the mixing be done for less than 2 minutes after all the materials are in the drum. When the mixing drum is charged by power loader all the mixing water shall be introduced into the drum before the soiled materials. The skip shall be loaded with about one half of the coarse aggregate, then with the fine aggregate, then with the cement and finally with the remaining coarse aggregate on top (if all-in-aggregate is used, the skip shall be loaded first with about one-half of the aggregate, then with the cement and finally with the remaining aggregate on top). Where the mixing drum is manually charged it shall be charged with the dry materials in a similar manner and the water shall be added immediately before the rotation of the drum is started.

402.6.2. *Hand Mixing* :—When hand mixing is permitted by the Executive Engineer it shall be carried out on a water tight, non-absorbent platform with a showel, trowel or a similar suitable implement. Care shall be taken to ensure that the mixing is continued until the mass is uniform in colour and consistency. The platform shall be large enough to enable atleast two batches to be mixed simultaneously. The following procedure shall be adopted while mixing.

(a) The cement and fine aggregate in the specified proportions shall be mixed dry until the mixture is thoroughly blended and is uniform in colour, with no pockets of sand or cement.

(b) As much quantity of coarse aggregate as can be mixed and laid within 15 minutes after water is added to the mixture shall then be laid on the dry platform and the required quantity of cement-sand mixture shall be spread over it. The whole mass shall then be mixed turning over atleast three times while adding the required quantity of water with a sprinkling can.

402.7. Placing and Compacting :

402.7.1. *Transporting* :—The concrete shall be handled from the place of mixing to the place of final deposit as rapidly as practicable by methods which will prevent the segregation or loss of any of the ingredients. If segregation does occur during transportation the concrete shall be remixed before being placed.

402.7.1.1. *Temperature control* :—During hot or cold weather concrete shall be transported in deep containers which on account of their lower ratio of surface area to mass reduce the rate of loss of water by evaporation during hot weather and loss of heat during cold weather. The temperature at the time of placement shall not be more than 104 °F or 40 °C and the depth of the concrete layer laid shall not exceed 600mm. when the temperature is 40 °C.

402.7.2. *Placing* :—The concrete shall normally be placed and compacted within half an hour of mixing and shall not be subsequently disturbed. Method of placing shall be such as to preclude segregation. All concrete which has set before placement shall be rejected and immediately removed from site.

402.7.3. *Placement under water* :—When it is necessary to deposit concrete under water, the method, equipment, materials and proportion of the mix to be used shall be approved by the Executive Engineer before the work is started. Such concrete shall not be treated as "controlled concrete". The concrete mix shall contain atleast 10% more cement than that required for the same mix placed in dry conditions, the quantity of extra cement varying with the conditions of placing. The volume or weight of the coarse aggregate shall not be less than one and half times, not more than twice that of the fine aggregate. The materials shall be so proportioned as to produce a concrete having a slump of not less than 100mm. and not more than 150mm. Coffer-dams or forms shall be sufficiently tight to ensure still water if practicable and in any case to reduce the velocity of water to less than 3m. per minute through the space into which concrete is to be deposited. Coffer-dams or forms in still water shall be sufficiently tight to prevent loss of mortar through the walls. Pumping shall not be done while concrete is being placed and until 24 hours thereafter. Concrete shall be deposited continuously until it is brought to the required height. While depositing, the top surface shall be kept as nearly level as possible and the formation of seams avoided. The methods to be used for depositing concrete under water shall be one of the following:

402.7.3.1. *Tremie* :—When concrete is to be deposited under water by means of a tremie the top section of the tremie shall be of a hopper large enough to hold the entire batch of the mix or the entire contents of the transporting bucket if any. The tremie pipe shall not be less than 200mm. in diameter and shall be large enough to allow a free flow of concrete are strong enough to withstand the external pressure of the water in which it is suspended even if a partial vacuum develops inside the pipe. Preferably flanged steel pipe of adequate strength required for the job shall be used. A separate lifting device shall be provided for each tremie pipe with its hopper at the upper end. Unless the lower end of the pipe is equipped with an approved automatic check value, the upper end of the pipe shall be plugged with a wadding of gunny sacking or other approved material before delivering the concrete to the tremie pipe through the hopper so that when the concrete is forced down from the hopper to the pipe it will force the plug (and along with it any water in the pipe) down the pipe and out of the bottom and thus establishing a continuous stream of concrete. It will be necessary to raise the tremie slowly in order to cause uniform flow of the concrete, but the tremie shall not be emptied so that water enters above the concrete in the pipe. At all times after the placing of the concrete is started and until all the concrete is placed the lower end of the tremie pipe shall be below the top surface of the plastic concrete. This will cause the concrete to build up from below instead of flowing out over the surface and thus avoid formation of laitance layers. If the charge in the tremie is lost while depositing, the tremie shall be raised above the concrete surface and unless sealed by a check value it shall be re-plugged at the top end (as at the beginning), before re-filling for depositing concrete.

402.7.3.2. *Drop bottom bucket* :—The top of the bucket shall be open. The bottom doors open freely downward and outward when tripped. The bucket shall be filled completely and lowered slowly to avoid backwash. It shall not be discharged until it rests on the surface upon which the concrete is to be deposited and when discharged shall be withdrawn slowly until well above the concrete.

402.7.3.3. *Bags* :—(of at least 0.028 cu.m. capacity) of jute or other coarse cloth shall be filled about two thirds full with concrete, the spare end being turned under so that the bag is square ended and securely tied. They shall be placed carefully in header and stretcher courses so that the whole mass is interlocked. Bags used for this purpose shall be free from deleterious materials.

402.7.4. *Construction joints* :—Concreting shall be carried out continuously up to construction joints, the position and arrangement of which shall be predetermined by the Executive Engineer. When the work has to be resumed on a surface which has hardened such surface shall be roughened by chiseling, swept clean, thoroughly wetted and covered with a 12mm. layer of freshly mixed mortar composed of cement and sand (in the same ratio as the cement and sand in the concrete) immediately before the placing of the concrete. When the concrete has not fully hardened all laitance shall be removed by scrubbing the wet surface with wire or bristle brushes, care being taken to avoid dislodgement of particles of aggregate. The surface shall be thoroughly wetted and all free water removed. The surface shall then be coated with neat cement grout. The first layer of concrete to be placed on the surface shall not exceed 150mm. in thickness and shall be well rammed against the old work, particular attention being paid to corners and close spots.

402.7.5. *Compaction* :—Concrete shall be thoroughly compacted during the operation of placing and thoroughly worked around the reinforcement, around embedded fixtures and into corners of form work. Wherever possible vibrators of the surface, form or immersion type shall be used. Over vibration or vibration of very wet mixes shall be avoided.

402.7.6. *Finishing* :—Exposed concrete is best finished while it is still green by floating. Concrete surfaces cast against forms shall normally not require any further finishing. If however, any defects are observed after removal of forms, any toughness or projections shall be removed by chipping and grinding with corborundum brick or a power grinding machine. Any hollows or honey combing shall be made good by the application of mortar having the same proportion as used in concrete and having as stiff a consistency as possible. No extra payment shall be involved for finishing concrete surfaces as mentioned above. If however for reasons other than defective work as mentioned above a cost of plaster has to be applied for which supplemental specifications are furnished, then the thickness and method of payment shall be defined in the schedule. Care shall be taken to roughen the hardened concrete surface by chiseling to get a good bond between the concrete surface and the plaster.

402.8. *Curing* :— Concrete shall be cured either by ponding or by covering with a layer of sacking-canvas, hessian or similar absorbent material which shall be kept constantly sprinkled with water. Alternatively the concrete being thoroughly wetted may be cured by a layer of approved water proofing material. Unless otherwise specified curing shall be continued for a period of three weeks.

402.9. Tests :

402.9.1. *Slump test* :—This test is used for measuring the workability of fresh concrete on the field as well as in the laboratory.

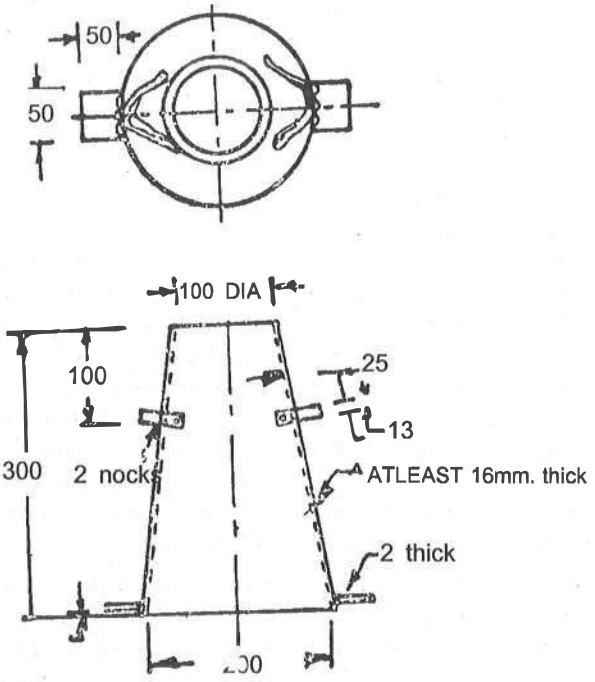
402.9.1.1. *Apparatus* :

(a) *Mould* :—The mould for the test specimen shall be in the form of frustrum of a cone having the following internal dimensions.

Dimensions	*mm.*
Bottom diameter	200
Top diameter	100
Height	300

The mould shall be constructed of non-corroding metal (brass or aluminium shall not be used) of atleast 1.6mm. thickness and the top and bottom shall open and at right angles to the axis of the cone. The mould shall have a smooth internal surface. It shall be provided with suitable foot pieces and also handles to facilitate lifting it up in a vertical direction as required by the test. A mould provided with a suitable guide attachment may be used. A typical mould without the guide is shown in Fig. 402-1.

TYPICAL MOULD FOR SLUMP TEST



All dimensions in mm.
[Fig. 402.1]

(b) *Tamping rod* :—The tamping rod shall be of steel or other suitable material 16mm. in diameter, 600mm. long and rounded at one end.

402.9.1.2. *Sampling* :—If this test is being carried out in the field the sample of freshly mixed concrete shall be used. In the case of concrete containing aggregate of maximum size more than 40mm. the concrete shall be wet sieved through 4mm. screens to exclude particles bigger than 40mm.

402.9.1.3. *Procedure* :—The internal surface of the mould shall be thoroughly cleaned and freed from superfluous moisture and any set concrete before commencing the test. The mould shall be placed on a smooth horizontal, rigid and non-absorbent surface, such as a carefully levelled metal plate the mould being firmly held in place while it is being filled. The mould shall be filled in 4 layers each approximately one quarter of the height of the mould. Each layer shall be tamped with 25 strokes of the rounded end of the tamping rod. The strokes shall be distributed in a uniform manner over the cross-section of the mould and for the second and subsequent layers shall penetrate into the under laying layer. The bottom layer shall be tamped throughout its depth. After the top layer has been rodded the concrete shall be struck off level with a trowel or the tamping rod, so that the mould is exactly filled. Any mortar which has leaked out between the mould and the base plate shall be cleaned away. The mould shall be removed from the concrete immediately by raising it slowly and carefully in a vertical direction. This allows the concrete to slump/subside and the slump shall be measured immediately by determining the difference between the height of the mould and that of the highest point of the slumped concrete. The above operations shall carried out at a place free from vibration or shock and within a period of 2 minutes after sampling. Any specimen which collapses or shears off laterally gives incorrect results. If this occurs the test shall be repeated with another sample. If in the repeat test also the specimen shears, the slump shall be measured and the fact that the specimen has sheared shall be recorded.

402.9.1.4. Very good indication of the cohesiveness and workability of the mix can be obtained, if after the slump measurement has been completed the side of the concrete is tapped gently with the tamping rod. A well proportioned concrete which has an appreciable slump will gradually slump further, but if the mix is harsh it is likely to fall apart.

402.9.2. *Compressive strength test* :—All the tests shall be done on hardened concrete in accordance with IS : 516-1959.

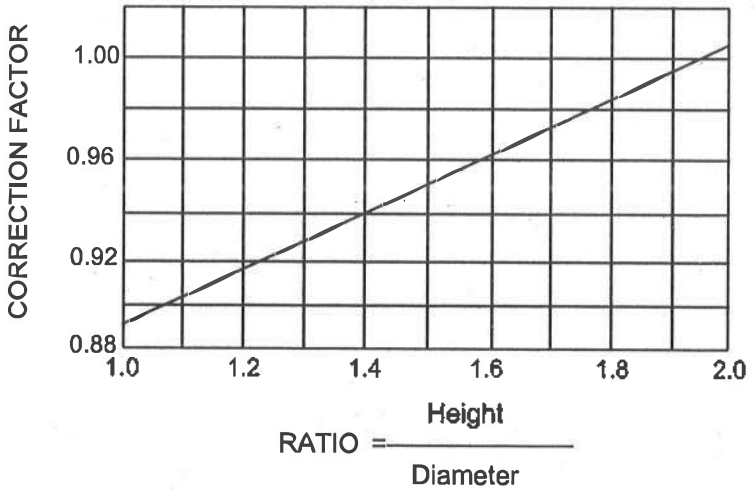
402.9.2.1. *Cube test* :

(a) *Size of cubes* :—In the works test with the approval of the Executive Engineer 100mm. cubes may be used in place of 150mm. cubes provided the maximum nominal size of the aggregate does not exceed 20mm. Even the use of 150mm. cubes shall normally be restricted to concrete having a maximum nominal size of aggregate not exceeding 40mm. Where concrete with aggregates larger than 40mm. size is required to be tested the size of cubes shall be specified by the Executive Engineer keeping in view that generally the length of the side of the cube shall be about four times the maximum nominal size of the aggregate in the concrete constituting the cube specimen. Alternatively 150mm. cube specimens may be used for such concrete by wet screening and removing aggregate pieces larger than 40mm. size.

(b) *Strength in relation to the size of the cube* :—When 100mm. cubes are used the values obtained from tests on 100mm. cubes shall be reduced to the extent established by comparative preliminary tests with 100mm. and 150mm. cubes (or in the absence of such comparative tests by 10 per cent of the value determined from the tests) in order to give the equivalent strength for 150mm. cubes. Where cubes larger than 150mm. are adopted generally no modification is necessary unless otherwise specified by the Executive Engineer.

402.9.2.2. *Cylinder Test* :—Compressive strength test may with the approval of the Executive Engineer be conducted on 150mm. diametre and 300mm. high cylinders in accordance with IS : 5-6-1959 instead of on cubes. Where cylinder strength figures are adopted the compressive strength figures given above shall be modified according to the formula :

Minimum cylinder compressive strength required = 0.8 compressive strength specified for 150mm. cubes.



[Fig. No. 402.2]

CORRECTION FACTOR HEIGHT/DIAMETER RATIO OF A CORE

402.9.2.3. *Core Test* :

Core specimen :—Core specimen for the determination of compressive strength shall be extracted from hardened concrete by using a diamond core bit or other suitable means. The diametre of the specimen shall preferably be atleast three times and in no case less than two times the nominal maximum size of the coarse aggregate. The length of the specimen shall be about twice its diametre and in no case less than the diametre. In case the height/diametre ratio is less than 20 the correction factor shown in Fig. 402.2 shall be applied to get the cylinder compressive strength. The corresponding cube strength shall be then got by adopting the formula in clause 402.9.2.2.

402.9.3. *Modulus of rupture test* :—The test shall be done in accordance with IS : 516-1959.

402.10. Sample, size, sampling frequency and acceptance criteria :—The number of test specimens required, the frequency of sampling and the criteria for acceptance of concrete as conforming to the specified grade shall be in accordance with Table V of IS : 456-1964 for both controlled and ordinary concrete.

402.11. Measurement :—This shall conform to clause 401.7.

402.12. Rate :—This shall conform to clause 401.8. The rate shall include cost of reinforcements also.

Specification No. 403

Reinforced, cement, concrete work

403.1. General :—Unless otherwise specified, R.C.C. work shall be done in accordance with IS : 456-1964 as revised from time to time.

403.1.1. *Terminology* :—This shall conform to SS : 402.

403.2. Materials :

403.2.1. *Coarse aggregate* :—The aggregate shall conform to SS : 108.

403.2.2. *Sand* :— Sand shall conform to SS : 110.

403.2.3. **Cement** :—Cement shall conform to SS : 112.

403.2.4. **Water** :—Water to be used shall conform to SS : 129.

403.2.5. **Reinforcing steel** :—Steel used for reinforcement shall conform to SS : 126.

403.3. Preparation and Laying of reinforcement :—

403.3.1. The reinforcement of the specified size and type shall be cut and bent in accordance with the bar bending schedule.

403.3.2. The reinforcement shall be located exactly in accordance with the drawings and securely tied together with soft iron binding wire of suitable thickness or tackwelded.

403.3.3. Proper care shall be taken by supporting the reinforcement on suitable precast cement mortar blocks of the required thickness at suitable intervals.

403.4. Splices :

403.4.1. As far as possible, reinforcement shall be of full length, but where this is not possible the reinforcement may be spliced by one of the following methods as instructed by the Executive Engineer. (All splices shall be properly staggered) :

(a) Lapping with or without hooks,

(b) Thread connections with bolts and nuts,

(c) Welding.

403.4.2. Where welding is done, representative samples from the welded joint shall be tested if so required by the Executive Engineer before the reinforcement is laid.

403.5. Form Work :

403.5.1. Form work shall conform to the shape, lines and dimensions as shown on the plans and shall be so constructed as to remain sufficiently rigid during the placing and compacting of the concrete. The joints shall be tight and shall permit no leakage of cement slurry.

403.5.2. Suitable struts or stiffeners or tiers shall be used for the form work wherever necessary.

403.5.3. All supports shall be properly braced and cross-braced in two directions.

403.5.4. All splices and braces shall be secured by bolting unless specially instructed otherwise.

403.5.5. All struts shall be firmly supported against settlement and slipping by suitable means as directed.

403.5.6. All supports shall be cut square at both ends and firmly supported against settlement and slipping. When the form work is supported on soils, planks, sleepers, etc., shall be used properly disperse the load. In case the supports rest on already completed beam or slab, suitable props shall be provided under the later.

403.5.7. The form work shall be of well seasoned timber or steel. When timber forms are used unless otherwise specified they shall be lined with M.S. sheets or other suitable smooth faced non-absorbent material as specified. Supports may be of timber or steel. Suitable wedges in pairs to facilitate adjustment and subsequent releasing of forms shall be provided preferably at the upper end of the supports. The details of the proposed form work and supports shall be submitted to the Executive Engineer and got approved before erection. Before laying the reinforcement the forms shall be thoroughly cleaned and lightly oiled unless any other treatment is specified.

403.5.8. In case of columns, retaining walls or other deep vertical components the height of the column shall facilitate easy placement and compaction of concrete and suitable arrangements may be made of securing the form to the already poured concrete for placing the subsequent lifts. No steel ties or wires used for securing this form work shall be left exposed on the face of the finished work.

403.5.9. Suitable inserts for blockouts or electrical and other service fixtures where necessary shall be provided in the required locations as specified.

403.6. Placing of the Concrete :

403.6.1. Concrete shall be thoroughly completed by rodding or by the use of vibrators (e.g., by means of suitable immersion, form, pan or screed vibrators). When vibrators are used concrete shall have suitable consistency and over vibration shall be avoided.

403.6.2. Before laying the concrete the form work with the reinforcement in place shall be inspected and approved by the Executive Engineer.

403.6.3. Care shall be taken to work the concrete thoroughly alround the reinforcement particularly in congested locations.

403.7. Construction Joints :

403.7.1. Vertical joints in floor and roof slabs shall be provided in the case of long buildings of more than 30m. in length, specially when the widths or depths of such building are less than 15m. and when narrow corridors connect blocks of relatively greater widths. The most suitable positions for such vertical joints are where the corridors take-off from inner blocks. On soils such as black cotton, such joints are more essential, shall be invariably provided at the places shown in the drawings or as directed by the Executive Engineer.

403.7.2. *Location of construction Joints* :

403.7.2.1. Construction joints when necessary shall be located as follows :

In the main beams over the centre of supports.

403.7.2.2. No vertical joints shall be permitted in case of main beams. In other cases they shall be provided if necessary in the following locations :

(a) in subsidiary beams at mid span ;

(b) in the case of slabs, the joints wherever possible shall be parallel to the main reinforcement in the case of one way reinforced slabs and over the centre of supporting beams or walls in other cases.

403.7.2.3. In general the joints shall not be provided in locations of considerable shear or under concentrated loads.

403.7.2.4. Suitable water stops as specified shall be provided in the case of water retaining structures.

403.8. Expansion Joints :

403.8.1. Wherever required, expansion joints shall be provided in accordance with the drawings.

403.8.2. Expansion joints shall be provided in the case of very long structures at locations of large variation in the height or width of the structure or where differences in foundation conditions are involved.

403.8.3. They shall be constructed in accordance with the drawings or as directed by the Executive Engineer.

403.9. Bearings of R.C.C. Slabs and Beams :

403.9.1. Where supports are not monolithic with the beam or slab the bearing surface shall be plastered with cement mortar (1 : 3) with the craft paper laid over the plaster before laying the concrete.

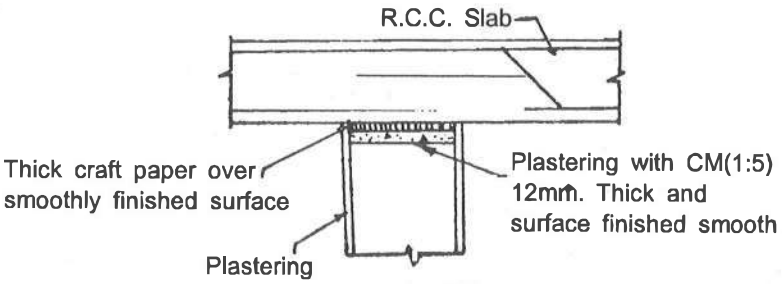
403.9.2. The vertical face of the masonry rebate at bearings shall be plastered smooth with C.M. (1 : 3). A gap of 12 mm. wide shall be left between the vertical face of the masonry and the beam face. This space shall be filled with a filler in the form of pads before the concrete is laid. This is illustrated by Figures. (Fig.403-1 and Fig. 403-2).

403.10. Removal of Form-work :

403.10.1. All form-work shall be removed without causing any shocks or vibrations to the structure.

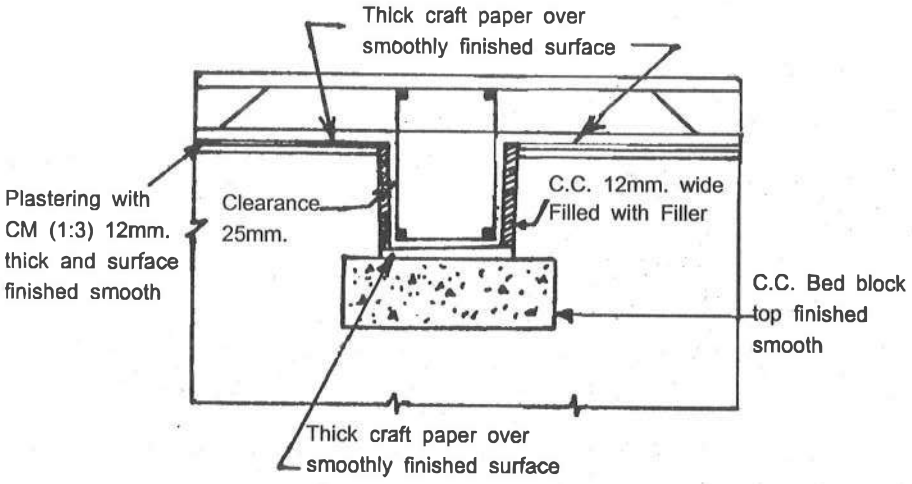
403.10.2. After the expiry of the period specified in clause 403.10.3 the wedges at the supports shall be loosened and the concrete watched for any distress after which the supports shall be completely removed.

SLAB BEARING OVER WALL



[Fig. 403.1]

R.C.C. T—BEAM AND SLAB BEARING OVER WALL



[Fig. 403.2]

403.10.3. In the case of big works where earlier removal of shuttering is necessary for economy in shuttering, the time limits may be deviated from on the approval of the Executive Engineer who will then give his orders based on the merits of each individual case. In deciding the time limit the following table which gives the minimum intervals of time between the placing of concrete and striking of the shutters may be used as a guidance. (In case this table is proposed to be followed it will be definitely specified so in the tender notice).

Table No. 403-A

	Removal of shuttering		*Normal portland cement concrete placed in normal weather conditions, (days)*
(a)	Walls, columns and vertical sides of beams and slabs	—	24 to 48 hours
(b)	Removal of props to slabs :		
	(i) Spanning upto 4.5. metres	—	7 days
	(ii) Spanning over 4.5. metres	—	14 days
(c)	Removal of props to beams and arches :		
	(i) Spanning upto 6 metres	—	14 days
	(ii) Spanning over 6 metres	—	21 days

403.10.4. In the case of cold wether it may be necessary to increase the above periods as directed by the Executive Engineer.

403.11. The structure shall not be put to normal use earlier than 28 days after completion.

403.12. Load testing of structures :

403.12.1. Loading tests on a completed structure shall be made if required by the specification or by the Executive Engineer in the event of a reasonable doubt as to the adequacy of the strength of the structure. Such tests shall be made after the expiry of 56 days of effective hardening of the concrete.

403.12.2. In such tests superimposed tests load on any structure shall unless otherwise specified be equal to one and quarter times the specified superimposed load for which such structure has been designed and this load shall be maintained for a period of 24 hours before removal. During the test struts strong enough to take the whole load shall be placed in position leaving a gap under the members.

403.12.3. If within 24 hours of the removal of the load the structure does not show a recovery of at least 75 per cent of the maximum deflection shown during the 24 hours under load, the test loading shall be repeated after a lapse of at least 72 hours. The structure shall be considered to have passed the test if the recovery after the second test is at least 75 per cent of the maximum deflection shown during the second test.

403.12.4. If the reinforced concrete structure satisfies the tests made, the payment for the labour involved in the test loading shall be made to the contractor under clause 63 of "Preliminary Specifications". If the reinforced concrete does not satisfy the tests no payment shall be made for the test and the whole work shall be liable for rejection and shall be redone at the contractor's expense. Thereby the contractor shall not be absolved from his liabilities under the "Rate of progress" clause in the "Articles of Agreement" to stick up to the original programme of completion of the work in time.

403.12.5. If during the test or upon removal of the load the member shows signs of weakness or faulty construction it shall be reconstructed or strengthened as may be ordered by the Executive Engineer at the contractor's cost.

403.13. Measurement :—This shall conform to clause 401.7. Measurement and check measurement of reinforcement shall be done before laying the concrete.

403.14. Rate :—The unit rate shall usually be per cu.m. or in the case of floors and roofs it may be per sq.m. of a specified thickness. The unit rate shall include complete execution of the work built in place inclusive of cost of materials, tools and plant, forms, finishing, curing and all other works involved in complying with this specification and the addendum specifications if any and the contract drawings. Extra leads and lifts shall be paid for separately. Where tests are specified by the Department the cost of testing shall be borne by the department, except where the materials have failed in which case the cost of such tests shall be borne by the contractor or supplier in addition to the rejection of the materials and redoing of the work at his expense.

Specification No. 404

Repair grouting to aprons and revetments with surki concrete and pointing with surki mortar

404.1. The surface of the apron or revetment shall be thoroughly cleaned and joints raked out to 250mm. depth or to any other depth as specified by the Executive Engineer. The whole surface shall be swept clean.

404.2. The joints shall then be filled in with surki concrete made with surki mortar (1: ½ : ½) as per SS : 114 and graded broken brick or broken brick aggregate of maximum size 20 mm. If the interstices are large, a larger size aggregate as specified by the Executive Engineer may be used. The concrete shall be rammed with flat bars, trowels or flat ends of small thin crowbars to ensure effective consolidation.

404.3. The surface shall then be neatly flush pointed with surki mortar (1 : ½ : 1) as per SS : 114, covering the joints of the newly laid concrete to the depth of pointing while the concrete filling is still green.

404.4. The concrete and pointing shall be continuously kept wet at all stages of the work and for three weeks after completion.

404.5. Measurement :—All linear measurements shall be in metres, correct to 0.01 of a metre. All areas shall be worked out in square metres, correct to 0.01 of a square metre.

404.6. Rate :—The unit rate shall be per 10 square metres. The rate shall include surface cleaning, filling joints with surki concrete, ramming, pointing, watering and tools and appliances required for completing the grouting operation. This shall also include the cost of baling but of water where required, unless otherwise specified. Extra leads and lifts shall be paid separately.

Specification No. 405

Prestressed concrete work

405.1. Scope :—This specification covers prestressed concrete work for bridges, buildings, pipes, tanks, pavements, transmission poles, etc.

405.2. Materials :

405.2.1. *Concrete* :—Concrete shall generally conform to SS : 402 as specified for reinforced concrete. Only controlled concrete of grade not less than M 350 shall be used. In addition to control tests at 7 days and 28 days age, additional tests shall be conducted at intermediate ages where so specified, to determine the strength of concrete at transfer or for stage prestressing. Unless otherwise specified, ordinary or rapid hardening portland cement conforming to SS :112 shall be used. The quantity of cement used shall not be less than 360 kg./cu.m. of concrete.

405.2.2. *Steel* :—Steel for untensioned and prestressed reinforcement shall conform to SS : 126.

405.2.3. *Sheaths* :—Sheaths shall be manufactured from bright or galvanized metal sheets or any other specified material. They shall be preferably machine made and of a large enough bore to allow easy threading of the cable or bars in long lengths.

They shall be strong enough so as not to be dented or deformed during handling or concreting.

405.2.4. *Anchorages* :—Preferably proprietary forms of anchorages shall be used and they shall be strictly in accordance with the manufacturer's specifications. If the Executive Engineer so instructs a few of the anchorages proposed to be used shall be got tested.

405.2.5. *Grout* :—Ordinary portland cement conforming to SS :112 shall normally be used for grouting. However at temperatures less than 7 °C rapid hardening portland cement conforming to SS :112 may be used where so specified.

Sand where used for large ducts shall be of a size smaller than 2 mm.

Water shall generally conform to SS : 129. Special care shall however be taken to ensure that it does not contain ingredients likely to include corrosion of steel.

Plasticizers or other additives shall be used only when specifically permitted. Additives containing chlorides, nitrates or other ingredient which induce corrosion of steel shall not be permitted.

The compressive strength of the grout after 7 days moist curing measured on 100mm. cubes shall be at least 175 kg./sq.cm.

405.3. Workmanship :

405.3.1. *General* :—Workmanship shall in general conform to SS : 403.

405.3.2. *Handling prestressing steel* :

405.3.2.1. *Cleaning* :—All prestressed steel shall be free from loose mill scale, rust, oil, grease or any harmful matter at the time of its placing in the member. A slight film of rust is however not harmful.

Cleaning of the steel may be carried out by immersion in suitable solvent solutions, wire brushing or passing through a pressure box containing carborundum powder.

405.3.2.2. *Straightening* :—As far as possible prestressing wire shall be obtained from the manufacturers in coils having diameter of not less than 350 times the diameter of the wire, so that the wire springs back straight on being uncoiled. If due to smaller diameter of the coil or any other reason it does not happen, the wire shall be carefully straightened before use.

Prestressing steel bars shall be obtained from the manufacturers in straight lengths. Any small adjustments necessary at the site shall be made by careful cold bending.

Bars shall not be bent when their temperature is less than 10°C.

405.3.2.3. *Positioning* :—Prestressing steel shall be accurately located and maintained in position, both vertically and horizontally as specified.

The method of supporting and fixing shall be such that the profile of cables is not disturbed by heavy and prolonged vibrations by pressure of wet concrete, by workmen or by construction traffic.

The steel sheaths or duct formers shall be suitably tied to the secondary reinforcement or to withdrawable bolts, precast concrete blocks or other effective means in such a manner that they do not give rise to excessive friction when the steel is being tensioned.

405.3.2.4. *Cutting* :—All cuttings to length and trimming of ends shall be done by suitable mechanical or flame cutters. When a flame cutter is used care shall be taken to ensure that the flame does not come in contact with other stressed steel.

In post-tensioning, ends of prestressing steel projecting beyond the anchorages be cut after the grout has set.

405.3.2.5. *Splicing* :—Prestressing reinforcement may be spliced with suitable coupling units which shall have ultimate tensile strength not less than that of individual wire or bar being jointed.

Welding of prestressing steel shall in no case be permitted.

405.3.2.6. *Protection* :—Internal prestressing steel shall be protected by grouting as detailed in clause 405.5.

External prestressing steel shall be protected by encasing it in a dense concrete cover secured to the main concrete.

405.3.3. *Placing of sheaths* :—Sheaths shall be sufficiently water tight to prevent concrete laitance penetrating them in quantities likely to increase friction. Special care shall be taken to ensure water tightness at joints.

The alignment of all sheaths and extractable cores shall be strictly as specified and maintained securely to prevent displacement during placing and compaction of concrete.

405.3.4. *Placing of anchorages* :—Anchor cones, blocks and plates shall be positioned and maintained during concreting so that the centre line of the duct passes axially through the anchorage assembly.

All bearing surfaces of the anchorages shall be cleaned prior to concreting and tensioning.

Adequate provision shall be made for protection of the anchorage against corrosion.

405.4. Tensioning :

405.4.1. *Equipment* :—The equipment used for prestressing shall be of suitable hydraulic or mechanical type and shall satisfy the following general requirements.

(i) It shall be capable of applying the controlled force without inducing undesirable secondary stresses in the anchorages, reinforcement or concrete;

(ii) Where two or more wires are stressed simultaneously, provision shall be available for equal stressing of the wires;

(iii) Suitable means shall be provided for direct measurement of the force in prestressing steel during all stages of tensioning as well as elongation of the prestressing steel.

(iv) All load measuring devices shall be kept properly calibrated. Permissible errors shall not exceed 5 plus or minus %.

405.4.2. **Procedure** :—

405.4.2.1. *General* :—The tensioning shall be carried out under competent supervision in such a manner that the stress in the steel increases at a gradual and steady rate.

No prestress shall be transferred to the concrete until it attains the specified strength at each stage.

No tensioning shall be carried out when the temperature is less than 2 °C.

Prestressing forces to be applied and corresponding extensions shall be worked out in advance taking into account all losses. No alterations shall be allowed unless specifically approved. A detailed record of the forces applied and the observed elongation shall be maintained.

405.4.2.2. *Pre-tensioning* :—It shall be ensured that the tension is maintained fully by some positive means during the period between tensioning and transfer.

In the long line method of prestressing, sufficient locator plates shall be distributed throughout the length of the bed to ensure that the wires are maintained in their proper positions during concreting. Where a number of units are fabricated in a line the moulds shall be free to slide in the direction of their length and thus permit transfer of the prestressing forces to the concrete along the whole line.

Sufficient space shall be left between ends of adjacent units to permit access for cutting of wires after transfer of stress.

The wire shall be cut in such a manner that the lateral eccentricity of the prestress in minimum.

Moulds when required to sustain the reaction from the prestressing force shall be sufficiently rigid.

405.4.2.3. *Post-tensioning* :—Where wires in a cable are not stressed simultaneously, spacers shall be securely held in position so as not to be displaced during successive tensioning operations.

Wires and cables shall be so arranged that they do not pass round sharp corners or bends avoiding setting up of high local stresses.

After the steel has been anchored the force exerted by the tensioning equipment shall be decreased gradually and steadily, so as to avid shock to the prestressing steel or anchorage.

In the case of precast concrete units which are to be prestressed together it shall be ensured that the faces in contract are true and the duct holes are properly aligned.

405.4.3. *Safety precautions* :—All reasonable precautions shall be taken when working with or near steel which has been tensioned or is in process of being tensioned. Personnel shall neither stand in line with the steel anchorages or the jacking equipment, nor shall they walk on the steel. Effective protective measures such as stout timber shields armoured with steel sheet shall be placed in line with prestressing steel and behind the jacks, so as to protect personnel crossing in the course of their duties.

405.5. Grouting :—

405.5.1. *Equipment* :—The equipment shall be capable of producing a grout of colloidal consistency and delivering it at pressures upto 7kg./sq.cm., under continuous operation without any appreciable pressure fluctuations. It shall also include provision for recirculating the grout while actual grouting is not in progress.

405.5.2. *Mixing* :—Water shall be added to the mixer first and then the cement added. After these have been thoroughly mixed sand in the specified proportion and the additive if specified shall be added. Mixing shall continue for at least 2 minutes or until a uniform consistency is obtained.

Unless otherwise specified the water cement ratio shall not exceed 0.45.

405.5.3. *Injection* :—Injection shall be continuous. Grout shall be allowed to flow from vent openings until its consistency at exit is comparable to that of the grout injected. The vent openings shall thereafter be firmly closed one after another in the direction of flow starting with the vent nearest the pump.

Sufficient pressure shall be used to force the grout completely through the duct care being taken not to rupture the ducts.

Grouting shall be carried out as soon as practicable after the steel has been stressed.

The injection tubes shall be topped up with cement grout if any wastage or subsidence of grout occurs when the pump is disconnected.

When grouting is done at temperature below 7°C provision shall be made for thoroughly protecting the concrete member against frost. Grouting is not recommended in very cold weather.

405.6. Storage, transportation and handling :—Precast structural members shall be transported and stored in such a manner that the stresses induced in them at all stages are always less than the permissible design stresses. Special care shall be taken during handling, transport and storage to ensure that the points of support and direction of the reactions are approximately the same as they would be during service. Care shall also be taken during storage, hoisting and transportation of the members to avoid damage due to any other causes.

405.7. Measurement :—All linear measurements shall be in metres, correct to 0.01 of a metre. Volumes shall be worked out in cubic metres, correct to 0.01 of a cubic metre. Weights shall be assessed in tonnes, correct to 0.01 of a tonne. If high tensile steel is to be paid for separately its length shall be measured as actually used in the finished work and its weight shall be calculated in tonnes. Alternatively, the weight of high tensile steel shall be calculated from the Tables in IS : 1732-1961.

Anchorage devices, ducts or metal sheath and mild steel shall be deemed to be included in the item of high tensile steel and shall not be measured separately.

405.8. Rate :—Unless otherwise specified the unit rate for prestressing cast-in-place concrete shall be per cu.m. and shall include full compensation for furnishing of labour, materials, tools, equipment, form work, finishing, curing and incidents and for doing all work involved in furnishing, placing and tensioning the prestressing steel cast-in-place, concrete structures, complete in place as specified in these specifications and the special provisions thereof or as directed by the Executive Engineer. The unit rate shall also include compensation for furnishing and placing additional reinforcing steel required by the particular system used (i.e., ducts, metal sheath, anchoring devices, distribution plates or assemblies and incidental parts) and for furnishing samples for testing, for grouting recesses and pressure grouting ducts.

In case high tensile steel is to be paid for separately the unit rate for high tensile steel shall be per tonne and shall cover the cost of all materials, labour, tools and plant required for fixing, placing, tensioning, anchoring and grouting the high tensile steel in the prestressed cement concrete as specified in these specifications here in above. The cost of anchoring devices and ducts or metal sheath shall also be included in this rate.

For pre-cast prestressed concrete members the rate in addition to the above shall also include the cost of all materials, tools and plant required to transport and place these members in their final positions in the work as specified and as directed by the Executive Engineer. Extra leads and lifts shall be paid for separately. Where tests are specified by the department the cost of testing shall be borne by department except where the materials have failed in which case the cost of such tests shall borne by the contractor or supplier in addition to the rejection of the materials and redoing of the work at his expense.

SECTION 5

STANDARD SPECIFICATIONS FOR BRICK MASONRY

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SECTION 5

STANDARD SPECIFICATIONS FOR BRICK MASONRY

Specification No. 501

Brick Masonry - General

501.1. Terminology :—

501.1.1. *Quoin* :—An external corner in brick work, the term may also denote the masonry unit used to form the quoin.

501.1.2. *Squint* :—A brick of special shape used at an oblique quoin. (See Fig. 571-1A).

501.1.3. *Bat* :—Any portion of a brick, cut or broken across its length usually known according to its fraction from the whole size, as for example half bats, three fourth bats, etc.

501.1.4. *Closer* :—Part of a brick either manufactured or cut from a whole brick and used to maintain bond.

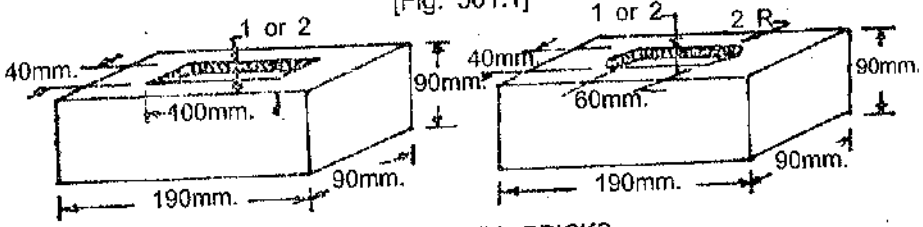
Bevelled closer—Illustrated in Fig. 501-1B.

King closer—Illustrated in Fig. 501-IC.

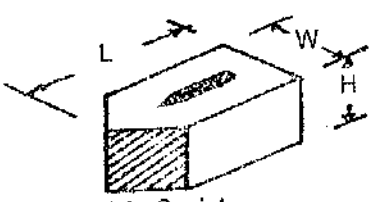
Queen closer—Illustrated in Fig. 501-ID.

DIFFERENT TYPES OF PART-BRICKS

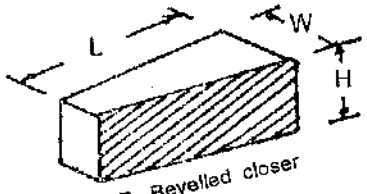
[Fig. 501.1]



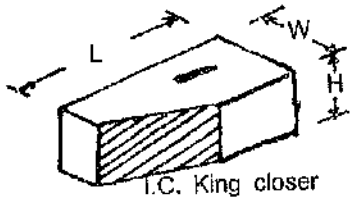
SIZES OF FULL BRICKS



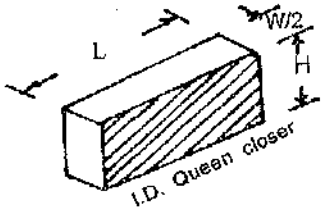
I.A. Squint



I.B. Bevelled closer



I.C. King closer



I.D. Queen closer

L = Legnth of Modular Brick
W = Width of Modular Brick
H = Height of Modular Brick

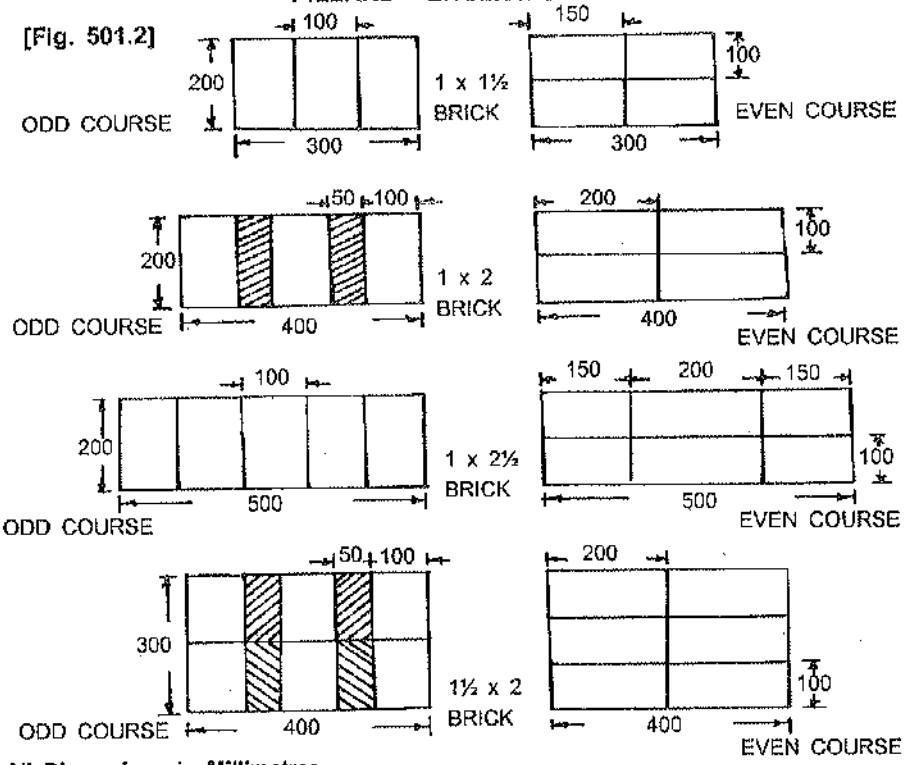
501.2. Materials :

501.2.1. *Bricks* :—Unless otherwise specified common burnt clay bricks shall conform to SS : 102.

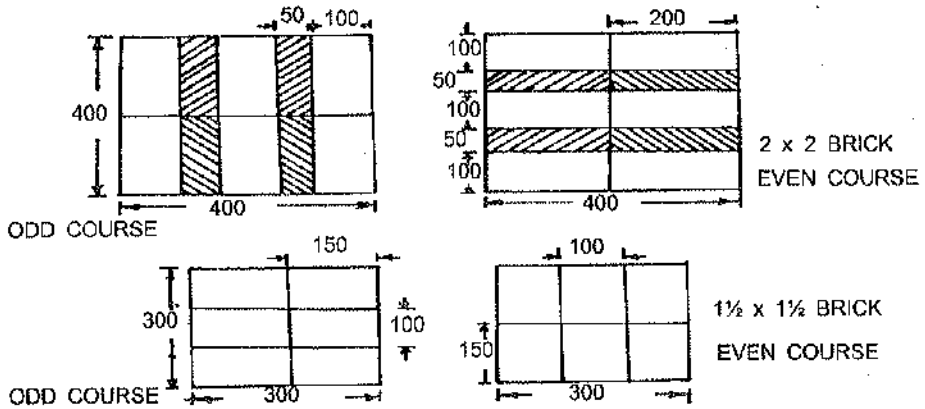
501.2.2. *Mortar* :—This shall be specified type and shall conform to SSs. : 113 to 116.

PILLARS - ENGLISH BOND

[Fig. 501.2]



All Dimensions in Millimetres



501.3. Joints in Brick work :—The thickness of joints in the case of masonry with first class bricks shall not be more than 10mm., and in the case of masonry with second class bricks shall not be more than 12mm.

501.4. Scaffolding :

501.4.1. Scaffolding shall be designed to withstand all the dead, live, and impact loads which are likely to come on them. They shall also be so designed to ensure the safety of the workmen using them and shall conform in all respects to the requirements of the relevant building regulations on safety, health, and welfare, and also the local building bye-laws.

501.4.2. For exposed brick work or title work double scaffolding having two sets of vertical supports shall be provided. The supports shall be sound and strongly tied together with horizontal pieces over which the scaffolding planks shall be fixed. For brick masonry to be covered with plaster, single scaffolding shall be allowed. In this case, the inner end of the horizontal scaffolding pole shall rest in a hole provided in the header course only. Only one header for each pole shall be left out. Such holes however shall not be allowed in pillars under one metre in width, or immediately near the skew backs, of arches. The holes left in masonry work for supporting the scaffoldings shall be filled and made good, before plastering.

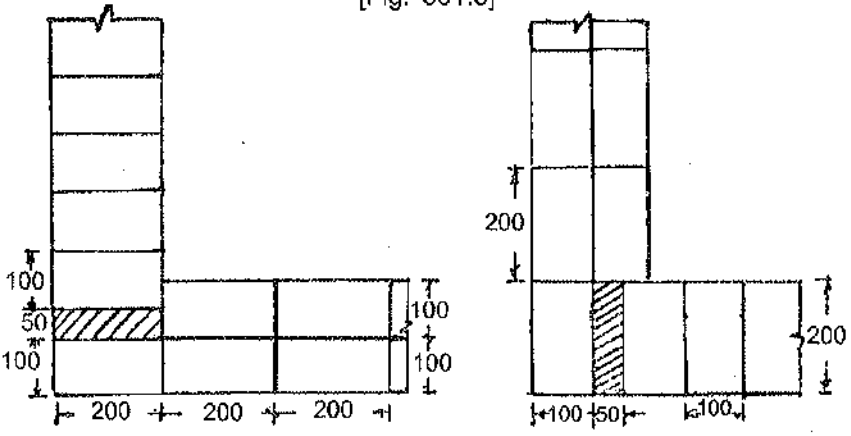
501.4.3. The contractor shall be responsible for providing and maintaining sufficiently strong scaffolding so as to withstand all loads likely to come upon it.

501.5. Soaking of Bricks :

501.5.1. Bricks required for masonry in cement or composite lime mortars, shall be thoroughly soaked in clean water for atleast an hour in brick lined tanks of sufficient size immediately before use. The cessation of bubbles, when the bricks are immersed in water, is an indication of thorough soaking of bricks. The soaked bricks shall be kept on wooden planks or brick platforms to avoid contact with earth.

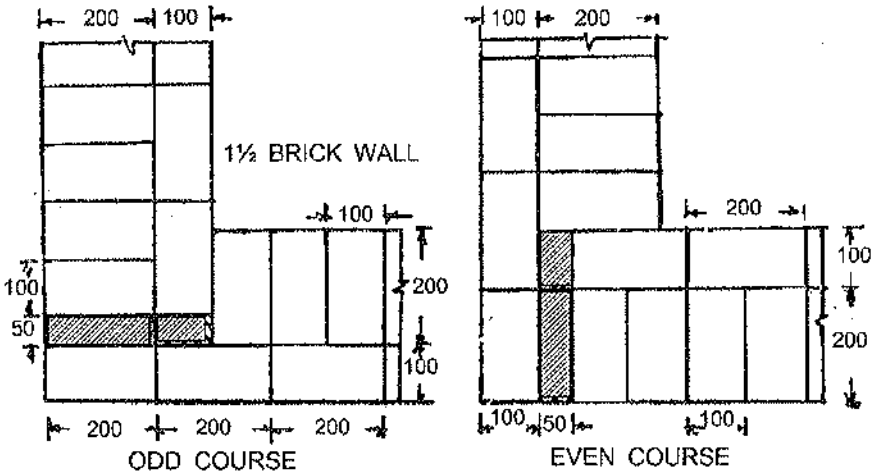
DETAILS OF BRICK BONDS (English Bond)

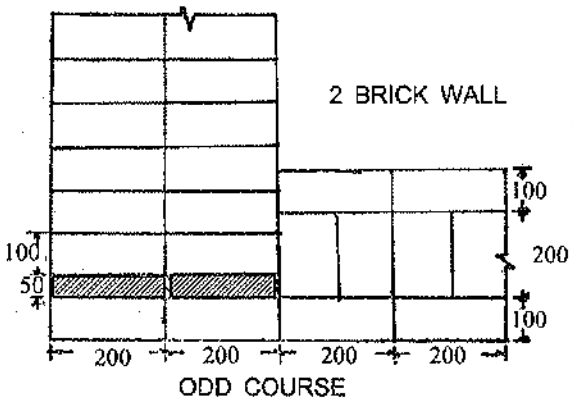
[Fig. 501.3]

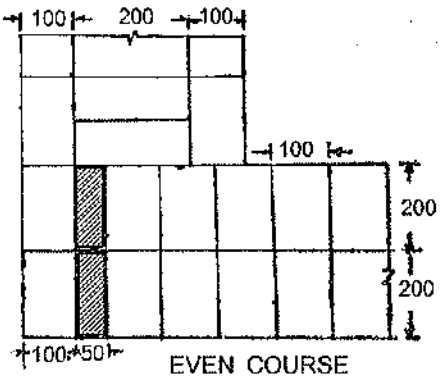


ODD COURSE EVEN COURSE

DETAILS OF BRICK BONDS (English Bond)

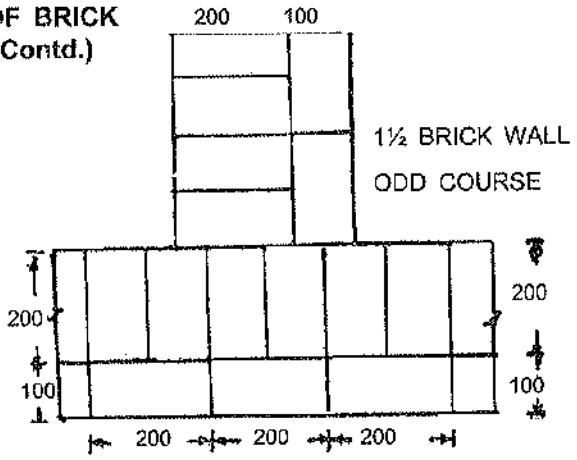


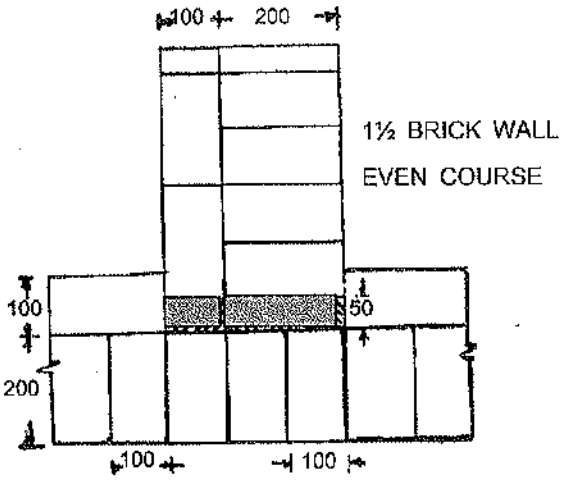




[Fig. 501.3]
All Dimensions in mm.

DETAILS OF BRICK BONDS (Contd.)





All Dimesions in mm.

[Fig. 501.4]

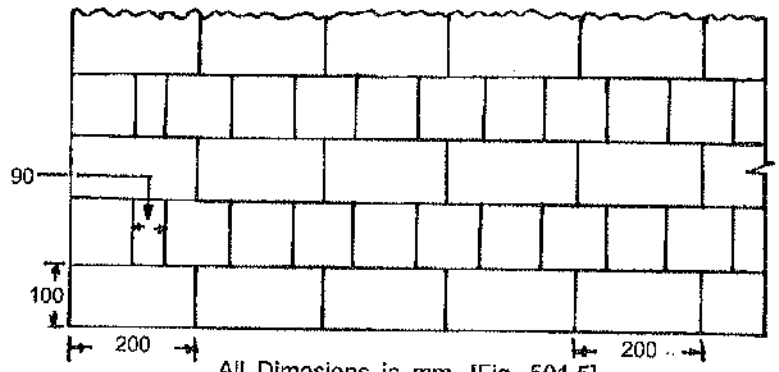
501.6. Laying :

501.6.1. *General* :

501.6.1.1. Brick work shall be laid in English bond as shown in Figures 501.2 to 501.5 unless specified otherwise. Half or cut bricks shall not be used except where necessary to complete the bond. Closers in such cases shall be cut to the required size and used near the ends of walls.

501.6.1.2. For exposed brick work selected bricks shall be used for the face.

DETAILS OF BRICK BONDS (Contd.)



All Dimesions in mm. [Fig. 501.5]

Elevation of Wall

501.6.1.3. *Method of laying* :—The bricks shall be laid as follows :

A layer of mortar shall be spread on full width for suitable length of the lower courses. Each brick shall first be laid so as to project over the one below, both at the end and at the side, then pressed into the mortar and shoved into final position, and set home by gentle tapping with the handle of a trowel or a wooden mallet. Its inside faces shall be buttered with mortar before the next brick is laid and pressed against it. On completion of a course, the vertical joint shall be fully filled from the top with mortar.

501.6.1.4. The walls shall be taken up truly plumb. All courses shall be laid truly horizontal and all vertical joints shall be truly vertical. Vertical joints in alternate courses shall come directly one over the other. The thickness of brick courses shall be kept uniform and for this purpose wooden straight edge with graduations giving thickness of each brick course included joint shall be used. The height of window sills, bottom of linte and such other important points in the height of the walls shall be marked on it. Bricks shall be laid with frogs upwards. A set of tools comprising of wooden straight edges, Mason's spirit level, square half metre rule, line and pins, string and plumb shall be kept on the site of work.

501.6.1.5. Both the faces of walls of thickness greater than 200mm. shall be kept in proper plan. All the connected brick work shall be carried up nearly at one level and no portion of the work shall be left more than one metre below the rest of the work. Where this is not possible the work shall be raked back according to bond (and not left toothed) at an angle not steeper thean 45°.

501.6.1.6. All iron fixtures, pipes, outlets of water, hold-fasts of doors and windows, etc., which are required to be built in walls shall be built in walls shall be embedded in cement mortar in cement concrete as specified, in their positions as the work proceeds. Cement concrete shall be paid for separately. Fixing of steel and Aluminium doors, windows and ventilators shall be done in accordance with SS : 1610.

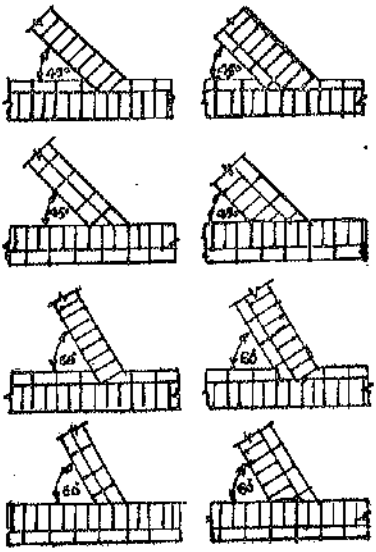
501.6.1.7. The flue of the chimney shall be pargetted that is plastered with mud gobar mortar (3 mud : 1 gobar) as the work proceeds.

501.6.1.8. *Joints* :—Bricks shall be so laid that all joints are quite full of mortar. The thickness of joints shall be as described in clause 501.3. The face joints shall be raked to a minimum depth of 15mm. by a jacking tool daily during the progress of work when the mortar is still green so as to provide proper key for the plaster or pointing to be done. Where plastering or pointing is not required to be done, the joints shall be struck flush and finished at the time of laying. The face of brick work shall be cleaned the very day after brick work is laid and all mortar droppings removed.

501.6.2. *Walls* :

501.6.2.1. All quoins shall be accurately constructed and the heights of the courses checked with storey rods as the work proceeds. In general quoin-bricks shall be headers and stretchers in alternate courses, the bond being established by placing a quoin closer next to the quoin header.

501.6.2.2. Acute and obtuse quoins shall be bonded, where practicable, in the same way as square quoins. Obtuse quoins shall be formed with squints showing a three-quarter brick on one face and a quarter brick on the other. See Figs. 501.6 and 507.7.



[Fig. 501.6]

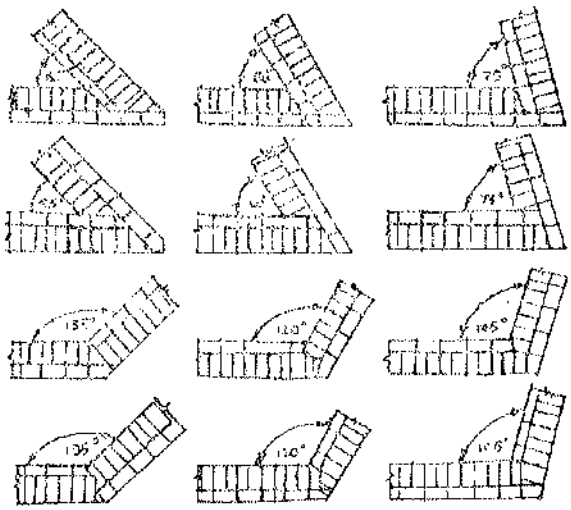
SQUINT JUNCTIONS IN ENGLISH BONDS

501.6.3. *Pilasters* :—These shall be so set out as to avoid broken bond.

501.6.4. *Openings* :

501.6.4.1. Door and window openings shall have arch work or lintels (stone or R.C.C.) over them of type as specified or as directed by the Executive Engineer where so specified a splay of (1 : 4) to (1 : 6) shall be provided in the jambs on inner sides, in cases where a door or window opens inward.

501.6.4.2. The depth of reveals and rebates shall, where, practicable, conform to standard brick sizes in order to avoid cutting of bricks and thereby weakening the work.



[Fig. 501.7]

ACUTE AND OBTUSE SQUINT QUOINS IN ENGLISH BONDS

501.6.4.3. The arrangement of bond at quoins at jambs of openings shall be symmetrical.

501.6.5. *Partitions* :—For half-brick portions to be keyed into main walls, indents shall be left in the later.

501.6.6. *Brick coping & cut brick corners* :—Care shall be taken that the bricks forming the top courses of all plinth parapets steps, the tops of walls below RCC slab and ends of walls shall be properly radiated and keyed into position as shown in Fig. 501-8.

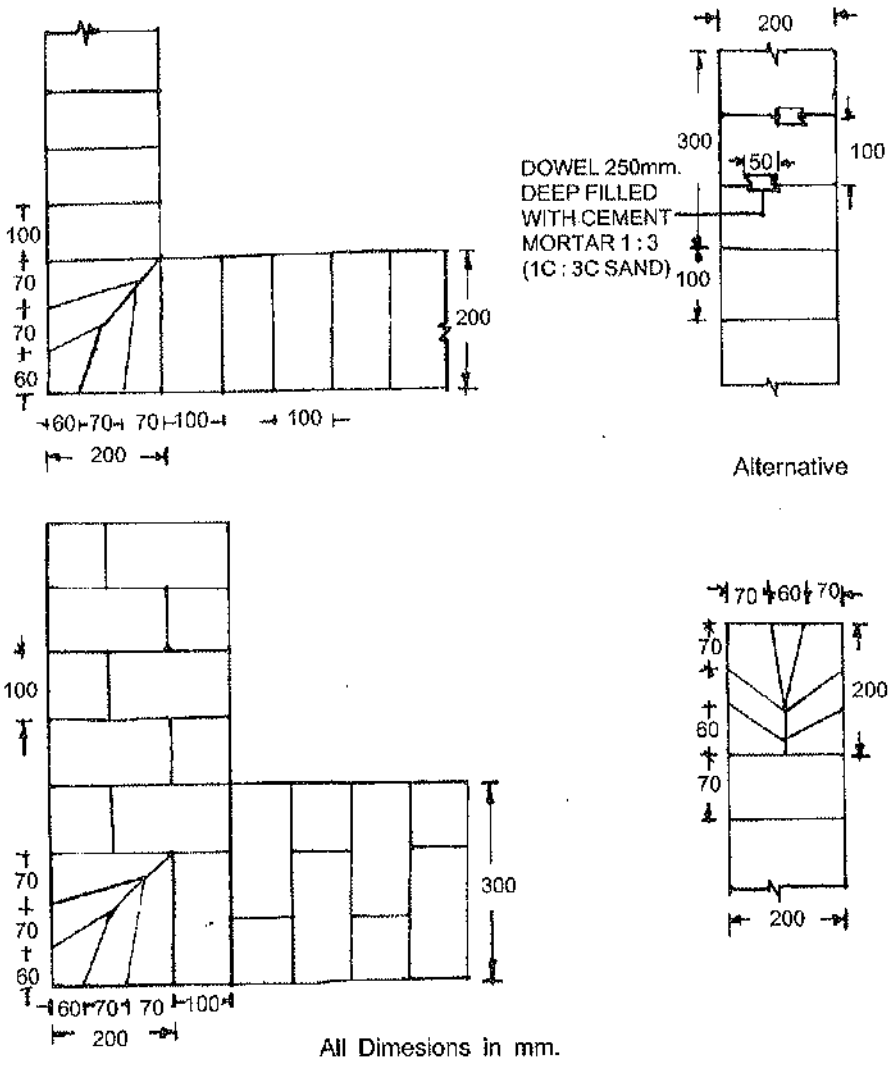
501.6.7. *Treatment at the ends of the beams and joists* :—The ends of all wooden beams, wooden roof trusses, etc., shall rest in recesses having 40mm. space, for the free circulation of air all round them and provided with perforated zinc sheeting. Where it is necessary to build ends of steel joists or other steel work into masonry, the masonry for atleast 130mm. all-round the imbedded steel shall be in cement mortar. Corbels under heavy beams, cornices or brick under joists and bed plates for beams, girders and trusses shall be built-in, as the work proceeds in accordance, with the drawings and addendum specifications, if any supplied.

501.7. Protection against damages :

501.7.1. Care shall be taken during construction that edges of jambs, sills, heads, etc., are not damaged.

501.7.2. The brick work shall be protected from the effects of sun, rain, frost, etc., (during the construction and until such time it is green and likely to be damaged) by covering with gunny bags, straw, etc.

501.8. Curing :—All masonry built with surki, hydraulic lime or cement mortar shall be kept wet for a period of two weeks after laying, unless a longer period is stipulated by the Executive Engineer.



All Dimesions in mm.

[Fig. 501.8]

SKETCHES SHOWING TOP COURSES CUT BRICK CORNER [MARU CONA]

501.9. Final Finish :

501.9.1. Unless otherwise specified all brick work shall be plastered as per the relevant standard specification for plastering as mentioned in the Tender Schedules.

501.9.2. Where pointing is specified it shall be done as per the relevant standard specification for pointing as mentioned in the Tender Schedules. After the pointing is properly curved the wall face shall be washed clean and stains and adhering mortar lumps removed.

501.10. Measurement :

501.10.1. The quantity of brick work to be paid under this item shall be in number of cubic metres measured of the completed brick work and limiting the dimensions to those shown on the plans. Battered, tapered and curved portions shall be measured net. Dimensions shall be measured correct to 0.01 of a metre and the quantities of individual items worked out correct to 0.1 of a cubic metre respectively.

501.10.2. The work shall be measured in the following categories in convenient stages stating the height or depth :

(i) From foundation to plinth level,

(ii) From plinth level to floor two level,

(iii) From floor two level to floor three level and so on,

(iv) Brick work in the parapets shall be measured and paid for separately.

501.10.3. Corbels, string courses, projecting pilasters, aprons and sills, cornices, drip courses, oversailing courses and other projections, etc., of splayed, bull-nosed or any other type or purpose made, or cut bricks shall be measured separately in running metres stating the dimensions of each.

501.10.4. No deductions shall be made, nor any extra payment made for the following:

(i) Ends of dissimilar materials (i.e., joists, beams, posts, girders, rafters, purlins, trusses, corbels, steps, etc.) each 0.05m^2 in section or less.

(ii) Openings each upto 0.01m^2, (in calculating the area of the openings any separate lintels or sills shall be included along with the size of the openings but the end portions of the lintels shall be excluded and the extra widths of the rebated reveals if any shall also be excluded).

(iii) Wall plates and bed plates, bearings of slabs, chajjas, and the like, where the thickness does not exceed 100mm. and the bearing does not extend over the full thickness of the walls.

501.10.5. Masonry (excluding fire brick work) in chimney breasts, chimney stacks, smoke or air flues upto 0.20 sq.m. sectional area, shall be measured as solid and no extra payment shall be made for pargetting and corning such flues. Where flues exceed 0.20 sq.m. in sectional area, deductions shall be made for the same and pargetting and coning flues paid for separately.

501.10.6. Appertures for fire places shall not be deducted and extra labour shall not be measured, for splaying of jambs and throating.

501.11. Rate :—The Rate shall be for a unit of one cubic metre of finished work inclusive of conveyance, scaffolding, construction, quoins and jambs, smooth rubbing of joints, curing, etc., complete in all respects.

Specification No. 502

Brick in Lime Mortar

502.1. All relevant clauses of SS : 501 shall apply.

502.2. Materials :

502.2.1. *Bricks* :—Whether first class or second class bricks are to be used shall be specified and shall comply with SS : 102.

502.2.2. *Lime mortar* :—The mortar shall conform to SS : 113 and the proportion of lime mortar shall be as specified in the relevant schedule item.

Specification No. 503

Brick in Surki Mortar

503.1. This shall be same as for SS : 502, except that Surki mortar complying to SS : 114 shall be used in this case.

Specification No. 504

Brick in Cement Mortar

504.1. This shall be same as for SS : 502, except that the cement mortar of specified proportion to be used shall conform to SS : 115.

Specification No. 505

Brick in Cement Lime Mortar

505.1. This shall be same as for SS : 502, except that the cement lime mortar of specified proportion to be used shall conform to SS : 116.

Specification No. 506

Brick work in Clay

506.1. All relevant clauses of SS : 501 shall apply.

506.2. Materials :

506.2.1. *Bricks* :—Second class bricks conforming to SS : 102 shall be used.

506.2.2. *Mud mortar* :—Mud mortar shall be as per clause 616.2.

506.3. Work shall be carried out as per SS : 502 with the exception that clay replaces the lime mortar. Thickness of joints shall not exceed 12mm. The bricks require no wetting before use and no curing is necessary.

Specification No. 507

Brick Arch Work

507.1. All relevant clauses of S.S. 501 shall apply.

507.2. Materials :

507.2.1. *Bricks* :—Bricks shall be of first class or second class of the specified type and shall be cut and rubbed to the required shape to give uniformly wide radial joints unless specially moulded bricks are specified. The bricks shall generally comply with SS : 102.

507.2.2. *Mortar* :—Mortar shall be of specified proportion and shall conform to SS : 113 to 116.

507.3. Form work :—Form work and centering for arches shall be erected and got approved by the Executive Engineer before the arch work is started. It shall be strong enough to bear the dead load of the arch and the live loads that are likely to come upon it during construction without any appreciable deflections.

The shuttering shall be tightened with hard wood wedges or sand boxes, so that the same could be eased without any jerks being transmitted to the arch work. The easing arrangement shall permit all portions of the shuttering being lowered simultaneously.

The shuttering shall be struck within 48 hours of the completion of the arch, and only after the spandrel has been filled in and the arch is loaded.

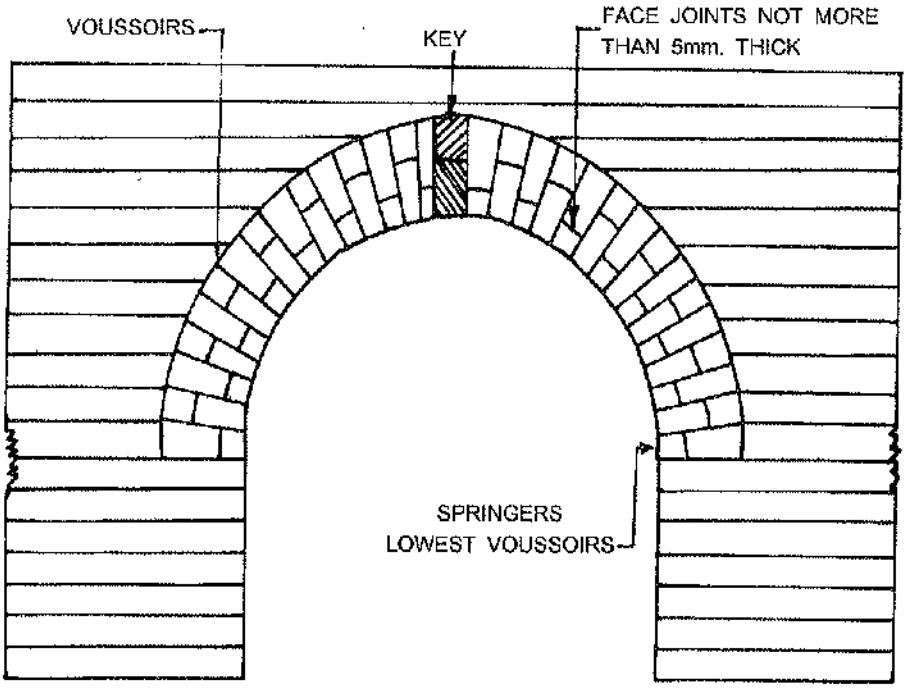
507.4. Laying :

507.4.1. *Circular Arches.*

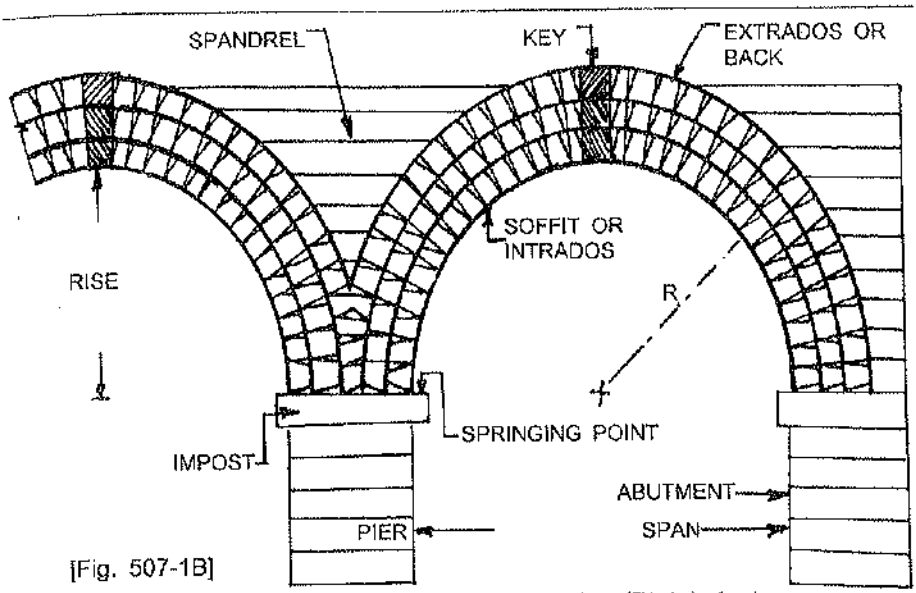
507.4.1.1. These are either (a) plain arches built in half brick concentric rings with break joints, or (b) gauged arches built out of bricks cut or specially moulded to be required shape as shown in Fig. 507-1. The arch work shall be carried on from both the ends uniformly and keyed in the centre. The bricks shall be flushed with mortar and well pressed into their positions, so as to squeeze out a part of the mortar and leave the joints thin and compact. All joints shall be full of mortar and the thickness of joints shall not be less than 5mm. and shall not be more than 15mm.

BRICK WORK IN ARCHES

Circular arch guaged cut or moulded bricks (When the Face is pointed)



[Fig. 507-1A]



[Fig. 507-1B]

BRICK WORK IN ARCHES Circular (Plain) Arch

(When the Face is plastered) ***Using Ordinary Bricks with varying thickness or mortar Joints 5mm. to 50mm.***

507.4.1.2. As soon as the arch is completed the haunches shall be loaded by filling up the spandrels with earth or any specified material upto the crown level of the arch. Care shall be taken to load the haunches on the two sides of the spandrels uniformly.

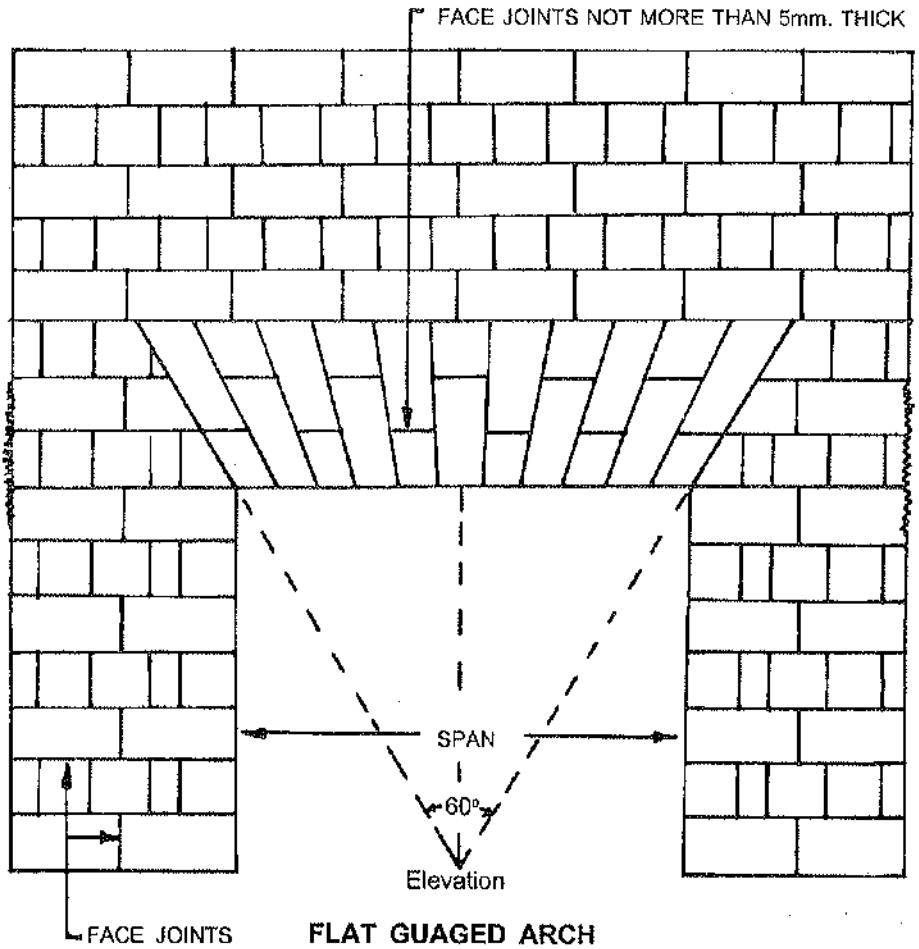
507.4.1.3. When the arch face is to be pointed (and not plastered) the face bricks shall be cut to proper shape or moulded so as to have joints not exceeding 5mm., in thickness. Bricks shall be laid radial through joints to the full depth of the arch and the voussoirs shall break joints to the full depth of the Arch. The voussoirs shall also break joints with each other.

507.4.2. *Flat Arches* :

507.4.2.1. These shall be gauged arches of bricks cut or moulded to proper shape as shown in Fig. 507.2. The extrados shall be kept horizontal and the intrados shall be given a slight camber of 1 in 100 of the span. The centre of the arch from which joints shall radiate, shall be determined by the point of the intersection of the two lines drawn from the ends of the arch at the springing level and at 60° to the horizontal.

507.4.2.2. In flat arches, bricks shall be laid radial through joints to the full depth of the arch and voussoirs shall also break joints with each other. The arch work shall be carried up from both the ends uniformly and keyed in the centre. This thickness of the points shall not exceed 5mm. The top of the arch shall be horizontal.

507.4.3. *Skew-backs* :—Bricks forming skew-backs shall be dressed or cut or as to give proper radial bearing to the end voussoirs. Improperly dressed bricks shall not be used.



FLAT GUAGED ARCH

[Fig. 507.2]

507.4.4. *Spandrels* :—The bricks of the spandrel walls at their functions with the extrados of the arch shall be cut to fit into the curvature of the arch.

507.5. Measurement :—The length of the arch shall be measured as the mean of the extrados and the intrados of the arch correct to 0.01 metre and quantities worked out in cubic metres, correct to 0.01 of a cubic metre.

507.6. Rate :—The unit rate shall be for one cubic metre of finished arch work including materials, scaffolding and labour, etc., complete.

Specification No. 508

Brick Honey Comb Work

508.1. All relevant clauses of SS : 501 shall apply.

508.2. Materials :

508.2.1. *Bricks* :—Bricks of specified class shall be used and shall conform to SS : 102.

508.2.2. *Mortar* :—Mortar shall be of specified proportion and shall conform to SSs. : 113 to 116.

508.3. Laying :—For half brick thick walls, stretcher bond shall be used throughout the length keeping equal openings of rectangular shapes or of shapes as specified. For one brick thick walls specified bonds shall be adopted. Bricks shall have a minimum bearings of 40mm. on either side. The thickness of joints shall be 10mm. and the joints shall be struck smooth or pointed with (1 : 3) cement mortar.

508.4. Measurement :—Linear dimensions shall be measured correct upto 10mm. and the areas worked out correct up two place of decimals in square metres.

508.5. Rate :—The unit rate shall be for one square metre of the honey-comb work without making any deductions for the openings.

Specification No. 509

Reinforced Half Brick Partition Walls

509.1. All relevant clauses of SS : 501 shall apply.

509.2. Materials :

509.2.1. *Brick* :—Bricks used shall be of first class variety shall comply with SS : 102.

509.2.2. *Motar* :—The cement mortar used for reinforced brick work shall generally be rich and dense and not of weaker mix than (1 : 4). Lime mortar shall not be used. The cement mortar used shall conform to SS : 113.

509.2.3. *Reinforcement* :

509.2.3.1. Reinforcement for half-brick partition walls may be in the form of mild steel flats or hoop iron or expanded mesh or mild steel bars or fabric and shall be of specified qualities.

509.2.3.2. In the case of round bars used as reinforcement, the diameter shall not exceed 8 mm. Flat bars or similar reinforcement used shall not have a thickness exceeding 8 mm.

509.3. Laying :

509.3.1. *Brick work* :—The brick work shall be done exactly in the same manner as for SS : 104 except that stretcher bond shall only be used. The heights of such walls shall not be more than 4 metres.

509.3.2. *Reinforcement* :

509.3.2.1. The reinforcement shall be well embedded in cement mortar at every third course or as specified. Half the joint thickness of mortar shall first be laid and the other half laid after the reinforcement is placed in position.

509.3.2.2. The inlaid steel reinforcement shall be completely embedded in mortar. Overlaps in the reinforcement, if any shall not be less than 300mm.

509.3.2.3. The joints shall be not more than 10mm. generally and where the reinforcing flats or bars are there the joints shall be not less than 15mm.

509.3.2.4. The mortar interposed between the reinforcement bars and the brick shall be not less than 5mm. thick.

509.3.2.5. In the case where the reinforcements cross inside a joint, the diameter of the reinforcement shall not exceed 5 mm. unless specially shaped bricks are used to permit larger reinforcement.

509.4. Measurement :—Where half brick thick wall is jointed to the main walls of 200 mm. or greater thickness the measurement for half brick thick wall shall be taken for its clear length from the face of the main wall. The length and height of walls shall be measured correct to the millimetres and areas worked out in square metres, correct to 0.01 of a square metre.

509.5. Rate :—The unit rate shall be for one square metre of the finished work.

Specification No. 510

Boiler Brick Works

510.1. All relevant clauses of SS : 501 shall apply.

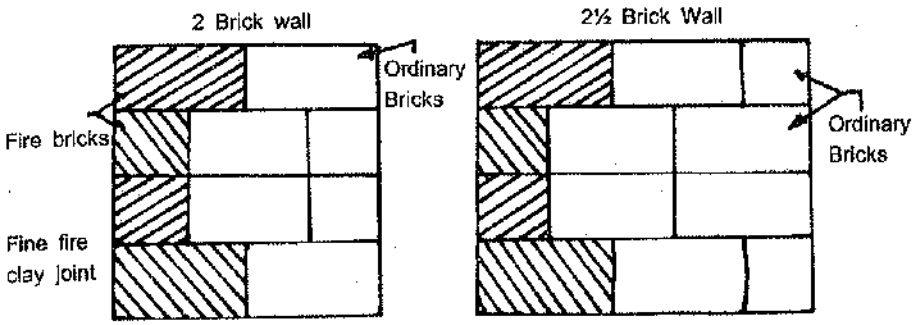
510.2. Materials :

510.2.1. *Fire bricks* :—They shall be moulded from fire clay (conforming to I.S. Specifications) burnt at a high temperature in special kilns. They shall be dense, tough, evenly burnt throughout and of the required size and shape. They shall be white or yellowish in colour and shall not show signs of fusion when heated to a temperature of about 1600 °C. Crushing strength of fire bricks shall not be less than 130 kg.sq.cm. Weight of the fire bricks shall be about 2.4 gm./c.c., land absorption of water shall not be more than 10% by weight when tested.

501.3. All brick work of boilers, flues, ash pits and economisers, etc., when exposed to flame or hot gases shall invariably be lined with specified fire bricks. Bricks chimneys shall be lined with fire bricks from the base to a height which shall be fixed in accordance with the local regulations, (Municipal bye-laws, etc.).

510.4. The joints of the fire brick lining shall be made with specified fire clay of fine quality and the ordinary bricks though set in with as fine mortar as possible, shall necessarily be laid with some what coarser joints. The ordinary bricks will therefore require to be specially moulded and selected to suit the make of fire bricks used so that the depth of one fire brick including one fire clay joint, shall correspond with the depth of one ordinary brick including one mortar joint as shown in Fig. 501-1.

510.4.1. The fire bricks shall be merely dipped in well puddled fire clay mixed with water to the consistency of paste so that there is no appreciable thickness of joints between the fire bricks. (Endeavours shall be made to obtain fire bricks of a suitable thickness to bond in with the local bricks to avoid the necessity of special moulding of local bricks. Fire bricks are made available in different thicknesses for this purpose).



SECTIONAL ELEVATION

[Fig. 510.1]

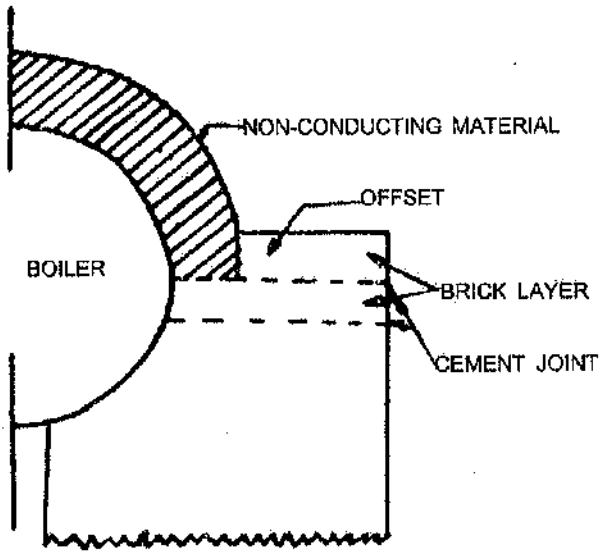
510.5. The fire brick linings shall be made of one course of headers followed by two courses of stretchers and the ordinary bricks work laid to correspond with this setting.

510.6. Where brick work touches the boiler fire clay only shall be used and on no account mortar containing lime or cement shall come in contact with any part of the boiler proper.

501.6.1. The top two courses of brick work shall be set in cement except where in contact with the boiler.

510.7. At the top of the boiler side walls an off-set or chase shall be left into which the non-conducting composition covering the boiler can be jointed, as shown in the Fig. 501.2.

SECTIONAL ELEVATION



[Fig. 510.2]

510.8. The brick work shall be allowed to dry thoroughly before a fire is lighted and any cracks appearing on a subsequent firing due to expansion or contraction or faulty drying of the mortar shall at once be rectified by scraping out the joints and repointing with fire clay whilst the brick work is hot, (ordinary mortar shall not be used in such cases).

510.8.1. The fire brick lining shall be carried round the fire box doors and across the top and bottom of the tube headers in water tube boilers. The space between the tube headers shall be carefully packed with asbestos packing and fire clay.

Specification No. 511

Honey Comb work with White Washed Pan Tiles

511.1. Materials :

511.1.1. *Pan tiles* :—Pan tiles shall conform to SS : 118.

511.1.2. *Mortar* :—The mortar shall be of specified proportion and shall conform to SSs. : 113 to 116.

511.2. Laying :

511.2.1. The tiles shall be soaked in water for 24 hours and allowed to dry. After they are quite dry they shall be dipped in white wash complying with SS : 908, (of the consistency of cream) and again allowed to dry.

511.2.2. The tiles shall then be laid in rectangular rows with the concave surface down-wards, with sufficient mortar at the joints to prevent the tiles from displacement. The tiles in each row shall be built-in, so that each tile cover the joint between the tiles in the row immediately below. Broken tiles shall never be used on the work. In no case shall tiles of different dimensions be used on the same work.

511.3. Measurement :—This shall conform to clause 508.4.

511.4. Rate :—This shall conform to clause 508.5.

Specification No. 512

Brick Nogging

512.1. General :—This work shall be 150mm. in thickness. This consists of a combination of teak posts and planking, (the timber complying with SS : 130, "Teak-wood"), the inter spaces being filled in with "Brick in Lime Mortar" of SS : 502 with first class bricks and finally plastered with lime mortar on both the faces.

512.2. Frame work of timber :—The uprights of posts shall be 150mm. by 120mm. and shall be placed at central distances of 1.5m. Between these posts and notched into them shall be horizontal ribs of teak planking 150mm. by 50mm. fixed 900mm. apart vertically. Between these cross braces of diagonals 150mm. by 40mm. shall be inserted halved together at points of inter-section and spiked to the posts. All faces of timber in contact with the masonry shall be well coated with bitumen paint (two coats) and the faces of timber exposed to view on completion of the walling shall be given three coats of best white lead paint or any other paint as may be specified.

512.3. Interspaces :—All the interspaces shall be filled in with brick in lime mortar.

512.4. Plastering :—After the completion of the brick work, the surface of the work shall be kept thoroughly wetted. Nails shall be driven into the ledge of the timber frame work to give a hold to the lime plaster, (with which both the faces of the work shall then be finished off to a thickness to be slightly sunk from the faces of the posts). The plastering shall be kept wet for one week.

512.5. The plastering shall be given two coats of white washing as for SS : 908.

512.6. If a door or window is to be fitted in a brick nogging wall, a drawing shall be given showing the details of the shutter and particulars of fittings, etc.

512.7. Measurement :—The work shall be measured in metres, correct to 0.01 of a metre and the areas worked out in square metres, correct to 0.01 of a square metre.

512.8. Rate :—The unit rate shall be for 10 sq.metres of completely finished work inclusive of painting and white washing in accordance with this specification. The rate shall include the cost of the door or window and all the accompanying fittings, etc., unless otherwise specified.

SECTION 6

STANDARD SPECIFICATIONS FOR STONE MASONRY

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Specification No. 601

Stone Masonry—General

601.1. Scope or Applicability :—The following clauses are to be complied with for all classes of stone masonry. The clauses of this specification shall be

applicable in all pertinent details to the following masonry specifications and the unit rate for each particular item of work is for completion in accordance with the relevant clauses of this specification and the other special specifications specified by the Executive Engineer.

601.2. Stone :—The source, type, quality strength and water absorption of stone conform to SS : 107.

601.2.1. **Selection** :—In selecting a stone the situation in which it is to be used has to be considered. The common types of stones in use for various situations are shown in Table 601-A.

Table 601-A

Common types of Stones

Sl.No. (1)	*Situation* (2)	*Types of Stones* (3)
1.	Masonry work submerged in water	Dense stones like granite and gneisses.
2.	Masonry work exposed to smoke and chemical fumes	Granite, quartzite
3.	For fire resistant masonry	Sand stone
4.	For carved or ornamental works, arches, etc.	Granite, Marble, sand stone, etc.
5.	For masonry below plinth course or in contact with soil	Dense stones like granite gneisses

601.2.2. *Dressing* :

601.2.2.1. The following are the common type of dressing :

(a) Pitched faced dressing

(b) Hammer dressing

(c) Rock facing

(d) Rough tooling

(e) Punched dressing

(f) Close picked dressing

(g) Fine tooling

601.2.2.2. *Pitched faced dressing* :—The edges of a pitched faced dressed stone shall be level and shall be in the same plane being absolutely square with the bed of the stone. Superfluous stone on the face shall be allowed to remain there and left raised in the form of natural rounded cobble stone. The minimum with of pitched faced dressing round the four edges of the face of the stone shall be 25mm. See Fig. 601.1.



PITCHED FACED DRESSED SURFACE

[Fig. 601.1]

601.2.2.3. *Hammer dressing* :—A hammer dressed stone shall have no sharp and irregular corners and shall have a comparatively even surface so as to fit well in the masonry. The hammer dressed stone is also known as hammer faced. The busing on the face shall not be more than 40mm. unless otherwise specified on an exposed face. See Fig. 601-2.



HAMMER DRESSED STONE SURFACE

[Fig. 601.2]

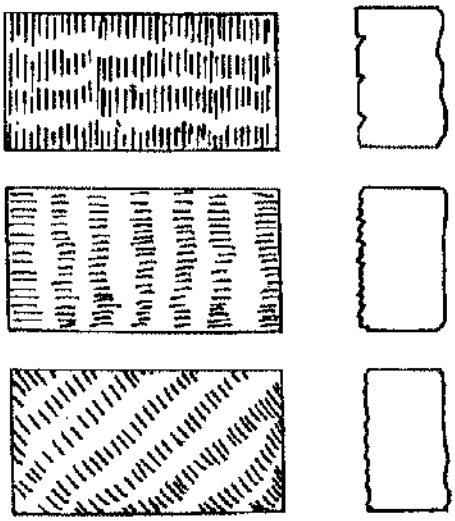
601.2.2.4. *Rock facing, Rock Rustic, Quarry faced* :—A stone which has been dressed in this manner shall have a minimum of 25mm. wide chisel drafts at the four edges, all the edges being at the same plane. The bushing on the exposed face shall not be more than 40 mm. unless otherwise specified. See Fig. 601.3.

601.2.2.5. *Rough tooling* :—Rough tooled surface shall have series of bands, 40mm. to 50mm. wide, more or less parallel to the tool marks all over the surface. These marks may be either horizontal, vertical, or at an angle of 45° as required. The edges and corners shall be rendered square and true. The dressed stone may have depressions on the surface. The depth of gap between the surface and a straight edge held against the surface shall not be more than 3 mm. See Fig. 601.4.

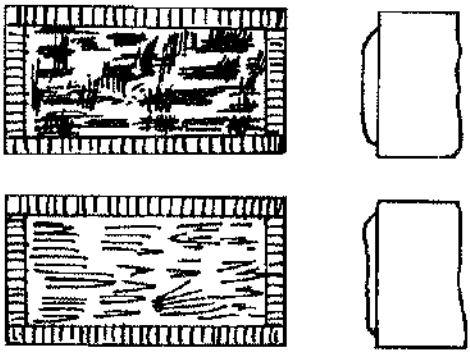
601.2.2.6. *Punched dressing* :—The rough tooled surface is further dressed to show series of parallel ridges. Chisel marks shall be left all over the surface. The depth of gap between the surface and a straight edge held against the surface shall not be more than 3mm. See Fig. 601.5.

601.2.2.7. *Close Picked dressing* :—The punched stone is further dressed so as to obtain a finer surface, the ridges or chisel marks left over being very tiny. The depth of gap between the surface and a straight edge kept over the surface shall not be more than 1.5mm. See Fig. 601.6.

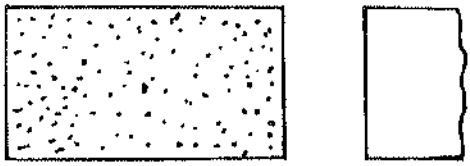
601.2.2.8. **Fine tooling** :—The close picked surface is further dressed so that all the projections are removed and a fairly smooth surface is obtained. The surface shall have 3 to 4 lines per 100mm. width depending on the degree of hardness of stone and the degree of fitness required. See Fig. 601.7.



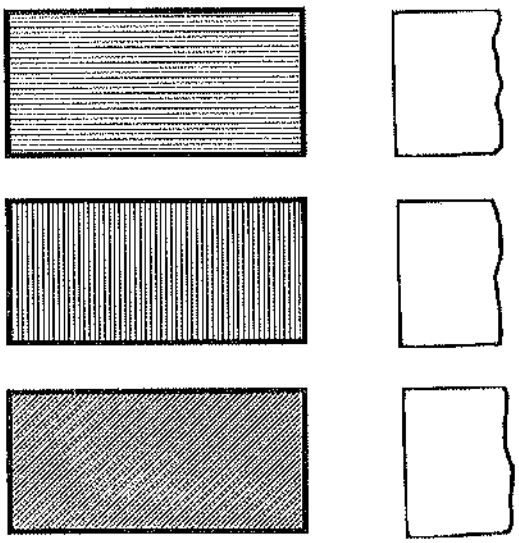
ROUGH TOOLED STONE SURFACE
[Fig. No. 601.4]



PUNCHED STONE SURFACE
[Fig. No. 601.5]



CLOSED PICHED STONE SURFACE
[Fig. No. 601.6]



FINE TOOLED STONE SURFACE
[Fig. No. 601.7]

Table 601-B

Uses for some types of Dressings

Sl. No.	*Type of dressing*	*Specific use*
1.	Rock facing	Used in buildings as quoin stones in the corners of brick masonry or rubble masonry and in the plinth to give an appearance of strength and solidity.
2.	Rough tooling	Used where fairly regular plane faces are required for masonry work.
3.	Punched dressing	Used where even surfaces are required.
4.	Fine tooling	Very commonly adopted for Ashlar work.

601.2.2.9. *Samples* :—Before starting masonry work, the samples of dressed stones shall be furnished to the Executive Engineer by the contractor for approval. These approved samples shall be kept at the site of work for verification.

601.2.3. *Size of Stone* :—Except in Dams stones used in rubble masonry shall be small enough to be lifted and placed by hand and as such the thickness of courses shall be limited to 250mm. The length of the stone shall not exceed three times the height and the breadth on base shall not be greater than three fourths of the thickness of wall nor less than 150mm. The height of stone for rubble masonry shall be not less than 150mm. The least thickness of laterite stone shall

be 175mm. and other dimensions shall be as laid down in the relevant specification, the stones beings laid header and stretcher alternatively, breaking joints by at least 75mm.

Unless otherwise specified all lintels and inside stones which are not to be plastered over shall be to the full width of the walls in which they are placed including the thickness of plaster.

601.3. Mortar :—The mortar to be used for each class of masonry shall conform to the particular standard specification for that class of mortar and the standard specification for the materials used therein. For example "Cut stone in cement mortar" the portland cement, sand and cement mortar shall conform to the three respective standard specifications for those items.

601.4. Scaffolding and tools and plant :—This shall be as per clauses 35 and 36 of Preliminary Specifications.

601.5. Laying of Stones :

601.5.1. Stones shall be laid on their broadest faces which gives better opportunity to fill the spaces between stones.

601.5.2. Stratified stones shall be laid on their natural bed, this is, with their strata perpendicular to the pressure.

601.5.3. The courses shall be built perpendicular to the pressure which the masonry shall bear.

601.5.4. Where there is to be variation in the depth of courses, larger stones shall be placed in the lower courses, the thickness of courses decreasing gradually towards the top of wall.

601.5.5. *Moving the stone after it has been placed upon the mortar bed* :—If it is necessary to move a stone after it has been placed on the mortar bed it shall be lifted clear and be reset. Attempt must never be made to slide it over the stones already laid. Care must be taken not to disturb joints already laid, when handling or moving the stone.

601.6. Bond :

601.6.1. To give sufficient lateral bond a stone in any course shall overlap the stone in the course below, i.e., joints parallel to the pressure in two adjoining courses shall not lie too closely in the same vertical line.

601.6.2. To give sufficient transverse bond, the prescribed number of headers shall extend from front to back of thin walls or from outside wall to the interior of thick walls vide masonry specifications for various classes of works.

601.6.3. To bond the work, at all junctions of walls the stones in each alternate course shall be so carried into each of the respective walls as to unite the work thoroughly.

601.6.4. To bond the work where breaks are unavoidable in carrying up the work continuously in horizontal courses, sufficiently long steps shall be left to join the old and new work.

601.6.5. The practice of building two thin faces tied with occasional through stones and filling up the middle with small stones or dry packing shall be strictly guarded against.

601.7. Watering :

601.7.1. Stones shall be sufficiently well wetted before laying to prevent absorption of water from the mortar and each mason shall be supplied by the contractor with a vessel for wetting stones.

601.7.2. All masonry built with surki, hydraulic lime or cement mortar shall be kept watered continuously for two weeks from the date of building in-place, unless a longer period is stipulated in respect of special cases. Watering is to be done carefully so as not to disturb or wash out the mortar.

601.7.3. Where the mortar has perished or has become dry, white or powdery through neglect or watering, the work shall be pulled down and rebuilt at the contractor's expense. If the contractor fails to water the work to the satisfaction of the officer in charge of the work, the latter shall arrange for the requisite to water the work properly and charge the cost to the contractor.

601.7.4. All masonry shall be washed clean on completion and all stains, lime or otherwise removed from the face.

601.8. Wet foundations :—In wet foundations the excavation shall be kept free of water, by the contractor, while the masonry is in progress and until the Executive Engineer considers the mortar has sufficiently set.

601.9. Jambs for door and window openings :—Jambs for door and window openings shall be formed with quoins of the full height of the course in the case of coursed masonry. The quoin shall be in breadth at least one and half times the depth of the course and in a length at least twice the depth. For each side of door openings three and for window openings two of these quoins shall be stones of the full thickness of the walls. Unless rebating of the whole frame into the masonry is specially specified, chisel dressing to the width of door and window frames shall be done to secure a close fit between the frame and the masonry.

A rebate shall be made in the frame where plastering is to joins with the frame as shown in the standard designs for doors and windows and the plaster shall be keyed well into the rebate to form a neat joins. Jambs shall be splayed as described in the Standard Specification for "Brick Masonry General". Unit rates for all classes of masonry shall include quoins, jambs and chisel dressing.

601.10. Bearings for Beams, Girders, Trusses, etc. :

601.10.1. *Bed plates* :—Bed plates are to be laid in all cases under the ends of beams, girders, roof trusses, etc. The bed plates are to be of sizes as specified or ordered by the Executive Engineer. In all important cases, cut stones or plain or reinforced concrete blocks shall be used and the size and quantity detailed and included under the relevant item of work. In all other cases where cut stone or plain or reinforced concrete bed plate are not required the contractor shall supply large stones of size and dressing as ordered by the Executive Engineer and he will not

be paid any extra rate above the contract rate for the wall masonry for such large stones.

601.10.2. *Recesses* :—The ends of all beams, girders, roof trusses, etc., shall be situated in a recess having 40mm. space all round them to permit free circulation of air and provided with perforated galvanised steel sheeting. No deduction from the contents of the wall shall be made for such recesses in order to compensate for the additional labour employed for forming them and the masonry unit rate shall include providing and fixing the perforated galvanised steel sheeting.

601.10.3. *Built-in-ends* :—Joists and rafters shall usually be built in the masonry and tarred for that position. When it is approved by the Executive Engineer to build ends of steel joists or other steel work into masonry, masonry for at least 150mm. alround the embedded steel shall be in cement mortar.

601.11. Treatment of corners :—The vertical exterior corners of buildings and pillars of buildings in coursed rubble in mortar, first and second sorts and random rubble in mortar (except for clay mortar masonry) shall be chisel drafted for 40mm. width on either side or such other width as may be specified. At the entrances of doors, windows, archways and other openings, the corners against which doors or windows will open shall be chamfered for 25mm. width and chisel drafter beyond the chamfer for 40mm. as above, (except when parliamentary hinges are used, in which case chisel drafting only is necessary).

All interior corners of rooms and projecting angles shall be rounded to 25mm. radius. The projecting angles shall in such cases be chamfered as necessary and the rounding for both interior corners and projecting angles shall then be done in the plaster. Similarly, rounded, chamfered and chisel drafter corners shall be built at the places shown on the drawings.

All chisel drafting and chamfering referred to under this clause shall be included by the contractor in his tender unit rate for masonry. Rounding of corners shall be included in his tender unit rate for plastering. No extra allowance shall be made for labour and materials involved in the compliance of this clause, unless it is so expressly stated in his agreement.

CHISEL DRAFTING FOR CORNERS OF BUILDINGS AND PILLARS

601.12. Dowels and Cramps :—When so specified or instructed by the Executive Engineer, copings shall be dowelled or cramped and courses of pillars, skew-backs and similar work joggled to the stones below using dowels and cramps of the hardest and toughest stone procurable or of copper and set in cement mortar as ordered. Iron cramps shall not be used. Extra payment for such dowels or cramps shall be fixed by prior agreement before execution of the work.

601.13. Holes and Recesses :—Care shall be taken to see that holes for passage of water wherever necessary (as from terraces and bathrooms) and recesses for down fall pipes, etc., are provided during construction and neatly finished off by pointing or plastering as ordered. Holes are also to be cut in the sill stones to receive the uprights of door frames in cases where there is no threshold plate to the frame.

601.14. Returns, Buttresses and Counterforts :—Returns, buttresses and counterforts etc., shall be built and bonded into the work as it proceeds and not inserted or joggled on after the masonry is advanced. No extra payment shall be made for labour involved in building in any fixtures, holdfasts, etc., which are given to the contractor for fixing in place.

601.15. Electrical sanitary and other Fixtures :—All electrical sanitary and other fixtures etc., shall be built and bonded into the work as it proceeds and not inserted or joggled on after the masonry is advanced. No extra payment shall be made for labour involved in building in any fixtures, holdfasts, etc., which are given to the contractor for fixing in place. Holes of the required size and shape shall be left in the masonry during construction alone for fixing pipes, service lines or for passage of water. After service lines, pipes, etc., are fixed the extra hollows left in any shall be filled with (1 : 3) cement mortar or (1 : 3 : 6) cement concrete as directed by the Executive Engineer. The face shall be neatly finished with matching stones. If any fixtures are to be provided, they shall be neatly embedded in the required positions while laying the masonry. Iron fixtures shall be embedded in (1 : 5) cement mortar.

Well seasoned wooden plugs and bricks of sizes and quality approved by the Executive Engineer are to be built-in as the work proceeds for fixing door and window shutter appliances, coat hangers, picture rails and for any other purpose decided as necessary by the Executive Engineer.

601.16. Pointing :—Pointing shall be done in accordance with the relevant Standard Specifications for pointing as mentioned in the Tender Schedules.

601.17. Measurement :—All linear measurements shall be in metres, correct to 0.01 of a metre. All areas shall be worked out in square metres, correct to 0.01 of a square metre. All volumes shall be worked out in cubic metres, correct to 0.01 of a cubic metre. All work shall be measured net as constructed. No deductions shall be made for openings upto 0.01 sq.metre in area.

601.18. Rate :

601.18.1. The rate for payment shall be for one cubic metre of finished work inclusive of quoins, conveyance, dressing, chised drafting, smooth rubbing of joints, stacking, scaffolding construction, pointing with same mortar and curing etc., complete in all respects. The rate shall include charges for leads and lifts, besides conveyance charges.

601.18.2. Where tests are specified by the department the cost of such testing shall be borne by the department, except where the materials have failed to satisfy the prescribed conditions of quality, etc., in which case the cost of such testing shall be borne by the contractor supplier.

601.18.3. Wherever required the samples of materials shall be produced to the Executive Engineer for approval and for keeping at the workspot.

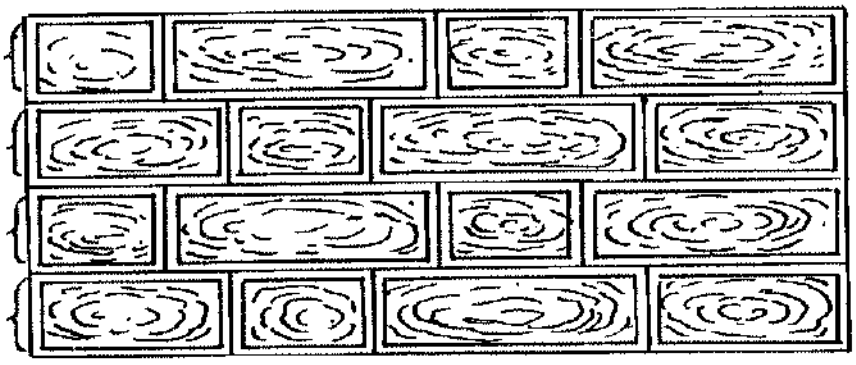
Specification No. 602

Cut Stone in Lime Mortar

602.1. All relevant clauses of SS : 601 shall apply.

602.2. Cut stone :—Every stone shall be fine tooled on all beds, joints and faces. Every stones shall be fine tooled exactly square on all faces unless curves or special angles are specified for any face or edge, in which case the dressing shall be exactly to template or drawings supplied. Ashlar is another name for this class of stone and masonry.

602.3. Cut stone rock rustic or Quarry faced :—This shall confirm to the requirements of cut-stone described above, except that the faces exposed to view shall have a fine dressed chisel draft 25mm. wide all round the edges of each stone and the stone between the drafts shall be left rough as the stone comes from the quarry but no rock-face or "bushing" is to project more than 75mm. from the plane of drafts. See Fig. 602-1. When this class of face finish is required, it shall be so described in the wording of the relevant schedule item.



ROCK OR RUSTIC ASHLAR WITH CHISEL DRAFT
[Fig. No. 602.1]

602.4. For any other type of face dressing or dressing of joints in cut stone work, or where cut stone is used as facing to other masonry, the class of work shall be described in the schedule item working and an addendum to this standard specification given by the Executive Engineer defining the nature of work to be done and method of measurement and payment.

602.5. When the supply of cut stone apart from masonry is made by a contractor, the stone and dressing shall be to the standards laid down here-to-fore in the specification.

602.6. Joints :—The masonry joints and shall bed in no case be more than 3mm. in thickness and all visible edges shall be quite free from unslightly chippings. Each stone shall be struck with a maul when laid to bring it to a solid bearing both as to bed and joint. All joints shall be set full in mortar and joints neatly struck on face in the manner specified or as may be directed by the Executive Engineer.

602.7. Courses :—The stone shall be laid in regular horizontal courses with vertical side joints and all the courses shall be of the same height unless otherwise specified or ordered by the Executive Engineer in which case no course shall be thicker than any course below it. No stone shall be less in breadth than in height, nor less in length than twice the height. Unless otherwise specified by the Executive Engineer or otherwise required to fit the particular work, the depth of courses shall not be less than 200mm. in height.

602.8. Bond :—The face stones shall be laid header and stretcher alternately (unless otherwise ordered by the Executive Engineer) the headers being arranged to come as nearly as possible in the middle of the stretchers above and below and the stones shall break joint on the face for atleast the height of the course and the bond shall be carefully maintained throughout the wall.

602.9. Through stones :—In walls 750mm. thick and under, the headers shall run right through the wall.

602.10. No pinning of any description shall be allowed. Each stone must first be fitted into its place dry in order that any inaccuracy of figure may be discovered and corrected by the stone cutter before it is finally laid in mortar and settled in its bed.

602.11. All fine dressed cut stone work shall be protected by means of wood boxing or other suitable means immediately after fixing at the contractor's expense.

602.12. All cut stone work shall be moulded or chamfered as may be ordered. Templates for moulding shall be cut out of galvanised steel sheet or other materials and approved by the Executive Engineer.

602.13. Coping stones shall be set in Standard Specification cement mortar (1 : 3) unless otherwise specified or defined in the schedule items.

602.14. Measurement :—The measurements of cut stone work whether moulded or chamfered shall be taken square over all the projection of the individual cut stones and not along the premitral face. The portions of the features tailing into the wall shall not be measured.

602.15. Rate :

602.15.1. All cut stone copings shall be paid for on running metre basis or on cubic metre basis as may be specified.

602.15.2. No payment shall be made for the portions of the features tailing into the wall.

602.15.3. All cut stone or ornaments or other enrichments shall be paid for by piece as also sculptured spouts and brackets. The rate shall include placing and proper fixing imposition. Where an enrichment is worked in mouldings, key stones, etc., the labour cost for the same shall be fixed by prior agreement before execution of the work.

602.15.4. The treads (only) of cut stone steps shall be measured and paid for as cut stone work. The hearting shall be measured and paid for as random rubble masonry.

Specification No. 603

Cut Stone in Surki Mortar

The specification shall be the same as Specification No. 602 except that Standard Specification "Surki Mortar" shall be used instead of lime mortar.

Specification No. 604

Cut Stone in Cement Mortar

The Specification shall be the same as specification No. 602 except that Standard Specification cement mortar of specified proportion shall be used instead of lime mortar.

Specification No. 605

Cut Stone Rock-Rustic or Quarry Faced in Mortar

This work shall be executed similar to Specification No. 602, 603 or 604 according as the mortar described in the Tender Schedule for the item i.e., lime mortar, surki mortar or cement mortar respectively. The face shall finish shall be as per clause 602.2.

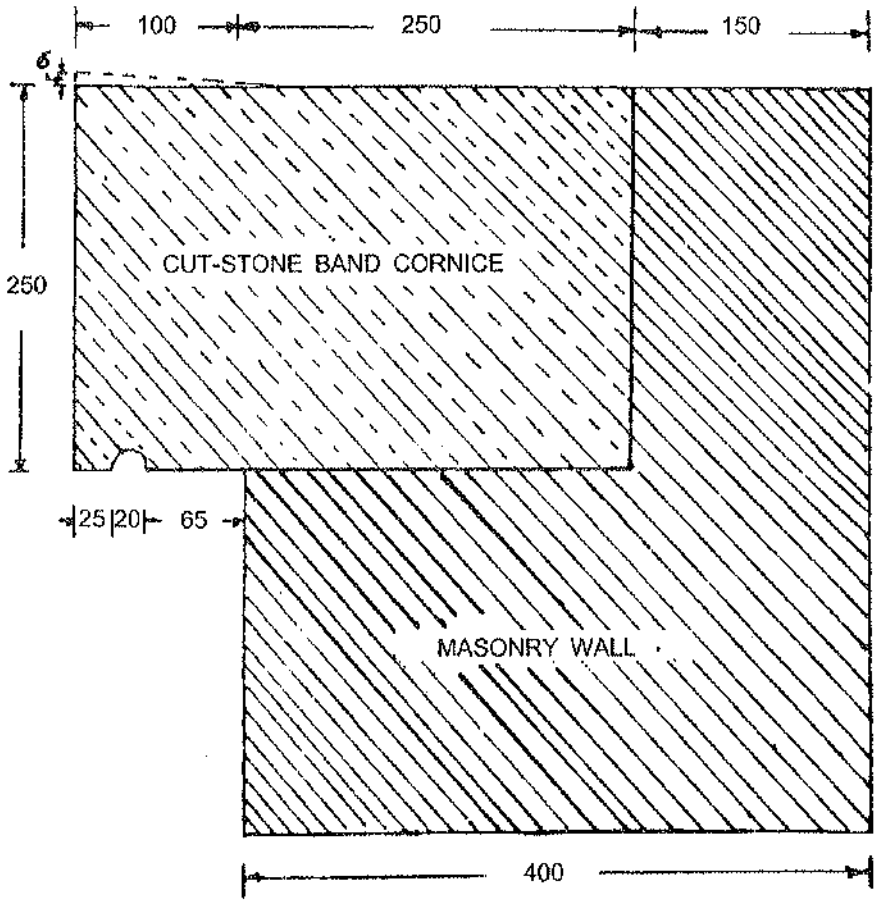
Specification No. 606

Cut Stone String Course Band and other Cornices, etc., in Mortar

606.1. All the relevant clauses of SSs : 601 to 605 shall apply.

606.2. All cut stone string courses, cornices, drip mouldings and chajjas shall be moulded or chamfered as may be ordered or shown in the drawings. They shall tail into the work not less than the projection with a minimum of 250mm. or such other depth and bearing as the Executive Engineer may direct and shall be paid at a rate per running metre along the courses i.e., the projecting portion only shall be paid for as special work. They shall also be throated on the under side if so ordered.

606.3. Cut stone quoins shall be laid header and stretcher in alternate courses. They shall ordinarily be of the full height of one masonry course.



FIXING OF BAND CORNICE ON A MASONRY WALL

[Fig. No. 606.1]

606.4. Band cornices shall be of uniform depth and perfectly horizontal, with no stone less than 450mm. in length on face. The cornice shall project from the face of the walls as shown in the drawings or as instructed by the Executive Engineer. See Fig. 606-1.

606.5. Measurement :

606.5.1. String courses, cornices, drip mouldings and chajjas etc., shall be measured in running metres along the course (i.e., the projecting portion only shall be measured).

606.5.2. Where cut stone quoins are provided in other types of masonry, they shall be measured for separately on cubic metre basis.

606.6. Rate :—The unit rate shall be per running metre or per cubic meter as may be specified.

Specification No. 607

Cut Stone Arching

607.1. All relevant clauses of S.Ss. 601 and 602 shall apply.

607.2. General :

607.2.1. The arch stones shall be closely of the same size and carefully and accurately wrought giving the proper radiating joints, that is, the arch stones shall be dressed full and true to their proper shapes and shall be carefully set in good fine mortar. Thickness of the ring and the class of the mortar shall be defined in the relevant schedule item.

607.2.2. The arch stones shall not be less than 250mm. as their least dimension and Leader joints shall break joint at least for 250mm. in arches upto 600 in thickness, the stones shall all be of the full thickness of the ring. For deeper arch rings, the Executive Engineer shall stipulate the bond, face-stones and key stones.

607.2.3. Exact uniformity shall be required in the thickness of the arch ring and in oblique or skew arches, great care is to be taken to dress the beds to the required winding.

607.2.4. All arch work stones shall be of specially large sizes. The breadth of each stone at top and bottom shall be determined at the time of execution according to the span and the number of stones.

607.3. Dressing :—The headers and the side radial joints shall be fine tooled to exact fit on all beds. The keying course shall be accurately fitted and driven into its place with heavy wooden beaters. The side or radial joints shall be perpendicular to the tangent of the curve of the arch at each point and at right angles to the face. The saffit shall be dressed to the true curve of the arch and the back or upper surface of the arch stones shall have its upper surface dressed to a plane flat surface according as the drawings may indicate. The thickness of each joint shall not exceed 5 mm.

607.4. Face Stones :—These stones shall be fine tooled or rock faced as specified or as shown in the drawings. It shall also be separately specified if chamfering is to be done to the exposed radial joints of face stones and the horizontal joints of the soffit.

607.5. Centering :

607.5.1. The contractor shall furnish for the approval of the Executive Engineer, plans for the centerings of all arches upto 5 metres span. For larger span arches, the Executive Engineer shall prepare centering plans and furnished the same to the contractor, except in case of lumpsum contracts, where the contractor shall prepare and submit the plans of the centerings proposed to be used for prior approval by the Executive Engineer. For spans larger than 2 metres, timber centerings are to be used and are to be provided with hard wood wedges for slackening the centerings. Sand boxes shall be used for slackening for spans over 6 metres. In all centerings the arrangement shall be such that the slackening can

be affected without any vibration being transmitted to the arch and in the case of a series of arches the arrangement shall be such that the centerings can all be slackened simultaneously. If the centerings are not of clear span, but rest on intermediate brick pillars, the brick pillars shall be well and strongly built, the top of each pillar being capped with wood and connected up with other pillars by a continuous piece of timber from abutment to abutment.

607.5.2. In all centerings the upper bearing surface shall be very correctly formed to the curve of the intrados of the arch.

607.5.3. The contractor shall obtain instruction from the Executive Engineer regarding the number of hours after completion of the arch when the centerings shall be sufficiently slackened to compress the joints (retightening at once) and also the time for complete removal. When using lime mortar, centerings shall ordinarily be slackened within 24 hours after completion of the arch. Care shall be taken however, that the centerings are not slackened while the mortar in the last finished joints is still so soft that it gets squeezed out, but at the same time the centerings shall be slackened while the mortar is still moist so as to allow the arch to compress itself and bring all the joints to fair bearing. In the case of a segmental arch, care shall be taken to see that the sewbacks are secure giving a week's time to set. In the case of semi circular, elliptical pointed or other arches springing from a horizontal joint, case shall be taken to see that the adjacent wall has been built up to two thirds of the height of the arch, before slackening centerings. With quick setting cement mortar, centerings shall be left till the mortar has finally set.

607.5.4. During the progress of the work care must be taken to distribute the load on the centerings in order to obtain a true curve at the completion of the work. Before turning arches exceeding 12 metres span, the middle half of the centerings shall be loaded with all the material which is to be used on that portion of the arch ring.

607.6. Removal of Bad work :—If any arch settles unduly or becomes unslightly through carelessness, bad workmanship, inadequate centering or bad material it shall be removed and rebuilt at the contractors' expense.

607.7. Measurement :—Measurement of arch work shall be the means of the length of extrados and intrados, the full breadth of the arch and the full thickness of the ring.

607.8. Rate :—The rate for arch work shall include the provision of proper centerings as described above together with the setting up of sand boxes, easing and removing the centerings irrespective of the size of the arch.

Specification No. 608

Rubble Arching

608.1. All relevant clauses of SSs : 601 and 607 shall apply.

608.2. Rubble arching shall consist of flat bedded stones laid solidly and flush in mortar with their radial joints perpendicular to the tangent to the curve of the arch at each point and the arch stones shall properly break joint at heading points. The mortar to be used shall be of standard specification of the class

described in the schedule item wording and the thickness of arch ring shall be defined therein. Each stone shall be hammer dressed approximately to the proper shape, with the necessary summering, so that the arch stones may bear fairly one upon another for the full thickness of the arch ring and should parts of the backs of the stones be open, they shall be solidly wedged up with spalls and chips of stones set in mortar. The exposed faces of the face or quoin stones shall be bushed or plain dressed as specified with face perpendicular to the length inwards. The soffit shall be dressed to a plane surface, true at all points to the curve of the arch.

608.3. The joints of face and soffit shall not exceed 12mm. in thickness.

608.4. The arch quoins shall be selected stones of the same thickness as the sheeting of the course in all cases extending right through from intrados to extrados or as may be specified.

608.5. Interior arch stones in the sheeting shall not be less than 75mm. in least dimension and the stones shall break joint with each other at least 180mm. In arch rings 400mm. thick and under, all stones shall be of the full thickness of the ring.

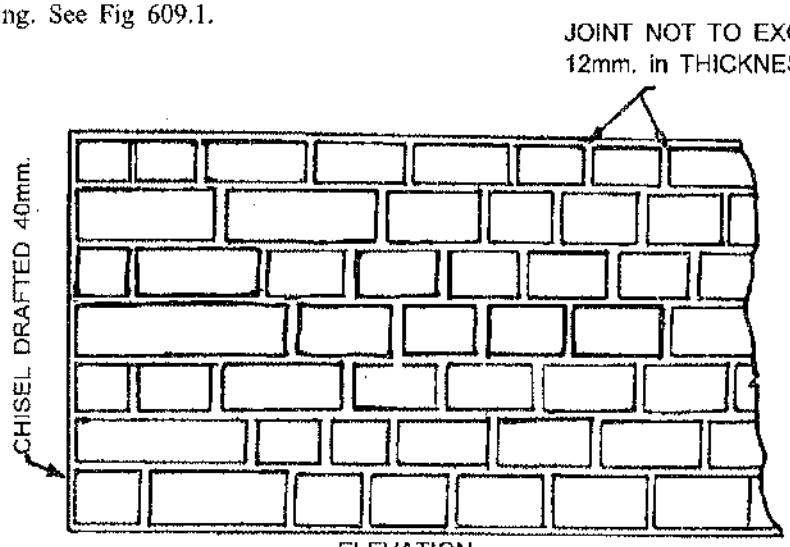
608.6. In arch rings more than 400mm. thick the stones shall be laid in alternate courses of headers and stretchers, unless otherwise specified, not more than two stones going to make up thickness of the arch ring.

Specification No. 609

Coursed Rubble in Lime Mortar (First Sort)

609.1. All relevant clauses of SS : 601 shall apply.

609.2. The work shall consist of a facing of selected stones hammer dressed at faces and joints with only a small proportion of smaller stones in the hearting. See Fig 609.1.



ELEVATION

[Fig. No. 609.1]

COURSED RUBBLE FIRST SORT

609.3. The face stones shall be squared on all joints with beds horizontal and unless otherwise ordered by the Executive Engineer, they shall be set in regular courses of uniform thickness from bottom to top throughout. Unless otherwise ordered by the Executive Engineer, each course shall be the height of each stone in the course, i.e., different depth stones are not to be used and levelled off at certain heights to form the course for this class of masonry. No fact stone shall be of less width in plan than 150mm. for walls 400mm. thick, 200mm. for walls 450mm. thick and 250mm. for walls 600mm. thick and more and half the quantity shall not less than $^{1}/_{70}$ cubic metre, $^{1}/_{50}$ cubic metre and $^{1}/_{35}$ cubic metre in volume for walls of the above thickness respectively. The face stone shall be laid headers and stretchers alternatively, so as to break joint by atleast 75mm. and headers shall project at least 100mm. beyond the stretchers. Long vertical faces shall be carefully avoided. The stones shall be solidly bedded, set full in mortar with joints not exceeding 12mm. in thickness and with no pinning whatever on the face and shall extend well back into the hearting. Height shall not exceed breadth at face nor length inwards. The backs shall be left rough as quarried, the bed and vertical joints being hammer dressed square with the face for a width of not less than 75mm. and 40mm. inwards from the face respectively. Bushing shall not project more than 40mm. in faces. C.R. Masonry 1st sort shall not be plastered, but it shall be pointed. Where plastering is proposed, the bushing shall not project more than 12 mm.

609.4. Height of Courses :—The courses are to be not less than 150mm in height unless otherwise specified. No course shall be deeper than and course below it and no course shall differ from that adjacent by more than 25mm. in depth.

609.5. Through Stones and Headers :—In all walls upto a width of 600mm. bond stones running through the wall shall be provided at intervals of 2 metres clear in every course. For walls thicker than 600mm. a line of headers each header overlapping the other by 150mm. or more shall be provided from front to back at 2 metres intervals in every course. Care shall be taken not to place the bond stones of successive courses over each other. The positions of bond stones shall be marked on both the faces for identification and verification. (Tar marking where plaster is to be applied will suffice).

609.6. No under-pinning of any kind is to be allowed and hollow bedding and flushing such gaps with mortar are to be carefully avoided.

609.7. Hearting :—All stones, chips, spalls, etc., shall be washed clean with water before use so as to ensure a clean surface for the mortar to adhere to. They shall be sprinkled with water before actually placing in work to prevent absorption of water from the mortar. This is specially necessary in the case of sand stones and other highly absorbent stones. The interior shall be filled in with good flat bedded stones set as close as possible, well flushed in mortar. Chips and spells of stone shall be wedged in wherever necessary so as to avoid thick beds or joints or mortar care being taken that no dry work or hollow space shall be left anywhere in the masonry. The face work and backing shall be brought up evenly but the backing shall not be levelled up at each course by the use of chips.

609.8. The quoins and the angles of the openings shall be of selected stone very carefully squared and bedded and arranged to bond alternately long and short in both directions. These shall be as per clause 601.9. Exterior and interior angles

and corners shall be chamfered, chisel drafted and rounded as described under clause 601.11.

609.9. The work on the interior face shall be precisely the same as on the exterior face, unless the work is to be plastered in which case the side joints need not be vertical.

609.10. Finishing of joints :—The joints shall be struck neatly at the close of the day's work. Where pointing of plastering to stone masonry is not contemplated the joints shall be rubbed smooth.

Specification No. 610

Coursed Rubble in Surki Mortar (First Sort)

The specification shall be exactly the same as the Standard Specification 609 for "Coursed Rubble in Lime Mortar, First Sort" except that the mortar is to be of the Standard Specification for "Surki Mortar" instead of "Lime Mortar".

Specification No. 611

Coursed Rubble in Cement Mortar (First Sort)

The specification shall be exactly the same as the Standard Specification 609 for "Coursed Rubble in Lime Mortar, First Sort" except that the mortar is to be of the Standard Specification for "Cement Mortar of Proportions as Specified" instead of "Lime Mortar".

Specification No. 612

Coursed Rubble in Mortar (Second Sort)

612.1. This work shall be executed similar to the specifications for C.R. Masonry First Sort, (Nos. 609, 610 or 611 according to the mortar described in the tender schedule for the item i.e., Lime Mortar, Surki Mortar or Cement Mortar respectively) with the exception that the hearting and backing shall conform to the standard specification for Random rubble masonry and bond with the face stones carried up continuously with the face work, clause 609.9 of the First Sort S.S. not applying. See Fig. 612.1.



[Fig. No. 612.1]

Coursed rubble second sort

612.2. Dam Masonry :

612.2.1. In the case of masonry dams the foundation shall be of a uniform and level surface without any dips of slopes. Where the surface is irregular or sloped

the rock shall be benched and all crevices, drilled holes, dips etc., shall be filled by grouting or with concrete as specified by the Executive Engineer. The foundation shall be thoroughly cleaned of all loose particles, dirt, oil or grease, etc., by chiseling and using stiff brooms, jets of water, air or wet sand under pressure.

612.2.2. The work shall be carried out in suitable blocks. Both the faces and hearting shall be carried but simultaneously, as far as possible and the difference in levels between the highest and the lowest points at any time in any block and the level difference between the successive blocks shall not be more than 1.5 metres. Each layer shall be left rough enough to form a good bond with the new course. Masonry surfaces, which before the succeeding layer of masonry is built on them have been exposed for a long time, shall be thoroughly cleaned of all loose particles, dirt, oil or grease, etc., by chiseling and by using stiff brooms, jets of water, air or wet sand under pressure.

612.2.3. Quality control tests for strength and permeability of mortar and filed tests for permeability of masonry shall be conducted regularly at frequent intervals.

612.2.4. Transverse joints, construction joints and metal seals, etc., shall be provided as specified.

612.3. Measurement :—For thick walls over 750 mm. thickness like dams, anicuts, lock walls, abutments and piers etc., the face work for 450 mm. thickness as built shall be measured separately, from the rest. Other thin walls shall be measured in full.

612.4. Rate :—For thick walls the face work of 450 mm. shall be paid for as C.R.S. 1st sort and the rest as for R.R. masonry. Other thin walls shall be paid for as for C.R.S. 2nd sort.

Specification No. 613

Uncoursed Rubble or Random Rubble in Lime Mortar

613.1. Dressing :—The face stone shall be hammer dressed on the face, sides and the beds to enable it to come into close proximity with the neighbouring stone. The bushing in the face shall not project more than 40 mm. on an exposed face and 12 mm. on a face to be plastered. Stones with round surface shall not be used in construction.

613.2. Size of Stones :—

613.2.1. *Face Stones* :—Face stones shall be of not less width in plan than 150mm. for walls 400mm. thick, 200mm. for walls 450mm. thick 250mm. for walls 600 mm. thick or more. Half the quantity shall not be less than $^1/_{70}$ cu.m. $^1/_{50}$ cu.m. and $^1/_{35}$ cu.m. in volume for walls of the above thicknesses respectively. No stone less than 150 mm. in height shall be used on the face.

613.2.2. *Hearting* :—Small stones shall be carefully selected to roughly fit between the larger ones.

613.2.3. *Bond Stones* :—Bond stones shall be at least $^1/_{20}$ sq.m. in area at face.

613.3. Laying :

613.3.1. *Face Stones* :

613.3.1.1. The face stone shall be laid headers and stretchers alternatively so as to break joints by at least 75 mm. Care is to be taken to break joints vertically. The stones shall be solidly bedded with joints not exceeding 20 mm. in thickness, further dressing being done if necessary to ensure this. No pinning whatsoever shall be used on the face and face stones shall extend well back into hearting. Height of the stones shall not exceed breadth at face nor length inwards.

613.3.1.2. Where burnt stone is used the masonry shall comply with this specification except that the work is to be levelled off in horizontal courses at every one metre in height or such other lever as the Executive Engineer may direct.

613.3.2. *Hearting* :—All stones, chips, spalls etc., shall be washed clean with water before use so as to ensure a clean surface for the mortar to adhere to and shall be sprinkled with water before actually placing in the work to prevent absorption of water from the mortar. Every stone shall be set flush in mortar and no dry work or hollow spaces shall be left. Chips and spalls shall be wedged in the work where necessary to prevent thick beds of mortar.

613.3.3. **Bond Stones** :—Bond stones shall be built in the wall at intervals of 2.0 meters in length and 600 mm. in height and shall run through the wall if the wall is not more than 600 mm. thick. If the wall is more than 600mm. thick a line of headers shall be laid from face to back, each header overlapping the other by at least 150 mm. The bond stone shall be clearly marked on both the faces. (Tar marking will do if the faces have to be plastered).

613.4. Quoins :—The quoins at corners of buildings, angles at entrances of doors, windows, archways or other openings and pillars unless provided for under other masonry items, shall be executed to the Standard Specifications for cursed rubble work, first sort, inclusive of chisel drafting, chamfering corners, etc., vide clause 601.11. Rough chisel dressing to the width of the frames of doors, windows, etc., shall be done to make the frames but closely against the Jambs unless rebating of the frame into masonry is expressly specified. No extra payment shall be made for any of the above items of work.

613.5. Mortar :—The lime mortar to be used shall conform to Specification in SS : 113.

613.6. Measurement :—This shall conform to Clause 601.17.

613.7. Rate :—This shall conform to Clause 601.18.

Specification No. 614

Random Rubble in Surki Mortar

614.1. The specification for this item shall be exactly the same as the Standard Specification 613 for "Random Rubble in Lime Mortar" except that the mortar shall be the Standard Specification "Surki Mortar" instead of "Lime Mortar".

Specification No. 615

Random Rubble in Cement Mortar (1 : 3)

The specification for this item shall be the same as the Standard Specification 613 for "Random Rubble in Lime Mortar" except that the mortar shall be the Standard Specification "Cement Mortar (1 : 3)" instead of Lime Mortar.

Specification No. 616

Random Rubble in Clay

616.1. Applicability :

616.1.1. The work shall be executed to the same specification as the Standard Specification 613 for "Random Rubble in Lime Mortar" with the exception that the clay of the description under clause 616.2 shall be used instead of "Lime Mortar".

616.1.2. Wherever masonry walls are built in Random Rubble in Clay it is necessary to construct top 300mm. of walls and 300mm. of wall around windows and doors with Random Rubble in Lime Mortar or cement mortar and it shall be paid for as such.

616.2. Mortar :—The mortar shall be prepared from carefully selected soil of tenacious nature to which sand shall be added wherever necessary in such quantity that a dried lump of the mixture shall not show signs of cracking. It shall be well trodden and worked into the consistency of a thick paste by the addition of sufficient water. The mixture thus made shall be kept for a week allowing water to stand on the top of it in a shallow pool and shall be well tamped with water by treading, before it is to be used on the work. Care shall be taken to remove all clods, stones, grass, etc., before the mortar is used on the work.

Specification No. 617

Dry Stone Masonry (for Retaining Walls)

The work shall be executed with bond and minimum size stones according to the Standard Specification 613 for "Random Rubble in Lime Mortar", the mortar, being omitted and chamfering and chisel drafting of corners not being required. The largest rubble stone procurable from the quarries specified shall be used. The batter to such masonry for walls and parapets shall not be less than 1 in 12.

Specification No. 618

Damp Proof (or Ant Proof) Course with Shahabad Stones/Cuddapah Stones 50mm. thick in Cement Mortar 1:3

618.1. The Shahabad stones/Cuddapah stones shall be 50mm. thick and each stone shall be of the full width of the wall. The stones shall be laid over a 12mm. thick cement mortar bed of (1 : 3) proportion and shall conform to the Standard Specification for the same type of Shahabad/Cuddapah stone flooring. The stone shall be laid at a level just below the under face of the flooring. If so shown on the drawings or specified the stones shall project 25mm. beyond the plinth in outer walls without verandahs and be neatly rounded off.

618.2. The damp proof course shall be provided for all walls except verandah retaining walls, or for particular walls only as may be shown on the drawings or as specified.

For buildings of minor importance, a damp proof curse of 20mm. of (1 : 3) cement mortar will suffice, laid at level just below the under face of the floor.

618.3. Measurement :—The relevant portion of clause 601.17 shall apply. The measurement shall be for the length and width corresponding to the length and width of the Shahabad/Cuddapah stones and limited to the dimensions shown in the drawings or as ordered by the Executive Engineer.

618.4. Rate :—The unit rate shall be per each square metre of surface of Shahabad/Cuddapah stones. The rate shall be inclusive of rounding off and flat nosing.

Specification No. 619

Rough Stone Dry Packing for Aprons & Revetments

619.1. The bed or slope to receive the packing shall first be prepared as specified and passed by the Executive Engineer. In cases where the work of preparation of bed and slope such as cutting out high bund, filling in hollows, etc., or the digging of the wall foundations is rather extensive, separate items shall usually be provided for such subsidiary kinds of work in the schedule to the agreement. But if the work involved in such subsidiary item is very little, no separate provision need be made and in the absence of such provision, the contractor shall understand that this tender rate is inclusive of all such work without extra charge. If the packing is to be laid on uncompacted made up soil, which is objectionable, it shall as far as possible not be laid till the soil has completely settled. If a backing of moorum, quarry rubbish or other material is to be given it shall be specified in a separate schedule item. (A 150mm. thick moorum or quarry rubbish backing well wetted and consolidated is prescribed for loose soils).

619.2. The stones used for Revetments and Aprons shall conform to SS : 106. The smaller size stones required for filling in interstices and wedging shall only be supplied to the actual requirements for the work and shall not be used in two or more layers as a substitute for the specified sizes of stones.

619.3. The stones shall be laid closely in position on the prepared bed and firmly set with their broadest ends downwards so that they may meet all round their bases and with the top of the stone level with the finished surface of the packing. The stones shall be laid breaking joint as far as possible in the direction of the flow of water. The stones shall be placed normal to the surface to be protected.

619.4. The interstices between adjacent stones shall be filled in with stones of the proper size, well driven in with crow bars to ensure tight packing and complete filling of all interstices. Such filling shall be carried on simultaneously with the placing in position of the large stones and shall in no case be permitted to lag behind. The final wedging shall be done only after obtaining the orders of the Executive Engineer. The final wedging shall be done with the largest sized chips practicable, each chip being well driven home with a hammer so that no chip is possible of being picked up or removed by hand.

619.5. Profiles of strings and pegs shall be put up to ensure that the pitching is done true, straight and to the proper slope throughout and revetments shall in all cases be built up from the foot of the bound to be revetted. Care is necessary that a strong toe wall or other protection is always given to the revetment, which protective measure shall be shown on the plans.

619.6. On completion, the surface presented by the apron or revetment shall be even throughout, free from irregularities and to the required length, breadth and slope as specified or as shown on the plans.

619.7. Measurement :—All linear measurements shall be in metres correct to 0.01 of a metre. All areas shall be worked out in square metres, correct to 0.01 of a square metre. All volumes shall be worked out in cubic metres, correct to 0.01 of a cubic metre. The thickness of revetment shall be measured normal to the slope. Any projections above the surface need not be measured separately. Unless otherwise specified the rough stones shall be stacked and premeasurements taken before laying and 40% deduction or voids shall be made.

619.8. Rate :—The unit rate shall be per one cubic metre of finished work and all the relevant sub-clauses of 601.18 shall apply.

Specification No. 620

Laterite or Rough Stone Pitching for River Conservancy Works

620.1. Laterite or rough stone of required size shall conform to clause 619.2.

620.2. Profile sections with strings and pegs shall be formed by the contractor at suitable intervals at his cost. The pitching shall be done true, straight and to the proper slope. The top layer of stones shall be 450mm. thick laid closely in position and firmly set with the broadest faces downwards.

620.3. The interstices between the stones shall be filled with large sizes chips and each chip shall be well driven home with a hammer so that it cannot be removed by hand.

620.4. On completion the surface shall be even throughout free from irregularities and to the required dimensions and slope as specified or as shown on plans.

620.5. Measurement :—This shall conform to Clause 619.7.

620.6. Rate :—The rate shall conform to Clause 619.8.

Specification No. 621

Mooram Backing to Rough Stone Dry Packing

621.1. The surface to receive the mooram backing shall be neatly trimmed to the required slope and freed from all roots and vegetation and profusely wetted before mooram is laid on.

621.2. Standard mooram as per SS : 138 shall then be mixed with water on the previous day. Next day morning it shall be well mixed and worked with mamoties till it can be formed into stiff plastic balls. Mooram so mixed shall be

carried in baskets to where it is to be laid and deposited in a single layer to give 150mm. of finished thickness and shall be well rammed in position with flat wooden or iron rammers.

621.3. The finished surface of mooram shall be left untouched until it dries up and does not show signs of yielding.

621.4. If any thickness other than 150mm. is specified, the work shall be executed to this specification, ramming in layers not exceeding 150mm. in thickness.

621.5. Measurement :—All linear measurements shall be in metres, correct to 0.01 of a metre. All areas shall be worked out in square metres, correct to 0.01 of a square metre. The mooram shall be stacked and premeasurements taken before laying.

621.6. Rate :—The unit rate shall be for 10 square metres (unless otherwise specified in the schedule) of finished work and all the relevant sub-clauses of clause 601.18 shall apply.

SECTION 7

STANDARD SPECIFICATIONS FOR FLOORING

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Specification No. 701

Flooring – General

701.1. Terminology :

701.1.1. *Sub-base* :—The prepared surface of ground on which the base concrete is laid.

701.1.2. *Base concrete* :—The layer of concrete on which the floor topping is laid.

701.1.3. *Sub-floor* :—The structural floor which serves as a base for the flooring.

701.1.4. *Laitance* :—The layer consisting essentially of fine cement particles which often forms into scum on the surface of freshly laid concrete, generally formed by excessive surface trowelling of concrete immediately after it has been laid.

701.1.5. *Bedding Mortar or underlayer* :—The layer of mortar on which the tiles or slabs are set.

701.1.6. *Cement slurry* :—Neat cement mixed with water to a honey like consistency. It may also include pigments.

701.1.7. *Terrazzo* :—Terrazzo stopping is the floor finish where the wearing surface is normally composed or marble chips in a matrix of cement with or without pigments and mechanically or manually grounded and polished.

701.1.8. *Pin holes* :—These are tiny air cells in tiles which open up during grinding and polishing and are too small to be filled in.

701.1.9. *Pores* :—Holes appearing in the surface of the hardened tiles initial grinding.

701.1.10. *Granolithic concrete* :—Concrete made with specially selected aggregate of high hardness, surface texture and particle shapes suitable for use as a wearing finish to floors.

701.1.11. *Surface hardner* :—A substance which may be applied to the surface of the hardened concrete to increase the wear resistance of the concrete.

701.1.12. *Abrasives* :—Metallic of non-metallic materials of high abrasion resistance which may be incorporated in the floor topping mix to increase the abrasion resistance of the floor topping.

701.2. Materials :

701.2.1. All the materials to be used for flooring shall conform to the relevant standard specifications.

701.2.2. All pigments to be used shall conform to appendix 'A' of IS : 2114-1962.

701.2.3. As far as possible coloured cement of standard quality only shall be used and the use of pigments avoided.

701.2.4. Clean and dry storage shall be provided at the site for all the materials. Glazed or polished tiles shall be stored in a room or under such cover as will prevent exposure to dampness, sun, rain and straining. The storage shall be done in such a way that excessive handling and accidental damages are avoided.

701.3. Concrete Base :

701.3.1. In the case of basement or ground floors the concrete base shall be laid on a bed prepared in accordance with SS : 310, level or sloped as specified or as instructed by the Executive Engineer. On the bed thus prepared lime or surki concrete complying with SS : 401 or Cement Concrete complying with SS : 402, as specified in the schedule, shall be laid in one thickness and tamped with iron rammers until the concrete is thoroughly compacted. The surface shall be left rough to form suitable key with the floor topping.

701.3.2. The top level of concrete base shall be to the top of basement without any plinth off-sets.

701.3.3. The finished depth of the concrete base shall be 100mm. or as specified in the schedule and shall be uniform for the whole floor. The surface shall be even and level or to the specified slopes.

701.4. Protection against Dampness :

701.4.1. Wherever it is suspected that dampness or water may find its way to the top of the base concrete or floor on the course of usage the following precautions may be taken.

(a) Laying the base concrete in two layers or not less than 50mm. thickness each, with a layer of water proof membrane of approved quality sandwitched between them.

(b) Laying the base concrete in two layers of not less than 50mm. thickness each and painting the top surface of the lower layer with two coats of bitumen of approved quality.

701.4.2. Where it is expected that the dampness may find its way from the surrounding walls, the damp proofing treatment shall be continued along the side walls to a height of at least 150 mm above the basement level. The said walls, shall be kept unplastered to this extent and shall be finished or plastered after the damp-proofing treatment is completed.

701.5. Joints & Panelling :

701.5.1. *Construction joints* :—Where construction joints are provided in the base concrete or sub-floor to tally with the construction joints in the walls or foundations, these joints shall be filled with an approved sealing compound. In such cases construction joints shall also be provided in the floors and floor toppings, adjusted so as to tally with the construction joints in the base concrete or sub-floor. The joints shall also be filled with an approved sealing compound.

701.5.2. *Expansion joints* :—Where expansion joints are provided to reduce the risk of cracking due to expansion or contraction of the floor and floor toppings, these shall tally with the construction joints provided if any. These joints shall also be filled with an approved sealing compound.

701.5.3. *Panelling* :—

701.5.3.1. Panelling of floors and floor topping or of base concrete or sub-floor where found necessary, shall be done to suitable sizes to facilitate easy construction and these panels shall tally with the construction joints and expansion joints where provided in the base concrete or sub-floor or walls.

701.5.3.2. The panels shall preferably be separated by means of dividing strips. The material for dividing strips shall be such that it has similar resistance to wear as the flooring. The dividing strips shall be of aluminium, glass or any other material as specified. The depth of the strips shall be not less than 25 mm. Portions of the bottom edges of the dividing strips may also be cut to a height not exceeding 12mm. and twisted, so as to provide anchorage into the floor topping. The spacing of such cut portions shall not be closer than 100mm. Anchorage arrangements may also be provided by fixing 40mm. long cross nails through the dividing strips.

701.5.3.3. Where dividing strips are not provided the bays or panels shall be laid alternately allowing for an interval of at least 24 hours between laying of the adjacent bays.

814.2.3. The sheets shall be secured together with 6mm. diametre galvanized bolts and nut, with a galvanized steel washer over a bituminous washer under the bolt head. The galvanized steel washer shall be of 25mm. dia. and 1.6mm. thickness and the bituminous felt washer shall be of 25mm. dia and 1.6mm. thickness.

814.2.4. Bolts shall be placed at 300mm. intervals along the edge of the length of the sheet or at such distance (approximately 300mm.) as will equally divide the sheets along their lengths. The bolts shall be placed zigzag so that the ends of each of the two overlapping sheets shall be drawn rightly one against the other. The horizontal joints of the sheets shall also be bolted together, the bolts being placed usually on each alternative corrugation ridge.

814.2.5. The holes for the bolts shall be drilled in the ridges from outside to inside. The bolt holes shall be slightly larger than the diameter of the bolt so as to allow for contraction and expansion of the sheets.

814.2.6. Where the sheets have to be cut to suit the dimensions of the roof, either along with slope or along the length, they shall be neatly cut along a straight line.

814.2.7. For outside wall and partitions, the sheets may be fixed with a lap of one and a half corrugations. This may be obtained by reversing each alternate sheet in order that the sharp edge of the outer corrugation shall, in all cases, lie inwards into the outer hollower of the corrugation in the next sheet which gives a neat finish to the joint.

814.2.8. Wherever it is necessary to embed the roofing sheets into the adjoining wall or gable, they shall be inserted into the masonry for a minimum of half corrugation and provided with mastic fillet or water proofing finish.

814.2.9. *Spacing of purlins* :—The purlin spacings shall be as specified and shall not exceed the following :

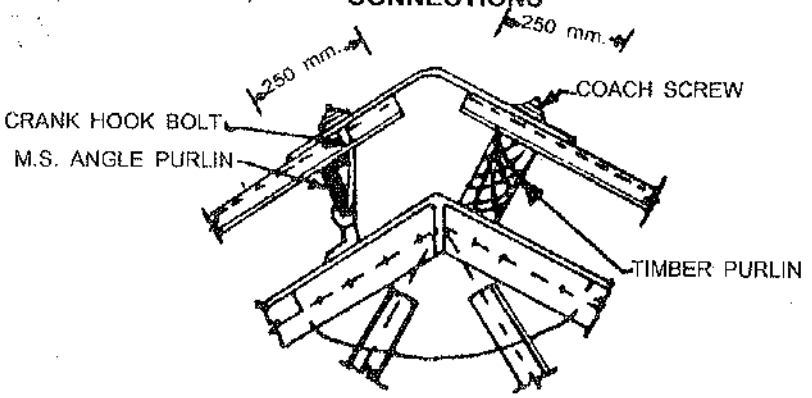
Gauge or thickness of the sheet (in mm..)	*Maximum allowable c/c spacing of purlins (in metres)*
1.25	2.5
1.00	2.0
0.80	1.8
0.63	1.6

Ridge purlins shall be fixed 75mm. to 100mm. from the apex of the roof. Purlins shall also be provided along the eaves to prevent the overlapping ends of the sheets from buckling or lying unevenly. The free overhanging of sheets at the eaves shall not be more than 400mm.

814.2.10. *Ridges and hips* :—Ridges and hips shall be covered or suitably shaped with one mm. thick and 0.9mm. wide galvanized plain steel sheets with a minimum lap of 250mm. on either side. See Fig. 814-1. They shall be secured to

the purlins along with the roofing sheets. The individual ridge and hips pieces coverings shall have a minimum lap of 150mm. along the ridges, or hips.

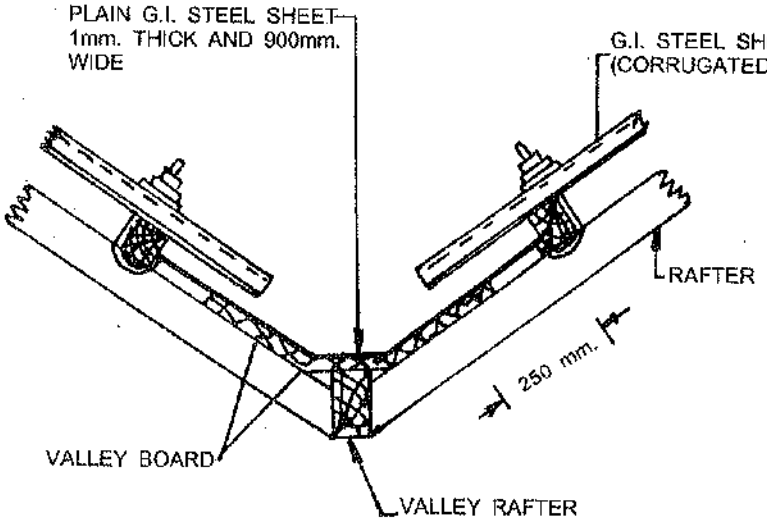
SKETCH SHOWING THE TYPICAL ARRANGEMENT OR RIDGE CONNECTIONS



[FIG. 814.1]

814.2.11. *Valley gutters* :—For the valley gutters plain galvanised steel sheets of not less than 1mm. thickness and 0.9 metre width shall be used. A minimum lap of 150mm. along the gutter length and a minimum lop of 250mm. under the roofing sheets on either side of the gutter shall be provided. See Fig. 814.2.

FIXING OF VALLEY GUTTER

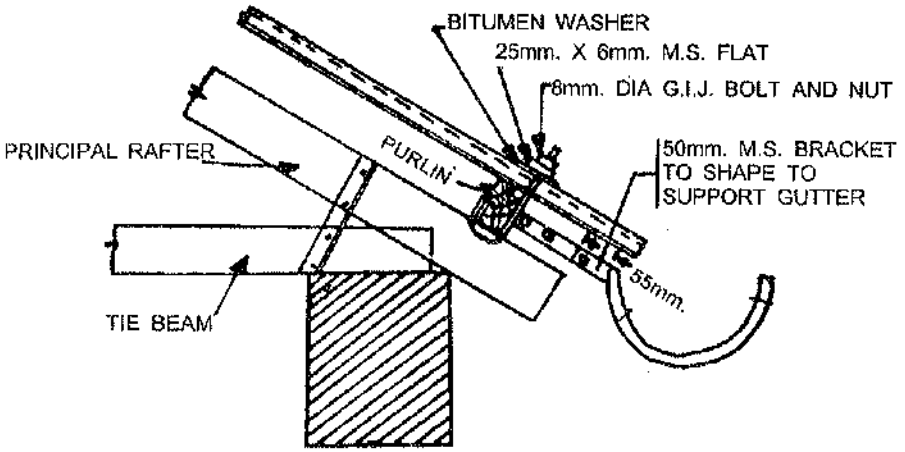


[FIG. 814.2]

814.2.12. *Wind ties* :—Wherever specified wind ties consisting of 25mm. x 6mm. mild steel flats laid over the roofing sheet at the eaves may be provided and secured to the purlins with the same belts as used for securing the roof sheets.

In windy locations, such as open sheds or verandahs, the Executive Engineer, shall also specify the measures to be adopted to secure the purlins themselves to the masonry or other parts. (See Fig. 814.3).

SKETCH SHOWING THE METHOD OF FIXING GUTTER & WIND TIE



[FIG. 814.3]

814.3. Measurement :—All linear measurements shall be in metres, correct to 0.01 of a metre, measured flat and not girthed. Areas shall be worked out in square metres, correct to 0.01 of a square metre. Overlaps and cutting to shape of sheets shall be covered by the net roof area and not measured separately. No deductions shall be made for opening upto 0.40 square metres each for skylights, etc.

814.4. Rate :—The unit rate shall be per square metre of the net roof area covered by the sheets, from top of ridge to the eaves.

Specification No. 815

Roofing with Corrugated Asbestos Cement Sheets

815.1. Materials :—The corrugated asbestos cement sheets shall conform to SS : 125.

815.2. Laying :

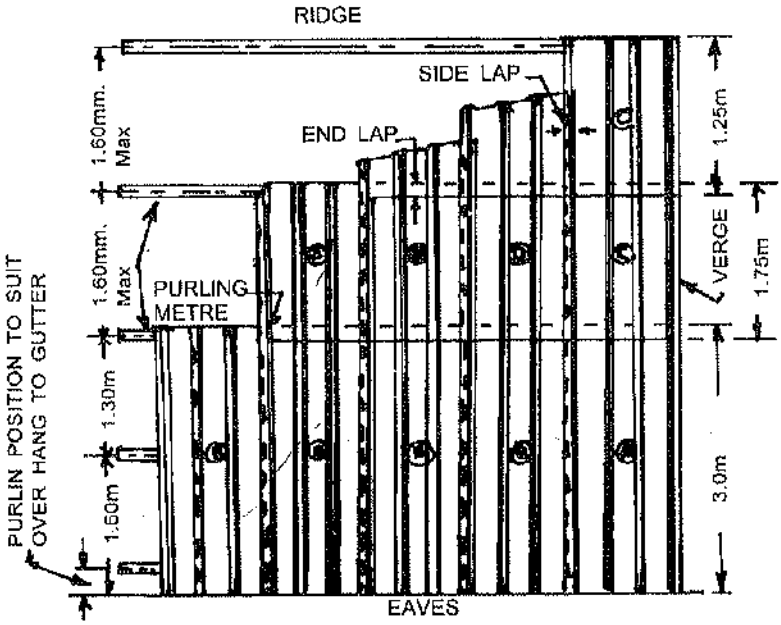
815.2.1. The sheets of specified class and thickness shall be laid on the roof with a lap of not less than 150mm. in length over the sheet below along the roof slope and the side laps shall be a minimum of half corrugation and the laps shall not open up in the normal wind direction.

815.2.2. Asbestos cement corrugated sheets shall be laid straight at the eaves either from left to right or from right to left depending upon the prevailing direction of the wind. If laid from left to right (See Fig. 815-3A) the first sheet shall be laid uncut, but the remaining sheets in the bottom row shall have the top left hand corners cut or mitred. The sheets in second and other intermediate rows shall have the bottom right-hand corner of the first sheet cut, all other sheets except

the last sheet shall have both the bottom right-hand corner and the top left-hand corner cut and the last sheet shall have only the top left-hand corner cut. The last or the top row sheets shall all have the bottom right hand corners cut with the exception of the last sheet which shall be laid uncut, if the sheets are laid from right to left, the first shall be laid uncut and the remaining procedure shall be reversed. (See Fig. 815-3B).

LAYING OF SEMI CORRUGATED SHEETS

(Sheets laid from right to left)



[FIG. 815.3B]

A = UNCUT SHEET
B = TOP RIGHT HAND CORNER CUT
C = BOTTOM LEFT HAND CORNER CUT
D = TOP RIGHT HAND CORNER AND BOTTOM LEFT HAND CORNER CUT

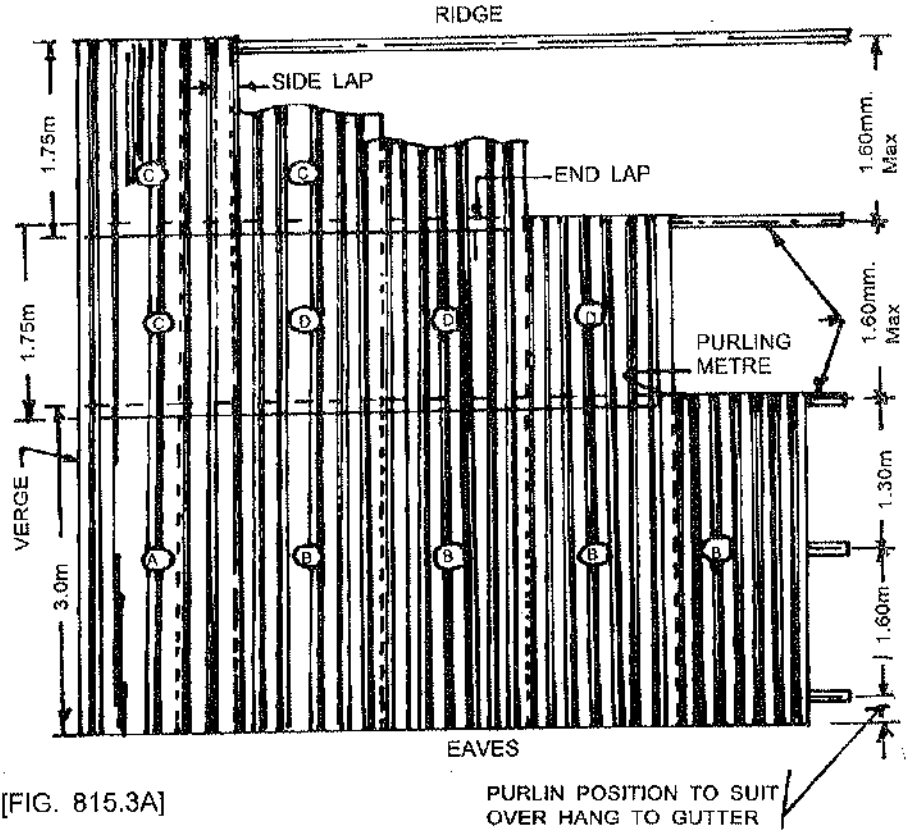
815.2.3. The metre described in clause 815.2.2 is necessary to provide a snug fit where four sheets meet at a lap. It is cut from a point 150mm. (or whatever the length of the end lap may be) up the vertical side of the sheet to a point 45mm. along the horizontal edge. This cutting shall be done with an ordinary wood saw at site.

815.2.4. The ends of all sheets at the eaves shall be supported and the support shall be placed as near to the margin of the sheets as practicable. The maximum free overhang at the eaves shall not be more the limits specified in clause 815.2.5 below.

815.2.5. *Laps* :—The sheet shall be laid with a side lap of half corrugation. (See Fig. 815.1). For the normal roof pitches (that is, inclinations greater than or equal to 18°, the end laps (See fig. 815-2) in sheets shall not less than 150mm.

For low roof pitches (that is, inclinations less than 18°) or for normal pitched roof in exposed positions, the end laps shall be increased suitably. The side laps shall as far as possible be sheltered from the prevailing wind direction. The free overhang at eaves, measured as the length of the sheet from its lower edge to the centre of the bolt holes shall not more than 300mm. for 6mm. thick sheets and 400mm. for 7mm. thick sheets.

LAYING OF SHEETS
(Sheets laid from right to left)



[FIG. 815.3A]

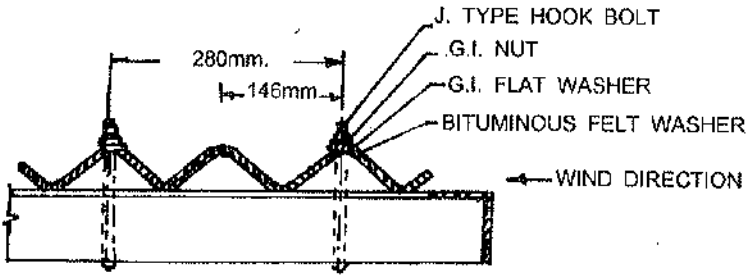
A = UNCUT SHEET
B = TOP RIGHT HAND CORNER CUT
C = BOTTOM LEFT HAND CORNER CUT
D = TOP RIGHT HAND CORNER AND BOTTOM LEFT HAND CORNER CUT

Wherever four corners of sheets overlap, two of them shall be mitred in the manner described in clause 815.12.2 and 815.2.3 in order to secure a perfect fit.

815.2.6. 'J' bolts or 'U' bolts or galvanized steel coach screws of atleast 8mm. size and conforming to IS : 730-1966 or IS : 1120-1975 or IS : 3007, part I, 1964 or as specified by the Executive Engineer, shall be fitted with a galvanized steel washer of 25mm. diameter and 1.6mm. thickness, over a bituminous washer

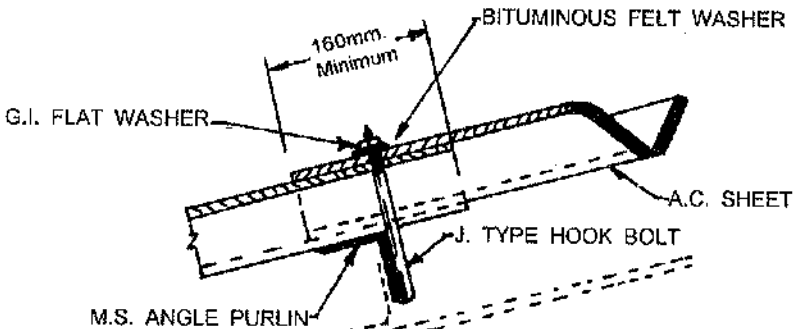
of 35mm. diameter and 1.5mm. thickness and of flat or suitable shape to fit the outer face the sheets and inserted through holes which are not punched but are only drilled in the crowns of the corrugations. These holes shall not be larger than 2mm. over the diameter of the bolts used for fixing. One bolt or screw shall be used on each side of the side laps. See Fig. 815.1. Nuts or screws shall be tightened lightly at first and then fully tightened when a dozen or more sheets have been laid. On no account shall, the fixing screws or the nuts or fixing bolts, be screwed down too tightly are care shall be taken not to deflect the sheets at the intermediate purlins in an attempt to make the sheets bear on such purlins. Light screwing also safeguards the roofing against any unexpected movements in the structure underneath.

DETAILS OF SIDE LAP



[FIG. 815.1]

DETAILS OF END LAP



[FIG. 815.2]

815.3. Spacing of Purlins :

815.3.1. All purlins shall be in one plane and shall be properly anchored to the supporting structure. The spacing of the purlins shall be arranged to suit the standard lengths of sheets but shall not exceed the following :

Thickness of sheet in mm.	*Distance between purlin centres*	
	For roof covering in metres	*For side cladding in metres*
6	1.4	1.7
7	1.6	1.9

815.3.2. Ridge purlins shall be fixed 75mm. to 115mm. from the apex of the roof, that is, from the bolt point.

815.3.3. Additional trimmers or bridging shall be used between purlins at all points where considerable roof traffic is likely to occur, for example, at adjoining valley or box gutters, below glazing and around chimneys, ventilators or other uptakes.

815.3.4. When a course of sheets of smaller length necessitating closer purlin spacing is required to make up a roof slope, the closer purlin spacing shall be provided at eaves rather than at ridges.

815.4. Ridges and hips :—Ridges and hips shall be covered with suitable A.C. specials. The specials shall be of the same type and manufacture as the A.C. sheets, unless otherwise specified.

815.5. Valley gutters :—Valley gutters may be provided as per Clause 814.2.11.

815.6. Embedding of sheets into the adjoining wall or gable may be done as per Clause 814.2.8.

815.7. Wind ties :—Wherever specified wind ties may be provided in conformity with clause 814.2.12.

815.8. The ends of all sheets at the eaves shall be supported and the supports shall be placed as near to the margin of the sheets as practicable.

815.9. Measurement :—This shall confirm to clause 814.3.

815.10. Rate :—The unit rate shall be per 10 square metres of the net roof area covered by the A.C. sheets from top of ridge to the eaves.

Specification No. 816

Roofing with Semi Corrugated Asbestos Cement Sheets

816.1. The S.S. 815 apply *in toto* to this specification also for all aspects of laying and securing the sheets, etc., except that semi-corrugated asbestos cement sheets shall be used in place of gully corrugated asbestos cement sheets.

Specification No. 817

False Ceilings

817.1. Materials :

817.1.1. Ceiling materials are usually available in the following general types, in various sizes, under various trade names : (a) Foam plastics, (b) Compressed

wood particle, wood chips or wood wool boards, (c) Hard boards, (d) Soft boards, and (e) Gypsum.

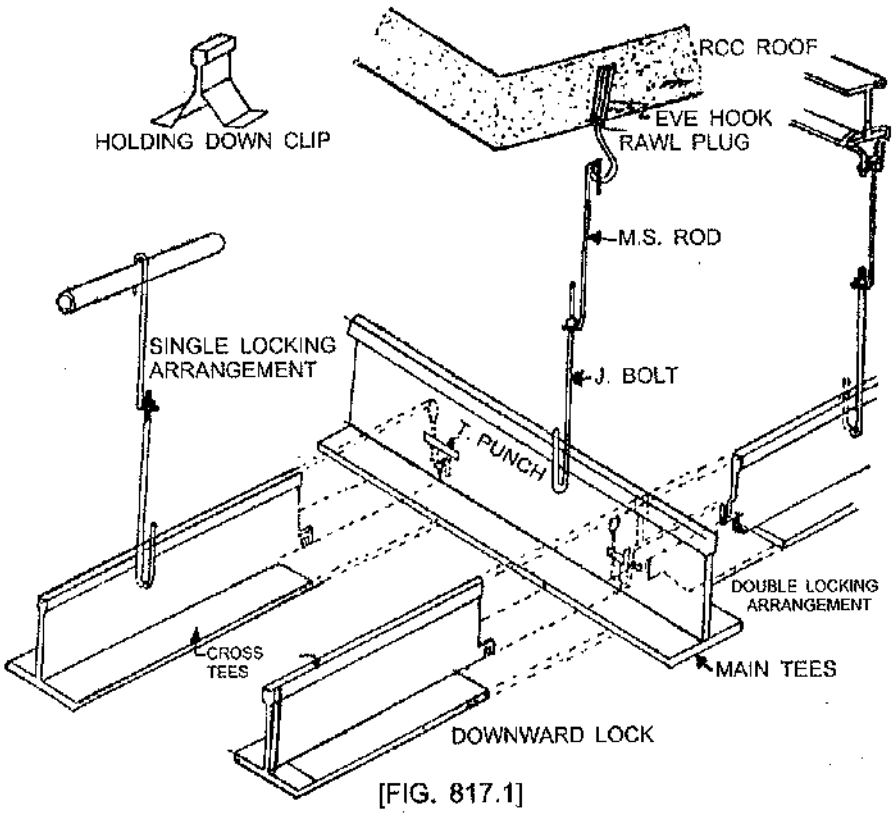
817.1.2. Aluminium tees and angles, steel hooks and 'J' bolts shall be as specified in the Tender Schedule.

817.1.3. The timber used for the frame work and beading shall conform to SS : 130.

817.2. Quality :—The ceiling material shall be homogeneous and stable in structure. The exposed surface shall have the desired texture free from flaws. In case of boards the edges shall be regular and smooth. The ceiling materials shall have rigidity and structural strength and shall be resistant to rats, termites, white ants, fungus, insects and weather action. Where required they shall pass necessary tests for thermal and acoustic insulation properties and fire resistance.

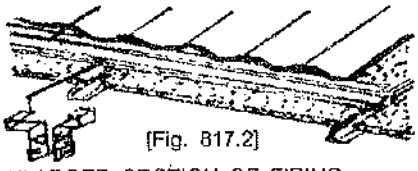
817.3. Laying :—The false ceiling may either be suspended from or fixed against the bottom of the roof. The frame work may either consist of Aluminium Tees & Angles or of suitable wooden frames, properly secured to the underside of the roof. In the case of suspended ceilings the hangers shall be adjustable. Typical arrangement for laying, fixing and jointing are shown in Figs. 817.1 to 817.7.

VIEW SHOWING THE INTERLOCKING ARRANGEMENTS OF ALLUMINIUM TEES FOR FALSE CEILING



[FIG. 817.1]

SUGGESTIONS FOR FIXING AND COVERING CEILING BOARDS JOINTS



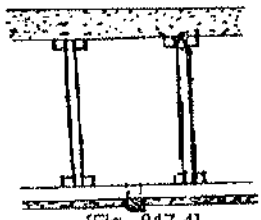
[Fig. 817.2]

ENLARGED SECTION OF FIRING CEILING : SLIDING CONSTRUCTION



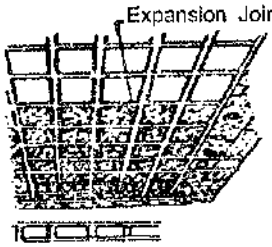
[Fig. 817.3]

FLAT CEILING AT TIE BEAM LEVEL



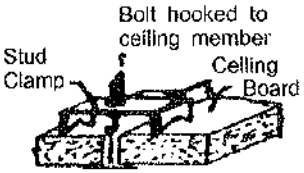
[Fig. 817.4]

SUSPENDED CEILING



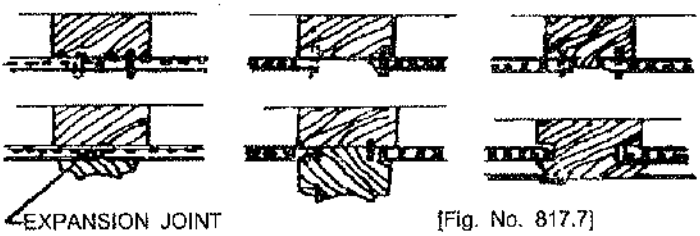
[Fig. 817.5]

CEILING FOR FLAT ROOF



[Fig. 817.6]

FIXING OF CEILING BOARD WITH STUD CLAMP



[Fig. No. 817.7]

In the case of suspended ceilings on aluminium tees and angles the laying of the panels shall start from one corner of the frame work. The last panel shall not be secured to facilitate inspection, dismantling and repairing of the ceiling.

817.4. Finishing :—Where required ceilings may be finished with a suitable water based distemper, or paint, or any other treatment as specified.

817.5. Storage and handling :—The ceiling panels shall be carried edge wise and shall not be dropped or thrown during transportation. They shall be stacked flat under cover on level surface in dry condition and shall not be allowed to come in contact with water. In case the panels get wet accidentally they shall be dried in the sun before use.

817.6. Packing and Marking :

817.6.1. The ceiling panels shall be securely packed and shall not allow any moisture to enter inside the packing.

817.6.2. Each board shall be clearly and permanently marked showing the following information :

(a) Manufacturer's name and trade mark,

(b) Sizes and types of panels.

817.7. Measurement :—All measurements shall be in metres, correct to 0.01 of a metre. Areas shall be worked out in square metres, correct to 0.01 of a square metre. Painting and other finishing shall be measured separately.

817.8. Rate :—The unit rate shall be per one square metre of laid ceiling area. Painting and other finishings shall be paid for separately in accordance with the relevant Standard Specifications.

SECTION 9

STANDARD SPECIFICATIONS FOR PLASTERING, POINTING, WHITE-WASHING, COLOUR-WASHING, DISTEMPERING AND WATER PROOF CEMENT PAINTING, ETC.

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Specification No. 901

Plastering – General

901.1. Terminology :

901.1.1. *Properties* :

(a) *Rendering* :—The application of plaster.

901.1.2. *Workmanship* :

(a) *Daubing* :—Operation of filling in hollows in the surface of a wall with mortar as a preliminary plastering.

(b) *Hacking* :—The process of making a surface rough by chiselling in order to provide a key for plaster work.

901.1.3. *Defects* :

(a) *Cracking* :—The development of one or more fissures in the plaster, not assignable to structural cause.

(b) *Crazing* :—The development of series of hair cracks on the finished surface, known as 'map crazing' when it forms a haphazard pattern over the surface affected.

901.2. Programme of work in relation to Plastering :

901.2.1. Construction operation such as construction of masonry, the encasement of steel columns and beams with concrete etc., requiring subsequent plastering, shall be so programmed that they are sufficiently cured and dry to receive the plaster without subsequent damage to plaster or decoration to the plaster.

901.2.1.1. All service pipes, conduits, cables, etc., that are to be embedded in masonry work and covered with plaster shall be completed and suitably protected against corrosion, where necessary, before plastering is begun.

901.2.2. *Operations during plastering* :—Where other operations are required to proceed simultaneously with plastering special care shall be taken to programme the work so as to cause minimum interference.

901.2.3. Plastering operation shall be so scheduled, as to allow sufficient interval between successive coats.

901.2.4. *Operations after plastering* :—Care shall be taken to ensure that subsequent operations do not cause damage to the plaster work.

901.3. *Preparation of the Surface* :

901.3.1. *Roughening* :—The roughening of the background improves the bond of plaster. This is particularly important in case of soffits and ceilings. A smooth surface shall be roughened by wire brushing if it is not hard or by hacking if it is hard. All joints shall be thoroughly raked. After roughening the surface care shall be taken to moisten the surface sufficiently before plastering as otherwise the freshly exposed surface may tend to absorb considerable amount of water from the plaster. In case of special backgrounds wood lath, expanded metal lathing, wire netting, etc., may be fixed to provide key to the plaster.

901.3.2. *Cleaning* :—The surface to be plastered shall be thoroughly brushed to remove dust, loose particles of mortar etc., or efflorescence where it has occurred.

901.3.3. *Daubing* :—Daubing shall be necessary where the background is very uneven and that unevenness cannot be made up in regular coat of plastering. The process of daubing consists in filling the holes and depressions with mortar of the same mix as per the first coat.

The patches of plaster thus done are left rough so that the subsequent coat of plaster would stick to it.

901.3.4. *Wetting* :—The surface shall be wetted evenly before applying the plaster. Care be taken to see that the surface is not too dry as this may cause lack of adhesion or excessive suction of water from the plaster. A fog-spray may be used for this work. As far as possible the plaster work shall be done under shade.

901.3.5. *Control of cracking* :—In case of discontinuity in backgrounds the two portions shall be separated by a neat cut or a groove at the junction. Where such cutting or grooving is not practicable the plaster at such locations may be reinforced by providing a suitable scrim of jute or wire gauze or other materials as directed.

901.3.6. *Control of surface crazing* :—Adequate time intervals shall be provided between successive coats so that each undergoes a portion of its shrinkage before the next one is applied. Care shall be taken to prevent rapid drying of the final or finishing coat.

901.4. Measurement :—All linear measurements shall be in metres, correct to 0.01 of a metre and areas, shall be worked out in metres correct to 0.01 of a sq.m. For jambs, soffits, sills, openings not exceeding 0.5m² each in area, ends of joists, beams, posts, girders, steps etc., not exceeding 0.5m² each in area, openings not exceeding 3m² each deductions and additions shall be made in the following manner :—

(a) No deductions shall be made for ends of joists, beams, posts, etc., and openings not exceeding 0.5m² each and no addition shall be made for reveals, jambs, soffits, sills, etc., of these openings nor for finishing the plaster around ends of joists, beams, posts, etc.

(b) Deductions for openings exceeding 0.5 m² but not exceeding 3m² each shall be made as follows and no addition shall be made for reveals, jambs, soffits, sills, etc., of these openings :—

(1) When only one face is plastered no deductions shall be made.

(2) When both faces of wall are plastered with the same plaster deductions shall be made for one face only.

(3) When two faces of wall are plastered with different plasters or if one face is plastered and the other pointed deductions shall be made from the plaster or pointing on the side of frames for doors, windows, etc., on which the width of reveals is less than that on the other side, but no deductions shall be made on the other side.

(c) In case of openings of area about 3m² each deductions shall be made for the openings but jambs, soffits and sills shall be measured.

(d) Ceilings shall be measured between the walls or partitions (the dimensions after plastering shall be taken). Cornices or coves if any shall be deducted and measured separately.

(e) Where the beams are exposed under the ceilings shall be measured over beams and the plastered sides of beams shall be measured and added to plastering on ceilings.

(f) Soffits or stairs shall be measured as plastering on ceilings. Flewings soffits shall be measured separately.

(g) Ribs and mouldings on ceilings and beams more than the thickness of the plaster shall be measured separately as for cornices.

(h) The measurements of lenghts of wall plastering shall be taken between walls or partitions (the dimensions after plastering shall be taken) and from the top of floor where there is no skirting or from top of skirting to the top of the wall for height. Cornices or coves if any shall be deducted and measured separately their lenghts being measured along the exposed face of the special at its centre line.

(i) Sides of pilasters, projections, etc., shall be added to the plaster on walls.

901.5. Rate :—The unit rate shall be per 10 sq.m. of plastered area and shall include all necessary scaffolding, preparation of the surface, all materials, finishing and curing.

Specification No. 902

Plastering with Lime Mortar, one coat 12mm. or 20mm. thick including Fine Rendering

902.1. All relevant clauses of SS : 901 shall apply.

902.2. Materials :

902.2.1. The lime mortar shall conform to SS : 113 and shall be of the specified proportions.

902.2.2. Lime putty (sebra) shall conform to SS : 117.

902.3. Preparation of the Surface :

902.3.1. This shall conform to clause 901.3.

902.4. Application of Lime Plaster :

902.4.1. The mortar used for plastering shall be stiff enough to cling and hold when laid. For ceiling the mix is required to be stiffer than that used for walls. To ensure even thickness and a true surface plaster shall be applied in patches of 150mm x 150mm of the required thickness at not more than 2 metres intervals horizontally and vertically over the entire surface to serve as guides. The surface of these guides shall be truly in the plane of finished plaster surface and truly plumb. The mortar shall then be applied to the surface to be plastered between the guides with a trowel. On soffits the mortar shall be laid in long even spreads outwards from the operator and upwards and across on walls. Each trowel full of mortar shall overlap and sufficient pressure shall be used to force it into thorough contact with the surface. On relatively smooth surfaces, the mortar shall be dashed on with the trowel to ensure adequate bond. The mortar shall be applied to a thickness slightly more than that specified, using a string stretched out between the guides. This shall then be brought to a true surface by working with a long wooden float with small sawing motion. The surface shall be periodically checked with a string stretched across it. Finally the surface shall be rendered smooth with a small wooden float. Over working shall be avoided. All corners, arises and junctions shall be brought truly to line with any necessary rounding or chamfering.

902.4.2. If it is necessary to suspend the work at the end of the day it shall be left in a clean horizontal or vertical line not nearer than 150mm. from any corner or arises or an parapet tops or on copings, etc. When recommencing the work the

edges of the old work shall be scraped clean and treated with lime putty before the new plaster is laid adjacent to it. After the first coat is done it shall be kept undisturbed for the next 24 hours and thereafter kept moist and not permitted to dry until the final rendering is applied.

902.5. Fine rendering :—After the plaster has sufficiently hardened, lime putty with cream like consistency shall be applied as thinly and evenly as possible and rubbed to a fine condition.

902.6. Curing :—The finished surface shall be kept moist for at least a week.

Specification No. 903

Plastering with Cement Mortar one coat 12mm. or 20mm. including Fine Rendering

903.1. All relevant clauses of SS : 901 shall apply.

903.2. Cement mortar shall conform to SS : 115 and shall be of the specified proportions.

903.3. Application :—The plastering shall proceed in accordance with clauses 902.4.1 and 902.4.2 except that cement mortar shall conform to SS : 115 and of the specified portions shall be used instead of lime mortar and the final rendering shall be applied immediately afterwards.

903.4. Fine rendering :—Neat portland cement slurry with a cream like consistency is applied as thinly uniformly as possible with a trowel and rubbed smooth.

903.5. Curing :—The surface shall be watered for a period of at least 10 days.

Specification No. 904

Plastering with Cement Mortar, two coats 20mm. thick with Sponge Finish

904.1. All relevant clauses of SS : 901 shall apply.

904.2. Materials :—Cement mortar for the first coat shall conform to SS : 115 and shall be of the specified proportions. The mortar for the second coat shall be made with fine sand, passing through IS sieves of 150 to 600 microns of the specified proportions.

904.3. Application of the first coat :—The first coat shall be laid in accordance with SS : 903 except that cement mortar 17mm. thick shall be applied. The surface after floating is again raked to provide a proper bond for the second coat.

904.4. Application of second coat :—Over the surface thus prepared and when the surface is green, cement mortar with fine sand as indicated in clause 904.2 of thick cream like consistency is applied with a trowel to a thickness of 3mm. and floated with a long wooden float to render the surface true. Then the entire surface is lightly rubbed with wet sponge and then daubed with sponge squeezed dry to obtain the required finish.

904.4.1. In case it is not possible to apply the second coat when the first coat is green, the first coat shall be cured for at least 10 days before it is permitted to dry. Before the second coat is applied the surface shall be thoroughly scrubbed and washed clean to remove dust and other particles. The surface shall be thoroughly wetted before applying second coat as indicated above.

904.5. Curing :—The finished surface be kept wet for a minimum period of 10 days.

Specification No. 905

Plastering with Combination Mortar one coat 12mm. or 20mm. thick including Fine Rendering

905.1. All relevant Clauses of SS : 901 shall apply.

905.2. The plaster shall be laid and finished as per SS : 902 except that cement lime mortar shall conform to SS : 116 of the specified proportions in place of lime mortar.

Specification No. 906

Pointing to Masonry with Cement Mortar

906.1. Materials :

906.1.1. Cement mortar for pointing shall conform to SS : 115 and shall be of the specified proportion.

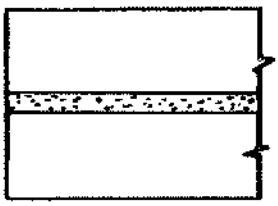
906.2. Types of pointing :—Pointing shall be one of the following types (See Figs. 906-1 to 906-3).

(a) Flush pointing, or

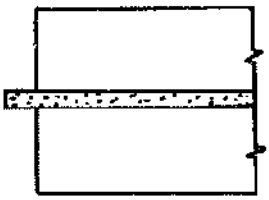
(b) Raised and cut pointing, or

(c) Line or groove pointing.

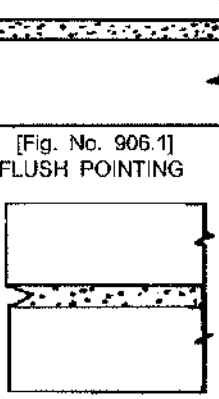
LINE OR GROOVE POINTING



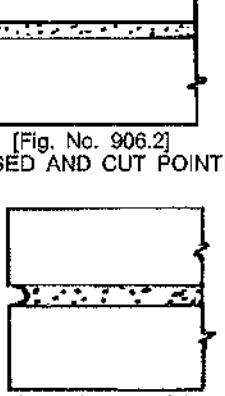
[Fig. No. 906.1]
FLUSH POINTING



[Fig. No. 906.2]
RAISED AND CUT POINTING



[Fig. No. 906.3A]



[Fig. No. 906.3B]

906.3. Preparation of surface :—The joints in the masonry shall be raked out to a depth not less than the width of the joint or as directed when the mortar is green. Joints are to be brushed clean of dust and loose particles with a stiff brush. The area shall then be washed and the joints thoroughly wetted before pointing is commenced.

906.4. Application of mortar and finishing :—The mortar shall be pressed into the raked out joints according to the type of pointing required. The mortar shall not be spread over the corners, edges or surface of the masonry. The pointing shall then be finished with the proper tool in the manner described under the respective types of pointing in clauses 906.4.1., 906.4.2 and 906.4.3. The superfluous mortar shall then be cut off from the edges of the lines and the surface of the masonry shall also be cleaned of all mortar. The finish shall be such that the pointing is the exact size and shape stipulated and the edges are neat and clean.

906.4.1. *Flush pointing* :—The mortar shall be pressed into the joints and shall be finished off flush and level with the edges of bricks, tiles or stones so as to give a smooth appearance. The edges shall be neatly trimmed with a trowel and straight edge. (See Fig. 906-1).

906.4.2. *Raised and cut pointing* :—Raised and cut pointing shall project from the wall facing with its edges cut parallel so as to have a uniformly raised band about 6mm. raised and width 10mm. or more as directed. The pointing shall be finished to a smooth but hard surface. (See Fig. 906.2).

906.4.3. *Line or groove pointing* :—The joint shall be initially formed as for flush pointing in clause 906.4.1 and then while the mortar is still green as groove of shape and size as specified shall be formed by running a forming tool along the centre line of the joints. This operation shall be continued till a smooth and hard surface is obtained. In the case of coursed rubble or brick masonry the vertical joints shall also be finished in a similar way. The vertical lines shall make true right angles at their junctions with the horizontal lines and shall not project beyond the same. (See Figs. 906-3A, 906-3B).

906.5. Curing :—The pointing shall be kept wet for seven days. During this period it shall be suitably protected from all damages.

906.5.1. If the mortar perishes or deteriorates through neglect of watering or any other default and if the work is not done as specified above the pointing shall be removed and redone at the expense of the contractor.

906.6. Measurement :—All linear measurements shall be in metres correct to 0.01 of a metre and areas shall be worked out in sq.m. correct to 0.01 of a sq.m.

For jambs, soffits, sills, openings not exceeding $0.5m^2$ each in area, ends of joists, beams, posts, girders, steps etc., not exceeding $0.5m^2$ each in area, openings not exceeding $3m^2$ each deductions and additions shall be made in the following manner :—

(a) No deduction shall be made for ends of joists, beams, posts, etc., and openings not exceeding $0.5m^2$ each and no addition shall be made for reveals, jambs, soffits, sills, etc., of these openings.

(b) Deductions for openings exceedings 0.5 m^2 but not exceeding 3m^2 each shall be made as follows and no addition shall be made for reveals, jambs, soffits, sills, etc., of these openings :—

(1) When both faces of wall are pointed with the same pointing deduction shall be made for one face only.

(2) When two faces of wall are treated with different pointings or if one face is plastered and the other pointed deduction shall be made from the plaster or pointing on the side of frames for doors, windows, etc., on which the width of reveals is less than that on the other side but no deduction shall be made from plaster or pointing on the other side.

(c) In the case of openings of area above 3m^2 each, deductions shall be made for the openings but jambs, soffits and sills shall be measured.

906.7. Rate :—The unit rate shall be per 10 sq.m. of finished work. The rate shall include erection and removal of scaffolding, materials and equipment incidental to completion of the pointing and dewatering where necessary till the mortar is set. The rate shall also include labour charges for raking out joints, cleaning, wetting, filling with mortar, trowelling and curing.

Specification No. 907

Pointing to Masonry with Surki Mortar

907.1. The pointing shall be done and finished as per SS : 906 except that the mortar shall be surki mortar shall conform to SS : 114 of the specified proportions.

907.2. Measurement :—This shall conform to clause 906.6.

907.3. Rate :—This shall conform to clause 906.7.

Specification No. 908

White-Washing

908.1. Materials :

908.1.1. *Lime* :—Lime used for white-washing shall be freshly burnt class 'C' lime (fat lime) and white in colour shall conform to SS : 111.

908.1.2. *Water* :—This shall conform to SS : 129.

908.1.3. Gum or glue, sodium chloride and ultra marine blue or indigo shall be of approved quality.

908.2. Scaffolding :—Wherever scaffolding is necessary it shall be erected in such a way that as far as possible no part of scaffolding shall rest against the surface to be white-washed. A properly secured and well tied suspended platform may also be used for white-washing or colour-washing. Where ladders are used pieces of old gunny bags shall be tied at top and bottom to prevent scratches to the walls and floors. For white-washing of ceilings proper stage scaffolding may be erected where necessary.

908.3. Preparation of Surfaces :

908.3.1. *New surfaces* :—The surface shall be thoroughly cleaned of all dirt, dust, mortar drops and other foreign matter before white-wash is applied.

908.3.2. *Old surface* :

908.3.2.1. Old surface already white-washed or colour-washed shall be broomed to remove all dust and dirt. All loose scales of lime-wash and other foreign matter shall also be removed. Where heavy scaling has taken place the entire surface shall be scraped clean.

908.3.2.2. *Old surfaces spoiled by smoke soot* :—The surface shall be scraped with steel wirebrushes, or steel scrapers. The surface shall then be broomed to remove all dust and dirt shall be washed with clean water.

908.3.2.3. *Oil and Grease spots* :—Oil and grease spots shall be removed by a suitable chemical and smooth surfaces shall be rubbed with wire-brushes.

908.3.2.4. While cleaning the surface the unwanted nails shall be removed and all nail holes, cracks and crevices filled with lime putty or plaster of paris to make the surfaces smooth.

908.3.2.5. All unsound portions of the surface plaster shall be removed to full depth of plaster in rectangular patches and plastered again after ranking the masonry joints properly. Such portions shall be wetted and allowed to dry and given a preliminary coat of white wash.

908.3.2.6. When white washing old surface is the surface is found to be infected with mould growth it shall be treated as below :

Any growth of moulds moss shall be removed by scraping with steel brush and ammoniacal copper solution consisting of 15 gm. of copper corbonate dissolved in 60 of liquor ammonia in 500 ml. water shall be applied to the surface and allowed to dry thoroughly before applying white-wash. An alternative to ammoniacal copper solution treatment may consist of 2% sodium penta chlorophenate solution in water.

908.4. Preparation of white-wash :

908.4.1. The lime shall be slaked at site and shall be mixed and stirred with about five litres of water for 1kg. of unslaked lime to make thin cream. This shall be allowed to stand for a period of 24 hours and this shall be screened through a clean coarse cloth. 1kg. of gum dissolved in hot water shall be added to each one come of lime cream. About 1.3 kg. of sodium chloride dissolved in hot water shall be added for every 10kg. of lime. Small quantity of ultra-marine blue (upto 3gm. per kg. of lime) shall also be added to the last two coats of white-wash solution and the whole solution shall be stirred thoroughly before use.

908.5. Application of white-wash :

908.5.1. White-wash shall be applied with jute coir or other similar brush or other brush to be specified number of coats. The operation for each coat shall consist of a stroke of bc brush given from the top to downwards, another from the bottom to upwards (over the first stroke) and similarly one stroke horizontally from the right and another from the left before it dries. Each coat shall be allowed to dry before the next coat is applied. For every coat of white-washing the entire surface area shall be covered continuously without leaving any patches. The brush shall be dipped in white-wash pressed lightly against the wall of the container and then applied by lightly pressing against the surface with full swing of hand.

908.5.2. The white-washing on ceiling shall be done prior to that on walls.

908.5.3. For new work minimum two coats shall be applied so that the surface presents smooth and a uniform finish through which the plaster does not show. The finished dry surface shall not show any signs of cracking and peeling and the white-wash shall not come off readily with the hand when rubbed.

908.5.4. For old work, after the surface has been prepared as in clause 908.3.2 a coat of white-wash shall be applied over the patches and repairs. Then one or two or more coats of white-wash as specified shall be applied over the entire surface. The white-washed surface shall present a uniform finish through which the plaster patches do not show.

908.6. Protective measures :—Surfaces of doors, windows, floors, articles of furniture etc., and such other parts of the building not to be white-washed shall be protected from being splashed upon. Such surfaces shall be cleaned of white-wash splashes if any. This will be done at the expense of the contractor.

908.7. Measurement :

908.7.1. This shall conform to clause 901.4.

908.7.2. Corrugated surfaces shall be measured flat as fixed and not girthed The quantities so measured shall be increased by the following percentages and the resultants shall be included with the general areas :

(a) Corrugated steel sheets —14%.

(b) Corrugated asbestos sheets —20%.

(c) Semi-corrugated asbestos cement sheets—10%.

908.8. Rate :—This shall conform to clause 901.5.

Specification No. 909

Colour Washing

909.1. Materials :

909.1.1. Lime, water and gum etc., shall conform to clause 908.1.

909.1.2. *Mineral colours* :—Shall be of approved quality and not affected by lime.

909.2. Scaffolding :—This shall conform to clause 908.2.

909.3. Preparation of Surfaces :—This shall conform to clause 908.3.

909.4. Preparation of colour-wash :—Sufficient quantity of colour-wash enough for the complete job shall be prepared in one operation to avoid and difference in shade. This basis white-wash solution shall be prepared in accordance with clause 908.4. Mineral colours shall be added to the white-wash solution.

909.5. Application of colour-wash :—The colour-wash shall be applied in accordance with the procedure given in clause 908.5.1. For colour-washing on new works, after the surface has been prepared as in clause 908.3.1, the first primary coat shall be of white-wash and the subsequent coats (minimum two) shall be of

colour-wash and the entire surface shall present a smooth and uniform finish. To start with o.1m² of the prepared surface shall be colour-washed with the first coat of white-wash and subsequent coats of colour-wash solution in full number of coats and the shade so obtained shall be examined before the entire work of colour-washing is taken up on hand. Small areas of colour-wash will appear lighter in shade than when the same shades are applied to large surfaces.

909.5.2. For colour-washing an old work, after the surface has been prepared as in clause 908.3.2 a coat of colour-wash shall be applied for the patches and repairs. Then the specified number of coat of colour-wash shall be applied over the entire surface. The colour-wash surface shall present a uniform colour shade. No primary coat is needed for old surface bearing colour of the same shade.

909.5.3. On surfaces requiring a change of colour, after the surface has been prepared as in clause 909.3.2 two coats of white-wash shall be applied before application of specified number (minimum two) of coats of colour-wash of the new shade.

909.6. Protective measures :—This shall conform to clause 908.6.

909.7. Measurement :—This shall conform to clause 908.7.

909.8. Rate :—This shall conform to clause 908.8.

Specification No. 910

Dry Distempering

910.1. Materials :

910.1.1. *Distemper* :—Dry distemper of approved make, colour and shade shall be used.

910.2. Scaffolding :—This shall conform to clause 908.2.

910.3. Preparation of Distemper :

910.3.1. The dry distemper shall be stirred slowly in clean water using 6 decilitres (0.6 litre) of water per kg. of distemper or as specified by the makers. Warm water shall be preferably be used. It shall be allowed to stand for atleast 30 minutes before use. The mixture shall be well stirred before and during use to maintain an even consistency.

910.3.2. Distemper shall not be used in larger quantity than is actually required for one day's work.

910.4. Preparation of Surface :

910.4.1. Before new work is distempered the surface shall be thoroughly brushed free from mortar droppings and other foreign matter and sand-papered smooth. New plaster surfaces shall be allowed to dry for atleast one month after curing before applying distemper.

910.4.2. For the old surface which had earlier been distempered, the surface shall be cleaned from grease, dust, etc. The flakings of the previous coatings if any shall be taken off. All crack holes and surface defects shall be repaired with gypsum and allowed to set hard and then sand papered smooth and wiped clean. But in

case the surfaces are coloured or white-washed, the wash shall be removed thoroughly first.

910.5. Priming coat :—Where prescribed a primary coat of whiting shall be applied over the dry surface. The whiting consists of ground white chalk dissolved in sufficient quantity of warm water thoroughly stirred to form a thick slurry which shall then be screened through a clean coarse cloth. Two kgs. of gum and 04. kg. of copper sulphate dissolved separately in hot water shall be added for every cu.m. of slurry which shall then be diluted with water to the consistency of milk. The whiting so prepared is ready for use as a priming coat. The priming coat when dry shall be rubbed as clean and smooth as possible. No white-washing coat shall be used as priming coat for distemper.

910.6. Application of Distemper :

910.6.1. In the case of new work the treatment shall consist of a priming coat as in clause 910.5 followed by the application of two or more coats of distemper as specified till the surface shows an even colour.

910.6.2. For old work the surface prepared as described in clause 910.4.2. shall be applied one or two coats of distemper as specified till the surface attains an even colour.

910.6.3. The entire surface shall be coated with the mixture uniformly with proper distemper brushes in horizontal strokes followed immediately by vertical strokes which together shall constitute one coat. The subsequent coats shall be applied only after the previous coat has dried. The finished surface shall be even and uniform and shall how no brush marks.

910.6.4. Enough distemper shall be mixed to finish one room at a time. The application of a coat in each room shall be finished in one operation and no work shall be started in any room which cannot be completed the same day.

910.6.5. After each day's work the brushes shall be washed in hot water and hungdown to dry. Old brushes which are dirty or caked with distemper shall not be used.

910.7. Protective measures :—This shall conform to clause 908.6.

910.8. Measurement :—This shall conform to clause 908.7.

910.9. Rate :—This shall conform to clause 908.8.

Specification No. 911

Oil Bound Distempering

911.1. Materials :

911.1.1. *Oil bound distemper* :—Oil bound washable distemper of approved make, colour and shade shall be used.

911.1.2. *Primer* :—The primer where used on new work shall be cement primer or distemper primer. These shall be of the same make as oil bound distemper.

911.2. Scaffolding :—This shall conform to clause 908.2.

911.3. Preparation of surface :—Oil bound distemper shall not be applied within six months of the completion of the wall plaster. The preparation of surface shall conform to clause 910.4.

911.4. Application :

911.4.1. *Primer coat* :—The primer coat shall be with distemper primer or cement primer. The distemper primer shall be applied with a brush on a clean, dry and smooth surface. Horizontal strokes shall be given first and vertical strokes shall be applied immediately afterwards. This entire operation shall constitute one coat. The surface shall be finished as uniformly as possible leaving no brush marks. It shall be allowed to dry for at least 48 hours before oil bound distemper is applied.

911.4.1.1. For old work no primer coat is necessary.

911.4.2. *Distemper Coat* :

911.4.2.1. For new works after the primer coat has dried for atleast 48 hours, the surface shall be lightly sand-papered to make it smooth for receiving the distemper taking care not to rub out the priming coat. All loose particles shall be dusted off after rubbing. One coat of distemper properly diluted with thinner (water or other liquid as stipulated by the manufacturer) shall be applied with brushes in horizontal strokes followed immediately by vertical strokes which together constitute one coat.

911.4.2.2. The subsequent coats shall be applied in the same way. Two or more coats of distemper as specified shall be applied over the primer coat to obtain an even shade.

911.4.2.3. A time interval of atleast 24 hours shall be allowed between consecutive coats to permit the proper drying of the preceding coat.

911.4.3. For old work the distemper shall be applied over the prepared surface in the same manner as in new work. One or more coats of distemper as specified shall be applied to obtain an even and uniform shade.

911.4.4. 150mm. double bristled distemper brushes shall be used. After each day's work brushes shall be thoroughly washed in hot water with soap solution and hung down to dry. Old brushes which are dirty and caked with distemper shall not be used on the work.

911.5. Protective measures :—This shall conform to clause 908.6.

911.6. Measurement :—This shall conform to clause 908.7.

911.7. Rate :—This shall conform to clause 908.8.

Specification No. 912

Water Proof Cement Painting

912.1. Materials :

912.1.1. The water proof cement paints shall be of approved make, colour and shade.

912.2. Scaffolding :—This shall conform to clause 908.2.

912.3. Preparation of mix :

912.3.1. Water proof cement paint shall be mixed in such quantities as can be used up within an hour of its mixing as otherwise mixture will set and thicken affecting flow and finish. Water Proof cement paint shall be mixed with water in two stages. The first stage shall comprise of two parts of water proof cement paint and one part of water stirred thorougly and allowed to stand for 5 minutes. Care shall be taken to add the water proof cement paint gradually to the water and not *vice versa*. The second stage shall comprise of adding further one part of water to the mix and stirring thoroughly to obtain a liquid of workable and uniform consistency. In all cases the manufacturer's instructions shall be followed meticulously.

912.3.2. The lids of cement paint drums shall be kept tightly closed when not in use, as by exposure to atmosphere the cement paint rapidly becomes air set due to its hygroscopic qualities.

912.4. Preparation of surface :

912.4.1. For new work, the surface shall be thoroughly cleaned of all mortar dropings, dirt, dust, algae, grease and other foreign matter by brushing and washing. The surface shall be thoroughly wetted with clean water before the water proof cement paint is applied.

912.4.2. In the case of old cement painted work all loose pieces and scales shall be removed and the surface shall be cleaned of all dirt, dust, algae, oil, etc., by brushing and washing. Pitting in plaster shall be made good and a coat of water proof cement paint shall be applied over patches after wetting them thoroughly.

912.5. Application :

912.5.1. The solution shall be applied on the clean and wetted surface with brushes or spraying machine. The solution shall be kept well stirred during the period of application. It shall be applied on the surface which is on the shady side of the building so that the direct heat of the sun on the surface is avoided. The method of application of water proof cement paint shall be similar to oil bound distemper. The completed surface shall be watered after the day's work.

912.5.2. The second coat shall be applied after the first coat has set for atleast 24 hours. Before application of the second or subsequent coats the surface of the previous coat shall not be wetted.

912.5.3. For new work surface shall be treated with two or more coats of water proof cement paint as specified to get a uniform shade.

912.5.4. For old work the treatment will be with one or two coats as specified to get a uniform shade.

912.5.5. Water proof cement paint shall not be applied on surface already treated with white-wash, colour-wash, distemper (dry or oil bound), varnishes paints, etc. It shall not applied in gypsum, wood and metal surfaces. In case of surfaces are coloured or white-washed the wash must be removed thoroughly first and surface treated as in clause 912.4.2 before application of cement paint.

912.6. Protective Measures :—This shall conform to clause 908.6.

912.7. Measurement :—This shall conform to clause 908.7.

912.8. Rate :—This shall conform to clause 908.8.

SECTION 10

STANDARD SPECIFICATIONS FOR WOOD WORK

CONTENTS

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Specification No. 1001

Wood Work

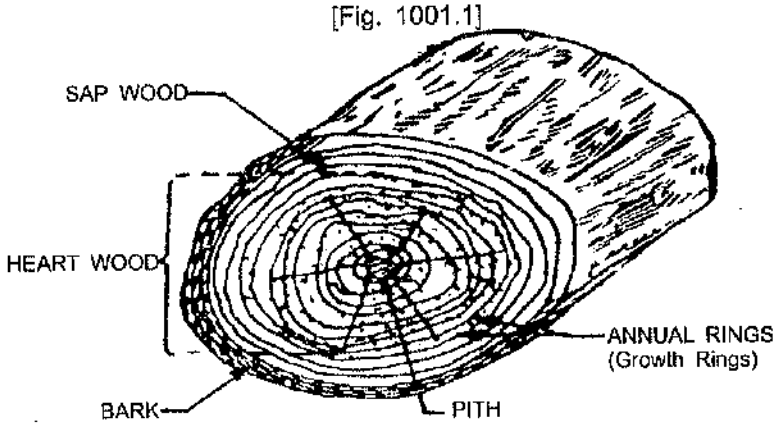
1001.1. Scope :—This specification covers the different types of timber and other wood based materials and their use in building, etc.

1001.2. Terminology :

1001.2.1. *Bark* :—The covering or rind of tree outside the wood. (See Fig. 1001.1).

CROSS SECTION OF LOG

[Fig. 1001.1]



1001.2.2. *Battern* :—A piece of sawn timber, dimensions of which do not exceed 50 mm. either in breadth or thickness.

1001.2.3. *Baulk* :—A piece of sawn timber whose cross-sectional dimensions exceed 50mm. in one direction and 200mm. in other direction.

1001.2.4. *Bonding* :—The process of uniting two or more pieces of wood or veneers by means of an adhesive. This process is characterised by continuity of the union over the whole of the areas of contact.

1001.2.5. *Braces* :—Diagonal members in the frame work.

1001.2.6. *Chamfering* :—Bevelling the sharp edge of a piece of timber.

1001.2.7. *Check* :—A fine crack.

1001.2.8. *Cross Grained timber* :—Timber in which the fibre alignment deviates from a direction parallel to the long axis of the piece.

1001.2.9. *Cup-board* :—Shelved closet or cabinet for storing provisions, etc.

1001.2.10. *Decay* :—Disintegration of wood tissues caused by fungi or other micro-organism. (The words "Dote and Rot" also mean decay).

1001.2.11. *Dressed Timber* :—Timber which has been sawn and planned to the exact required dimensions.

1001.2.12. *Durability* :—Resistance offered by wood to agents of natural destruction like insects at fungi etc., which determines its useful service life.

1001.2.13. *Face* :—The better side of the plywood panel in any grade calling for a face and a back also, either side of a panel where the grading rules draw no distinction between faces.

1001.2.14. *Fibre* :—a comparatively long narrow cell with closed ends.

1001.2.15. *Frame work* :—The frame work is the structure consisting of the edge members, diagonal braces and struts that contribute primarily to the strength and the rigidity of the crate.

1001.2.16. *Green timber* :—Freshly felled timber which has not lost much of its moisture or timber which still contain free water in its cell cavities.

1001.2.17. *Heart-wood* :—The inner portion of wood in a long or in cut timber which is usually of a darker colour than sap-wood and which is usually durable by nature.

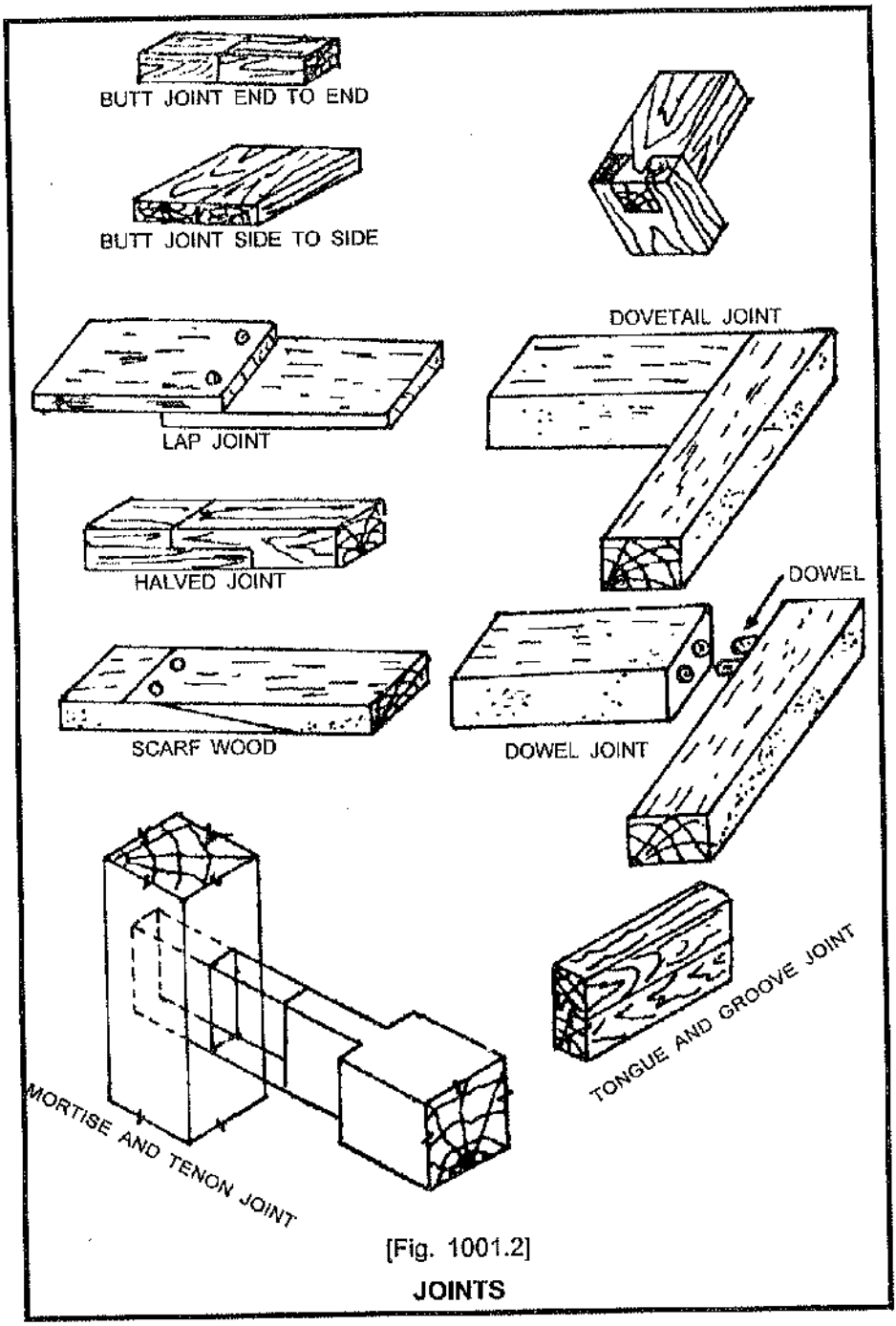
1001.2.18. *Hard-wood* :—A conventional term used to denote the wood generally derived from broad-leaved trees irrespective of physical properties of hardness or strength.

1001.2.19. *Joints* : (See Fig. 100-2 – Joints)

1001.2.19.1. *Butt-joint* :—Joint in which two pieces of timber are joined end to end or side to side secured by suitable method depending on whether the Joint is for lengthening or widening the wood pieces.

1001.2.19.2. *Dowel-joint* :—A joint in which dowels or pegs made on one piece are fitted tightly in corresponding holes made on the other piece.

1001.2.19.3. *Dove-tail joint* :—Joint at the corner of two pieces made in such a way that the notches made on the one are fitted exactly into projections of corresponding size and shape made in the other.



[Fig. 1001.2]

JOINTS

1001.2.19.4. *Halved joint* :—Sometimes this word is restricted only to the case when timber is reduced to half-section to a certain length at the edge on both the pieces and the pieces are lapped on one another and joined.

1001.2.19.5. *Lap joint* :—A joint in which two pieces of timber jointed in such a way that one overlaps the other and the entire surface may or may not remain continuous.

1001.2.19.6. *Mitred Joint* :—A joint, between two members at an angle in which the jointing surface are cut to corresponding edges at the inner section.

1001.2.19.7. *Mortise and tenon joint* :—A joint in which the reduced end (Tenon) of one member fits into the corresponding slot (Mortise) in the other member.

1001.2.19.8. *Scarf joint* :—A lap joint in which the ends and edges are levelled and the entire surface remains continuous.

1001.2.19.9. *Tongue and groove joint* :—A joint in which a tongue is provided on edge of one member and a corresponding groove on the other.

1001.2.20. *Knot* :—A portion of branch, which has become embedded in the wood by the subsequent growth of a tree. The cross-section of a knot is usually circular or oval in shape and is measured taking its mean diameter. Knots are classified as follows.

1001.2.20.1. *Decayed or unsound knot* :—It is a knot softer than the surrounding wood because of decay. If the decay is advanced, there may be a hole in the centre of the knot and the sides of the hole contain indications of decay.

1001.2.20.2. *Loose and hollow knot* :—It is a knot which has fallen out or likely to fall, leaving a hole with sides free from decay.

1001.2.20.3. *Live or sound knot* :—Live or sound knot is a knot, solid across its face and except for its own pith, it is atleast as hard as the surrounding wood to which it is firmly attached. It shows no indication of decay and is usually darker in colour than the surrounding wood.

1001.2.21. *Moisture content* :—The weight of water present in wood expressed as a percentage of its oven-dry weight.

1001.2.22. *Mortise* :—A hole or slot to receive a tenon or dowel of corresponding size.

1001.2.23. *Moulding* :—Shaping timber to a required outline or contour.

1001.2.24. *Particle board* :—A board manufactured from particles of wood or other lignoe cellulose material for example flakes, granules, silvers splinters agglomerated formed and pressed together by use of an organic binder together with one or more agents such a heat pressure, moisture and a catalyst.

1001.2.25. *Plank* :—A piece of sawn timber with thickness not exceeding 50mm. and the width not less than 100mm. or four times the thickness.

1001.2.26. *Rails* :—Horizontal members of shutters of doors, window panels or fencing.

1001.2.27. *Rebate* :—A recess along the edge of a piece of timber to receive another piece of door, sash or frame.

1001.2.28. *Reeper* :—Batter used in roof construction.

1001.2.29. *Sap wood* :—The outer layers of the log or the outer edges in cut timber which are usually lighter in colour than heart wood. Sap wood of all species of timber is subject to decay and decomposition unless treated with preservative. Sap wood has however the same mechanical strength as heard wood.

1001.2.30. *Scantling* :—A piece of timber whose cross-sectional dimensions exceed 50mm. in both the directions and do not exceed 200 mm.

1001.2.31. *Seasoning* :—A process involving the reduction of moisture content in timber under more or less controlled conditions towards or to an amount suitable for the purpose for which it is to be used. This shall be achieved either by air seasoning or kiln seasoning.

1001.2.32. *Shake* :—A partial or complete separation between the adjoinings layers of tissues.

1001.2.33. *Shrinkage* :—The reduction in dimensions of timber which takes place during drying.

1001.2.34. *Soft wood* :—A conventional term used to denote the wood generally derived from coniferous variety of wood like Pine, Deodar, Fir, etc. Locally available samples of soft wood are Anduk, Gumpene, Tabsy Burgu.

1001.2.35. *Split* :—A crack extending from one face to another face.

1001.2.36. *Structural timber* :—Timber used in framing and load bearing structures.

1001.2.37. *Style* :—A vertical piece of door shutter to which rails are joined.

1001.2.38. *Tenon* :—A tongue like projection made on the end of a piece of timber to fit into a corresponding mortise.

1001.2.39. *Veneer* :—A thin sheet of wood of uniform thickness obtained slicing, rotary cutting or sawing.

1001.2.40. *Warp* :—A deviation in sawn timber from a true plane surface.

1001.3.1. *Timber* :

1001.3.1.1. *Quality* :—Unless otherwise specified, timber used in wood work shall be of approved quality from the species of wood listed in IS : 399 : 1963. (Classification of commercial timbers and their zonal distribution).

Timber shall be well seasoned, proper dressed, of uniform coloured and durability of reasonably straight grains and shall be from knots, cracks, shakes, splits, cross grains decay and sapwood, etc.

Recommended species of wood for certain selected types of wood work appear in Table 1001-A.

Table 1001-A

Recommended species of wood for selected types of wood work

	Type of wood work	*Recommended species*
1.	Fames of Door, Window, Ventilator and Cupbaord.	Teak (Tectonogranndis lenn.) Bijasal (BIJ Ptercarpas marsupium Roxb) Nallamaddi (Terminalia tomenlosa weightel) Banduru (Adina cordifolia Hook. F).
2.	Shutters of Door, Window and Cupboard	
	(a) Frame	Teak, Bijasal, Nallamaddi, Bandaru, mango (Manjifira indicalinn).
	(b) Panel	Teak, Bijasal, Bandaru, Mango.
3.	Frame work for ceiling, cladding and partitions	Bijasal, Nallamaddi, Bandaru, Chinduga (Allizzia ohora tinima benth) Teak.
4.	Trusses, purlins, rafters, beams, posts, etc.	Bijisal, Nallamaddi, Chimanu (Anogeisus late folia wall), Ippa (Madjuca sp Syn. Bassia sp) Chennangi (Lagers tramia parviflôra robx) Konda tangedu zylia, xylocarpa tanb) chinduga, teak.

Moisture content of timber used in wood work shall be close as close as possible, to the lower values laid down in Table 1001-B.

Table 1001-B

Recommended values of moisture content in timber at the time of assembly of framing

	Type of wood work	*Recommended range of moisture content (%)*	
		Coastal Areas	*Inland areas*
1.	Frames of doors, windows, etc.	16 to 18 per cent	14 to 15 per cent
2.	Shutters of door, window, etc.	15 to 16 per cent	12 to 14 per cent
3.	Frame work for ceiling, cladding, etc.	16 to 18 per cent	14 to 15 per cent
4.	Trusses, purlins, rafters, etc.	25 to 28 per cent	20 to 22 per cent

1001.3.1.2. *Cut sizes* :—Cut size shall be grouped in terms of width and thickness or sectional area as follows :

(a) Batten — Cross sectional dimension not exceeding 50mm. in either direction.

(b) Plank — Thickness not exceeding 50mm. but width exceeding 100mm.

(c) Scantling — Cross sectional dimensions exceeding 50mm. but not exceeding 200mm. in either directions.

(d) Bulk — Cross sectional dimensions exceeding 50mm. in one direction and 200mm. in other direction.

1001.3.2. *Wood based product* :

1001.3.2.1. *Plywood* :—Plywood shall generally conform to IS : 303 and shall be of three grades, namely, B.W.R. (Boiling Water Resistant) WWR (Warm Water Resistant) and C.W.R. (Cold Water Resistant) depending upon the adhesive used for bonding the veneers and shall be of either commercial or decorative variety.

Plywood for general purposes shall be of six types, namely, AA, AB, AC, BB, BC and CC based on the quality of the two faces, each face being of three kinds namely A, B and C. Type AA shall have both faces of quality type AB shall have one face of quality A and the other of quality B and so on.

Unless otherwise specified the thickness, ply rating and grade of plywood for various applications of wood work shall be given below in Table 1001-C.

Table 1001-C

Recommended thickness, ply rating and grade of plywood for various applications

	Applications (1)	*Thickness* (2)	*Plyrating* (3)	*Grade* (4)
1.	Shutter panels :			
	(i) Interior location	9 mm.	5 ply.	W.W.R.
		12 mm.	5 ply.	W.W.R.
		15 mm. or 16 mm.	7 ply.	W.W.R.
	(ii) Exterior location	9 mm.	5 ply.	B.W.R.
		12 mm.	5 ply.	B.W.R.
		15 mm. or 16 mm.	7 ply.	B.W.R.
2.	Shelving	12 mm.	5 ply.	C.W.R.
		15 mm. or 16 mm.	7 ply.	C.W.R.
3.	Cladding, ceiling and partitions	4 mm.	3 ply.	W.W.R.
		6 mm.	3 ply.	W.W.R.
		9 mm.	5 ply.	W.W.R.

1001.3.2.2. **Block board** :

1001.3.2.2.1. Block board shall generally conform to IS : 1659-1965 and shall be of the following two grades :

(i) *Grade 1* :—Exterior grade of block board meant for bus bodies, railway coaches fabricated houses and where it is likely to be exposed to high humidity, rain etc.

(ii) *Grade 2* :—Interior grade of block board meant for furniture, partitions, panelling, ceiling, etc.

Each of the grades specified above shall be of commercial or decorative variety.

The grades and varieties of block board in general use are designated, as below.

Grade and type		*Symbol*
Interior grade, commercial type	—	ICOM
Interior grade, decorative type	—	IDEC
Exterior grade, commercial type	—	XCOM
Exterior grade, decorative type	—	XDEC

The recommended thickness for use of block board for panels used for doors, windows and cupboard shutters may be 19mm., and for shelving may be 19mm.-25mm.

1001.3.2.3. *Particle board* :

1001.3.2.3.1. Particle board shall generally conform to IS : 3087-1965 and shall be of four types and designated as below :

(i)	pressed single layer board	FPSI
(ii)	Flat pressed three layer board	FPTH
(iii)	Extrusion pressed solid board	XPSO
(iv)	Extrusion pressed tubular-core board	XPTC

1001.3.2.3.2. Veneered particle board shall generally conform to IS : 3097-1965 and shall be of eight types and designated as below :

(i)	Interior solid core, general purpose	INSOGP
(ii)	Interior solid core, decorative	INSOD
(iii)	Interior tubular core, general purpose	INTUCP
(iv)	Interior tubular core, decorative	INTUD
(v)	Exterior solid core, general purpose	EXSOGP
(vi)	Exterior solid core, decorative	EXSOD
(vii)	Exterior tubular core, general purpose	EXTUGP
(viii)	Exterior tubular core, decorative	EXTUD

Table 1001-D

The recommended type and thickness of particle board for various applications

	Application	*Type*	*Thickness*	*Face of board and kind of resin*
1.	Panel inserts in shutters :			
	Interior	Flat press single or multi layer	12mm. or 15-16mm.	Naked urea formal dehyde.
	Exterior	Flat press single or multi layer	12mm. or 15-16mm.	Naked urea formal dehyde.
2.	Panels in wardrobes and cupboards	Flat press single layer	15-16 or 19mm.	Naked or veneered urea formal dehyde.
3.	Pahels in ceiling partitions & cladding	Extrusion	9mm. or 12mm.	Naked urea formal dehyde
4.	Shelves	Extrusion	12mm. or 15-16mm.	Veneered, urea formal dehyde.

Thickness varies with the panel size and spans.

Particle board shall be worked and prepared for use in wood work in accordance with 1001.

While using particle board in wood work guidance shall be taken from the appendix 'A' namely "Storage and working of wood particle Board" in IS : 3087-1965.

1001.3.2.4. *Fibre hard board* :

1001.3.2.4.1. Fibre hardboard shall generally conform to IS : 1658-1965 and shall be of the following three types.

No.	*Type*	*Density kg./cu.m. (m^3)*
1.	Medium hard board	480 to 800
2.	Normal hard board	800 to 1,200
3.	Tempered hard board	1,200 and above

1001.4. Workmanship :

1001.4.1. *Sawing and planing* :—Timber as well as furniture to be used in wood work when so required, shall be inspected and passed by the Executive Engineer at the site of work or at the site of manufacture. Rejected timber, wood work or furniture shall not remain at the site of work. Timber shall be sawn truly straight and square and in the direction appropriate to the requirement of design and strength. The scantlings shall be planed smooth and accurate with rebates,

grooves, roundings and mouldings as shown in the drawings or as directed by the Executive Engineer. All machining of timber or scantlings for planing shall be done before any preservative treatment is given and not afterwards.

1001.4.2. *Jointing and framing* :—Unless otherwise specified all joints shall be simple mortise and tenon with the end of the tenon exposed to view. All joints shall fit closely neatly and accurately and in no case wedging or filling in shall be done. The following principles shall be observed in forming joints unless otherwise specified—

(i) to cut the joints and arrange the fastening so as not to unduly weaken the members of timber they connect ;

(ii) to place each abutting surface in a joint as nearly as possible normal to the pressure it may have to transmit ;

(iii) to form and fit accurately every pair of surface that come in contact;

(iv) joinery work shall before assembly be passed by the Executive Engineer;

(v) all joints shall be secured with hard wood or corrosion resisting, star shaped metal pins not less than 7mm. dia.

Framing and trusting are to be done accurately in the best possible manner using all necessary iron ties, strap bolts, hold fasts, nails, trinails, spikes, screws, etc., as per the drawings or as directed by the Executive Engineer. Driving in the screws with a hammer is prohibited and correct size holes shall be drilled before inserting the screws.

1001.5. Finishing :—The junction of all frame works, rafters and other wood works with masonry shall be neatly finished with pointing or plaster as the case may be so as to fit into the grooves, if any left in the wood work for this purpose. The exposed wood work shall be finished in accordance with the relevant specifications of A.P.S.S. under Section 12 with one coat of primer and two coats of oil paint of approved colour and shade or with French polish or varnish as may be specified.

The faces of all timber in contact with or embedded in masonry shall be well painted with two coats of hot boiling tar in accordance with A.P.S.S. No. 1206 or given any other approved treatment.

Specification No. 1002

Doors, Windows, Ventilators, Ward Robes and Cup-boards, etc.

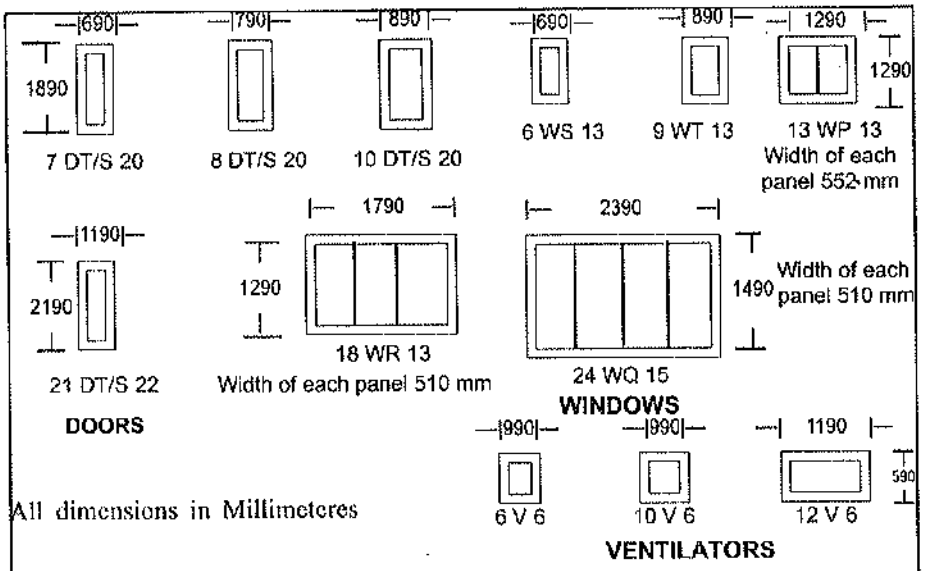
1002.1. All relevant clauses of 1001 shall apply.

1002.2. Scope :—This specification lays down the requirements regarding material, design, construction workmanship finish and inspection of doors and windows, etc., using timber, plywood, particle board, lipped block board and asbestos cement panels.

It does not cover the doors and windows for industrial and other special type of buildings such as work-shops, garages, godowns, etc.

1002.3. Frames for doors, windows, ventilators, ward-robs and cup-boards, etc.

1002.3.1. *Sizes and types* :—The sizes and types of frames of doors, windows and ventilators shall be as shown in Table 1002-A seen with Fig.1002.1.



[Fig. 1002.1]

TIMEBER DOORS, WINDOWS AND VENTILATORS

1002.3.2. *Designation* :—Frames of doors, windows and ventilators shall be designated by symbols denoting their width, type and height in that order and in the following manner.

Width :—It shall be indicated to by the number of modules in the width of opening.

Types :—It shall be indicated by the following letters of the alphabet.

D—Door	T—Double shutter
W—Window	P—Two panels
V—Ventilator	R—Three panels
S—Single shutter	Q—Four panels

Weight :—It shall be indicated by the number of 100mm. modules in the height of opening.

Example :—11 DT 20 should mean a frame of a double shutter door with a width of 11 modules (1090mm.) and height of 20 modules (1990).

1002.3.3. **Combination of frames of Doors, Windows and Ventilators** :—When frames of doors and windows are combined with those of windows and ventilators, they shall be designated in the following manner :

Example :—(1) 6 WS 10/11 DT 20/6 WS 10 means 11 modules wide and 20 modules high double shutter door frame combined, on its two sides, with two single shutter, windows 6 modules wide and 13 modules high.

Unless otherwise specified the sizes of scantlings for frames of doors, windows and ventilators shall conform to the requirements specified in Table 1002-A subject to a general tolerance + 3mm – 2mm.

Table 1002-A

Sizes of scantlings for frames of doors, windows and ventilators

Description	*Size of opening in modules*	*Scantilings*	
		Width in mm.	*Depth in mm.*
A. Doors	7 DT/S 20	50	75
	8 DT/S 20	50	75
	10 DT/S 20	50	100
	12 DT/S 22	65	100
B. Windows	6 MS 13	50	75
	9 WT 13	50	75
	13 WT 13	50	100
	18 WQ 13	65	100
	24 WQ 15	65	100
C. Ventilators	6 V 6	50	65
	10 V 6	50	65
	12 V 6	65	75

1002.3.4. *Construction and fixing* :

1002.3.4.1. This item shall be carried out in conformity with IS : 4021-1967 (clause 4) with dove tail or mortise and tenon joints.

1002.3.4.2.1. When ventilator is included in the door or window frame full length for the total height shall be used. The unrebated edges of the frame in the opening shall be rounded or beaded uniformly unless other types of moulding or grooves are shown on the drawings.

1002.3.4.2. The frames shall be erected in position and held plumb with strong supports from both sides. Hold fasts shall be embedded firmly in C.C. beds as specified. The shutters shall be fixed later. Frames shall have dove tail or tenon and mortise joints.

1002.3.4.3. The transom shall be through-tenoned into the mortise of the jamb posts to the full width of the jamb post and the thickness of the tenon shall be not less than 15 mm. The tenons shall be closely fitting into the mortises and pinned with corrosion resisting, star shaped metal pins not less than 7mm. dia. or with wooden dowels not less than 7mm. dia. The size of the rebate in frames for

housing the shutters shall be from 32 to 35 x 12mm. except when a flush door shutter of different thickness is intended to be used.

1002.3.4.4. Unless otherwise specified the frame shall have the same finish as the shutters.

1002.3.4.5. While fixing door frames without sills, the vertical member shall buried in the floor to a minimum of 10mm. depth.

The door frames without sills be provided with temporary wooden bracings between the styles at the sill level which shall be withdrawn after fixing in position.

1002.3.4.6. Before fixing in position, the frames shall be inspected and passed by the Executive Engineer. Priming coat shall be applied before the frames are fixed in position. All portions of untreated timber abutting against or embedded in masonry or concrete shall be painted with boiling coal tar before be placed in position. In place of coal tar use of approved preservative may be permitted.

The frames shall then be placed in proper position and secured to the structure with iron hold fast or any other media as per drawings or as directed by the Executive Engineer.

1002.3.4.7. *Frame work for cup boards* :—The sectional dimension of frames shall 75mm. x 50mm. in case of cup boards equal to door heights, and 65 x 32mm. in case of smaller cup boards, with a standard rebate of 32mm. wherever shutters are to be used.

1002.3.4.8. *Hold fasts* :—A minimum number of three hold fasts shall be fixed to each post of the door frame, one at the centre point and the other two at 300mm. from the top and the bottom of the frame. Two hold fasts to each post of the windows and ventilator frames, shall be fixed at quarter points of the frame. The hold fasts shall be fixed in suitable block of cement concrete. The mild steel hold fasts shall be of the size 300 x 400 x 5mm. of the 'Z', shape and each shall have two holes drilled in for fixing counter-sunk lead screws. Each hold fast shall be fixed with two mild steel screws of not less than 35mm. * 5mm.. For window frames, two hold fasts as above shall be fixed to each post of frame.

1002.4. Shutters for doors, windows, ventilators, wardrobes and cup boards :—

1002.4.1. *Shutter frames* :—The recommended sectional dimensions of scantlings of shutter frames are given in Table 1002-B.

Table 1002-B

Recommended Sections of frame scantling in mm.

Components		*Door Shutter*	*Window and Ventilator shutter*	*Ward-robe and cupboard shutter*
Styles	—	75 x 32–35	65 x 32–35	50 x 32
Top rail	—	75 x 32–35	65 x 32–35	50 x 32

Bottom rail	—	100 x 32–35	65 x 32–35	50 x 32
Lock rail	—	100 x 32–35	—	50 x 32
Intermediate rail	—	50 x 32–35	50 x 32–35	50 x 32

Tolerance ± 2mm. in larger dimensions and ± 1mm. in the smaller dimensions.

The styles and rails shall be properly and accurately mortised and tenoned.

The end styles and all rails of shutters shall be made out of one piece only. Where more than one piece of timber is used the joint shall be made with a continuous tongue and groove glued together and reinforced with rust proof metal dowels or headless pins not less than 35mm. length at regular intervals not more than 200mm. apart. Jointed pieces of timber shall be of one species only.

The styles and rails shall be grooved on the inner faces for the panel inserts to fit in.

1002.4.2. *Shutter panels* :—Materials for shutter panels, for doors, windows, ward-robes and cupboards shall be as per Table 1001-A and 1001-C.

1002.4.3. *Timber Shutters* :—Timber for panelling shall be from the recommended specie of wood and shall be kiln seasoned, unless otherwise specified. The shutters shall be of any of the following types :

1. Plain panelled shutters.
2. Bevelled panelled shutters.
3. Ledged, braced and battened shutters.

These shutters are recommended both for doors and for interior and exterior locations.

1002.4.3.1. *Plain panelled shutters* :—The direction of the natural grain of wood shall be the direction in which the long dimension of the panel will run. The minimum width of each panel shall be 150mm. and the minimum thickness 12mm.. Panels shall be inserted to the extent of 10mm. in the grooves made inside the style and rail frame on all the four sides.

1002.4.3.2. *Bavelled panelled shutters* :—The planks used for bevelled panels shal have a minimum width of 200mm. and minimum thickness of 15mm. Bevelling or chamfering shall be done at the outer edges of each panel so as to achieve a thickness of 10mm. at the end, to suit the groove made in the style and rail frame on all the four sides.

The edge shall be beaded, grooved or moulded as specified. The panel, or fitting into the shutter frame, shall show its bevelled face towards the outer side of the door or window and shall be raised by a minimum of 2 mm. The inside face of the panel shall be flat.

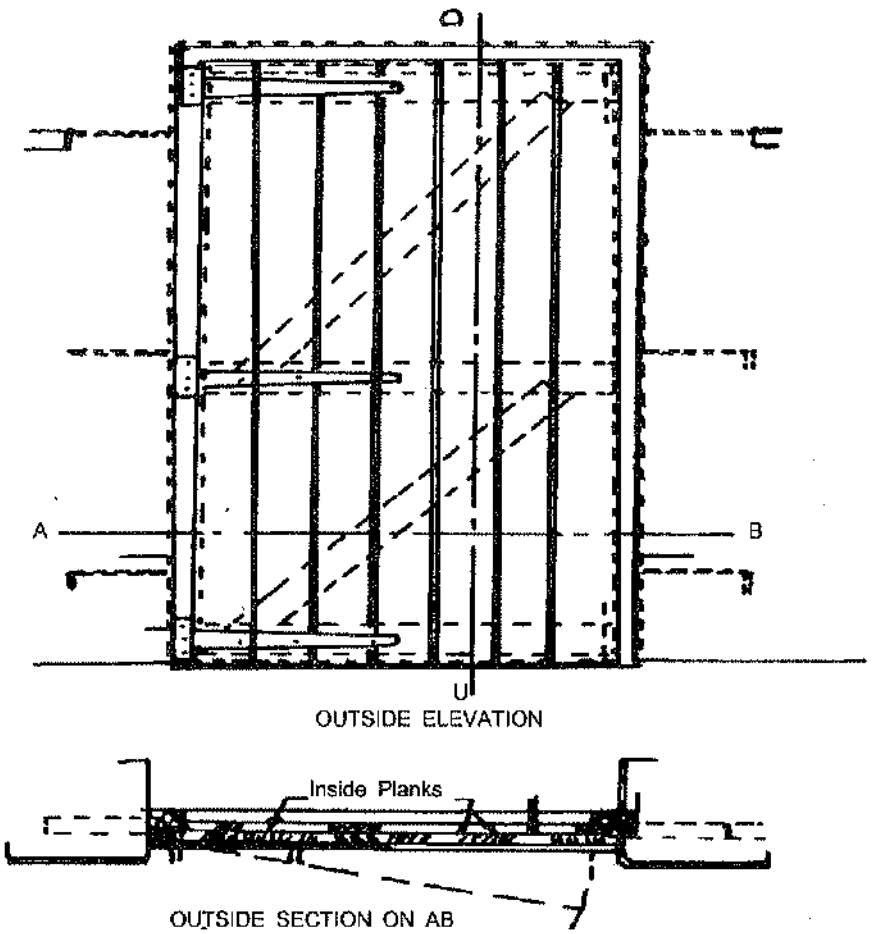
1002.4.3.3. *Ledged, braced and battened shutters* :—The battens used shall have a thickness of 25mm. width of each being not less than 150 mm. Unless otherwise specified, all battens in a shutter shall be of equal width. The top, bottom and middle ledges of the shutter shall be 150 x 30mm. For windows, the battens

shall have a thickness of 29mm. and width not less than 75mm. The ledges shall be of 75 x 25mm. size. The braces shall be fixed as shown in the drawing and shall be of the same section as that of the ledges. The ledge shall be 30mm. shorter in length than the width of the shutter, and fixed across the shutter in such a way as to be short by 15mm. at the outer end of the outer most battens. The top and bottom ledges shall be fixed 15mm. from the top and bottom ends of the shutter. The braces shall be notched into the ledges and each batten shall be fixed at every crossing with ledge and brace, with a nail 65mm. long which shall then be clenched at the end. The batten shall in addition be rebated together with 10mm of rebates all along their length, except the end batten which shall have moulded edges on the front face. The shutter shall be fixed in the frame with the ledges and braces showing on the outside face of the door or window.

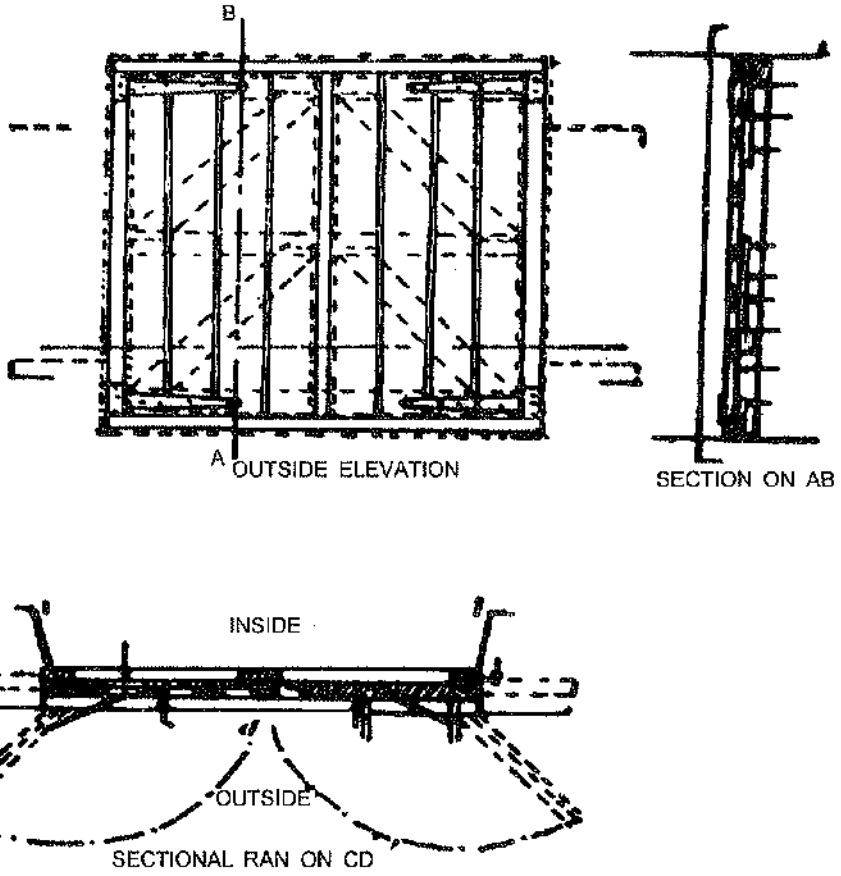
The shutters shall be fixed to the frame with 'T' strap hinges screwed to the ledges. (See Fig. 1002.2 & 1002.3).

DOOR WITH LEDGED BRACED AND BATTENED SHUTTERS

[Fig. 1002.2]



WINDOW WITH LEDGED BRACED AND BATTENED SHUTTERS
[Fig. 1002.3]



1002.4.4. *Plywood and particle board panels for shutters* :—Panel inserts shall be set in the grooves or corresponding width and 12mm. depth made in the style and rail of the shutter. In the case of cupboards and wardrobes plywood panels with wooden lipping alround may themselves be used as a shutter. Lipping shall be of the same quality of wood as used for shutter, style and rails and shall be 6mm. thick. Lipping shall be glued with resin to the plywood or particle board and the panel shall be secured to the frame with continuous hisge.

1002.4.5. *Flush type shutters* :—The flush door shutters are generally manufactured by different firms and the department purchases their produce wherever flush doors shutters are to be fixed in a building.

The flush door shutters shall be of the following types and shall conform to the ISS noted against each :

1. Flush-door shutters solid-crore type :

(a) Plywood face panels IS : 2202 (Part-I) 1-1 1973.

(b) Particle board face panels IS : 2202 (Part-II)-1966.

2. Flush door shutters with cellular and hollow-core type :

(a) Plywood face panels IS : 2191 (Part-I) 1973.

(b) Particle board face panels IS : 2191 (Part-II)-1966.

1002.4.6. *Glazed shutters* :

1002.4.6.1. *Glass* :

1002.4.6.1.1. The glass shall have uniform thickness and shall be free from air holes, bubbles, scratches, flaws and specks and other defects. The following shall be the specification for different kinds of glasses generally used.

1002.4.6.1.2. *Transparent sheet Glass* :

1002.4.6.1.2.1. The sheet glass shall conform to IS : 1761-1960 and shall have the following thickness as shown in Table 1002-E.

Table 1002-C

Size of Glass Panes	*Maximum required thickness*
Upto 600mm. x 600 mm.	3mm.
From 600mm. x 600 mm. to 900mm. x 900mm.	4mm.
From 900mm. x 900mm. to 1200mm. x 1200mm.	5mm.

For panes above 900mm. x 900 the thickness shall be as fixed by the Executive Engineer.

1002.4.6.1.2.2. *Tolerance* :—In measuring the thickness of glass panels tolerance shall be permitted as per Table 1002-F.

Table 1002-D

Tolerances

Thickness	*Tolerance thickness mm.*
2.00 to 4mm.	plus and minus 0.2
5.00	plus and minus 0.3

1002.4.6.1.3. *Obscured Glass* :—This type of glass transmits light so that the vision is partially or almost completely obscured. Plane rolled or double rolled, figured, rolled ribbed fluted, forsted glass on one or both sides are principal types. The ribbed or fluted type of glass shall be used when more diffused types of lighting is desired that can be obtained with other types of obscured glass. The type and

thickness of glass shall be as mentioned in the item or specified with drawings, or as directed by the Executive Engineer.

1002.4.6.1.4. *Wired Glass* :—In this type of glass wire netting is embedded in a sheet glass. Electrically welded 13mm. georgian square mesh or 22mm. hexagonal mesh is inserted during rolling. The thickness of glass shall not be less than 6 mm unless otherwise specified.

1002.4.6.1.5. *Putty* :—The putty to be used for fixing the glass in wooden frames shall conform to IS : 419-1967. The putty may be coloured to suit the colour of door or window, etc.

1002.4.6.2. *Glazing* :—Glazing shall be of good glass panes not less than 3mm. thick, and in accordance with the sizes given in Table 1001-E or as specified. The glass panel shall be cut as to fit slightly loose in the rebates of sashes. In doors, windows and ventilators of bath and W.C. translucent glass panes or louvers shall be used. The panes shall be fixed with the plain face on the outer side. Superior glass panes such as sheet glass, plate glass, pin-head glass etc., shall be used where so specified. Glass panes shall be fixed by wooden beading having mitred joints. A thin layer of putty shall be applied between glass panes and sesh bars and also between glass panes pas and the beading. Putty shall be prepared by mixing one part of white lead with three parts of finely powdered chalk and adding boiled linseed oil to the mixture to form into a stiff paste. Putty shall conform to IS : 419-1967 and shall be coloured to suit the colour of wood work.

Where dry glazing is specified, glass shall be held in place by moulded wooden fillets fixed with brass screws. Round the end of the glass and between the glass and wooden fillet a piece of chamois wash leather or felt shall be inserted to act as a cushion.

Glass panes shall not be inserted in the frame until the latter has been primed and prepared for painting to prevent the oil being drawn out of the putty.

Glazing shall not be considered completed unless all stains and marks have been removed from the surface of the glass.

1002.4.7. *Fixtures and fastenings* :—All fixtures and fastenings shall unless otherwise specified be of mild steel, brass or aluminium alloy and shall comply with relevant IS Specification as given below :

IS : 204-1974 Specification for Tower Bolts.

IS : 205-1966 Specification for non-ferous metal but hinges.

IS : 206-1973 Specification for fee and Strap hinges.

IS : 207-1967 Specification for Gate and shutter hooks and eyes.

IS : 208-1972 Specification for Door handles.

IS : 281-1973 Specification for sliding door bolts, mild steel for use with pad locks.

IS : 362-1975 Specification for parliament hinges.

IS : 363-1970 Specification for hasps and staples.

Unless otherwise specified door, window, ward-robe and cupboard shutters shall be provided with fittings and furniture as shown in the following table :

Table 1002-E

Recommended Fittings and Furniture for Door Shutters

Particulars of fittings and furniture	*Two leaf*	*Single leaf*
Butt hinges with suitable slotted counter sunk head screws conforming to IS : 1341-1970 125mm. long with 50mm. screws	6	3
Tower bolts conforming to IS : 204-1974 top tower bolts (300mm. long with 25mm. screws)	2	1
(ii) Bottom tower bolts 150mm. long with 25mm. screws	1	1
Aldrop	1	1
Door handles conforming to IS : 208-1972	2 (where aldrop not used)	
Wind cleats or other approved type of leaf. stoppers	2	1

Table 1002-F

Recommended Fittings and Furniture for Window Shutters

Particulars of fittings and furniture	*Single leaf type*	*More than 1 leaf/per leaf*
But hinges with suitable counter sunk head screws conforming to IS : 1341-1971, 100mm. long with 50mm. screws (for side hung and top hung window)	2	2
Tower bolt conforming to IS : 204-1974- Top tower bolts 150mm. long with 25mm. screws	1	1
Bottom tower bolt with 25mm. screws	1	1
Wind cleats or other approved type of leaf stoppers	1	1

Table 1002-G

Recommended Fittings and Furniture for Cupboards and Wardrobes Shutters

Butt hinges as per details for window shutters	—	2 per leaf
Door handles	—	1 No. leaf
Sliding latches	—	1 No. leaf
Any approved type of locking arrangement	—	1 No. leaf

The size, design and finish of the fixture shall be as shown on drawings or as directed by the Executive Engineer. Samples of all fixtures and fastenings to be used shall be got approved by the Executive Engineer and deposited in his office for reference.

All fixtures shall be securely fixed to the joinery. Any of the fixtures damaged during fixing shall be removed and new ones fixed in their place and the surface of joinery made good where affected at the contractors' expense.

The lock rail of door shutters where provided shall be so placed that its centre line is at a height of 750mm. from the bottom of the shutter.

Unless otherwise specified each leaf of the door shall be hung carefully so as to move freely and fitted accurately with three butt hinges, one at the centre and the other two at 200mm. from the top and the bottom of the shutter. Each window shutter shall be fixed to its frame with two butt hinges at quarter points. Each ventilator shutter shall be fixed either to its frame with two butt hinges at top rail or suspended on a suitable peg stay in the centre of frame.

Where parliament hinges are to be used, the door or window frame shall be fixed so that the shutter will fold back parallel to the wall, leaving 5mm. clearance.

A metal sleeve or other suitable device shall be provided, where the end of the bolt enters brick, stone concrete, etc. These shall be fixed flush with the surface and cemented or otherwise secured where the bolt enters the wood. Mortise plates set flush with the surface shall be used over the holes. Butt and similar hinges shall be countersunk flush with the leaf edge and wood frame.

1002.4.8. *Weld mesh, expanded metal and Fly proof mesh panels* :

1002.4.8.1. *Welded steed wire fabric (welded mesh)* :

1002.4.8.1.1. *General* :—Welded steel wire fabric shall consist of a series of longitudinal and transverse cold drawn steel wires (as drawn or galvanised) arranged at right angles to each other and welded together at all the points of intersection. The fabric shall generally conform to the requirements of IS : 4948-1974.

1002.4.8.1.2. *Pattern* :—Standard patterns used in square or oblong meshes. The common sizes of meshes are given in Tables 1002-H.

Table 1002-H

Mesh sizes and Wire Sizes commonly used

Sl. No.	*Mesh size nominal pitch of wire mm.*	*Diameter of wire way mm.*
1.	20	2.00
2.	25	2.00
3.	50	2.50
4.	75	3.15

Oblong mesh :

Sl. No.	*Longitudinal mm.*	*Transverse mm.*	*Longitudinal mm.*	*Transverse mm.*
5.	50	25	2.5	2.5
6.	75	25	3.15	3.15
7.	75	50	3.15	3.15

1002.4.8.2. *Expanded metal steel sheet (Expanded metal jalee)* :—Expanded metal steel sheet (Expanded metal Jalee) shall generally conform to IS : 412-1962. The expanded metal sheet shall be free from flaws, joints, stands, laminations and other harmful effects. It shall have a suitable protective treatment to prevent corrosion. It shall be specified in terms of both short-way mesh and long-way mesh. Table 1002-J shows the properties and dimensions of expanded metal sheets for general purposes.

	Size of mesh		Dimensions of strands (Nominal)				Largest strand & size of sheets		
1.	25	75	3.25	2.24	4.564	5.82	2.5	4.85	
2.	25	75	3.25	1.60	3.262	4.16	2.5	4.85	
3.	25	75	3.25	1.25	2.548	3.25	2.5	4.85	2.5 x 3.75 & 1.25x 3.75
4.	20	60	3.25	3.15	8.023	10.23	2.5	3.75	2.5 x 3.75
5.	20	50	3.25	3.15	8.023	10.23	3.75	3.75	2.5 x 3.75
6.	20	60	3.25	2.24	5.709	7.28	2.50	3.75	2.5 x 3.75 & 1.25 x 3.75
7.	20	50	3.25	2.24	5.709	7.25	3.75	3.75	Do.
8.	20	60	3.25	1.60	4.078	5.20	2.50	3.75	Do.
9.	20	50	3.25	1.60	4.078	5.20	3.75	3.75	Do.
10.	20	60	2.50	1.25	2.447	3.12	2.50	4.75	Do.
11.	20	50	2.50	1.25	2.447	3.12	3.75	3.75	Do.
12.	12.5	50	3.25	1.60	6.525	8.32	2.50	3.00	2.50 x 2.75 & 1.25 x 2.75
13.	12.5	40	3.25	1.60	6.525	8.32	3.75	3.00	Do.
14.	12.5	50	2.50	1.60	5.019	6.40	2.50	3.00	Do.

15.	12.5	50	2.50	1.25	3.921	5.00	2.50	3.00	Do.
16.	12.5	40	2.50	1.25	3.921	5.00	3.75	3.00	Do.
17.	12.5	50	2.50	1.00	3.137	4.00	2.50	3.00	Do.
18.	12.5	40	2.50	1.00	3.137	4.00	3.75	3.00	Do.

1002.4.8.3. *Wire cloth (Fly proof mesh)* :

1002.4.8.3.1. The wire cloth shall generally conform to IS : 1568-1970.

1002.4.8.3.2. The wire used in the manufacture of the wire cloth (Gauze) shall be of brass, bronze, mile steel, aluminium alloy or plastic. Specification for the material and for protection covering on the wire, where required, shall be as given by the Executive Engineer.

1002.4.8.3.3. The wire used in the manufacture of the wire gauze shall be well drawn, free from scales, inequalities, splits, etc., of circular cross-section and of uniform ductility throughout its length to avoid hard lumps or soft spots in the finished wire gauze.

1002.4.8.3.4. Unless otherwise specified the size of the opening shall be about 1mm. and the thickness of the wire unless otherwise specified shall be not less than 0.5mm.

1002.4.8.3.5. The wire gauze shall be regularly woven with a number of equally spaced parallel wires in both warp and weft directions to produce uniform square meshes or openings. The wire gauze shall be properly secured by one or more wires on both the edges.

1002.4.8.3.6. Crimping of wires may be done, where necessary to facilitate construction and to minimise distortion of apertures.

1002.4.8.4. *Fixing* :

1002.4.8.4.1. Unless otherwise specified, the expanded metal or weld mesh shall be cut in one piece to the required size and shall be fixed on to the frame with staples over which wooden heading shall be fixed with screws.

1002.4.8.4.2. Where fly proof mesh is used, the wire gauge shall be bent at right angles in the rebates of styles and rails, and turned back and fixed tight with tack nails to the two faces of the rebates. Over this wooden heading shall be fixed with brade or small screws. The space between the beading and the rebates, where the wire gauze is bent shall be nearly finished with putty so that the end of the wire gauze shall not be visible.

1002.4.9. *M.S. Bars, Flats and Grills fixed in Frames for windows, etc.* :

1002.4.9.1. M.S. Bars, M.S. Flats and M.S. Grills shall be fixed as per detailed drawings or as directed by the Executive Engineer.

1002.4.9.2. Where M.S. Bars are to be fixed in wooden frames of window etc., through holes shall be drilled in the frame and the bars shall be passed in to the frame from one side to the other and these shall be of correct length to fit flush with the outside of the frame at both ends. Where M.S. Flats are provided along

with the bars, the former shall be inserted into the frame to a depth of not less than 25mm. at either end. The bars shall be passed through the holes drilled in the flats.

Grills shall be fabricated as per design and fixed to the frame by round-headed bolts and nuts in new work and by wood screws in old work.

1002.4.9.3. M.S. Bars and flats if provided shall be finished with two coats of paint of approved colour and shade over a priming coat in accordance with the relevant specifications of Section 12. All iron work inserted in the wood work or to be embedded in masonry shall be treated before erection with two coats of hot coat as per S.S.No. 1206 or with bituminous paint as per S.S. No. 1215 or any other anticorrosive paint as may be specified. M.S. Bars or flats wherever fitted to frames shall be given the first coat of paint before the frames are fixed in position and the remaining coats after the frames are fixed.

1002.5. Measurement :

1002.5.1. All linear measurements shall be in metres, correct to 0.01 of a metre. All area shall be worked out in square metres, correct to 0.01 of a square metre. All volume shall be worked out in cubic metres, correct to 0.001 of a cubic metre.

1002.5.2. Only the overall dimensions of doors, windows, ventilators, wardrobes and cup-boards after fixing frames and shutters and finished in accordance with this specification shall be measured.

1002.5.3. Where shutters are measured separately, they shall be measured in closed position including the rebates of the frame. Overlaps of shutters shall not be measured. All shutters shall be measured net as fixed without any allowance for joints, mouldings, etc.

1002.5.4. Where the drawings show a wooden threshold plate for a door opening on to a verandah, the floor level of the room and not of the verandah shall be the point of measurement for the height of the door.

1002.5.5. M.S. Bars and flats shall be measured in running metres, correct to 0.01 of a metre separately for different diametres and the weight worked out in tonnes, correct to 0.001 of a tonne. Grills shall be measured out to out including the frame work.

1002.5.6. Where frames are to be measured separately, they shall be measured in number according to their sizes or according to their area.

1002.6. Rate :

1002.6.1. The unit rate for payment for door, window, ventilator, wardrobes and cupboard shall be per number of per sq.m.

1002.6.2. Unless otherwise specified, the rate shall include sawing, planing, moulding, jointing framing and fixing in position, chamfering and glazing in accordance with the drawing or as directed by the Executive Engineer. Unless otherwise specified the rate shall also include all fastenings, fittings and fixtures.

1002.6.3. M.S. Bars, flats and grill shall be paid for per 100kg.

1002.6.4. Where frames are to be paid for separately the rate shall be per sq.m.

1002.6.5. Where shutters are to be paid for separately the rate shall be per sq.m.

Specification No. 1003

Frame Work for Roofs

1003.1. All relevant clauses of SS : 1001 and 1002 shall apply.

1003.2. Timber for frame work for roofs shall generally be from the species recommended in Table 1001-A. Seasoned timber shall be used with preservative treatment wherever necessary.

1003.2.1. The truss members, joints and fastenings shall be in accordance with drawings. A full scale layout of the truss on a suitably prepared level surface shall be used to ensure accurate assembly.

1003.2.2. The trusses shall be carefully hoisted and stayed in true position till built in or otherwise secured with bolts, holdfasts, purlins or other connecting members. The trusses shall be fixed on templates or cement concrete bed blocks.

1003.2.3. The portion of truss members abutting against or embedded in masonry or concrete shall be painted with building coal tar or bituminous or red lead paint before being placed in position. Junctions of rafers, purlins, beams, walls plates, etc., shall be suitably treated. All metal fastenings shall be protected against corrosion by approved treatment.

Note :—The Timber Engineering Branch of Forest Research Institute, Dehra Dun, has developed the theory and practice of Timber Engineering in this country to such an extent that effective spans upto 35 metres have been executed in wood and further details and designs can be obtained from them. In these designs, the dimensions of individual pieces of timber used are usually very small. Rails, bolts and discs and dowels are used as connectors in the lengthening joints. The construction of trusses (above 7 metres span) is of the twin-chord type (in respect of the principal rafters and tie beam of the truss) and the tension and compression members are provided as a web between chords.

1003.3. Other members of sloping roofs :

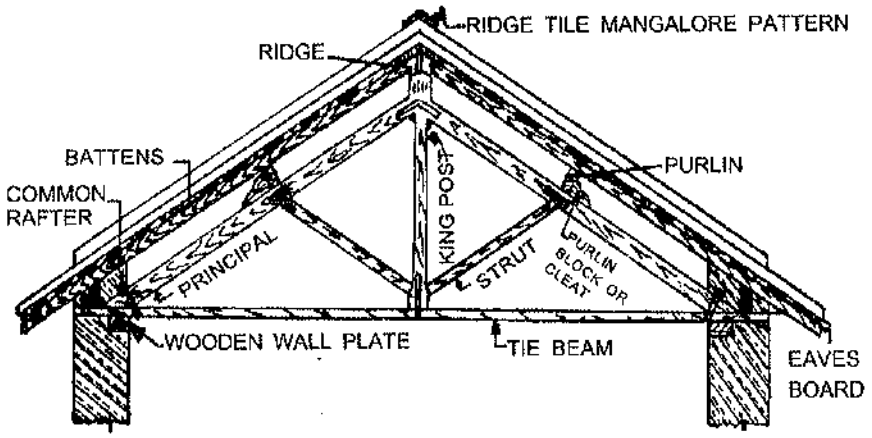
1003.3.1. *Common rafters* :—Common rafters shall be fixed at specified distances or as directed by the Executive Engineer. They shall as far as possible be in one continuous length from ridge to eaves. They shall be slightly notched to fit into the purlins and notched and nailed to the wall plates near their lower ends. At the upper ends the common rafters shall be lapped and spiked. In the case of varandah roof coverings, the tops of common rafters, shall be secured to the wall plate laid in the wall and not merely built into it.

1003.3.2. *Purlins and purlin cleats* :—Purlins shall be fixed at specified distances or as directed by the Executive Engineer. They shall be in the greatest lengths procurable. They shall be scarfed together, wherever necessary immediately

above the principal rafters of the truss on which the ends rest. They shall be secured in position by cleats, cleats prepared to the required shape shall be spiked on to the principal rafter or housed in it. All these are shown in Figs. 1003.1 & 1003.2.

KING POST TRUSS

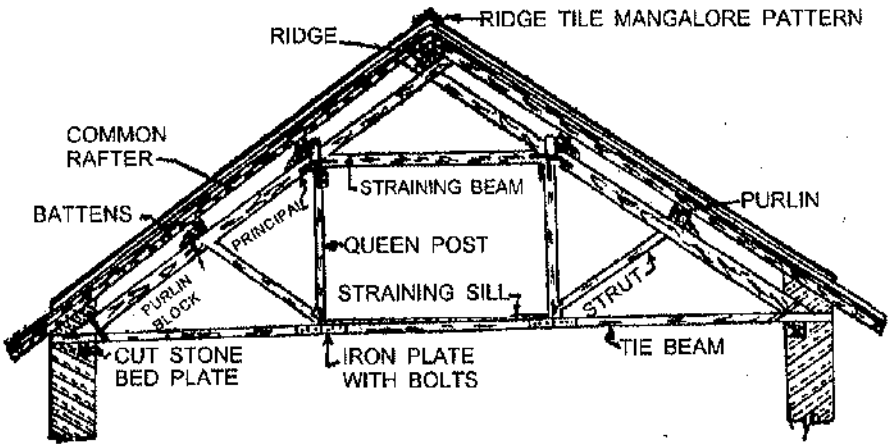
[Fig. No. 1003.1]



NOTE :—WOODEN WALL PLATES UNDER TIE BEAMS MAY BE USED BUT CUT STONE BED PLATES OR CC BEDS ARE PREFARABLE

QUEEN POST TRUSS

[Fig. No. 1003.2]



1003.3.3. *Ridge* :—In the case of king post truss roof, the ridge piece shall be held in position by slotting the head of the king post. In the case of queen post

truss the ridge piece shall be supported over the joint of extenders of principal rafters and shall be spiked on to them. In case there are no end trusses, the ridge shall be supported on a template over the masonry and secured to it. Vide Figs. 1003.1 and 1003.2.

1003.3.4. *Hip rafter and valley rafters* :—Hip and valley rafter shall abutt against and be spiked to the ridge board. They shall be continous over the wall plate and secured to it by notching and nailing and terminated at the eaves board.

1003.3.5. *Jack rafters* :—Jack rafters shall have one end against the valley of hip rafters. In the case of hip rafters, the jack rafters shall be continuous over the wall plate and terminate at the eaves board. In the case of valley rafter, the jack rafters shall be spanned between the valley rafters and the ridge board. At both ends it shall be secured by spiking.

1003.3.6. *Wall plates* :—Where purlins, post plates, ridges, etc., rest directly on the walls continuous wall plates or detached wall plates (templates) shall be provided. The wall plates shall be securely fastened to the walls as directed by the Executive Engineer.

1003.3.7. *Post-plates (bressumeers)* :—They shall have the same width as the posts and shall be connected to the posts as shown in the drawings. The common rafters shall be securely fixed to the post-plates by notching or with steel knee-straps between the post-plates and the common rafters.

Specification No. 1004

Wooden Partitions

1004.1. All relevant clauses of SSs : 1001 and 1002 shall apply.

1004.2. Frame work

1004.2.1. *Frame* :—The Frame for partitions shall consist of a rigid arrangement of vertical members called studs and horizontal member called noggings, of specified sizes joined together at given spacings and jointed at top to the head piece and at bottom to the still piece either by mortise and tenson joints or by lap joints. The head piece shall be of bigger section that the head piece. Where doors or windows are required to be provided in partitions, the members framing the openings shall be of adequate sections.

1004.2.2. *Panels* :

1004.2.2.1. Panels may consist of A.C. sheets, plywood, glass panels, wooden planks, wood-based products or any other approved materials. Panels shall be fitted inside the frames in grooves or in rebates with beading or fitted over the frames on both the sides.

1004.2.2.2. Panels shall be fixed by wooden screws or bolts and nuts or beading with nails and putty as may be specified.

1004.2.3. *Fixing* :—(i) The frames shall be fixed to the side walls by taking the Head and the sill pieces into the side walls to a depth of 75mm. to 100mm. or alternatively where the frames are to be fixed to RCC members they shall be fixed by using suitable brackets or cleats, etc., (ii) the frame shall in addition be secured to the proof and/or floor at specified intervals using suitable cleats, or by any other approved methods.

Specification No. 1005

Wall Panelling

1005.1. All relevant clauses of SSs : 1001 and 1002 shall apply.

1005.2. The frame work shall be fabricated in accordance with the drawings or as directed by the Executive Engineer. It shall be screwed to wooden plugs fixed in the walls or secured to the walls by any other approved means.

1005.3. The panels shall then be fixed to the frame work with countersunk screws and finished as may be specified.

1005.4. Cornices skirtings shall be done to the sizes and shapes as shown in the drawings or as directed by the Executive Engineer.

Specification No. 1006

Wooden Railing

1006.1. All relevant clauses of SS : 1001 shall apply.

1006.2. Construction of hand railing :

1006.2.1. The hand railing shall be moulded and shaped to the dimensions and slopes as shown in the drawings, or as directed by the Executive Engineer. The railing shall be secured to the newels, posts, tops of balusters or grill work as the case may be with joints, grooves, screws or clamps as directed by the Executive Engineer.

1006.2.2. The railing shall follow the inclination of the stairs, rising more rapidly over the narrow ends of the winders than over the full width rectangular treats.

1006.2.3. In winding stair cases, the hand railings shall also be required to wind in order that its cross section may be normal to the stairs while rising simultaneously following the lateral curves.

1006.2.4. Hand rails may preferably be provided with wreaths wherever there is a change in the direction of the flight of stairs.

1006.2.5. Railing shall be jointed along the length with dowelled butt joints.

1006.2.6. On the wall side the hand rail may be rigidly fixed to the wall and it shall be at the same level as the hand rail on the other side.

1006.3. Measurement :

1006.3.1. The wooden hand railing shall be measured in running metres, correct to 0.01 of a metre.

1006.4. Rate :

1006.4.1. Hand railing shall be paid per running metre.

1006.4.2. The rate include all sawing, planing, moulding, jointing, fixing and finishing, etc., for the complete work in accordance with this specification.

SECTION 11

STANDARD SPECIFICATIONS FOR STRUCTURAL STEEL WORK

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Specification No. 1101

Materials

1101.1. Steel :—All structural steel sections, unless otherwise specified, shall conform to the standard quality steel as specified in the Table 1101-A.

Table 1101-A

Sl. No.	*Application*	*Type of Steel*	*IS : No.*
1.	Rivetted, bolted or single section and welded steel work where structures are not subjcted to dynamic load. Thickness of member not exceeding 20mm.	Mild	42-S. IS : 226-1962
2.	Structures subject to dynamic loading	Fusion quantity steel	St. 42-W. IS : 2062-1962
3.	For general purpose such as door frames, window frames, window bars, grills, steel gates, hard railing, builders hard-ware, fencing post & tie bars, etc.	Mild steel	St. 32-0 IS : 1977-1969

4.	Structures not subjected to dynamic loading other than wind lods such as platform roofs, foot over bridges, office buildings, transmission towers, factory sheds,where welding is not employed and structures not in earthquake zones.	Mild Steel	St. 42-0 IS : 1977-1969

1101.1.2. All finished steel shall be well and cleanly rolled to the dimensions, sections and weights specified or required subject to permissible tolerance as given in IS : 1852-1962. It shall be free from cracks, surface flaws, laminations, rough and imperfect edges and all other harmful defects.

1101.1.3. Steel sections shall be well protected against excessive rust and scaling as per SS : 127. The decision of the Executive Engineer regarding rejecting any steel section on account of excessive rust and scaling shall be final and binding on the contractor.

1101.2. *Rivets* :—These shall conform to IS : 1929-1961 and IS : 2155-1962.

1101.3. Black bolts :—These shall conform to IS : 1363-1967.

1101.4. Precision and semi-precision bolts :—These shall conform to IS : 1364-1967.

Specification No. 1102

Steel work in single section of R.S. Joints, Flats, Tees, Angles and Channels, etc.

1102.1. Straightening, Shaping to form and Cutting :—The steel sections as specified or required, shall be straightened and cut, square and to correct lengths and measured with a steel tape. The cut ends exposed to view shall be finished smooth. No two pieces shall be welded or otherwise jointed to make up the required length of a member.

All straightening and shaping to form, shall be done by pressure and not by hammering. Any bending or cutting shall be carried out in such a manner as not to impair the strength of the metal.

1102.2. Painting :—Before hoisting, steel work shall be thoroughly cleaned of rust, loose scales, dust etc., and given one coat of red oxide paint of approved quality, over surfaces inaccessible after placing in position, two coats of red oxide paints shall be applied. Painting shall not be done to steel work till it has been inspected by the Executive Engineer, unless otherwise permitted.

1002.3. Hoisting and placing in position :—Steel work shall be hoisted and placed in position carefully, without any damage to itself and other building work and injury to work-men. Where necessary mechanical appliances such as lifting tackle, winch, etc., shall be used.

1002.4. Measurement :—Finished sections shall be measured in running metre correct to 0.01 of a meter and their weights calculated on the basis on which

steel is supplied to the contractor, by the department, or form standard table if the steel is arranged by the contractor.

1102.5. Rate :—Rate includes cost of labour and materials required for all the operations described above. This will include only the steel work where single sections are used and no two members are jointed together. It will exclude the steel work in built-up sections, trusses and framed work, where riveting, bothing or welding is involved. The unit rate shall be per kg. or tonne as specified in schedule.

Specification No. 1103

Steel Work Riveted and bolted in built-up sections, trusses and framed work

1103.1. Laying out :—Steel structure shall be laid out on a level platform to full scale and to full size or in parts, as shown on drawings or as directed by the Executive Engineer. A steel tape shall be used for measurements. Wooden templates 12mm. to 19mm. thick, or metal steel template shall be made to correspond each member as well as plate and rivet holes shall be marked accurately on them and drilled. The templates shall be laid on the steel members, and holes for riveting and bolting mark on them. The ends of the steel members shall also be marked for cutting. The base of steel columns and the position of anchor bolts shall be carefully set out.

1103.2. Fabrication :—

1103.2.1. *Straightening, Shaping to form and cutting* :—

1103.2.1.1. This shall conform to SS : 1102.1.

1103.2.1.2. All stiffeners shall be formed by pressure and where practicable, the metal shall not be cut and welded in making these.

1103.2.1.3. In major works or where so specified, shop drawings giving complete information for the fabrication of the component parts of the structure including the location, type, size, length and details of rivets, bolts or welds, shall be prepared in advance of the actual fabrication and approved by the Executive Engineer. The drawings shall indicate the shop and filled rivets, bolts and welds. The steel members shall be distinctly marked or stencilled with paint with the identification marks as given in the shop drawings.

1103.2.1.4. Tie bars shall be thickened at other ends so as to provide full affective section at the threads and gradually tapered off to meet their normal section.

1103.2.1.5. Great accuracy shall be observed in the fabrication of various members, so that these can be assembled without being unduly packed, strained or forced into position and when built-up, shall be true and free from twist, kinks, buckles or open joints.

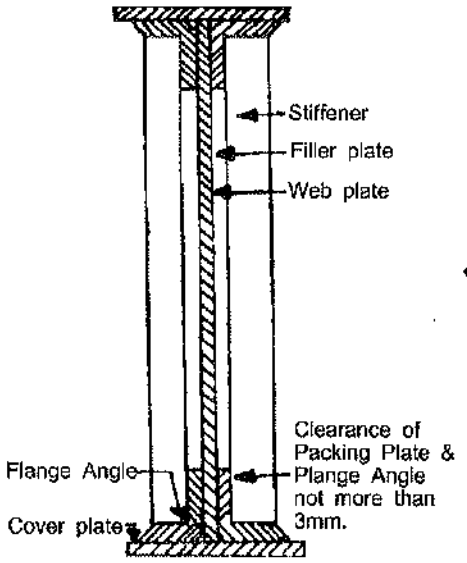
1103.2.2. *Assembling* :

1103.2.2.1. Assembled and clamped properly and tightly so as to ensure close abutting or lapping of the surfaces of the different members. All stiffeners

shall bear tightly both at top and bottom without being drawn or caulked. The abutting joints shall be cut or dressed true and straight, and fitted close together.

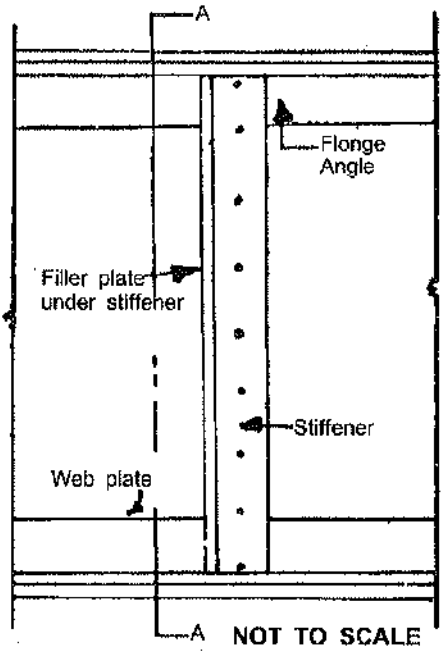
1103.2.2.2. Web splice plates and fillers under stiffeners shall be cut to fit within 3mm. of flange angles, vide Figs. 1103.1, 1103.2 and 1103.3. Web plates of girders which have no cover plates shall have their ends flush with the top of angles forming the flanges, vide Fig. 1103.3 unless otherwise required. The web plates, when spliced, shall have clearance of not more than 6mm. (Vide Fig. 1103.3).

ERECTION OF STEEL SECTIONS ERECTION CLEARANCES AND WEB SPLICING



SECTION at A.A.

[Fig. No. 1103.1]



NOT TO SCALE

[Flg. No. 1103.2]

1103.2.2.3. The erection clearance of cleated ends of members connecting steel to steel shall preferably be not greater than 1.5.mm. vide Fig. 1103.4. The erection clearance at the ends of beams without web cleats shall not be more than 3mm. at each end (Vide Fig. 1103.5) but where for practical reasons, greater clearance is necessary, suitably designed seating shall be provided.

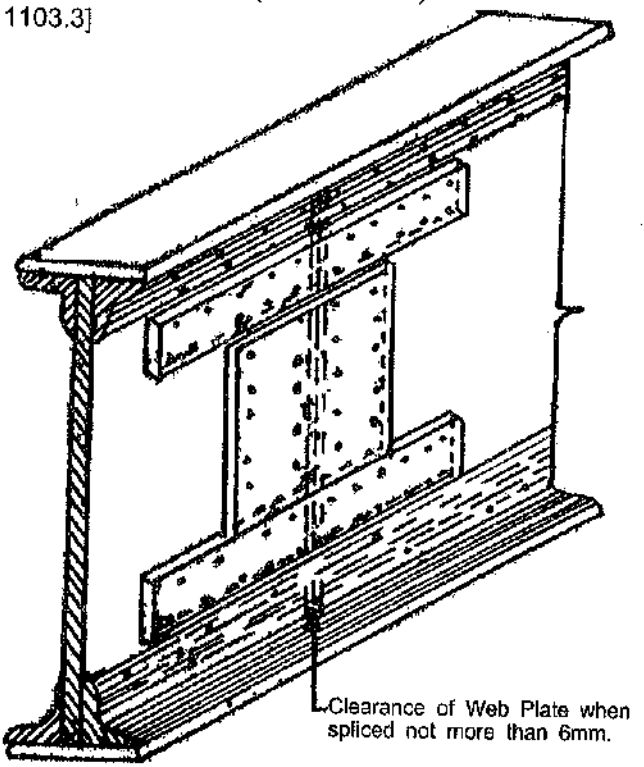
1103.2.2.4. Pin and rollers shall 1103.2.2 can be accurately turned to guage. These shall be straight smooth and free from flaws. The roller bearing shall be provided with adequate arrangement of holding the girder or truss resting on it from lateral displacement.

1103.2.2.5. Expansion bed plates shall be planed true and smooth. The planning of bed plates shall be done in the direction of movement of the girder or truss resting on it.

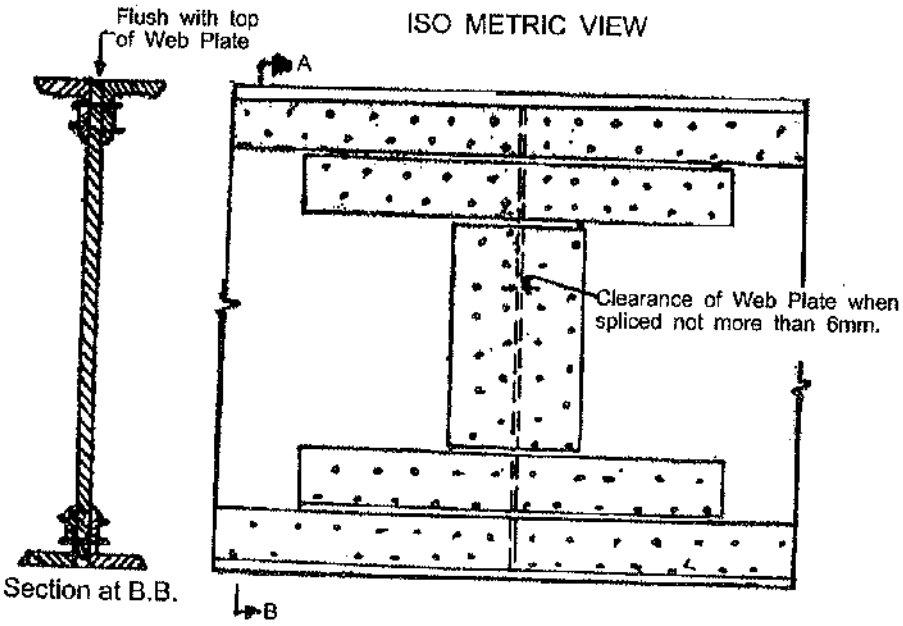
ERECTION OF STEEL SECTION

(Not to Scale)

[Fig. No. 1103.3]



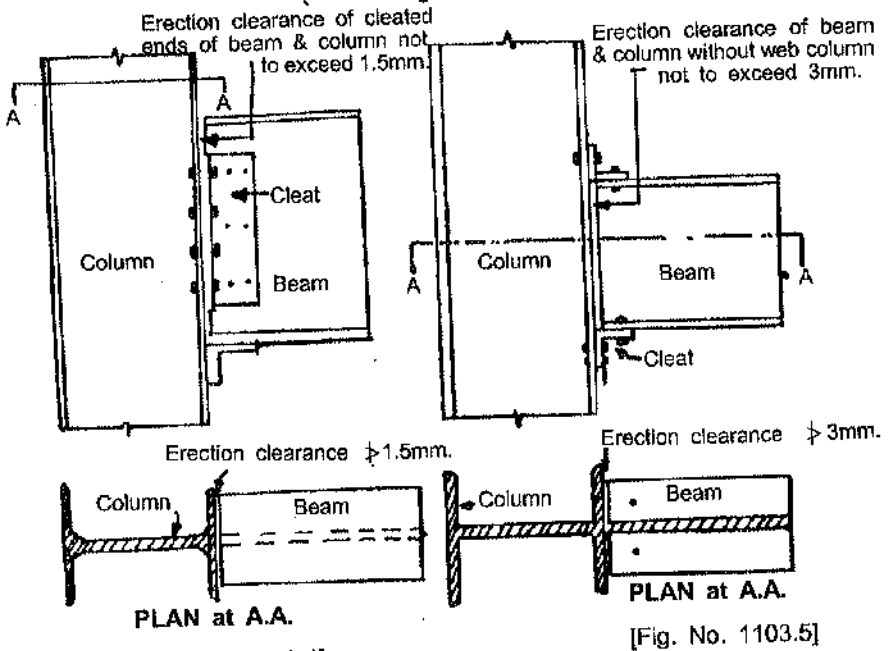
ISO METRIC VIEW



Section at B.B.

COLUMN AND BEAM CONNECTION

(With flange cleats)



[Fig. No. 1103.4] [Fig. No. 1103.5]

1103.2.2.6. Column splices and butt joints of struts and compression members depending on contact for stress transmission shall be accurately machined and close butted over the whole section. In column caps and bases, the ends of column together with the attached gussets, angles, channels, etc., after riveting together shall be accurately machined so that the parts connected, butt against each other on the entire surface of contact. Connecting angles or channels shall be fabricated and placed in position with great accuracy so that they are not unduly reduced in thickness by machining.

1103.2.2.7. The ends of all bearing stiffeners shall be machined or ground to fit tightly both at top and bottom.

1103.2.3. *Making holes* :

1103.2.3.1. All holes shall generally be drilled to the required size and at the required position, sub-punching shall be permitted provided it is done 3mm. less in diameter and reamed thereafter to the required size.

1103.2.3.2. Holes for rivets and black bolts shall be larger by 0.4 to 0.6mm. than the nominal diameter of rivets or black bolts depending upon the diameter of bolt or rivet.

1103.2.3.3. Holes for precision bolts shall be drilled and reamed larger by 0.2 to 0.3mm. depending upon the diameter of bolts.

1103.2.3.4. When the number of plates or sections to be riveted together exceeds three, or when their total thickness is 90mm. or more, holes shall be drilled

or reamed in position, after the members are assembled and the parts firmly held together by clamps. Before riveting or bolting up finally, the members shall be taken apart and all burrs removed.

1103.2.3.5. Holes shall have their axis perpendicular to the surface bored through. The drilling or reaming shall be free from burrs, and the holes shall be clean and accurate.

1103.2.3.6. Holes for counter-sunk bolts shall be made in such a manner that their heads sit flush with the surface after fixing.

1103.2.4. *Use of rivets, precision bolts and black bolts* :—The work of fabrication including riveting shall be completed in the workshop as far as it is practicable to do so. Site joining shall be done with rivets or precision bolts, or blackbolts, as shown in drawing or as directed by the Executive Engineer.

1103.2.5. *Riveting* :

(a) *Preliminaries before riveting* :—The parts assembled for riveting shall be in close contact with each other, and the bearing stiffeners shall bear tightly both, at top and bottom, without being drawn or caulked. Members to be riveted, shall be well pinned or bolted and rigidly held together while riveting. Drifting of holes shall bot be permitted except to draw the parts together and the drifting tool so used shall have its maximum diameter not exceeding the nominal diameter of rivets or bolt. Drifting done during assembling shall not distort the metal or enlarge the holes.

(b) *Rivets* :—The rivets shall have snap head, flat counter sunk head, rounded counter sunk head, or pan head (vide Fig. 1103.6) as shown in the drawing or as directed by the Executive Engineer. The shanks of rivets shall project beyond the plate surface sufficiently so as to fill the hole thoroughly and form the required head after revetting.

(c) *Process of Riveting* :—Riveting shall be done by hydraulic or pneumatic process. However, where such facilities are not available, hand riveting shall be permitted, unless otherwise specified. The rivets shall be heated to red hot, care being taken to control the temperature of beating so as not to burn the steel. Rivets of diameter less than 10mm. may be driven cold. Rivets shall be finished neat, with heads full and of equal size. The heads shall be central on shanks and shall grip the assembled members firmly. All loose, burnt or badly formed rivets with eccentric or defficient heads shall be cut out and replaced. In cutting out rivets, care shall be taken so as not to injure the assembled members. Caulking and recupping shall not be permitted.

For testing rivets, a hammer weighing approximately 0.25 kg. shall be used. Both heads of the rivets (specially the machine head) shall be tapped. Slack rivets will give a hollow sound and jar.

All rivet heads shall be painted with red oxide paint within a week of their fixing.

1103.2.6. *Bolting* :

1103.2.6.1. All bolt heads and nuts shall be hexagonal and of equal size, unless specified otherwise. The screwed threads shall conform to IS : 1363-1967 and the threaded surface shall not be tapered. The bolts shall be of such length as to project two clear threads beyond the nuts when fixed in position and these shall fit in the holes without any shake. The nuts shall fit in the threaded end of bolts properly.

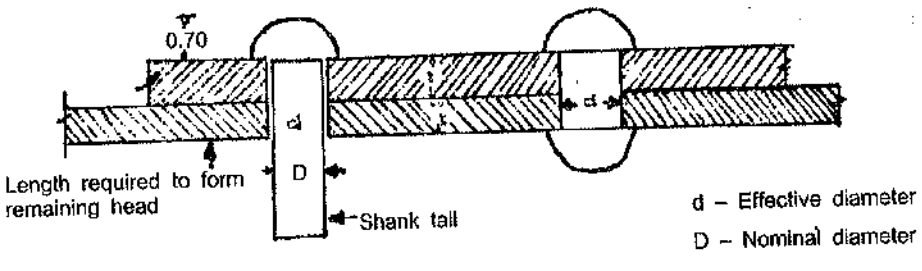
1103.2.6.2. Where turned and fitted bolts are proposed to be used in place of rivets, permission of the Executive Engineer shall be obtained and these shall be provided with washers not less than 6mm. thick, so that the nut, when tightened, shall not bear on the unthreaded body of the bolt. Tapered washers shall be provided for all heads and nuts bearing on levelled surfaces. The threaded portion of the bolt shall not be within the thickness of the parts bolted together. The faces of bolt heads and nuts abutting against steel members shall be machine finished.

1103.2.6.3. Where there is risk of the nuts being removed or becoming loose due to vibration or reversal of stresses, these shall be secured from slackening by the use of locknuts, spring washers, cross cutting or hammering down of threads, as directed by the Executive Engineer.

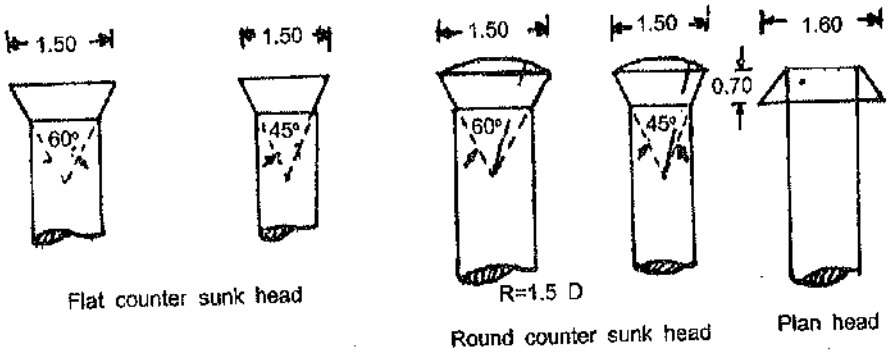
1103.2.6.4. The nominal length of the bolt shall be the distance from the under side of the head to the further end of the shank. The nominal diameter of the bolt shall be the diameter at the shank above the screwed threads.

M.S. RIVETS (Not to Scale)

[Fig. No. 1103.6]



SNAP HEAD



1103.2.6.5. Bolts, nuts and washers, shall be thoroughly cleaned and dipped in double boiled linseed oil, before use.

1103.3. Hoisting and Erection :

1103.3.1. *General* :

1103.3.1.1. *Shop erection* :—Before the steel work is despatched to the site, it shall be temporarily shop erected for inspection by the Executive Engineer to check the accuracy of the fabricated material. In case of parts drilled or punched to steel jigs with bushes resulting all similar parts being inter changeable, the steel work may be shop erected in such position as directed by the Executive Engineer.

1103.3.1.2. Steel work shall be hoisted and erected in position carefully, without any damages to itself, other building work and injury to workmen. The method of hoisting and erection proposed to be adopted by the contractor shall be got approved from the Executive Engineer. The approval of the Executive Engineer however, shall not relieve the contractor of his responsibility for the work being carried out in a safe and proper manner without unduly stressing the various members. Proper plant such as derricks, lifting tackles, winches, ropes, etc., shall be used.

Frames shall be lifted at such points that these are not liable to buckle or deform or be unduly stressed. The steel work may be erected in suitable units as may be directed by the Executive Engineer. During erection, the steel work shall be securely bolted or otherwise fastened and when necessary, temporarily braced to provide for all loads to be carried by the structure during erection including these due to erection equipment and its operations. The steel work shall be placed in proper position as per approved drawings. No riveting or permanent bolting shall be down until proper alignment has been obtained. But the structure or the part of it placed in position, shall be secured against over turning or collapse by suitable means.

1103.3.2. *Trusses* :

1103.3.2.1. These shall be lifted only at nodes. The trusses above 12 metres shall not be slung at the apex, as it will develop compression stresses in the bottom tie member. It shall be lifted by slinging at two mid points of rafters, which shall be temporarily braced by a wooden member of a suitable section. After the trusses are placed in position, purlins and wind bracings shall be fixed as soon as possible.

1103.3.2.2. The end of the truss which faces the prevailing winds shall be fixed with holding down bolts and the other end kept free to move. In case of small trusses of spans say upto 12 metres the free end of the truss shall be laid on leads sheet or steel as per design and the holes for holding down bolts shall be made in the form of oblong slots, so as to permit the free movements of the truss end. For large spans, the free end of the truss shall be provided with suitable rocker and roller bearing.

1103.3.2.3. In sheds open at the sides, the trusses shall be strongly braced together by wind bracings both on the slope and at the tie level so as to secure them against the effect of gales.

1103.3.2.4. The steel columns shall be erected as per drawings truly vertical with the necessary cross bracing etc., and the base shall be properly fixed with the foundation concrete by means of anchor bolts, etc., as the case may be.

1103.3.3. *Holding down bolts and column bases* :—Anchor bolts shall be placed in the concrete pedestals while concrete is being poured with a wooden template clamping their tops to keep them in position and with a 75mm. x 75mm. timber mould or pipe around them which allows the anchor bolts to play for adjustment. The timber mould or pipe shall be removed after initial set of concrete. The spaces left around anchor bolts shall have a sloping channel leading to the side of the pedestal and on the underside of the base plate to allow the spaces being grouted after the base plate is fixed in the position along with the column footing. Grouting shall be, unless otherwise specified, of cement mortar 1 : 2 (1 Cement : Two coarse sand.).

1103.3.4. *Bedding of column, stanchions etc.* :—Bedding shall not be carried out until the steel work has been finally levelled, plumbed and connected together. The stanchions shall be supported on steel wedges and adjusted to bring them in plumb. For multi-storied buildings, the bedding shall not be done until sufficient numbers of bottom lengths of stanchions have been properly lined, levelled and plumbed and atleast beams of two floors fixed in position. The base plate shall be wedged clear of the bed by M. wedges and adjusted where necessary to plumb the columns. The gaps under the base plates upto 25mm. shall then be pressure grouted with neat cement.

In case of small columns, if permitted by the Executive Engineer, the column base shall be floated on the thick cement grout on the concrete pedestal. The anchor bolt holes in the base plate may be made about 12 to 25mm. larger than necessary. This would allow for the adjustment of the base plate relative to the anchor bolts which need not therefore be surrounded by cylindrical pipes or wooden moulds.

1103.3.5. *Extension* :—When extending or remodelling existing structure, drawings of existing structure must be checked by actual measurements before new work is taken on hand.

1103.3.6. *Painting* :—Before the members of the steel structure are placed in position or taken out of the work shop, these shall be painted as given in SS : 1102.2. Subsequent coats shall be applied after all the members are fixed in position finally. The surfaces shall be thoroughly cleaned and dried before applying the specified paint.

1103.3.7. *Inspection and Testing* :

113.3.7.1. The Executive Engineer shall have free access at all reasonable times to those parts of manufacturer's work which are concerned with the fabrication of the steel work and shall be afforded all reasonable facilities for satisfying himself that the fabrication is being undertaken in accordance with this specification.

1103.3.7.2. Unless specified otherwise inspection shall be made at the place of manufacture prior to despatch and shall be conducted so as not to interfere unnecessarily with the operation of the work. If any structure or part of structure be found not to comply with the specifications, it shall be liable to rejection. No

structure or part of the structures once rejected shall be resubmitted for test except in cases where the Executive Engineer consider the defect is rectifiable. Defects which may appear during fabrication shall be made good with the consent of the Executive Engineer.

1103.3.7.3. All gauges and templates necessary to satisfy the Executive Engineer shall be supplied by the manufacturer. The Executive Engineer may at his discretion accept test certificate furnished by any other authority approved by him and the cost of such test shall be borne by the manufacturer.

1103.3.8. *Measurement* :—Each member of the steel structure, as fixed, shall be measured in running metre correct to 0.01 of a metre and the weights calculated on the basis on which steel is supplied to the contractor by the Department, or from standard tables, if the steel is arranged by the contractor. The net weight of the cleats, brackets, packing pieces, rivet-heads, bolts and nuts, distance-pieces, separators, gussets and fish plates etc., shall be added to the weight of the respective items. In riveted work the weight of rivet heads, except in the case of counter-sunk rivets shall be added. No deduction shall be made for rivets or bolt holes.

1103.3.9. *Rate* :—The rate shall include the cost of materials and labour involved in all the operations described above. The unit rate shall be per kg./tonne as specified in the schedule.

Specification No. 1104

Steel Work (welded) in built by Sections-Trusses and Framed Works

1104.1. Structural Steel :—All structural steel shall conform to SS : 1101.1.

1104.2. Laying out :—This shall conform to SS :1103.1.

1104.3. Fabrication :

1104.3.1. *Straightening shaping to form cutting and assembling* :—The Specification 1103.2.1. and SS : 1103.2.2 shall hold good as far as applicable except that the words "riveted or bolted" shall be read as "welded" and holes shall only be made for the bolts used for temporary fastening as shown in drawings.

1104.4. Erection :—This shall conform to SS : 1103.3 except that while erecting a welded structure, adequate means shall be employed for temporary fastening the members together and bracing the frame work until the joints are welded. Such means shall consist of erection bolts, tack welding or other positive devices imparting sufficient strength and stiffness to resist all temporary weights and lateral forces including wind. Owing to the small number of bolts, ordinarily employed for joints which are to be welded temporary support of heavy girders carrying columns shall be specially attended. Different members which shall be fillet welded, shall be brought into, as close contact as possible and the gap due to faulty workmanship or incorrect fit up shall not exceed 1.5mm.. If separation of 1.5mm. or more occurs locally, the size of fillet weld shall be increased at such position by an amount equal to the width of the gap.

1104.5. Welding :

1104.5.1. *Scope* :

1104.5.1.1. All welding shall generally conform to IS:816-1969.

1104.5.1.2. Welding shall generally be done by electric are process. Gas welding shall be resorted to using oxyacetylene flame with specific prior approval of the Executive Engineer. Gas welding shall not however be permitted for structural steel work.

Gas welding requires heating of the members to be welded along with the welding rod and is likely to create temperature stresses in the welded members. Precautions shall therefore be taken to avoid distortion of the members due to these temperatures stresses.

1104.5.1.3. The work shall be done as shown in the shop drawings which shall clearly indicate the details of the joint to be welded, type of welds, shop and site welds as well as the type of electrodes to be used. Symbol for welding on plans and shop drawings shall be according to IS : 813-1961.

1104.5.1.4. As far as possible every effort shall be made to limit the welding that must be done after the structure is erected so as to avoid the improper welding that is likely to be done due to heights and difficult positions on scaffolding etc.

1104.5.2. *Types of welding* :—Welds used for jointing structural members are generally of two types and known as butt welds and fillet welds.

Special type of welds as slot welds etc., shall be used where so specified.

1104.5.2.1. *Fillet weld* :—The cross section of fillet weld is like a triangle and it is used to join two surfaces normally at right angle to each other. This type of weld is used more frequently in structural connections than any other type and is usually in the form of isosceles triangle. The fillet welds shall be continuous or intermittent as specified in the design.

1104.5.2.2. *Butt welds* :—These are classified according to the method of groving or preparing of the base metal. The metal pieces shall be filled or chiselled to the required shape for butt welding at the throat.

1104.6. Welding equipment and electrodes :

1104.6.1. *Plant* :—The welding plant and equipment shall be of the best type and shall be approved by the Executive Engineer.

Either direct or alternating current (but not both kinds) may be used, through out the whole of the work. An ammeter shall be provided to each arc and so situated that the Executive Engineer can check easily the current being used by the operator. Each welder shall be supplied with portable current regulator to enable him to adjust the welding current within the approved limits without leaving his work. Qualified operators shall be employed for welding and they shall have been trained and shall be tested after every three months as per provisions of IS : 814-1974. "Code of practice for training and testing of Metal arc welders".

1104.6.2. *Electrodes* :—The electrodes required for metal arc welding shall be covered electrodes and shall conform to IS : 814-1974, P-I and P-II. "Covered electrodes for metal arc welding of Structural Steel".

1104.6.2.1. *Types of covering* :—This shall conform to IS : 815-1974.

The maximum dia. of electrodes for welding any work shall be as under unless otherwise specified.

Average thickness of plate of section			*Max. Dia. of electrodes to be used*
Less than 5mm.	—	—	3.2 mm.
5mm. upto but not including 8mm.	—	—	4 mm.
8mm. upto but not including 10mm.	—	—	5 mm.
10mm. upto but not including 16mm.	—	—	6 mm.
16mm. and over	—	—	9 mm.

1104.7. Making holes :—In welded structure holes are necessary for service bolts required during erection.

These holes shall be made as specified in para 1103.2.3 for rivets and black bolts. The holes in the various sections shall be filled with punches and welded properly to form a complete section.

1104.8. Preparation of surfaces :—Surfaces which are to be welded together, shall be free from loose mill scale, rust, paint, grease or other foreign matter. A coating of boiled linseed oil shall be permitted.

1104.9. Assembly for welding :—Before welding is commenced, the plates shall first be brought together and firmly clamped or spot welded at specified distance. This temporary connection has to be strong enough to hold the parts accurately in place without any disturbance.

1104.10. Precautions :—All operations connected with welding and cutting equipment shall conform to the safety requirements given in IS : 818-1968 for "Safety Requirements and Health Provision in Electric and Gas Welding and Cutting Operations".

1104.11. Operations and Workmanship :—

1104.11.1. Welds shall be made in the flat position whenever practicable.

1104.11.2. Arc length, voltage and amperage shall be suited to the thickness of material, type of groove and other circumstances of the work.

1104.11.3. Freedom of movement of one member of the joint shall be allowed wherever possible. Wherever joints shall be welded allowance shall be made for the movement of one competent to the order of 1.5mm..

1104.11.4. The sequence of welding shall be such that where possible the members which offer the greatest resistance to compression are welded first.

1004.11.5. *Process of welding* :—The electrode manipulation during welded shall be such as to ensure the following :

(i) The base metal is in a fused state when the filler metal makes contact with it.

(ii) The filler metal does not over flow upon any unfused base metal.

(iii) The base metal is not under-cut along the weld edges.

(iv) The following metal floats the slages, the oxides and the gas bubbles to the surface, behind the advancing pool. In case any of these requirements is unattainable by manipulation, the current shall be adjusted or the electrode size changed.

(v) Each time the arc is started the electrode shall be moved in such a way that the fusion of base metal at the starting point is assured. At the completion of a run the movement the electrode shall be slowed down to fill the arc crater.

(vi) After every interruption of the arc except at completion of a run, the arc shall be re-started of the previous deposit and then moved back to fill the crater; or such alternative technique shall be used as will ensure complete filling of the crater, or complete fusion between the new and old deposits and the base metal at the point of junction and resulting in continuity of weld. Before welding operation is completed, all tracts of slag shall be removed from the deposit, by chipping if necessary and the deposit and the adjoining basemetal shall be write brushed and cleaned at all points. The requirements shall apply not only to successive layers, but also to successive beats and to the over-lapping area wherever a junction is made on starting a new electrode.

(vii) The welds shall be free from cracks, discontinuity in welding and other defects such as (i) under-size, (ii) over size, (iii) under-cutting, and (iv) over-cutting in the case of fillet welds vide Fig. (a), (b), (c), (d) of Fig.1104-1 and Fig. (i), (ii) and (iii) of the 1104.1 in the case of butt welds.

(viii) All defective welds which shall be considered harmful to the structural strength shall be cut out and re-welded.

(ix) In case of welded butt joints in steel of thickness upto 50mm. the weld joint shall be examined for radiographic examination as described in IS : 1182-1967.

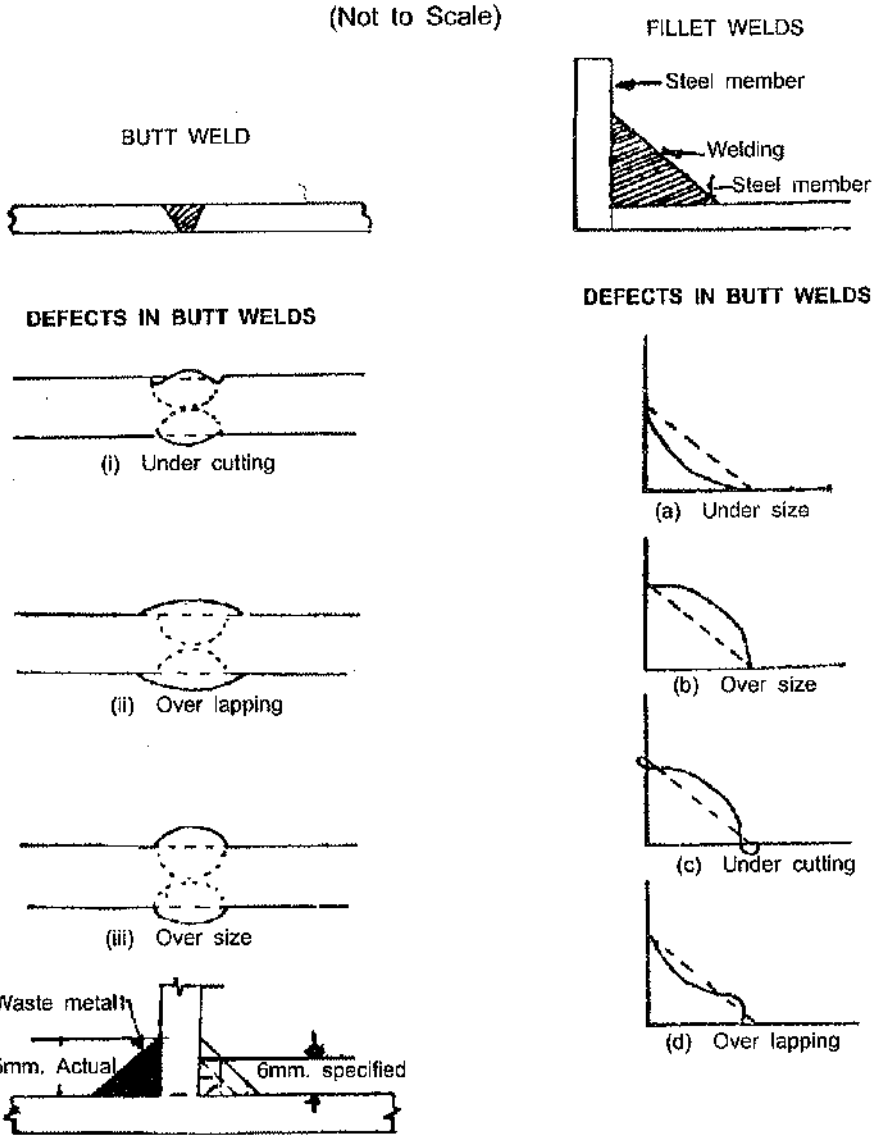
(x) Finished welds and adjacent parts shall be protected with cleaned boiled linseed oil and after all slag has been removed.

(xi) Welds and adjacent parts shall be painted after the same are approved by the Executive Engineer.

1104.12. Inspection and testing of welds :—Inspection and testing shall be as under :

(1) Visual inspection,
(2) Bend testing,
(3) Tensile testing,
(4) Magnetic particle, radiographic testing.

TYPICAL BUTT AND FILLET WELDS
(Not to Scale)



[Fig. No. 1104.1]

The increase in cross section between 46mm and 49.5mm file!

1104.12.1. *Visual inspection* :

Factor-1. *Dimension of weld deposit* :—The dimension of the weld shall be checked. The size of the weld shall be a specified and it may be slightly over but not under.

Factor-2. *Shape of profile* :—The profile of the weld is affected by the position of the joint, but it shall be uniform. In the case of butt and corner welds the profile shall be slightly convex and in the case of fillet weld it is usually slightly concave.

Factor-3. *Uniformity of surface* :—The height and spacing of the ripples shall be uniform these being indicative of the quality of workmanship.

Factor-4. *Degree of under-cut* :—Under-cutting is undesirable. The weld joint shall be free from under cut but slight intermittent occurrences may be disregarded.

Factor-5. *Smoothness of joints where welding is recommended* :—The joints in the weld run where welding has been recommended, shall be as smooth as possible and shall show on pronounced hump or crater in the weld surface.

Factor-6. *Freedom from surface defects* :—The surface of the weld shall be free from porosity, cavities and burnt on scale.

Factor-7. *Penetration bead in butt welds* :—A slight penetration bead shall be present and it shall be reasonably uniform in width and appearance. Intermittent occurrences of lack of penetration bead may be disregarded.

Inspection of weld fractures :—Inspection of weld fractures give information concerning degree of fusion, degree of root penetration, gas cavities and quality of weld metal.

Factor-8. *Degree of Fusion* :—Fusion shall be completed over the whole area of the joint surface.

Factor-9. *Degree of root penetration, Butt and Fillet welds* :—The defects are most likely to occur at the root of the weld and in this position they are liable to have the maximum effect in reducing the strength of the weld. A close examination of the root shall, therefore, be made. In butt welds the penetration shall extend to the underside of the plates producing a penetration bead of the right size. In fillet welds with good root penetration the metal shall reach the corner.

Factor-10. *Gas cavities and flux entrampments* :—Unless they are caused by the use of unsuitable material, they are attributable to the quality of workmanship, the desired result being to achieve uniform appearance and freedom from cavities and flux, entrampments (where flux is used). In fusion welding of mild steel, cast iron and aluminium where neutral flame is used, and in fusion welding of brass or braze welding of case iron where oxidising flame is used, in current welding technique may result in rough, porous, discoloured and lustrelles appearance in the fracture.

Note :—In case of fusion welding or non-fusion welding of cast iron is isolated below holes or concentration of pin holes in the weld metal shall be regarded as grounds for rejection but isolated pin-holes shall not be so regarded.

1104.12.2. *Bend testing (for ductility)* :—The elongation shall be not less than 30 percent for stress relieved welds and not less than 25 per cent for non-stress relieved welds.

1104.12.3. *Tensile testing* :—(Reduced section tensile testing) : The tensile strength shall be not less than that minimum of the specified tensile range of the parent metal.

1104.12.4. *Magnetic particle and Radio graphic test* :—This shall be done as given in IS : 5354-1969 and IS : 1182-1967 respectively.

1104.13. Inspection and testing :—This shall conform to SS : 1103.3.7.

1104.14. Measurement :—This shall conform to SS : 1103.8 except that weight of welding material shall not be added in the weight of members for payment and nothing extra shall be paid for making and filling holes for temporary fastening of members during erection before welding.

1104.15. Rate :—The rate shall include the cost of all labour and materials involved in all the operations described above. The unit for payment shall be tonne as specified in the schedule.

MISCELLANEOUS STEEL WORK

Specification No. 1105

Collapsible Steel Shutters

1105.1. General :—Collapsible steel shutters shall be of approved manufacture and shall be fabricated from mild steel sections. Typical sketches of collapsible gate are given in Figs. 1105.1 and 1105.2.

Note 1 :—In tube to tube branch joints, both butt and fillet welds appear in joint, fillets being at the cretches.

Note 2 :—In case of non-fusion of welding of cast iron the joint shall show satisfactory penetration and adhesion.

1105.2. Collapsible gates :

1105.2.1. These shall consist of double or single collapsible gates depending on the size of the opening. These shall consist of vertical double channels each 20 x 10 x 2mm. (provisional at 100mm. centres braced with flat iron diagonals 20 x 5mm. and top and bottom, rails of T. Iron 40 x 40 x 6mm. at 3.5 kg./m. with 38mm. (provisional) dia. steel pulleys or ball bearings in every fourth double channels, unless otherwise specified.

1105.2.2. Wherever collapsible gate is not provided within the opening and is fixed along the outer surface T. iron at the top may be replaced by feat iron 40 x 10mm..

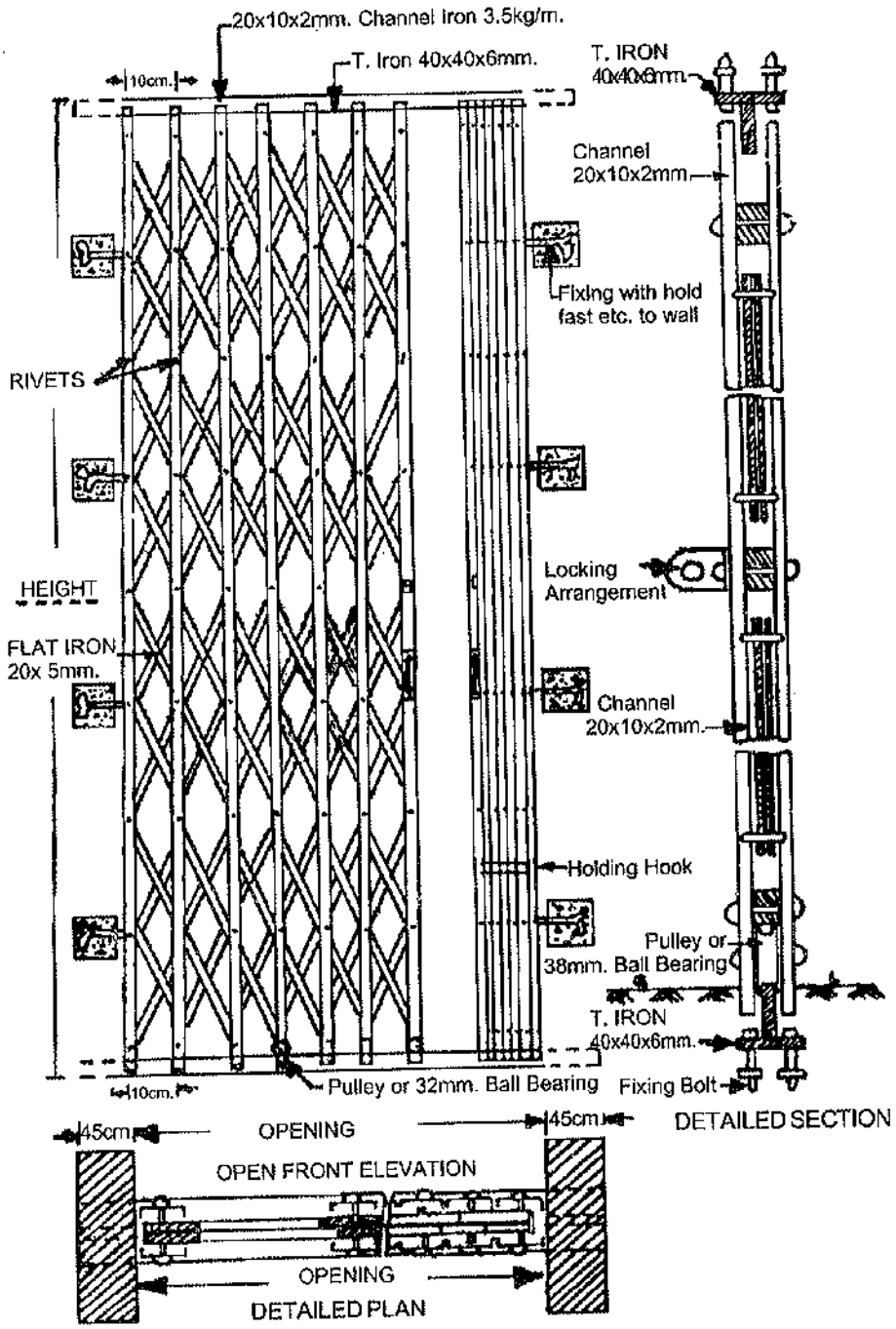
1105.2.3. The collapsible gate shall be provided with necessary bolts and nuts, locking arrangement, stuppers and handles. Any special settings like springs, catches, locks, etc., shall be so specified in the description of the stem where so required.

1105.2.4. The gate shall open and close smoothly and easily.

TYPICAL SKETCH OF COLLAPSIBLE STEEL GATE

(Not to Scale)

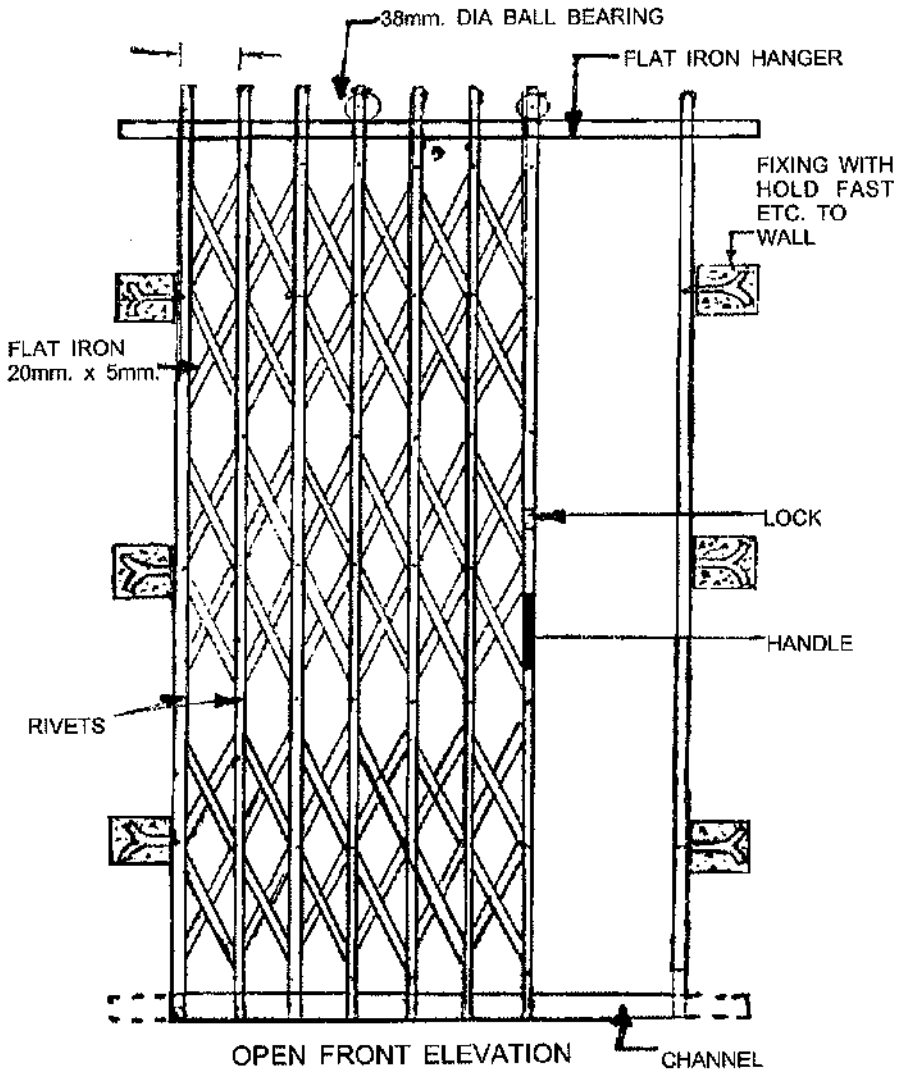
[Fig. No. 1105.1]



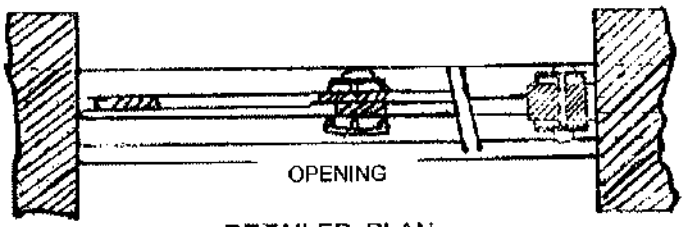
TYPICAL SKETCH OF COLLAPSIBLE STEEL GATE FOR LIFT

(Not to Scale)

[Fig. No. 1105.2]



OPEN FRONT ELEVATION



DETAILED PLAN

1105.3. Fixing :

1105.3.1. T-Iron rails shall be fixed to the floor and to the lintel at top by means of anchor bolts embedded in cement concrete of floor and lintel. The anchor bolts shall be placed approximately at 450mm. centres alternatively in the two flanges of the T-iron. The bottom runner (T-iron) shall be embedded in the floor and proper grove shall be formed along the runner for the purpose. The collapsible shutter shall be fixed at sides by fixing the end double channels with T-iron rails and also by hold fasts bolted to the end double channel and fixed in the masonry of the side walls on the other side.

1105.3.2. In case the collapsible shutter does not reach the lintel, beam or slab level, a Tee section suitably designed may be fixed at the top, embedded in masonry and provided with necessary clamps and roller arrangement at the top.

1105.3.3. All the adjoining work damaged in fixing of gate shall be made good to match the existing work.

1105.4. Painting :—All the members of the collapsible gate including T-iron shall be thoroughly cleaned off rust, scales, dust, etc., and given a priming coat of red oxides before fixing them in position.

1105.5. Measurement :—The height of the gate shall be measured as the length of the double channels. The breadth shall be measured from outside to outside of the double channel fixed at ends of the gate. The height and breadth shall be measured correct to 0.01 of a metre and the area shall be worked out in sq.m. correct to 0.01 of a sq.m.

1105.6. Rate :—The rate shall include the cost of materials and labour involved in all the operations described above. The unit rate of payment shall be per square metre.

Specification No. 1106

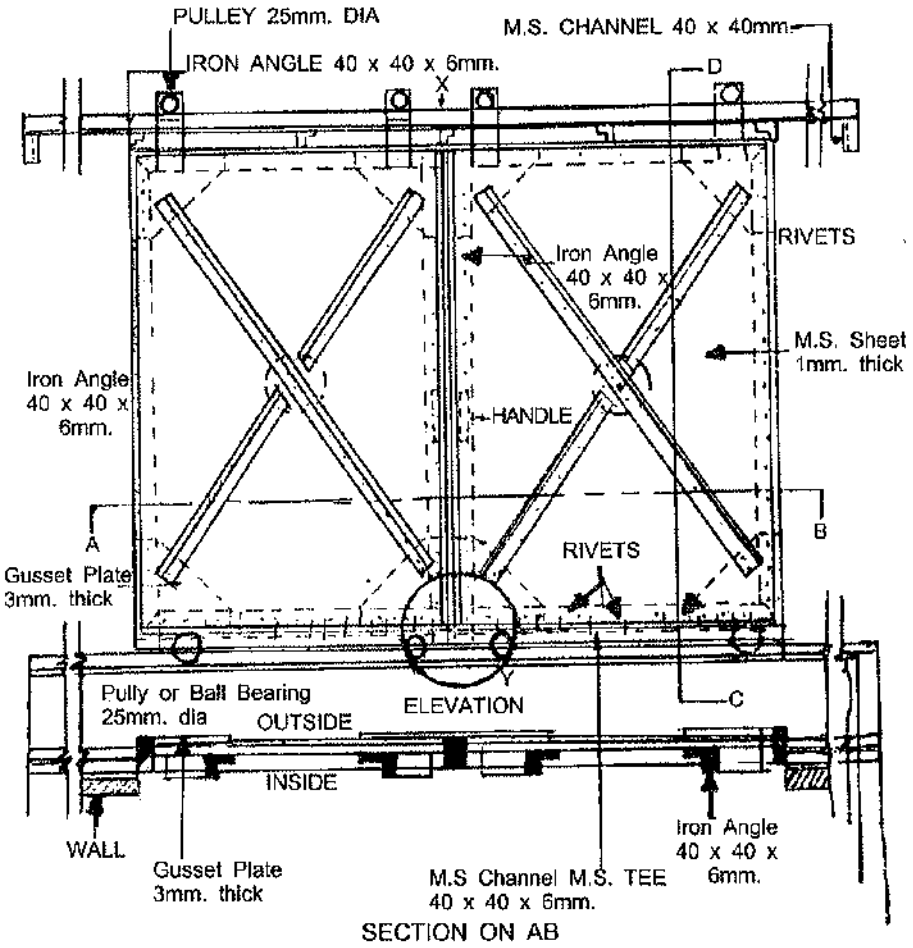
M.S. Steel Sliding Shutters

1106.1. General :—These shall be manufactured from mild steel as per drawings and specifications. Necessary details of fabrications are shown in Figs.No. 1106-1 and 1106-2.

1106.2. M.S. Sheet Sliding Shutters :

1106.2.1. These shall be double or single leaf shutters as specified. The shutters shall be fabricated of specified size of M.S. angle iron frame diagonally braced with the same size M.S. angle and riveted together with (minimum) 3mm. gusset plate at junction to form a rigid frame. M.S. sheet of 1mm. thickness or as specified shall be fixed to the frame with rivets, or welds as approved by the Executive Engineer. These shall also be provided with top and bottom guide rails of angles or T-Irons of specified size. Unless otherwise specified 25mm. dia. pulleys/or ball bearings shall be provided over, guide rail at the bottom and guide block with steel pulleys at the top. The shutters shall also be provided with locking arrangements, handles, stoppers, held-fasts and other fittings as may be specified.

M.S. SHEET SLIDING SHUTTER
(Not to Scale)



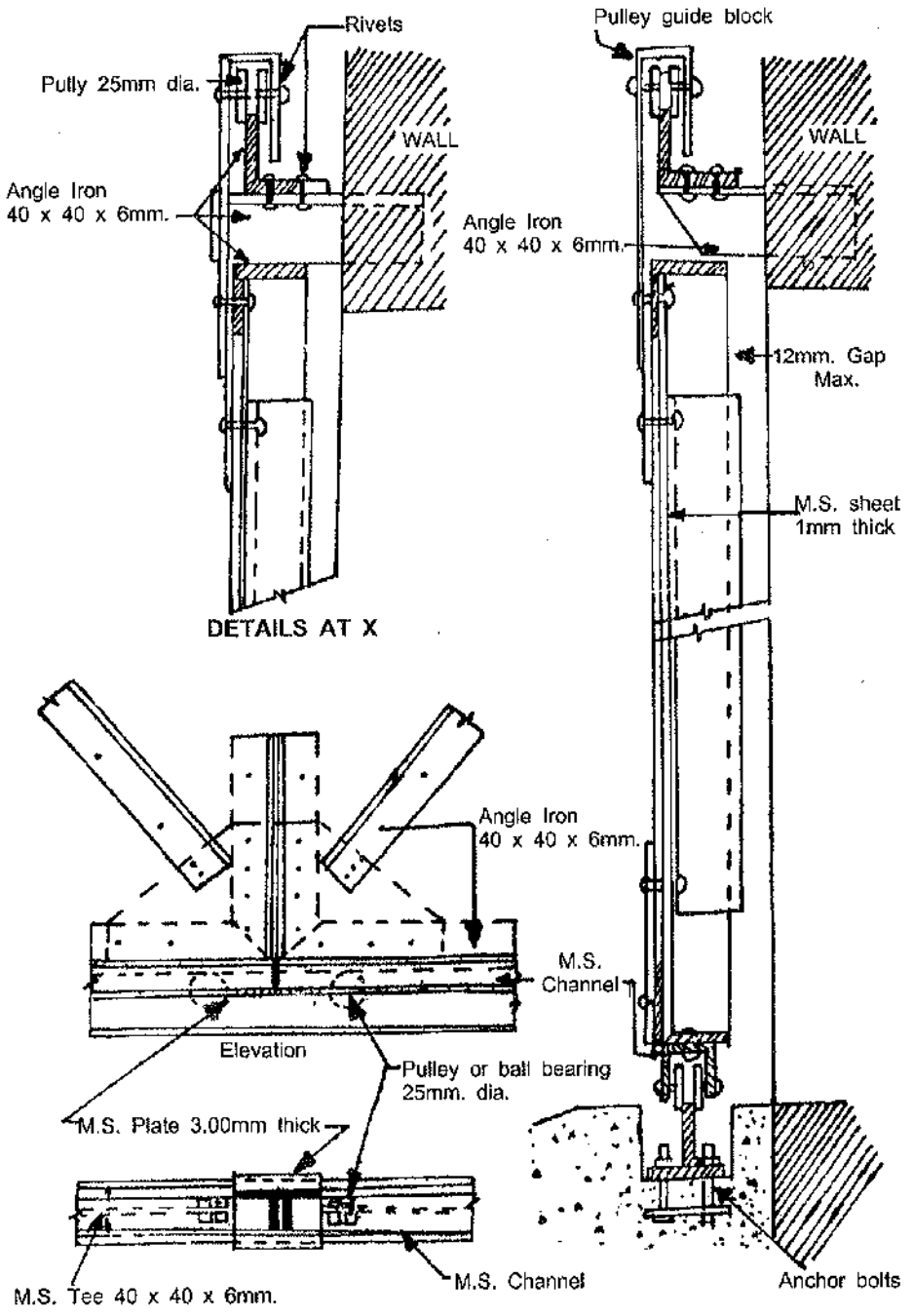
[Fig. No. 1106.1]

1106.2.2. The guide rails shall be sufficiently long and continued along the wall on both ends so that the sliding shutters can rest against the walls, giving full opening when so required.

1106.3. Fixing :

1106.3.1. The guide rails shall be fixed to the floor by means of anchor bolts embedded in the cement concrete. The steel section at the top shall be suitably supported from the walls. Two channel sections shall be suitably fixed vertically below the extreme clamps in the wall and floor, to avoid the shutter from going out of the supports at, top and bottom. A suitable clamping arrangement shall be provided at either end of the opening to avoid the shutters from rolling back into the opening.

[Fig. 1106.2]


Rivets
Pully 25mm dia.
WALL
Angle Iron
40 x 40 x 6mm.
DETAILS AT X
Pulley guide block
WALL
Angle Iron
40 x 40 x 6mm.
12mm. Gap
Max.
M.S. sheet
1mm thick
Angle Iron
40 x 40 x 6mm.
M.S.
Channel
Elevation
Pulley or ball bearing
25mm. dia.
M.S. Plate 3.00mm thick
M.S. Tee 40 x 40 x 6mm.
M.S. Channel
Anchor bolts
PLAN DETAILS AT Y
SECTION ON CD

1106.3.2. All the adjoining work damaged in fixing shall be made good to match the existing work.

1106.4. Painting :—This shall conform to SS : 1105.4.

1106.5. Measurement :

1106.5.1. The height of the shutter shall be measured from outside to outside of the guide rail and width outside to outside of shutter including the vertical channels on sides.

1106.5.2. The height and width shall be measured correct to 0.01 of a metre and the area shall be worked out in sq.m. correct to 0.01 of a sq.m.

1106.6. Rate :—The rate shall include the cost of materials and labour involved in all the operations described above. It also includes the cost of the full length of guide rails. The unit rate shall be per square metre.

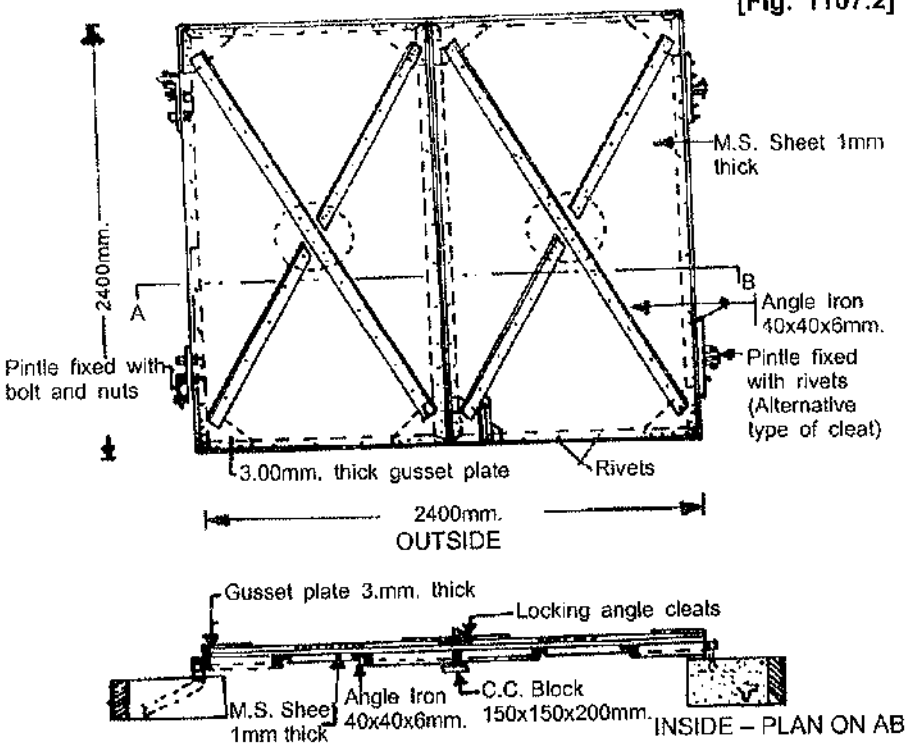
Specification No. 1107

M.S. Sheet Doors

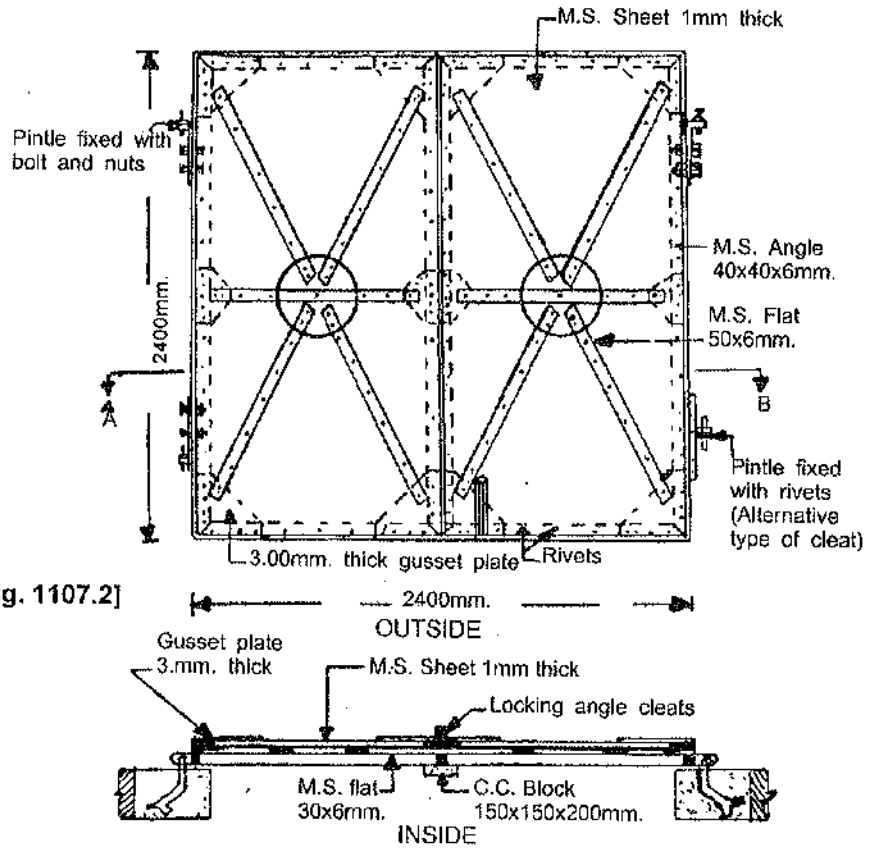
1107.1. General :—These shall be manufactured as per drawings and specifications. Necessary details of fabrications, etc., for a typical door of 2400 x 2400mm. are given in Figs. 1107.1 & 1107.2.

TYPICAL M.S. SHEET DOOR 2400mm. & 2400mm.
(Not to Scale)

[Fig. 1107.2]



TYPICAL M.S. SHEET DOOR 2400mm. & 2400mm.
(Not to Scale)



[Fig. 1107.2]

PLAN ON AB

1107.2. **M.S. Sheet Garage Doors** :

1107.2.1. These shall be provided as double leaf shutters unless otherwise specified. The shutters shall be fabricated from M.S. frame of 40 x 40 x 6mm. size angle or as specified and two diagonal braces of the same section as shown in Fig.1107.1 unless otherwise specified. The frame shall be riveted and or welded at the junctions. Wherever riveting is done 3.00mm. (minimum) gusset plate shall be provided at the junction. M.S. sheet of 1mm. thickness or as specified, shall be fixed to the frame with rivets or welds as approved by the Executive Engineer.

1107.2.2. Alternatively the diagonal bracing may be replaced by one horizontal and two cross flats 30 x 6mm. as shown in Fig. 1107.2 unless otherwise specified.

1107.2.3. The outer frame shall be provided with cleats made of flat iron of Section 40 x 10mm. and bent in the shape of angle cleats with one arm 150mm. long and the other arm 50mm. long and fixed to the angle iron frame of the door

with two 12mm. dia. bolts and nuts. For doors upto 2.40 metre height, two angle cleats per shutter shall be provided.

1107.2.4. The cleat shall have a vertical leg of 150mm. which shall be fixed with frame and horizontal leg of about 50mm. which shall be provided with a hole of 24mm. dia. and fixed in the projected pin of the pin clamp.

1107.3. Fittings and Fixing :

1107.3.1. The shutter shall be fixed to the wall masonry, with four pin clamps (pintles) where the height of the shutter is upto 2.40 m. Each pin clamp shall consist of 50mm. x 6mm. flat iron 450mm. long bent and forked at one end and provided with 20mm. diametre, M.S. pin on the other. The pin shall be firmly riveted or welded to the pin clamp, the other end of which shall be embedded in masonry by means of cement concrete block 400 x 200 x 200mm. of 1 : 2 : 4 mix (1 cement : 2 coarse sand : 4 graded stone aggregate 20mm. nominal size). It shall be so placed that the bottom pin shall face upwards and top pin downwards, in order that the gate may not be removed by lifting over pins.

1107.3.2. One hook with eye 450mm. long of 10mm. diametre shall be provided for each shutter to keep it fixed in open position. The hook shall be fixed in wall masonry with wooden block and the eye shall be fixed on 6mm. thick M.S. plate as staple and fixed in the shutter frame with rivet or weld.

1107.3.3. A cement concrete block 150m x 100m x 200mm in 1 : 2 : 4 mix (1 cement : 2 coarse sand : 4 graded stone aggregate of 20mm. nominal size) shall be embedded in the floor at junction of two shutters so that the door shutter opens only outside and not inside.

1107.3.4. The shutters shall also be provided with lockings arrangements and two handles of the shape and pattern as approved by the Executive Engineer.

1107.4. Painting :—This may be done as per SS : 1105.4

1107.5. Measurement :—The width and height of shutters shall be measured correct to 0.01 of a metre and the area shall be worked out in sq.m. correct to 0.01 of a sq.m.

1107.6. Rate :—The rate shall include the cost of material and labour involved in all the operations described above. Nothing extra shall be paid for cement concrete blocks or wooden blocks nor anything deducted for these from the masonry of wall. The unit rate shall be per square metre.

Specification No. 1108

Rolling Shutters

1108.1. General :—Rolling shutters complete with accessories shall be obtained from a firm as specified from a firm of repute. These shall be suitable for fixing in the position as specified i.e., outside or inside on or below lintel or between jambs of the opening. The door shall be either push and pull type or operated with chain and crank device supplied by the firm. Shutters upto 12 square metres shall be of push and pull type and shutters with an area of over 12 square metres shall generally be provided with reduction gear operated by mechanical

device with chain or handle. For easy operation, in case ball bearings are specified with push and pull type from 9.00 to 12.00 square metres. These shall be paid for separately.

1108.2. Rolling Shutters :

1108.2.1. These shall consist of 125mm. thick or as specified with 80mm. M.S. laths of best quality mild steel sheet machine rolled and straightened with an effective bridge depth of 16mm.. Lakhs shall be interlocked together throughout their entire length and joined together at the end with end locks. These shall be mounted on specially designed pipe shafts.

1108.2.2. The springs shall be of coiled type of best quality. The spring shall be manufactured from tested high tensile spring steel wire or strip of adequate strength to balance the shutters in all positions. The spring pipe shafts, etc., shall be supported on strong mild steel or malleable cast iron brackets.

1108.2.3. Both the side guides and bottom rail shall be jointless and of single piece of pressed steel.

1108.2.4. Top cover of shaft, spring etc., shall be of the same materials as that of lath and extra payment shall be made for this.

1108.3. Fixing :

1108.3.1. Brackets shall be fixed on the lintel or under the lintel as specified with raw plugs and screw bolts, etc. The shaft along with the spring shall then be fixed on the brackets.

1108.3.2. The lath partition (shutter) shall be laid on ground and the side guide channels shall be bound with it with ropes, etc. The shutter shall then be placed in position and top fixed with suspension shaft with bolts and nuts. The side channels and the cover frame shall then be fixed to the walls through the plate welded to the guides. These plates and bracket shall be fixed by means of steel screw bolts and raw plugs drilled in the wall. The plates and screw bolts shall be concealed in plaster to make their location invisible. Fixing shall be done accurately in a workman like manner that the operation of the shutter is easy and smooth.

1108.4. Measurement :—The actual area of the rolling shutters shall be worked out in square metres correct to 0.01 of a sq.m. The width shall be measured as the width of the shutter including portions hidden in the guide channels and height shall be measured as the length of the shutter from the bottom of the locking plate to the top of the laths including portions above the opening.

Widths and heights shall be measured correct to 0.01 of a metre.

1108.5. Rate :—The rate shall include the cost of materials and labour involved in all the operations, described above except for top cover, ball bearings, and mechanical device of chain and crank operations, which shall be paid for separately. The unit rate shall be per square metre.

Specification No. 1109

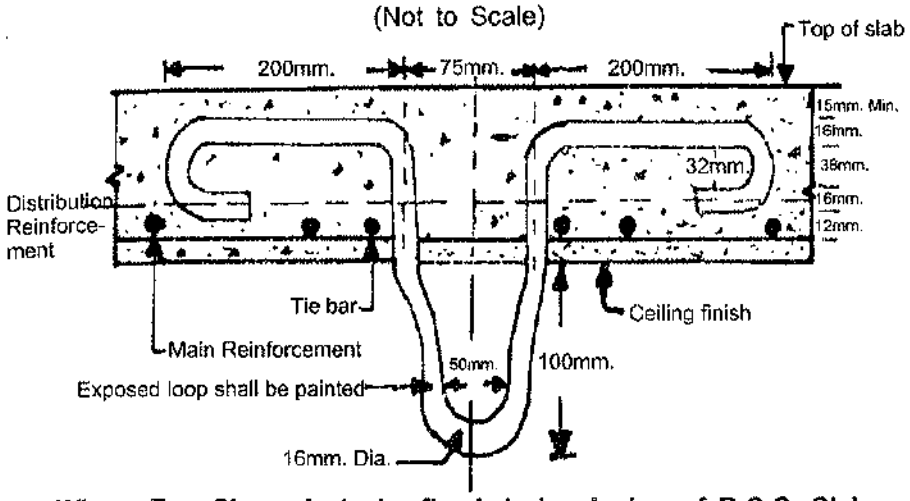
Clamps for Ceiling Fans

1109.1. Clamps :

1109.1.1. Fan clamp shall be fixed during the laying of RCC slab with the shape-I as shown in Fig. 1109.1. This shall be made of 16mm. dia. M.S. bar be to shape. The over all height of the clamps shall be made to suit the depth of the slab.

TYPICAL DESIGN OF M.S. FAN CLAMPS

(Not to Scale)

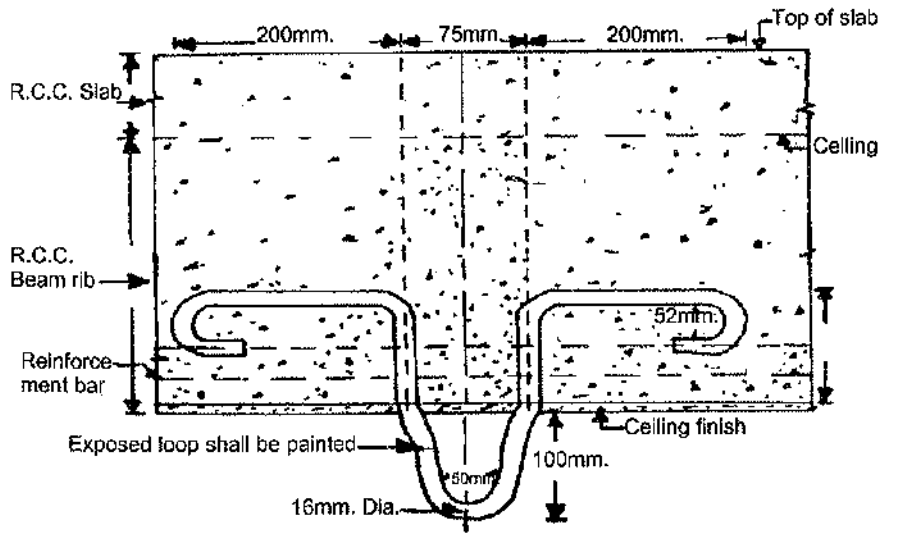


Where Fan Clamp is to be fixed during laying of R.C.C. Slab

[Fig. No. 1109.1]

1109.1.2. Fan clamp for beams shall be shown in Fig. 1109.2. It shall be similar to the above except that its height shall be greater depending on the depth of the beam cut.

Note :—Fan clamp shall be placed in position such that its projection arms are in the line of length of beam.



Where Fan Clamp is to be fixed during laying of R.C.C. Beam

[Fig. No. 1109.2]

1109.2. Fixing of clamps in slabs and beams :—Holes for inserting the fan clamps in the positions shown in the drawing or as instructed by the Executive Engineer shall be made in the shuttering after the latter has been fixed in position. After steel reinforcement is tied, fan clamps shall be fixed with their loops truly vertical and at the correct depth from the underside of the slab or beam and the plane of the loops shall be truly parallel or at right angles to the lines of walls as directed by the Executive Engineer in the case of slabs and parallel to line of beams in the case of the latter. The arms and the loop shall be tied to the reinforcement, either directly or through Cutpieces of M.S. bars with annealed steelwire. The clamps shall neither be disturbed out of position during concreting nor shall they be bent out of shape when shuttering of slabs or beams is removed.

The exposed portion of loops of the clamp shall be given two or more coats of paint, including priming coat, of shade as ordered by the Executive Engineer.

1109.3. Measurement :—Clamps shall be counted in numbers.

1109.4. Rate :—The rate per fan clamp shall include the cost of labour and materials involved in all the operations described above. The unit rate shall be per number.

SECTION 12

STANDARD SPECIFICATIONS FOR PAINTING AND VARNISHING

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Specification No. 1201

Painting - General

1201.1. Materials :—Paints, oils, varnishes, etc., of approved make shall be used. Approved paints, oils or varnishes shall be brought to the site of work

in their original containers in sealed condition. The materials shall be brought in at a time in adequate quantities to suffice for the whole work or atleast for a forthnight's work.

1201.2. Commencing of work :

1202.2.1. Painting shall not be started until the Executive Engineer has inspected the items of work to be painted.

1202.2.2. Painting except the priming coat shall generally be taken on hand only after all other builder's work is practically finished.

1201.3. Preparation of surface :

1201.3.1. The surface shall be thoroughly cleaned and dusted. All rust, dirt, scales, smoke and grease shall be thoroughly removed before painting is started. In the case of old painted surfaces the old paint shall be removed by any method specified in SSs :1202, 1203 and 1204. Where a patent paint remover is used for removing old paint the surface shall be washed down with mineral turpentine to remove all traces of paraffin wax which forms one of the ingredients of patent paint remover and which if kept in place will prevent the paint from drying. The prepared surface shall have received the approval of the Executive Engineer after inspection before painting is commenced.

1201.4. Application :—Before pouring into smaller containers for use the paint shall be stirred thoroughly in its container. When applying also the paint shall be continuously stirred in the smaller containers so that its consistency is kept uniform.

1201.4.1. The painting shall be done evenly and smoothly by means of crossing and laying off, the later in the direction of the grain of wood. The crossing and laying off consists of covering the area over with paint, brushing the surface hard for the first time over and then brushing alternately in opposite directions two or three times and then finally brushing lightly in a direction at right angles to the same. In this process no brush marks shall be left after the laying off is finished. The full process of crossing and laying off will constitute one coat.

1201.4.2. Where so stipulated the painting shall be done with spray. Spray machine used may be (a) high pressure (small air aperture) type or (b) a low pressure (large air gap) type, depending on the nature and location of work to be carried out. Skilled and experienced workmen shall be employed for this class of work. Paints used shall be brought to the requisite consistency by adding a suitable thinner.

1201.4.3. Spraying shall be done only when dry condition prevails.

1201.4.4. Each coat shall be allowed to dry out thoroughly and rubbed smooth before the next coat is applied. This shall be facilitated by thorough ventilation.

1201.4.5. Each coat except the last coat shall be lightly rubbed down with sand paper or fine pumice stone and dust cleaned off before the next coat is laid.

1201.4.6. No left over paint shall be put back into the stock tins. When not in use the containers shall be kept properly closed.

1201.4.7. No hair marks from the brush or clogging of paint puddles in the corners of panels, angles of moulding etc., shall be left on the work.

1201.4.8. In painting doors and windows the putty round the glass panels shall also be painted care being taken to see that no point stains etc., are left on the glass. Tops of shutters and surfaces in similar hidden locations shall not be left out in painting.

1201.4.9. In painting steel work special care shall be taken while painting over bolts, nuts, rivets, overlaps, etc.

1201.5. Brushes and Containers :—After work, the brushes shall be completely cleaned of paint and linseed oil by rinsing with turpentine. A brush on which paint has dried up is ruined and shall on no account be used for painting work. The containers when not in use shall be kept closed and free from air so that paint does not thicken and shall also be kept safe from dust. When the paint has been used, the containers shall be washed with turpentine and wiped dry with soft clean cloth so that they are clean and can be used again.

1201.6. Precautions :—All furniture, fixtures, glazing, floors etc., shall be protected by covering and stains, smears, splashings, if any shall be removed and any damage done shall be made good by the contractor at his cost.

1201.7. Measurement :

1201.7.1. All inner measurements shall be in metres, correct to 0.01 of a metre. All areas shall be worked out in sq. m. correct to 0.01 of a sq.m.

1201.7.2. Small articles not exceeding 10 square decimetres (0.1 sq.m.) of painted surfaces where not in conjunction with similar painted work shall be enumerated.

1201.7.3. Painting upto 150mm. in width or in girth and not in conjunction with similar painted work shall be given in running metres.

1201.7.4. In measuring painting, varnishing, oiling, etc., of joinery and steel work etc., the coefficients as in following table shall be used to obtain area payable. The coefficients shall be applied to the areas measured flat (and not girthed) in all cases.

Table 1201-A

Table of coefficients to be applied over areas of different surfaces to get equivalent plain areas

Sl.No.	*Description of work*	*Multiplying Co-efficients*
1.	Batten of doors and windows.	$1^{1}/_{8}$ (for each side)
2.	Panelled doors and windows	$1^{1}/_{8}$ (for each side)
3.	Iron barred doors	$^{3}/_{4}$ (for each side)
4.	Iron barred doors with batten and sheet.	$1^{7}/_{8}$ (for each side)

5.	Batten windows with iron bars	$1^3/_8$	(for each side)
6.	Venetian windows	$1^3/_4$	(for each side)
7.	Venetian windows with iron bars	2	(for each side)
8.	Glazed windows with iron bars	1	(for each side)
9.	Glazed windows with iron bars	$^3/_4$	(for each side)
10.	Glazed shutters (measured over shutters only)	½	(for each side
11.	Panelled or framed and braced doors, windows etc.	$1^1/_8$	(for each side)
12.	Ledged and braced or ledged, battened and braced doors windows, etc.	$1^1/_8$	(for each side)
13.	Flush doors, etc.	1	(for each side)
14.	Trellis (or Jaffri) work one way or two way	2	(for painting all over)
15.	Carved or enriched work	2	(for each side)
16.	Weather boarding	2	(for each side)
17.	Wood single roofing	1½	(for each side)
18.	Boarding with cover fillets and match boarding.	$^{11}/_{20}$	(for each side)
19.	Title and slate battening	$^3/_4$	(for painting all over)
20.	Plain sheeted steel doors or windows	1½	(for each side)
21.	Fully glazed or gauzed steel doors and windows	½	(for each side)
22.	Corrugate sheeted steel doors or windows	$1^1/_4$	(for each side)
23.	Collapsible gates	1½	(for painting all over)
24.	Rolling shutters of interlocked laths.	1¼	(for each side)
25.	Expanded metal, hard drawn steel wire fabric of approved quality, grill work and gratings in guard bars, balustrades, railings and partitions	1	(for painting all over)
26.	Open palisade fencing and gates including standard, braces, rails, stays, etc. in timber or steel	1	(for painting all over)

The height shall be taken from the bottom of the lowest rail if the palisades do not go below it or from the lower end of palisades if they project below the lowest rail, upto the top of palisades but not upto the top of standards if they are higher than the palasides.

27.	Corrugated iron sheeting in roofs, side, cladding, etc.	1.14	(for each side)
28.	A.C. corrugated sheeting in roofs, side cladding, etc.	1.20	(for each side)
29.	A.C. Semi-corrugated sheeting in roofs, side cladding, etc., or Nainital pattern using plain sheets	1.10	(for each side)
30.	Wire gauze shutters including painting of wire gauze	1	(for each side)

1201.8. Rate :

1201.8.1. The unit rate shall be per 10 sq.m. of painted area and shall include cost of all labour, scaffolding and materials involved in all the operations described above.

1201.8.2. Small articles not exceeding 0.1 sq.m. and not in conjunction with similar painted work shall be paid per each.

1201.8.3. Painting upto 150mm. in width or in girth and not in conjunction with similar painted work shall be paid per running metre.

Specification No. 1202

Removing Old Paint with Patent Paint Remover

1202.1. Paint remover :

1202.1.1. Patent paint removers shall consist of volatile organic liquids thickened with waxes and other ingredients to retard the evaporation of the liquid and to enable a substantial layer of remover to be applied to the surface.

1202.1.2. The paint remover shall be of specified brand and make.

1202.1.3. It shall be free from alkaline matter and non-caustic so that it can be handled by workmen without injury. It shall be of non-inflammable quality (as far as possible).

1202.2. Application :

1202.2.1. Paint remover shall be used where burning off with blow lamp is not suitable. The paint remover shall be applied liberally with a brush and allowed to remain on the surface for a period of depending on the particular brand of remover used and on the thickness of the paint coating to be removed. When the point film lifts and wrinkles under the action of the remover it shall be stripped with a sharp instrument. If the film is not thoroughly removed, a second coat of remover may be applied if necessary over such patches and then the film thoroughly scrapped off.

1202.2.2. After the surface has been stripped it shall be washed down with mineral turpentine to remove all traces of paraffin wax, which forms one of the ingredients of patent paint remover and which if left in place will prevent the paint from drying.

1202.2.3. The cleaned surface shall be suitably prepared for application of point or other finish.

1202.3. Precautions :

1202.3.1. Where the paint remover used is of inflammable type suitable precaution against risk of fire shall be taken.

1202.3.2. Neighbouring painted surfaces which are not to be treated shall be properly protected from contact with paint remover.

Specification No. 1203

Removing Old Paint with Caustic Soda Solution

1203.1. Method :—Caustic soda dissolved in 48 items its volume of water shall be applied to the old paint with a brush and when the paint film lifts and wrinkles it shall be thoroughly scrapped off in the same way as in clause 1202.2. After the surface has been stripped thoroughly, it shall be rinsed with several changes of clean water to remove all traces of alkali which if allowed to remain are liable to spoil the new point applied over it. A little acetic acid or vinegar added to the final change of rinsing water helps to neutralise any remaining alkali.

1203.2. Precaution :—Caustic soda as its name implies is a corrosive liquid and care shall be taken to see that no liquid spills over the skin or clothing.

Specification No. 1204

Removing of Old Paint with Blow Lamp

1204.1. The paint shall be removed either with a blow lamp or with an air-acctylene equipment. The flame shall be allowed to play upon the paint just enough to soften it without charring either the paint or the background. The softened paint shall then be removed with a stripping knife following the flame as it is moved up the surface.

1204.1.1. Burning off shall begin at the bottom of a vertical surface and shall proceed upwards.

1204.2. Precaution :—Removal with blow lamp shall not be done on narrow or carved under cut surfaces or where there is risk of damage to neighouring materials such as panes in glazed windows.

Specification No. 1205

Painting with Wood Preservative

1205.1. All relevant clauses of SS : 1201 shall apply.

1205.2. Wood preservative :

1205.2.1. Oil type wood preservative of approved make shall be used.

1205.3. Preparation of surface :

1205.3.1. The painting shall be done only if the surface is perfectly dry to permit good absorption. All dirt, dust or other foreign matter shall be removed from the surface to be painted. All roughness shall be sand prepared and cleaned.

1205.4. Application :

1205.4.1. *New work* :—The preservative shall be applied liberally with a stout brush and not daubed with rags or cotton waste. It shall be applied with a pencil brush at the joints of wood work. The first coat shall be allowed atleast 24 hours to soak in before the second (the final) coat is applied. The second coat is applied in the same manner as the first coat. The excess of preservative which does not soak into the wood shall be wiped off with a clean dry piece of cloth.

1205.4.2. *Old work* :—The work shall be done in the same manner as for new work in clause 1205.4.1 except that only one coat shall be done.

Specification No. 1206

Coal Tarring

1206.1. All relevant clauses of SS : 1201 shall apply.

1206.2. Materials :

1206.2.1. *Coal tar* :—Coal tar of approved quality and grade shall be used. The tar to every litre of which 200 gms. of unslaked lime has been added shall be heated till it begins to boil. It shall then be taken off the fire and kerosene oil added to it slowly at the rate of 1 part of kerosene oil to 6 to 16 parts of coal tar by volume and stirred thoroughly. The addition of lime is for preventing the coal tar from running.

1206.3. Preparation of Surface :

1206.3.1. It shall be done as per clause 1205.3 except that sand papering is not necessary. Where iron work is to be painted it shall freed from scales and rust before painting.

1206.4. Application :

1206.4.1. *New work* :—The mixture shall be applied as hot as possible with a brush. The second coat shall be applied only after the first coat thoroughly dried up. Where possible the article to be tarred shall be dipped in the hot mixture for better results. The quantity of tar to be used for the first or second coat shall be not less than 0.16 and 0.12 litre per sq.m. respectively. Thinning with kerosene oil shall be suitably done to ensure this.

1206.4.2. *Old Work* :—The work shall be done in the same manner as for new work except that only one coat using 0.12 litre per sq.m. of area shall be done.

Specification No. 1207

Painting Priming coat on Wood, Iron or Plastered Surfaces

1207.1. All relevant clauses of SS : 1201 shall apply.

1207.2. Materials :

1207.2.1. The priming coat for wood work, iron work or plastered shall be as specified.

1207.2.2. The priming coat shall be prepared at the site of work or ready made primer of approved make shall be used.

1207.2.3. If the primer for wood work is to be mixed at site it shall be prepared from a mixture of red lead, white lead and double boiled linseed oil in the ratio of 0.7kg. : 0.7kg. : 1 litre.

1207.2.4. Where primer for steel work is to be mixed at site it shall be prepared from a mixture of red lead, raw linseed oil and turpentine in the ratio of 2.8kg. : 1 litre : 1 litre.

1207.2.4. Where primer for steel work is to be mixed at site it shall be prepared from a mixture of red lead, raw linseed oil and turpentine in the ratio of 2.8kg. : 1 litre : 1 litre.

1207.2.5. The specifications for the base vehicle and thinner for mixed on site primers shall be as follows :

(a) *White lead* :—The white lead shall be pure and free from adulterants like barium sulphate and whiting.

(b) *Red lead* :—This shall be in powder from and shall be free from adulterants like brick dust etc.

(c) *Raw linseed oil* :—Raw linseed oil shall be lightly viscous but clear and of yellowish colour with light browntinge. Its specific gravity at a temperature of 30 °C shall between 0.923 and 0.928. The oil shall be mellow and sweet to the taste with very little smell. The oil shall be of sufficiently matured quality. Oil turbid or thick with acid and bitter taste and rancid odour and which remains sticky for a considerable time shall be rejected. The oil shall be of approved brand.

(d) *Double boiled linseed oil* :—This shall be more visious than the raw oil, have deeper colour and specific gravity between 0.931 and 0.945 at temperature of 30 °C. It shall dry with a glossy surface. The oil shall be approved brand.

(e) *Turpentine* :—Mineral turpentine, that is, petroleum distillate which has the same rate of evaporation as vegetable turpentine (distillate product of oleoresh of conifers) shall be used. It shall have no grease or other residue when allowed to evaporate.

1207.2.6. All the above materials shall be of approved make and brought to site in their original packings in sealed condition.

1207.3. Preparation of Surface :

1207.3.1. *Wood work* :

1207.3.1.1. The wood work to be painted shall be dry and free from moisture. The surfaces shall be thoroughly cleaned. All uneveness shall be rubbed down smooth with sand paper and shall be well dusted. Knots if any shall be covered with preparation of red lead made by grinding red lead in water and mixing with strong glue-size and used hot.

1207.3.1.2. The surface treated for knotting shall be dry before painting is applied. After a priming coat is applied the holes and indentation on the surface shall be stopped with glazier's putty or wood putty. Stopping shall not be done before the priming coat is applied as the wood will absorb the oil in the stopping and the later is therefore liable to crack.

1207.3.2. *Iron and steel work* :—All rust and scales shall be removed by scrapping or by brushing with steel wire brushes. Hard skin of oxide formed on the surface of wrought iron during rolling which becomes loose by rusting shall be removed. All dust and dirt shall be thoroughly wiped away from the surface. If the surface is wet it shall be dried before priming coat is undertaken.

1207.3.3. *Plastered surface* :—The surface shall be painted after it has cured and dried completely. Trial patches of primer shall be laid or intervals and where drying is satisfactory painting shall be taken up. Before primer is applied holes and undulations shall be filled up with plaster of pairs and rubbed smooth. Where it is proposed to use enamel paint the priming coat shall not be applied earlier than 12 months after plastering in order that the evaporation of water inside the wall is not impeded.

1207.4. Application :—The primer shall be applied with brushes worked well into the surface and spread even and smooth. The painting shall be done by crossing and laying off as described in clause 1201.4.1.

Specification No. 1208

Painting with Ready Mixed Paint

1208.1. All relevant clauses of SS : 1201 shall apply.

1208.2. Paint :—Ready mixed paints shall be of approved brand and make and of specified shades.

1208.3. Preparation of surface :

1208.3.1. *New wood work* :—This shall conform to clauses 1207.3.1.1. and 1207.3.1.2.

1208.3.2. *New iron and steel work* :—This shall conform to clause 1207.3.2.

1208.3.3. *New plastered surface* :—This shall conform to clause 1207.3.3.

1208.3.4. *Old wood work* :—If the old paint is sound and firm and its removal is considered unnecessary the surface shall be rubbed down with pumice stone after it has been cleaned of all smoke and grease by washing with lime and rinsing with water and drying. All dust and loose paint shall be completely removed. The surface shall then be washed with soap and water.

1208.3.4.1. If the old painted surface is blistered or flaked badly old paint shall be completely removed as specified and such removal shall be paid for separately. Holes and cracks if any shall be stopped with glazier's putty or wood putty.

1208.3.5. *Old iron and steel work* :—If the old paint is sound and firm and its removal is considered unnecessary it shall be rubbed with wire brushes and any loosened paint taken off. All dust shall then be thoroughly wiped away.

1208.3.5.1. If the old painted surface is in bad condition and blistered and flaked the old paint shall be completely removed as specified and such removal shall be paid for separately.

1208.3.6. *Old plastered surface* :—If the old paint is firm and sound it shall be cleaned of grease, smoke, etc., and then all dust, dirt and loose paint removed as specified in clause 1208.3.4.

1208.3.6.1. If the old paint is badly blistered and flaked it shall be completely removed as specified in clause 1208.3.4.1.

1208.3.6.2. If before painting, any portion of the wall shows signs of dampness, the causes shall be investigated and the damp surface shall be properly treated. Such treatment shall be paid for separately. A thin coat of white lead if so required shall be applied on the wet or patchy portion of the surface before painting is undertaken and this shall be paid extra.

1208.4. Application :—This shall conform to clause 1201.4. The number of coats to be given shall be as specified in the description of the item.

Specification No. 1209

Painting of G.I. Sheets with Ready Mixed Paint

1209.1. All relevant clauses of SS : 1201 shall apply.

1209.2. Paints :—Ready mixed paint of approved brand and make and of the specified shade shall be used.

1209.3. Preparation of Surface :

1209.3.1. *New work* :—The painting of new G.I. sheets shall not usually be done till the sheets have weathered for about a year. When new sheets are to be painted before they have weathered they shall be treated with a mordant solution prepared by mixing 38gm. of copper acetate in a litre of soft water or 13gm. of Hydrochloric acid in a solution of 13gm. each of copper chloride, copper nitrate and ammonium chloride dissolved in a litre of soft water. This quantity of solution is sufficient for about 235 sq.m. to 280 sq.m. of area and is applied for ensuring proper adhesion of point. The painting with the mordant solution shall be paid for separately.

1209.3.1.1. Before painting weathered G.I. sheets rusty patches shall be completely cleaned with coarse emery paper and brush. All grease marks also shall be removed and the surface washed and dried and rusted surface shall be touched with ready mixed paint of red lead.

1209.3.2. *Old work* :—If the old paint is firm and sound it shall be cleaned of grease, smoke, etc. The surface shall then be rubbed down with sand paper and dusted. Dusty patches shall be cleaned up and touched with red lead.

1209.3.2.1. If the old paint is blistered and flaked it shall be completed removed as specified. Such removal shall be paid for separately.

1209.4. Application :—The number of coats to be applied shall be as specified in the description of item. In case of corrugated G.I. sheets the crowns of the corrugations shall be painted first and when these get dried the general coat shall be given to ensure uniform finish over the entire surface without the crowns showing signs of thinning. The second or additional coats shall be applied when the previous coat has dried.

Specification No. 1210

Spray Painting with Flat Wall Paint on New Work including Priming Coat

1210.1. All relevant classes of SS : 1201 shall apply.

1210.2. Materials :—The priming coat shall consist of "Distempering Primer" or "Cement Primer" as specified in the description of the item and shall be approved brand and make.

1210.2.1. The flat wall paint shall be of approved brand and make and of the specified shade.

1210.3. Preparation of surface for printing coat :—The surface shall be prepared as specified in clause 910.5.

1210.4. Application :

1210.4.1. *Primer coat* :—The specified primer shall be painted or sprayed over the surface in an even and uniform layer. Where new walls are painted the primer coat shall be a cement primer. When walls are painted 12 months after completion distemper primer shall suffice.

1210.4.2. *Painting* :—When the surface is dry the spray painting with the wall paint in uniform and even layers shall be done to the required number of coats. Each coat shall be allowed to dry overnight and lightly rubbed with very fine grade of sand paper and loose particles brushed off before the next coat is sprayed.

1201.4.2.1. If, after the final coat of wall paints is applied, the surface obtained is not upto the mark due to defective workmanship further one or more coats as required shall be given after rubbing down the surface and dusting off all loose particles to obtain a smooth and even finish and no extra payment shall be made for this.

1210.4.2.2. If the primer or wall paint gets thickened during the application it shall be thinned suitably with the thinner recommended by the manufacturer.

1201.4.2.3. Adequate ventilation shall be provided to disperse spray fumes. Filaments and floor shall be protected from the spray.

Specification No. 1211

Spray Painting with Flat Wall Paint on Old Work

1211.1. All relevant clauses of SS :1201 shall apply.

1211.2. Paint :—This shall conform to clause 1211.2.1.

1211.3. General :—Where the old paint is in sound condition renewal shall be carried out as given in clauses 1211.4 to 1211.5. Otherwise the old paint shall be completely stripped and spray painting shall be carried out as new work. Such removal shall be paid for separately.

1211.4. Preparation of surface :—The surface shall be washed to remove dust and dirt. A mild detergent solution like soap water shall be used for washing and the surface shall also be rubbed down lightly with abrasive paper when dry. Any patches appearing on the surface shall first be touched up with a coat of paint. These shall be allowed to dry and then rubbed down lightly.

1211.5. Application :—The paint shall then be applied with spraying machine in a uniform and even layer. A second coat shall be applied where specified but only after the first coat is completely dry and hard.

Specification No. 1212

Painting with Synthetic Enamel Paint

1212.1. All relevant clauses of SS : 1201 shall apply.

1212.2. Paint :—Synthetic enamel paint of approved brand of first class quality and of the specified shade shall be used for the top coat. An undercoat to match with top coat as recommended by the manufacturer shall be used.

1212.3. Preparation of surface :

1212.3.1. *New work* :—This shall conform to clause 1108.3.

1213.3.2. *Old Work* :—Where the existing paint is firm and sound it shall be cleaned of grease, smoke, etc., and rubbed with sand paper to remove all loose paint and loose particles dusted off. All patches and cracks shall then be treated with stopping and filler prepared with the specified paint. The surface shall again be rubbed and made smooth and uniform.

1212.3.2.1. If the old paint is blistered and flaked it will be necessary to completely remove the same as specified. Such removal shall be paid for separately.

1212.4. Application :

1212.4.1. *New work* :—The number of coats including the undercoat shall be as stipulated in the description of item.

1212.4.1.1. *Undercoat* :—One coat of the specified paint of the desired shade suited to the shade of the top coat shall applied and allowed to dry overnight. It shall be rubbed next day with the finest grade of wet abrasive paper to ensure a smooth and even surface free from brush marks and all loose particles dusted off.

1212.4.1.2. *Top coats* :—Top coats of paint of the specified shade shall be applied after the undercoat is thoroughly dry. If after the final coat is applied the surface obtained is not upto the mark due to defective workmanship further one or more coats as required shall be given after rubbing down the surface and dusting of all loose particles to obtain a smooth and even finish and no extra payment shall be made for this.

1212.4.2. *Old works* :—The number of coats as stipulated in the item shall be applied with the specified paint. Each coat shall be allowed to dry and rubbed down smooth with very fine wet abrasive paper to get an even glossy surface. If however the surface obtained is not satisfactory due to defective workmanship additional coats as required shall be applied to get correct finish without extra payment.

Specification No. 1213

Painting with Aluminium Paint

1213.1. All relevant clauses of SS : 1201 shall apply.

1213.2. Paint :—Aluminium paint of approved brand and make shall be used. The paint comes in compact dual containers with the paste and the medium separately. The two shall be mixed together to proper consistency before use.

1213.3. Preparation of surface :

1213.3.1. *New steel work* :—All rust and scales shall be removed by scraping or brushing with steel wire brushes and then smoothened with sand paper. The surface shall be thoroughly cleaned of dust.

1213.3.2. *New corrugated G.I. sheets* :—This shall conform to clauses 1209.3.1 and 1209.3.1.1.

1213.3.2. *Old steel work or corrugated G.I. sheets* :—This shall conform to clauses 1209.3.2 and 1209.3.2.1.

1213.4. Application :—The number of coats to be applied shall be as stipulated in the description of the item. Each coat shall be allowed to dry for 24 hours and lightly rubbed down with fine grade sand paper and dusted before the next coat is applied. The finished surface shall present an even and uniform appearance.

1213.4.1. As the Aluminium paste is likely to settle in the container care shall be taken to frequently stir the paint during use. The paint shall also be applied and laid off quickly as the surface is otherwise not easily finished.

Specification No. 1214

Painting with Acid Proof Paint

1214.1. All relevant clauses of SS : 1201 shall apply.

1214.2. Paint :—Acid proof paint of approved brand and make and of the specified shade shall be used.

1214.3. Preparation of surface :—This shall conform to clause 1208.3.

1214.4. Application :—This shall conform to clause 1207.4

Specification No. 1215

Painting with Anti-corrosive Bitumastic Paint

1215.1. All relevant clauses of SS : 1201 shall apply.

1215.2. Paint :—Anti-corrosive bitumastic paint of approved brand and make shall be used.

1215.3. Preparation of surface :—This shall conform to clause 1207.3.

1215.4. Application :—This shall conform to clause 1208.4. The drying time between consecutive coats shall be not less than 3 hours.

Specification No. 1216

Wall Painting with Plastic Emulsion Paint

(Plastic emulsion paints are not suitable for application on external surfaces of wood and iron and surfaces which are liable to heavy condensation and are to be used generally on masonry or plastered surfaces).

1216.1. All relevant clauses of SS : 1201 shall apply.

1216.2. Paint :—Plastic emulsion paint of approved brand and make of the specified shade shall be used.

1216.3. Preparation of surface :

1216.3.1. *New work* :—This shall conform to clause 910.4.

1216.3.2. *Old work* :—This shall conform to the relevant portions of clause 1208.3. The surface before application of paint shall be flattened well to get the proper flat velvety finish after painting.

1216.4. Application :

1216.4.1. *New work* :—The number of coats shall be as stipulated in the item. The paint shall be applied in the usual manner with brush or roller. The paint dries by evaporation of the water content and as soon as the water has evaporated the film gets hard and the next coat can be applied. The time of drying varies from one hour on absorbent surfaces to 2 to 3 hours on non-absorbent surfaces. The thinning of emulsion shall be done with water and not with turpentine. Thinning with water will be particularly required for the undercoat which is applied on the absorbent surface. The quantity of thinner to be added shall be per manufacturer's instructions. The surface on finishing shall present a flat velvety smooth finish. If after the final coat is applied the surface obtained is not upto the mark due to defective workmanship further one or more coats as required shall be given after rubbing down the surface and dusting of all loose particles to obtain a smooth and even finish and no extra payment shall be made for this.

1216.4.2. *Old work* :—The number of coats to be applied shall be as specified in the description of the item. The application shall be as specified in clause 1208.4 except that thinning with water will not normally be required.

1216.5. Precautions :

1216.5.1. Old brushes if they are to be used with emulsion paints shall be completely dried of turpentine or oil paints by washing in warm soap water. Brushes shall be quickly washed in water immediately after use and kept immersed in water during break periods to prevent the paint from hardening on the brush.

1216.5.2. In the preparation of walls for plastic emulsion painting no oil base putties shall be used in filling cracks, holes, etc. These shall be filled with plaster of paris and rubbed smooth.

1216.5.3. Splashes on the floors etc., shall be cleaned out without delay as they will be difficult to remove after hardening.

1216.5.4. Washing of surfaces treated with emulsion paints shall not be done within 3 to 4 weeks of application.

Specification No. 1217

Varnishing

1217.1. Material :

1217.1.1. *Varnishing* :—Varnish shall be of the specified type and shall conform to the following relevant IS Standards. Products carrying I.S.I. certification mark shall be preferred.

IS : 337-1975 Specification for varnish finishing, interior.

IS : 338-1952 Specification for varnish undercoating, exterior natural resin.

IS : 339-1952 Specification for varnish undercoating, exterior synthetic resin.

IS : 342-1952 Specification for varnish, Acid resisting.

IS : 347-1975 Specification for varnish, shellac for general purposes.

IS : 524-1968 Specification for varnish finishing, exterior synthetic.

IS : 525-1968 Specification for varnish finishing, exterior and general purposes.

1217.2. Preparation of surface :

1217.2.1. *New Work* :—New wood work to be varnished shall be planned smooth. Knots shall be cut to a slight depth. Cracks and holes shall be cleaned of dust. The knots, cracks, etc., shall then be filled in with wood putty made as follows.

1217.2.1.1. On a piece of wood say 200mm. x 150mm. on the face and on the sides where cross grains appear a small quantity of glue-size shall be poured and the surface scraped with the edge of a fine carpenter's chisel. Fine saw dust shall be mixed with the glue and the stiff paste thus formed shall be used for the filling.

1217.2.1.2. The fillings when dry shall be rubbed down with a carpenter's file and then the entire surface shall be rubbed down perfectly smooth with (medium grained and fine) sand papers and wiped with dry clean cloth so that it presents a uniform appearance. In no case shall and papers be rubbed across the grains as in this case even the finest marks will be visible when the varnishing is applied.

1217.2.2. *Old work* :—If the old varnished surface is firm and sound it shall be cleaned of grease and dirt with turpentine and then rubbed with wet sand paper until the surface is clean and smooth. It shall be dried and wiped clean with a soft cloth. Knots, holes and cracks shall be filled as in clause 1217.2.1. The entire surface shall then be rubbed down smooth with sand paper and wiped clean.

1217.2.2.1. If the old varnished surface is peeled or cracked then it will be necessary to remove the entire surface as specified and such removal shall be paid for separately. Further the varnishing itself shall have to be done like new work and shall be paid for as such.

1217.3. Sizing and Transparent wood filler coat :—The surface shall then be treated with either glue-sizing or with transport wood filler coat as stipulated in the description of item.

1217.3.1. *Sizing* :—When sizing is stipulated a coat of thin clean glue-size shall be applied hot on the surface. When dry the surface shall be rubbed down smooth with sand paper and cleaned. It shall then be given another coat of glue-size nearly cold and allowed to dry. The sized wood work shall again be rubbed down smoothly with fine sand paper and cleaned. The surface shall be perfectly dry and all dust shall be removed not only from the surface but also from the edges and joints before varnishing is commenced. If the wood work is to be stained the

staining colour shall be mixed with the second coat of the size which must be applied evenly and quickly keeping the colour on the flow. Any joining up with work already dry will show badly. The object of application of the glue-size is to seal the pores in wood to prevent absorption of the oil in the varnish.

1217.3.1.1. Glue-sizing is inadvisable on floors, table tops and other horizontal surfaces likely to carry wet house-hold utensils which are likely to disturb the size coatings and thus expose bare wood. Where glue-sizing is omitted to be done the rate for the work shall be suitably reduced.

1217.3.2. *Application of transparent wood filler* :—Where instead of glue-sizing, transparent wood filler application is stipulated in the item then the surface prepared as in clause 1217.2.1 shall be given an application of the filler with brush or rag in such a way that the filler fills up all the pores and indentations and levels up the surface. It shall be allowed to dry for 24 hours. Then it shall be cut and rubbed with emery paper so that the surface of wood is laid bare with the filler only in the pores and crevices of the wood.

1217.4. Application of Varnish :—

1217.4.1. *New Work* :—The number of coats to be applied shall be as stipulated in the description of item. The undercoat shall be with a flatting varnish. This dries hard and brittle and when cut and rubbed down to produce a smooth surface enhances the gloss of the finishing varnish. The top coat shall be given with specified type of finishing varnish.

1217.4.1.1. The varnish shall be applied liberally with a full brush and spread evenly with short light strokes to avoid frothing. If the work is vertical the varnish shall be crossed and recrossed and then laid off. The above process will constitute one coat. If the surface is horizontal varnish shall be worked in every direction with light quick strokes and finished in one definite direction so that it will set without showing brush marks. While laying off excess varnish shall be scrapped out of the brush.

1217.4.1.2. Rubbing down and flatting the surface shall be done after each coat except the final coat with fine sand paper. The work shall be allowed to dry away from draughts and damp air. The finished surface shall then present a uniform appearance and fine glossy surface free from streaks, blisters, etc.

1217.4.1.3. Any varnish left over in the small container shall not be poured back into the stock tin as it will render the later unfit for use. Special varnishing brushes shall be used and not ordinary paint brushes. Brushes shall be perfectly clean.

1217.4.2. *Old work* :—This shall conform to clause 1217.4.1 as far as applicable varnish for except that the coats to be applied shall be with the stipulated type of finishing coat.

1217.5. Other details :—This shall conform to the relevant clauses of SS : 1201.

1217.6. Measurement :—This shall conform to clause 1217.7.

1217.7. Rate :—This shall conform to clause 1201.8.

Specification No. 1218

Oiling with Raw Linseed Oil

1218.1. Materials :

1218.1.1. *Oil* :—This shall conform to clause 1207.2.5.(c).

1218.2. Preparation of surface :

1218.2.1. *New work* :—This shall conform to clause 1217.2.1 except that no sizing shall be done on the prepared surface.

1218.2.2. *Old work* :—The wood work shall be cleaned of all smoke and grease by sand papering or by washing with lime and water. The surface shall then be washed with soap and water and completely dried.

1218.3. Application :

1218.3.1. *New work* :—The number of coats to be applied shall be as stipulated in the description of item. The oil shall be applied freely with brushes (not rags) and spread evenly and smoothly until no more oil is absorbed. Each subsequent coat shall be applied after the previous coat is thoroughly dried and in any case not before 24 hours of application of first coat. Work after completion shall not be patchy and sticky to the touch and shall present a uniform appearance.

1218.3.2. *Old work* :—This shall conform to clause 1218.3.1.

1218.4. Other details :—This shall conform to the relevant clauses of SS : 1201

1218.5. Measurement :—This shall conform to clause 1201.7.

1218.6. Rate :—This shall conform to clause 1201.8.

Specification No. 1219

Wax Polishing with Readymade Wax Polish

1219.1. Materials :—The wax polish shall be of approved quality.

1219.2. Preparation of surface :

1219.2.1. *New work* :—This shall conform to clause 1217.2.1.

1219.2.2. *Old work* :—The wood work shall be cleaned of all smoke and grease by washing with soap in luke warm water and completely dried. Then it shall be prepared smooth as in clause 1217.2.2.

1219.3. Application :

1219.3.1. *New work* :—The polish shall be applied evenly with a clean soft pad of cotton cloth in such a way that the surface is completely and fully covered. The surface is then rubbed continuously with a pad made up of cotton lint wrapped in multilayered piece of cloth for half an hour. When the surface is quite dry a second coat shall be applied in the same manner and rubbed continuously for one

hour or until the surface is dry. The final coat shall then be applied and rubbed for two hours (more if necessary) until the surface has assumed uniform finish and is dry showing no signs of stickiness. The final polish depends largely on the amount of rubbing which shall be continuous and with uniform pressure with frequent changes in the direction.

1219.3.2. *Old work* :—The polish shall be applied in the same manner as specified in clause 1219.3.1 for the final coat on new work. In this case one or two coats shall be applied as necessary to get uniform finish instead of three coats in the case of new work.

1219.4. Other details :—This shall conform to the relevant clauses of SS : 1201.

1219.5. Measurement :—This shall conform to clause 1201.7.

1219.6. Rate :—This shall conform to clause 1201.8.

Specification No. 1220

Painting Cast Iron Rain Water, Soil, Waste and Vent Pipes and Fittings including Priming Coat

1220.1. Paints :

1220.1.1. *Primer* :—The primer where necessary shall be of approved quality and make.

1220.1.2. *Paint* :—Paint shall be anti corrosive bitumastic paint or other type of paint as specified in the description of the item.

1220.2. Preparation of surface :

1220.2.1. *New work* :—This shall conform to clause 1207.3.2.

1220.2.2. *Old work* :—This shall conform to clause 1208.3.5.

1220.3. Application :

1220.3.1. *New work* :—The number of coats of painting over the priming coat shall be as stipulated in the description of the item. The application of paint over priming coat shall be carried out as per specification for application of the relevant quality of paint in new work.

1220.3.2. *Old work* :—This shall conform to clause 1208.4.

1220.4. Other details :—This shall conform to the relevant clauses SS : 1201.

1220.5. Measurement :—All linear measurement shall be in metres, correct to 0.01 of a metre. This shall be taken over the finished time of pipe including specials, etc. Pipes of different boats shall be measured and paid for separately. Specials and fittings such as holder-bat clamps, plugs, etc., shall not be measured separately.

1220.6. Rate :—The unit rate shall be per running metre which shall include the cost of all materials and labour involved in all the operations described above including painting of all specials and fittings.

Specification No. 1221

Lettering with Paint

1221.1. Paint :—Paint of approved quality shall be used.

1221.2. Lettering :—

1221.2.1. *New work* :—The letters and figures shall be of size and style specified. These shall be stencilled or drawn in pencil and got approved before painting. They shall be finished neatly. Two or more costs of paint shall be applied till uniform colour and required finish are obtained.

1221.2.2. *Old work* :—Painting shall be done over the existing letters and shall accurately follow their lines and curves. One or more coats of paints shall be applied till a uniform colour and required finish are obtained.

1221.3. Measurement :—Measurement shall be taken in terms of vertical heights of letter in mm. punctuations. The letter height shall be measured correct to 10mm.. Dots, dashes, punctuations and other similar marks or lines shall not be measured for payment.

1221.4. Rate :—The unit rate shall be per 10mm. height of letter or figure irrespective of the style of the lettering and shall include the cost of all labour and materials involved in the operations.

Specification No. 1222

French Polishing

1222.1. French Polish :—French polish of approved quality shall be used and shall conform to IS : 348-1968.

1222.2. Preparation of Surface :

1222.2.1. *New work* :—This shall conform to clause 1217.2.1.

1222.2.2. *Old work* :—This shall conform to clause 1217.2.2.

1222.3. Application :

1222.3.1. *New work* :—The number of coats of polish to be applied shall be described in the item. A pad made up of cotton lint wrapped in a multilayered piece of cloth shall be used to apply the polish. The pad shall be moistened with polish and rubbed hard on the wood on a series of overlapping circles applying the mixture sparingly but uniformly over the entire area to give an even level surface. A trace of linseed oil on the face of the pad facilitates this operation. The surface shall be allowed to dry and the remaining costs applied in the same way. To finish off the pad shall be covered with a fresh piece of clean fine cotton cloth slightly dampened with methylated spirit and rubbed lightly and quickly with circular motions. The finished surface shall have a uniform texture and high gloss.

1222.3.2. *Old work* :—This shall conform to clause 1222.3.1 as far as applicable.

1222.4. Other details :—This shall conform to the relevant clauses of SS : 1201.

1222.5. Measurement :—This shall conform to clause 1201.7.

1222.6. Rate :—This shall conform to clause 1201.8.

SECTION 13

STANDARD SPECIFICATIONS FOR SANITARY WORK AND ROOF PLUMBING

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Specification No. 1301

Stone-Ware Pipes and Fittings

1301.1. General :—Straight pipes and specials shall conform to IS : 651-1971 for "Salt Glazed Stone-ware pipes and fittings".

1301.2. Dimensions of Indian Standard Salt Glazed stone-ware pipes are given below in Table No. 1301-A.

Table No. 1301-A

Dimensions of Barrels and Sockets (All dimensions in Milli-metres)

Internal dia of pipe	*Mean thickness of barrel and socket Min.*	*Internal depth of socket Min.*	*Excess shoulder measurement Min.*	*Length of Grooving on spigot Min. 1 1/2B*
	A	B	C	D
100	12	50	10	75
150	16	57	11	85.5
200	17	63	12	94.5
230+	19	63	12	94.5
250	20	70	16	105
300	25	70	16	105
350	30	75	16	112.5
400	35	75	16	112.5
450	38	76	16	114
500	40	80	19	120
600	44	90	19	135

Ex=Width of shoulder of socket which shall exceed the mean thickness of the barrel of the pipe by not less than values for 'C' given in Column 4 above.

+=This is a non-preferred size and its manufacture is permitted for a limited period.

1301.3. Pipes with glazing damaged, chipped or cracked shall be rejected (unless the Executive Engineer considers any such pipe can be used without prejudice to the work).

1301.4. Hydraulic test :—When subjected to the Hydraulic Test in accordance with IS : 651-1971 straight pipes shall withstand an internal Hydraulic Test pressure of 1.5 kg./cm^2 on the barrels, and closed trapers, bends and junctions shall withstand a test pressure of 0.75 kg./cm^2 without showing signs of injury or leakage.

1301.5. Measurement :—All linear measurements shall be in metres correct to 0.01 of a metre for pipes. Fittings and specials etc., shall be measured in numbers.

1301.6. Rate :—This unit rate for pipes shall be per running metre for different diametres and the unit rate for fittings and specials etc., shall be per each for different diametres.

Specification No. 1302

Cast Iron Pipes and Special Castings for Water Supply and Sewage

1302.1. General :—The cast iron pipes and fittings shall conform to relevant Indian Standard Specifications as furnished in the following table :

Specifications	*I.S.No.*
(1) Vertically cast pipes and fittings	IS : 1537-1960
(2) Spun pipes	IS : 1536-1967
(3) Cast iron fittings for pressure pipes	IS : 1538-1969

1302.2. Hydrostatic test pressure for the various classes of pipes and fittings are furnished in the following tables :

Table 1302-A

Hydrostatic Test Pressures for Centrifugally, Cast (Spun) Iron Pipes

Class	*Hydrostatic test pressure at works kgf./cm²*	*Maximum Hydrostatic test pressure after installation kgf./cm²*
Socket and Spigot Pipes		
L.A.	35	12
A.	35	18
B.	35	24
Flanged Pipes (Upto 300mm. diametre)		
A.	35	18
B.	35	24

Table 1302-B

Hydraulic Test Pressures for Vertically Cast Iron Pipes

Nominal diametre	*Test pressure in kg./cm² Socket and spigot pipes*		*Flanged pipes*	
Upto and including 300mm.	*Class A 20*	*Class B 25*	*Class A 20*	*Class B 25*
Over 300mm. upto and including 600mm.	25	25	15	20
Over 600mm. and upto and including 1000mm.	15	20	10	15
Over 1000mm. to 1500mm.	10	15	10	10

1302.3. Dimensions and weights :—Nominal diametres, lengths and weights of various types of pipes are furnished in the following tables (for dimensions and weights of fittings refer IS : 1538-1969).

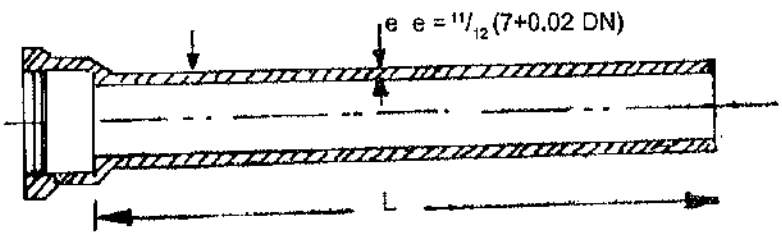
Table 1302-C

Socket and Spigot Pipes Class A

(Vertically cast iron pipes)

Nominal diametre (DN) mm.	*Total weight for one working length 'L' in metres*				
	3.66 kg.	*4.00 kg.*	*4.88 kg.*	*5.00 kg.*	*5.50 kg.*
80	64	69.5	—	85.5	—
100	82	89	—	109	120
125	106	115	—	141	155
150	133	144	—	178	194
200	193	209	251	257	281
250	261	283	340	348	380
300	337	366	440	450	492
350	422	458	550	563	615
400	517	561	674	690	754
450	627	680	817	836	914
500	728	790	949	971	1,061
600	973	1,055	1,267	1,296	1,417
700	1,257	1,363	—	1,675	1,830
750	1,409	1,527	—	1,876	2,051
800	1,568	1,704	—	2,093	2,288
900	1,917	2,080	—	2,554	2,791
1000	2,303	2,502	—	3,072	3,357
1,100	2,726	2,955	—	2,628	3,966
1,200	3,175	3,446	—	4,229	4,623
1,500	4,974	5,389	—	6,612	7,223

(See Figure 1302.1)



[Fig. No. 1302.1]

SOCKET AND SPIGOT PIPES CLASS–A

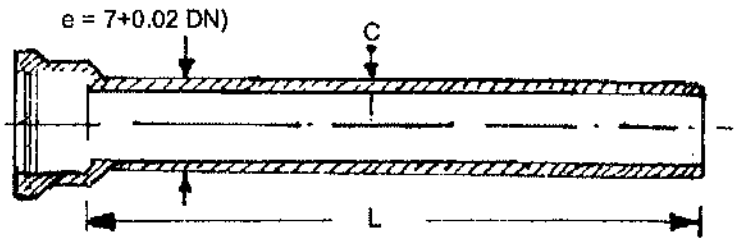
Table 1302-D

Socket and Spigot Pipes Class B

(Vertically cast iron pipes)

Nominal diametre (DN) mm.	*Total weight for one working length 'L' in metres*				
	3.66 kg.	*4.00 kg.*	*4.88 kg.*	*5.00 kg.*	*5.50 kg.*
80	69	74.5	—	92	—
100	88	95	—	117	128
125	114	124	—	153	167
150	143	155	—	191	209
200	207	225	271	278	304
250	281	305	368	376	411
300	364	395	476	487	533
350	457	495	596	610	667
400	557	604	727	744	814
450	675	732	881	901	986
500	786	853	1,026	1,049	1,148
600	1,052	1,141	1,372	1,404	1,535
700	1,355	1,470	—	1,808	1,977
750	1,525	1,644	—	2,035	2,225
800	1,696	1,840	—	2,263	2,478
900	2,073	2,249	—	2,766	3,024
1000	2,489	2,699	—	3,318	3,628
1,100	2,970	3,192	—	3,923	4,326
1,200	3,430	3,725	—	4,578	4,993
1,500	5,380	5,834	—	7,167	7,833

(See Figure No. 1302.2)



[Fig. No. 1302.2]

SOCKET AND SPIGOT PIPES CLASS–B

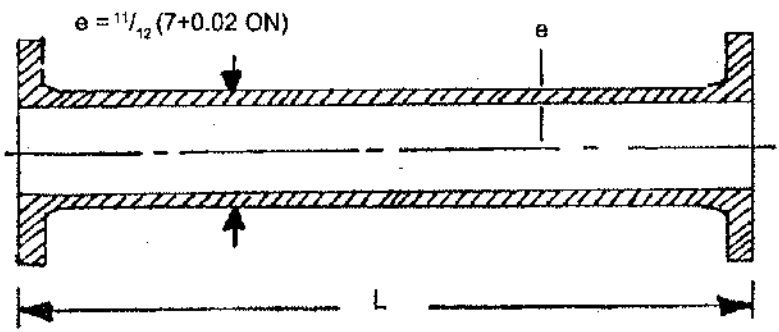
Table 1302-E

Flanged Pipes—Sand Cast—Class-A

(Vertically cast iron pipes)

Nominal diametre (DN) mm.	*Weight for one meter of barrel (approx.) Kg.*	*Weight for one flange (approx.) Kg.*	*Nominal length 'L' m.*
80	16.0	3.7	2 to 3
100	20.5	4.2	2 to 4
125	26.4	5.3	2 to 4
150	33.2	6.7	2 to 4
200	48.1	9.3	2 to 4
250	65.0	12.0	2 to 4
300	84.0	14.8	2 to 4
350	105.0	19.0	2 to 4
400	128.7	23.4	2 to 4
450	156.0	26.5	2 to 4
500	181.0	32.1	2 to 4
600	241.4	44.0	2 to 4
700	311.6	59.9	2 to 4
800	389.1	80.8	2 to 4
900	474.3	94.6	2 to 4
1000	570.0	120.0	2 to 4
1,100	672.0	139.0	2 to 4
1,200	783.1	173.0	2 to 4
1,500	1,222.1	276.2	2 to 4

(See Figure 1302.3)



[Fig. No. 1302.3]

FLANGED PIPES SAND CAST CLASS–A

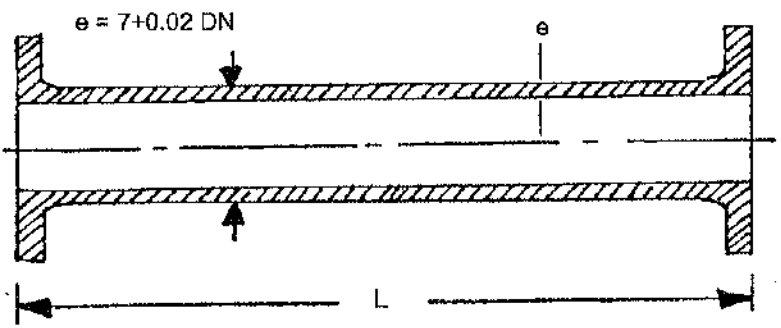
Table 1302-F

Flanged Pipes—Sand Cast—Class-B

(Vertically cast iron pipes)

Nominal diametre (DN) mm.	*Weight for one meter of barrel (approx.) Kg.*	*Weight for one flange (approx.) Kg.*	*Nominal length 'L' m.*
80	17.3	3.7	2 to 3
100	22.0	4.2	2 to 4
125	28.7	5.3	2 to 4
150	35.9	6.7	2 to 4
200	52.1	9.3	2 to 4
250	70.6	12.0	2 to 4
300	91.4	14.8	2 to 4
350	114.5	19.0	2 to 4
400	139.5	23.4	2 to 4
450	169.0	26.5	2 to 4
500	196.7	32.1	2 to 4
600	262.9	44.0	2 to 4
700	338.2	59.9	2 to 4
750	380.6	69.8	2 to 4
800	423.1	80.8	2 to 4
900	516.6	94.6	2 to 4
1000	619.2	120.0	2 to 4
1,100	739.0	139.0	2 to 4
1,200	851.6	173.0	2 to 4
1,500	1,333.1	276.2	2 to 4

(See Figure 1302.4)



[Fig. No. 1302.4]

FLANGED PIPES SAND CAST CLASS–B

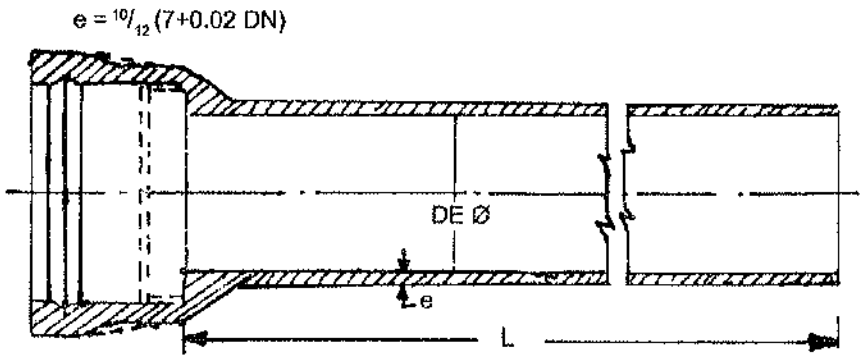
Table 1302-G

Socket and Spigot Pipes Centrifugally Cast (Spun)

Class 'LA'

Nominal diameter (DN) mm.	*Total weight for one working length 'L' in metres*					
	3.66 kg.	*4.00 kg.*	*4.88 kg.*	*5.00 kg.*	*5.50 kg.*	*6.00 kg.*
80	59	64	77	79	86	93.5
100	75	81.5	98	100	109	119
125	98	106	127	130	142	154
150	122	132	158	162	177	192
200	178	193	231	237	259	281
250	240	260	312	319	349	373
300	310	336	403	412	450	489
350	390	423	507	519	567	615
400	474	514	617	631	690	748
450	572	620	744	751	832	902
500	671	727	872	892	974	1,057
600	894	968	1,162	1,188	1,298	1,408
700	1,163	1,250	1,499	1,533	1,675	1,816
750	1,293	1,400	1,680	1,828.5	1,876	2,035

(See Figure 1302.5)



[Fig. No. 1302.5]

SOCKET AND SPIGOT PIPES CLASS–A

Table 1302-H

Socket and Spigot Pipes Centrifugally Cast (Spun)

Class A

Nominal diametre (DN) mm.	*Total weight for one working length 'L' in metres*					
	3.66 kg.	*4.00 kg.*	*4.88 kg.*	*5.00 kg.*	*5.50 kg.*	*6.00 kg.*
80	64	69.5	84	85.5	93.5	101
100	82	89	107	109	120	130
125	106	115	138	141	155	168
150	133	144	173.5	178	194	211
200	193	209	251	257	281	305
250	261	283	340	348	380	413
300	337	366	440	450	492	534
350	422	458	550	563	615	668
400	517	561	674	690	754	819
450	627	680	817	836	914	992
500	728	790	949	971	1,061	1,152
600	973	1,055	1,267	1,296	1,417	1,538
700	1,257	1,363	1,637	1,675	1,830	1,986
750	1,409	1,527	1,834	1,876	2,051	2,225

Table 1302-I

Socket and Spigot Pipes Centrifugally Cast (Spun)

Class B

Nominal diametre (DN) mm.	*Total weight for one working length 'L' in metres*					
	3.66 kg.	*4.00 kg.*	*4.88 kg.*	*5.00 kg.*	*5.50 kg.*	*6.00 kg.*
80	69	74.5	90	92	101	109
100	88	95	114.5	117	128	139
125	114	124	149	153	167	181
150	143	155	187	191	209	227
200	207	225	271	278	304	330
250	281	305	368	376	411	447
300	364	395	476	487	533	578
350	457	495	596	610	667	724
400	557	604	727	744	814	883
450	675	732	881	901	986	1,070

500	786	853	1,026	1,049	1,148	1,246
600	1,052	1,141	1,372	1,404	1,535	1,667
700	1,355	1,470	1,767	1,808	1,977	2,146
750	1,525	1,644	1,989	2,029.5	2,225	2,415

(See Figure 1302.5)

Table 1302-J

Flanged Pipes Centrifugally cast with Screwed flanges–Class 'A'

Nominal diametre (DN) mm.	*Weight for one meter of barrel (approx.) kg.*	*Weight for one flange (approx.) kg.*	*Working length 'L' m.*
80	16.0	4.3	2, 2.8, 3, 4, 4.88, 5, 5.5 & 6
100	20.5	5.0	-Do.-
125	26.4	6.6	-Do.-
150	33.2	8.2	-Do.-
200	48.1	11.4	-Do.-
250	65.0	14.7	-Do.-
300	84.0	18.6	-Do.-

(See Figure 1302.6)

Note 1 :—'L' depends upon manufacturer's facilities.

Note 2 :—The method of screwing and the exact form of thread shall be left to the discretion of the manufacturer as the flanges are never removed after screwing on the barrels of the pipes.

Table 1302-K

Flanged Pipes Centrifugally cast with Screwed flanges–Class 'B'

Nominal diametre (DN) mm.	*Weight for one meter of barrel (approx.) kg.*	*Weight for one flange (approx.) kg.*	*Working length 'L' m.*
80	17.3	4.3	2, 2.8, 3, 4, 4.88, 5, 5.5 & 6
100	22.0	5.0	-Do.-
125	28.7	6.6	-Do.-
150	35.9	8.2	-Do.-
200	52.1	11.4	-Do.-
250	70.6	14.7	-Do.-
300	91.4	18.6	-Do.-

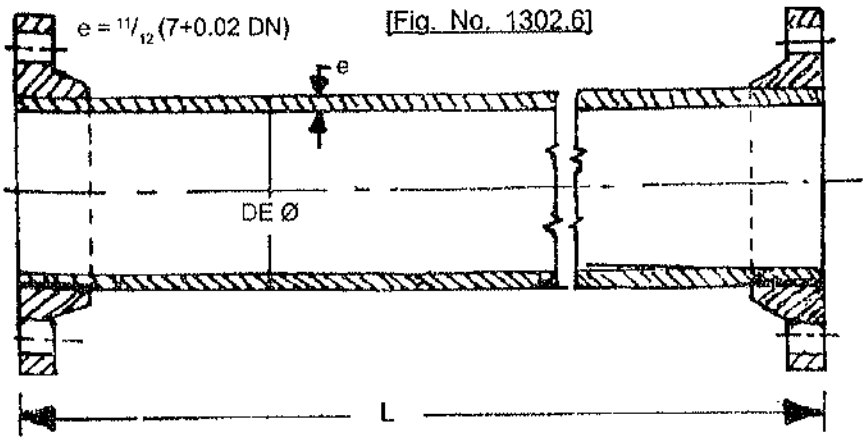
(See Figure 1302.6)

Note 1 :—'L' depends upon manufacturer's facilities.

Note 2 :—The method of screwing and the exact form of thread shall be left to the discretion of the manufacturer as the flanges are never removed after screwing on the barrels of the pipes.

FLANGED PIPES CENTRIFUGALLY CAST WITH SCREWED FLANGES CLASS–A

[Fig. No. 1302.6]



1302.4. Coating :—Each pipe shall be coated as per relevant Indian Standard Specifications.

1302.5. The inside coating of pipes and fittings shall not contain any constituents soluble in water or any ingredient which could impart any taste or odour whatsoever to the potable water after sterilisation and suitable washing of the mains.

1302.6. Marking :— All pipes and fittings shall be clearly marked with the manufacturer's name trade mark and date of manufacture.

1302.7. Measurement and Rate shall be same as per SS : 1301.

Specification No. 1303

Galvanised Mild Steel Pipes and Fittings

1303.1. General :—The pipes shall be galvanized, but welded and seamless, screwed and socketed, and plain end mild steel tubes conforming to the requirements of IS : 1239-(Part-1) 1968.

1303.2. Terminology :

1303.2.1. *Exact length of screwed and socketed pipe* :—The length of the pipe exclusive of the socket.

1303.2.2. *Length of screwed and socketed pipe* :—The length of the pipe inclusive of the socket.

1303.2.3. *Nominal bore* :—A size reference denoting the approximate bore of the pipe. For each size of pipe, the outside diameter is fixed by the corresponding

screw thread dimensions of IS : 554-1964 and therefore the actual bore of each size of pipe will vary according to the thickness.

1303.2.4. *Random length* :—Normal manufacturing lengths which may vary over a range of several metres.

1303.2.5. *Socket* :—The screwed coupling utilised in jointing the pipes together (The 'socket' is synonymous with the term "coupler" or "coupling").

1303.2.6. *Pipe* :—A long, hollow, open ended object of circular or other cross section. The term is synonymous with the term "Tube".

1303.3. Designation :

1303.3.1. Mild steel galvanized pipes covered by this standard specification shall be designated by their nominal bore and shall be further classified as—

(1) 'Light',

(2) 'Medium', and

(3) 'Heavy duty' depending on wall thickness.

Unless otherwise specified, mild steel galvanized pipes used in plumbing system shall be of medium class conforming to IS : 1239-(Part-I) 1968.

1303.3.2. Mild steel galvanised socket (Coupler) shall be designated by the respective nominal bore of the pipe for which it is intended.

1303.4. Supply of material :—General requirements relating to the supply of mild steel galvanised pipes and sockets shall conform to IS : 1387-1967. 'General requirements for the supply of Metallurgical Materials'.

1303.5. Manufacture :

1303.5.1. Galvanized mild steel pipes shall be made from tested quality steel manufactured by any approved process.

1303.5.2. Steel pipes and sockets, shall be manufactured by one of the following processes :

(a) Hot finished seamless (H.F.S.),

(b) Hot finished welded (H.F.W.).

1303.5.3. The pipes shall be either welded or seamless as agreed to between the Executive Engineer and the supplier.

1303.5.4. If any other process is employed in the manufacture, prior approval of Executive Engineer shall be obtained.

1303.6. Lengths :

1303.6.1. *Random lengths* :—Tubes shall be supplied in random lengths from 4 to 7 metres.

1303.6.2. *Exact lengths* :—Where exact lengths are specified either for screwed and socketed pipes, or for plain end pipes, each pipe shall be within–6mm./ –0mm of the specified length.

1303.7. Joints :

1303.7.1. All screwed pipes and sockets shall be supplied with pipe threads conforming to IS : 554-1964.

1303.7.2. Unless specified otherwise, pipes shall be supplied screwed with taper threads and sockets with parallel threads.

1303.7.3. Each pipe shall be supplied with one socket. The ends of the sockets shall be chamfered internally to prevent damage to the leading thread.

1303.8. Galvanising :

1303.8.1. The zinc coating on the steel tubes shall be done in accordance with IS : 473-1968 " Hot dip zinc coating on steel tubes where galvanizing is required to be done".

1303.8.2. Pipes which are to be screwed shall be galvanised before screwing.

1303.9. Dimensions and weights :—The dimensions and weights of the "Medium" Class pipe, shall be in accordance with Table 1303-A, subject to the tolerances permitted vide clause 1303.10.

Table No. 1301-A

Dimensions of Barrels and Sockets (All dimensions in Milli-metres)

Nominal bore	*Dimensions of pipes (outside diameter)*		*Thick-ness*	*Dimensions of ordinary sockets*		*Weight of pipe plain End*
	Max.	*Min*		*Appro. outside dia.Min.*	*length Min.*	
(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*
mm.	mm.	mm.	mm.	mm.	mm.	kg./m.
10	17.5	16.7	2.35	22	28	0.852
15	21.8	21.0	2.65	27	37	1.22
20	27.3	26.5	2.65	32.5	39	1.58
25	34.2	33.3	3.25	39.5	46	2.44
32	42.9	42.0	3.25	49	51	3.14
40	48.8	47.9	3.25	56	51	3.61
50	60.8	59.7	3.65	68	60	5.10
65	76.6	75.3	3.65	84	69	6.51
80	98.9	88.0	4.05	98	75	8.47
100	115.0	113.1	4.50	124	87	12.1
125	140.8	138.5	4.85	151	96	16.2
150	166.5	163.9	4.85	178	96	19.2

1303.10. Tolerances on thicknesses and weights :

1303.10.1. The following manufacturing tolerances shall be permitted on open pipes and sockets in addition to those indicated in the table above.

(A) Tubes (Pipes) :

(I) *Thickness* :

(i)	Medium pipes butt welded	+ Not limited – 10 percent
(ii)	Medium pipes seamless	+ Not limited – 12.5 percent

(II) *Weight* :

(i)	For single pipe	+ 10 percent – 8 percent
(ii)	For quantities of less than 150 m. of one size	+ 10 percent – 8 percent
(iii)	For quantities of 150 m. and above one size.	+ or – 4 percent

(B) Sockets :

Out-side diameter	+ or – 2.5 percent

1303.11. Workmanship :

1303.11.1. The pipes shall be cleanly finished and reasonably free from scale. They shall be reasonably straight, free from cracks, surface flaws, laminations and other defects. The screw threads of screwed pipes and sockets shall be clean and well cut. The ends shall be cut cleanly and square with the axis of the pipe.

1303.12. Tests :

1303.12.1. *Hydraulic test* :

1303.12.1.1. Each pipe shall be hydraulically tested at the manufacturer's works either before or after galvanising.

1303.12.1.2. Unless otherwise agreed to, each pipe shall withstand a test pressure of 50 kg. f/cm^2 without showing defects of any kind. The pressure shall be applied by approved means and maintained sufficiently long for proof and inspection. The testing apparatus shall be fitted with an accurate pressure indicator, and provision shall be made for its accuracy to be verified by the Executive Engineer if required.

1303.12.2. *Tests on finished pipes and sockets* :

1303.12.2.1. The pipes and sockets shall withstand the following tests that shall be conducted by the manufacturer on finished pipes and sockets as specified in IS : 1239 (Part-I)-1968 on samples of pipes selected in accordance with IS : 4711-1968.

(a) Bend test on pipes upto and including 50mm.. nominal bore.

(b) Flattening test on pipes above 50mm. nominal bore.

(c) Expansion test on socket.

1303.13. Marking :

1303.13.1. The different classes of pipes shall be distinguished by colour bands which shall be applied as follows before the pipes leave the manufacturer's work :

'Light' pipes	–	Yellow.
'Medium' Pipes	–	Blue.
'Heavy' pipes	–	Red.

1303.13.2. All long random lengths shall have two 75mm. bands, one near each end, all other lengths each have one 75mm. band.

1303.14. Protection and packing :

1303.14.1. Where pipes are bundled for transport, all quantities of pipes shall be packed in accordance with IS : 4740-1968 ("Code of Practice for packaging of steel tubes").

1303.15. Pipe fittings :

1303.15.1. The fitting shall be malleable cast iron or mild steel tubes complying with all the appropriate requirements given above or as specified. The fittings shall be designated by the respective nominal bores of the pipes for which they are intended. Where fittings are required to be galvanised, the zinc coating on the fittings shall be in accordance with IS : 4736-1968.

The fittings shall have screwed threads at the ends conforming to the requirements of IS : 554-1964. Female threads on fittings shall be parallel and male threads (except on running nipples and collars of union) shall be tapered.

1303.16. Measurement and rate shall be same as per SS : 1301.

Specification No. 1304

Concrete and Pre-stressed Concrete Pipes and Collars

1304.1. General :—Concrete pipes shall conform to IS : 458-1971.

Prestressed concrete pipes shall conform to IS : 784-1959.

1304.2. Classification and test pressure :

1304.2.1. Concrete pipes shall be classified as under.

Class		*Description*
NP1	—	Unreinforced concrete non-pressure pipe.
NP2	—	Reinforced concrete light duty non-pressure pipes.
NP3	—	Reinforced concrete, Heavy-duty non-pressure pipes.

P1 — Reinforced concrete pressure pipe tested to a hydrostatic pressure of 20 metres.

P2 — Reinforced concrete pressure pipes tested to hydrostatic pressure of 40 metres.

P3 — Reinforced concrete pressure pipe tested to hydrostatic pressure of 60 metres.

1304.2.2. Un-reinforced and reinforced concrete non-pressure pipes shall be capable of withstanding a test pressure of 0.7 kg./cm^2 (7 metres head).

1304.2.3. Pre-stressed concrete pipe shall be designed and tested to a pressure stipulated in the tender specifications.

1304.3. Nominal sizes, dimension and strength requirement :

1304.3.1. The nominal internal dia. of pipes and dimension of barrels and collars of concrete pipes and strength requirements shall be as given in the following tables :

Table 1304-A

Design and Strength test Requirements of concrete pipes, Class NPI— Unreinforced Non-Pressure Pipes (Clause 1304.3.1)

Barrel dimensions				*Collar dimensions*		*Strength test requirements*	
Internal diameter of pipes	*Length*	*Min. thick-nes*	*Min. caul-king space*	*Thick-ness*	*Min. length of collar*	*Three edge bearing test ultimate load*	*Sand bearing test ultimate load*
(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*
mm.	m.	mm.	mm.	mm.	mm.	m. kg./linear	m. kg./linear
80	1	25	13	25	150	—	—
100	1	25	13	25	180	1,560	2,340
150	1	25	13	25	150	1,560	2,340
250	1	25	13	25	150	1,670	2,505
300	1	30	16	30	150	1,790	2,685
350	1	32	16	32	150	1,880	2,820
400	1	32	16	32	150	2,020	3,030
450	1	35	19	35	200	2,230	3,345

Table 1304-B

Design and Strength test requirements of concrete pipes of Class NP2 Reinforced Concrete, Light Duty, Non-Pressure Pipes (Clause 1304.3.1)

Internal diameter of pipes	*Barrel dimensions*		*Collar dimensions*		
	Length	*Min. thickness*	*Min. caulking space*	*Min. thick-ness*	*Min. length*
(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*
80	2.0	25	13	25	150
100	2.0	25	13	25	150
150	2.0	25	13	25	150
250	2.0	25	13	25	150
300	2.0 or 2.5 or 3.0	30	16	30	150
350	2.0 or 2.5 or 3.0	32	16	32	150
400	2.0 or 2.5 or 3.0	32	16	32	150
450	2.5 or 3.0	35	19	35	200
500	2.5 or 3.0	35	19	35	200
600	2.5 or 3.0	40	19	40	200
700	2.5 or 3.0	40	19	40	200
800	2.5 or 3.0	45	19	45	200
900	2.5 or 3.0	50	19	50	200
1000	2.5 or 3.0	55	19	55	200
1100	2.5 or 3.0	60	19	60	200
1200	2.5 or 3.0	65	19	65	200
1400	2.5 or 3.0	75	19	75	200
1600	2.5 or 3.0	80	19	80	200
1800	2.5 or 3.0	90	19	90	200

Reinforcement			*Strength test requirements*			
Longi-tudinal	*Spiral*		*Three edge Bearing test*		*Sand bearing test*	
	A	*B*				
Mild Steel at 1265 kg./cm²	*cold drawn steel wire at 1400 kg./cm²*	*Soft grade mild steel wire at 840 kg./cm²*	*Load to produce 0.25mm. crack*	*Ultimate load*	*Load to produce 0.25mm. crack*	*Ultimate load*
(7)	*(8)*	*(9)*	*(10)*	*(11)*	*(12)*	*(13)*
Kg./ linear m	*Kg./ linear m*	*Kg./ linear m*	*Kg./ linear m*	*Kg./ linear m*	*Kg./ linear m*	*Kg./ linear m*
0.863	0.083	0.138	1040	1560	1560	2340
0.863	0.166	0.277	1040	1560	1560	2340

(7)	(8)	(9)	(10)	(11)	(12)	(13)
0.863	0.219	0.365	1040	1560	1560	2340
0.863	0.710	—	1140	1710	1710	2565
1.00	1.295	—	1200	1800	1800	2700
1.00	1.750	—	1260	1890	1890	2835
1.00	2.250	—	1360	2040	2040	3060
1.00	2.750	—	1480	2220	2220	3330
1.25	3.220	—	1660	2490	2490	3735
1.25	4.90	—	1900	2850	2850	4275
1.78	6.05	—	2100	3150	3150	4725
1.78	9.10	—	2300	3450	3450	5170
1.78	11.35	—	2500	3750	3750	5625
2.50	13.50	—	2680	4020	4020	6030
2.50	16.30	—	2780	4170	4170	6255
2.50	18.20	—	2880	4320	4320	6480
3.36	22.60	—	2980	4470	4470	6705
3.36	28.30	—	2980	4470	4470	6705
3.36	36.00	—	2980	4470	4470	6705

Note (1) :—If steel wires are used as longitudinal of reinforcement, the weight specified in col. 7 shall be modified by a factor 1265/1400

Note (2) :—If mild steel is used for spiral reinforcement, the weight specified under col. 8 shall be increased to 1400/1265.

Table 1304-C

Design and Strength test requirements of concrete pipes of Class NP3 Reinforced Concrete, heavy duty, Non-Pressure Pipes (Clause 1304.3.1)

Internal diameter of pipes	*Barrel dimensions*		*Reinforcement*	
	Length	*Min. thickness*	*Longitudinal mild steel at 1.265 kg./cm²*	*Spiral*
				Cold drawn steel wire 1400kg./cm²
(1) *mm.*	*(2)* *mm.*	*(3)* *mm.*	*(4)* *mm.*	*(5)* *mm.*
350	2.5 or 3.0	75	1.24	7.25
400	2.5 or 3.0	75	2.15	8.25
450	2.5 or 3.0	75	2.40	9.00
500	2.5 or 3.0	75	2.45	10.50

(1) *mm.*	*(2)* *mm.*	*(3)* *mm.*	*(4)* *mm.*	*(5)* *mm.*
600	2.5 or 3.0	80	2.45	14.50
700	2.5 or 3.0	80	2.05	23.75
800	2.5 or 3.0	90	3.60	26.50
900	2.5 or 3.0	100	4.35	32.75
1000	2.5 or 3.0	100	5.80	44.00
1100	2.5 or 3.0	115	7.40	52.50
1200	2.5 or 3.0	115	7.60	63.75

Strength Test requirements

Three edge bearing test		*Sand bearing test*	
Load to produce 0.25mm. crack (6)	*Ultimate load (7)*	*Load to produce 0.25mm. crack (8)*	*Ultimate load (9)*
kg./linear m.	*kg./linear m.*	*kg./linear m.*	*kg./linear m.*
3040	4560	4560	6840
3460	5190	5190	7785
3760	5640	5640	8460
4160	6240	6240	9360
4720	7080	7080	10620
5320	7980	7980	11970
6060	9090	9090	13120
6760	10140	10140	15210
7400	11100	11100	16650
8200	12300	12300	18450
9000	13500	13500	20250

Note (1) :—Heavy duty non-pressure pipes shall normally have flush joints. Collar joints may, however, be permitted in which case the design and dimensions of the collar shall be the same as for corresponding NP2 pipes.

Note (2) :—If steel wires are used as longitudinal of reinforcement, the weight specified in col. 4 shall be modified by a factor 1265/1400.

Note (3) :—If mild steel is used for spiral reinforcement, the weight specified under col. 5 shall be increased to 1400/1265.

Table 1304-D

Design and Strength test Requirements of concrete pipes, Class PI—Reinforced concrete pressure pipes safe for 2.0kg./cm² pressure test (Clause 1304.3.1)

Internal diameter of pipes	*Barrel dimensions*		*Collar dimensions*		
	Length	*Min. thickness*	*Min. caulking space*	*Min. thick-ness*	*Min. length*
(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*
mm.	*m.*	*mm.*	*mm.*	*mm.*	*mm.*
80	2.0	25	13	25	150
100	2.0	25	13	25	150
150	2.0	25	13	25	150
250	2.0	25	13	25	150
300	2.0 or 2.5 or 3.0	30	16	30	150
350	2.0 or 2.5 or 3.0	32	16	32	150
400	2.5 or 3.0	32	16	32	150
450	2.5 or 3.0	35	19	35	200
500	2.5 or 3.0	35	19	35	200
600	2.5 or 3.0	40	19	40	200
700	2.5 or 3.0	40	19	40	200
800	2.5 or 3.0	45	19	45	200
900	2.5 or 3.0	50	19	50	200
1000	2.5 or 3.0	55	19	55	200
1100	2.5 or 3.0	60	19	60	200
1200	2.5 or 3.0	65	19	65	200

Reinforcement		
Longitudinal steel at permissible stress of at 1265 kg./cm²	*Spirial*	
	Hard drawn steel wire at permissible stress of 1400 kg./cm²	*Soft grade mild steel wire at permissible stress of 840 kg./cm²*
(7)	*(8)*	*(9)*
Kg./linear m.	*Kg./linear m.*	*Kg./linear m.*
0.863	0.213	0.355
0.863	0.327	0.545
0.863	0.640	1.067

(7) *Kg./linear m.*	*(8)* *Kg./linear m.*	*(9)* *Kg./linear m.*
0.863	1.575	—
1.00	2.250	—
1.00	2.925	—
1.00	3.800	—
1.00	4.750	—
1.25	5.75	—
1.25	8.15	—
1.78	11.20	—
1.78	14.50	—
1.78	18.00	—
2.50	22.50	—
2.50	27.50	—
2.50	32.50	—
3.36	—	—

Note (1) :—Strength requirement for pressure pipes shall be the same as for NP2 pipes.

Note (2) :—If steel wires are used as longitudinal of reinforcement, the weight specified in col. 7 shall be modified by a factor 1265/1400

Note (3) :—If mild steel is used for spiral reinforcement, the weight specified under col. 8 shall be increased to 1400/1265.

Table 1304-E

Design and Strength test Requirements of pipes, Class P2— Reinforced concrete pressure pipes safe for 4.0kg./cm² pressure test (Clause 1304.3.1)

Internal diameter of pipes	*Barrel dimensions*		*Collar dimensions*		
	Length	*Min. thickness*	*Min. caulking space*	*Min. thick-ness*	*Min. length*
(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*
80	2.0	25	13	25	150
100	2.0	25	13	25	150
150	2.0	25	13	25	150
250	2.0	30	13	30	150

(1)	(2)	(3)	(4)	(5)	(6)
300	2.0 or 2.5 or 3.0	40	16	40	150
350	2.0 or 2.5 or 3.0	45	16	45	150
400	2.5 or 3.0	50	16	50	150
450	2.5 or 3.0	50	19	50	200
500	2.5 or 3.0	55	19	55	200
600	2.5 or 3.0	65	19	65	200

Reinforcement		
Longitudinal mild steel at permissible stress of at 1265 kg./cm²	*Spirial*	
	Hard drawn steel wire at permissible stress of at 1400 kg./cm²	*Soft grade mild steel wire at permissible stress of 840 kg./cm²*
(7)	(8)	(9)
Kg./linear m.	*Kg./linear m.*	*Kg./linear m.*
0.863	0.475	0.972
0.863	0.650	1.083
0.863	1.25	2.08
0.863	2.95	—
1.00	4.65	—
1.00	6.30	—
1.00	8.07	—
1.00	10.10	—
1.25	12.40	—
1.25	18.00	—

Note (1) :—Strength requirement for pressure pipes shall be the same as for NP2 pipes.

Note (2) :—If steel wires are used as longitudinal of reinforcement, the weight specified in col. 7 shall be modified by a factor 1265/1400.

Note (3) :—If mild steel is used for spiral reinforcement, the weight specified under col. 8 shall be increased to 1400/1265.

Table 1304-F

Design and Strength test Requirements of pipes, Class P3— Reinforced concrete pressure pipes safe for 6.0kg./cm² pressure test (Clause 1304.3.1)

Internal diameter of pipes	*Barrel dimensions*		*Collar dimensions*		
	Length	*Min. thickness*	*Min. caulking space*	*Min. thick-ness*	*Min. length*
(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*
80	2.0	25	13	25	150
100	2.0	25	13	25	150
150	2.0	25	13	25	150
250	2.0	35	13	35	150
300	2.0 or 2.5 or 3.0	45	16	45	150
350	2.0 or 2.5 or 3.0	55	16	55	150
400	2.0 or 2.5 or 3.0	60	16	60	150

Reinforcement		
Longitudinal mild steel 1265 kg./cm²	*Spirial*	
	Hard drawn steel wire at 1400 kg./cm²	*Soft grade mild steel wire at 840 kg./cm²*
(7)	*(8)*	*(9)*
Kg./linear m.	*Kg./linear m.*	*Kg./linear m.*
0.863	0.600	1.000
0.863	0.863	1.438
0.863	1.67	2.78
0.863	4.62	—
1.00	6.60	—
1.00	8.60	—
1.00	11.50	—

Note (1) :—Strength requirement for pressure pipes shall be the same as for NP2 pipes.

Note (2) :—If steel wires are used as longitudinal of reinforcement, the weight specified in col. 7 shall be modified by a factor 1265/1400.

Note (3) :—If mild steel is used for spiral reinforcement, the weight specified under col. 8 shall be increased to 1400/1265.

1304.4. Workmanship and finish :—

1304.4.1. The pipes shall be straight and free from crack except craze cracks. Ends of pipe shall be square with their longitudinal axis so that when placed in straight line in the trench no gap between the two faces required to be in contact shall exceed 3mm. in pipe upto 600mm. dia. and 6mm. in pipe larger than 600mm. in dia.

The outside and the inside surface pipe shall be smooth, dense and hard. The pipe shall be free from local dents or bulges greater than 3mm. in depth and extending over a length in any direction greater than twice the thickness of barrel.

1304.4.2. *Deviations from straight* :—The deviations from straight in any pipe throughout its effective length tested by means of a rigid straight edge parallel to longitudinal axis of pipes shall not exceed for all diameters, 3mm. for every metre run.

1304.5. Tests :—

1304.5.1. The specimens of concrete pipe selected in accordance with clause 9.1. of IS : 458-1971 and subjected to the Hydrostatic pressure test, three-edge of sand bearing test and Absorptions test as described in IS : 458-1971 shall withstand the test pressures and strength test and absorption test requirements stipulated in IS : 458 - 1971 read with IS : 1357-1966.

1304.5.2. The specimens of pre-stressed concrete pipes selected in accordance with clause 7.1 of IS : 784-1959 and subjected to hydrostatic pressure test, three-edges bearing test or sand bearing test and absorption test in accordance with IS : 458-1971 shall withstand the specified test pressure stipulated in tender specification and the strength test requirements and absorption test requirements as stipulated in IS : 784-1959 read with IS : 1357.

1304.6. Measurement and rate shall be same as per SS : 1301.

Specification No. 1305

Asbestos Cement Pressure Pipes and Fittings

1305.1. General :— Asbestos cement pressure pipes shall conform to IS : 1592-1970. The test pressure for water-tightness for various classes of pipes shall be as given in the table below :

Classification	*Test pressure for water tightness*
Class 5	5 kgf/cm^2
Class 10	10 kgf/cm^2
Class 15	15 kgf/cm^2
Class 20	20 kgf/cm^2
Class 25	25 kgf/cm^2

1305.2. Dimensions :— The nominal diametre of pipes shall be as follows :—50mm., 65mm., 80mm., 100mm., 125mm., 200mm., 250mm., 300mm., 350mm., 400mm., 500mm., 600mm., and 900mm.

The nominal effective lengths shall not be less than 3m. or 4m. for pipes of nominal diametres 100mm. or less and 4m. for pipes of nominal diameters greater than 100mm.

The nominal effective lengths shall preferably be in multiples of 0.05m.

1305.3. Asbestos cement pipe fittings :— The specifications, dimensions, sizes, tolerances and test etc., of specials shall conform to IS : 5531-1969. "Indian Standard Specification for Cast Iron Specials for use with Asbestos Cement pressure pipes."

1305.4. Marking :— All pipes and fittings shall be clearly marked with the manufacturer's name/trade mark/date of manufacture.

1305.5. Measurement and rate shall be same as per SS : 1301.

Specification No. 1306

Unplasticized (Rigid) P.V.C. Pipes and Fittings for Potable Water Supplies

1306.1. General :—Unplasticized P.V.C. pipes shall conform to IS : 4985-1968.

1306.2. Classification of pipes :—

1306.2.1. The pipes shall be suitable for the following maximum working pressures [(2.5, 4.0, 6.0 and 10.0) kgf/cm².)]

1306.3. Dimension of pipes for various working pressures :

1306.3.1. The outside diametres, the tolerance on outside diameters and wall thickness of pipes shall be as given in Table 1306-A.

Table 1306-A

Dimensions of unplasticized PVC Pipes for various working pressures

(All dimensions in millimetres)

Outside diametre	Tolerance on outside dia	*Wall thickness for working pressure*							
		2.5 Kgf./cm²		4.0 Kgf./cm²		6.0 Kgf./cm²		10.0 Kgf./cm²	
		Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
16	+0.3	—	—	—	—	—	—	1.1	1.5
20	+0.3	—	—	—	—	—	—	1.1	1.5
25	+0.3	—	—	—	—	—	—	1.4	1.8
32	+0.3	—	—	—	—	—	—	1.8	2.2

40	+0.3	—	—	—	—	1.4	1.8	2.2	2.7
50	+0.3	—	—	1.2	1.6	1.7	2.1	2.8	3.3
63	+0.3	—	—	1.5	1.9	2.2	2.7	3.5	4.1
75	+0.3	—	—	1.8	2.2	2.6	3.1	4.2	4.9
90	+0.3	1.3	1.7	2.1	2.6	3.1.	3.7	5.0	5.7
110	+0.4	1.6	2.0	2.5	3.0	3.7	4.3	6.1	7.0
125	+0.4	1.8	2.2	2.9	3.4	4.3	5.0	6.9	7.7
140	+0.5	2.0	2.4	3.2	3.8	4.8	5.5.	—	—
160	+0.5	2.3	2.8	3.7	4.3	5.4	6.2	—	—
180	+0.6	2.6	3.1	4.2	4.6	6.1	7.0	—	—
200	+0.6	2.9	3.4	4.6	5.3	6.8	7.7	—	—
225	+0.7	3.3	3.9	5.2	6.0	7.6	8.6	—	—
250	+0.8	3.6	4.2	5.7	6.5	8.5	9.6	—	—
280	+0.9	4.1	4.8	6.4	7.3	9.5	10.7	—	—
315	+1.0	4.6	5.3	7.2	8.2	10.7	12.0	—	—

Note :—The wall thickness of pipes are based on a safe working stress of 86kgf./cm^2 at 27°C and working pressure get reduced at higher temperature.

Note :—The pipes shall be supplied in straight lengths of 3, 5 and 6 metres. The pipes may be supplied in other lengths where so required by the Executive Engineer.

1306.4. Marking :

1306.4.1. The pipes and fittings shall be clearly marked with the manufacturer's name/trade mark/date of manufacturer.

1306.4.2. The pipes shall be marked in colour as indicated below for different classes of pipes.

Class of pipe	*Colour*
.5 kgf/cm^2	Red
4.0 kgf/cm^2	Blue
6.0 kgf/cm^2	Green
10.0 kgf/cm^2	Brown

1306.5. Measurement and rate shall be same as per SS : 1301.

Specification No. 1307

Polyethylene Pipe and Fittings for Portable Water Supplies

1307.1. General :—

1307.1.1. The requirements for low density polyethylene pipes for potable water supplies shall conform to IS : 3076-1968.

1307.1.2. The requirements for high density polyethylene pipes for potable water supplies shall conform to IS : 4984-1972.

1307.2. Classification of pipes :—The low density and high density polyethylene pipes are classified for pressure ratings (working pressures at 27°C) as follows :—

(a) 2.5. kg f/cm²
(b) 4.0. kg f/cm²
(c) 6.0. kg f/cm²
(d) 10.0 kg f/cm²

1307.2.1. The low density polyethylene pipes shall be used for temperatures ranging between 40°C and 38°C. The high density polyethylene pipes shall be used for temperature ranging between 40°C and 45°C.

1307.2.2. The density of the base polyethylene shall not be greater than 0.93g/ml. at 27°C for low density polyethylene pipes and that for the high density polyethylene pipes shall not be greater than 0.94 gml. at 27°C.

1307.2.3. The maximum working stress for the material at 20°C in a pipe form is 32 kg. f/cm² for low density polyethylene pipes and 50 kg. f/cm² for high density polyethylene pipes.

1307.3. Composition :—The requirements for the composition of the low density polyethylene pipes shall be in accordance with IS : 3076-1968 and that for the high density polyethylene pipes shall be in accordance with IS : 4984-1972.

1307.4. Dimensions :—The outside diametre shall be the average of two measurements taken at right angles. The wall thickness shall be measured with a ball ended micrometre. The resulting dimension shall be expressed correct to 0.01mm..

1307.4.1. Outside diametres, tolerances and wall thicknesses of low density polyethylene pipes shall be as given in Table 1307-A.

Table 1307-A

Dimensions of low density polyethylene pipes

(All dimensions in millimetres)

Outside diametre	Tolerance on outside dia	*Wall thickness for working pressure*							
		2.5 Kgf./cm²		4.0 Kgf./cm²		6.0 Kgf./cm²		10.0 Kgf./cm²	
		Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
10	+0.3	—	—	—	—	—	—	—	—
12	+0.3	—	—	—	—	—	—	2.0	2.4
16	+0.3	—	—	—	—	—	—	2.7	3.2
20	+0.3	—	—	—	—	2.2	2.7	3.3	3.9
25	+0.3	—	—	—	—	2.7	3.2	4.2	4.9
32	+0.3	—	—	2.4	2.9	3.4	4.0	5.3	6.1

40	+0.4	1.9	2.3	3.0	3.5	4.3	5.0	6.6	7.5
50	+0.5	2.4	2.9	3.7	4.3	5.3	6.1	8.3	9.4
63	+0.6	3.0	3.5	4.7	5.4	6.7	7.6	10.4	11.7
75	+0.7	3.6	4.2	5.6	6.3	8.0	9.0	—	—
90	+0.8	4.3	5.0	6.6	7.5	9.6	10.8	—	—
110	+1.0	5.2	6.0	8.1	9.2	11.7	13.1	—	—
125	+1.2	5.9	6.7	9.2	10.4	—	—	—	—
140	+1.3	6.6	7.5	10.3	11.6	—	—	—	—

Note :—(1) Reference shall be made to the Indian Standard Code of Practice for use of plastic pipes for the use of pipes of 2.5 kgf/cm^2 pressure rating.

(2) Wall thickness of pipes are based on a safe working stress of 25.28 kgf/cm^2 at 27°C and working pressures get reduced at higher temperatures.

(3) The safe working stress at 20°C is 32 kgf/cm^2 and for every degree rise of temperature, it is a useful guide to assume a reduction of safe working stress of 3 per cent of the above value at 20°C upto 38°C.

(4) Pipes shall be supplied in coils of nominal lenghts of 20, 50, 100, 150 and 200m. unless otherwise specified each coil shall contain not less than the specified length.

(5) When pipe is supplied in coils, the minimum internal diametre of the coil shall conform to the following :

Nominal size mm.	*Minimum internal dia of coil cm.*
10	110
12	110
20	110
25	120
32	150
40	180
50	200
Above 50	As agreed to between the Executive Engineer and the supplier

The ends shall be plugged or covered.

If at the request of the Executive Engineer and for the purpose of shipment, the pipe is coiled to diametres smaller than those recommended the material shall be recoiled to the larger diametres immediately upon receipt at the point of delivery.

1307.4.2. Outside diametres, tolerances and wall thicknesses of high density polyethylene pipes shall be as given in Table 1307-B.

Table 1307-B

Dimensions of high density polyethylene pipes
(All dimensions in millimetres)

Outside diameter	Tolerance on outside dia	*Wall thickness for working pressure* 2.5 Kgf./cm²		4.0 Kgf./cm²		6.0 Kgf./cm²		10.0 Kgf./cm²	
		Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
10	+0.3	—	—	—	—	—	—	—	—
12	+0.3	—	—	—	—	—	—	—	—
16	+0.3	—	—	—	—	—	—	—	—
20	+0.3	—	—	—	—	—	—	2.3	2.8
25	+0.3	—	—	—	—	—	—	2.8	3.3
32	+0.3	—	—	—	—	2.3	.8	3.6	4.3
40	+0.4	—	—	2.0	2.4	2.9	3.4	4.5	5.2
50	+0.5	—	—	2.4	2.9	3.6	4.2	5.6	5.1
63	+0.6	2.0	2.4	3.0	3.5	4.0	5.2	7.1	8.1
75	+0.7	2.3	2.8	3.6	4.3	5.3	6.1	8.4	9.5
90	+0.8	2.8	3.3	4.4	5.1	6.4	7.3	10.1	11.4
110	+1.0	3.4	4.0	5.0	5.8	7.8	8.8	12.4	13.9
125	+1.2	3.9	4.5	6.0	6.8	8.9	10.0	14.1	15.8
140	+1.3	4.3	5.0	6.8	7.7	9.9	11.1	15.8	17.6
160	+1.5	4.9	5.6	7.8	8.8	11.3	12.7	18.0	20.0
180	+1.7	5.6	6.4	8.7	9.8	12.8	14.3	20.3	22.6
200	+1.8	6.2	7.1	9.7	10.9	14.2	15.9	22.5	25.0
225	+2.1	6.9	7.8	10.9	12.2	15.9	17.7	25.4	28.2
250	+2.3	7.7	8.8	12.1	13.60	17.7	19.7	28.2	31.3
280	+2.6	8.6	9.7	13.5	15.1	19.8	22.0	31.5	34.9
315	+2.9	9.7	10.8	15.2	17.0	22.3	24.8	35.4	39.2
355	+3.2	10.9	12.2	17.1	19.1	25.1	27.9	39.9	44.1
400	+3.6	12.3	13.8	19.3	21.5	28.3	32.4	45.0	49.7
450	+4.1	13.8	15.4	21.7	24.1	31.8	35.2	50.5	55.8
500	+4.5	15.4	17.2	24.1	26.8	35.3	39.1	56.3	62.2

Note :—(1) Reference shall be made to the "Code of practice for use of plastic pipes" for the use of pipes of 2.5 kgs/cm² pressure rating.

(2) The wall thickness of pipes are based on a safe working stress of 39.5 kgf/cm² at 27°C and working pressures get reduced at higher temperatures. See Table 1307.C.

(3) The pipe shall be supplied either as coils with a minimum inner diametre of 25 times the outer diameter of the pipe or in straight length of 5 to 20 metres. The pipes may also be supplied in other lengths where so agreed to between the supplier and the Executive Engineer. The end shall be cut at right

angles to the pipe axis and shall be plugged or covered. The length shall not be less than the specified length.

Table 1307-C

Maximum admissible working pressures for water temperatures upto 45°C for high density polyethylene pipes

(Note 2 of Table 1307-B)

	Water temperature between					
	0-20°C	20-25°C	25-30°C	30-35°C	35-40°C	40-45°C
Maximum admissible working pressure equal to the nominal pressure (Multiplication factor for corresponding working pressures given in Table 1307.B)	1.58	1.26	1.00	0.79	0.63	0.5

1307.5. Finish :—The internal and external surfaces of pipes shall be smooth; clean and reasonably free from grooving and other defects.

1307.6. Tests :—(1) The test requirement for the low density polyethylene pipe shall be in accordance with IS : 3076-1968.

The test requirements for the high density polyethylene pipe shall be in accordance with IS : 4984-1972.

(2) The pipe shall be marked in colour as indicated below or different classes of pipes.

1307.7. Marking (1) :—Each pipe shall be indelibly marked at intervals of not more than 5m. The marking shall show the manufacture's name or trade mark if any.

Class of pipes	*Colour*	*Remarks*
2.5 kgf/cm²	Red for low density and also for high density pipes	
4.0 kgf/cm²	Blue	Do.
6.0 kgf/cm²	Green	Do.
10.0 kgf/cm²	Brown/Yellow	Do.

1307.8. Fittings :—Fittings for polyethylene low density and high density pipes of potable water supply shall be in accordance with the Indian Standard Specifications issued from time to time.

1307.9. Measurement and rate shall be same as per SS : 1301.

Specification No. 1308

Cast Iron Manhole Covers and Frames, intended for use in Drainage Works

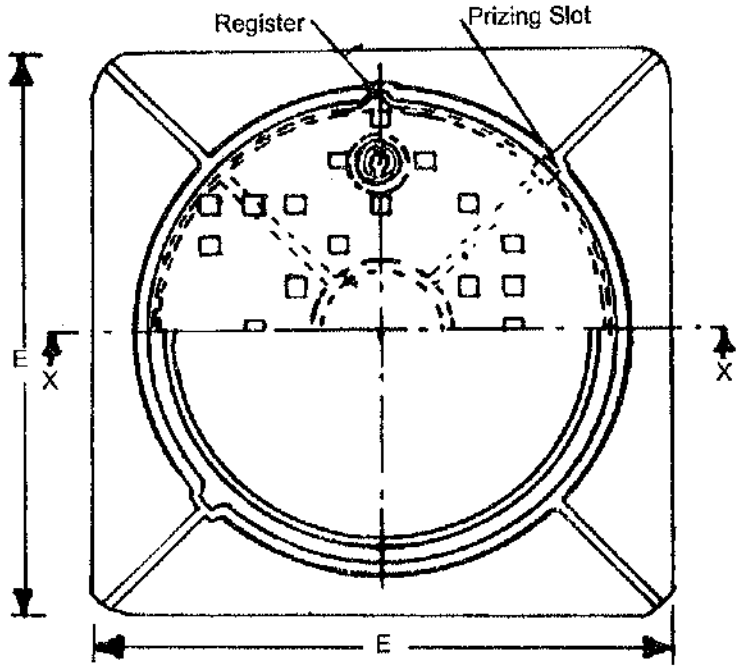
1308.1. General :—Covers for manholes, flush tanks, etc., shall be of Standard Specification Cast Iron unless otherwise defined and of weights and designs in accordance with IS : 1726-1967 "Specification for manhole covers and frames intended for use in Drainage Works".

1308.2. Grades and types :—The manhole covers and frames covered by this specification shall be of the following three grades and types:

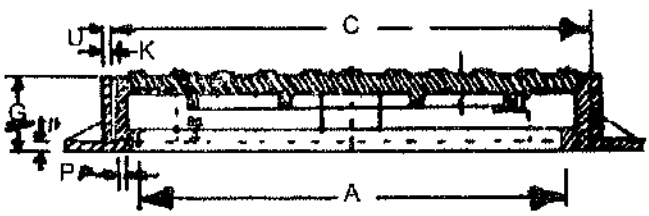
(A) Heavy duty, denoted by the letters 'HD' Circular, solid type for use under heavy vehicular traffic conditions and capable of bearing wheel loads upto 11.25 tonnes (See Fig. 1308.1) : double triangular solid type (See Fig. 1308-2) may also be used where so desired for these load conditions.

HEAVY DUTY AND MEDIUM DUTY CIRCULAR COVER AND FRAME

[Fig. No. 1308.1]

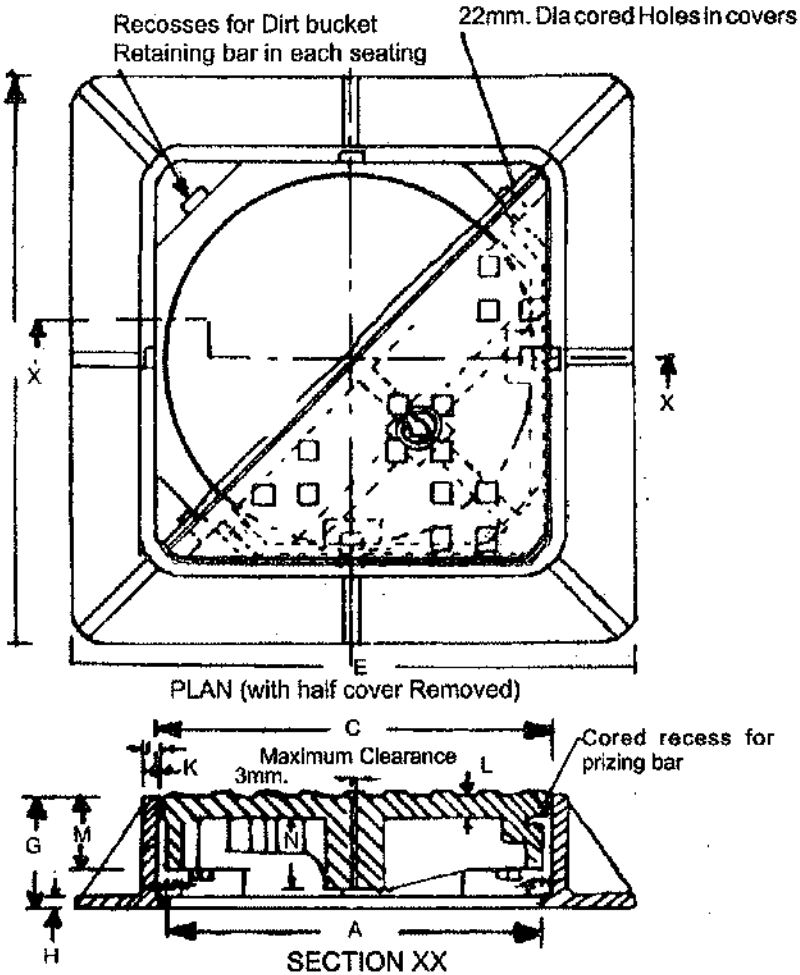


PLAN (with half cover removed)



SECTION XX

HEAVY DUTY DOUBLE TRIANGULAR, SOLID TYPE COVER AND FRAME



[Fig. No. 1308.2]

(Covers loosely coupled by 20mm. Nominal Dia. Hexagonal Bolts with Lock Nuts)

(B) Medium duty, denoted by the letters 'MD', solid type for use under light traffic conditions, such as in footpaths and cycle tracks (*See* Fig. 1308-3).

(C) Light duty, denoted by the letter 'LD', rectangular for use in domestic premises or other places where they are not subjected to wheeled traffic loads. (*See* Figs. 1308.4, 1308.5 and 1308.6).

1308.3. Materials :—Manhole covers and frames shall be of suitable quality gray cast iron not inferior to grade 15 of IS : 210-1962.

1308.4. Manufacture and workmanship :—Covers and frames shall be cleanly cast and they shall be free from air and sand holes, cold shuts and warping which are likely to impair the utility of the castings.

1308.4.1. Covers shall have raised chequered design to provide an adequate non slip grip.

Note :—Where a chequered pattern is shown in the figures it shall be not regarded as a particular design.

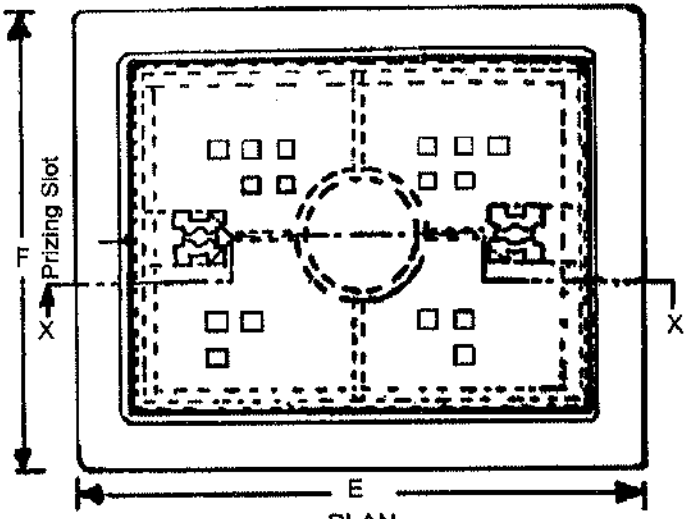
1308.5. Dimensions :—The dimensions of covers and frames shall be in accordance with Table 1308-A read with Figures 1308-1, 1308-2, 1308-3, 1308-4, 1308-5 and 1308-6.

Light duty double seal rectangular cover and frame

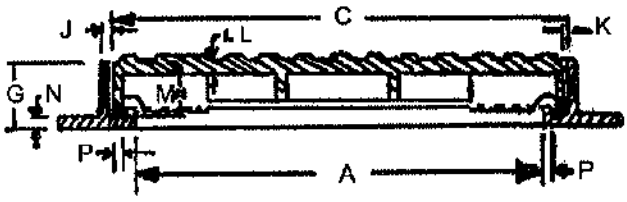
The amount of drawn in pattern may slightly affect the measurements given. They may be made for dimensions other than those shown in the figures where so agreed to between the manufacturer/supplier and the Executive Engineer.

MEDIUM DUTY RECTANGULAR COVER AND FRAME

[Fig. No. 1308.3]

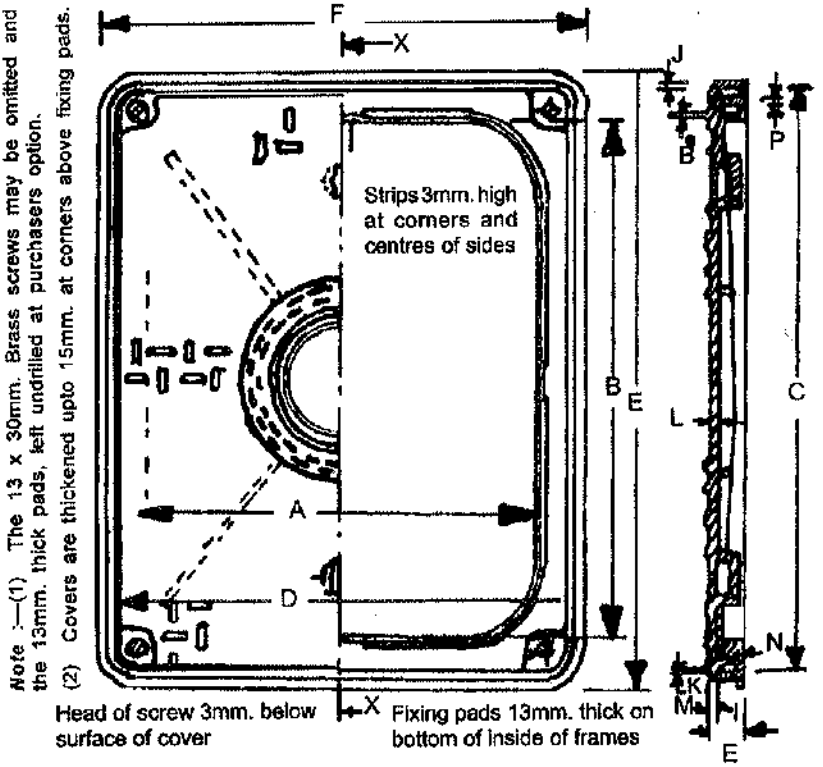


PLAN



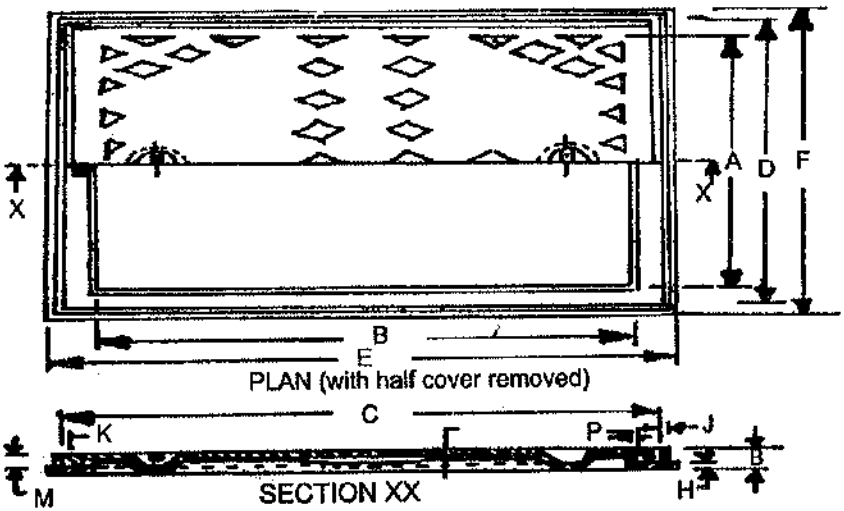
SECTION XX

LIGHT DUTY SINGLE SEAL RECTANGULAR COVER AND FRAME (PATTERN) GRADE C (LIGHT DUTY) SINGLE SEAL MANHOLE COVER [Fig. No. 1308.4]

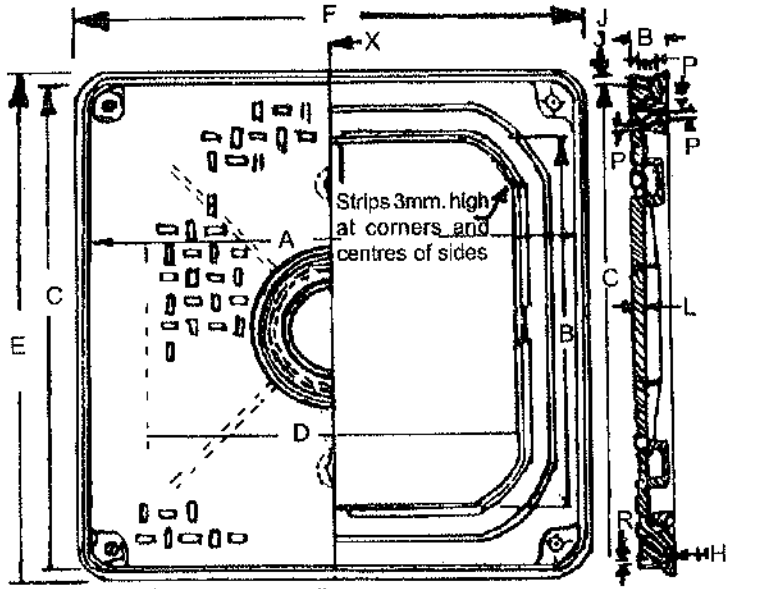


Note :—(1) The 13 x 30mm. Brass screws may be omitted and the 13mm. thick pads, left undrilled at purchasers option.
(2) Covers are thickened upto 15mm. at corners above fixing pads.

LIGHT DUTY SINGLE SEAL RECTANGULAR COVER AND FRAME (PATTERN 2) [Fig. No. 1308.5]



GRADE "C" (LIGHT DUTY) SINGLE SEAL MANHOLE COVER
[Fig. No. 1308.6]



Note :—(1) The 13 x 300mm. Brass screws may be omitted and the 13mm. thick pads, left undrilled at purchasers option.

(2) Covers are thickened upto 15mm. at corners above fixing pads.

Table 1308-A

Dimensions of Covers and Frames

(Clause 1308.5.1. and Figs. 1308.1 to 1308.6)

(All dimensions in Millimetres)

Grade and Type *(1)*	*A* *(2)*	*B* *(3)*	*C* *(4)*	*D* *(5)*	*E* *(6)*	*F* *(7)*
H.D. Double triangular	500	—	530	—	760	—
	560	—	580	—	810	—
H.D. Circular	500	—	600	—	760	—
	560	—	660	—	810	—
M.D. Circular	500	—	580	—	710	—
	560	—	630	—	760	—
M.D. Rectangular	610	455	680	530	840	685
L.D. Rectangular	—	—	—	—	—	—
Pattern 1	455	610	685	530	710	560
Pattern 2	455	610	675	525	695	545
Double seal	455	610	745	590	775	620

G *Min.* *(8)*	*H* *Min.* *(9)*	*J* *Min.* *(10)*	*K* *Min.* *(11)*	*L* *Min.* *(12)*	*M* *Min.* *(13)*	*N* *Min.* *(14)*	*P* *Min.* *(15)*
150	16	22	3	29	100	100	20
150	16	22	3	29	100	100	20
100	15	22	3	29	85	—	20
100	15	22	3	32	85	—	20
100	15	12	3	20	85	—	11
100	15	12	3	20	85	—	11
100	15	22	3	20	85	—	12
—	—	—	—	—	—	—	—
40	7	5	2	8	22	—	5
30	8	5	5	3	20	—	5
40	7	5	2	7	22	—	5

1308.5.1. Permissible tolerances on the dimensions of covers and frames shall be as given below read with Figs. 1308-1 to 1308-6 :

Letters in figurer	*Tolerances in mm.*
A	+5
B	+5
C	+3
D	+3
E	±3
F	±3
G	+2

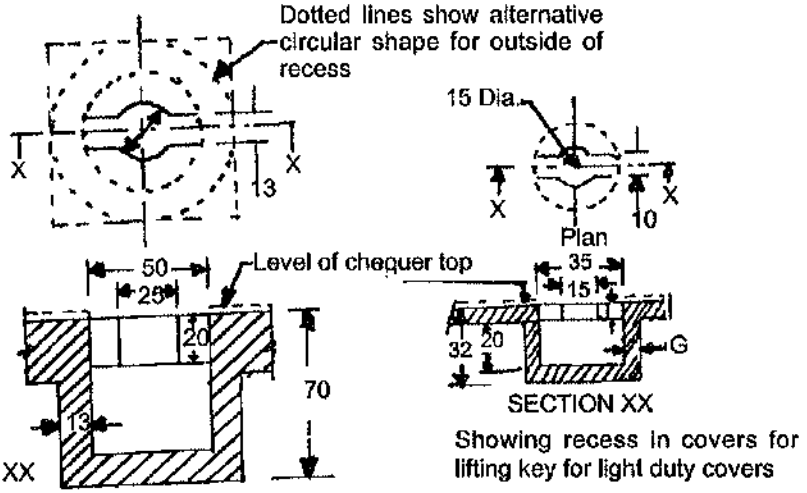
1308.6. Key holes and keys :—Key holes and keys shall be as indicated in Fig. 1308.7.

1308.7. Locking devices :—Locking devices such as galvanised chain or lock or a combination or both may be provided if required by the Executive Engineer.

1308.8. Weights and tolerance :—The minimum weights of manhole frame and covers shall be as specified in Table 1308.B.

DETAILS OF KEY HOLES AND KEYS

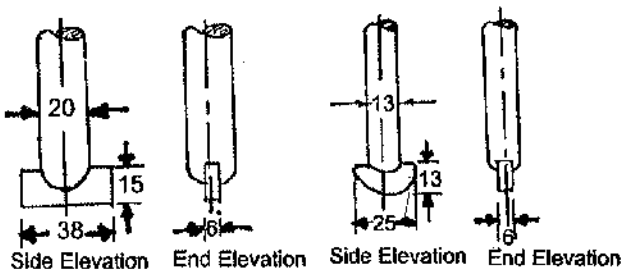
[Fig. No. 1308.7]



Showing recess in covers for lifting key for heavy duty and medium duty cover

Showing recess in covers for lifting key for light duty covers

(All dimensions in Millimetres)



Lifting key for heavy duty medium duty covers

Lifting for light duty covers

Table 1308-B

Minimum weights of manhole frames and covers

Grade and type	*Clear opening mm.*	*Weight of cover kg.*	*Weight of frame kg.*
HD double Triangular	500	118	111
	560	140	115
H.D. Circular	500	118	111
	560	140	115
M.D. Circular	500	58	58
	660	64	64
M.D. Rectangular	—	80	64
L.D. Rectangular Single seal	—	—	—

Pattern 1 :	—	—	—
Pattern 2 :	—	15	10
Double seal	—	29	23

1308.9. Coating :—Manhole covers and frames shall be coated with a material having tar base or with a black bituminous composition. The costing shall be smooth and tenacious. It shall not flow when exposed to a temperature of 63°C and shall not be so brittler to chip off at a temperature of 0°C.

1308.10. Test, testing procedure and Requirements :—Test and testing procedure and requirements for cast iron manholes covers shall be as specified in IS : 1726-1967.

1308.11. Inspection :—The Executive Engineer or his authorised representative shall have free access to the works of the manufacturer at all reasonable times for carrying out inspection during any stage of manufacture and testing.

1308.12. Manufacture's Guarantee :—When so required by the Executive Engineer, the manufacturer shall supply, free of cost, a certificate stating that each lot or part thereof, of manhole covers and frames has been subjected to the test requirements as laid down in IS : 1726-1967 and conform in all respects to the specification.

1308.13. Marking :—The following information shall have been marked on each manhole cover and frame :

(a) Manufacturer's name or trade mark.

(b) Grade denoted by the abbreviation given in 1308.2.

(c) The words "S.W.D", or "SEWER" to denote "storm water drain" and "SEWER" respectively if required by the Executive Engineer, and

(d) An identification mark as required by the Executive Engineer.

1308.14. Measurement :—Manhole covers including their frames shall be measured in numbers as per their sixes, grades and types.

1308.15. Rate :—The unit rate for manhole covers shall be per each for different sizes, grades and types and shall also include the cost of frames.

Specification No. 1309

Cast Iron Surface Boxes for Sluice Values, Fire Hydrants and Air Valves

1309.1. General :—Cast iron to be used for the manufacture of surface boxes shall be of a quality not less than grade 15 of IS : 210-1967.

1309.2. Manufacture and workmanship :—Surface boxes shall be cleanly cast. The castings shall be free from air and sand holes, cold shuts and chucks. They shall be neatly dressed, carefully fettled and also free from voids due to shrinkage, as gas inclusions or other causes.

1309.3. Construction :—The surface boxes shall comprise of a frame and cover as per dimensions specified. The upper surface of the cover shall be designed with an adequate non-slip surface which shall unless otherwise specified, include the letter 'W' Cast thereon. The design may include such other letters as may be specified by the Executive Engineer.

1309.3.1. Surface boxes for sluice valves and fire hydrants shall be provided with a hinged lid and locking arrangement. Surface boxes for air valves shall be of drop, lid type provided with suitable lifting keys and chain attachment.

1309.4. Dimensions :—The dimensions of the surface boxes unless otherwise specified shall be as follows with a tolerance of ±2mm.

TABLE 1309-A

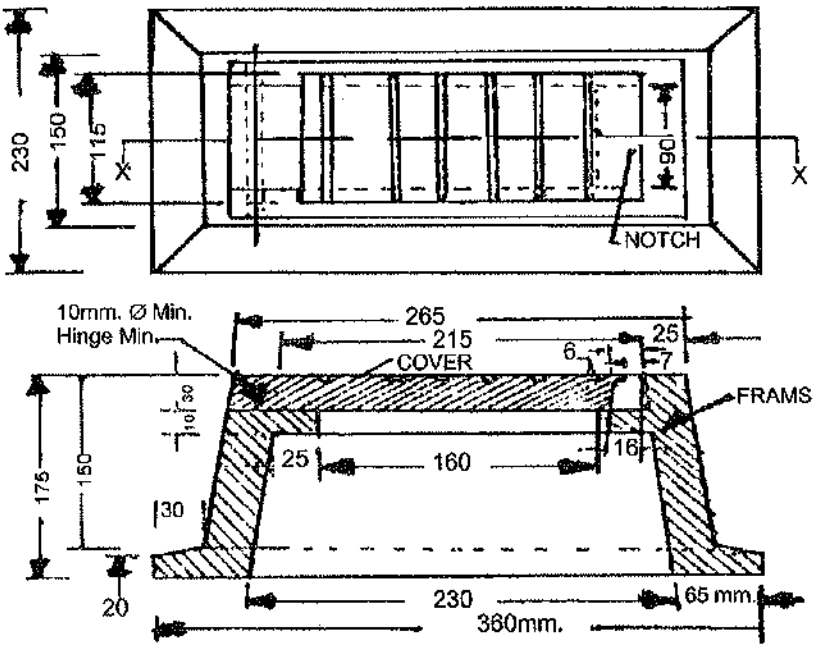
Dimensions of various surface Boxes

Surface box for	*Dimension at base in mm.*		*Clear opening mm.*	*Height mm.*
	External	*Internal*		
(1)	*(2)*		*(3)*	*(4)*
1. Sluice valve Fig. 1309.1	30 x 230	230 x 155	160 x 90	175
2. Fire hydrant with valve surface type Fig. 1309.2	750 x 550	610 x 410	500 x 300	210
3. Single Air valve upto 80mm. Fig. 1309.3	440 x 440	310 x 310	260 x 260	150
4. Double air valve 50mm. Fig. 1309.4.	930 x 480	800 x 350	750 x 300	150
5. Double air valve 80mm. Fig. 1309.4.	1030 x 530	900 x 450	850 x 400	150
6. Double air valve 100m.. size Fig. 1309.4	1230 x 730	1100 x 600	1050 x 550	150

1309.4.1. *Thickness of frame and cover* :—The thickness of frame and cover unless otherwise specified shall be as follows :

Surface Box for	*Thickness of frame*	*Thickness of cover*	*Special feature*
	mm.	*mm.*	
Sluice valves —	25	30	
Fire hydrants —	25	30	
Air valves —	25	30	Ribbed covers to be provided for air valve chambers.

TYPICAL ILLUSTRATIN OF RECTANGULAR SURFACE BOX FOR SLUIE VALVES (Surface Box for Siulee Valves)



[Fig. No. 1309.1]
All dimensions in Millimetres

1309.5. Protective coating :—Surface boxes shall be thoroughly cleaned and dried and they coated by being dipped in a bath containing a composition having a bitumen or tar base.

The coating shall be smooth and tenacious so as not to flow when exposed to a temp. of 63°C and shall not be so brittle as to chip off at a temp. of 0°C.

1309.6. Marking :—Each surface box shall have cast on them the following information :

(a) Manufacturer's name and trade mark.

(b) The word 'W' or any other letters as specified by the Executive Engineer.

1309.7. Measurement :—C.I. surface boxes shall be measured in numbers as per their sizes and types.

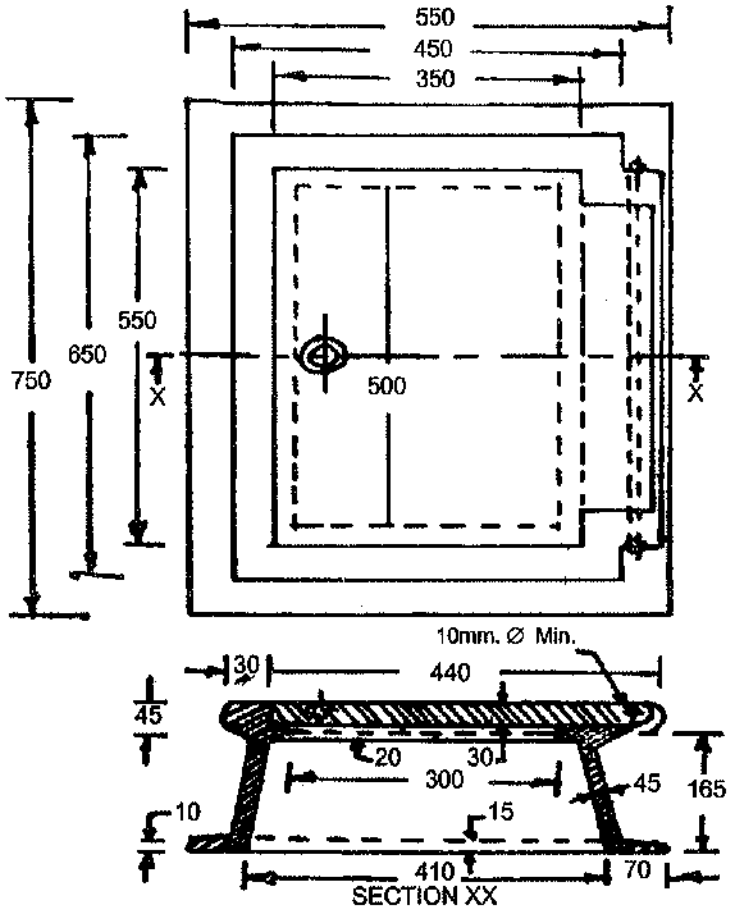
1309.8. Rate :—The unit rate shall be per each for different sizes and types and shall also include necessary frame work and other accessories.

Specification No. 1310

Cast Iron Grating for Drainage Works

1310.1. General :—The frame and cover shall be of grey cast iron conforming to Grade I to IS : 210-1967. Hinge pins shall be made of mild steel wire of ¼ hard condition as per IS : 280-1962.

ROAD SURFACE BOX
[Fig. No. 1309.2]



All dimensions in Millimetres

1310.2. Manufacture and workmanship and construction :—The grating shall conform to IS : 5961-1970.

1310.3. Dimensions and tolerances :—The dimensions shall conform to those specified in Fig. 1310.1 with a tolerance of + or – 2mm.

1310.4. Weight :—The minimum weight of cast iron grating shall be 75 kilogram.

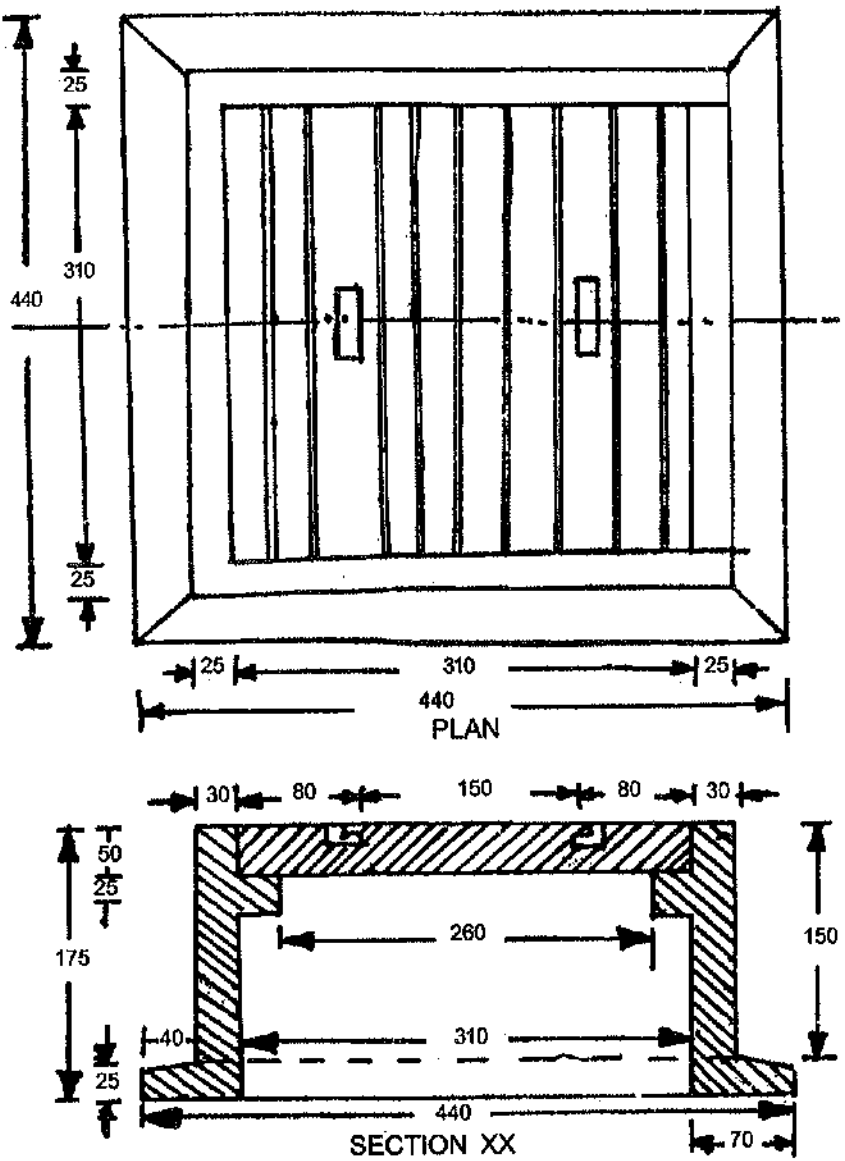
1310.5. Protective coating :—The frame and cover shall be coated as in 1309.5.

1310.6. Marking :—Each cast iron grating shall have, cast on the covers, information regarding manufacturer's name and trade mark.

1310.7. Measurement and rate shall be same as per SS : 1309.

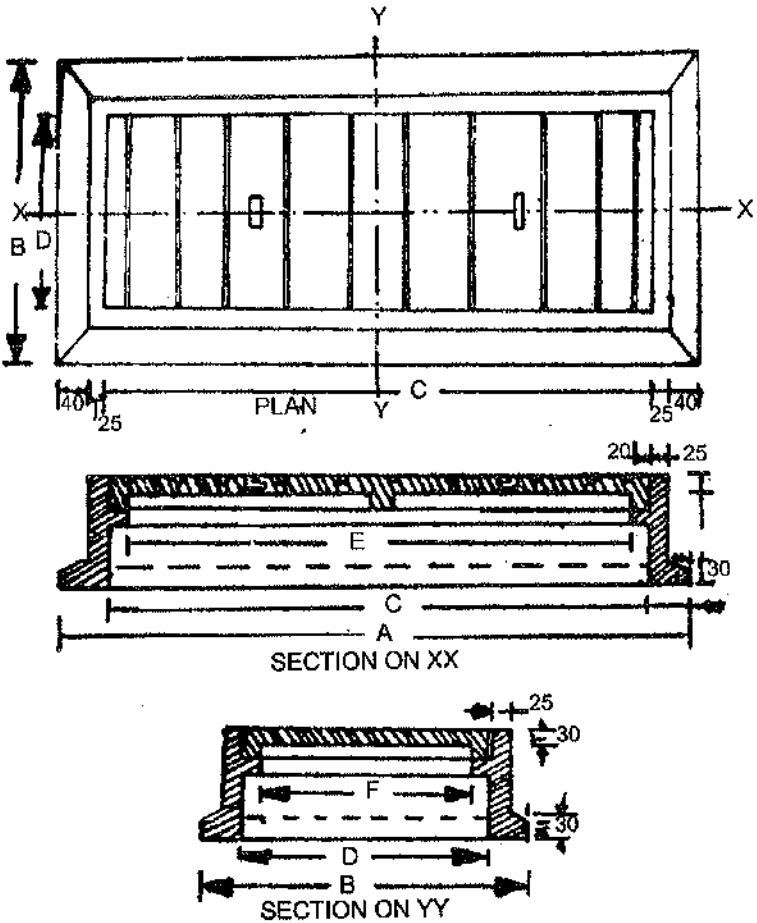
TYPICAL ILLUSTRATION OF SURFACE BOX FOR SINGLE AIR VALVE

[FIG. 1309.3]



All dimensions are in Millimetres

TYPICAL ILLUSTRATION OF CI SURFACE BOX FOR DOUBLE AIR VALVE

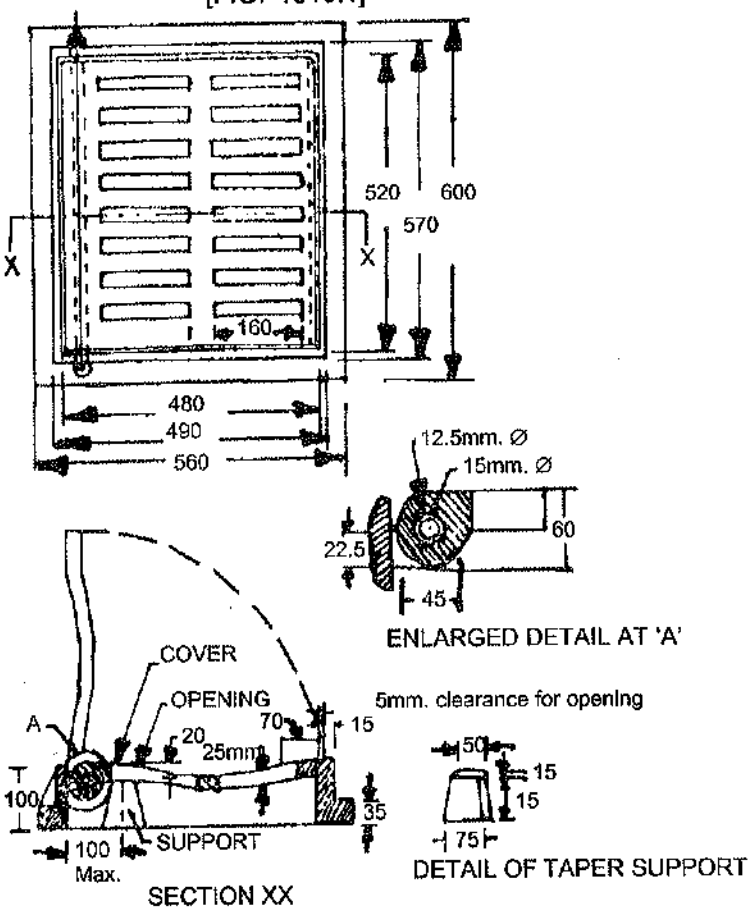


[FIG. 1309.4]
All dimensions are in Millimetres

Sl. No.	Surface Box for	Dimension at base in mm. External A x B	Dimension at base in mm. Internal C x D	Clear opening in mm. Exp.	Height in mm. (W)
1.	Double Airvalve 50 mm.	930 x 480	800 x 350	750 x 300	150
2.	Double Airvalve 80mm.	1030 x 580	900 x 450	850 x 400	150
3.	Double Airvalve 100mm.	1230 x 750	1100 x 600	1050 x 550	150

TYPICAL ILLUSTRATION OF CAST IRON GRATING FOR DRAINAGE PURPOSES

[FIG. 1310.1]



All dimensions are in Millimetres

Specification No. 1311

Sheet Metal Rain Water Pipes, Gutters, Fittings and Accessories

1311.1. General :—Sheet metal rain water pipes, gutters, fittings and accessories shall generally conform to IS : 1728-1960 for "Sheet metal rain water pipes upto 100mm. nominal size, gutters, fittings and accessories" unless otherwise specified.

1311.2. Pipes and pipe fittings :

1311.2.1. Unless otherwise specified, the nominal sizes of pipes and pipe fittings shall be as 50mm. 60mm., 80mm., 90mm., and 100mm, internal diameter. The pipes shall be supplied in lengths of 2.0m., 1.5m. and 1.0m. inclusive of the internal lengths of socket. A tolerance of 5mm., shall be permitted. For nominal size, types and other details size Figure 1311.1 and Table 1311.A.

RAIN WATER PIPES AND PIPE FITTINGS
[FIG. 1311.1]

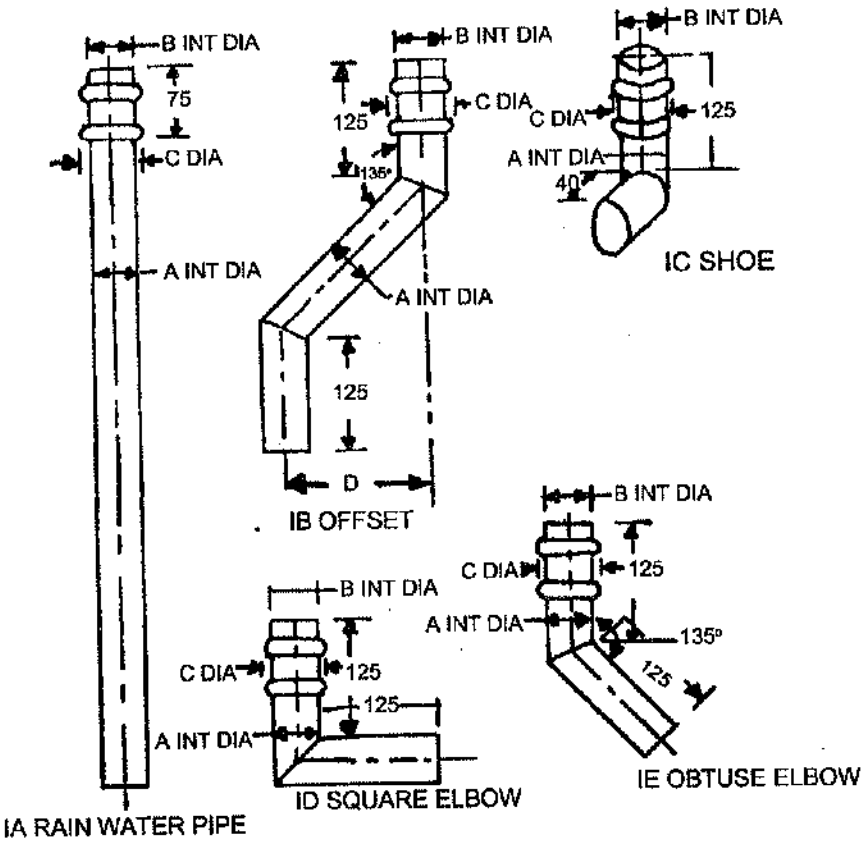


TABLE 1311-A

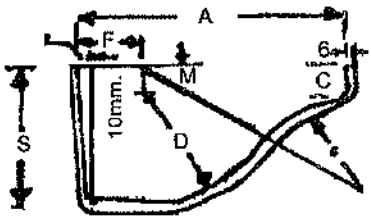
Dimensions of Rain Water Pipes and Pipe Fittings

Nominal size of pipe or pipe fitting	*Internal dia of pipe* *A*	*Internal dia of Socket* *B*	*Outside dia of beading* *C*	*Offset* *D*	*Thickness of pipe or pipe fitting*
mm.	*mm.*	*mm.*	*mm.*		
50	50	53	65	150	Not less than 1.00 mm. before galvanizing in the case of black mild steel sheets.
60	60	63	75	150	
80	80	83	95	225	
90	90	93	105	300	
100	100	103	115	375	

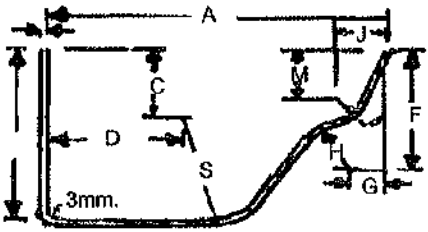
1311.3. Gutters :

1311.3.1. Unless specified otherwise, gutters shall be supplied in length of 2.0 metres, 1.5 metres and 1.00 metre inclusive of the internal length of the socket. A tolerance of 5mm. shall be permitted. The types and nominal sizes of gutters shall be as given, below :

(a) Ogee gutters type 1.



[Fig. No. 1311.2]
OGEE GUTTERS – TYPE 1



[Fig. No. 1311.3]
OGEE GUTTERS – TYPE 2

TABLE 1311-B

Dimensions of Ogee Gutters—Type 1

Nominal size of gutter mm.	*A mm.*	*B mm.*	*C mm.*	*D mm.*	*E mm.*	*F mm.*	*G mm.*
100	100	60	13	50	40	25	1.25
115	115	70	17	60	45	30	1.25
125	125	75	18	65	50	32	1.25
150	150	90	24	80	55	38	1.25

(b) Ogee gutters type 2.

TABLE 1311-C

Dimensions of Ogee Gutters—Type 2

Nominal size of gutter mm.	*A mm.*	*B mm.*	*C mm.*	*D mm.*	*E mm.*	*F mm.*	*G mm.*	*H mm.*	*J mm.*	*K mm.*	*L mm.*	*M mm.*
125	125	75	30	50	45	52	13	21	18	9	1.25	22
200	200	150	90	80	60	70	24	20	24	8	1.60	43

(c) Half-round gutters.

TABLE 1311-D

Dimensions of Half-round Gutters

Nominal size of gutter mm.	*A mm.*	*B mm.*	*C mm.*
75	75	37.5	1.25
90	90	45.0	1.25
100	100	50.0	1.25
115	115	57.5	1.25
125	125	62.5	1.60
150	150	75.0	1.60

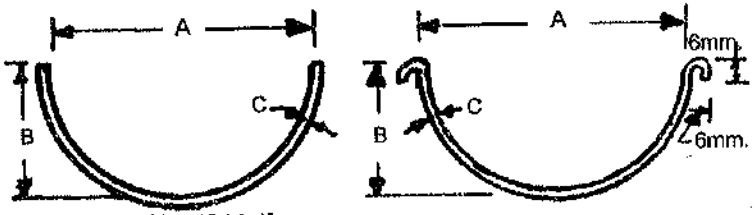
(d) Valley gutters.

TABLE 1311-E

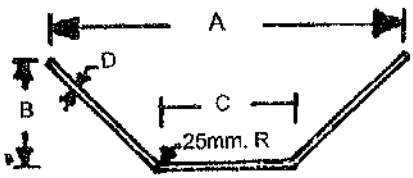
Dimensions of Valley Gutters

Nominal size of gutter mm.	*A mm.*	*B mm.*	*C mm.*	*D mm.*
400	400	125	150	3.15
450	450	125	150	3.15
600	600	150	225	5.00
900	900	200	225	6.00

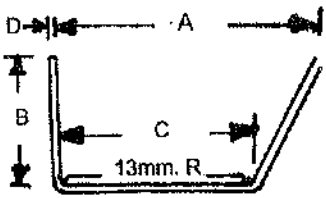
(e) Eaves gutters.



[Fig. No. 1311.4]
HALF ROUND GUTTERS



[Fig. No. 1311.5]
ALLEY GUTTERS



[Fig. No. 1311.6]
EAVES GUTTERS

TABLE 1311-F

Dimensions of Eaves Gutters

Nominal size of gutter mm.	*A mm.*	*B mm.*	*C mm.*	*D mm.*
275	275	125	175	3.15
300	300	125	225	3.15
450	450	150	250	5.00
500	500	150	300	5.00

1311.4. Quality and workmanship :

1311.4.1. Rain water pipes, gutters and fittings shall be manufactured from plain galvanized mild steel sheets or from black mild steel sheets. Pipes and fittings shall be made with a seamed joint except in the case of pipes of 1.5mm., thick in which case the joint shall be made either by revetting or continuous welding. All flaws shall be removed before galvanizing or painting.

1311.4.2. Pipes, gutters, fittings and accessories shall be true, and smooth and the ends shall be finished square to their axes. They shall be sound and free from imperfections.

1311.5. Finish :—

1311.5.1. In the case of rain water pipes, gutters and gutter fittings manufactured from galvanised plain sheets, if holes are punched for purposes of fixing or jointing, these shall be finished by painting with suitable anticorrosive paint.

1311.5.2. Pipes and gutters and fittings made from black sheets and mild steel shall be either hot dip galvanized after manufacture or painted with two coats of approved anticorrosive paint before fitting.

1311.5.3. For galvanised pipes, gutters and fittings, the zinc coating at any place shall not be less than 0.045kg./cm^2 and no portion shall show evidence of acid spot, cracks or blister.

1311.5.4. Holes required in any of the pipes, gutters or fittings for purpose of fixing shall be punched before galvanising.

1311.5.5. The mild steel accessories for rain water pipes and fittings shall be either hot dip galvanised or electro-galvanised and shall have zinc coating of a minimum average, thickness of 0.015mm.

1311.6. Testing :

1311.6.1. Pipes, gutters and fittings shall not show any sign of leakage when filled with water after closing their ends.

1311.7. Marking :

1311.7.1. The pipes, gutters, fittings, etc., shall be clearly and permanently marked with the following information.

(a) Name of manufacturer or Trade mark,

(b) Size of pipe, gutter, fitting etc., and

(c) Tear of manufacture.

1311.8. Measurement :—All linear measurements shall be in metres correct to 0.01 of a metre. Gutters and fittings shall be measured in numbers.

1311.9. Rate :—The unit rate for pipes shall be per running metre for different diameters and the unit rate for gutters and fittings shall be per each for different sizes.

Specification No. 1312

Cast Iron Rain Water Pipes and Fittings

1312. General :—Pipes and fittings shall be cylindrical, reasonably true with inner and outer surface and as nearly concentric as practicable. The outer surface shall be smooth and shall, in all respects, be sound, and free from pinholes, laps or other imperfections calculated to affect their utility, neatly dressed and carefully fitted. The ends shall be finished reasonably square to their axes. The pipes and fittings shall comply with IS : 1230-1957 of Indian Standard Specification for "Cast Iron Rain Water Pipes and Fittings".

1312.2. Dimensions :—Standard lengths of straight pipes shall be :

(a) 1.5m. effective length, inclusive of the depth of the socket.

(b) 1.8m. overall length inclusive of the depth of the socket. Nominal bores of rain water pipes and fittings available are 50mm., 75mm. 100mm., 125mm. and 150mm..

1312.3. Holder bats for fixing rain water pipes shall comply with para 4.2.1 of IS : 1230-1957.

1312.4. Marking :—Nominal bore with manufacturer's initials or trade mark and the letter 'RW' shall be cast on all pipes and fittings in a legible manner.

1312.5. Finish :—Unless otherwise specified, all pipes and fittings shall be given one coat of anticorrosive paint.

1312.6. Measurement and rate shall be same as per SS : 1311.

Specification No. 1313

Asbestos Cement Rain Water Pipe, Gutters and Fittings

(Spigot and Socket Type)

1313.1. General :—Asbestos cement rain water pipes, gutters and fittings shall conform to IS : 1626-1960, for "Asbestos Cement Building Pipes", Gutters, and Fittings (Spigot and Socket type)".

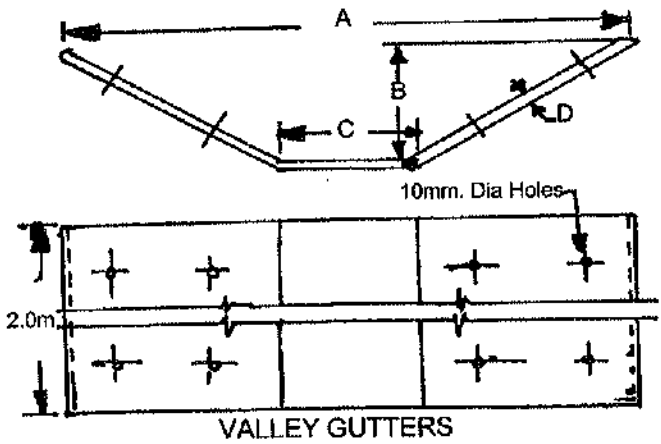
1313.2. Pipes and pipes fittings :

1313.2.1. The pipes and fittings shall be of 50mm., 60mm., 80mm., 90mm., 100mm., 125mm. and 150mm., internal diameter. Effective lenghts of pipes excluding the sockets shall be 0.5, 1.0, 1.5, 2.0 & 3.0 metres with a tolerance of + or –5mm.

1313.3. Gutters :—The gutters shall be of the following types and sizes :

(A) Valley gutters :

[Fig. No. 1313.1]



VALLEY GUTTERS

TABLE 1313-A

Dimensions of Valley Gutters

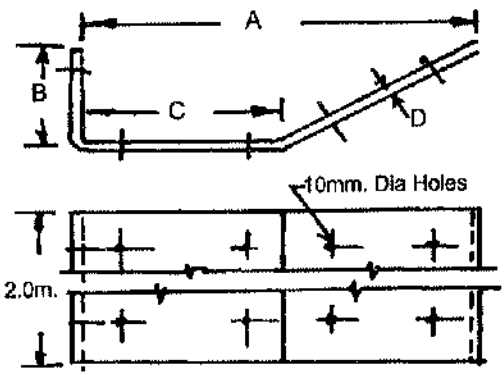
Nominal size	*A*	*B*	*C*	*D*
900 x 200 x 225	900	200	225	12.5
600 x 150 x 225	600	150	225	12.5
450 x 125 x 150	450	125	150	12.5
450 x 125 x 150	400	125	150	12.5

All dimensions in Milli-metres

Note :—Manufactured in 2m. lengths.

(B) Boundary wall gutter :

[Fig. No. 1313.2]



BOUNDARY WALL GUTTERS

TABLE 1313-B

Dimensions of Valley Gutters

(Clause 1313.6 and Fig. 1313.2)

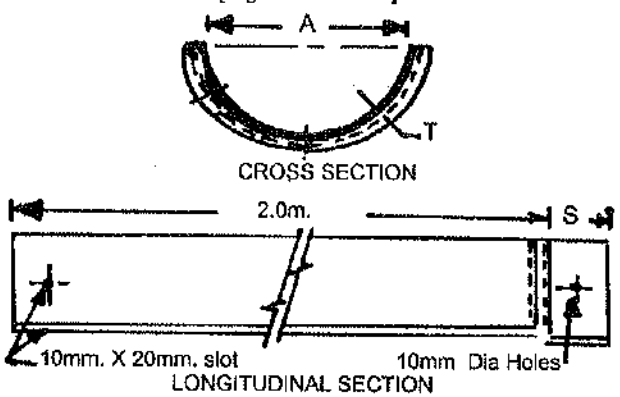
Nominal size	*A*	*B*	*C*	*D*
300 x 150 x 250	300	150	250	12.5
450 x 150 x 300	400	150	300	12.5
300 x 150 x 225	300	150	225	12.5
375 x 125 x 175	275	125	175	10.0

All dimensions in milimeres.

Note :—Munufactured in 2m. lengths.

(C) Half round gutters :

[Fig. No. 1313.3]



HALF ROUND GUTTER

TABLE 1313-C

Dimensions of Half-Round Gutters

(Clause 1313.3(c) and Fig. 1313.3)

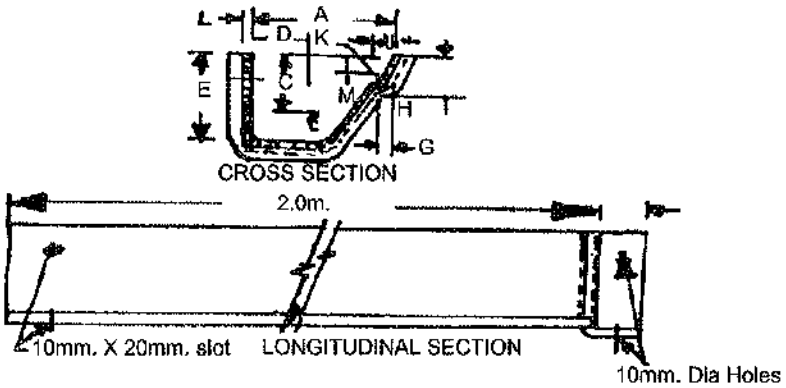
Nominal size	*A*	*B*	*C*
150	150	70	9.5
250	250	100	9.5
300	300	100	9.5

All dimensions in milli-metres.

Note :—Munufactured in 2m. lengths.

(D) Ogee gutters :

[Fig. No. 1313.4]



OGEE GUTTERS

TABLE 1313-D

Dimensions of Ogee Gutters

(Clause 1313.3(c) and Fig. 1313.3)

Nominal size	*A*	*B*	*C*	*D*	*E*	*F*	*G*	*H*	*J*	*K*	*L*	*M*	*N*	*S*
125	125	75	30	50	45	52	13	21	18	9	9.5	22	57	70
200	200	150	90	80	60	70	24	20	24	8	9.5	43	96	70

All dimensions in milli-metres.

1313.4. Quality and Workmanship :

1313.4.1. The pipes shall be straight and the edges of the pipe gutters and fittings shall be finished square to their axes.

1313.4.2. The finished pipes and fittings shall be true and smooth, the inner and the outer surfaces being as nearly as practically concentric. They shall be in all respects sound homogenous and free from imperfections and visible defects.

1313.5. Tests :

1313.5.1. The sample or samples of pipes shall be tested where required in accordance with IS : 1626-1960.

1313.5.2. The pipes, gutters, and fittings shall be allowed to mature for atleast 4 weeks before the specified tests are carried out and before delivery is made.

1313.6. Marking :

1313.6.1. Pipes, gutters and fittings, shall be clearly and indelibly marked with the following :

(a) Manufacturer's name or trademark,

(b) Size of pipe, gutter or fittings, and

(c) Date of manufacture.

1313.7. Measurement and rate shall be as per SS : 1311.

Specification No. 1314

Asbestos Cement, Soil, Waste and Ventilating Pipes and Fittings

1314.1. General :—All asbestos cement, soil, waste, vent and antisyphonage pipes and fittings, shall conform to IS : 1626-1960. This specification covers all pipes and fittings of diameters from 50 to 150mm.

1314.2. Composition :—The material used in the manufacture of pipes and pipe fittings shall be composed of an inert aggregate, consisting of clean asbestos fibre cemented together by ordinary portland cement conforming to IS : 269-1958 or portland blast furnace slag cement conforming to IS : 455-1963. No organic material shall be added to the composition.

1314.3. Dimensions :—The pipes and pipe fittings shall be of 50mm., 60mm., 80mm., 90mm., 100mm., 125mm. and 150mm. internal diametres. Effective length of pipes excluding the sockets shall be 0.5, 1.0, 1.5, 2.0 and 3.0 metres with a tolerance of + or –5mm.

1314.4. Quality and workmanship :

1314.4.1. The pipes shall be straight and the ends of the pipe and pipe fittings shall be finished square to their axes.

1314.4.2. The finished pipes and fittings shall be true and smooth, the inner and outer surfaces being as nearly as practically concentric. They shall be in all respects sound homogenous and free from imperfections and visible defects.

1314.5. Tests :

1314.5.1. The sample or samples of pipes shall be tested where required in accordance with IS : 1616-1960.

1314.5.2. The pipes and pipe fittings shall be allowed to mature for atleast 4 weeks before the specified tests are carried out and before delivery is made.

1314.6. Marking :—Pipes and pipe fittings shall be clearly and indelibly marked with the following :

(a) Manufacturer's name or trade mark,

(b) Size of pipe fitting,

(c) Date of manufacture,

1314.7. Measurement and rate shall be same as per SS : 1311.

Specification No. 1315

C.I. Soil Waste and Ventilating Pipes and Fittings

1315.1. General :—All pipes and fittings shall conform to IS : 1729-1964 and IS : 3989-1967.

1315.2. Material :

1315.2.1. Metal used for the manufacture of pipes shall be good quality cast iron. When fractured, it shall reveal a grey, close and regular grain.

1315.2.2. The requirements relating to the supply of C.I. spigot and socket soil pipes shall be as laid down in IS : 1387-1967.

1315.3. Freedom from defects :

1315.3.1. Pipes shall be sound and free from surface and other defects. Pipes having slight imperfections, which are inevitable as a consequence of manufacturing process and are in no way harmful to their use, will not be rejected.

1315.3.2. Pipes shall be such that they could be cut drilled or machined.

1315.4. Tests :

1315.4.1. *Hammer test* :—Each pipe, when tested for soundness by striking with a light hand hammer, shall emit a clear ringing sound.

1315.4.2. *Hydrostatic test* :—If so required by the Executive Engineer, the pipe shall be tested hydrostatically at a pressure of 0.4 kg.f/cm^2 without showing any sign of leakage, sweating or other defect of any kind. The pressure shall be applied internally and shall be maintained for not less than 15 seconds. The test shall be conducted before coating the pipe.

1315.5. Sizes :—The dimensions of pipes shall conform to the sizes specified in Table 1315-A and 1315-B (See Figures 1315.1 and 1315.2).

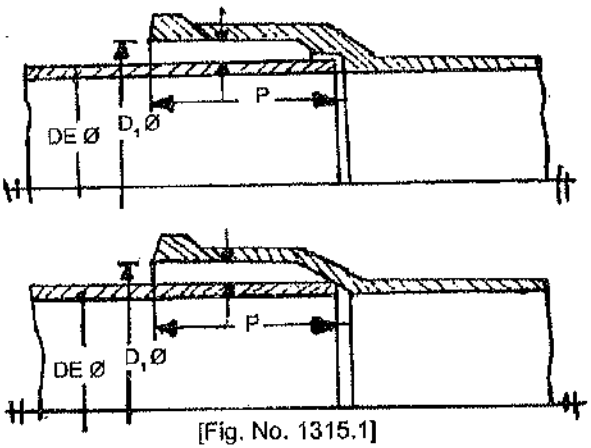
TABLE 1315-A

Dimensions of Sockets and Spigots of Pipes

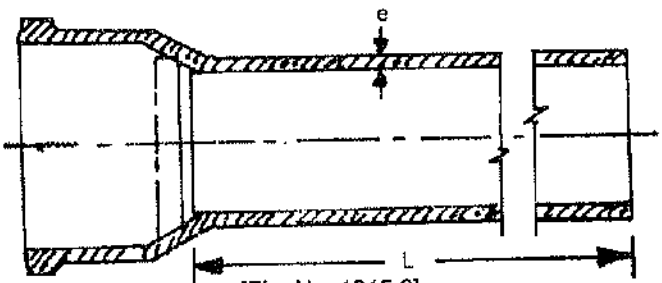
Nominal diameter (D.N.)	*Barrel D.E.*	*Socket*		*Joint thickness F.*
		D1	*P.*	
60	57	73	60	8
75	83	99	65	8
100	109	126	70	8.5
150	161	179	75	9

All dimensions in millimetres.

DIMENSIONS OF SOCKETS AND SPIGOTS OF PIPES



[Fig. No. 1315.1]



[Fig. No. 1315.2]

Note :—Nominal diameter is a number used to classify pipes and corresponds approximately to their internal diameter.

TABLE 1315-B

Dimensions of Sockets and Spigots of Pipes (See Fig. 1315.2)

Nominal diameter (DN)	Thickness (e)	Approximate mass in Kgs. for an effective length 'L' in meters of							
mm.	mm.	3.000 Kg.	2.500 Kg.	2.000 Kg.	1.830 Kg.	1.750 Kg.	1.500 Kg.	1.000 Kg.	0.500 Kg.
50	3.5	13.4	11.3	9.2	8.5	8.2	7.1	5.0	2.0
75	3.5	20.0	16.8	13.8	12.7	12.2	10.6	7.4	4.3
100	4.0	30.0	25.5	21.0	19.2	18.4	16.0	11.2	6.5
150	5.0	56.0	47.0	38.5	35.5	34.0	29.5	21.0	12.0

Note :—For spigot and socket dimensions, see table 1315-A.

*Pipes of intermediate lengths are obtained by cutting a longer pipe.

1315.6. Tolerances :

1315.6.1. Tolerances on external diameter of the barrel, internal diameter of the socket shall be as follows :

	Dimension	*Nominal diameter mm.*	*Tolerance mm.*
(i)	External diameter of barrel	50,75	+ or – 3.0
		100	+ or – 3.5
		100	+ or – 4.0
(ii)	Internal diameter of socket	All diameters	+ or – 3.0
(iii)	Depth of socket	All diameters	+ or – 10.0

1315.6.2. Tolerances on the wall thickness shall be –15 percent.

1315.6.3. Tolerances on the length of the pipe shall be + or –20 percent.

1315.7. Weight :

1315.7.1. The nominal weights of uncoated pipes shall be as given in the 1315-B.

1315.7.2. Tolerances on weight shall be –10 percent.

1315.7.3. Pipes weighing more than the nominal weight may be accepted provided they comply in every other respect with the requirements of this specification.

1315.8. Coating :

1315.8.1. After inspection and hydrostatic test, each pipe shall be coated in accordance with clause 1315.8.2 to 1315.8.6.

1315.8.2. Coating shall not be applied to any pipe unless its surface is clean, dry and free from rust.

1315.8.3. Except when otherwise agreed to between the Executive Engineer and the manufacturer, all pipes shall be coated externally and internally with the same material, the pipes being heated prior to total immersion in a bath containing a uniformly heated composition having a tar or other suitable base.

1315.8.4. The coating material shall be rapidly with good adherence and shall not scale off.

1315.8.5. In all bases where the coating material has a tar or similar base, it shall be smooth tenacious hard enough not to flow when exposed to a temperature of, 77°C and not so brittle at a temperature of 0°C at to chip off when scribed lightly with a pen knife.

1315.8.6. In case of wholly or partially coated pipes which are imperfectly coated or when coating does not set or conform to the quality specified above, the coating shall be removed and the pipes recoated.

1315.9. Marking :

1315.9.1. Each pipe shall have nominal diameter and manufacturer's trademark suitably marked on it.

1315.9.2. The pipe shall be marked when specified with the I.S.I. certification mark.

1315.10. Measurement and rate shall be same as per SS : 1311.

Specification No. 1316

Handling Transport and Custody of Pipes, Fittings, Valves, etc.

1316.1. Handling Transport and custody :

1316.1.1. The contractor shall carefully unload the pipes, fittings, valves and other items of store from the railway wagon or take delivery of the materials when they are stacked as may be defined in the tender notice. In either case he shall be responsible for the safe handling, transportation and custody of the pipes, fittings or other stores till the pipe line is laid and back filled to the satisfaction of the Executive Engineer or till the notes are handed over to the department in good condition in accordance with the terms of contract.

The contractor shall verify the condition of all pipes or other items of store supplied to him under the contract and immediately bring to the notice of the Executive Engineer, any breakages or cracks. Otherwise the contractor shall be responsible for the damaged pipes or articles subsequently discovered. If the articles are so packed as to render the examination difficult or impossible while taking delivery, the contractor shall at once inform the Executive Engineer or the Assistant Engineer incharge and obtain written instructions thereon.

1316.1.2. If intermediate storage of pipes or other items of store are required to be done after receipt, and prior to laying or installation, the site where they are to be stacked shall be defined in the Tender Notice and the contractor shall quote his tender rate to include the double conveyance and stacking.

1316.1.2.1. Store sheds shall be provided as necessary by the contractor at his own expense, to enable safe custody of valves, small stores etc., until they are required on the work.

1316.1.2.2. Stacking shall be done in a neat and orderly manner to facilitate checking and counting and to avoid damage to the stores.

1316.1.3. Conveyance to work site, stacking or laying of pipes and fittings along the track shall be done in a manner to cause minimum inconvenience to the traffic and the public, and to a programme approved by the Executive Engineer. Pipes and other articles shall not be dumped from the cart but shall be unloaded by hand or by means of lifting tackles with care.

1316.2. Responsibility for damages to the material :—The cost of any damages occurring to the pipes, fittings, valves, or other articles, either during transport and handling, or during and after installation until the materials or work is handed over to the department, shall be recovered from the contractor concerned.

The recovery for such damages shall be affected at the original price of such articles including transport and handling charges plus 10%.

If in the opinion of the Executive Engineer, a damaged pipe can be used by cutting off the damaged portion, the recovery of the pipe shall be effected to the extent of damaged portion only. The damages of pipes and specials if any, revealed in a hydraulic or a pressure test, shall not however be a charge on the contractor.

Specification No. 1317

Trench Work Excavation and Back Filling

1317.1. Excavation of trenches and protection :

1317.1.1. *General* :—The trench shall be excavated so that the pipe may be laid to the required alignment and to the required depth. Where the pipe line is under a road way, a minimum cover 900mm. thick shall be provided. The Executive Engineer, may modify the cover thickness to suit the site conditions, if such modification is warranted. The trench shall be excavated only so far in advance of pipe laying as specified by the Executive Engineer. The trench shall, where necessary, be shored and drained so that the workmen may work therein safely and efficiently. This drained water shall be conveyed either to the drainage channel or to any drain.

1317.1.2. *Trench* :—The excavation shall be carried out with manual labour or with suitable mechanical equipment as approved by the Executive Engineer.

1317.1.3. *Width of trenches* :—

1317.1.3.1. Unless otherwise indicated in the approved plans and drawings, the width at bottom of trenches for different depths shall be as given below :—

(a) For all diametres upto an average depth of 1.2 metres, width of trench shall be equal to the external diametre of pipe plus 300mm.

(b) For all diametres for depths above 1.2 metres width of trench shall be equal to external diametre of pipe plus 400mm.

(c) Notwithstanding (a) and (b) above, the total width of trench shall not be less than 750mm. for depths exceeding 900mm.

1317.1.3.2. The trenches shall be excavated vertically unless otherwise specified.

1317.1.4. *Provision for joints* :—Additional width shall be provided at position of sockets and flanges for jointing to be made properly. Depths of pits at such places shall also be sufficient to permit the finishing of joints and to ensure that the barrels of pipe rest throughout the entire length on solid ground.

1317.1.5. *Pipe clearance in rocks* :—Ledge rock, boulders and large stones shall be removed to provide necessary clearance below and on each side of all pipes, valves and fittings. For pipe 600mm diametre or less the minimum clearance shall be 150mm. and for pipes larger than 600mm. dia. the maximum clearance shall be 200mm.

1317.1.5.1. The specified minimum clearance or the minimum clear distances which shall be permitted is/are between any part of the pipe or appurtenance being laid, and any part, projection or point of such rock, boulder or stone.

1317.1.6. *Limits of excavation relative to gradients* :—Except where special foundations are to be provided for reason in clause 1317.1.8 the trench shall be excavated in accordance with one of the alternative as may be considered appropriate by the Executive Engineer.

(a) The trench shall be excavated to the exact gradient specified so that no making up of the sub-grade with back filling is required and the pipe rests on solid and undisturbed ground.

(b) If the bottom of the trench of the specified gradient is found to be unstable or to include ashes and cinders, all types of refuse, vegetable or other organic material, or large pieces of inorganic materials, they shall be removed to the satisfaction of the Executive Engineer. The specified gradient shall be restored by backfilling with an approved material in layers of 100mm. which shall be tamped as directed by the Executive Engineer.

1317.1.7. *Training of trench bottoms* :—Before laying the pipe, the bottom of the trench shall be properly trimmed down to present a plane surface and all irregularities shall be levelled. Where rock and large boulders are removed in accordance with clause 1317.1.5, the bottom shall be made up with granular material like sand or moorum to depth of 80mm. and well rammed to farm true and firm bed for pipes. Pits for joints shall be excavated to such dimensions as will allow the joints to be thoroughly and conveniently made. The rest of the finished surface shall not be disturbed except to the extent required for the withdrawal of signs used for lowering pipes.

1317.1.8. *Special foundation in poor soil* :—When the bottom of the trench or subgrade is found to consist of material which is unstable to such a degree that in the opinion of the Executive Engineer, it cannot be removed or replaced with an approved material thoroughly composed and placed to support the pipe properly, a suitable foundation for the pipe consisting of piling timbers and other materials in accordance with plan approved by the Executive Engineer incharge shall be constructed.

1317.1.9. *Blasting* :—Blasting for rock excavation shall be permitted only after securing the approval of the Executive Engineer and proper measures are taken for the protection of life and property. The procedure for blasting shall be in accordance with SS : 203.

1317.1.10. *Bracing and sheeting of trenches* :—Open cut trenches shall be sheeted wherever necessary as directed by the Executive Engineer to protect life and property and to facilitate work. Where close sheeting is required, it shall be

driven as to prevent adjacent soil from entering the trench either from below or through such sheeting.

1317.1.10.1. The Executive Engineer shall have the right to order the sheeting to be driven to the full depth of the trench or to such additional depths as may be required for the protection of the work. Where the soil in the lower limits of the trench has the necessary stability, the Executive Engineer, at his discretion may permit stopping driving of sheeting at some designated elevation above the trench bottom.

1317.1.10.2. Sheeting and bracing which have been ordered to be left in place shall be removed for a distance of 900mm. below the established street level or the existing surface of the street, whichever is lower. Trench bracing except that which should be left in place, may be removed when the back filling has reached the respective levels of such bracing, sheeting, except that which has been left in place, may be removed after the back filling has been completed or has been brought upto such an elevation as to permit its safe removal.

1317.1.11. *Tunneling* :—If extensive tunneling is to be done, such work shall be described in a separate specification. This does not apply to tunneling and timbering at road crossings and other short lengths where it is necessary and shall be considered as included in the agreement unit rate of trench work excavation.

1317.1.12. *Surface material suitable for re-use* :—All surface materials which are suitable for re-use in restoring the surface shall be kept separate from the general excavation materials as directed by the Executive Engineer.

1317.1.12.1. *Stacking excavated materials* :—All excavated material shall be stacked in such, a manner that it will not endanger the work and it will avoid obstructing footpaths and roads. Hydrants under pressure, surface boxes, fire or other utility controls shall be left unobstructed and accessible until the work is completed. Gutters shall be kept clear or other satisfactory provisions made for street drainage and natural water course shall not be obstructed.

1317.1.13. *Protection and safety measures* :

1317.1.13.1. To protect persons from injury and to avoid damage to property, adequate, barricades, construction signs, torches, red lanterns and guards, as required, vide preliminary specifications shall be placed and maintained during the progress of construction work and until it is safe for traffic to use the roadway. All materials, stacks, equipment and pipes which may cause obstruction to traffic shall be enclosed by fences or barricades and shall be protected by proper lights when the visibility is poor. The rules and regulations of the local authority regarding safety provisions shall be observed.

1317.1.13.2. Temporary supports, adequate protection and maintenance of all underground and surface structures, drains, sewers and other obstructions encountered in the progress of the work shall be provided under the direction of the Executive Engineer. The structures which may have been disturbed shall be restored upon completion of the work. Trees, shrubby fences, poles and other property and surface structure shall be protected unless their removal is shown on the drawings or authorised by the Executive Engineer. Where it is necessary to cut

roots and tree branches, such cutting shall be done under the direction of the Executive Engineer.

1317.1.13.3. The contractor shall make all arrangements—(1) to prevent caving in of the sides of the trenches by timbering, shoring, etc., (2) to safeguard traffic, public and workmen, (3) to prevent damage to buildings and other properties in the proximity of the excavation.

1317.1.14. *Interruption of services* :—No valve or other control of the existing service shall be operated without the permission of the Executive Engineer.

1317.1.15. *Maintenance of traffic and closing of streets* :—The work shall be carried in such manner which will cause the least interruption to traffic and the road or street may be closed in such a manner that it causes the least interruption to the traffic. Where it is necessary for traffic to cross open trenches, suitable bridges shall be provided.

1317.2. Back filling of trenches :

1317.2.1. *Starting of back filling* :—Filling of the trench shall not be commenced until the length of pipes therein, has been tested and passed. In the case of cast iron and concrete pipe lines, the trench can be partially back filled upto a level 300mm. above the top of pipe line before testing except at the joints.

1317.2.2. *Trench Zoning* :—For the purpose of back filling, the depth of the trench shall be considered as divided into the following three zones from the bottom of the trench to its top.

Zone 'A' :—From the bottom of the trench to the level of the centre line of the pipe.

Zone 'B' :—From the level of the centre line of the pipe to a level 300mm. above the top of the pipe.

Zone 'C' :—From a level 300mm. above the top of the pipe to the top of the trench.

1317.2.3. *Back filling material* :—All back filling material shall be free from cinders, ashes, slag, refuse, or organic material, lumpy of frozen material, boulders, rocks or stones, or other material which in the opinion of the Executive Engineer, is unsuitable or deleterious. However, material containing stones upto 200mm., as greatest dimension, may be used in Zone 'C' unless specified otherwise.

1317.2.3.1. *Back fill sand* :—Sand used for back fill shall be natural sand complying with para 1317.2.3 graded from fine to coarse. The total weight of loam and clay in it shall not exceed 10%. All materials shall pass through a sieve of aperture size 20mm., and not more than 5% shall remain on sieve of aperture size 630mm.

1317.2.3.2. *Back fill moorum* :—Moorum used for back filling shall comply with para 1317.2.3 and shall have durable particles graded from fine to coarse in a reasonably uniform combination with no boulders or stones larger than 50mm. in size. It shall not contain excessive amount of loam and clay.

1317.2.4. *Back filling in Zone 'A'* :—Back filling shall be done by hand with sand murram or other, approved material placed in layers of 100mm. and compacted by tamping. The back filling material shall be deposited in the trench for its full width on each side of the pipe, fillings and appurtenance simultaneously.

1317.2.5. Back filling in Zone 'B' shall be done by hand or approved mechanical methods, special care being taken to avoid damage or disturbance to the pipe. The type of backfill material to be used shall be as prescribed in the detailed tender specification or as directed by the Executive Engineer to suit local situation. The back fill material specified shall be placed in layers of 160mm. and watered and compacted by tamping.

1317.2.6. Back filling in Zone 'C' shall be done by bend or by approved mechanical methods. The type of back filling material shall be as prescribed in the detailed tender specification or as directed by the Executive Engineer to suit the local conditions. The back fill material shall be placed in layers of 160mm. and watered and compacted by tamping.

1317.2.7. *Back filled with excavated material* :—The excavated material may be used for following cases provided it complies with clause 1317.2.3.

(a) In zone 'C' in cases where settlement is unimportant and where shown on the drawings or specified, the back fill shall be neatly rounded over the trench to a sufficient height to allow for settlement to the required level.

(b) In any zone, where the type of back fill material is not indicated or specified provided that such materials consists of loam, clay sand, moorum or other materials which are suitable for back filling in the opinion of the Executive Engineer.

1317.2.8. *Surplus soil* :—All excavated surplus soil which is not fit for backfilling shall be conveyed to the specified location shown on the drawings or as directed by the Executive Engineer.

1317.2.9. *Back fill under permanent pavement or road surface* :—Where the excavation is made through permanent pavements road kerbs, paved foot paths or where such structures are under cut by the excavation, the entire back filling to the sub-grade of the structure shall be made with sand, gravel or moorum in accordance with para 1317.2.3. Pavement consisting of broken gravel, slag or cinder shall not be considered as or permanent construction. Method of placing and consolidating back fill material under permanent pavements of road shall be as prescribed in the detailed tender specification to suit individual location.

1317.3. Removal, restoration and maintenance of permanent pavement or paved foot pants after laying pipes :

1317.3.1. *Allowable removal of pavement* :—Pavement and road surfaces may be removed as part of the trench excavation and the extent removed shall depend upon the width of the trench specified for the installation of the pipe; and the width and length of pavement area required to be removed for the installation of the gate valves specials, manholes or other structures. The width of pavement or road removed along the normal trench for the installation of the pipe shall not exceed the width of the trench specified by more than 150mm. on each side of

the trench. The width and length of the area of pavement or road removed for the installation of the gate valves specials, manholes or other structures shall not exceed the maximum linear dimension of such structure by more than 150mm. on each side. Wherever in the opinion of the Executive Engineer site conditions make it necessary or advisable to remove additional pavement it shall be removed as directed by the Executive Engineer.

Where any pavement or other property has been damaged beyond the limits specified above the restoration of such pavement or other property shall be done at the expense of the contractor.

1317.3.2. *Restoration of damaged surfaces and property* :—Wherever pavement or road surface fence poles or other property and surface structures has been damaged, removed or disturbed during the course of work, such property or surface structures shall be replaced or repaired after completion of the work.

1317.3.3. *Replacement of pavement and structure* :—All pavements or road structures, paved foot-paths, kerbing, gutters, fence, poles, sod, or other property and surface structures removed or disturbed as part of the work shall be restored to condition equal to that before the work began. In restoring the pavement or road, sound granite blocks, sound brick or asphalt paving block, soiling stone and road metal excavated may be refused. No permanent pavement or road surface shall be restored unless and until, in the opinion of the Executive Engineer the condition of the back fill is such as to properly support the pavement or road.

1317.3.4. A separate schedule item shall be provided for removal restoration or replacement of permanent pavements, road surfaces, or paved foot-paths complying with Specifications 1317.3.1, 1317.5.2 and 1317.3.3 and the rate for payment shall also be specified therein.

1317.4. Measurement :

1317.4.1. All linear measurements shall be in metres correct to 0.01 of a metre. Volumes shall be worked out in cubic metres correct to 0.01 of a cu.m.

1317.4.2. Measurements shall be made according to the sections shown on the drawings or such other sections including stepping or sloping back as may be authorised by the Executive Engineer.

1317.4.3. In case of excavation in rock, when measurement is not directly possible from sections, it may be arrived at by measuring compactly formed stacks of the excavated rock. Deduction of 40% shall be made to allow for voids.

1317.4.4. The quantity of backfill material used, other than excavated material shall be arrived at on the basis of pre-measurements. While measuring back fill with excavated material the volume of pipes (in the trench) of diametres 300mm. or more shall be deducted.

1317.5. Rate :

1317.5.1. The rate for earthwork shall be for a unit of 10 cu.m. The rate for excavation in rock shall be for a unit of one cu.m.

1317.5.2. The rate for excavation shall include the following for which no extra payment shall be made :

(a) Site clearance such as clearing of shrubs, brushwood, under growth small trees not exceeding 300mm. in girth measured at one metre above ground.

(b) Marking out.

(c) Initial lead of ten metres and initial lift of two metres.

(d) Forming temporarily steps at sides of deep trenches.

(e) Removing slips and blows during excavation.

(f) Protection by fencing and other safety measures.

(g) All dewatering required during excavation unless provided for separately in the agreement.

(h) All shoring, sheeting, planking and shrutting, etc., unless provided for separately in the agreement.

1317.5.3. Where the trench is excavated with extra slopes not covered by the approved sections for the convenience of the contractor with the prior approval of the Executive Engineer, no extra shall be paid for either excavation or for refilling of such extra slopes.

1317.5.4. Where the excavated material is not suitable for back fill or where other materials are prescribed for back fill, they shall be paid for separately.

Specification No. 1318

Laying and Jointing of Glazed Stone Ware Pipes and Fittings

1318.1. Handling and laying of pipes :

1318.1.1. *Unloading of pipes* :—While unloading, pipes shall not be thrown down from the trucks on hard ground. Unloading them on timber skids without a steadying rope and thus allowing the pipes to bump hard against one another shall not be allowed. In order to avoid damage to the pipes and specially to the spigot end, pipes shall not be dragged along concrete and similar pavements with hard surfaces.

1318.1.2. *Lowering of stone ware pipes into trench* :—In shallow trenches, manual handling is enough but in deep surface trenches they shall be lowered into the trench by means of ropes. Under no circumstances shall the pipes be dropped or dumped into the trench.

1318.1.3. *Detection of cracks in pipes and fittings* :—The pies and fittings shall be inspected for defects, and be rung with a light hammer preferably while suspended, to detect cracks.

1318.1.4. *Cleaning pipes and fittings* :—All lumps, blisters and excess coating materials shall be removed gently from the socket and spigot end of each pipe and the outside of the spigot and the inside of the socket shall be wiped clean and dry before the pipe is laid.

1318.1.5. *Placing the pipes in trench* :—Every precaution shall be taken to prevent foreign materials from entering the pipes when it is being placed in the

line. Normally the socket ends shall face the upstream. When the line runs up hill, the socket ends shall face the upgrade.

1318.1.5.1. Sight rails shall be provided at all changes of directions or gradients at distances of about 30m. along straight lengths. The centre line shall be marked on each horizontal rail which is fixed at true level. All inverts shall be laid to grade and line there from with the help of bonding roads.

1318.1.5.2. After placing a length of pipe in the trench on concrete bedding where that is specified the spigot end shall be centered in the socket and the pipe pushed home and aligned to gradient. The pipe shall be secured in place with approved back fill material or concrete tamped under it, except at the socket. Pipes and fittings which do not allow a sufficient and uniform space for joints shall be removed and replaced with pipe and fittings of proper dimensions to ensure such uniform space. Precautions shall be taken to prevent dirt from entering the joint space.

1318.1.5.3. At times, when pipe laying is not in progress, the open ends of pipe shall be closed by a water tight plug or canvas or other means approved by the Executive Engineer.

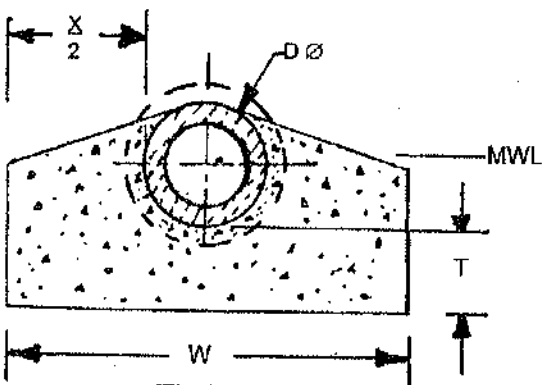
1318.2. Bed Concrete :—

1318.2.1. *Bedding and haunching* :—Where the pipes are laid on a soft soil with high water table level or where there is possibility of damage due to roots of growing trees, the pipe shall be bedded and haunched in concrete. (*See* Fig. 1318-1).

1318.2.2. *Encasement* :—Where the pipe is laid at shallow depths and where the intensities of the traffic or other loads on the pipe exceed the limits given below, the pipe shall be encased. Completely in concrete as shown in Figure 1318-2 or provided with other protection as may be specified. The super imposed load shall not normally exceed 1600 kg. per metre length which is the minimum crushing strength specified on IS : 651. The super imposed load on a laid pipe may be calculated by Marston's formula, given below :

$W=CWB^2$ Where

HAUNCHING



[Fig. No. 1318.1]

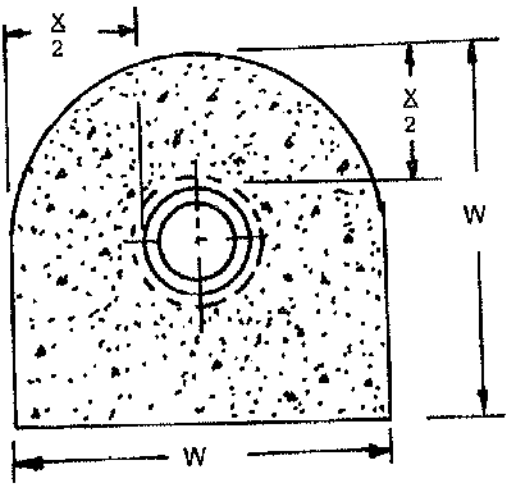
W=D+X =Where D is the External Diameter of the pipe.

X = 300mm. upto trench Depth of 1200mm.
400mm. Trench Depth more than 1200mm.

T = 100mm. for pipes under 150mm. Nominal Diameter one fourth of Internal Diameter subject to a minimum of 150mm. and maximum of 300 for pipes of more than 150mm. Diameter

MWL = Maximum Water Level

SORROUND OR ENCASING



[Fig. No. 1318.2]

W=D+X =Where D is the External Diameter of the pipe

X = 300mm.. upto trench Depth of 1200mm
400mm. Trench Depth more than 1200mm

T = 100mm. for pipes under 150mm. Nominal Diameter, one-fourth of Internal Diameter subject to a minimum of 150mm. and maximum of 300mm. for pipes of more than 150mm. Diameter

W = Load on pipe in Kilograms/Linearmetre

C = Coefficient which depends upon the ratio of depth of trench to trench width and the filling materials. (See Table 1318-1)

W = Weight of filling materials in kg./m^2 (See Table 1318-2) &

B = Width of trench in metres

Table 1318.1

Value of 'C'

Ratio of depth to trench width (1)	*Sand & Damp top soil* (2)	*Saturated soil* (3)	*Damp clay* (4)	*Saturated clay* (5)
0.5	0.46	0.46	0.47	0.47
1.0	0.85	0.86	0.88	0.90
1.5	1.18	1.21	1.24	1.28
2.0	1.46	1.50	1.56	1.62
2.5	1.70	1.76	1.84	1.92
3.0	1.90	1.98	2.30	2.44
3.5	2.08	2.17	2.30	2.44
4.0	2.22	2.33	2.49	2.66
4.5	2.34	2.47	2.65	2.87
5.0	2.45	2.59	2.80	3.03
5.5	2.54	2.69	2.93	3.19
6.0	2.61	2.78	3.04	3.33
6.5	2.68	2.86	3.14	3.46
7.0	2.73	2.93	3.22	3.57
7.5	2.78	2.98	3.30	3.67
8.0	2.81	3.03	3.37	3.76
8.5	2.85	3.07	3.42	3.85
9.0	2.88	3.11	3.48	3.92
9.5	2.90	3.14	3.52	3.98
10.0	2.92	3.17	3.56	4.04
11.0	2.95	3.21	3.63	4.14
12.0	2.97	3.24	3.68	4.22
13.0	2.99	3.27	3.72	4.29
14.0	3.00	3.28	3.75	4.34
15.0	3.01	3.33	3.77	4.28
Very great	3.03	3.33	3.85	4.55

Table 1318.2

Weights of Common fittings materials

Material	*Weight kg./m³*
Dry sand	— *1600*
Ordinary (Damp) sand	— *1840*
Wet sand	— *1920*
Damp clay	— *1920*
Saturated clay	— *2080*
Saturated top soil	— *1840*
Sand and damp soil	— *1600*

1318.2.3. *Materials* :—The concreting wherever necessary shall be done with 1 : 5 : 10 mass cement concrete, unless otherwise specified.

1318.3. Connection :

1318.3.1. *Cutting of pipes* :—The cutting of pipes for inserting, filling or closure pieces, shall be done in a neat and workman like manner without damage to the pipe so as to leave a smooth end at right angles to the axis of the pipe.

1318.3.2. *Connection to an existing sewer* :—The connection to an existing sewer shall be done through manholes.

1318.3.3. *Connection to manholes* :—Before connecting a pipe to a manhole, a relieving arch or any other similar protection device shall be made in the manhole for the safety of the pipe.

1318.4. Jointing of pipe :

1318.4.1. *Types of joints* :—The stoneware pipes shall unless otherwise be specified be cement jointed.

1318.4.1.1. *Materials for cement joints* :—The materials shall consist of the following :

(i) Spun yarn or tarred gaskets.

(ii) Cement conforming to specification 112.

(iii) Sand conforming to specification 110.

1318.4.1.2. *Jointing procedure for cement joints* :—The procedure as given below shall be followed.

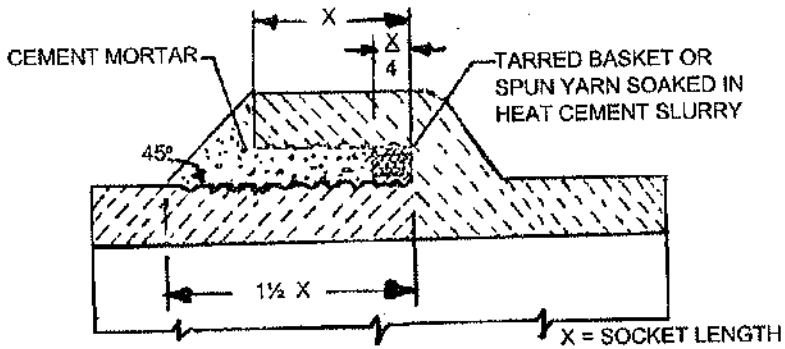
1318.4.1.2.1. *Caulking with yarn or gasket* :—In each joint spun yarn soaked in neat cement slurry or tarred gasket shall be passed round the joint and inserted in it by means of a caulking tool. More skeins of yarn or gasket shall be added if necessary and shall be well caulked. Yarn or gasket rammed shall not occupy more than ¼th of the depth of the socket.

1318.4.1.2.2. *Caulking of cement mortar* :—Cement mortar 1 : 1 (one part of cement to one part of sand) shall be slightly moistened and carefully inserted by hand into the remaining space of the joint after caulking of yarn or gasket. The mortar shall then be caulked into the joint with a caulking tool. More cement mortar shall be added until the space of joint has been completely filled with tightly caulked mortar. The joint shall then be finished off neatly outside the socket at an angle of 45° as shown in Figure 1318.3.

1318.4.1.2.3. *Curing* :—The cement mortar joints shall be cured at least for seven days before testing.

1318.4.1.2.4. The approximate quantity of cement and spun yarn required for each joints for certain common sizes of pipes are given below for guidance.

TYPICAL DETAIL OF CEMENT JOINTS FOR GLAZED STONEWARE PIPES



[Fig. No. 1318.3]

Nominal dia. of pipe mm.	*Cement kg.*	*Spun yarn kg.*
100	1.00	0.25
150	1.50	0.35
200	2.00	0.70
250	2.50	0.80
300	3.25	1.10
350	4.50	1.25
400	5.50	1.50

1318.4.2. *Jointing with cast iron pipes* :—Where any cast iron soil pipe, waste pipe, ventilating pipe or trap is connected with a stone-ware pipe, the joint shall be made with cement. (See clause 1318.4.1).

1318.4.3. *Jointing with concrete pipes* :—The procedure shall be the same as described for cement joints, (see clause 1318.4.1) but the socket or the spigot shall be thoroughly wetted before the joints are made.

1318.5. Testing :

1318.5.1. All sewer lines shall be subjected to hydraulic pressure tests as explained below :

The sewer lines shall be filled with water and maintained full for 24 hours under a head of 600mm. of water, by adding further water if the water level subsides. Subsidences of the test water may be due to one or more of the following causes :

(a) Absorption by sewers and joints,

(b) Sweating of sewers or joints,

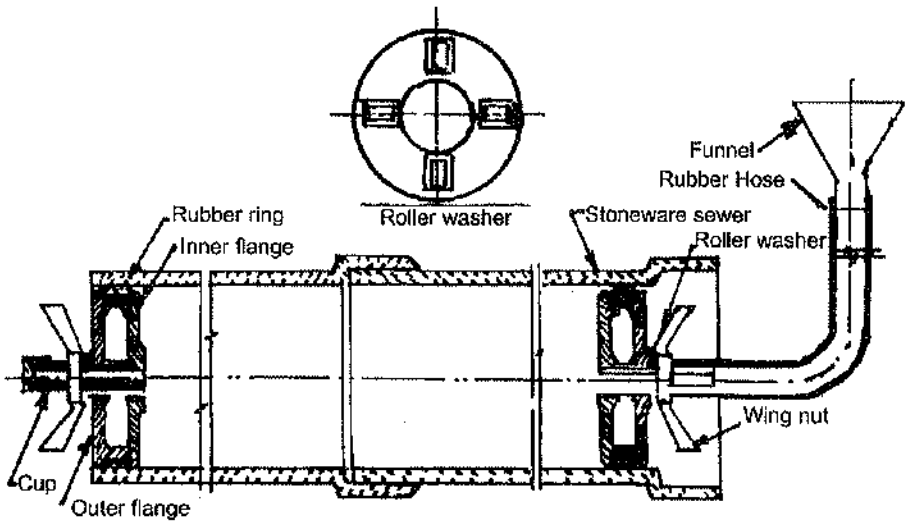
(c) Leakage at joints or from defective sewers,

(d) Trapped air.

After this, sewer testing plugs shall be inserted at the upstream and downstream ends of the line under testing and also in the various service trappings and tightened. The plugs shall comprise of two flanges, one rubber ring, wing nut, etc. The plug is made leak proof by expanding the ring against the sewer wall by tightening the wing nut against a rubber washer used for the purpose. (See Fig. 1318.4). The downstream end shall be capped after plugging.

TYPICAL ARRANGEMENT FOR HYDRAULIC TEST OF SEWERS

[Fig. No. 1318.4]



A knuckle bend shall be temporarily jointed in at the testing end (generally top end) and a sufficient length of vertical pipe jointed to it so as to provided the required test head, or the top end may be plugged with a connection to a hose ending in a funnel facilitating the raising or lowering of the funnel to obtain the required head, the fixed suitably for observation. The funnel shall be kept at a height of 2.5m. from the invert of the sewer.

Water for testing is filled in through the funnel or through the vertical pipe. To allow the entrapped air in the sewer to escape, a small hole is made at the top end after filling the sewer completely the hole is tightly closed with a wooden plug wound with hemp.

The sewer line shall be considered sound if it does not show a leakage of not more than 2 litres/10mm., of dia per kilometre during a period of 10 minutes under a test pressure of atleast 2½ m. head of water at the highest point of the section under test.

1318.5.2. Any leakage will be visible and the defective part of the work shall be removed and made good. A slight amount of sweating which is uniform may be over looked, but excessive sweating from a particular sewer or joint shall be watched for and taken as indicating a defect to be made good.

The filling of the trench shall not be commenced until the sewer line is tested and passed.

1318.5.3. *Rectification of faulty joints* :—Any joint found leaking or sweating shall be rectified or embedded into 150mm. layer of cement concrete (1 : 2 : 4), 300mm. in length and the section retested.

1318.5.4. *Measurement* :—The linear measurements shall be in metres correct to 0.01 of a metre. Unless otherwise stated, the lengths of all sewer pipes shall be measured net along their central line as laid, over all fittings such as bends, junctions, etc., which shall not be measured separately.

1318.5.5. *Rate* :—The rate for the payment shall be per metre length of sewer pipe laid in position and shall include jointing, testing and making good any defects, cost of jointing material and cost and conveyance of water from sources within distance of 200 metres from the work site. All pipes and fittings are classified according to their diameters, method of jointing and fixing substances, quality and finish. The diameter shall be the nominal diameter of the internal bore. In case of fittings of unequal bore, the largest bore shall be measured. Unless otherwise stated all cuttings and waste shall not be paid for separately.

The cost of concrete bedding, haunchings, casing and any other special protection required shall be paid for separately as per the relevant Standard Specification.

Specification No. 1319

Laying and Jointing of Cast-iron Pipes, Fittings and Fixing Accessories

1319.1. Handling and laying :

1319.1.1. *Lowering of material into the trench* :—Necessary facilities shall be provided for the safe and convenient execution of the work. All pipes, fittings and values shall be carefully lowered into the trench, piece by piece, by means of derrick, ropes or other suitable means, in such a manner as to prevent damages to materials and protective coatings and linings. Under no circumstances shall material be dropped into the trench pipes over 300mm. diametres shall be handled and lowered into trenches with the help of chain pully blocks or other such devices. Tripod supports if used for this purpose shall be regularly checked to prevent all risks of accidents.

1319.1.2. *Detection of cracks in pipes* :—The pipes and fittings shall be inspected for defects and be rung with a light hammer preferably while suspended to detect cracks. A doubt persists, further confirmation may be obtained by pouring a little paraffin on the inside of the pipe at the suspected spot. If a crack is present, the paraffin seeps through and shows on the outer surface.

1319.1.3. *Cleaning pipes and fittings* :—All lumps, blisters, and excess coating materials shall be removed from the socket and spigot end of each pipe and the outside of the spigot and the inside of the socket shall be wire brushed and wiped clean and dry and free from oil and grease before the pipe is laid.

1319.1.4. *Laying pipe* :—Every precaution shall be taken to prevent foreign material from entering the pipe while it is being placed in the line. If the pipe laying team cannot put the pipe into the trench and in place without getting earth into it, the Executive Engineer may require that before lowering the pipe into trench, a heavy tightly wove canvas or gunny bag of suitable size shall be placed over each and left there, until the connection is made to the adjacent pipe. During laying operations, no debris, tools, clothing or other materials shall be placed in the pipe.

1319.1.4.1. After placing a length of pipe in the trench, the spigot end shall be centered in the socket and the pipe forced home and aligned to gradient. The pipe shall be securely bedded in place with approved back fill material tamped under it except at the socket. Pipe and fittings which do not allow a sufficient and uniform space for joint shall be removed and replaced with pipe and fittings of proper dimensions to ensure such uniform space. Precautions shall be taken to prevent earth or other extraneous material from entering the joint space.

1319.1.4.2. At times when pipe laying is not in progress, the open ends of pipe shall be closed by water tight plug or other means approved by the Executive Engineer.

1319.1.5. *Number of pipes laid before jointing* :—Wherever the jointing material specified cement, six or more lengths of pipes shall be laid in place ahead of each joint before such a joint is finished.

1319.1.6. *Cutting of pipe* :—The cutting of pipe for inserting valves, fittings, or closure pieces shall be done in a neat and workmanlike manner without damage to the pipe or cement lining so as to leave a smooth end at right angles to the axis of the pipe. For this purpose, use of a pipe cutting machine is recommended.

1319.1.6.1. When pipe cutting machine is not available for cutting pipes of large diameter, the electric arc cutting method may be permitted using a carbon or steel rod. Only qualified and experienced workman shall be employed on this work. Alternatively pipes can be cut manually by using hand tools employing skilled and experienced workmen.

1319.1.6.2. The flame cutting of pipe by means of an oxy-acetylene torch shall not be allowed.

1319.1.7. *Direction of laying of socket ends* :—On level ground the socket ends shall face the upstream. When the line runs uphill, the socket end shall face the upgrade.

1319.1.8. *Permissible deflection at joints* :—Wherever it is necessary to deflect pipe from a straight line, either in the vertical or horizontal plane, to avoid obstructions or where long radius curves are permitted, the deflection allowed at any joint shall not exceed 2.5°.

1319.1.9. *Conditions unsuitable for laying of pipe* :—No pipe shall be laid when, in the opinion of the Executive Engineer, trench conditions are unsuitable.

1319.2. Usage of anchor and thrust block in pipeline :—Thrust block suitably designed shall be provided whether necessary to transmit hydraulic pressure. Where the hydraulic thrust is in an upward direction, anchor blocks of sufficient

weight shall be provided to which the pipes shall be secured holding down arrangements.

1319.3. Jointing of pipes :

1319.3.1. *Jointing of socket and spigot pipes* :

1319.3.1.1. *Jointing materials* :—Jointing may be done with any one of the following materials :

(a) Molten lead (under dry conditions) conforming to IS : 782-1962.

(b) Lead wool (under wet conditions).

(c) Portland cement.

1319.3.1.2. *Packing material shall consist of one of the following* :

(a) Spun yarn.

(b) Moulded or tubular rings.

(c) Asbestos rope.

(d) Treated paper rope.

All the materials mentioned above shall be handled with care in order to prevent contamination and shall be dry where put into place in the joint. The material used shall be free of oil or greasy substances.

Spun yarn used as a packing material in potable water mains shall be of sterilised quality.

1319.3.1. *Placing of packing material* :—The packing material shall be placed around the spigot of the pipe and shall be proper dimensions to centre the spigot in the socket. When the spigot is pushed home, the packing material shall be driven tightly against the inside base or hub of the socket with suitable tools.

Except when moulded or tabular rings are used, each turn of the packing material, shall be an individual piece. When a single turn is used, it shall have an overlap at the top of not more than 50mm.

Where more than one turn is required for a joint, each piece shall be cut a sufficient length so that the ends shall meet without any overlap. The ends of the successive turns shall meet alternatively on opposite sides of the pipe and not on the top or at the bottom. Successive turns of packing material shall be driven home separately.

1319.3.1.4. *Lead joints* :

1319.3.1.4.1. Lead joints shall ordinarily by made with molten lead. When this is not possible, joints may alternatively be made with lead wool.

1319.3.1.4.2. The minimum depth of lead for various diameters of pipes shall be as in Table 1319-A. The corresponding approximate quantities of lead for molten lead joints and spun yarn are shown in the same table for guidance.

1319.3.1.4.3. *Pouring of lead* :—The joint runner shall fit snugly against the face of the socket and the outside of the pipe shall be dammed with clay to

form a pouring lip to provide for filling the joint flush with the face and to the top of the socket.

Lead shall be heated in a melting pot kept within easy reach of the joint to be poured so that the molten metal will not be chilled during transit. It shall be brought to a proper temperature so that when stirred, it will show a rapid change of colour. Before pouring all sum shall be removed. Each joint shall be made with one continuous pour, filling the entire joint space with solid lead. Spongy or imperfectly filled joints shall be melted out and repoured.

Table 1319-A

Quantity of lead and spun yarn for different sizes of pipes

Nominal size of pipe mm.	*Depth of lead in joint mm.*	*Qty. of lead joint kg.*	*Spun yarn joint kg.*
80	44.50	2.0	0.10
100	44.50	2.4	0.18
125	44.50	2.8	0.2
150	44.50	3.6	0.2
200	50.80	5.4	0.30
250	50.80	6.6	0.35
300	50.80	7.6	0.48
350	61.50	9.0	0.60
400	61.50	10.5	0.75
450	61.50	15.0	0.95
500	61.50	16.0	1.00
600	61.50	20.5	1.20
700	61.50	24.0	1.35
750	61.50	21.0	1.45
800	61.50	32.5	1.53
900	61.50	35.0	1.88

Note :—The quantities of lead and spun yarn given in the table are provisional and variation of 1% is permissible.

1319.3.1.4.4. *Caulking* :—Caulking may be done with pneumatic tools or manually with a caulking tool and a hammer weighing not less than 2kg. lead run joints shall be preferably finished 3mm. behind the socket face.

1319.3.1.5. *Lead wool joints* :—In the event of the Executive Engineer specifying or permitting the use of lead wool, the joints shall be made as follows :

A strand of lead wool first be introduced into the socket and thoroughly caulked, care being taken that no lead wool passes into the interior of the pipe.

A portion of the remainder of the socket shall then be filled in with best white hemp or spun yarn and this shall be thoroughly caulked with suitable caulking tools (kutcha tools or cold chisels are not to be used). Lead wool shall then be introduced and this caulking shall be repeated with each turn of the lead wool until the socket is full to within an eighth of an inch and the whole of the lead wool is compressed into a dense mass. The joint shall then be finally faced up with a finishing tool.

1319.3.1.6. *Cement joint* :

1319.3.1.6.1. Cast iron pipes may be jointed with cement in the case of low to moderate pressure system where so specified.

1319.3.1.6.2. The cement used shall conform to IS : 269-1958 Cement conforming to IS : 455-1953 may also be used where considered necessary.

1319.3.1.6.3. *Procedure for jointing* :—Closely twisted spun yarn gasket of such diameter as required to support the spigot of the pipe at the proper grade and make truly concentric joints, and in one piece of sufficient length to pass around the pipe and the lap at the top, shall be thoroughly saturated in thick cement slurry. This gasket shall be laid in the socket for the lower third of the circumference of the joint and covered with cement mortar. The spigot of the pipe shall be thoroughly cleaned with a wet brush, inserted and carefully driven home, after which a small amount shall be inserted in the annular space around the entire circumference of the pipe. Then the gasket shall be positioned around the pipe and solidly rammed into the joint with a caulking tool, the mortar previously placed being driven ahead of the gasket. The remainder of the joint shall then be completely filled with mortar and levelled off at an angle 45 degrees with the outside of the pipe. On pipes of larger diameter, the joint shall be pointed and smoothened from the inside where possible.

The inside of the pipe shall be cleaned after the mortar sets slightly by dragging a large block of wood or a bundle of straw wrapped with gunny through the pipe. Care is however necessary to see that this is not left in the pipe when the work is interrupted or completed.

1319.3.1.6.4. *Time interval before filling pipe* :—Pipe laid with cement joints shall not be filled with water until a lapse of twelve hours after the last joint in any valved section has been made and pressure shall not be permitted in the pipe until the lapses of 36 hours after filling.

1319.3.2. *Jointing of flanged pipes* :—

1319.3.2.1. *Jointing material* :—The jointing material shall be sheet rubber or rubber reinforced with cotton fabric as per IS : 638-1965. Alternative material where specified may also be used.

The packing shall be of approved thickness as per the following table. It shall be of the full diameter of the flange with necessary holes for the bolts and pipe bore. It shall be even both at the inner and outer edge. Where flange is not fully faced, the packing may be of the dimension of the facing strip only. Its proper placing shall be tested before another pipe is jointed on.

Table 1319-B

Thickness and number of fabric piles

Sl. No.	*Diameter of pipe* mm.	*Thickness of sheet rubber jointing or Rubber reinforced cotton fabric jointing* mm.	*Tolerance on thickness* mm.	*No. of piles in rubber insertion jointing*
1.	For pipes upto 300mm.	5mm.	± 0.5mm.	2
2.	For pipes above 300mm	8mm. & above	± 0.7mm.	4

1319.3.2.2. *Bolts and nuts* :—The bolts shall be of the maximum diameter to go into the holes. The bolts and nuts shall conform to IS : 1363-1963.

1319.3.2.3. *Procedure for jointing* :—The gasket shall be positioned against one of the flanges so that the bolt holes register properly and the other flange brought into position against it. The bolts shall be inserted, and each bolt shall be tightened a little at a time taking care to tightened diametrically opposite bolts alternatively. The bolts shall be tightened sufficiently to prevent leakage but shall not be overtightened.

1319.3.2.4. *Special joints* :—Where so specified special or proprietary joints shall be used strictly in accordance with the manufacturer's instructions.

1319.4. Hydro Static tests :—After a new pipe line has been laid, jointed and back filled, vide Specification No. 1317 it (or any valved section thereof) shall be subjected to the following tests:

1319.4.1. Pressure test at a pressure of atleast double the maximum working pressure pipes with lead and flanged joints shall be absolutely water tight under the test.

1319.4.2. Leakage test (to be conducted on pipes laid with cement joints, after the satisfactory completion of the pressure test) at a pressure to be specified by the Executive Engineer not less than double the working pressure for water mains for a duration of 2 hours.

1319.4.2.1. Where any section of a main is provided with concrete thrust blocks or anchorages in accordance with the pressure, test shall not be made until atleast five days have elapsed after the concrete was cast. If rapid hardening cement has been used in these blocks or anchorages, the test shall not be made until atleast two days have elapsed.

1319.4.3. *Back filling* :—Before testing, the trench shall be partially backfilled upto 300mm. above the top of pipe except at the joints as laid down in the Specification 1317.

1319.4.4. *Time of testing* :—Lead jointed and flanged jointed pipes can be tested at any time after the pipe line has been laid and jointed. Cement jointed pipes

shall not be subjected to the test pressure until atleast 36 hours have been lapsed after filling the pipe line.

1319.4.5. *Procedure for pressure test* :—

1319.4.5.1. Each valved section of the pipe shall be slowly filled with water and all air shall be expelled from the pipe through hydrants or blown off through an air release arrangement. If these are not available at high places, necessary tapping may be made at points of highest elevation before the test is made and plugs inserted after the tests have been completed.

1319.4.5.2. The specified pressure based on the elevation of the lowest point of the line or section under test and corrected to the elevation of the test gauge, shall be applied by means of a pump connected to the pipe in a manner satisfactory to the Executive Engineer. The duration of the test shall not be less than 5 minutes.

1319.4.5.3. *Examination under pressure* :—All pipes and all exposed fittings, valves, hydrants, and joints shall be carefully examined during the test. When the joints are made with lead, all such joints showing visible leaks, shall be recaulked until tight. When the joints are made with cement and show seepage or slight leakage, such joints shall be cut out and replaced as directed by the Executive Engineer. Any cracked or defective pipe fittings, valve or hydrant, discovered in consequence of this pressure test shall be removed and replaced by sound material and the test shall be repeated to the satisfaction of the Executive Engineer.

1319.4.6. *Procedure for leakage test* :—

1319.4.6.1. Leakage is defined as the quantity of water to be supplied into the newly laid pipe, or any valved section thereof, necessary to maintain the specified test pressure after the pipe has been filled with water and the air expelled.

1319.4.6.2. No pipe installation shall be accepted until the leakage is less than the number of cubic centimetre, per hour as determined be the formula ;

$$Q1 = \frac{N.D.\ \sqrt{P}}{3.3}$$

Where Q1 = The allowable leakage in cm^3 per hour.

N = Number of joints in the length of the pipe line.

D = Diameter in m.m.

P = The average test pressure during the leakage test in $kg./cm^2$.

1319.4.6.3. *Variation from possible leakage* :—If any test of pipe laid discloses leakage greater than that specified in para 1319.4.6.2 the defective joints shall be repaired until the leakage is within the specified allowance.

1319.5. Fixing accessories to the pipe line :—Type plans and in some cases, also detailed plans, shall be furnished to the contractor for fixing specials, branches, valves, etc. Deviation from approved type designs and plans will, at times, be found necessary while the work is in progress to suit the local conditions. The contractor shall in all such cases, take timely instructions from the Executive Engineer and carry out the work in accordance with such instructions.

The following guidelines are for general compliance in connection with fixing accessories :

1319.5.1. *Fixing sluice valves* :—The sluice valves to be fixed on the pipe lines shall be examined, cleaned and placed in the position as indicated in the approved plans or as directed by the Executive Engineer. The valves shall be supported in the valve chamber so that no stress or strain occurs in the flanger or other joints of the valve.

The valve shall be carefully protected from lime or cement or other dust by suitable mat or gunny covering and the chamber itself shall be cleared of mortar and other refuse.

1319.5.2. *Fixing air valves* :—Air valves shall be fixed at the summits of the pipe line.

1319.5.3. *Fixing scour valve* :—At all depressions on a main, a scour valve of diameter atleast equal to half the diameter of the main, plus 25mm. subject to a minimum of 80mm. in diameter shall be fixed. The scour valve shall be fixed so that the outlet is from the underside of the main it is intended to scour. The outlet shall lead to the nearest drain or low place and special care shall be taken that the outlet is above ordinary flood level.

1319.5.4. *Fixing reflux valves* :—These shall be fixed at the position shown in the plans or as directed by the Executive Engineer. As a rule they will be fixed on the raising main and near the pumping station.

In cases where there are long lengths of ascending mains, reflux valve will be suitably fixed at positions on these mains, so as to avoid less of water from the mains, in the event of a burst on the long ascending mains, which would otherwise occur if reflux valves were not fixed.

1319.6. Repair to coating of pipes :—If damage is done to coating of cast iron pipes during handling the pipe shall be recoated with approved bitumen coating as directed by the Executive Engineer before the trench is refilled. If the damage is due to the carelessness of the contractor due to bad handling, the damages shall be made good at the contractor's expense.

1319.7. Cutting of pipes :—The cutting of ends of damaged pipes and the cutting of sound pipes required for laying, branches, bends, values or other specials in any particular position shall be done carefully.

Pipes damaged in transit shall not have their damaged portions cut off, till they are actually required for use.

1319.8. Measurement :

1319.8.1. All linear dimensions shall be measured in metre correct to 0.01 of a metre. The length of pipes shall be measured along the centre line of pipe line. Specials shall be measured as follows :

1319.8.2. *Bends* :—The net length measured along the centre line of curve multiplied by a coefficient of 1.5 shall be taken as the length to be paid for and the rate shall be the same as for plain pipes of corresponding diametre.

1319.8.3. *Branches* :—In a cast iron branch say 300mm. x 800mm., the net length of the 30mm. piece shall be paid for at the rate, for laying a similar length of 300mm. plain pipe, and the branch will be measured as 80mm. pipe. The coefficient of 1.5 may be given to the branches also as in the case of bends.

1319.8.4. *Tapers* :—The net length shall be measured as the length of the pipe of the larger diametre of taper. For example, a taper of 1.5 metres in length, 350mm. x 300mm. will be paid for as 1.5 metres of 350mm. plain pipe.

1319.8.5. *Collars* :—The measurement for laying a collar will be three times its length.

1319.9. Rate :

1319.9.1. The unit of measurement for laying pipes and specials shall be one metre. The rate shall be for the complete work finished in accordance with the specification, modified as may be necessary by a supplemental specification.

1319.9.2. The rate for specials such as bends, branches (tees etc.), tapers and collars etc., shall be the same as for the plain pipe of relevant diametres as measured in the preceding sub-clauses.

1319.9.3. The rate for cutting of pipes shall be according to the size of the pipes cut.

1319.9.4. *Joints* :—The joints shall be paid for separately and the unit of measurement shall be one joint including the cost of all jointing material and labour for jointing and testing, included cost and transport of water for testing from sources within a distance of 200 metres from the work, and making good any defective work.

Specification No. 1320

Laying and Jointing of Galvanized Mild Steel Pipes and Fittings

1320.1. External pipe line works :

1320.1.1. *Formation* :—Before pipe line is laid proper formation has to be prepared. For underground pipe line, suitable trenches shall be excavated. Pipe line above ground may be laid on embankments or be supported by pillars as the case may be.

1320.1.2. *Excavation and preparation of trench for laying underground pipe line* :—Excavation and preparation of trench for laying under ground pipe line shall be done in accordance with the SS : 1317 of Andhra Pradesh State Steel "Trench work excavation and back filling".

1320.1.3. The excavation shall be done only so much in advance of laying of pipes as to cause least damage to the trench and least inconvenience to traffic and in other respects.

1320.1.4. *Materials* :—The pipes and fittings shall conform to SS : 1303.

1320.1.5. *Handling and laying* :—Delivery of the pipes and specials and appurtenances shall be taken from the stock yard of the authority and transported to the site of laying and stacked along the route on timber skids. Suitable gaps in

the pipes, stacked shall be left at intervals to permit access from one side to the other.

1320.1.5.1. *Inspection and defection of defects* :—Each pipe before it is laid shall be examined and tested with a hammer to prove its soundness. The pipes and fittings shall be inspected and the defective material rejected. In case of pipes the defective portion may be cut out and sound portion re-threaded for use.

1320.1.5.2. *Cleaning* :—The pipes shall be carefully cleaned of all foreign matter before being laid.

1320.1.5.3. *Laying of pipes* :

1320.1.5.3.1. The pipes shall be laid on a well compacted bed on the trench.

1320.1.5.3.2. Where there is a gradient pipe laying shall proceed in on "uphill" direction to facilitate joint making.

1320.1.5.3.3. The pipes shall be carefully laid to the alignment, levels and gradients shown on the plans and sections and great care shall be taken to prevent any sand, earth or other matter from entering the pipes during laying.

1320.1.5.3.4. *Thrust blocks* :—Where specified thrust blocks of concrete shall be formed at bends to transmit the hydraulic thrust on to undisturbed ground and to spread it over sufficient area. Where the hydraulic thrust is in an upward direction, anchor blocks of sufficient weight shall be provided to which the pipes shall be suitably secured.

1320.1.5.4. *Jointing of pipes* :

1320.1.5.4.1. The screw threads of the pipes and fittings shall be protected from damage and before jointing, they shall be cleaned and smeared with white lead paste. The end of the pipe to be laid, shall be screwed into the coupling of the free end of the pipe, already laid. The joint shall be tightened with a pipe wrench so that the ends of the pipes abut firmly at the centre of the coupling. In cases where the joints require it owing to slackness of the screw threads a few turns of fine hemp smeared with white lead may be used to make water tight joints. The joints between the pipes and other fittings shall also be made in similar manner.

The branch connections shall not protrude in the bore of the parent pipes. When tapping the coupling and threading the pipes at site care shall be taken to avoid slackness in the joints.

1320.1.5.4.2. Where the pipes have to be cut or threaded the ends shall be carefully filed out so that no obstruction to bore is offered. The ends of the pipe shall then be threaded conforming to the requirements of IS : 554-1955 with suitable pipe dies, while tapping, coupling and threading pipes, care shall be taken to avoid any slackness in the joints.

1320.2. Internal pipe line work :—For internal work, the galvanized steel pipes and fittings shall normally run on the surface of the walls or ceiling. The fixing shall be done by means of standard pattern holder butt clamps, keeping the pipes about 15mm. clear of the wall. When it is found necessary to conceal the

pipes, chasing may be adopted or pipes fixed in the ducts or recesses etc., provided there is sufficient space to work on the pipes with usual tools. The pipes shall not ordinarily be buried in walls or solid floors. Where unavoidable, pipes may be buried for short distances provided adequate protection is given against damage and joints are not buried. Where directed by the Executive Engineer, a M.S. tube sleeve shall be fixed at a place a pipe is passing through a wall or floor for reception of the pipe and to allow freedom for expansion and contraction and other movements. In case the pipe is embedded in-walls or floors, it shall be painted with anticorrosive bitumastic paint of approved quality. The pipe shall not come contract with lime mortar or lime concrete as the pipe is affected by lime. Under the concrete floors the pipes shall be laid providing a cushion of sand filling

All pipes and fittings shall be fixed truly vertical and horizontal unless unavoidable.

The clamps shall be embedded in brickwork in cement mortar 1 : 3 (1 cement and 3 coarse sand) and shall be spaced at regular intervals in straight lengths as shown in the Table 1320-A.

Table 1320-A

Size of pipe mm.	*Horizontal runs metres*	*Lengths, Vertical runs metres*
15	2	2.5
20	2.5	3
25	2.5	3
32	2.5	3
40	3	3.5
50	3	3.5
65	3.5	5
80	3.5	5

The clamps shall be fixed at shorter lengths near the fittings as directed by Executive Engineer.

For pipes 15mm. to 25mm. dia., the holes in the walls and floors shall be made by drilling with chisel or jumper and not by dismantling the brick work concrete. However for bigger dimension pipes the holes shall be carefully made of the smallest size as directed by the Executive Engineer. After fixing the pipes the hole shall be made good with cement mortar 1 : 3 (1 cement and 3 sand) and properly finished to match the adjacent surface.

1320.3. Testing the joints :—After laying and jointing, the pipes and fittings shall be inspected under working conditions of pressure and flow. Any joint found leaking shall be redone and all leaking pipes removed and replaced without extra cost. The pipes and fittings after they are laid shall be tested to a hydraulic pressure of 6 kgs./cm^2 (60 metres water head). The pipe shall be slowly and carefully charged with water allowing all air to escape and avoiding all shock or

water hammer. All off-takes and stop cocks shall then be closed, and specified hydraulic pressure shall be applied gradually. Pressure gauge must be accurate and preferably should have been recalibrated before the test. The test pump having been stopped the test pressure shall maintain without loss for atleast half and hour. The pipes and fittings shall be tested in sections as the work of laying proceeds, keeping the joints exposed for inspection during the testing.

1320.4. Measurement :—The lengths shall be measured in metres correct to 0.01 of a metre for the finished work which shall include galvanized iron pipes and fittings such as bends, tees, toes, elbows, reducers, crosses, plugs, sockets, nipples and nuts, but exclude brass or gun metal taps (cocks), valves, lead connection pipes and shower roses. The measurements shall be taken separately for internal and external works. The lengths shall be taken along the centre line of the pipe and fittings. All pipes and fittings shall be classified according to their diametres, quality and method of jointing. In case of fittings of unequal bore the largest bore shall be considered.

1320.5. Rate :—

1320.5.1. *External pipe line work* :—The rate for external pipe line work shall include the cost of laying, jointing and testing including cost of jointing material but shall exclude cost of pipes and fittings. The rate shall not include excavation in trenches, painting of pipes and sand filling all round the pipes, unless specified otherwise, for which separate payment shall be made.

1320.5.2. *Internal pipe line work* :—The rate for internal pipe line work shall include the cost of laying, jointing and testing and jointing material but shall exclude cost of pipes and fittings. The rate shall include the cost of cutting holes in walls and floors and making good the same. This shall not however include concealed pipe work in which case cutting of chase and making good shall be paid for separately. The rate shall not include painting of pipes and providing sleeves, unless specified otherwise, for which separate payment shall be made.

Specification No. 1321

Laying and Jointing of Concrete Pipes

1321.1. Handling and laying of pipes :

1321.1.1. Every care shall be exercised in loading and transporting of concrete pipes. Handling shall be such as to void impact. Gradual unloading by inclined plane or chain pulley block is recommended.

1321.1.2. All pipe sections and connections shall be inspected carefully before being laid. Broken or defective pipes or connections shall not be used.

1321.1.3. If the sides of the trench are not vertical the toes of side slopes shall end at the top of the pipe and practically vertically sided trench shall be dug from the top of the pipe to the subgrade.

1321.1.4. The trench shall be of sufficient width to provide a free working space on each side of the pipe. The free working space shall be preferably not more than $^1/_3$rd diametre of the pipe and not less than 150mm. on either sides.

1321.1.5. The pipe shall be lowered into the trench carefully. Mechanical appliances may be used.

1321.1.6. The pipe shall be laid true to line and grade specified.

1321.1.7. Laying of pipe shall always proceed upgrade of slope. In case of pipes having spigot and socket joints, the socket ends shall face upstream. In the case of pipes with joints to be made with loose collars, the collars shall be slipped off before the next pipe is laid. Adequate and proper expansion joint shall be provided wherever necessary.

1321.1.8. The section of the pipe shall be joined together in such a manner that there shall be as little unevenness as possible along the inside of the pipe.

1321.1.9. In cases where the foundation conditions are unusual such as the proximity of trees and poles, under existing or proposed tracks etc., the pipe shall be encased in low strength concrete or compacted sand and gravel.

1321.1.10. In places where the natural foundation is inadequate, the pipe shall be laid and supported either in concrete cradle or proper proportion, or any other suitably designed structure. Where a concrete cradle bedding is used, the depth of concrete below the bottom of the pipe shall be at least ¼th of the internal diametre of the pipe subject to a minimum of 100mm. and maximum of 300mm. The concrete shall extend up the sides at least to a distance of ¼th of the outside diametre, for pipes 300mm. and over in diametre. The pipe shall be laid in the concrete bedding before the concrete has set.

1321.1.11. Pipes laid in trenches in earth shall be bedded evenly and firmly as far up the haunches of the pipe as to safely transmit the load, expected from the back fill through the pipe to the bed. This shall be done either by excavating the bottom of the trench to fit the curve of the pipe or by compacting the earth under and around the pipe to form an even bed.

1321.1.12. When pipe is laid in trench of rock, hard clay, shale or other hard material, the space below the pipe shall be excavated and replaced with an equalised bed of sand. The pipe shall not be laid directly on such hard material.

1321.1.13. Any one of the three methods defined in clauses 4.2.2, 4.2.3, 4.2.4 of IS : 783-1959 may be adopted for bedding of pipes in trenches. Where any particular method of bedding is not specified in the tender document, it shall be assumed that the pipes have to be laid adopting ordinary pipe bedding method as defined in IS : 783-1959.

1321.1.14. Trenches shall be kept, free from water until the material in the joints has hardened.

1321.1.15. When the pipe is closed and the trench is liable to be flooded by rain, care shall be taken to prevent the pipe from floating.

1321.1.16. Walking and running on completed pipe shall not be permitted until the trench has been back filled to a height of at least 330mm. over the pipe except as may be necessary in tamping or back filling.

1321.1.17. Trenches shall be back filled immediately the pipe has been laid and jointed (subject to the condition, the joint material has hardened) to a depth of 300mm. above the pipe, except at the joints which shall be kept open till the hydraulic test is completed. The back fill material shall be selected and deposited with reference to the future safety of the pipe. Care shall be taken when back filling not to injure or disturb the pipe or the joints.

1321.1.18. Tamping around the pipe shall be done by hand or other hand operated mechanical means. The water content of the soil shall be as near the optimum moisture content as possible.

1321.1.19. Filling of the trench shall be carried on simultaneously on all sides of the pipe in such a manner that unequal pressure does not occur.

1321.1.20. When the pipes have to be laid and jointed in culvert condition or open condition, they shall be handled and laid as described in clauses 9.2 and 9.3 of IS : 783-1959.

1321.1.21. Suitably designed Anchor Blocks at change of direction and grades for pressure lines shall be provided when required.

1321.1.22. *Jointing of pipes* :

1321.1.22.1. *Joints may be any of the following types* :

(a) Rigid collar joint,

(b) Rigid spigot and socket joint,

(c) Semiflexible spigot and socket joint,

(d) Semi flexible collar joint.

1321.1.22.2. *Collar joint* :— The recess at the end of the pipe shall be filled with a ring of jute or hamp braiding dipped in hot bitumen or other suitable approved compound. The ring shall be thoroughly compressed by jacking. The number of pipes that are jacked at a time shall depend on the diametre of the pipes and bearing capacity of the soil. For small pipes upto 250mm. diametre, 6 pipes can be jacked together at a time. The quantity of jute and bitumen in the ring shall be just sufficient to fill the recess or groove in the pipe and pressed hard by jacking. Before and during jacking, care shall be taken to see that there is no offset in the joint. The external face of the joint shall then be coated with cement mortar flush with the pipe surface. Loose collar shall be set up over the joint so as to have an even caulking space alround. Into this caulking space shall be rammed a mixture of cement and sand just sufficiently moistened to hold together in the form of cold when compressed in the hand. The caulking shall be so firm that it shall be difficult to drive the point of a pen knife into it. The caulking shall be applied on both sides of it in a slope of 1 : 1. The proportion of cement sand mixture shall be 1 : 2 in the case of non pressure pipes and 1 : 5 in the case of pressure pipes. In place of cement mortar, any other suitable compound may be used subject to prior approval of the Executive Engineer. For potable water mains, sterilized hemp or jute shall be used in making joints.

1321.1.22.3. *Curing the joints* :—Every joint shall be kept wet for about 10 days for maturing.

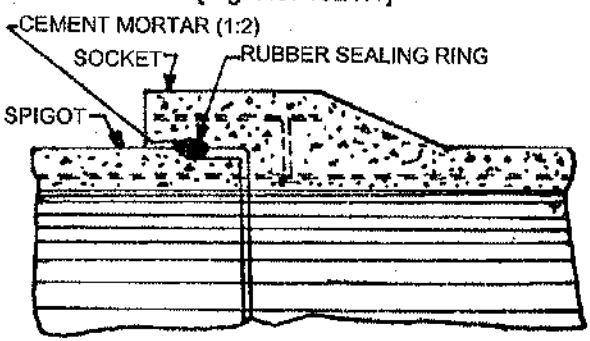
1321.1.22.4. *Expansion joints* :—Expansion joints shall be provided for buried lines at maximum intervals of 45 metres but for exposed pipe line, the joint interval shall not exceed 12 metres. Cast iron or steel collars and lead caulking conforming to IS : 782-1957 shall be used for expansion joints. Expansion joints need not however be provided for buried sewer lines unless ordered by the Executive Engineer depending on local situation.

1321.1.22.5. *Rigid spigot and socket joints* :—The joint may be adopted for pipes of 600mm. diametre and under. The method of jointing shall be as described in the relevant specification for jointing with cement mortar for stone ware pipes.

1321.1.22.6. *Spigot and socket joint semi-flexible* :—This joint is composed of specially shaped spigot and socket ends on the concrete pipes. A rubber sealing ring is placed on the spigot which is forced into the socket of the pipe previously laid. This compresses the rubber sealing ring as it rolls into the annular space formed between the two surfaces of spigot and socket and forms a flexible and water tight joint as shown in Figure 1321.1. The annular space around the spigot between the socket end and rubber sealing ring shall be filled with cement mortar 1 : 2 just sufficiently moistened to hold together in the form of a cold and compressed in the hand.

SPIGOT AND SOCKET JOINT (SEMI-FLEXIBLE) TYPE

[Fig. No. 1321.1]



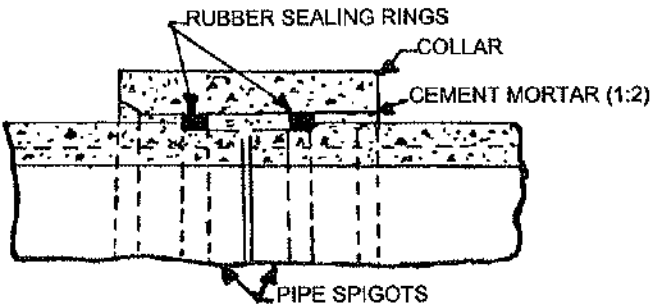
1321.1.22.7. *Collar joint – semi-flexible* :—This joint is made up of a loose collar which cover two specially shaped pipe ends as shown in Fig. 1321.2. Each end is uttered with a rubber sealing ring which when compressed between the spigot and collar, seals the joint. The annular space around the pipe of spigot between the rubber sealing ring and the ends of the collar shall be filled with cement mortar 1 : 2 moistened to a suitable consistency. Expansion joints need not be provided where flexible rubber sealing ring joints are used.

1321.2. Testing :

1321.2.1. While testing a pipe line hydraulically, the LINE shall be filled completely with water and kept filled for a week. The pressure shall then be increased gradually to the full test pressure, specified and the pipe line maintained at this pressure for one hour. In testing pipe lines, a seepage allowance of 2.50 litres per kilometer per hour per 10mm. diameter of the pipe shall be permissible.

COLLAR JOINT SEMI-FLEXIBLE TYPE

[Fig. No. 1321.2]



The following table gives the working pressure and test pressure in field for different classes of pipe.

Class of pipes	*Working pressure upto which the class of pipe may be used*		*Maximum test pressure in field upto which the pipeline is to be tested*
	(Gravity Main) Head of water	*(Pumping Main) Head of water*	*In terms of Head of water*
P1	13.30 metres	10 metres	20 metres
P2	26.60 metres	20 metres	40 metres
P3	40.00 metres	30 metres	60 metres
Non-pressure concrete, pipe			5 metres

1321.3. Measurement :— The measurement shall be in metres correct to 0.01 of a metre jointing shall be measured in number of joints.

1321.4. Rate :

1321.4.1. The rate for payment of laying of pipes shall be per metre. The rate shall be for the complete work finished in accordance with this specification, modified at may be necessary by an addendum specification.

1321.4.2. The rate for payment of jointing and testing pipe line with rigid or flexible joints shall be per joint and shall include the cost of all jointing material and cost of transport including water, required for testing and pipe line from sources within a distance from a pipe line not exceeding 200m., and filling the main and testing and making good any defective work in addition to labour charges for jointing. The expansion joints shall be paid for separately.

Specification No. 1322

Laying & Jointing of A.C. Pressure Pipes & Fittings

1322.1. Materials :—(a) The pipes and fittings shall conform to SS : 1305.

(b) Rubber rings used in jointing shall comply with the requirements of IS:5382-1969.

1322.2. Excavation and preparation of trench for laying under ground pipe line :—Excavation and preparation of trench for laying under ground pipe line shall be done in accordance with SS : 1317 for "Trench work excavation and back filling" and clause 1320.1.3 on "Laying & Jointing of galvanized mild steel pipes & fittings".

1322.3. Handling & Laying :

1322.3.1.1. Delivery of the pipes, fittings, and appurtenances shall be taken from the stock yard of the department and transported to the site of laying and the materials stocked along the trenches after they are ready to receive them.

1322.3.1.2. Where mechanical handling facilities are not available, the following procedure for unloading pipes shall be adopted.

Pipes weighing upto 60 kgs. shall be handled by two persons by hand passing. However pipes shall be unloaded from the lorry or wagon by holding them in loops, formed with rope and sliding over planks set not steeper than 450. The planks shall be sufficiently rigid and two ropes shall always be used to roll the pipes down the planks. Only one pipe shall be unloaded at a time.

(c) Under no circumstances shall the pipes be thrown down from the carriage or be dragged or rolled along hard surface.

1322.3.2. *Inspection and detection of defects* :—The pipes and fittings shall be inspected and defective material rejected. In the case of pipes the defective portion may be cut out at a point not less than 150mm. beyond the visible defect and sound portion retained for use.

1322.3.3. *Cleaning* :—The pipes shall be carefully cleaned of all foreign matter before laying.

1322.3.4. *Cutting of pipes* :—Cutting of pipes may be necessary where pipes are to be laid in lengths shorter than the lengths supplied, such as, while salvaging the pipes with damaged ends or while replacing C.I. accessories like tees, bends, etc., at fixed position in the pipe line. In such cases, it may also be necessary to reduce the cut ends by rasps to suit the inner diameter of central collar. The cutting of pipes shall be done as below.

A line shall be marked around the pipe with a chalk piece at the point where the cut is to be made. The line shall be so marked that the cut is truly at right angle to the longitudinal axis of the pipe. The pipe shall be rigidly held on two parallel rafters nailed to cross beams, taking care that the portion to be cut does not overhang and the cut mark is between the two rafters. The pipes shall be neatly cut at the chalk mark with carpenters saw or hacksaw having a long blade, by slowly rotating the pipe around its longitudinal axis so as to have the uncut portion on top for cutting. Cutting of the pipe at the overhang should as far as possible be avoided as an overhanging end is liable to tear off due to its weight before the cut is completed. (See Fig. 1322.1)

1322.3.5. *Lowering the pipes* :

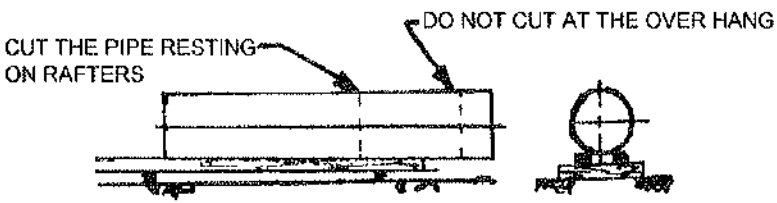
(a) No pipe shall be laid, where in the opinion of the Executive Engineer, trench conditions are unsuitable.

(b) Before the pipe is lowered, the trench shall be carefully examined to determine that even bedding is provided for the pipe line and that the pipe may be lowered into it without damage.

(c) The pipe shall be lowered into the trench by means of suitable pulley blocks, shear legs, clauses, ropes, etc. Where these mechanical handling facilities are not available, the pipe shall be lowered into the trenches either by hand passing or by means of two ropes. One end of each rope shall be tied to a wooden or steel peg driven into the ground and the other end shall be held by men which, when slowly released, will lower the pipe into the trench.

(d) In no case the pipe shall be rolled and dropped into the trench.

CUTTING OF ASBESTOS CEMENT PRESSURE PIPE
[Fig. No. 1322.1]



1322.3.6. *Laying* :—Clause 1320.1.5.3 "Laying and Jointing of Galvanised mild steel pipes and fittings" shall apply. In addition the following precautions shall be taken.

(a) The pipe shall rest continuously on the bottom of the trench. The pipe shall not rest on lumps of earth or on the joints. 4m. long wooden templates may be used to check the level of the bed. Clearance of approximately 100mm. in depth and width equal to length of the collar plan 30mm .on both sides shall be provided at the joint which shall be refilled from sides after the joint is made.

(b) In unstable soils, such as soft soils and dry lumpy soils, it shall be checked whether the soil can support the pipe lines and if required suitable special foundation shall be provided.

(c) In clayey soils (such as back cotton soil), the Executive Engineer shall establish whether the conditions exist to a degree justifying special precautions. It is recommended that in such cases an envelope of a minimum 100mm. of tamped sand shall be made around the pipe line to avoid any bonding.

(d) In places where rock is encountered, cushion of fine earth or sand shall be provided for a depth of 150mm. by excavating extra depth of trench, if necessary, and the pipe laid over the cusion. Where the gradient of the bed slope is more than 30°, it may be necessary to anchor a few pipes against their sliding downwards.

1322.4. Jointing of pipes :—

1322.4.1. The trench shall be kept quite dry during jointing unless in any particular case, the Executive Engineer permits laying the pipe in wet conditions, in which case the instructions of the Executive Engineer shall be followed.

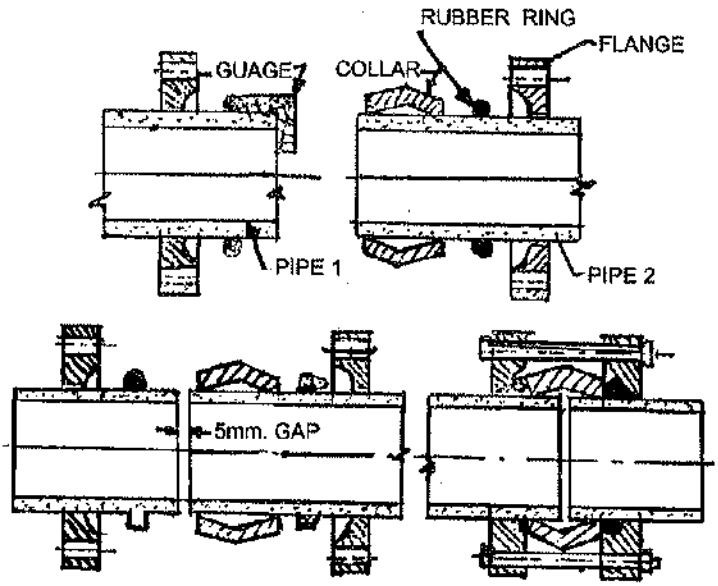
1322.4.2. Before commencing jointing the pipe shall be cleaned. The joints and ends of the pipe shall also be cleaned preferably with a hard wire brush to remove loose particles.

1322.4.3. *Cast iron detachable joints* :

1322.4.3.1. The joint shall consist of a central collar, two rubber rings, two flanges of C.I. and the required number of bolts and nuts.

1322.4.3.2. One flange and rubber ring shall be placed on the end of the pipe already laid and the other flange, rings and central collar shall be slipped, on to the pipe to be assembled. (See figure 1322.2).

CAST IRON DETACHABLE JOINT



[Fig. No. 1322.2]

1322.4.3.3. The rubber ring shall be kept positioned at half the collar width less 2.5mm. from the end of the pipe already laid. A site gauge as shown in Figure 1322.2 may be used for convenience.

1322.4.3.4. The other pipe shall be brought nearer leaving a gap of 5mm. between the two pipe ends. This gap will facilitate manouvering of deflection at joints after assembly and will take care of an expansion in the pipe line.

1322.4.3.5. The collar shall be slided to sit square around the rubber ring on pipe, and then the rubber ring shall be rolled on pipe-2 to sit around the collar.

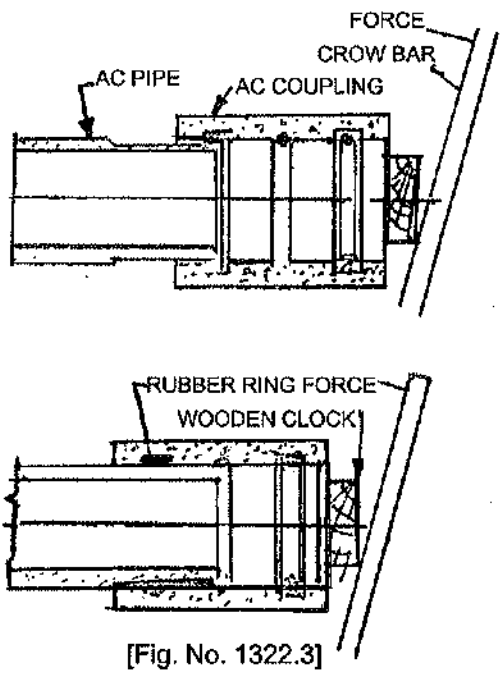
1322.4.3.6. The flanges shall be moved on both ends to enclose rubber rings. The fastening bolts shall be inserted through the holes of the flanges and the bolts shall be tightened alternatively and evenly for proper sitting of the joint.

1322.4.4. *Asbestos cement coupling* :

1322.4.4.1. This joint shall consist of three rubber rings and an asbestos cement coupling machined on the inside.

1322.4.4.2. The rubber ring shall be sealed in the respective grooves, after cleaning the coupling and rubber rings. The machined ends of the pipe and rings in the coupling shall be suitably lubricated with a soft soap solution or other lubricant which is not detrimental to rubber rings or drinking water. Then the assembly shall be made by pushing with a crow bar or using a pipe puller. (See figure 1322-3).

ASBESTOS CEMENT COUPLINGS JOINT



[Fig. No. 1322.3]

1322.4.4.3. The joints shall be made by keeping the pipes in one line. Any permissible deflection of the joint shall be made after completion of the joint only. The amount of deflection and the radius of the curvature be successive deflection shall be as given in the Table 1322-A.

Table 1322-A

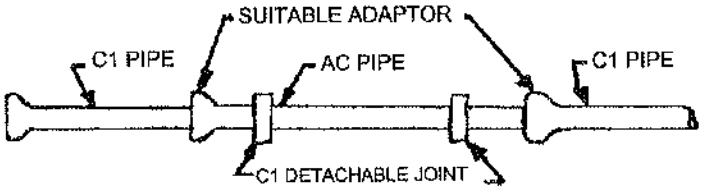
Deflection and Radius of Curvature (Clause 1322.4.4.3)

Angle of deflection	*Displacement 'D' in mm for pipe length*				*Radius 'R' of curvature for pipe length*			
	1m	*2m*	*3m*	*4m*	*1m*	*2m*	*3m*	*4m*
1	20	35	50	70	60	120	180	240
2	35	70	100	135	30	60	90	120

3	50	100	150	200	20	40	60	80
4	70	135	200	270	15	30	45	60
5	85	170	250	335	12	24	36	48

1322.4.4.4. Wherever necessary, change over from C.I. pipe to asbestos of cement pipe and *vice versa* shall be done with the help of suitable adapters. (See Fig. 1322.4).

LINE DIAGRAM SHOWING CHANGE OVER FROM CAST IRON TO ASBESTOS CEMENT PRESSURE PIPE



[Fig. No. 1322.4]

1322.5. Thrust blocks :—Thrust blocks are required to transfer the resulting hydraulic thrust from the fitting or pipe on to a larger load bearing soil section. These shall be provided as indicated in Cl. 7.2 to 7.6.1 of IS : 6530-1972.

1322.6. Special cast iron fitting & accessories :

1322.6.1. Normally when pipe line is laid, a certain number of C.I. fittings such as tees, bends, reducers etc., and accessories such as air or sluice valves are required.

1322.6.2. All C.I. fittings shall be plain ended to suit the outside diameter of asbestos cement pressure pipes and to the class and diameter of pipe manufactured. When using such C.I. fittings they are joined by C.I. detachable joints only. For any C.I. specials having flanges they are joined in the pipe line with C.I. flange adapters having one end flanged and the other plain ended.

1322.6.3. *Anchorages* :—It shall particularly be noted that the C.I. joints do not hold pipe ends within it firmly. During working or test pressure there will be tendency for the pipe ends or special ends to slip out of the joint, more so in the case of blank end cap used for closure of pipe line and all degree bends and tees. In order to keep them firmly in the pipe line, anchoring of these specials is necessary against the direction of thrust.

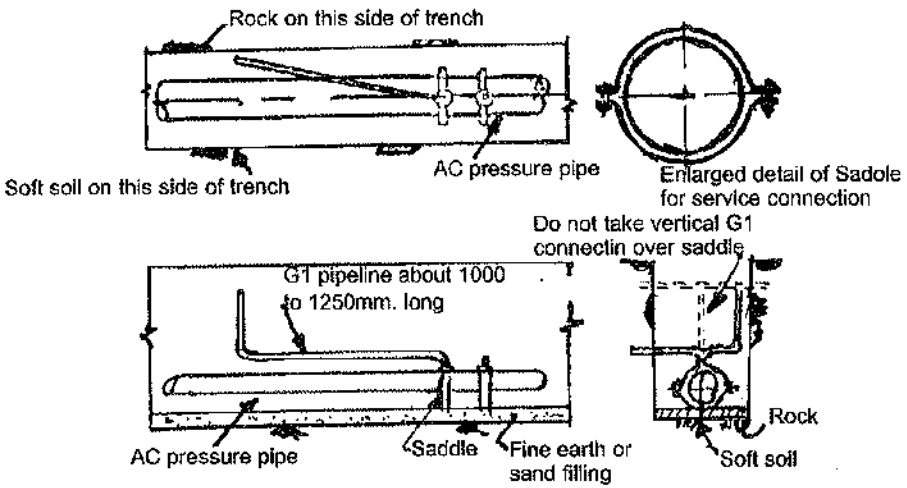
1322.6.3.1. The anchorage shall consist of either concrete cast-in-situ or masonry built in cement mortar. The anchors shall be extended to the firm soil of the trench side. The shape of the anchors will depend on the kind of the specials used. They shall be spread for full width of trench & carried vertically by the side and over the special to about 150mm. The bearing area on sides of the trench shall be proportional to be the thrust and to the bearing capacity of the sides of the trench.

1322.7. Service connections :

1322.7.1. Where the pipe line is used in distribution system, house service connections shall be provided through a saddle piece as indicated below.

1322.7.2. The saddle piece consists of two straps which envelopes the portion of pipe from where connection is to be given. The hole of required size shall be drilled through the pipe and the boss provided in the top strap. Ferrule piece shall be connected after making threads in the boss and pipe. Suitable rubber packing shall be used between the straps and the pipe to provide cushioning as well as sealing against leakage. (See Fig. 1322.5).

DETAIL SHOWING METHOD OF TAKING SERVICE CONNECTIONS FROM THE ASBESTOS CEMENT PRESSURE PIPE



[Fig. No. 1322.5]

1322.7.3. The size of the hole drilled in the pipe shall be limited to those given in Table 1322-B.

Table 1322-B

Size of hole Drilled in pipe

Pipe size mm.		*Maximum Size of Drilled hole mm.*
80 to 100	—	20
125 to 150	—	25
200	—	35
250 and above	—	50

1322.8. Back filling and tamping :—Back filling shall follow pipe installation as closely as possible to protect the pipe from falling boulders, eliminating possibility of lifting of the pipe due to flooding of open trenches and shifting pipe out of line by caved in soil. This shall be done in accordance with SS : 1317 on 'Trench work Excavation and Back filling". If it is desired to observe the joint or coupling during the testing of mains. They shall be left exposed. Sufficient backfill shall be placed on the pipe to resist the movement due to pressure while testing.

1322.9. Testing :—The portions of the pipe line shall be tested, where required, by subjecting, to a pressure test as the laying of the pipe line progresses, before the entire line is completed. The length of the section to be tested shall not exceed 500m. at a time. The test pressure shall be kept at 1.5 times the working pressure, unless a higher test pressure is specified. However the test pressure during the field test shall not exceed the values given in the following Table-1322-C.

Table 1322-C

Test pressure for pipes

Class of pipe		*Max. field test pressure k.gf./cm.*
5	—	3.75
10	—	7.50
15	—	11.25
20	—	15.00
25	—	18.75

1322.10. Measurement :

1322.10.1. The lengths of pipes inclusive of collars shall be measured net as laid or fixed in running metres correct to 0.01 of a metre excluding specials which shall be enumerated separately.

1322.10.2. Excavation, refilling, shoring and timbering in trenches masonry or concrete pillar, and thrust blocks, wherever required shall be measured separately under relevant items of work.

1322.11. Rate :—The unit of rate shall be per running metre, and unless otherwise specified, the rate shall include cost of laying, jointing and testing including cost of transport of water from sources within a distance of 200 metres but shall exclude the cost of pipes, fittings, collars, C.I.D., joints and rubber rings which shall be paid for separately per each.

Specification No. 1323

Laying and Jointing of Unplasticised (Rigid) PVC Pipes and Fittings for Potable Water Supplies

1323.1. Materials :—These shall conform to SS : 1306.

1323.2. Handling and custody of pipes and fittings :—The pipes and fittings shall be stored in a shed and shall be protected against direct sun rays. While unloading, they shall not be thrown down from carrier on to the hard surfaces. This shall conform to SS : 1316.

1323.3. Trench work excavation :—The trench work excavation shall be done generally in accordance with SS : 1317.

1323.4. Installation of rigid PVC pipes :—Sharp edged supports shall be avoided P.V.C. clips only shall be used. If unavoidable, standard pipe clips can also be used, but care shall be taken not to overtighten and cause the clips to bite into the pipe. Pipe clips shall be correctly aligned and shall provide a smooth flat surface for contact with pipe.

1323.5. Under ground installation :

1323.5.1. Pipes do not flatten under load due to lateral support derived from the passive resistance of the soil at the soil of the pipe. Hence it is essential, while laying, to ensure that lateral support is effective. To minimise thermal stresses final connection for water supply shall be deferred until most of the line has been covered with back fill.

1323.5.2. The trench bottom shall be free from hard and sharp objects.

1323.5.3. In uniform and relatively soft fine granted soils the pipes shall be directly laid on the evenly finished trench bottom. In other cases the pipe shall be laid on the prepared under bedding. Ideally prepared under-bedding shall consist of free running granular material passing 12.5mm. sieve, offering free of drainage. The thickness of the prepared bedding shall be one quarter of the pipe of diameter subject to minimum of 50mm.. The backfill at the sides and immediately above the pipe shall be similar to the under-bedding specified above. It shall extend to a minimum height above the pipe equivalent to that of under-bedding. It shall be compacted around the pipe.

1323.5.4. *For internal pipe line work* :

1323.5.4.1. The pipe line shall be laid clamped to wooden plugs fixed on walls. The pipes shall be aligned properly before fixing them on the wooden plugs as the pipe line may become wavy, if the clamps are not fixed for keeping the pipe plump.

1323.5.4.2. The pipe line shall be well supported at regular intervals. The recommended support spacing for temperature upto 40°C for various diametres of rigid P.V.C. pipes are shown below.

20 mm. dia. 0.5 metre,

25 mm. dia. 0.75 metre,

32 mm. dia. 0.90 metre.

For temperature above 40°C and for higher diametres of pipes closer spacing, of supports shall be provided.

1323.6. Laying :—This shall conform to clause 1320.1.5.3.

1323.7. Jointing :—The following methods of jointing shall be adopted according to the suitability of the situations.

1323.7.1. *Solvent welded joints* :—This technique is used with spigot and socket type joints. The sockets may be in the form of injection moulded or fabricated fittings. The solvent cement (consists essentially of solution of vinyl polymer dissolved in a suitably volatile mixture of organic solvents) shall be applied on the pipe ends to the full length of the spigot and on the inside surface of the socket, after cleaning the surfaces to ensure facedom from dirt oil grease and foreign matter. The pipe ends shall be pushed tight immediately into the socketed fitting and given a quarter turn to evenly distribute the cement and held for about 30 seconds. However, 'drying time' is a function of surrounding temperature. In hot weather jointing must be carried out in the minimum possible time and pipes shall be kept

is cool as possible to minimize the evaporation of cement. The surplus solvent cement shall be wiped out. Joints shall not be disturbed for at least 5 minutes. The solvent constituents soften the matting surface which diffuse into one another to form a cold weld.

1323.7.2. *Flanged joints* :—Flanged particularly used for the connection of larger size pipes to valves and vessels, where strength in tension is required can also be used for jointing of P.V.C. pipes. The joint is made by compression of gasket or ring seal set in the face of the flange. The flange may be formed after heating and flaring the pipe and on a mandrel, or by solvent-cementing a P.V.C. stub flange on the pipe end. Wide washers or preferably backing ring shall be used in flanged connections to distribute the bolt load. This prevents distortion of the P.V.C. flange.

1323.7.3. *Screwed/thread joints* :—Injection moulded threaded Joints or fabricated threaded joints shall be used for jointing P.V.C. to metal.

Although rigid P.V.C. pipes can be screwed and joined, cutting of threads in P.V.C. pipes strongly discouraged as these pipes are very much sensitive. Therefore, all threading shall be done in metal pipes only. If threading is unavoidable, only short pieces of thicker walled pipes than that of the pipe under consideration shall be used for threading at one end and solvent cemented to normal walled pipe at the other end. Such a situation may arise only when connecting the P.V.C. pipe to galvanised mild steel pipe. In any threaded joint in P.V.C. pipe, hemp and paste shall not be used. Cement solvent can be used for making the joint leak proof. It is always advisable to use P.V.C. as the male portion of the joint in all P.V.C. to metal connections.

1323.8. Testing :

1323.8.1. After laying and jointing the pipe line shall be tested for a hydraulic pressure equivalent to 1½ times the maximum working pressure for atleast one hour without any symptom of leakage, subject to the condition that the field test pressure does not exceed two third of the test pressure for any class of pipe.

1323.8.2. The duration of test shall be sufficient to make a careful check on the pipe line section

1323.8.3. After the test has been completed, the trench shall be backed filled. Back filling shall conform to SS : 1317.

1323.9. Repairs to pipes :—The damaged portion of the pipe shall be cut and replaced by a new pipe. The connection of new pipes to either end of the old pipe shall be done by insert type pipe fittings.

1323.10. Measurement and rate shall be as per SS : 1322.

Specification No. 1324

Disinfection of Water Mains before Commissioning

1324.1. The mains intended, for potable water supplies shall be disinfected before commissioning them for use. The mains shall be thoroughly flushed by opening scours and hydrants until clear water is observed to flow out of them. The mains shall than be filled with a liquid chlorine solution (that is chlorine gas and

water mixture) with chlorine content of about 30 PPM. The disinfection shall be considered to have been achieved if a chlorine residual of about 10 PPM remains in the water after 24 hours standing in the pipe. If this requirement is met with, the mains shall be thoroughly flushed again with clean water, before putting them into commission.

1324.1.1. If disinfection by liquid chlorine solution as specified in clause 1324.1 is not possible for lack of adequate facilities, enough chlorinated lime, calcium or sodium hypochlorite mixed with water be produce a solution with about 30 PPM concentration of chlorine shall be introduced into the mains. The solution shall then be allowed to stand for not less than 24 hours, after which it shall be tested for residual chlorine, which shall be around 10 PPM. If found satisfactory, the mains shall be thoroughly flushed with clean water.

Specification No. 1325

Construction of Manholes, Flush Tanks and other Masonry Works on Sewers

1325.1. The masonry work shall be built in the sewer trench at such a place and to such level as is shown on the plans supplied to the contractor or at such place and level as may be instructed by the Executive Engineer during progress of the work. The work shall be executed to the type design or other design specified modified as may be necessary during progress of the work to suit local conditions and which modifications shall be carried out into plans and furnished to the contractor with written instructions as an authority for the deviation.

1325.2. All materials and workmanship shall comply with the relevant Standard Specification for the class of work shown on the plans.

1325.3. Covers for manholes, flush tanks etc., shall be Standard Specification for cast iron, unless otherwise defined and of weights and designs as per IS : 1726-1967. The manhole covers shall be of the following three grades or types.

(A) Heavy duty denoted by the letter 'HD' circular solid type for use under heavy vehicular traffic conditions and capable of bearing wheel loads upto 11.25 tonnes (See Fig. 1308.1), double-triangular solid type (See Fig. 1308.2) may also be used where so desired for these load conditions.

(b) Medium duty, denoted by the letters "MD" solid type for use under light traffic conditions, such as in foot paths and cycle tracks (See Fig. 1308.3).

(C) Light duty, denoted by the letters 'LD' rectangular for use in domestic premises of other places where they are not subjected to wheeled traffic loads (See Figs. 1308-4,1308-5 & 1308-6).

1325.4. All pipes and steel iron, of type specified shall be built in while the walls are being constructed and fixed in cement mortar 1 : 3.

1325.5. Unless otherwise specified or ordered, in the case of manhole upon pipe sewers the channels shall be formed of half round glazed stone ware channels bedded in Standard Specification cement mortar 1 : 2 and they shall be shaped to fit the ends of the sewer accurately where possible, there shall be a fall of not less than 40mm. in the inverts of pipes in each man-hole.

1325.6. All pipes entering manhole shall be relieved of pressure by having an arch over them.

1325.7. The manholes into which the flushing tanks discharge shall be provided with ven shafts to allow free in flow of fresh air to follow the flush.

1325.8. The designs furnished to the contractor will describe whether the flush tank is to be equipped with automatic syphon or other arrangement. If supply is obtained by a pipe connection to municipal main, such connection shall be provided with a stop clock in a suitable chamber with a surface box, and a water seal shall be provided to prevent ingress of sewer gases to the water main.

1325.9. Measurement :—The measurements shall be in numbers of masonry works completed in accordance with this specification or the individual work items may be measured as per the relevant specification clauses.

1325.10. Rate :—Payment shall be made for each masonry work completed in accordance with the drawings furnished together with all necessary accessories detailed therein or for the separate classes of work items at their unit rates.

Specification No. 1326

Fixing and Plumbing of Sanitary Fitting in Building

1326.1. General :—This work shall be got done by a licensed plumber in conformity with the plumbing regulations of the local authority. Any damage done to floors, walls etc., during the process of fixing pipes and fittings and sanitary appliances shall be made good and floors, walls etc., shall be restores to their original condition. All the pipes and fittings and appliances shall be thoroughly cleaned before fixing. All items required for ensuring efficient functioning of the pipes and appliances shall be carried out without extra cost.

1326.2. Terminology :

1326.2.1. *Soil appliance* :—A sanitary appliance, which handles soil waste i.e., waste containing human or animal excreta or urine.

1326.2.2. *Waste appliance* :—A sanitary appliance, which handles spent water from baths, wash basins, sinks and similar appliances which does not contain human or animal excreta or urine.

1326.2.3. *Soil pipe* :—Pipe which receives the discharges from soil appliances.

1326.2.4. *Waste pipe* :—A pipe which receives the waste water from waste appliances.

1326.2.5. *Ventilating pipe* :— A pipe which provides a safe outlet into the atmosphere for the foul gases in the drain or sewer.

1326.2.6. *Trap* :—A bend or a depression in a fitting pipe or drain which remains constantly full of liquid, thus providing a water seal shutting off air connection between portions of the pipe or drain on opposite sides of the water-seal.

1326.2.7. *Anti-syphonage* :—A device to preserve the water seal in trans by providing ventilation.

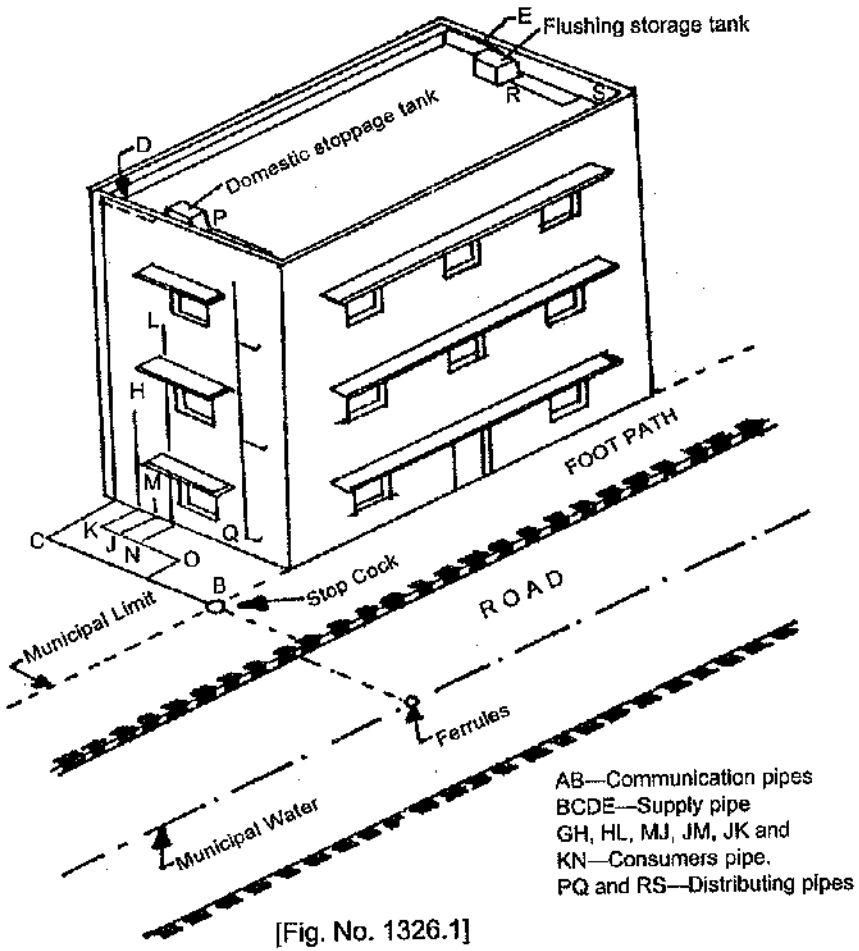
1326.2.8. *Plumbing system* :—A system of water supply and drainage in buildings which includes, the water supply and distribution pipes, storage tanks, soil, waste, vent and anti-syphonage pipes, soil and waste appliances, taps, other fixtures, building drains and sewers, including their respective connections, devices and appurtenances within the property line of the premises.

1326.2.9. *Service pipe* :—Any pipe used for conveying water from a water main to any building or premises and is subject to water pressure from such main.

1326.2.10. *Supply pipe* :—The pipe which extends from the stop-cock up to the ball-cock of the storage tank; and any consumer's pipe subject to water pressure from the water main.

1326.2.11. *Communication pipe* :—The part of the service pipe extending from the water main upto and including the stop-cock vide Fig. 1326.1 which is under the control or municipal or water authority.

TYPICAL SKETCH FOR IDENTIFICATION OF DIFFERENT TYPES OF WATER SUPPLY PIPES



[Fig. No. 1326.1]

1326.2.12. *Consumer's pipe* :—The portion of service pipe within the premises of the consumer excluding the communication pipe.

1326.2.13. *Warning pipe* :—An overflow pipe so fixed that its outlet is in an exposed and conspicuous position where the discharge of any water may be readily seen and where practicable, outside the house or building.

1326.3. Sanitary appliances :—Unless otherwise specified they shall be supplied and installed generally in accordance with IS : 2064-1962. The appliances shall be of the make and type specified in the tender schedule. In the absence of such specific stipulation the contractor shall submit full particulars of the appliances offered including the name of manufacturers.

1326.3.1. *General requirements* :—The sanitary appliances shall satisfy the construction and performance requirements of IS : 771-1963 and IS : 2556-1963 and shall be free from warpage, cracking and crazing.

1326.3.2. *Location* :—The appliance shall be located in accordance with approved plans of drawings to ensure convenience and comfort in their use.

The soil and waste appliances shall be conveniently grouped both in plan and elevation, to facilitate, easy and efficient connection of the appliances into a one pipe or two pipe system of plumbing as may be specified.

A sink shall, as far as possible be so placed that the light from the window shall directly fall on it.

Urinals shall be placed to allow a minimum clear width of 600mm between partitions. Top of bowl shall be about 0.65 m from the floor level.

A bath tub shall be comfortable, easy to get in and out and easy install and maintain. It shall either be fixed sufficiently away from the wall, so that the space behind the bath tub can easily be cleaned or alternatively placed closed against the wall and the gap sealed with a suitable caulking compound.

1326.3.3. *Supply & installation of waste appliances* :

(a) *Shower bath fitting* :—The installation comprises of a combined supply fitting for hot and cold water with two pillar valves and shall include either a hand Dower fitted to flexible stainless or of any suitable material piping provided with suitable rest for the handle, or a shower rose fixed over head as specified. The installation shall include necessary length of piping connected to the water supply.

(b) *Bath tub fittings* :—The installation shall comprises of porcelain enamelled cast iron or pressed steel bathing tub, fitted with a combined supply fitting provided with pillar valves. The combined supply fitting shall, where specified also incorporate a hand shower. Where globe valves are fitted in place of pillar valves the bath tub shall be provided with and over flow at a lower level than the value outlet. The bath tub shall be fitted with waste pipe made of lead having 40mm. bore with a brass or enamelled cast iron trap fixed immediately beneath the waste outlet. The waste fitting shall be provided with a waste plug and chain. The installation shall include necessary length of piping connected to the water supply.

(c) *Wash basin* :—The installation shall include a basin of the specified pattern and size provided with one or two pillar taps, as required and fitted with a waste made of lead or other suitable material having bore of 32mm. with a chromium plated brass 'P' or 'S' trap fixed immediately beneath the waste out let. The waste fitting shall conform to IS : 2963-1964 and provided with a waste plug and chain as per IS : 3311-1965. The installation shall include one or two stop taps as required, fixed beneath the basin and connected to the water supply and necessary lengths of polyethene piping between the stop taps and pillar taps. In operation theatres in hospitals wash basins shall be provided with quick closing taps designed for elbow action. The basin shall be supported on pedestal, or cast iron wall fixing brackets. The brackets shall conform to IS : 775-1970. The pillar taps and stop tops shall be nickel or chromium plated.

(d) *Sink* :—The installation shall be suitable for kitchen or laboratory use as may be specified with a size indicated in the tender specification. The floor or the sink shall gently slope towards the waste outlet. The sink shall have an overflow of the weir type and its invert shall be 30mm. below the top. For laboratory sinks the waste fitting shall be of glazed earthenware. The kitchen installation shall include necessary length of lead or other suitable piping from waste outlet equipped with a 'P' trap. The waste fitting shall conform to IS : 2962-1964 and provided with a waste plug and chain. The kitchen sink shall be supported or cast iron wall fixing brackets.

(e) *Drinking fountain* :—The installation shall comprise of (i) A basin of glazed earthen ware or vitreous ware or enamelled cast iron as specified, (ii) Stainless steel or brass pipe work for jet mechanism with fittings, (iii) A bronze or copper alloy nozzle in conformity with IS : 1700-1973. The water supply to the jet shall be controlled by a self closing tap of nominal size of 15mm. conforming to IS : 1711-1971. The inlet feed pipe shall be fitted with an adjustable or automatic pressure regulating device. The drain shall be provided with a trap and shall terminate in a tail piece suitable for connecting to waste pipe. The waste opening shall be provided with a strainer or grating or cross-bars formed integrally which shall be equivalent to a circle of 20mm. diameter. All metal work other than stainless steel shall be chromium plated.

(f) *Gully traps* :—The gully trap is provided in the drainage system to disconnect both the waste pipe and rain water pipes from the drainage system. The trap is provided with a back in let to connect the waste pipe. Pipe the trap shall be fixed in a bed of cement concrete (1 : 5 : 10) mix.

The traps of waste appliances shall be provided with a cleaning hole and plug.

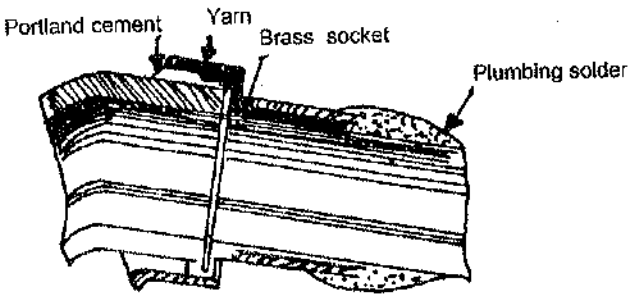
1326.3.4. *Supply and installation of soil appliances* :

(a) *Water closet (squatting pan with trap)* :—The installation shall consist of squatting pan of a specified size and make with an integral flushing rim coupled to a 'P' or 'S' Trap with or without an inspection vent as specified by the Executive Engineer. The installation shall be securely fixed level in brick jelly concrete with lime mortar of SS : 401, so that the floor of the privy gently slopes towards the rim of the squatting pan. The outlet of the trap shall unless otherwise specified be

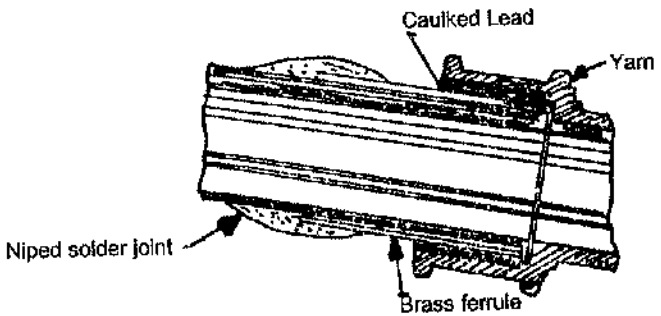
connected to the C.I. soil pipe through a short length of lead pipe of the same bore by means of a brass socket and a ferrule. The brass socket and ferrule shall be jointed to the lead pipe by means of plumbing solder. The joint between the trap outlet and the brass socket shall be made by cement mortar 1 : 1 with a packing of yarn. The joint between the C.I. soil pipe and the brass ferrule shall be made by caulked pig lead with a packing of yarn, vide Fig. 1326-2 where A.C. soil pipes are permitted, the outlet of the trap can be directly connected to the soil pipe using cement joint with yarn packing.

When ordered with a flushing cistern a 15 litres flushing a cistern shall be fixed such the height between the top of closet pan and the bottom of the cistern is atleast 1.25m. and closet pan is connected to the cistern by a 40mm. diameter flush pipe.

JOINT BETWEEN THE OUT GO OF A.W.C. BASIN AND A LEAD PIPE



CONSTRUCTIN OF A JOINT BETWEEN LEAD PIPE & A CAST IRON SOIL PIPE



[Fig. No. 1326.2]

(b) *Wash down water closets* :—These are one piece construction (i.e.) the trap is integral with the closet. The installation shall include a W.C. of the specified pattern, with seats and flaps. The seats shall be made of a suitable hard wood or plastic. The seats shall be provided with hinged flaps to cover the aperture. Where ordered a 15 litres flushing cistern shall be fixed such that the height between the top of the closet and the bottom of cistern shall be 1.25m. and the W.C. shall be connected with the cistern by 40mm. nominal diameter flush pipe. The W.C. shall be connected to the soil pipe as in clause 1326.3.4 (a). Where a low level flushing

cistern is specified, a flush pipe of 40mm. dia. shall be used and the cistern shall be fixed at a height not less than 300mm. from top of the closet.

(c) *Syphonic W.C. basin* :—This differs from the wash down W.C. in this contents of the basin are removed by a syphonic action instead of the momentum flushing water and can be fitted with a low level flushing cistern which is actually integral with the closet. The installation will otherwise be similar to 1326.3.4(b).

(d) *Urinal* :—The installation shall consist of a single bowl urinal or a range of two or more urinals as specified by the Executive Engineer. The outlet pipe is fixed to the outlet bore of the bowl urinal with cement or other suitable binding material. The outlet pipe conveys the contents to a half-round channel. The outlet of channel takes the form of domical grating made of brass or heavily galvanized iron discharging directly into a trap fitted immediately below channel outlet.

The capacity of the flush shall be 5 litres per bowl. The flushing cistern shall be of the automatic type, made of cast-iron or pressed steel, with the working parts made of copper and fitted with removable lids. The cistern is fed by a pat clock adjusted to suit the frequency of flush. Partition slabs are provided at 600mm. intervals between bowls.

The installation shall be complete in all respects as detailed above inclusive of necessary length of flushing pipe (galvanised mild steel) from the flush to the bowl.

(e) *Slop-sink* :—A slope sink or hopper is provided with a hinged grating of galvanized cast-iron to rest the buckets etc., and a hard wool pad fitted on the front edge of the hopper. A pair of hot and cold bib valves with splash nozzles shall be fixed over the hoppers connected to water supply for filling and vinsing the buckets. The slop sing shall be provided without integral flushing rim and fitted with a 40mm. flush pipe and a 15 litre flushing cistern. A loose circular grating made of enamelled cast iron is fitted just above the water level of the trap to guard against floor, cloth and scrubbing brushes gaining access to the trap when a bucket of water is discharged into the hopper. The tap is integral with the hopper and is connected to the soil pipe in exactly the same manner as a water closed. The installation shall comprise of a hopper including all accessories as detailed above, inclusive of the connection to the soil pipe.

(f) *Flushing Cistern with flush pipe* :—For flushing water closets the cistern used shall be of the siphonic water waste preventing type in conformity with IS : 774-1921. The installation shall comprise of a 15 litres flushing cistern fixed 1.25 metres above closet with 40mm. diametre lead or galvanised steel tubing, connecting the cistern and the closet. The low level flushing cistern fitted to siphonic basic at a height of 300mm. are provided with 500mm. flush pipe. In whatever position the flushing cistern is fixed, care shall be taken to ensure that there are as few bends as possible in the flush pipe and that all bends of an easy radius.

For urinals, automatic flushing cisterns conforming to IS : 2326-1970 shall be provided.

Scale of sanitary appliances to be provided in residential and office building and hospitals shall be as per IS : 1172-1963.

(g) *Bidets* :—The general requirements of materials manufacture, finish, methods of tests, sampling and inspection shall conform to IS : 2566.

Bidets shall be made in three sizes viz., large, medium or small. The dimensions of bidets and tolerances in dimensions shall be as per the specifications, given in the above IS Code.

1326.4. Water supply :

1326.4.1. *Materials* :—The pipes fittings and appliances used in the plumbing system shall conform to relevant Indian Standard Specification where available. Where no such standard exists, the material shall be of the quality and workmanship acceptable to the Executive Engineer. Pipes normally used in the plumbing system are (1) mild steel galvanised tubes (medium class) of SS : 1303, or (2) copper tubes, or (3) polyethylene and polyvinyl chloride in pipes of SS : 1307. Copper piping may be used particularly in hot water installation provided the water is not capable of dissolving an undue amount of copper. Polyethylene and P.V.C. pipes shall not be laid on hot surfaces or in too close a proximity of hot water pipes of in locations where they are likely to be exposed to atmosphere charged with coal gas.

1326.4.2. *General requirements* :—The internal arrangement of cold water pipes can be carried out in two different ways depending upon whether the water supply is continuous or intermittent.

(1) To supply all fittings except hot water system and W.C. and urinal flushing systems under pressure from the mains, where the water supply is continuous.

(2) To supply all fittings from a storage cistern excepts taps from which drinking water is drawn, where the water supply is intermittent. A combination of the above two system may also be adopted where specified.

1326.4.3. *Plumbing and pipe joints* :—A typical sketch indicating the lay out of a piped service from a municipal water main is furnished, vide Fig. 1326-1. The following general principles shall apply in the lay out and planning of pipe work :

(a) Every premises supplied with water by the water authority shall have its own separate communication pipe and no communication pipe shall be used to supply water to more than one premises. The communication pipe between the water main and stop cock at the boundary of the premises shall be laid by the water authority.

(b) The consumer pipe within the premises shall be laid under ground with a cover measured from the top of the pipe to the surface of the ground of not less than 750mm.

(c) No piping shall be laid fixed so as to pass into for through any sewer, scour outlet or drain or any man-hole connected therewith nor any ash-pit or manure-pit or any material that is likely to cause undue deterioration of the pipe. Where the laying of any pipe though fouled soil or impervious materials is unavoidable

the piping shall be properly protected from contact with such soil or material by being carried through an exterior cast iron tube or concrete pipe. All pipe work shall be so, laid of fixed as to be, and to remain, completely water-tight. Laying and jointing of pipes and fittings shall be done as per relevant specification of APSS for the class of pipe in use. The design of the pipe work shall be such that there is no possibility of backflow towards the source of supply from any cistern or appliances, whether by siphonage or otherwise. This shall be achieved by providing an air gap, i.e., an unobstructed free atmosphere between the lowest opening of any pipe or fitting, supplying water to a tank. Sanitary appliance or other device and the flood level rim of the receptacle in the water supply system. Reflux on non-return valves shall not be relied upon to prevent such back flow.

Water for drinking or culinary purposes shall not, as far as possible pass through any cistern, and therefore, direct taps supplying water for these pipes shall be on branch taps connected directly to the service pipe.

(d) Service pipes and distribution pipes shall be so laid as to avoid air locks. Piping shall be confined to rooms where appliances are fixed; it shall have easy bends and where quietness is particularly desired, holder bats and clamps shall be insulated from the piping by suitable pads. Piping under floors and basements and in roof spaces and unventilated air spaces shall be adequately protected from corrosion. All pipe work shall be accessible for inspection, replacement and repair. Piping shall not be buried in walls or solid floor, where unavoidable piping may be buried for short distances provided adequate protection is given against damage and that no joints are buried. Where it is necessary for a pipe to pass through a wall or floor a sleeve shall be fixed therein for reception of the pipe and to allow for freedom for expansion and contraction. If piping is laid in ducts or chases, these shall be roomy enough to facilitate replacement and shall be so constructed as to prevent entry of vermin.

1326.4.3.1. *Prohibited connections* :—A service pipe shall not be connected into any down-take pipe or distribution pipe. Such connection may permit the backflow of water from a cistern into the service pipe in certain circumstances with consequent danger of contamination.

No service pipe or supply pipe shall be connected directly to any water closet or urinal. All such supplies shall be from flushing cisterns which shall be supplied from a storage tank meant for that purpose.

No service or supply pipe shall be connected directly to any hot water system or to any apparatus used for heating other than a feed cistern thereof.

No service or supply pipe from the water main shall communicate with a pipe or cistern or tank used for reception of any water other than water supplied by the municipal or water authority. A service pipe shall not be connected to the suction side of any pump.

1326.4.3.2. *Storage of water* :—

1326.4.3.2.1. *Storage capacities* :—Separate storage tanks shall be provided for domestic storage and flushing storage. Flushing storage capacities for different classes of buildings shall be as per IS : 2065-1963.

1326.4.3.2.2. Cisterns and tanks required for storage of water shall be constructed of concrete galvanized mild steel plates, or sheets or cast iron. Every storage tank shall be made water tight and shall be properly covered with a close fitting, dust-light and mosquito-proof lid and where specified fitted with a lock and key and shall be provided with a sound and suitable ball valve of the prescribed kind (as per IS : 1703-1968), securely fixed and set in such a position that the body of the ball-valve cannot become submerged when the cistern is full up to the water line. Every valve shall be so adjusted as to limit the level the water in the cistern to 25mm. below the top of the warning or over flow pipe. A stop valve of approved type shall be provided as near the tank as practicable on every outlet pipe from a storage tank except the warning pipe. A stop valve shall be provided on the inlet connection also to facilitate closing of supply temporarily for cleaning of storage tank or for repairs to the ball valve.

Every tank shall be provided with an efficient mosquito proof warning pipe. The outlet of the warning pipe shall be in such a position outside the building as well allow the discharge of water from such warning pipe being readily seen. The outlet of the warning pipe shall not be less than 600mm. above any drain sink or gulley over which the same may be fixed. Any warning pipe union shall be not less than 20mm. in bore and shall be so fixed that the bottom of the pipe shall be 25mm. above top water level.

For jointing steel pipes to a storage tank the end of the pipe shall be threaded, passed through a hole in the tank and secured by back-nuts both inside and outside. The pipe end shall be flush with the face of inside back nut to obviate corrosion of pipe threads. For jointing copper pipe to steel or copper tank a connection of non-ferrous metal shall be used having a shoulder to bear on the outside of the tank and secured by a back-nut inside.

The outlet pipe shall be fixed 50 to 75mm. above the bottom of the tank and provided preferably with copper gauze strainer. The wash-out or draining pipe shall be flush at the bottom of the tank at its lowest point. The floor of the tank shall be erected so as to give a slight fall to the washout pipe for cleaning purposes.

Every storage tank used in connection with the water supplied by a municipal or water authority, shall be easily accessible and placed in such a position as to admit of thorough inspection and clearing and if placed within the house or building, it shall have a clear space of not less than 0.60m. between the top of the cistern and the ceiling.

1326.4.3.3. *Pumping water* :—

1326.4.3.3.1. In the case of multi-storey building where the height of the storage tank is such as will not permit of its being fed with the available pressure in the water main, pumping is necessary. The house service pumps are usually of the centrifugal type driven by electric mortar. The suction tank shall be either at ground level or partially buried under ground. The capacity of the suction tank shall normally be forty percent of the total overhead storage both for flushing and domestic requirements. The tank shall project atleast 300mm. above the ground level. The tank shall be water proof. The design of the tank shall be such as to facilitate draining of the tank when necessary and water shall not be allowed to

collect around the tank. The tank shall have a complete cement concrete cover, with a manhole opening provided with a properly fitting mosquito proof hinged C.I. cover in a cast iron frame. Overflow pipe shall have a wire gauze cover of 1.5mm. mesh. No gap shall be allowed to remain round the suction pipe and arrangements shall be made for the proper disposal of spill water from the pump.

1326.4.3.4. *Disinfection* :—All the service pipes, storage tanks and distribution pipes shall be thoroughly and efficiently flushee and disinfected before use.

1326.4.4. *Taps, valves and other fittings* :—Bath, lavatory and mixing taps self closing and other fittings shall generally comply with relevant Indian Standards.

1326.4.5. *Domestic hot water system* :—This work shall comply with requirements of IS : 2065-1963 when water supplied is having appreciable salt content, galvanized iron vessels and pipes shall not be used. In general tinned copper and monel metal are suitable for most waters. Under no circumstances ungalvanized (black) mild steel pipes and fittings shall be used in part of the hot water installation.

1326.4.5.1. *Cistern capacity* :—

1326.4.5.1.1. The hot water cistern or cylinder for an average single family dwelling shall not be less than 115 litres capacity. The cold water feed tank shall be atleast equal in capacity to the hot water cistern. If the cold water feed is from a storage tank than the tank shall not be less than 250 litres capacity and the cold feed pipe to the hot water tank and cold-water drainoff pipe shall be connected to common storage tank at the same level, so that cold water supply does not fail before the hot water supply, thus avoiding the risk of scalding.

1326.4.5.2. *Pipe connections* :—

1326.4.5.2.1. A storage water heater shall be fed from a cold water storage tank and not directly from water main except the type which incorporates a feed tank with ball valve and overflow pipe arrangement and it shall be so installed that the draw-off pipe length from the heater to the most frequently used hot taps are as short as possible.

1326.4.5.3. *Electric water heater* :—Storage type electric water heater shall conform to the requirements given in IS : 2082-1962. The electric water heaters of capacity 760 litres and above may be coupled to and operated with a fuel type water heater.

1326.5. Drainage :—

1326.5.1. *Materials* :—The pipes and fittings used in the construction of the house drainage system, shall conform to the relevant Indian Standard Specifications where available. Where no such standard exists the materials, fittings and appliances shall be of the quality and workmanship approved by the Executive Engineer.

1326.5.1.2. *Choice of materials* :—For all sewers and drains in ordinary ground salt-glazed stoneware pipes conform to IS : 651-1965 shall be used as far as possible, in preference to other types. They shall be invariably used where acid

effluents and acid sub-soil conditions are encountered. Cost iron pipes are used in un-suitable ground and in made-up ground. Branch soil pipes from fittings to main soil pipe and branch waste pipes from fittings to main stack and branch anti-siphonage pipes may be of lead conforming to IS : 404-1962 or other suitable material approved by the Executive Engineer.

Table 1326-A

Nominal internal diametre mm.	*Wall thickness mm.*	*Weight per metre in kg.*
50	2.7	5.07
75	2.7	7.48
100	2.7	9.88
150	3.0	16.38

Unless otherwise specified soil pipes and main waste pipes shall be of cast iron.

1326.5.2. *General requirements* :

(1) Drains shall be arranged in straight lines between fixed points, such as inspection chambers and means of access provided at all changes of direction for inspection.

(2) Every part of the system must be adequately ventilated.

(3) House drain connection to the public sewer must be intercepted. Waste and rain water pipe must be disconnected from the drain by means of trapped gullies.

1326.5.2.1. *Gradients* :—Adequate gradients may be adopted to assure self cleaning velocity. Unless otherwise specified the minimum gradients shown in Table No. 1326-B shall be adopted.

Table 1326-B

Pipe of diametre	*Gradient*
100 mm	1 in 60
150 mm	1 in 100
230 mm	1 in 120

1326.5.3. *Plumbing and pipe joints* :

1326.5.3.1. *Choice of plumbing system* :—For the disposal of sanitary wastes from buildings the two pipe system of plumbing shall be adopted unless otherwise specified. However, for reasons of economy, the one pipe system fully or partially ventilated may be adopted with specific prior permission of municipal or sewerage authority.

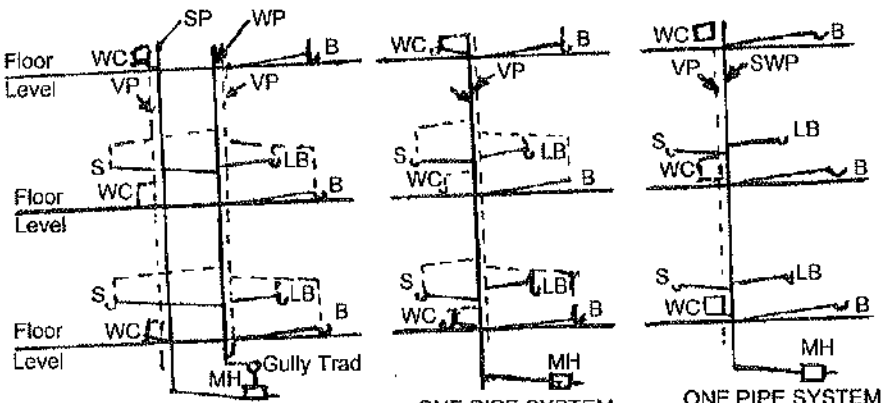
1326.5.3.1.1. *Two pipe system (fully ventilated)* :—The system of plumbing in which soil and waste pipes are distinct and separate, the soil pipes being

connected to the drain direct and waste pipes through a trapped gulley (See Fig. 1326-3). All traps of soil and waste fittings are completely ventilated.

1326.5.3.1.2. *One pipe system (fully ventilated)* :—The system of plumbing in which the waste connection from sinks, baths and wash-basins and the soil pipe branches from water closets are all collected into one main pipe which is connected directly to the drainage system. Gully traps and waste pipes are dispensed with but all traps of water closets, basins etc., are completely ventilated to preserve the water seal. (See Fig. 1326.3).

SYSTEM OF PLUMBING FOR BUILDING DRAINAGE

[Fig. No. 1326.3]



B—Bath
LB—Lavatory Basin
SP—Soil pipe
SWP—Soil and waste pipe
S—Sink
VP—Ventilating pipe
WP—Waste pipe
WC—Water closet
MH—Man hole.

1326.5.3.1.3. *One pipe system (partially ventilated)* :—There is one soil pipe into which all water closets, baths, sinks and basins discharge. In addition there is a relief vent which ventilates only the traps of water closets.

1326.5.3.1.4. *Safeguards for one pipe system (fully ventilated)* :—The safeguard shall be as follows :—

(a) The waste pipe shall joint the stack above the soil branch at each floor.

(b) Cast iron fittings and branches for waste pipe shall be of the same quality as for soil pipes and all waste pipe joints shall be made gas tight.

(c) Each waste pipe shall be directly connected to the common stick.

(d) All traps shall be of the deep seal type with a 75mm. water seal, and

(e) All traps shall be ventilated by means of pipe not less than 50mm. diametre for preserving their seals.

1326.5.3.1.5. *Safeguards for one pipe system (Partially ventilated)* :

(a) Waste pipe shall be on the stack above the soil branch at each floor.

(b) All traps shall be of the deep seal type with 75mm. water seal.

(c) Waste pipe shall fall gradually and continuously in the direction of flow. Waste pipes shall have a slope of 1 to 12 to 1 to 48.

(d) Water closets shall be ventilated by a pipe of not less than 50mm. for preserving their seals.

1326.5.3.1.6. *Other requirements* :

(a) All vertical soil, waste, ventilating and anti-siphonage pipes shall be covered on top with a copper or heavily galvanized iron wire dome or cast iron terminal guard and shall be fixed suitably to the wall to give a minimum clearance of 50mm.

(b) The soil pipe shall have a minimum diametre of 100mm. and shall be located outside the building or in suitably designed pipe shafts and shall be continued upwards without reduction in diametre and without any bend or angle to such a height and position as to afford by means of its open and a safe outlet for foul air. The soil pipes shall not be permitted on a wall abutting a street.

(c) Where pipe shafts are provided, the cross-sectional area shall be such, as to allow free and un-hampered access to the pipes to be installed in the shaft and in no case the cross-section shall be less than a square of one metre side. All pipe shafts shall be provided with an access door at ground level and facilities for ventilation.

(d) Soil pipes shall not be connected with any rain water pipes and there shall not be any trap in such soil pipe or between it and any drain with which it is connected.

(e) The soil pipes shall be properly supported at the foot upon a bed of concrete and firmly attached to the walls with mild steel holder bat clamps.

(f) Every pipe in a building for carrying off the waste or overflow water from every bath wash-basin or sink to a drain shall be 32 to 50mm. in diametre and shall be trapped immediately beneath such wash basin or sink by an efficient siphon trape with adequate means of inspection and cleaning. Such traps shall be ventilated into the external air wherever such ventilation is necessary to preserve the seal of the trap. No tube trap shall be constructed in the waste pipe of wash-basin or a sink. The overflow pipe from washing-basin or sink etc., shall be connected with the waste pipe immediately above the trap.

Vertical pipes carrying off waste shall have minimum diametre of 75mm. The pipe carrying waste to a drain shall be taken through an external wall by the shortest practicable route and shall discharge below the granting of the surface box of the chamber of a properly trapped gulley. The waste pipe shall be continued

upwards, without any reduction in diametre, to afford, means of the open end of the waste pipe, a safe outlet for foul air. The open ends of toe soil and waste pipes shall be carried to a height of atleast 0.60mm. above the outer covering of the roof of the building, or in the case of a window 2 metres above the top of the window. In the case of terrace roof to which access is provided it shall be carried upto a height of atleast 1.20m. above the parapet and not less than 2 metres above the head of any window with a horizontal distance of 3 metres from the pipe.

1326.5.3.2. *Pipe joints* :—All joints in soil pipe, waste pipes when above grounds shall be gas-tight and all sewers and drains below ground shall be water-tight.

The method of jointing pipes and the outlet of appliances and fitting is indicated in Table 1326-C.

Table 1326-C

Material of pipes to be connected	*Method of jointing*	*Reference to specification, if any*
Lead to lead	Wiped solder joint	1326.5.3.2.1
Lead to brass	Wiped solder joint	1326.5.3.2.1
Cast iron to cost iron	Caulked lead joint	SS : 1319.3
Stoneware to stoneware	Cement joint	SS : 1318.4
Asbestos cement soil and ventilating pipes/ Socket and spigot	Cement joint	SS : 1326.6.3
Lead to stoneware	Thimble or socket of brass wiped solder joint to lead pipes and cement joint between stoneware pipes with thimble	SS : 1326.3.4
Lead to cast iron	Brass thimble with wiped solder joint to lead pipe and caulked lead joint between brass thimble and cast iron pipe	SS : 1326.3.4.
C.I. to stoneware	Same as per stoneware to stoneware	SS : 1318.4
Lead to galvanised rubbed steel tubes	Brass union with wiped solder joint with lead pipe and connected to a nipple on galvanized pipe and screwed by a socket and lock-nut.	

1326.5.3.2.1. *Wiped solder joint* :—The solder unless otherwise specified shall consist of two parts of lead and one of tin. The lengths of wiped solder joint for various diametres of pipes shall be as per Table 1326.D.

Table 1326-D

Size of pipe	*Length of joints*	
	Minimum	*Maximum*
15mm.	60mm. (Provisional)	70mm. (Provisional)
20mm.	65mm. (Provisional)	70mm. (Provisional)
25mm.	70mm. (Provisional)	75mm. (Provisional)
32mm.	70mm. (Provisional)	80mm. (Provisional)
40mm.	70mm. (Provisional)	80mm. (Provisional)
50mm.	75mm. (Provisional)	90mm. (Provisional)
80mm.	75mm. (Provisional)	90mm. (Provisional)
100mm.	80mm. (Provisional)	90mm. (Provisional)

The parts to be jointed shall be thoroughly cleaned to a sufficient length by wire brushing or scrapping to remove surface dirt and oxide. Tallow or other suitable fix shall be applied to the cleaned surface and wiped joint made. The joint shall be neatly formed with an elliptical shape.

1326.5.4. *Manholes and inspection chambers* :—At every change of alignment, gradient or diametre of drain there shall be manhole or inspection chamber. Bends and junctions in the drain shall be grouped together in manholes as far as possible. The maximum distance between manholes shall be 30m. The distance between manholes and gulley chamber shall not exceed 6m. Where the diametre of a drain is increased the crown of the pipes shall be fixed at the same level and necessary slope given in the invert of the manhole chamber. In exceptional cases where the required fall is not available, connection may be made up to half the difference in diametre.

The minimum internal sizes of chambers shall be as follows :

(a)	For depth of 0.8 or less	75 x 0.75m.
(b)	For depth of 0.8m. x 2.1m.	1.20 x 0.90m.
(c)	For depth more than 2.1m.	Circular chamber with a minimum diametre of 1.4m. or rectangular chamber with minimum internal dimension of 1.2. x 0.9m.

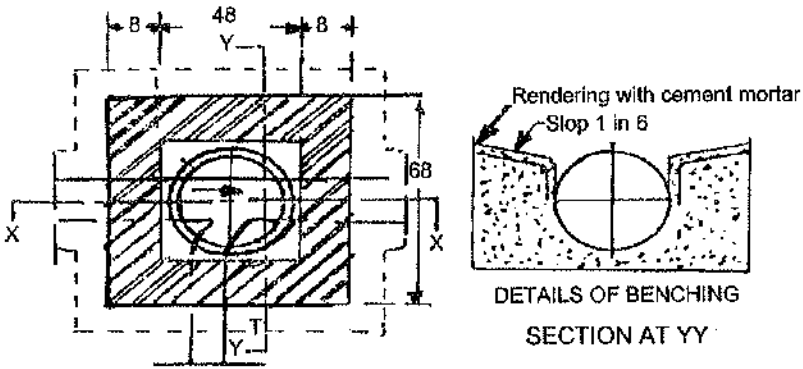
The access shaft shall be corbelled inwards on three sides at the top to reduce its size to that of the cover frame to be fitted or alternatively the access shaft shall be covered over by a reinforced concrete slab of suitable dimension with an opening for the manhole frame and cover. The manholes shall be built on a base of concrete of atleast 150mm., for manholes upto 0.8m. depth, atleast 225m. for manholes from 0.8 to 2.1m. depth and atleast 300mm., for manholes of greater depth. The thickness of walls shall not be less than 300mm. upto 1.5m. depth and 300mm., for depth greater than 1.5m. suitable rungs shall be provided in all manholes over 0.80m., depth.

1326.5.4.1. *Drop manhole* :—Where it is uneconomical or impracticable to arrange the connection of a sewer with its invert with in 0.60m. above the invert of a manhole, the connection shall be made by constructing a vertical shaft outside the manhole chamber, vide Fig 1326.4.

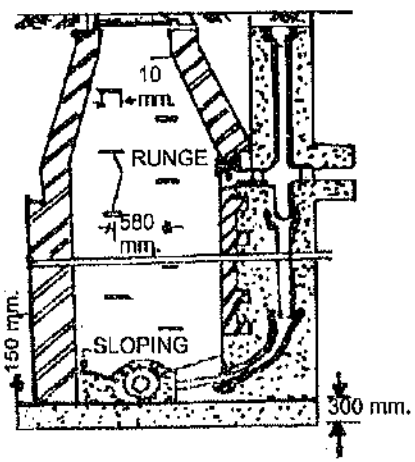
1326.5.4.2. *Channels is manholes* :—These shall be semicircular in the bottom half and of diametre equal to the sewer. Above the horizontal diametres the sides shall be extended vertically, preferably to the full vertical diametre and the top edge shall be suitably rounded off. The branch channels shall also be suitably constructed with respect to the benching but at their junction with the main channel an appropriate fall suitably rounded off in the direction of flow in the main channel shall be given. Details of benching a manhole shall as per Fig. 1326.4.

DROP MAN HOLE

[Fig. No. 1326.4]

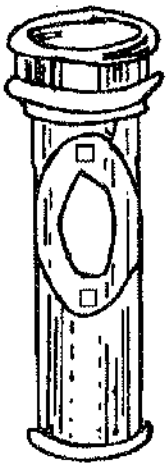


SECTIONAL PLAN OF MANHOLE



1326.5.5. *Access cover* :—Entry can be provided to branch drains by means of access cover at the foot of each soil pipe. (See Fig. 1326.5).

TYPE OF ACCESS COVER PROVIDED ON SOIL PIPE



[Fig. No. 1326.5]

1326.5.6. *House drain connection to street sewer* :—The drain shall be laid outside the building and the work shall be carried out as per SS : 1327. Where it is unavoidable to lay a drain under a building, it may be taken under a stair case room or a passage avoiding living rooms and kitchen. The drain shall be laid in a straight line at a uniform gradient. Means of access in the form of manholes shall be provided at each end immediately outside the building. The pipes under the building shall be of cast iron.

1326.6. Ventilation :

1326.6.1. *Material* :—Ventilating pipes and fittings shall conform to SS : 1314 or 1815 as may be specified.

1326.6.2. *General requirements* :—The drain intended for carrying waste water and sewage from a building shall be provided with atleast one ventilating pipe situated as near as practicable to the buildings and as far away as possible from the point at which the drain empties into the street sewer or other carrier.

Such ventilating pipes shall be carried up vertically from the drain to such a height, and in such a position as to afford by means of the open end of such pipe or vent shaft safe outlet for foul air with the least possible nuisance. Ventilating pipe or shaft shall be carried to a height of atleast 0.6 metre above the outer covering of the roof of the building or in the case of a window in a gable wall or a corner window, it shall be carried upto the ridge of the roof or atleast 2m., above the top of the window.

In the case of a flat roof to which access is provided it shall be carried upto a height of atleast 1.20m. above the parapet and not less than 2m., above the head of any window with a horizontal distance of 3m., from the vent pipe and in no case shall it be carried to a height less than 3m. above plinth level.

Where more than one bath sink or wash basin is connected to the same waste pipe, anti-syphonage pipe of 400mm. dia. shall be provided for waste pipe also.

1326.7. Workmanship and finish :—All the plumbing work and pipe joints, fittings and fixtures shall be carried out in a neat workman like manner true to plumb and grade with quality finish. All openings made in masonry for installing pipes and fixtures shall be made good and plaster restored original condition without unsightly patches, and surface finished with two coats of whitewash, colour wash or distemper or paints as specified by the Executive Engineer.

1326.8. Test :

1326.8.1. Comprehensive tests of all appliances shall be made by simulating condition of use. Overflows shall also be examined for obstructions.

1326.8.2. *Smoke test* :—All soil pipes, waste pipes and vent pipes and other pipes above ground shall be approved gas-tight by a smoke test conducted under a pressure of 25mm. of water and maintained for 15 minutes after all trap seals have been filled with water. The smoke is produced by burning oiled waste or tar paper or similar material in the combustion chamber of a smoke machine.

1326.8.3. *Water test* :— The drains or sewers shall be subjected to a test pressure of atleast 1.5m. head of water at the highest point of the section under test. The testing arrangement shall be as described in clause 1318.5. A leakage of two litres of water per ten millimetre diametre, per kilometer of pipe line may be allowed during a period of 10 minutes. Subsidence of water may be due to one or more of the following causes :

(a) Absorption by pipes and joints,

(b) Sweating of pipes and joints,

(c) Leakage at joints or from defective pipes,

(d) Trapped air.

Allowances shall be made for by adding water until absorption has ceased, after which the test proper shall be conducted. Any defective part of the work with visible leakage shall be removed and made good. A slight amount of sweating which is uniform may be overlooked but excessive sweating of a pipe or a joint shall be watched for and made good.

1326.8.4. *Testing of the internal pipework of water supply system* :—The pipes and fittings shall be tested after they are laid to a hydraulic pressure of 6 kg./cm^2 (60 metre head of water) as per clause 1320.3 in case of galvanized mild steel tubes and 1½ times the maximum working pressure in the case of P.V.C. pipes.

1326.9. Measurement :—Supplying and installation of sanitary appliances shall be measured in numbers of appliance installed as per this standard. Laying, fixing, jointing and testing of all pipe work and fittings for water supply, drainage (including soil and waste pipes and ventilation) shall be measured in running metres correct to 0.01 of a metre as installed in position as per this specification including holder bats required for fixing to walls and all jointing materials complete.

Manholes and inspection chambers shall be measured in numbers of chamber of the specified depth, built to this specification or any supplemental specification.

1326.10. Rate :—The unit rate for supplying installation of sanitary appliances shall be per each appliance installed in accordance with the specification. The unit rate for man-holes and inspection chambers shall be per each chamber built in accordance with this specification or any supplemental specification. The unit rate for laying, fixing, jointing and testing of all pipe work and fittings, for water supply, drainage (including soil and waste pipe) and ventilation shall be per running meter.

Specification No. 1327

House Drain and Connections – Construction

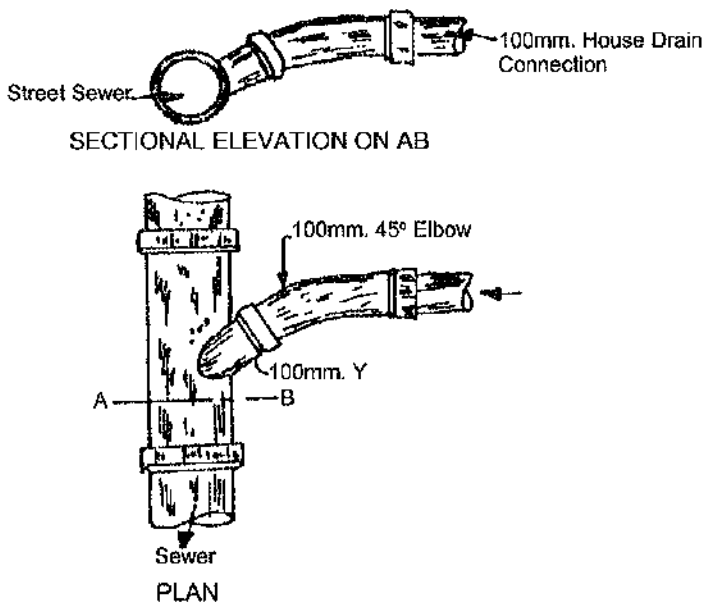
1327.1. Pipes :— Stoneware pipes shall be of size specified (usually 100mm.) and complying with the Standard Specification for stoneware pipes. They shall be laid and jointed in accordance with the Standard Specifications for "laying and jointing stoneware pipes and fittings". They shall be laid on concrete bed if the soil is soft.

1327.2. Gradients :—The minimum gradient shall be 1 to 40 for 100mm. diametre drains and 1 to 69 for 150mm. diameter drains.

1327.3. Sewer connections :—The house drain shall be connected to the street sewer generally by means of a "y" junction pipe (vide Fig. 1327.1) or at manhole if convenient. The system of drainage on the house side of the connection shall be disconnected from the street sewer means of a disconnecting trap as shown if Fig. 1327.2.

HOUSE DRAIN CONNECTION TO STREET SEWER

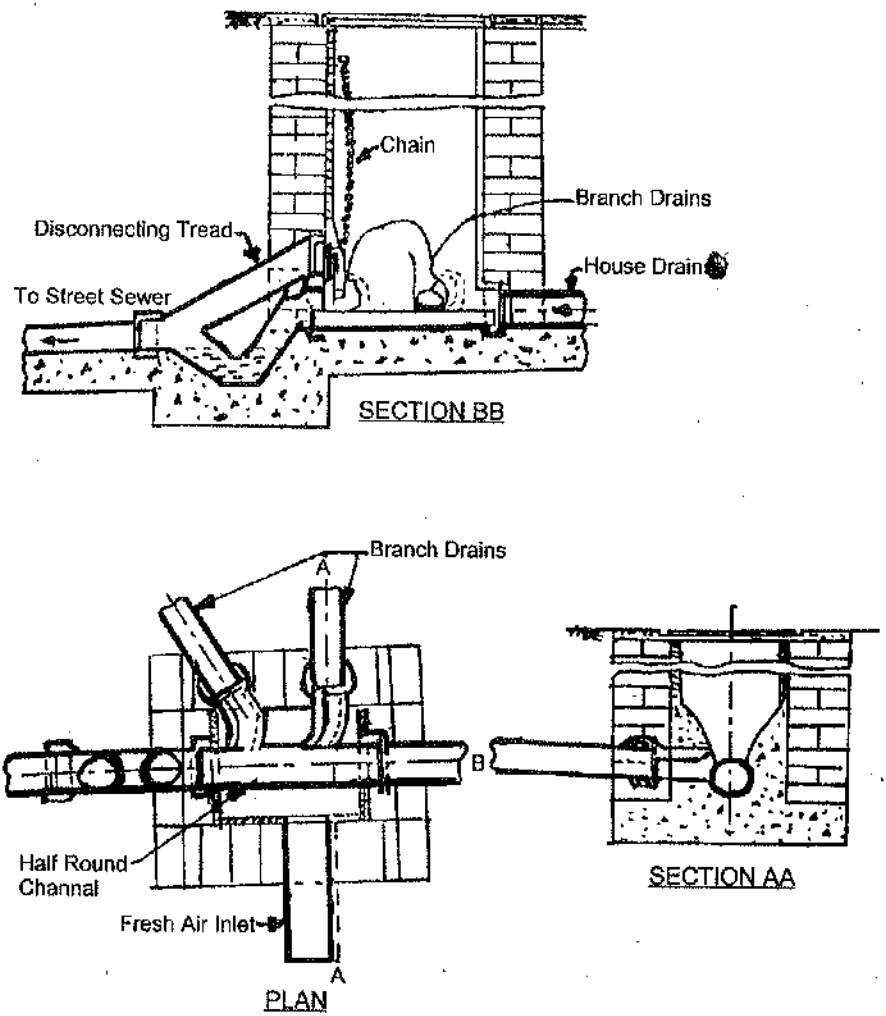
[Fig. No. 1327.1]



1327.4. Disconnecting trap :—Disconnecting trap shall comply with the following requirements.

PLAN AND TWO SECTION VIEWS OF AN INSPECTION CHAMBER (with disconnecting Trap) OF WATERTIGHT BRICK WORK CONSTRUCTION. THE BENCHINGS ARE OF CONCRETE WITH A RENDERING OF CEMENT AND SAND [1 : 2] MIX ON TOP

[Fig. No. 1327.2]



1327.4.1. The trap shall be free of all angels, corners and places where filth can accumulate.

1327.4.2. The body section of the trap shall be smaller in area than in its inlet section, so as to hold as the small as quantity of water as possible. The minimum sized trap shall be used consistent with circumstances.

1327.4.3. The inlet side of all traps shall be open to the atmosphere.

1326.10. Rate :—The unit rate for supplying installation of sanitary appliances shall be per each appliance installed in accordance with the specification. The unit rate for man-holes and inspection chambers shall be per each chamber built in accordance with this specification or any supplemental specification. The unit rate for laying, fixing, jointing and testing of all pipe work and fittings, for water supply, drainage (including soil and waste pipe) and ventilation shall be per running meter.

Specification No. 1327

House Drain and Connections – Construction

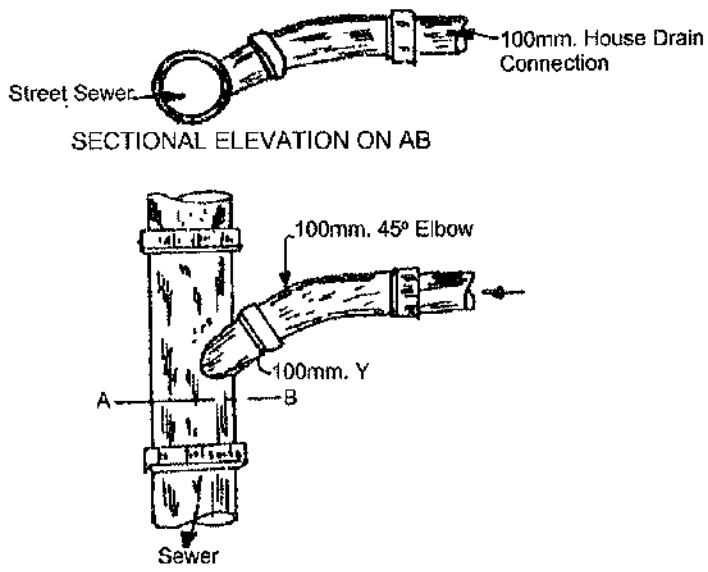
1327.1. Pipes :— Stoneware pipes shall be of size specified (usually 100mm.) and complying with the Standard Specification for stoneware pipes. They shall be laid and jointed in accordance with the Standard Specifications for "laying and jointing stoneware pipes and fittings". They shall be laid on concrete bed if the soil is soft.

1327.2. Gradients :—The minimum gradient shall be 1 to 40 for 100mm. diametre drains and 1 to 69 for 150mm. diameter drains.

1327.3. Sewer connections :—The house drain shall be connected to the street sewer generally by means of a "y" junction pipe (vide Fig. 1327.1) or at manhole if convenient. The system of drainage on the house side of the connection shall be disconnected from the street sewer means of a disconnecting trap as shown if Fig. 1327.2.

HOUSE DRAIN CONNECTION TO STREET SEWER

[Fig. No. 1327.1]



1327.4. Disconnecting trap :—Disconnecting trap shall comply with the following requirements.

1327.5. Branch drains :—All branches to the main house drain shall be connected to an inspection chamber and on the house side of the disconnecting trap.

1327.6. Air vents :—The inlets of disconnecting traps shall be connected to the atmosphere by means of a fresh air inlet, or by some alternative method shown in the detailed drawings or as directed by the Executive Engineer. The head of the main drain shall be ventilated by means of a soil pipe extension or by means of a ventilating shaft.

1327.7. Testing :—All drains shall be water tight and shall be passed by the Executive Engineer before being filled in vide clause 1325. On the Standard Specification for "fixing and plumbing of sanitary fittings in buildings" which shall apply.

1327.8. Alignment :—House drains shall be laid without bends between the house or inspection chamber and the sewer connection.

1327.9. Measurement :—Complete supply and construction of the house connection together with section chamber, if any, disconnecting trap and air vent complying with the plan furnished and in accordance with this specification and addendum specifications if any, shall be measured in number, as a complete unit. Alternatively the quantities of different work items shall be measured as specified in the relevant Standard Specifications.

1327.10. Rate :—The unit rate for payment of the house connection together with inspection chamber, if any, disconnecting trap and air vent shall be for each complete unit or different work items shall be paid for as specified in the relevant Standard Specification.

Specification No. 1328

Fixing of Rain Water Gutter and Down Pipes for Roof Drainage

1328.1. This specification covers the fixing of rain water gutters and down pipes and their fittings for roof drainage in residential and non-residential buildings and shall generally conform to IS : 2557- 1963 "Code of practice for fixing rain water gutters and down pipes for roof drainage".

1328.2. Terminology :— For the purpose of this specification the following definitions shall apply :

(i) *Down pipe* :—Pipe which collects rain water from the roof, from the roof gutters, or from both and conveys to a drain sump or other point of discharge.

(ii) *Drip* :—A joint between two gutters which provides for a sudden drop in fall.

(iii) *Expansion device* :—A detail in jointing between two lengths of gutters or at the free end of a gutter to accommodate its expansion due to thermal and other volumetric changes.

(iv) *Roof gutter* :—A channel for collecting drainage water at the Caves or edges roof.

(v) *Valley gutter* :—A channel located in the valley between two roof surface to collect or drainage water.

1328.3. Materials :

1328.3.1. Rains water pipes and fittings shall conform to :

(a) SS : 1312 for "Cast iron water pipes and fittings".

(b) SS : 1313 for "Asbestos cement rain water pipes, gutter and fittings".

(c) SS : 1311 for "Steel metal rain water gutters pipes, fittings and accessories".

1328.3.2. *Stays for sheet metal gutters* :—Stays for sheet metal gutters shall conform to IS : 2527-1963.

1328.3.3. *Brackets* :—The minimum sizes of metal sections to be used for making gutter brackets shall be as given below :

(a) Fascia brackets = 20 x 3mm.

(b) Rafter brackets = 20 x 5mm. for the arm.

= 20 x 3mm. for the clamp.

1328.4. Programming of the work :—Necessary work for supporting the rain water fittings properly in position shall be completed before the actual works of fixing rain water gutters and pipes is taken up. Any plaster finish in building work near the location of the down pipe shall be completed before fixing of the down pipe. Holdfast and clamps for the pipes may also preferably be fixed to the wall before plastering so as avoid damage to the plastering work later.

1328.5. Storage and handling of materials :—Materials such as pipes, roof gutters, etc., shall be stored and handled at site in accordance with the appropriate provisions of relevant Standard Specifications of A.P.S.S.

1328.6. Fixing of rain water gutters :—The contractor shall fix the rain water gutter as per the drawings provided in his contract or as directed by the Executive Engineer.

1328.6.1. *Asbestos cement gutters* :

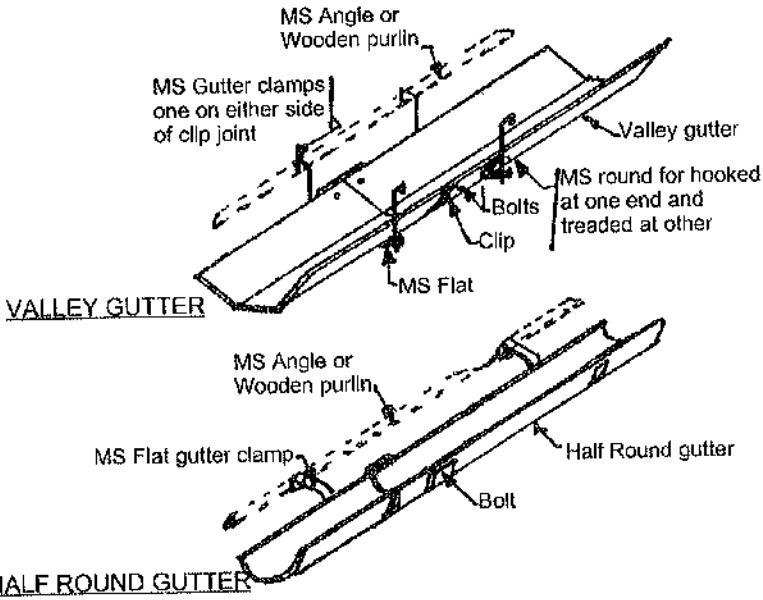
1328.6.1.1. Socketed gutters shall be supported with a bracket close to the socket and another in the centre of the gutter. Plain ended gutters shall be supported with a bracket on either side of each joint, and for gutters of large size, one extra supporting bracket in the centre of the gutter shall be fixed.

1328.6.1.2. Brackets shall be fabricated from mild steel flats and mild steel rods. (See fig.1328.1).

All brackets shall be provided with a suitable means of securing the gutter in position at the back.

1328.6.1.3. The joints shall be rendered water-tight by means of a suitable bitumastic jointing compound.

FIXING OF ASBESTOS CEMENT GUTTERS [Fig. No. 1328.1]



1328.6.2. *Sheet metal gutters* :

1328.6.2.1. *Use of stays* :—Steel gutters of thin gauge shall be stiffened with stays where necessary. The spacing of stays usually shall not exceed 400mm. and they shall be soldered in position to the gutter.

1328.6.2.2. *Jointings* :—all joints shall be lapped and soldered for at least 40mm. in the direction of flow. In case where the joints are soldered, the jointing faces of sheet metal gutters shall be primed with solder to ensure running of the jointing metal. Soldering of the resulting joint throughout the full girth of the gutter and to the full extent in the lap shall be ensured. Jointing may also be done by press folding of the jointing faces.

1328.6.2.3. *Fixing* :—All gutters shall be supported at centres not exceeding 750mm. and the supporting brackets or screws shall normally coincide with the alternate stays where provided. Gutters of the ogee and rectangular patterns in the 75mm. and 100mm. sizes may be fixed by screws inserted through alternative stays. The 115mm. and 125mm. sizes shall be fixed by screws inserted through every stay. The screws shall not be less than 2.6mm. in diametre and not shorter than the nominal thickness of the stay plus 25mm. Screws shall not be hammered into place.

1328.7. Fixing of rain water pipes :—The contractor shall fix the rain water pipes as per the drawing provided in his contract or as directed by the Executive Engineer, as the case may be.

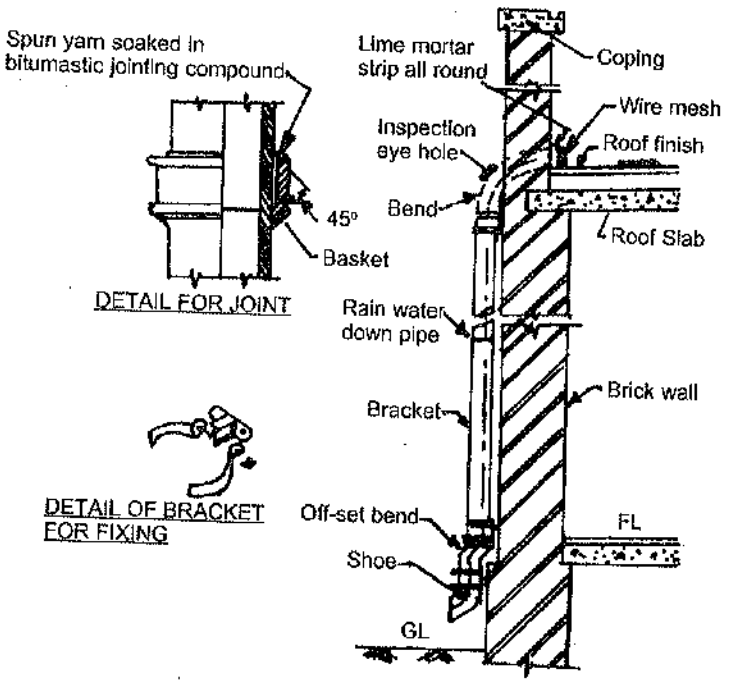
1328.7.1. *Jointing* :—The annular space between the socket and the spigot shall be filled with spun yarn soaked in bitumastic jointing compound. It shall be

pressed home by means of a caulking tool. More skeins of yarn shall be wrapped, if necessary and well rammed home. The joint shall then be finished with cement mortar at an angle of 45°.

1328.7.1. *Cast iron pipes* (See Fig. 1328.2 & 1328.3).

A TYPICAL DETAIL SHOWING FIXING OF DOWN PIPES TO WALL FOR ROOF DRAINAGE

[Fig. No. 1328.2]



1328.7.2.1. The pipe fitting shall be fixed in vertical alignment unless otherwise specified.

1328.7.2.2. The pipes and fittings shall be secured to the walls. Wooden cleats shall be inserted so that the pipes and fittings are kept at a distance of not less than 30mm. from the wall to facilitate cleaning, painting, etc.

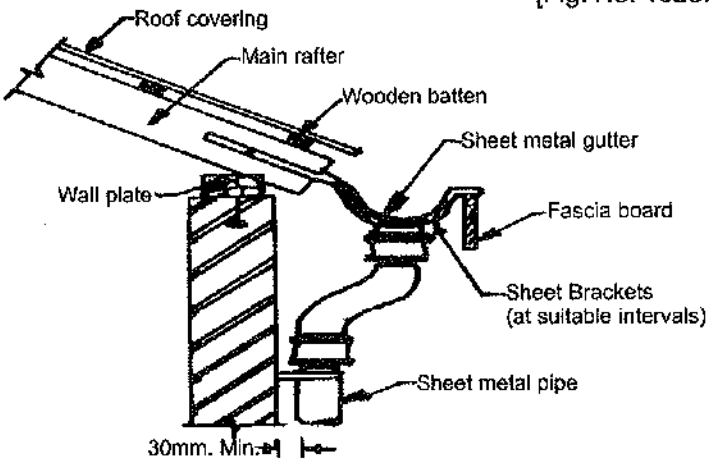
1328.7.2.3. If not provided with lugs, the pipes shall be secured to the wall at joints by means of mild steel or cast iron holder at clamp. Pipes which are provided with suitable lugs may be directly fixed to the wall by means of screws inserted into suitable wall plugs.

1328.8. Asbestos cement pipes :

1328.8.1. Pipes and fittings shall be fixed in vertical alignment unless otherwise specified.

A TYPICAL DETAIL OFFIXING OF SHEET METAL GUTTERS AND DOWN PIPES FOR SLOPE ROOF

[Fig. No. 1328.3]



1328.8.2. The pipes and fittings shall be secured to the walls with mild steel holder bat clamps in the same manner as given in clause 1328.7.1 for C.I. pipes.

1328.8.3. *Sheet metal pipes* :

1328.8.3.1. All joints shall be soldered or riveted or otherwise secured as directed before the pipe is fixed. The pipe shall be held by clamps fixed to the structure by means of wood screws inserted into suitable wall plugs.

1328.8.3.2. Where it is required to fix the pipe clear of the wall a hard wood block shall be used and shall be secured in place by screws inserted into suitable wall plugs. The overall size of the block shall be the same as that of the "ears" of the pipe as to afford full support to their entire surface.

1328.9. Measurement :—Measurements shall be in metres correct to 0.01 of a metre for the length of pipes or gutters fixed. The length shall be measured along the centre line of the pipe or gutter overall fittings from end to end.

1328.10. Rate :—The unit rate shall be for one metre length of pipe or gutter fixed and finished in accordance with this specifications.

SECTION 14

STANDARD SPECIFICATIONS FOR RIVER CONSERVANCY

Sl. No.	*Specification No.*	*Name of Specification*	*Page Nos.*
1.	1401	Planting Nanal Cuttings	528
2.	1402	Planting Nanal Cuttings with Roots	529
3.	1403	Planting Dubbus	530
4.	1404	Planting Thilla or Alchi with Roots	530
5.	1405	Uprooting and Burning Spontaneous Growth	531
6.	1406	Ploughing Sand Shoals and Hard Geddas	531
7.	1407	Dharba or Nanal Roller Revetment	531
8.	1408	Korukkai Roller Revetment	533
9.	1409	Weighted Bamboo Brush Wood Roller protection	533
10.	1410	Brush wood Edging with Piles	534
11.	1411	Brush wood Edging with Bamboos	536

Specification No. 1401

Planting NANAL Cuttings

1401.1. General :

1401.1.1. Plantation with *nanal* cuttings is particularly suitable for silt accretions marginal slopes of rivers, etc.

1401.1.1.2. *Nanal* cuttings shall be procured from Government Lands where available.

1401.2. Planting of *Nanal* Cuttings :

1401.2.1. Healthy sticks measuring not less than 500mm. in length and having not less than three knots shall be inserted on the marginal slopes, three for every hole at intervals of 500mm. either way, such that at least two knots go below the ground level. After the sticks are inserted the holes shall be refilled properly with earth and pressed. Where the silt is cracked due to exposure these sticks shall not be put into the cracks. Where unavoidable the sticks shall be put in duly filling up the crack around the sticks.

1401.2.2. This plantation shall generally be done only at the time when the water is receding at the end of the flood season. Where this is not possible watering may be permitted by the Executive Engineer for the specified areas.

1401.2.3. The plantation shall be protected and maintained in good condition for at least three months after the plantation has been completed and until the

plantation attains new growth to a height of not less than 600mm. The contractor shall be liable for all costs incurred in maintaining the growth and for all losses or damage of the plantation from whatever causes arising.

1401.3. Measurement :—

1401.3.1. All linear measurements shall be in metres, correct to 0.01 of a metre. All areas shall be worked out in square metres correct to 0.01 of a square metre.

1401.3.2. Pre-measurements shall be taken immediately after the *nanal* cuttings are planted.

1401.3.3. Final measurements of the *nanal* plantation shall be made three months after planting has been completed or as soon thereafter as found practicable. Payment shall be made for such portions of the plantations as have, at the time of final measurements, attained new growth to height of not less than 600mm.

1401.3.4. However the Executive Engineer may make proportionate final payment depending on the growth attained by the *nanal* plantations in the areas where it has not attained a new growth of 600mm. at the end of three months at his discretion.

1401.4. Rate :—

1410.4.1. The unit rate shall be per 100 square metres of *nanal* plantation inclusive of cutting, conveyance, planting and growing in accordance with this specification.

1401.4.2. Where *nanal* cuttings are obtained from sources other than Government plantations, the cost of *nanal* shall also be paid for.

1401.4.3. No watering charges shall be paid. But in cases where watering has been allowed by the Executive Engineer the watering charges shall be paid extra.

1401.4.4. No intermediate payments will be made for this type of plantation.

Specification No. 1402

Planting *Nanal* Cuttings with Roots

1402.1. Plantation of *nanal* cuttings with roots is suitable for low shoals. These have to be planted later in the season than in the case with *nanal* cuttings. In this case the growth has to be more rapid. Late planting shall be avoided.

1402.2. Good green sticks with roots not less than three knots and measuring not less than 500mm. in length shall be inserted at least 300mm. below ground level, three for every hole at intervals of 600mm either way. A hole shall be made for each three sticks with a crow-bar and they shall not be forced into the ground. Stout full grown sticks which have lost their sap shall not be used. Young sticks shall be chosen and planted within 24 hours of being cut, otherwise they do not take root well. The holes shall be refilled properly with earth and pressed so that the portions below the ground level are not exposed.

1402.3. Protection and maintenance of the plantation shall be as per SS : 1401.3.

1402.4. Measurement :—This shall conform to Clause 1401.3.

1402.5. Rate :—This shall conform to Clause 1401.4.

Specification No. 1403

Planting DUBBUS

1403.1. *Dubbu* plantation is suitable for sand shoals and clay soils.

1403.2. Holes means measuring 250mm. diametre, 500mm. deep shall be made at intervals of 800mm either way.

1403.3. Clumps of green, stout, well grown *nanal* shall be dug up with roots and planted in the prepared holes at eight sticks per hole, with roots at least 300mm. below the ground level and filled-up with good earth (silt having an admixture of fine sand approved by the Executive Engineer).

1043.4. The *dubbus* shall be staggered and planted so as not to form furrows during flood flows.

1403.5. *Paadus* or cup-like basins shall be made round each plant of sufficient size to receive and hold on pot full of water. Into each *paadu* one pot full of water shall be poured so that the earth may settle well. To avoid formation of pits or holes in the *paadu* water shall not be poured directly into the *paadu*. When the soil is hard and water poured in the *paadu* does not sink, a pointed stick shall be used to loosen the soil so that the water may sink to the root zone.

1403.6. To ensure proper growth, watering shall be done daily for the first ten days, every alternate day for the next 20 days and once in three days for the next two months.

1403.7. The plantation shall be protected and maintained in good condition for at least three months after the plantations has been completed and until the plantation attains a growth of at least one metre.

1403.8. Measurement :—This shall conform to Clause 1401.3 except that in this case the plantation shall grow to a height of one metre instead of 600mm.

1403.9. Rate :—This shall conform to Clause 1401.4 except that in this case the rate shall include watering charges also.

Specification No. 1404

Planting *Thilla* or *Alchi* with Roots

1404.1. See plants, *Thilla, Alchi* shall be planted in areas which are generally under the influence of salt water i.e., near river and sea confluences below high tide level.

1404.2. Holes 150mm. to 250mm. diametre and 500mm. deep shall be dug at intervals of one metre either way. *Thilla* or *Alchi* shall be dug up with roots and planted in the holes, one to three sticks per hole depending on the size of the

roots, the roots being fixed not less than 300mm. below the ground level. The holes shall then be carefully filled with good earth.

1404.3. Planting, preparation of *paadus*, watering, protection and maintenance shall conform to SS : 1403.

1404.4. Measurement :—This shall conform to Clause 1403.8.

1404.5. Rate :—This shall conform to Clause 1403.9.

Specification No. 1405

Uprooting and Burning Spontaneous Growth

1405.1. The site shall be cleared of all scrub-jungle and dirt. A pit 600mm. x 600mm. x 600mm. or deeper if the roots of the bush have gone down, shall be excavated round each plant or bush and the same with roots shall be completely removed. All the plants and bushes shall in a similar manner be removed and then burnt to ashes.

1405.2. Before uprooting and burning is taken up pre-measurements to the area to be cleared of scrub jungle shall be recorded.

1405.3. Measurement :—This shall conform to Clause 1401.3.1.

1405.4. Rate :—This unit rate shall be per 100 square metres of the cleared rate.

Specification No. 1406

Ploughing Sand Shoals and Hard *Geddas*

1406.1. The surface of the sand shoals and *geddas* shall be ploughed just before floors once lengthwise and once breadthwise. The interval between two lines of ploughing shall be 600mm. or such distance as specified by the Executive Engineer. The point of the plough shall run not less than 150mm. below the surface of shoal and uproot all grass and scrub over it and thoroughly loosen the surface to enable the floods to wash away the shoal.

1406.2. The work done shall be measured immediately after the work is completed and in any case before the ensuing floods.

1406.3. Measurement :—This shall conform to Clause 1401.3.1.

1406.4. Rate :—The unit rate shall be per 100 square metres of ploughed area.

Specification No. 1407

Dharba or *Nanal* Roller Revetment

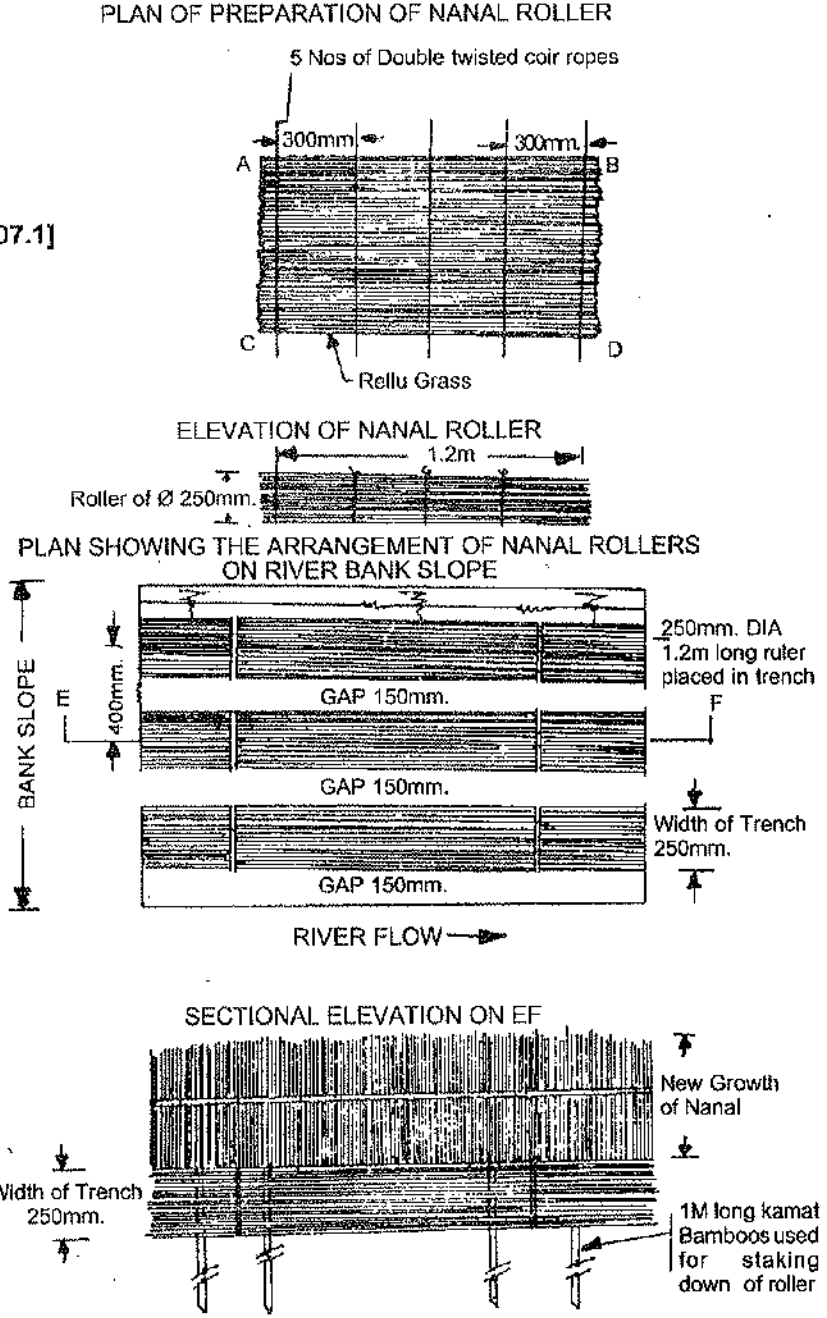
1407.1. *Dharba* roller revetment which is cheap, is useful for protection of banks Newly sloped, from caving-in. (See Fig. 1407.1.)

1407.2. On level ground, five strings of double twisted coir rope sufficiently long to securely tie the rollers, shall be stretched at intervals of 300mm in parallel lines for a length of 1.20 metres. Over this, three 200mm. diametre bundles of nanal shall be uniformly spread in two layers, the stems being placed differently in the

second layer. Over this 0.02cu.m. fine silt (earth) shall be sprinkled evenly and the whole thing rolled tightly and tied properly into a roller, about 250mm. diametre.

NANAL ROLLER REVETMENT

[Fig. 1407.1]



1407.3. Trenches 250mm. wide and spaced at 400mm. centre to centre shall be dug on slopes parallel to the river flow. In these trenches the roller shall be laid end to end and staked down with third class bamboos, not less than one metre long, at intervals of not more than one metre.

1407.4. The revetment shall be watered for at least three months and until a new growth of dense of plantation comes upto a height of 2m.

1407.5. Measurement :—This shall conform to Clause 1403.8 except that in this case the plantation shall grow to a height of two metres instead of one metre.

1407.6. Rate :—This shall conform to Clause 1403.9.

Specification No. 1408

Korukkai Roller Revetment

1408.1. *Korukkai* roller revetment thrives well in reaches affected by salt water i.e., near river and seal confluences. It is not easily damaged by cattle trespass.

1408.2. Preparation of roller shall conform to SS : 1407 except that only two bundles of green *Korukkai* sticks shall be uniformly spread instead of three bundles of *nanal* and fine slit earth mixed with roots of *Korukkai* plants shall be sprinkled instead of fine silt (earth). (See fig. 1407-I).

1408.3. Laying of *Korukkai* rollers in trenches shall conform to SS : 1407.

1408.4. The revetment shall be watered for atleast three months and until a new growth of dense plantation comes up to a height of one metre.

1408.5. Measurement :—This shall conform to Clause 1403.8.

1408.6. Rate :—This shall conform to Clause 1403.9.

Specification No. 1409

Weighted Bamboo Brush Wood Roller Protection

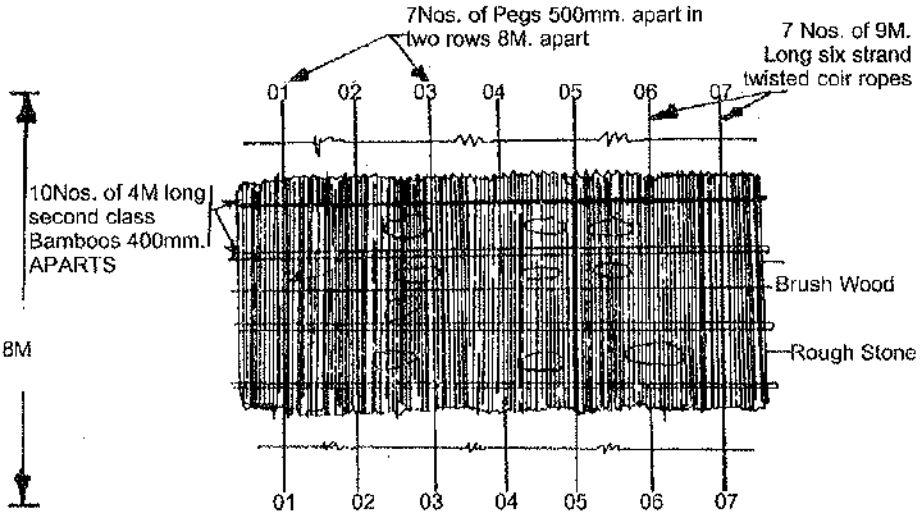
1409.1. This type of rollers shall be used for protecting the inner slopes and toes of river banks against caving in erosion. (See Fig. 1409.1).

1409.2. Seven pegs shall be driven into the ground at 500mm. apart. About 8 metres away seven other pegs shall be driven opposite to the above pegs. Strong twisted coir ropes of six strands and nine metres long shall then be temporarily tied to these pegs at either end. The Strong Standard specification second class bamboos, each 4m. long, shall then be tied transverse to the ropes 400mm. apart. Three cubic metres of brush wood shall be spread and pressed evenly over these bamboos and one third cubic metre of rough stone shall then be laid over the brush wood uniformly. Over these stones one and half cubic metres of brush wood shall again be spread and the whole thing rolled up closely and tied very tightly to form a roller of about one metre diametre and four metres long. The centre and the two ends of the roller shall then be tied up securely with coir ropes and each roller shall be gently lowered into the river, by means of three stout ropes, at the specified places. The lowering ropes shall then be removed.

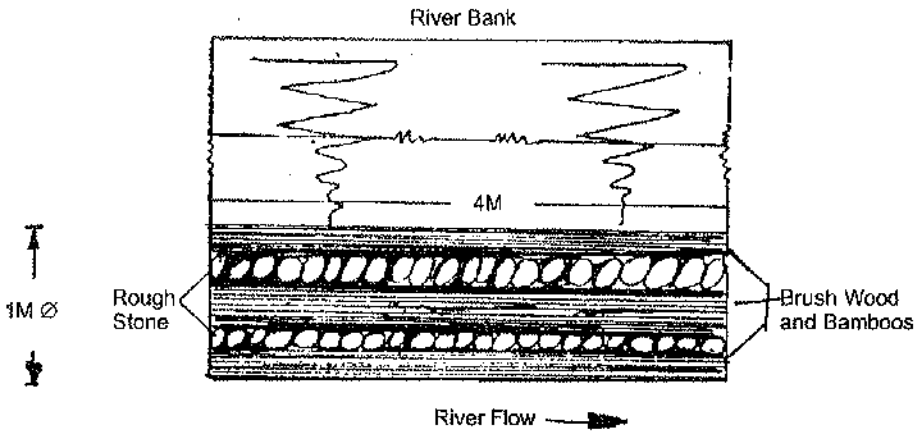
1409.3. If rough stones are not available six bags of sand (about one third cubic metre) stitched strongly shall be used.

WEIGHTED BAMBOO BRUSH WOOD ROLLER

[Fig. No. 1409.1]



PLAN OF PREPARATION OF WEIGHTED BAMBOO BRUSH WOOD ROLLER



SECTIONAL ELEVATION

1409.4. Measurement :—This shall consist of completed numbers of rollers.

1409.5. Rate :—This shall be for each roller completed and placed in position in accordance with this specification.

Specification No. 1410

Brush Wood Edging with Piles

1410.1. This type of brush wood edging shall be used for protection of slopes of river banks. (See Fig. 1410.1).

1410.2. Piles shall be of country wood, casuarina or half split palmyrah as may be specified by the Executive Engineer. They shall be straight and free from projections. Where split palmyrah piles are used they shall be cut from sound, full grown palmyrah trees and shall be used immediately after cutting, when fresh.

1410.3. The mid-girth of the pipes shall not be less than 300mm. upto 3 metre lengths. 400mm. upto 5 metre lengths and 500mm. for lengths over 5 metres.

1410.4. Waling pieces shall be of the above varieties. Quarter split palmyrah can also be used. These shall be straight and 3.5 metres to 4 metres long and not less than 250mm. at mid girth.

1410.5. Cross pieces shall be the same as the waling pieces. Their lengths shall be about two metres.

1410.6. The piles and the waling pieces shall be stripped of bark and painted with two coats of approved bitumen before use. The piles shall be marked with serial number, girth and length, 150mm. below the top. The thinner end of piles shall be sharpened neatly to a point for 500mm. length from the bottom. Piles shall be grouped and arranged serially in the order in which they are to be driven.

1410.7. Driving Piles :—The head of each pile shall be provided with a temporary wooden cap to prevent it from splitting while driving. The piles shall be driven in one of the following ways or as specified by the Executive Engineer :

(1) By wooden mallets,

(2) By heavy wooden monkeys dropped from a tripod, and

(3) By a pile driver or other approved methods.

They shall be driven truly vertical to a depth of not less than two and a half metres or as specified. The tops of piles shall be correct level. The spacing between the piles in one row and between the rows shall be one metre or as specified. Any pile which is 100mm. or more out of position at top shall be removed and redriven correctly.

1410.8. Waling pieces shall be fixed at intervals of 500mm. to 700mm. with iron nails penetrating atleast 75mm. into the piles. The number of rows of waling pieces shall be as specified, the top row being fixed 300mm. below the top of piles.

1410.9. Cross pieces shall be fixed over the waling pieces, bridging the two rows of piles using iron nails penetrating at least 75mm. into the piles or with coir rope as may be specified.

1410.10. Brush wood bundles consisting of 50mm. to 75mm. dia. branches shall placed in between the two rows of piles and well pressed by tampling over wooden planks placed over the brush wood or by any other means. The brush wood shall be protected from washing out by nailing reapers diagonal over the top row of waling pieces.

1410.11. Measurement :—This shall conform to 1401.1.

1410.12. Rate :—The unit rate shall be per running metre of the finished brush wood edging except or the piles which shall be paid for separately on running metre basis.

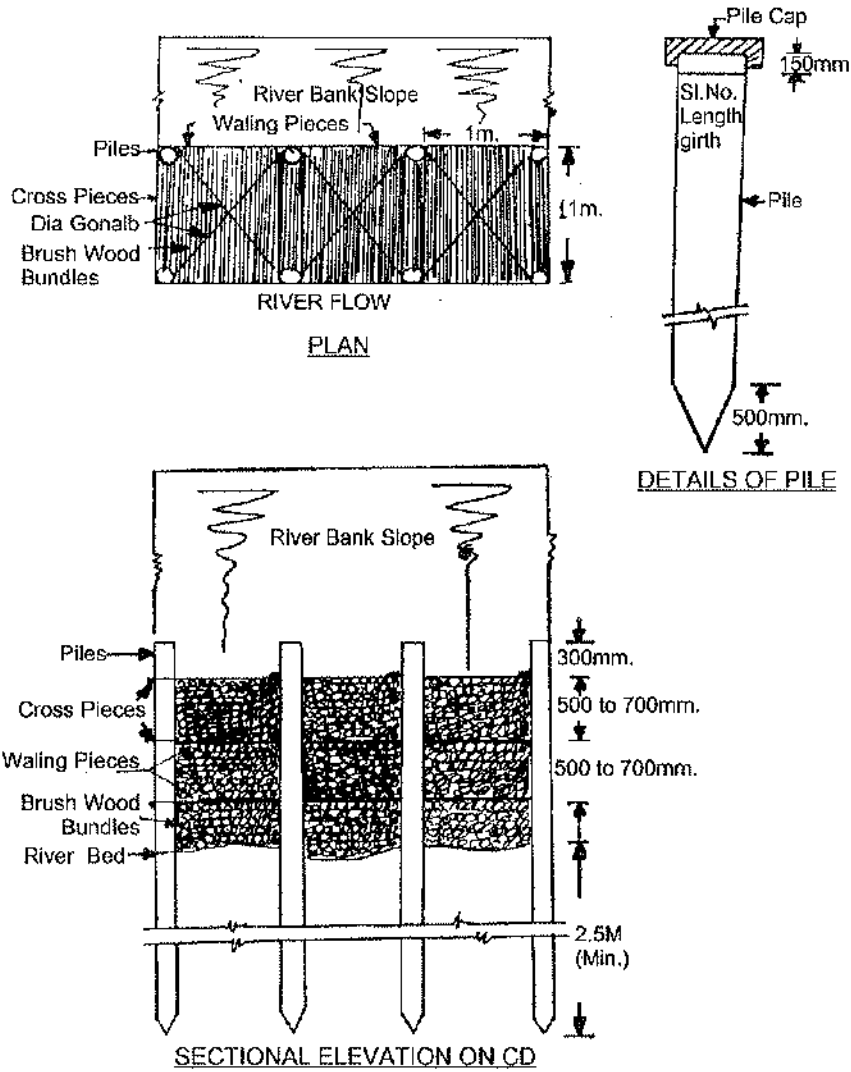
Specification No. 1411

Brush Wood Edging with Bamboos

1411.1. This type of brush would edging with suitable for canals and for cross-edging in rivers. (See Fig. 1410-1).

BRUSH WOOD EDGING WITH PILES

[Fig. No. 1410.1]



1411.2. Bamboo pegs shall be prepared from storing and sound bamboos of not less than 150mm. midgirth, which are straight and free from projections. They shall be cut just above the knot at the top and sharpened to a point at the bottom.

1411.3. The bamboo pegs shall be marked with serial number, girth and length near the top. Bamboo pegs shall be grouped and arranged serially in the order in which they are to be driven.

1411.4. Waling pieces shall be of the same variety as bamboo pegs and shall have a minimum midgirth of 125mm. and three to four metres long.

1411.5. Cross pieces shall be of the same variety as waling pieces and shall have a minimum mid-girth of 100mm. and two to three metres long. These shall be cut from the thin edges of bamboos.

1411.6. The bamboo pegs shall be carefully driven into the ground with wooden mallets to a depth of not less than one and half-metres, in two parallel rows. Pegs whose tops have split while driving shall be replaced with fresh ones. The spacing between the pegs in one row and between the rows shall be one metre or as specified.

1411.7. Waling pieces shall be fixed to the bamboo pegs, in two rows for both the rows of bamboos pegs, with iron nails penetrating atleast 75mm. into the pegs.

1411.8. Cross pieces shall be fixed over the waling pieces bridging the two rows of bamboo pegs with iron nails penetrating at least 75mm. into the pegs.

1411.9. Brush would shall be filled in and protected as per SS : 1410.

1411.10. Measurement :—This shall conform to clues 1410.3.1.

1411.11. Rate :—The unit rate shall be per running metre of completed brush wood edging including driving of bamboo pegs in accordance with this specification.

SECTION 15

STANDARD SPECIFICATIONS FOR ROAD WORKS

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Specification No. 1501

Road Works – General

1501.1. Terminology :

1501.1.1. *Right-of-way* :—The areas existing or acquired for road purposes.

1501.1.2. *Road-way* :—The portion of the right-of-way included between the toes embankment or the tops of cuts.

1501.1.3. *Formation width* :—The portion of the roadway extending between the outside shoulder lines.

1501.1.4. *Sub-base* :—The portion of the formation width upon which the surfacing material for the carriageway is to be laid.

1501.1.5. *Base* :—It is a portion of the road structure resting upon the sub-base through which the load is transmitted to the sub-base.

1501.1.6. *Pavement* :—It is a portion of the road which carries the traffic and transmits the load to the base.

1501.1.7. *Overlay* :—Overlay is an additional layer laid over the existing pavement either to strengthen or to improve the riding surface.

1501.1.8. *Carriage-way* :—Carriage-way is the effective width of the road formation intended for the use of vehicular traffic.

1501.1.9. *Shoulders* :—The portion of the formation between the edges of the carriage way and top of fill slope of bottom of cut-slope of inner edge of side drain.

1501.2. Road Materials :—

1501.2.1. ***General*** :—

1501.2.1.1. *Source* :—All road materials shall be obtained from the quarries specified.

1501.2.1.2. *Conveyance to site* :—Materials shall be brought to the site sufficiently in advance of construction.

The contractors shall be responsible that vehicles used for transporting materials do not drop any of their contents on the road. The Executive Engineer shall order the removal of such material at the expense of the contractor in cases of neglect. Carts shall invariably be provided with tail boards.

Depositing of material shall commence at one end of the kilometer and be carried continuously to the other end. Material shall not be deposited on the carriage way or shoulders or in such a manner as to interfere with free drainage or free movement of traffic.

While depositing the materials the vehicles shall not be kept across the road obstructing the carriage way or the shoulders.

Collection and utilisation of material shall not be carried out simultaneously.

1501.2.1.3. *Stacking* :—This shall conform to SS : 101.

1501.2.1.4. *Measurement* :—Whenever the collection of materials forms and a separate item in a contract or payment for the materials is contemplated before their use or pre-measurement required as in the cases of revetment, pitching and rip rap, materials shall be measured before they are used. Measurement shall not be taken until materials are collected atleast in one kilometer fully. Immediately after measurement the stacks shall be marked with white wash or as specified, to safeguard against double payment.

All linear measurements shall be in metres, correct to 0.01 of a metre. All areas shall be worked out in square metres, correct to 0.01 of a square metre. All quantities shall be worked out in cu.m. correct to 0.01 of a cu.m.

1501.2.1.5. *Rate* :—The unit rate shall be per cu.m.

1501.2.2. *Coarse Aggregates* :

1501.2.2.1. *Quality* :—The coarse aggregate may either be hand broken or crushed. The aggregate shall consist of hard, sharp and angular pieces broken to specified sizes. Flaky and or weathered stones shall not be used. It shall be free from dust and other deleterious purities.

1501.2.2.2. *Nominal sizes* :—The nominal sizes of coarse aggregates shall conform to the nominal sizes shown in Table 1501-A when tested in accordance with IS : 460-1962. The aggregate may be used in single size or in combination of different sizes as may be specified.

Table 1501-A

Sizes of Coarse Aggregates

Nominal size	*Wholly passing through a sieve of square mesh of size*	*Wholly retained on a sieve of square mesh of size*
80 mm.	100 mm.	63 mm.
63 mm.	80 mm.	50 mm.
50 mm.	63 mm.	40 mm.
40 mm.	50 mm.	25 mm.
25 mm.	40 mm.	20 mm.
20 mm.	25 mm.	12.5 mm.
12.5 mm.	20 mm.	10 mm.
10 mm.	12.5 mm.	6.3 mm.
6.3 mm.	10 mm.	2.36 mm.

1501.2.2.3. *Sampling and testing* :—Sampling and testing where required shall be conducted in accordance with the relevant Indian Standards.

1501.2.2.4. *Measurement* :—This shall conform to clause 1501.2.1.4.

1501.2.2.5. *Rate* :—This shall conform to clause 1501.2.1.5.

1501.3. Arrangements for traffic during construction :—

1501.3.1. *General* :—The work on the highway shall be carried out causing least interference to the flow of traffic. For all works involving improvements to an existing highway a passage for traffic, either along a part of the existing carriage way under improvement or along a temporary diversion (constructed close to the highway) shall be provided and maintained during the execution of the work in accordance with the directions of the Executive Engineer.

1501.3.2. *Passage of traffic along a part of the existing carriageway under improvement* :—This method shall be adopted where the improvement works, viz.,

widening/strengthening of the existing pavement or reconstruction/repairs to cross drainage works could be carried out on part widths while the traffic could simultaneously be passed (without undue delay and difficulty) on the other part. The road shoulder shall be dressed and brought in line with the pavement and maintained throughout the duration of the work to the satisfaction of the Executive Engineer. Where work is in progress (continuous) long stretches, passing places atleast 20 metre along and 6 metre wide inclusive of the width of the existing carriage way shall be provided at half to one kilometre intervals at suitable points as directed by the Executive Engineer. Extra treatment to shoulders where necessary shall be given as ordered by the Executive Engineer.

1501.3.3. *Passage of traffic along a temporary diversion* :—If it is not possible to pass the traffic on the part width of carriageway for any reason, a temporary diversion close to the highway shall be constructed as directed by the Executive Engineer. It shall be paved with locally available materials such as hard moorum, gravel, broken brick or broken stone to the specified thickness and provided with bituminous surfacing where so directed. In all cases the alignment, gradients, width and type of surface of the diversion included its junction points shall be approved by the Executive Engineer before the highway to be detoured is closed to traffic. At cross drainage points temporary crossings for the diversion shall be provided according to the designs approved by the Executive Engineer.

1501.3.4. *Traffic safety and control* :—Before taking up any construction an agreed phased programme for the diversion of traffic on the highway shall be drawn up in consultation with the Executive Engineer.

Necessary barricades, sign, lights and flagmen shall be provided and maintained at either end of the by-passes, re-locations and at such other intermediate points as may be directed by the Executive Engineer.

The signs shall be approved design and be properly located. Reflector type signs shall be used if so directed. Temporary warning lamps shall be installed at all barricades during the hours of darkness and kept lit at all times during these hours. If required by the Executive Engineer flagmen shall be posted at both ends of the work and at such other intermediate points as may be necessary during the hours specified.

1501.3.5. *Maintenance of diversion and traffic control devises* :—Signs, lights, barricades and other traffic control devices as well as the riding surface of diversion shall be maintained in satisfactory condition till such they are required as directed by the Executive Engineer. The diversion shall be kept free of dust by frequent watering, if necessary.

1501.3.5.1. Construction of diversions, initial dressing of the shoulders and extra pavement at passing places and initial cost of traffic control device shall be paid for.

1501.3.5.2. Unless otherwise specified maintenance of diversion and traffic control devices shall not be paid for separately.

1501.4. Quality Control :

1501.4.1. *General* :—All works performed shall conform to the line, grade and cross sections shown on the drawings or as directed by the Executive Engineer subjected to the permitted tolerances described hereinafter.

1501.4.1.1. *Horizontal alignments* :—Horizontal alignments shall be reckoned with respect to the center line of the carriage way as shown on the drawings. The edges of the carriageway as constructed shall be correct within a tolerance of ± 25mm. therefrom. The corresponding tolerance for edges of the roadway and lower layers of pavement shall be ± 40mm.

1501.4.1.2. *Longitudinal profile* :—The levels of the sub-grade and different pavement courses as constructed shall not vary from those calculated (with reference to the longitudinal and cross sectional profiles of the road shown on the drawings or as directed by the Executive Engineer) beyond the tolerances mentioned below :

Sub base	± 25mm.
Base course	± 15mm.
Wearing course	± 10mm.
C.C. Pavement	± 10mm.

Provided, however, that the negative tolerance for wearing course shall not be permitted in conjunction with the positive tolerance for base course if the thickness of the former is thereby reduced by more than 6mm.

1501.4.1.3. *Surface regularity of sub-base and pavement courses* :—The surface regularity of constructed sub-base, base courses and wearing surfaces both in longitudinal and transverse directions shall be within the relevant tolerances specified in Table 1501-B.

The longitudinal profile shall be checked with a 3 metre long straight edge at the middle of each traffic lane along a line parallel to the centre line of the road. The transverse profile shall be checked with a set of three camber boards at intervals of 10 metres.

Table 1501-B

Permitted tolerances of surface regularity for pavement courses

		Longitudinal profile	*Cross profile*
Sl. No.	*Type of Construction*	*Max. permissible variation when measured with a 3 metre straight edge*	*Max. permissible variation from specified profile when measured with a chamber template*
(1)	*(2)*	*(3)*	*(4)*
		mm.	*mm.*
1.	Sub-base	18	10
2.	Water bound macadam for base course	15	12

3.	Water bound macadam wearing course	12	8
4.	Built-up spray grout	12	8
5.	Surface dressing over WBM	6	8
6.	Bituminous Macadam	6	6
7.	Surface dressing over bituminous macadam	6	6
8.	Bitumen renewal coat by hot mix process	6	6
9.	Asphaltic concrete	3	4
10.	Cement Concrete Pavement	3	4

1501.4.1.4. *Rectification* :—Where the surface irregularity of sub-grade and the various pavement course fall outside the specified tolerances the contractor shall be liable to rectify these in the manner described below and to the satisfaction of the Executive Engineer.

(i) *Moorum and mechanically stabilised sub-base* :—Where the surface is high it shall be trimmed and suitably compacted. Where the same is low the deficiency shall be corrected by adding fresh material and compacted to the specifications.

(ii) *Cement / Lime stabilised sub-base* :—For cement/lime treated materials where the surface is high the same shall be suitably trimmed while taking care that the material below is not disturbed due to this operation. However, where the surface is low the same shall be corrected as described herein below:

When the time elapsed between the time of mixing the materials with cement/lime and the detection of irregularity is less than 2 hours/3 hours (respectively) the surface shall be scarified to a depth of 50mm. and supplemented with necessary freshly mixed material and recompacted to the relevant specification. When this time is more than two/three hours, the full depth of the layer shall be removed from the pavement and replaced with fresh material conforming to specifications. In either case the area treated shall not be less than 5 metres long by 2 metres wide.

(iii) *Water bound macadam base* :—When the surface is high or low the top 75mm. shall be scarified, re-shaped with added material where necessary and recompacted to conform to SS : 1506. The area treated as a place shall not be less than 5 metres long and 2 metres wide.

(iv) *Bituminous constructions* :—For bituminous constructions other than wearing course where the surface is low the deficiency shall be corrected by adding fresh material and recompacting to conform to specifications. Where the surface is high the full depth of the layer shall be removed and replaced with fresh material and compacted to conform to specifications.

For wearing course where the surface is high or low the full depth of the layer shall be removed and replaced with fresh material and compacted to conform to specifications. In all cases where the removal and replacement of bituminous layer is involved the area treated shall not be less than 5 metres long and 1 lane wide.

(v) *Cement concrete Pavement* :—Any high spots shall be cut down and refinished. Depressions shall be enlarged to about 80mm. to 100mm. and filled up with fresh concrete, compacted and finished. All above operations shall be completed within 75 minutes (60 minutes in hot weather) of mixing. Where the removal or replacement is involved the area of pavement to be removed and replaced shall be that represented by the transverse joints immediately adjacent to the deviation across the full width of the slab.

1501.4.2. *Tests during construction* :

1501.4.2.1. *General* :—The materials supplied and the works carried out by the contractor shall conform to the specifications.

For ensuring the requisite quality of construction the materials and works shall be subjected to tests as directed by the Executive Engineer/Quality Control Staff. The testing frequencies set forth are the desirable minimum and the Executive Engineer/Quality Control Staff shall have the full authority to carry out tests as frequently as they may deem necessary to satisfy themselves that the materials and works are in conformity with the various specifications.

Where specified procedure for testing is not indicated in these specifications the same shall be carried out as per the prevalent accepted engineering practices as per the directions of the Executive Engineer/Quality Control Staff.

1501.4.2.2. *Tests on sub-bases and bases (excluding bitumen bound bases)* :—The tests and their frequencies for the different types of bases and sub-bases shall be given in Table 1501-C.

Table 1501-C

Control tests their frequency for Sub-base and Bases (Excluding Bitumen Bound Bases)

Sl. No. (1)	*Type of construction* (2)	*Test* (3)	*Frequency* (4)	*Procedure* (5)
1.	Moorum sub-base	(i) Gradation	One test per 200m³	IS : 2720 (Part-IV) 1975
		(ii) Plasticity	One test per 200m³	IS : 2720 (Part-IV) 1970
		(iii) Natural moisture content	One test per 250m³	IS : 2720 (Part II) 1973
		(iv) Deleterious constituents	As required	IS : 2720 (Part XXVII) 1968
		(v) Moisture contents prior to compaction	One test per 250m³	IS : 2720 (Part II) 1973
		(vi) Density of compacted layer	One test per 500m³	IS : 2720 (Part XXVIII) 1974

(1)	(2)		(3)	(4)	(5)
		(vii)	Control of grade, camber, thickness and surface finish	Regularly	Vice Clause 1501.4.1
		(viii)	C.B.R. Test (On* a set of 3 specimens)	As required	IS : 2720 (Part XVI) 8965
2.	Mechanically stabilised soil sub-base	(i)	Gradation	One test per 200m³	IS : 2386 (Part IV) 1963
		(ii)	Plasticity index of mixed material	One test per 1,000m²	IS : 2720 (Part V) 1970
		(iii)	Moisture content prior to compaction	One test per 250m²	IS : 2720 (Part II) 1972
		(iv)	Dry density of compacted layer	One test per 500m²	IS : 2720 (Part XXVIII) 1974
		(v)	Control of grade camber, thickness and surface finish	Regularly	As per Clause 1501.4.1
		(vi)	C.B.R. Test* for materials mixed at site (on a set of 3 specimens).	One test per 3,000m³	IS : 2720 (Part XVI) 1965
		(vii)	Deleterious constituents	As required	IS : 2720 (Part XXVII) 1968.
3.	Lime Stabilised soil sub-base	(i)	Purity of lime and available calcium oxide.	One test for each consignment subject to a min. of one test per 5 tonnes of lime.	IS : 1514-1959
		(ii)	Lime content immediately after mixing.	One test per 250m²	IS : 1514-1959
		(iii)	Degree of pulverisation	Regularly	
		(iv)	Moisture content prior to compaction	One test per 250m²	IS : 2720 (Part II) 1973
		(v)	Dry density of compacted layer	One test per 500m²	IS : 2720 (Part XXVIII) 1974

(1)	(2)		(3)	(4)	(5)
		(vi)	Control of grade, camber, thickness and surface finish.	Regularly	As per clause 1501.4.1
		(vii)	C.B.R. Test* for materials mixed at site (on a set of 3 specimens).	One test per 3,000m²	IS : 2720 (Part XVI) 1965
		(viii)	Deleterious constituents of soil	As required	IS : 2720 (Part XXVI) 1973
4.	Cement Stabilised soil sub-base	(i)	Deleterious constituents	As required	IS : 2720 (Part XXVII) 1968
		(ii)	Quality of cement		IS : 269-1967 IS : 455-1967 IS : 1489-1967
		(iii)	Cement content immediately after mixing.	One test per 250m²	
		(iv)	Degree of pulverisation.	Regularly	
		(v)	Moisture content prior to compaction	One test per 250m²	IS : 2720 (Part II) 1973
		(vi)	Dry density	One test per 500m²	IS : 2720 (Part XXVIII) 1974
		(vii)	Control of grade, camber, thickness and surface finish.	Regularly	As per clause 1501.4.1.
		(viii)	C.B.R. Test* on materials mixed at site (on 3 set of 3 specimens).	One test per 3,000m²	IS : 2720 (Part XVI) 1965
5.	Water bound Macadam base	(i)	Los Angeles Abrasion Value/Aggregate Impact Value	One test per 200m²	IS : 2386 (Part IV) 1963
		(ii)	Grading of aggregate and screenings	One test per 100m²	IS : 2386 (Part-I) 1963
		(iii)	Flakiness index of aggregate	One test per 200m²	IS : 2386 (Part-I) 1963
		(vi)	Plasticity of binding material	One test per 25m²	IS : 2720 (Part-V) 1970

(1)	(2)	(3)	(4)	(5)
		(v) Control of grade, camber, thickness and surface finish.	Regularly	As per clause 1501.4.1.

1501.4.2.4. *Tests on Bituminous Constructions* :—The tests and their frequencies for the different types of bituminous constructions shall be given in table 1501-D.

Table 1501-D

Tests and their frequencies for bituminous constructions

Sl. No. (1)	*Type of construction* (2)	*Test* (3)	*Frequency* (4)	*Procedure* (5)
1.	Seal coat and single coat Surface dressing	(i) Quality of binder	As required	IS : 73-1961 IS : 215-1961 IS : 217-1961 IS : 454-1961 As applicable.
		(ii) Los Angeles Abrasion Value/Aggregate Impact Value	One test per $50m^3$	IS : 2386 (Part IV) 1963
		(iii) Stripping value of aggregate		IS : 6241-1971
		(iv) Flakiness index of aggregate	One test per $50m^3$	IS : 2386 (Part-I) 1963
		(v) Water absorption of aggregate	One test per $50m^3$	IS : 2386 (Part-III) 1963
		(vi) Grading of aggregate	One test per $25m^3$	IS : 2386 (Part-III) 1963
		(vii) Temperature of binder during application	Regularly	
		(viii) Rate of spread of binder	One test per $500m^2$	
		(ix) Rate of spread of aggregate	One test per $500m^2$	
2.	Bituminous renewal coat by hot mix progress	(i) Quality of binder	As required	IS : 73-1961 IS : 215-1961 IS : 217-1961 IS : 454-1961 As applicable.

(1)	(2)	(3)	(4)	(5)
		(ii) Los Angeles Abrasion value/Aggregate Impact Value.	One test per $50m^3$	IS : 2386 (Part IV) 1963
		(iii) Stripping value of aggregate	One test per $50m^3$	IS : 6241-1971
		(iv) Flakiness index of aggregate	One test per $50m^3$	IS : 2386 (Part I) 1963
		(v) Water absorption of aggregates	One test per $50m^3$	IS : 2386 (Part III) 1963
		(vi) Grading of aggregate	One test per $25m^3$	IS : 2386 (Part I) 1963
		(vii) Temperature of binder, during application.	Regularly	
		(viii) Binder content	Two tests per day	
		(ix) Rate of spread of premix	Regular control through checks on materials & layer thickness	
3.	Bituminous Macadam	(i) Quality of binder	As required	IS : 73-1961
		(ii) Loss Angeles Abrasion value/Aggregate Impact Value	One test for $50m^3$ to $100m^3$ of aggregate	IS : 2386 (Part IV) 1963
		(iii) Flakiness index of aggregate	One test per $50m^3$ to $100m^3$ of aggregate	IS : 2386 (Part I) 1963
		(iv) Stripping value of aggregate	One test per $50m^3$ to $100m^3$ of aggregate	IS : 6241-1971
		(v) Mix grading	Two tests per day on both the constituents H mixed aggregate from the dryer	IS : 2396 (Part I) 1963
		(vi) Control of temperature of binder and aggregate of the mix at the time of laying.	Regularly	
		(vii) Control of binder content* and	Periodically subject to minimum of	

* A variation in binder content of + 0.3 percent by weight of total mix shall be permissible.

(1)	(2)		(3)	(4)	(5)
			aggregate gradation in the mix	two tests per day per plant.	
		(viii)	Control of grade, camber, thickness and surface finish.	Regularly	As per clause 1501.4.1
4.	Build up spray grout	(i)	Los Angeles Abrasion value/Aggregate Impact Value	One test per 200m³	IS : 2386 (Part IV) 1963
		(ii)	Aggregate gradation	One test per 100m³	IS : 2386 (Part I) 1963
		(iii)	Flakiness Index of aggregate	One test per 200m³	IS : 2386 (Part I) 1963
		(iv)	Stripping value	One test per 200m³	IS : 6241-1971
		(v)	Quality of binder	As required	IS : 70-1961 IS : 215-1961 IS : 217-1961 IS : 454-1961 As applicable.
		(vi)	Rate of spread of binder		
		(vii)	Rate of spread of Key aggregates	Regularly	
		(viii)	Temperature of binder during application	Regularly	
		(ix)	Control of grade, camber, thickness & surface finish.	Regularly	As per clause 1501.4.1
5.	Asphaltic concrete	(i)	Quality of binder	As required	IS : 73-1961
		(ii)	Los Angeles Abrasion Value/Aggregate Impact Value	One test per 50m³ to 100m³	IS : 2386 (Part IV) 1963
		(iii)	Stripping value of aggregates	One test per 50m³ to 100m³	IS : 6241-1971
		(iv)	Water absorption of aggregates	One test per 50m³ to 100m³	IS : 2386 (Part III) 1963
		(v)	Flakiness Index of aggregate	For each size one test per 50m³ to 100m³ of aggregate	IS : 1386 (Part I) 1963
		(vi)	Sieve analysis for filler	One test for each consignment,	IS : 2386 (Part I) 1963

(1)	(2)	(3)	(4)	(5)
			subject to a Min. of one test per 50m² of filler	
		(vii) Mix grading	One set of tests on individual constituents and mixed aggregates from the dryer for each 100 tonnes of mix, subject to a minimum of two sets of tests per plant per day	IS : 2385 (Part I) 1963
		(viii) Control of temperature of binder in boiler aggregate in the dryer and mix during laying and rolling	Regularly	
		(ix) Stability of mix	For each 100 tonnes of mix produced, a set of 3 Marshal specimens to be prepared and tested for stability, flow value, density and void content, subject to a min. of two sets being tested per plant per day.	ASTM:D-1559
		(x) Binder content and gradation in the mix.	One test for each 100 tonnes of mix, subject to min. of two tests per day per plant.	
		(xi) Thickness and density of compacted layer.	One test per 500m²	

1501.4.2.5. *Tests on Cement Concrete Pavement* :—The tests on the materials as well as their frequencies shall be as given in Table 1501-E.

Table 1501-E

Tests on Materials and their Frequencies for Cement Concrete Pavement

Sl. No.	*Material*		*Test*	*Frequency*	*Procedure*
1.	Cement		Physical and Chemical Tests	Once for each source of supply and occasionally when called for in cases of long and/or improper storage	IS : 1269-1967 IS : 445-1964 IS : 1489-1967
2.	Course and fine aggregate	(i)	Gradation	One test for each $15m^3$ or fraction thereof course aggregate & fine aggregate.	IS : 2386 (Part I) 1963
		(ii)	Deleterious constituents	-Do.-	IS : 2386 (Part II) 1963
		(iii)	Moisture content	Regularly as required subject to a minimum of one test/day for course aggregate and two tests/day for fine aggregate	IS : 2386 (Part III) 1963
		(iv)	Bulking of fine aggregate (for volume batching)	Once for each source for deriving the moisture content bulking relationships.	IS : 2386 (Part III) 1963
3.	Course aggregate	(i)	Los Angeles Abrasion value/ Aggregate Impact test	Once for each source of supply and subsequently when warranted by changes in the quality of aggregate.	IS : 2386 (Part IV) 1963
		(ii)	Soundness	As required	IS : 2386 (Part V) 1963
		(iii)	Alkali aggregate reactivity	As required	IS : 2386 (Part VII) 1963
4.	Water		Chemical tests	Once for approval of source of supply and subsequently only in cases of doubt.	

1501.4.2.5.1. *Control of concrete strength* :—The strength of concrete shall be ascertained either from cube or beam specimens are specified. During the

progress of work cube/beam samples shall be cast for testing at 7 days and 28 days. Tests on concrete strength and frequency shall be as given in Table 1501-F.

Table 1501-F

Tests on Concrete Strength and their Frequencies

Sl. No.	*Test*	*Frequency*	*Procedure*
1.	Workability of fresh concrete.	One test per $10m^3$	IS : 1199-1959
2.	Concrete strength	3 cube/beam samples as specified for each age of 7 & 28 days for every $30m^3$ of concrete.	IS : 516-1959
3.	Core Strength on hardened concrete	2 cores-for every $30m^3$ of concrete.	IS : 516-1959

Specification No. 1502

Road Formation

Preparation for road bed, earth work for road embankment, earthwork in cutting reaches, earthwork for widening existing road embankments, earthwork for raising existing road embankment etc., shall be done in accordance with the relevant Standard Specifications of Section 3 "Earthwork".

Specification No. 1503

Moorum Sub-base

1503.1. *Description* :—The work shall consist of laying and compacting moorum on prepared sub-grade in accordance with the requirements of these specifications. The material shall be laid in one or more layers as necessary to lines, grades and cross sections (as shown in the drawings or as directed by the Executive Engineer.

1503.2. Materials :—Moorum shall conform to SS : 138.

1503.3. Construction :

1503.3.1. *Preparation of sub-grade* :—The sub-grade shall be cleared of all vegetation and other extraneous matter and all uneven pockets shall be made up with moorum and consolidated with an 8 to 10 tonnes power roller so that the density may be not less than 98 per cent of Proctor's density.

1503.3.2. *Spreading and compaction* :—The moorum shall be spread on the prepared sub-grade to the required lines, grades and cross sections as shown in the drawings or as directed by the Executive Engineer. The thickness of loose layers shall be so regulated that the maximum thickness of the layer after consolidated does not exceed 150mm. It shall be then consolidated under optimum moisture conditions with 8-10 tonne power roller and the number of passes regulated to get a density of not less than 98% of Proctor's density.

If the thickness of the sub-base is more than 150mm., it shall be done in layers not exceeding 150mm. each in accordance with the above specifications. The surface of each layer shall be raked out and wetted before the next layer is laid. All the relevant portions of clauses 303.6.5, 303.6.6 and 303.6.7 regarding control of moisture content, compaction and special precautions shall also apply. Rolling shall commence at edges and progress towards the centre except at super elevated portions where it shall commence at the inner edge and progress towards the outer edge. The required camber/super elevation shall be ensured.

1503.3.3. *Quality control* :—This shall conform to clause 1501.4.

1503.4. Arrangements for traffic :—This shall conform to clause 1501.3.

1503.5. Measurement :—This shall conform to clause 1501.2.1.4. Pre-measurements for moorum shall be taken.

1503.6. Rate :—The unit rate shall be per cubic metre for finished work in accordance with the above specifications. It shall include the cost and conveyance of moorum.

Specification No. 1504

Sand Moorum Sub-base

1504.1. Description :—This work shall consist of laying and compacting the sand moorum mix of specified proportions on prepared subgrade in accordance with the requirements of these specifications. The material shall be laid in one or more layers as necessary to the lines, grades and cross-sections as shown in the drawings or as directed by the Executive Engineer.

1504.2. Materials :

1504.2.1. *Sand* :—This shall conform to SS : 110.

1504.2.2. *Moorum* :—This shall conform to SS : 138.

1504.3. Proportion of sand moorum mix :—The proportion of sand and moorum shall be 1 : 1 by volume or any other special proportion.

1504.4. Construction operations :

1504.4.1. *Preparation of sub-grade* :—This shall conform to clause 1503.3.1.

1504.4.2. *Mixing* :—Sand and moorum shall be stacked alternately in suitable sizes as specified by the Executive Engineer. The height of the stack shall not normally exceed 500mm. for effective mixing. After the pre-measurements are taken the sand stacks are spread over the moorum stacks in the specified proportions and thoroughly mixed dry and the mix restacked. The required quantity of water is added to the stacks on the previous evening so as to achieve moisture content of 1 to 2 per cent over the optimum moisture content and on the next morning wet mixing is thoroughly done to an uniform colour and uniform moisture content.

1504.4.3. *Spreading and compaction* :—This shall conform to clause 1503.3.2.

1504.4.4. *Quality control* :—This shall conform to clause 1501.4.

1504.5. Arrangements for traffic :—This shall conform to clause 1501.3.

1504.6. Measurement :—This shall conform to clause 1503.5.

1504.7. Rate :—This shall conform to clause 1503.6.

Specification No. 1505

Stabilised Soil Sub-base

1505.1. Description :—This work shall consist of laying and compacting a sub-base course of mechanically stabilised soil or soil stabilised with lime or cement on prepared sub-grade in accordance with the requirements of these specifications and in conformity with the lines, grades and cross sections shown in the drawings or as directed by the Executive Engineer.

1505.2. Materials :

1505.2.1. *Soil* :—Except where otherwise specified the soil used for stabilisation shall be the local soil.

1505.2.2. *Blending material for mechanical stabilisation* :—Blending materials for mechanical stabilisation may be moorum, crushed stone, crushed slab, crushed bricks, soft aggregate like laterite and kankar, natural sand or clay depending upon the grading requirements. The grading of mixed material shall conform to one of the three gradings given in Table 1505-A.

Table 1505-A

Grading for mixed materials for mechanical stabilisation

Sieve designation	*Per cent by weight passing the sieve nominal maximum size*		
	80mm.	40mm.	20mm.
80 mm.	100	—	—
40 mm.	80-100	100	—
20 mm.	60-80	80-100	100
10 mm.	45-65	55-80	80-100
4.75 mm.	30.51	40-60	50-75
2.36 mm.	—	30-50	35-60
600 micron	10-30	15-30	15-35
75 micron	0-10	0-10	0-10

Note :—(1) Not less than 10 per cent should be retained between each pair of successive sieves specified for use excepting the larger pair.

(2) The material passing 425 micron sieve when tested according to IS : 2720 (Part-V) 1966 shall have liquid limit and plasticity index of not more than 25 per cent and 6 per cent respectively.

1505.2.3. *Cement* :—Cement for cement soil stabilisation shall conform to SS:112.

1505.2.4. *Lime* :—Lime for lime-soil stabilisation work shall be quick lime slaked at site or hydrated lime delivered at the site in suitable containers and shall conform to SS : 111.

1505.2.5. *Quantity of lime/cement in the stabilised mix* :—The quantity of lime/cement to be added to the soil shall be that as specified in the contract or as directed by the Executive Engineer.

In the case of lime stabilisation the quantity of lime to be added shall be on the basis of the available calcium oxide content of lime just prior to the incorporation in the works as determined in accordance with IS : 1514-1959.

The actual quantity of lime in terms of net calcium oxide content to be used would be determined in the laboratory by conducting C.B.R. value test on the lime gravel mix for achieving a laboratory 4 days soaked C.B.R. value of not less than 25 per cent so as to get for the material in the field a 4 days soaked C.B.R. values of minimum 12 per cent.

The quantity of cement for stabilisation shall also be decided in a similar way to achieve the required C.B.R. as above.

1505.3. Construction operations :

1505.3.1. *General* :—Stabilised soil sub bases shall normally be constructed by mix-in-place method of construction using mechanical mixing. Manual mixing shall be permitted only when width of laying is not adequate for mechanical operations.

The plant used for mix-in-place construction shall be capable of pulverising the soil to specified degree to the full thickness of the layer being processed and of achieving the desired degree of mixing and uniformity of the stabilised material. If so desired by the Executive Engineer, trial runs with the plant shall be carried out to establish its suitability for the work.

The thickness of any compacted layer shall be not less than 100mm. and not more than 150mm..

1505.3.2. *Mix-in-place method of construction* :—The plant used shall either be of single pass of multiple pass type. The mixer shall be equipped with an appropriate device for controlling the depth of processing and the mixing blades shall be maintained or reset periodically so that the correct depth of mixing is obtained at all times.

With single-pass equipment for forward speed for the machine shall be so selected in relation to the rotor speed that the required degree of mixing, pulverization and depth of processing is obtained.

In multi-pass processing the soil on the prepared sub-grade shall be pulverised to the required depth with successive passes of the plant and the moisture content adjusted to be within prescribed limits mentioned herein-after. The blending or stabilising material shall then be spread uniformly and mixing continued with

successive passes until the required depth and uniformity of processing has been obtained.

The mixing plant shall be so set that it cuts slightly into the edge of the adjoining lane processed previously so as to ensure that all the material forming a layer has been properly processed for the full width.

In the case of manual mixing it shall be ensured that there has been a uniform mixing the various ingredients to the full depth of the layer.

1505.3.3. *Degree of pulverization* :—For cement/lime stabilisation the soil before addition of the stabiliser shall be pulverized to the extent that at least 80 per cent passes through 4.75mm. sieve.

1505.3.4. *Moisture content for compaction* :—For mechanical stabilisation moisture content at compaction shall be within the range of 1 per cent above 2 per cent below the optimum moisture content corresponding to IS : 2720-(Part-VII) 1966. For cement or lime stabilisation shall not be less than the optimum moisture content and not more than 2% above it.

The moisture content shall be adjusted during mixing operations (making allowances for evaporation losses) and checked before rolling starts.

1505.3.5. *Rolling* :—Immediately after spreading, grading and levelling of the mixed material compaction shall be carried out with 8 to 10 tonnes smooth wheel rollers or other approved plant, preceded by a few passes of lighter rollers if necessary. Rolling shall commence at edges and progress towards the centre except at super elevated portions where it shall commence at the inner edge and progress towards the outer. During rolling the surface shall be frequently checked for grade and camber and any irregularities corrected by loosening the material and removing or adding fresh material. Compaction shall be continued until 98 per cent of standard Proctor's density is achieved.

Care shall be taken to see that the compaction of cement stabilised material is completed within two hours of its mixing or such shorter period as may be found necessary during hot weather. In the case of lime stabilised material this period shall not be more than 3 hours.

In the case of lime or cement stabilised construction it shall be ensured during rolling that compaction plant does not bear directly on hardened or partially hardened treated material previously laid.

The final surface shall be free from movement under compaction plant and free from any compaction planes, ridges, cracks or loose materials. All loose segregated or otherwise defective areas shall be made good to the full thickness of the layer and recompacted.

1505.3.6. *Quality control* :—This shall conform to clause 1501.4.

1505.3.7. *Curing* :—The sub-base course stabilised with lime or cement shall be well cured for 7 days, soon after which subsequent pavement courses shall be laid to prevent the surface drying out and becoming friable. No traffic of any kind shall play over the compacted sub-base.

1505.4. Arrangements from traffic :—This shall conform to clause 1501.3.

1505.5. Measurement :—This shall conform to clause 1501.2.1.4. The pre-measurements for the materials used shall be taken.

1505.6. Rate :—This shall conform to clause 1503.6.

Specification No. 1506

Water Bound Macadam

1506.1. Description :—Water bound macadam shall consist of clean aggregates mechanically interlocked by rolling, and bonded together with screenings/ filler material with the help of water laid on a prepared sub-grade, sub-base, base or existing pavement as the case may be and finished in accordance with the requirements of these specifications and in conformity with the lines, grades and cross-sections shown on the drawings.

1506.2. Materials :

1506.2.1. *Coarse aggregates* :—Coarse aggregates shall conform to clause 1501.2.2. It shall further conform to the physical requirements set-forth in Table 1506-A. The type of the aggregate shall be as specified in the agreement bond.

Table 1506-A

Physical requirements of coarse aggregates for Water Bound Macadam

Sl. No.	*Type of construction*	*Test*	*Test method*	*Requirements*
1.	Sub-base	Los-Angeles Abrasion Value* or Aggregate Impact Value	IS : 2386 (Part IV) 1963 IS : 2386 (Part IV) 1963 or IS : 5640 1970	60 per cent maximum 50 per cent maximum.
2.	Base	(a) Los Angles Abrasion Value* or Aggregate Impact Value	IS : 2386 (Part IV) 1963 IS : 2386 (Part IV) 1963 or IS : 5640** 1970	50 per cent maximum 40 per cent maximum
		(b) Flakiness Index	IS : 2386 (Part I) (Part I) 1963.	15 per cent maximum.

**Aggregates may satisfy requirements of either of the two tests.*

***Aggregates like Kankar and laterine which get softened in presence of water shall be tested for impact value under wet conditions in accordance with IS : 5604-1970.*

1506.2.2. *Laterite* :—Laterite shall be hard, compact, heavy and of dark colour. The light coloured sandy laterites as well as those containing much Ochrous clay shall be rejected.

1506.2.3. *Lime kankar* :—Lime Kankar shall be tough and shall not contain any clay in the cavities between modules.

1506.2.4. *Size and grading* :—The aggregates shall be either of single size or graded as may be specified in the agreement bonds. Where graded aggregate is required, it shall conform to one of the gradings given in Table 1506-B, for the specified size range.

Grading	*Size Range*	*Sieve Designation*	*Per cent by weight passing the sieve*
1.	90mm. to 40mm.	100 mm.	100
		80 mm.	65-85
		63 mm.	25-60
		40 mm.	0-15
		20 mm.	0-5
2.	63mm. to 40mm.	80 mm	100
		63 mm.	90-100
		50 mm.	35-70
		40 mm.	0-15
		20 mm.	0-5
3.	50mm. to 20mm.	63 mm.	100
		50 mm.	95-100
		40 mm.	35-70
		20 mm.	0-10
		10 mm.	0-5

1506.2.5. *Filler Material* :—Where single size aggregate is used moorum conforming to SS : 138 shall be used to fill the voids. Where graded aggregates are used screenings preferably of the same materials as the coarse aggregates shall be used.

1506.2.6. *Screenings* :—Screenings shall conform to the grading set forth in Table 1506-C. Screenings of type A in Table 1506-C shall be used with coarse aggregate of grading 1 in Table 1506-B. Screenings of type A or B as specified, shall be used with coarse aggregate of gradings 2. Type B screenings shall be used with coarse aggregates of grading 3.

Grading classification	*Size of Screenings*	*Sieve Designation*	*Per cent by weight passing the sieve*
A	12.5 mm.	12.5 mm.	100
		10.0 mm	90-100
		4.75 mm	10-39
		1.50 mm	0-8

B	10 mm	10 mm	100
		4.75 mm	85-100
		150 micron	10-30

The use of screenings may be omitted in the case of soft aggregates such as Kankar and laterite.

1506.2.7. *Binding materials* :—Binding material shall comprise of moorum conform to SS : 138. Where moorum is used as filler, application of binding material is not necessary.

1506.3. Construction operations :—

1506.3.1. *Preparation of base* :—The sub-grade/sub-base to receive the water bound macadam course shall be prepared to the specified grade and camber and made free of dust other extraneous material. Where renewal of W.B.M. is to be done the entire existing surface shall be picked up and the useful material shall be reused. Where water bound macadam is to be laid over an existing black topped surface 50mm. x 50mm. furrows shall be cut at an angle of 45 degrees to the centre line of the road at one metre intervals in the later before laying the coarse aggregate. Any ruts for soft yielding places shall be corrected in an approved manner and rolled until the sub-grade/sub-base/surface to be renewed is firm.

The W.B.M. shall be laid either in a trench section cut to camber or between suitable earth-bounds or any other suitable arrangement made on either side of the prepared sub-grade or sub-base course to confine the aggregates while spreading and rolling.

1506.3.2. *Spreading coarse aggregate* :—The coarse aggregate shall be spread uniformly and evenly upon the prepared sub-base in required quantities from the premeasured stacks along the side of the roadway. The aggregates shall be spread uniformly to proper profile by using templates placed across the road about 6 metre apart.

The surface of the aggregate spread shall be carefully trued up and all high or low spets emedied by removing or adding aggregate as may be required.

The W.B.M. course shall be normally constructed in layers of not more than 75mm. compacted thickness. No segregation of large or fine particles shall be allowed and the course aggregate as spread shall be of uniform gradation with no pockets of fine material.

1506.3.3. *Rolling* :—Immediately following the spreading of the course aggregate rolling shall be started with power rollers of 8 to 10 tonnes capacity or tandem or vibratory rollers of approved type.

Except on super elevated portions where the rolling shall proceed from inner edge to the outer rolling shall begin from the edges gradually progressing towards the centre. First the edges shall be compacted with roller running forward and backward. The roller shall then move inwards parallel to the centre line of the road in successive passes uniformly lapping preceding tracks by at least one half width.

Rolling shall be discontinued when the aggregate are partially compacted with sufficient void space in them to permit application of screenings. However where screenings are not to be applied as in the case of crushed aggregates like laterite or kankar compaction shall be continued until the aggregate are thoroughly keyed. During rolling slight sprinkling of water shall be done. Rolling shall not be done when the sub-grade or sub-base course causes a wave like motion.

The rolled surface shall be checked transversely and longitudinally with camber board land straight edge and any irregularities corrected by loosening the surface, adding or removing necessary amounts of aggregate and re-rolling until the entire surface conforms to desired camber and grade. In no case shall the use of screenings be permitted to make up depressions the finished surface shall not have variation greater than the permissible tolerances specified in clause 1501.4.

1506.3.4. *Application of filler materials/screenings* :—After the coarse aggregate has been rolled conforming to clause 1506.3.3 filler materials screenings to completely fill the interstices shall be applied gradually over the surface. These shall not damp or wet at the time of application. Dry rolling shall be done while the filler materials/screenings are being spread so that vibrations of the roller cause them to settle into the voids of the coarse aggregate. The filler materials/screenings shall be spread uniformly in successive thin layers.

The filler materials screenings shall be applied at a uniform rate so as to ensure filling of all voids. Rolling and brooming shall continue with the spreading. These operations shall continue until no more filler materials/screenings can be forced into the voids of the coarse aggregate.

The spreading, rolling and brooming of filler materials/screenings shall be carried out in only such lengths of the road which could be completed within one day's operation.

1506.3.5. *Sprinkling and grouting* :—After the filler materials/screenings have been applied the surface shall be copiously sprinkled with water, swept and rolled. Hand brooms shall be used to sweep the wet filler materials/screenings into voids and to distribute them evenly. The sprinkling, sweeping and rolling operations shall be continued with additional filler materials/screenings applied as necessary until the coarse aggregate has been thoroughly keyed, well bonded, and firmly set in its full depth and a grout has been formed of filler materials/screenings. Care shall be taken to see that the sub-base or sub-grade does not get damaged due to the excessive quantities of water during construction.

1506.3.6. *Application of binding material* :—The binding material where it is required to be used shall be applied successively in two or more thin layers at a uniform rate. After each application the surface shall be copiously sprinkled with water and the resulting slurry swept in with brooms to fill the voids properly and rolled. Water shall be applied to the wheels of the rollers if necessary to wash down the binding material sticking to them. These operations shall continue until the resulting slurry after filling of voids forms a wave ahead of the wheels of the moving roller.

1506.3.7. *Setting and drying* :—After the final compaction of water bound macadam course the road shall be allowed to dry overnight. Next morning hungry spots shall be filled with screenings/filler material and lightly sprinkled with water if necessary and rolled. No traffic shall be allowed on the road until the macadam has set.

1506.3.8. *Multiple layered courses* :—When it is necessary to construct the course in more than one layer to conform to the lines, grades and cross sections indicated on the plans or as directed by the Executive Engineer, each layer shall be constructed as described above. The same degree or refinement shall be sued in conforming the surfaces of all component layers and the smoothness and uniformity for the surface of each layer shall conform closely to the requirements for the surface of the final layer.

1506.3.9. *Quality control of works* :—This shall conform to clause 1501.4.

1506.3.10. *Curing* :—The W.B.M. base shall be kept lightly sprinkled with water and kept moist for 15 days.

1506.4. Arrangement for traffic :—This shall conform to clause 1501.3.

1506.5. Stacking :—This shall conform to SS : 101.

1506.6. Measurement :—This shall conform to clause 1501.2.1.4.

Spreading and consolidation of materials shall be worked out in sq.m. the length being taken along the centre line of the W.B.M. base and the width a long a line at right angles to the centre line.

1506.7. Rate :— The unit rate shall be per cubic metre.

The spreading and the consolidation of materials shall be paid for at the unit rate per 10 square metres for carrying out the required operations in accordance with these specifications.

Specification No. 1507

Built-up Spray-Grout Base

1507.1. Description :—This specification is intended as an alternative to conventional water bound macadam, where water may be scarce or construction may otherwise be difficult such as when strengthening of an existing road is involved which can not be closed to traffic.

Build-up spray grout shall consist of a two layer composite construction of compacted coarse aggregates with application of bituminous binder after each layer for bonding and finishing with key aggregates at the top of second layer so as to yield a thickness not exceeding 75mm. in accordance with the requirements of these specifications and in conformity with the lines, grades and cross sections shown in the drawing or as directed by the Executive Engineer.

1507.2. Materials :—

1507.2.1. *Binder* :—The binder shall be either cut back bitumen conforming to SS : 135 or paving bitumen conforming to SS : 136 of the specified grade.

1507.2.2. *Aggregates* :

1507.2.21. *General requirements* :—Coarse aggregates shall conform to clause 1501.2.2.

1507.2.2.2. *Physical requirements* :—The coarse and key aggregates shall satisfy the requirements given in Table 1507-A.

Table 1507-A

Sl.No. (1)	*Test* (2)		*Requirements* (3)	*Test method* (4)
1.	Abrasion value, using Los-Angles machine	—	Max. 50%	IS : 2386 (Part IV) 1963
	or			
	Aggregate Impact Value	—	Max. 40%	IS : 2386 (Part IV) 1963
2.	Flakiness index	—	Max. 25%	IS : 2386 (Part I) 1963
3.	Stripping value	—	Max 25%	IS : 6241-1971
4.	Water Absorption	—	Max. 1%	IS : 2386 (Part III) 1963

1507.2.3. Quantities of materials required for 10 sq.m. for 75mm. thick builtup spray grout base are given in Table 1507-B.

Table 1507-B

1.	Aggregates	(a) 40mm. size	(i) Bottom layer	0.5 cu.m.
			(ii) Top layer	0.5 cu.m.
		(b) 12mm. size	Key aggregate	0.13 cu.m.
2.	Binder	(a) For tack coat	(i) Over W.B.M. Surface	7.5 kg.
			(ii) Over existing B.T. Surface	6 kg.
		(b) For spraying	(i) 1st layer	12.5 kg.
			(ii) 2nd layer	12.5 kg.

1507.3. Construction operations :

1507.3.1. *Weather and seasonal limitations* :—Built-up spray grout shall not be constructed when the atmospheric temperature in shade is below 16°C or when the pavement is damp or the weather is foggy or rainy or a dust storm is on.

1507.3.2. *Preparation of base* :—The underlying course on which the built up spray grout base is to be laid shall be prepared by patching up pot holes and bringing the surface to the specified lines, grades and cross sections (through a levelling course, where necessary). The underlying course may be an existing W.B.M. course or black topped surface.

The surface shall be dry and thoroughly cleaned before starting of construction. The surface shall be swept free of caked earth and other foreign matter first using hard brushes and then softer brushes and finally by blowing with sacks or gunny bags to remove the first dust.

1507.3.3. *Tack coat* :—After the underlying surface is prepared as per clause 1507.3.2, the tack coat shall be applied. The binder shall be heated to the temperature appropriate to the grade of bitumen (unless a cut back is used) uniformly at the rate specified in clause 1507.2.3. preferably with a sprayer. The tack coat shall be applied just ahead of the spreading of coarse aggregates.

1507.3.4. *Spreading and compacting the first layer of coarse aggregates* :—Immediately after the application of tack coat the coarse aggregates shall be spread and hand packed (with suitable edge protection) at the rate of 0.5cu.m. per 10 sq.m. to a uniform depth true to the required alignment and profile.

The surface of the layer shall be carefully checked with templates and all high and low spots remedied by removing or adding aggregate as may be required.

The entire surface shall then be compacted with an 8 to 10 tonnes smooth wheeled roller. Rolling shall be connected at the edge, and shall progress towards the centre except in super elevated portions where it shall proceed from the inner edge to the outer. Each pass of the roller shall uniformly overlap not less than one half of the track made in the preceding pass.

After initial rolling as described above the surface shall be checked transversely and longitudinally with templates and if there are any irregularities here and there they shall be corrected loosening the entire surface and adding or removing necessary qualities of aggregates and compacting it well with an 8 to 10 tonnes roller.

Too much of rolling shall note done as the closing up of Coids in the aggregate layer prevents free and uniform penetration of the binder to be sprayed in the next operation.

1507.3.5. *Application of binder (first spray)* :—The binder shall be heated to the temperature appropriate to the grade of bitumen used and then applied on the aggregate layer at the rate of 12.5 kg per 10 sq.m. uniformly (preferably with sprayers). Excessive deposits of binder caused by stopping or starting of the sprayers or through leakages or any other reason shall promptly corrected.

1507.3.6. *Spreading and rolling of course aggregate for second layer* :—When the first spray of binder is still hot the second layer of coarse aggregates shall be immediately spread and rolled as per clause 1507.3.4.

1507.3.7. *Application of binder (second spray)* :—The second aggregate layer shall then be given a binder spray at the rate of 12.5kg. per 10sq.m. as per clause 1507.3.5.

1507.3.8. *Application of key aggregate* :—When the second spray of binder is still hot key aggregates in a clean and dry state shall be immediately spread uniformly at the rate of 0.1 cu.m. per 10sq.m. so as to cover the surface completely. If necessary the surface shall then be broomed to ensure uniform application of the key aggregates. The entire surface shall then be rolled with an 8 to 10 tonnes

smooth wheeled roller as per clause 1507.3.4. While rolling is in progress additional key aggregates where required shall be spread by hand. Rolling shall continue until the entire course is thoroughly compacted and the key aggregates are firmly in position.

1507.3.9. *Quality control* :—The surface evenness of the completed course in the longitudinal and transverse directions shall be within the tolerance limits specified in clause 1501.4.

1507.4. Arrangements for traffic :—This shall conform to clause 1501.3.

1507.5. Measurement :—This shall conform to clause 1501.2.1.4. The aggregates shall be stacked for pre-measurements.

1507.6. Rate :—The unit rate shall be per 10 sq.m. of finished surface in accordance with the above specifications and shall include the cost any conveyance of bitumen and the aggregates. Filling of pot holes and laying of levelling course (if carried out) shall be paid as separate items of work.

Specification No. 1508

Bituminous Macadam Base

1508.1. Description :—This work shall consist of open graded construction in a single course of 50mm./75mm. thickness of compacted crushed aggregates premixed with a bituminuous binder laid immediately after mixing on a base, prepared previously in accordance with the requirements of these specifications and in conformity with the lines, grades and cross-section shown in the drawings or as directed by Executive Engineer. It shall not be used as a wearing course as such.

1508.2. Materials :

1508.2.1. *Binder* :— unless otherwise specified the binder shall be paving bitumen of 80/100 grade conforming to IS : 136.

1508.2.2. *Aggregates* :

1508.2.2.1. *General requirements* :—This shall conform to Clause 1501.2.2.

1508.2.2.2. *Physical requirements* :—The aggregates shall satisfy the requirements given in Table 1508-A.

Table 1508-A

Sl.No.	*Test*		*Requirements*	*Test method*
1.	Abrasion value, using Los-Angles machine	—	Max. 35%	IS : 2386 (Part IV) 1963
	or			
	Aggregate Impact Value	—	Max. 30%	IS : 2386 (Part IV) 1963
2.	Flakiness index	—	Max. 25%	IS : 2386 (Part I) 1963
3.	Stripping value	—	Max. 25%	IS : 6241-1971
4.	Water Absorption	—	Max. 2%	IS : 2386 (Part III) 1963

1508.2.2.3. **Grading of aggregate** :—The aggregates for bituminous macadam for different thicknesses shall conform to the gradings A or B given in Tables 1508-B and 1508-C. (The actual grading to be used shall be specified in the Agreement Bond).

Table 1508-B

Aggregate grading for 75mm. compacted thickness of bituminous macadam

Sieve Designation	*Per cent by weight passing the sieve*	
	Grading A	*Grading B*
63mm	100	—
50mm	90-100	—
40mm	35-65	100
25mm	20-40	70-100
20mm	—	50-80
12.5mm	5-20	—
4.75mm	—	10-30
2.36mm	—	5-20
75 Micron	0-5	0-4

Table 1508-C

Aggregate grading for 50mm. compacted thickness of bituminous macadam

Sieve Designation	*Per cent by weight passing the sieve*	
	Grading A	*Grading B*
50mm	100	—
40mm	90-100	—
25mm	50-80	100
20mm	—	70-100
12.5mm	10-30	—
10mm	—	35-60
4.75mm	—	15-35
2.36mm	—	5-20
75 Micron	0-5	0-4

1508.2.3. *Proportioning of materials* :—The binder content for premixing shall be 56 kg. per cu.m. of the total mix of aggregate unless otherwise specified.

1508.2.4. Quantities of materials required for 10 sq.m. for 75mm. thick bituminous macadam base :

(a)	Aggregates		1.0cu.m.
(b)	Binder (80/100) :	(i) For tack coat	7.5kg.
		(ii) For Premixing at	56kg./cu.m. 56kg.
	For 50mm. thick bituminous macadam base :		
(a)	Aggregates		0.70 cu.m.
(b)	Binder (80/100) :	(i) for tack coat	7.5kg.
		(ii) For premixing at	56kg./cu.m. 39.2kg.

1508.3. Construction operations :

1508.3.1. *Weather and seasonal limitations* :—This shall conform to clause 1507.3.1.

1508.3.2. *Preparation of base* :—This shall conform to clause 1507.3.2.

1508.3.3. *Tack coat* :—A tack coat as per clause 1507.3.3 shall be applied over the base except when the laying of bituminous macadam is being preceded by a bituminous levelling course.

1508.3.4. *Preparation and transport of mix* :—Hot mix plant of adequate capacity shall be used for preparing the mix.

The temperature of binder at the time of mixing shall be in the range of 100°C and that of aggregates shall be in the range of 155° to 165°C. Provided also that at no time shall the difference in temperature between the aggregates and the binder exceeds 15°C.

Mixing shall be thorough to ensure that a homogeneous mixture is obtained in which all particles of the aggregates are coated uniformly.

The mixture shall be transported from the mixing plant to the point of use in suitable vehicles. The vehicles employed for transport shall be clean and shall be covered over in transit if so directed by the Executive Engineer.

1508.3.5. *Spreading* :—The mix shall be spread immediately after mixing by means of a self propelled mechanical paver with suitable screeds capable of spreading, tamping and finishing the mixture to the specified lines, grades and cross sections. However in restricted locations and in narrow widths where the available plants cannot operate in the opinion of the Executive Engineer he may permit manual laying of the mix.

The temperature of mix at the time of laying shall not be less than 120°C.

Longitudinal joints and edges shall be constructed true to the delineating lines parallel to the centre line of the road. All joints shall be cut vertical to the full thickness of the previously laid mix and the surface painted with hot bitumen before placing fresh material.

1508.3.6. *Rolling* :—Immediately after the spreading of mix rolling shall be done by 8 to 10 tonnes power rollers or other approved plant. Rolling shall

commence at the edges and progress towards the centre longitudinally except that on super elevated portions it shall progress from the lower to the upper edge parallel to the centre line of the pavement.

When the roller has passed over the whole area once any high spots or depressions which become apparent shall be corrected by removing or adding fresh material. The rolling shall then be continued till the entire surface has been rolled to compaction and ensuring that there is no crushing of the aggregates and all the roller marks have been eliminated. Each pass of the roller shall uniformly overlap not less than one half of the track made in the preceding pass. The roller wheels shall be kept damp if necessary to avoid the bituminous material from sticking to the wheels and being picked up. In no case shall fuel lubricating oil be used for this purpose.

Rollers shall not stand on newly laid material while there is a risk that it will be deformed thereby. The edges along and transverse to the bituminous macadam laid and compacted earlier shall be cut to their full depth so as to expose fresh surface which shall be painted with a thin surface coat of appropriate binder before the new mix is placed against it.

1508.3.7. *Quality control of works* :—This shall be conform to clause 1501.4.

1508.4. Arrangements for traffic :—This shall be conform to clause 1501.3.

1508.5. Measurement :—This shall conform to clause 1507.5.

1508.6. Rate :—This shall conform to clause 1507.6.

Specification No. 1509

Bituminous Surface Dressing with Dry Aggregates over W.B.M. or Worn-out Bituminous Surface

1509.1. Description :—This work shall consist of one coat surface dressing consisting of a layer to bituminous binder sprayed on a base prepared previously, followed by a cover of stone aggregates properly rolled to form a wearing course to the requirements of these specifications in conformity with the lines, grades and cross sections shown on the drawings or as directed by the Executive Engineer.

1509.2. Materials :

1509.2.1. *Binder* :—The binder shall conforms to SS : 136 and unless otherwise specified the grade shall be 80/100.

1509.2.2. **Stone aggregates** :

1509.2.2.1. *General requirements* :—This shall conform to clause 1501.2.2.

1509.2.2.2. *Physical requirements* :—This shall conform to clause 1508.2.2.2.

1509.2.2.3. *Size* :—The nominal size of stone aggregate shall be of 12.5mm..

1509.2.3. *Quantities of materials required for 10sq.m. of* :

Sl. No.	*Type of construction*	*Binder (80/100) Grade*	*Stone aggregate*
1.	Surface dressing over W.B.M.	18.0 kg.	0.15 cu.m.
2.	Surface dressing over worn-out bituminous surfaces	15.5 kg.	0.15 cu.m.

1509.3. Construction operations :

1509.3.1. *Weather and seasonal limitations* :—This shall conform to clause 1507.3.1.

1509.3.2. *Preparation of base* :—This shall conform to clause 1507.3.2.

1509.3.3. *Application of binder* :—Binder shall be heated to about 160°C to 180°C and sprayed on the dry surface in a uniform manner preferably with the help of mechanical sprayers. Excessive deposits of binder caused by stopping or starting of the sprayers or through leakages or any other reason shall suitably corrected before the stone aggregates are spread.

1509.3.4. *Application of stone aggregates* :—Immediately after the application of binder while it is shall hot stone aggregates in a dry and clean state shall be spread uniformly on the surface so as to cover the surface completely. The surface shall be broomed to ensure uniform spread of aggregates.

1509.3.5. *Rolling* :—Immediately after the application of the stone aggregates the entire surface shall be rolled with an 8 to 10 tonnes smooth wheeled roller. Rolling shall commence at the edges and progress towards the centre except in super elevated portions where it shall proceed from the inner edge to the outer. Each pass of the roller shall uniformly overlap not less than one half of the track made in the preceding pass. While rolling is in progress additional aggregates shall be spread by hand in whatever quantities required to make up regularities. Rolling shall continue until all aggregate particles are firmly bedded in the binder and present a uniform closed surface.

1509.3.6. *Quality Control* :—This shall conform to clause 1501.4.

1509.4. Arrangements for traffic :—This shall conform to clause 1501.3.

1509.5. Measurement :—This shall conform to clause 1507.5.

1509.6. Rate :—This shall conform to clause 1507.6.

Specification No. 1510

Bituminous Surface Dressing with Premixed Aggregates over W.B.M. or Worn-out Bituminous Surfaces

1510.1. Description :—This work shall consist of laying of a single layer composed of stone aggregate premixed with bituminous binder on a previously prepared base i.e., W.B.M. surface or on existing black topped surface, to the

requirements of these specifications and in conformity with the lines, grades and cross-sections shown on the drawings or as directed by the Executive Engineer.

1510.2. Materials :

1510.2.1. *Binder* :—The binder shall either the cutback bitumen conforming to SS : 135 or straight run bitumen of 80/100 grade conforming to SS : 136.

1510.2.2. *Stone aggregate* :

1510.2.2.1. *General requirements* :—This shall conform to clause 1501.2.2.

1510.2.2.2. *Physical requirements* :—This shall conform to clause 1508.2.2.

1510.2.3. Quantity of materials required for 10 sq.m. of—

(i)	*for 20mm. thick bituminous surface dressing* :			
	(A)	Stone aggregates	12.5mm. size	0.27cu.m.
	(B)	Binder (80/100) :		
		(i) for tack coat	(a) Over W.B.M.	9.8 kg.
			(b) Over existing bituminous surface	7.5 kg.
		(ii) for premixing :	12.5mm. stone aggregates of 0.27 cu.m. at 52kg. per cu.m..	1.400kg.
(ii)	*for 12.5mm. thick bituminous surface dressing* :			
	(A)	Stone aggregate	12.5mm. size.	0.15 cu.m.
	(B)	Binder (80/100) :		
		(i) for track coat Grade	(a) Over W.B.M.	9.8kg.
			(b) Over existing bituminous surface	7.5kg.
		(ii) For premixing	12.5mm. stone aggregates of 0.15 cu.m at 52kg. per cu.m	8.00kg.

1510.3. Construction operations :

1510.3.1. *Weather and seasonal limitations* :—This shall conform to clause 1507.3.1.

1510.3.2. *Preparation of base* :—This shall conform to clause 1507.3.2.

1510.3.3. *Tack coat* :—This shall conform to clause 1507.3.3.

1510.3.4. *Preparation of premix* :—Mixers of approved type shall be employed for mixing the stone aggregates with the bituminous binder.

The binder shall be heated to the temperature 160° to 180°C. (unless cut back bitumen used) in boilers of suitable design avoiding local overheating and ensuring a continuous supply.

The stone aggregates shall be dry before these are placed in the mixer. The heated binder shall be distributed over the aggregates at the rate specified.

The mixing of binder with aggregates shall be continued until the aggregates are thoroughly coated with the binder. The mix shall be immediately carried to the site in tippers or wheel barrows.

1510.3.5. **Spreading and rolling** :—The premixed material shall be spread on the road surface with rakes to the required thickness and camber and distributed evenly without any under loss of time the camber shall be checked by means of camber boards and inequalities evened out. As soon as sufficient length of bituminous material has been laid rolling shall commence with 8 to 10 tonnes power rollers preferably of smooth wheel tandem type or other approved plant. The speed of the power roller shall not exceed 5KM. per hour and at all times be slow enough to avoid displacement of the mixture.

Rolling shall begin at the edges and progress towards the centre longitudinally except that on the super elevated portions it shall progress from the lower to the upper edge parallel to the centre line of the pavement.

When the roller has passed over the whole area once any high spots or depression which become apparent shall be corrected by removing or adding premixed materials. Rolling shall then be continued until the entire surface has been rolled to compaction and all the roller marks eliminated. In each pass of the roller preceding track shall be overlapped uniformly by at least one half of their width. The roller wheels shall be kept damp to prevent the premix from adhering to the wheels and being-picked up. In no case shall fuel/lubricating oil be used for this purpose. Rollers shall not stand on newly laid material to prevent deformation of the surface. To give a good bond with the surface laid on the previous day the edge shall be cut diagonally for the full width and full depth and shall be painted with a thin surface coat of appropriate binder before the new mix is placed against it.

1510.3.6. *Flushing sand* :—Over the compacted surface coarse sand or hard stone dust shall be spread on at the rate of 0.015 cu.m. per 10 sq.m. and lightly rolled.

1510.3.7. *Quality control* :—This shall conform to clause 1501.4.

1510.4. Arrangements for traffic :—This shall conform to clause 1501.3.

1510.5. Measurement :—This shall conform to clause 1507.5.

1510.6. Rate :—This shall conform to clause 1507.6. This includes the cost of the sand or stone dust and labour charges for flushing the same over the compacted surface.

Specification No. 1511

Bituminous Renewal Coat with Premixed Aggregates over Existing Bituminous Surface by Hot Mix Process including Seal Coat

1511.1. Description :—This work shall consist of laying and compacting an open graded carpet of 20mm. thickness in a single course composed of suitable small sized aggregates premixed with a bituminous binder on a previously prepared

based and application of seal coat in accordance with the requirements of these specification and in conformity with the lines, grade and cross sections shown on the drawings or as directed by the Executive Engineer.

1511.2. Materials :

1511.2.1. *Binder* :—Unless otherwise specified the binder shall be bitumen of 80/100 grade conforming to SS : 136.

1511.2.2. **Stone Aggregates :**

1511.2.2.1. *General requirements* :—The stone aggregates shall conform to clause 1531.2.2.

1511.2.2.2. *Physical requirements* :—This shall conform to clause 1508.2.2.2.

1511.2.3. Quantities of materials required for 10 sq.m. of 20mm. thick bituminous, renewal coat :

(1)	Stone aggregates for carpet :	
	(a) 12.5mm. nominal size	0.18 cu.m.
	(b) 10mm. nominal size	0.09 cu.m.
	Total :	0.27 cu.m.
(2)	Binder (80/100) grade :	
	(a) For tack coat 7.5 kg.	
	(b) For premixing—	
	(i) for 0.18 cu.m of 12.5mm. stone aggregates at 52 kg. per cu.m	9.5 kg.
	(ii) for 0.09 cu.m of 10mm. size stone aggregates at 56 kg. per cu.m	5.1 kg.
	Total for premixing :	14.6 kg.

1511.3. Construction operations :

1511.3.1. *Weather and seasonal limitation* :—This shall conform to clause 1107.3.1.

1511.3.2. *Preparation of base* :—This shall conform to clause 1507.3.2.

1511.3.3. *Tack coat* :—This shall conform to clause 1507.3.3.

1511.3.4. *Preparation of premix* :—The premixing shall be done by mechanical mixers by hot mix process using batching plant or a continuous mixing plant.

The binder shall heated to the temperature appropriate to the grade (for 80/100 grade 160° or 180°C) of bitumen approved by the Executive Engineer in boilers of suitable design avoiding local overheating and ensuring a continuous supply.

The aggregates shall be dry and heated to about 155°C to 165°C before these are placed in the mixer. After about 15 second of dry mixing the heated binder shall be distributed over the aggregates at the rate specified. The mixing of binder with aggregates shall be continued until the aggregates are thoroughly mixed with the binder.

The mix shall be transported to the work site in tippers or wheel barrows. The vehicles employed for transport shall be clean and lightly lubricated with a thin oil or solution just before loading a prevent the mixture sticking to the vehicles.

1511.3.5. *Spreading and rolling* :—This shall conform to clause 1508.3.5. and 1508.3.6. respectively.

1511.3.6. *Quality control* :—This shall conform to clause 1501.4.

1511.4. Seal coat :—A seal coat conforming to SS : 1512 or 1513 shall be applied to the surface immediately after laying the carpet. No traffic shall be allowed on the road till the seal coat has been placed.

1511.5. Arrangements for traffic :—This shall conform to clause 1501.3.

1511.6. Measurement :—This shall conform to clause 1507.5.

1511.7. Rate :—This shall conform to clause 1507.6.

Specification No. 1512

Bituminous Seal Coat with Premixed Aggregates

1512.1. Description :—This work shall consist of application of a seal coat with premixed aggregates for sealing the voids in a bituminous surface laid to the specified levels, grade and camber.

1512.2. Materials :

1512.2.1. *Binder* :—Unless otherwise specified the binder shall be bitumen of 80/100, grade conforming to SS : 136.

1512.2.2. *Stone aggregates* :—

1512.2.2.1. *General requirements* :—The stone aggregates shall conform to clause 1501.2.2.

1512.2.2.2. *Physical requirements* :—This shall conform to clause 1508.2.2.2

1512.2.2.3. Quantity of materials required for 10 sq.m. of bituminous seal coat :—

(a)	Stone aggregates	6.3mm. nominal size	0.09 cu.m.
(b)	Binder (80/100)	for premixing	9.8 kg.

1512.3. Construction operations :

1512.3.1. *Preparation of base* :—The seal coat shall be applied immediately after the laying of bituminous course which is required to be sealed. Before application of seal coat materials the surface shall be cleaned free of any dust other extraneous matter.

1512.3.2. *Construction* :—Mixers of approved type shall be employed for mixing the aggregates with the bituminous binder.

The binder shall be heated in boilers of suitable design to the temperature (for 80/100 grade 160°C to 180°C) appropriate to the grade of the bitumen. Mixing of binder with stone aggregate to the specified proportions shall be done in mixers until the aggregates are thoroughly coated with the binder.

The mix shall be immediately transported from the mixing plant to the point of use and spread uniformly on the bituminous surface to the sealed.

As soon as sufficient length has been covered with the premixed material the surface shall be rolled with an 8 to 10 tonnes power roller. Rolling shall be continued till the premixed material completely seals the voids in the bituminous course and a smooth uniform surface is obtained.

1512.4. Arrangement for traffic :—This shall conform to clause 1501.3.

1512.5. Measurement :—This shall conform to clause 1507.5.

1512.6. Rate :—This shall conform to the relevant portion of clause 1507.6.

Specification No. 1513

Bituminous Seal Coat with Premixed Sand

1513.1. Description :— This work shall consist of application of a seal coat with premixed sand for sealing the voids in a bituminous surface laid to the specified levels, grades and camber.

1513.2. Materials :

1513.2.1. *Binder* :—Unless otherwise specified the binder shall be bitumen of 80/800 grade conforming to SS : 136.

1513.2.2. *Sand* :—The sand shall consist of clean, hard, durable, uncoated dry particles and shall be free from dust, soft or flaky materials, organic matter or other deleterious substances. The sand shall pass 1.7mm. seive and shall be retained on 180 micron sieve and shall have a fineness modulus of not less than 2.5.

1513.2.3. Quantity of materials required 10 sq.m. of bituminous seal coat :

(a)	Sand	0.09 cu.m.
(b)	Binder (80/100 grade) for premixing	11.2 kg.

1513.3. Construction operations :—This shall conform to clause 1512.3 except that the sand shall be suitably heated to a temperature as directed by Executive Engineer before premixing with binder in the mixer.

1513.4. Arrangements for traffic :—This shall conform to clause 1501.3

1513.5. Measurement :—This shall conform to clause 1507.5.

1513.6. Rate :—This shall conform to the relevant portion of clause 1507.6.

Specification No. 1514

Asphaltic Concrete Surfacing

1514.1. Description :—This work shall consist of constructing a single ayer of 25mm. to 50mm. thick asphaltic concrete wearing course to the following pecifications on a previously prepared base in conformity with the lines, grades nd cross sections shown in the drawings or as directed by the Executive Engineer.

1514.2. Materials :

1514.2.1. *Binder* :—Unless otherwise specified the binder shall be paving itumen of grade 30/40 conforming to SS : 136.

1514.2.2. *Coarse aggregate* :—The general and physical requirements of ggregates shall conform to clauses 1501.2.2 and 1508.2.2.2 respectively.

1514.2.3. *Fine aggregate* :—The fine aggregates shall consist of crushed creenings, natural sand or a mixture of both passing 2.36mm. sieve and retained n 75 micron sieve. They shall be clean, hard, durable, uncoated, dry and free from njurious, soft or flaky pieces and organic or deleterious substances.

1514.2.4. *Filler* :—The filler shall be an inert material the whole of which asses 600 micron sieve, at least 90% passing 150 micron sieve and not less than 0% passing 75 micron sieve. The filler shall be lime-stone dust, cement, hydrated ime, any stone dust, fly ask or other nonplastic mineral matter as specified.

1514.2.5. *Aggregate gradation* :—The mineral aggregates including mineral iller shall be so graded so combined as to conform to the gradings set forth in Table 1514-A below. Unless otherwise directed for a compacted layer of 25 to 0mm. thickness any of the two gradings could be used but for layers over and bove 40mm. thickness only grading No. 2 shall be used.

Table 1514-A

Aggregate gradation for Asphaltic Concrete

Sieve Designation	*Per cent by weight passing the sieve*	
	Grading 1	*Grading 2*
0 mm	—	100
2.5 mm.	100	80-100
0 mm	80-100	79-90
4.75 mm.	55-75	50-70
2.36 mm.	35-50	35-50
600 micron	18-29	18-29
300 micron	13-23	13-23
120 micron	8-16	8-16
75 micron	4-10	4-10

1514.3. Mix design :

1514.3.1. *Requirements of mix* :—Apart from conformity with the grading and quality requirements of individual ingredient the mix shall meet the following requirements set for Table 1514-B.

Table 1514-B

Requirements of Asphaltic Concrete Mix

Sl. No.	*Description*	*Requirement*
1.	Marshall stability (ASTM Designation D. 1559) determined on Marshall specimens compacted by 50 compaction blows one each end.	340kgs. minimum
2.	Marshall flow (0.025mm.)	8-16
3.	Per cent voids in mix	3-5
4.	Per cent voids in mineral aggregate filled with bitumen	75-85

1514.3.2. *Binder content* :—The binder content shall be so fixed as to achieve the requirements of the mix set forth in 1514.3.1 above and shall be in the range of 5 per cent by weight of the mix.

1514.4. Construction operations :

1514.4.1. *Weather and seasonal limitations* :—This shall conform to clause 1507.3.1.

1514.4.2. *Preparation of base* :—This shall conform to clause 1507.3.2.

1514.4.3. *Tack coat* :—A tack coat conforming to clause 1507.3.3 at the rate 7.5 kg per 10 sq.m. shall be applied over the base. Application of tack coat shall however not be necessary when the laying of asphaltic concrete follows soon after the provision of a bituminous base/levelling course.

1514.4.4. *Preparation of mix* :—Hot mix plant of adequate capacity and capable of producing a proper and uniform quality shall be used for preparing the mix. The plant may either be of batch type or a continuous one having co-ordinated set of essential units such as a dryer for heating the aggregates, a device for grading and batching, feeding the required unit for letting out the correct quantity of heated binder together with a paddle mixer for intimate mixing of the binder and aggregates. A fines feeder for incorporation of the correct quantity of filler is also a necessary auxiliary.

The temperature at the time of mixing shall be in the range 160° to 180°C for the binder and for the aggregates about 155°C to 165°C, provided also that at no time shall the difference in the temperature between the aggregates and binder exceeds 15°C.

Mixing shall be thorough to ensure that a homogeneous mixture is obtained in which all particles of the mineral aggregates are coated uniformly.

The mix shall be transported from the mixing plant to the point of use in suitable vehicles. The vehicles employed for transport shall be clean and be covered over in transit if so directed by the Executive Engineer.

1514.4.5. *Spreading* :—The mix transported from the hot mix plant to the site shall be spread by means of a self-propelled mechanical paver with suitable screeds capable of spreading the mixture to the specified grades, lines and cross sections. The temperature of the mix at the time of laying shall not be less than 120°C.

Longitudinal joints and edges shall be constructed true to the delineating lines parallel to the centre line of the road. Longitudinal joints shall be off-set by at least 150mm. from those in the binder course. All joints shall be cut vertical to the full thickness of the previously laid mix and the surface painted with hot bitumen before placing fresh material.

1514.4.6. *Rolling* :—Immediately after the spreading of mix by paver it shall be thoroughly compacted by rolling with a set of rollers of 8 to 10 tonnes moving at a speed not exceeding 5km. per hour. The wheels of rollers shall be kept moist to prevent the mix from adhering to them but in no case shall fuel/ lubricating oil be used for this purpose. Rolling shall commence longitudinally from the edges and progress towards the centre except that on superelevated portions it shall progress from the lower to the upper edge parallel to the centre line of the pavement. Each pass of the roller shall, uniformly overlap not less than one half of the track made in the preceding pass. Rolling shall be continued till the density achieved is at least 95 per cent of that of the laboratory Marshall specimen and all the roller marks are eliminated.

1514.4.7. *Opening to traffic* :—Traffic may be allowed immediately after completion of the final rolling when the mix has cooled down to the surrounding temperature.

1514.4.8. *Quality Control* :—This shall conform to clause 1501.4.

1514.5. Arrangements for traffic :—This shall conform to clause 1501.3.

1514.6. Measurement :—This shall conform to clause 1101.4.

1514.7. Rate :—This shall conform to clause 1507.6.

Specification No. 1515

Cement Concrete Pavement

1515.1. Description :—Cement concrete pavement consists of a pavement of portland cement concrete with or without reinforcement as specified constructed on the prepared sub-base or base course or other existing surface as indicated by these specifications and in conformity with the lines, grades, thickness and cross-sections as shown in the drawings or as directed by the Executive Engineer.

1515.2. Material :

1515.2.1. *Cement* :—This shall conform to SS : 112.

1515.2.2. *Aggregates* :

1515.2.2.1. *Coarse aggregates* :—Coarse aggregate shall conform to SS : 108 and it shall either be a combination of $66^{2}/_{3}$ per cent of 40mm. or nominal size and $33^{1}/_{3}$ per cent of 20mm. nominal size alternatively 40mm. or alternatively 40mm. graded aggregate in full as may be specified.

1515.2.2.2. *Fine aggregate* :—Fine aggregate shall be natural sand conforming to SS : 110.

1515.2.3. **Water** :—Water used for mixing or curing of concrete shall conforming to SS : 129.

1515.2. Admixtures :—Where specified this shall conform to clause 402.2.5.

1515.2.5. *Reinforcement* :—Where specified reinforcement shall conform to SS : 126.

1515.2.6. *Load transfer devices* :—Dowel and tie bars where specified shall be plain round steel bars conforming to the requirements of IS : 432-1966 "Specification for Mild Steel and Medium-Tensile Steel Bars and Hard Drawn Steel Wire for Concrete Reinforcement".

1515.2.7. *Premoulded joint filler* :—The premoulded joint filler used for expansion joint in concrete shall be of non-extruding and resilient type (Bitumen-impregnated Fibre)" and shall comply with IS : 1838-1961.

Premoulded joint filler shall be of the specified thickness or within a tolerance of ± 1.5mm. It shall be 25mm. less in depth that the thickness of the slab within a tolerance of ± 3mm. and of the full width between road forms. Holes to accommodate dowel bars where necessary shall be accurately bored or punched out.

1515.2.8. *Joint sealing compound* :—The sealing compound shall comply with the requirements of IS : 1834-1961 "Specification for Hot Applied Sealing Compounds for Joints in Concrete".

1515.3. Grade of concrete :—Concrete shall generally conform to SS : 4.2 and be of specified grade or proportion and thickness.

1515.4. Preparation of base :—The base for laying of the concrete pavement shall be free of soft spots and shall be properly drained.

The surface shall be thoroughly cleaned with wire brushes and brooms etc., as directed. The prepared base shall conform to the lines, grades and cross sections shown in the plans.

1515.5. Forms :

1515.5.1. *Steel forms* :—All the side forms shall be of mild steel unless use of wooden sections is specially permitted. The steel forms shall be M.S. channel sections with then depths equal to the thickness of the pavement.

The sections shall have a length of at least 3m. except on curves of less than 45 metres radius where shorter lengths may be used. The method of connection between sections shall be such that the joint formed shall be free from play or movement in any direction. The use of bent, twisted or wornout forms shall not be permitted. At least three stake pockets for bracing pins or stakes shall be provided for each 3 metre length of form. The bracing and support for the forms shall be ample to prevent the springing of the forms under the pressure of concrete or due to the weight or thrust of the machinery operation on the forms.

The number of forms shall be adequate to permit their remaining in place not less than 12 hours after the concrete has been placed.

1515.5.2. *Wooden forms* :—Wooden forms where permitted shall be dressed on one side and shall have a minimum base width of 100mm. for a slab thickness of 200mm. and a minimum base width of 150mm. for slabs over 200mm. thick and equal in depth to the edge thickness of the work prescribed. These forms when used on straights shall have a minimum length of 3 metres, except on curves of less than 45 metres radius where shorter lengths shall be permitted. Forms shall be held by stakes set at intervals not exceeding 2 metres, two stakes being placed at each joint. The forms shall be firmly nailed or secured to the side stakes and securely braced at points where necessary so that no movement will result from the pressure of the concrete or the impact of the tamper and during finishing work. Wooden forms shall be capped along the inside upper edge with 50mm. angle iron well recessed and kept flush with the face of the wooden forms.

1515.5.3. *Setting of forms* :—The forms shall be jointed neatly and shall be staked firmly and set to the required grade and alignment. The deviations shall not exceed 3mm. in the vertical plane and 5mm. in the horizontal plane. All the forms shall be cleaned and oiled each time before they are used. Forms shall be set as herein specified for at least 150mm. ahead of the actual placing of concrete.

When forms have to be fixed on existing concrete bases they shall be secured at the side by M.S. stakes of 20mm. and properly anchored into the base. Holes of suitable size for such stakes shall be drilled at least 75mm. deep into the base and after the stakes are inserted they shall be properly wedged so that the stakes shall not get loosened during the compaction of concrete.

1515.6. Joints :

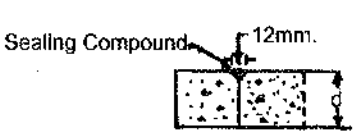
1515.6.1. *General* :—The location and type of joints shall be as shown in the plans. The details of different types of joints are shown in Figures 1515-1 to 1515-6.

1515.6.2. *Transverse joints* :—Transverse joints shall be expansion, contraction, on construction joints and shall be placed as indicated on the plans. They shall be at right angles with the centre lines of the pavement. Contraction and expansion joints shall be continuous from edge to edge of the pavement through all lanes constructed at the same or different times.

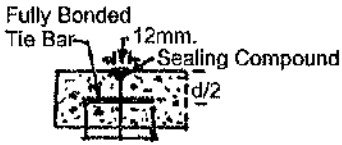
1515.6.2.1. *Transverse expansion joints* :—These joints shall be as shown on the plans and shall be of the premoulded type and shall extend over the entire width of the pavement and from the subgrade down to 25mm. below the surface

of the pavement. They shall be of the dimensions and spacings as shown in the plans. The filler shall be held accurately in place during the placing and finishing of the concrete by a metal bulk-head by a metal channel cap or by any other approved method.

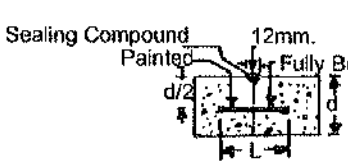
DETAILS OF JOINTS



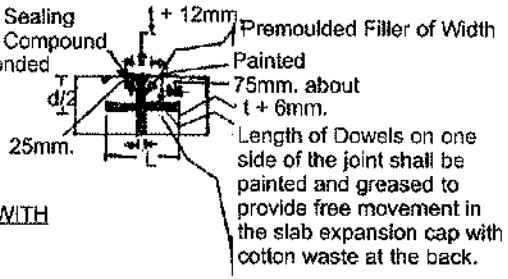
[Fig. 1515.1]
PLAIN BUTT JOINT



[Fig. 1515.2]
LONGITUDINAL JOINT WITH THE BAR HINGED JOINT

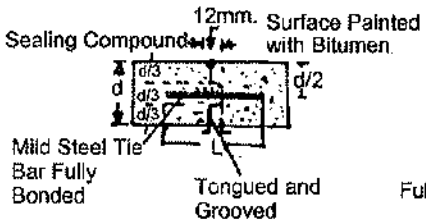


[Fig. 1515.3]
CONSTRUCTION JOINT WITH DOWEL BAR

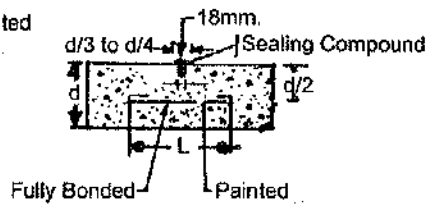


[Fig. 1515.4]
EXPANSION JOINT WITH DOWEL BAR

NOTE :— Maximum Radius for Rounding of Corners of Slabs 6mm.
L = Length of Dowel or the Bar
d = Slab Thickness
t = Expansion Joint Width



[Fig. 1515.5]
KEYED LONGITUDINAL JOINT



[Fig. 1515.6]
TYPICAL DUMMY GROOVE CONTRACTION JOINT

The bulkhead may be made tighter by having the bottom portion cut into sections like saw teeth but shall retain sufficient strength to remain straight from edge to edge of the slab when concrete is placed against it. The bulkhead shall

be securely staked in place at right angles to centre line and surface of the pavement with sufficient stakes to hold it in the specified position. Concrete shall be deposited on both sides of the joint and shall be compacted and struck off before the header or bulkhead is removed.

The metal channel cap (when used) shall be of 10 gauge steel having two equal parallel lugs not less than 50mm. deep. The metal cap shall be placed over the top of the expansion joint material and the two held in position in the sub-grade by flat metal stakes spaced so closely together that the joint material shall remain straight as the concrete is placed and finished. After the pavement has been struck off and finished the metal cap shall be removed.

Under no circumstances shall any concrete be left above the expansion joint material or across the joint at any point. Any concrete spanning the end of the joint next to the forms shall be carefully cut away after the forms are removed.

1515.6.2.2. *Transverse contraction joints* :—These shall be placed as shown on the plans and shall be of 'dummy' groove type. They shall be constructed by forming in the surface of the slab a slot not less than 6mm. wide and having a depth equal to ¼th the depth of the pavement at the thinnest part of its section. This slot may be formed in any manner approved by the Engineer such as by pushing into the concrete a flat bar or the web of 'T' bar and later removing the bar and keeping the slot open.

1515.6.2.3. *Transverse construction joints* :—These shall be provided whenever placing of concrete is suspended for more than 30 minutes. Except for emergency stops construction joints shall be located at the regular site of expansion of contraction joints. If the construction joint is at the site of an expansion joint the regular expansion joint shall be provided and it is at the site of a contraction joint the construction joint as shown on the plans shall be used with dowels.

At all the construction joints care shall be taken in striking off and finishing the surfacing to the face of the bulkhead. When work is resumed the future surface shall conform to the grade and cross section of the previously laid pavement and a straight edge at least 3 metres in length shall be used parallel to the centre line, to check any deviations in the surfaces of the two sections. Any deviations from the general surface in excess of 3mm. shall be corrected.

1515.6.3. *Longitudinal joints* :—These shall be of the plain butt type and shall be formed by placing the concrete against the faces of the slabs concreted earlier. The faces of the old concrete slabs shall be painted with bitumen before placing of fresh concrete.

The bars where specified shall be used as longitudinal joints and they shall be of the dimensions and at such spacings as shown in the plans. Tie bars shall be fairly well supported so as not to be displaced during the construction operations. Tie bars where specified shall be bonded into the slabs across longitudinal joints and while casting the first slabs they may be bent so that one end of them lies along the forms. After the removal of the forms the tie bars shall be straightened so that they extend into the concrete placed on the other ends of the joints.

1515.7. Construction :

1515.7.1. *Mixing* :—This shall conform to clause 402.6.

1515.7.2. *Transporting and placing of concrete* :—This shall conform to the relevant portion of clauses 402.7.1 to 402.7.2.

The concrete shall be mixed in quantities required for immediate use and shall be deposited on the base to the required depth and with of the pavement section in successive batches and in continuous operation without the use of intermediate forms are bulkheads between the joints. In case of unavoidable interruption in placing of concrete a full depth transverse joint shall be placed at the joint of stopping the work provided the section on which the work has been suspended shall be atleast 3m. long (shorter sections shall be removed).

In placing concrete for a two course construction necessitated either by the positioning of the reinforcement or by the use of a richer mix for the wearing surface, or when the thickness of the concrete is beyond 200mm. the bottom layer of concrete shall be struck off to the required levels by a levelling screed working on the side forms with notches corresponding to the depth of the top course of the concrete. This levelling screed shall have a vibrating unit mounted on it similar to that of the screed used for the compaction of the final surface of the concrete. The time lag between the lying of the two courses shall not exceed the initial setting time of cement.

1515.7.3. *Placing of joints* :—The edges of the slab at all joints shall be rounded with an edging tool having a radius of not larger than 6mm. The concrete along the faces of the joints and around all tie bars and dowels shall be compacted with a vibrator inserted it the concrete and worked along the joint and around all the tie bars and dowels, to ensure that the concrete is free from honey-combs.

1515.7.4. *Placing of reinforcement* :—This shall conform to relevant portions of clause 403.3 and 403.4.

Where reinforcement fabric is used the width of the fabric shall be such that when properly placed in the concrete the extreme longitudinal bars or wires of the fabric shall be located not less than 50mm. or more than 100mm. from edges of the slabs. Except for dummy joints the length of the fabric shall be such that when properly placed in the concrete the reinforcement shall be clear of transverse joints by not less than 5mm. and not more than 100mm. as measured from the centres of the joints to the ends of longitudinal bars of the fabric. For overlappings of the fabric in either direction the overlaps shall atleast be equal to the spacings the wires in the respective directions.

While using reinforcement the concrete shall be placed in two layers. The initial layer shall be uniformly struck off to a depth corresponding to the level of the reinforcement shown in the drawings and lightly compacted by a screed to obtain uniform levels. The reinforcement fabric shall then be placed on the compacted layer of concrete and the remaining depth shall be filled in with concrete. During this operation the initial layer of concrete shall be struck off to the entire width of the slab and of sufficient length to permit the reinforcement during concreting.

1515.7.5. *Placing of load transverse devices dowels* :—Transverse expansion joints shall be provided with dowels where specified as indicated on the plans. They shall be firmly supported in place and accurately aligned parallel to the sub-grade and the centre line of the pavement and shall not be displaced during construction. One-half of each dowel shall be painted and oiled and equipped with a tight fitting cap of the dimensions shown on the plans to provide space for the dowels when the pavement expands and the joint closes. These caps are not required on dowels if used in dummy contraction or construction joints.

1515.7.6. *Water-proofing Paper* :—The water proofing paper where necessary shall be laid prior to the placement of concrete. The paper shall be unrolled with an overlap of not less than 100mm.

1515.7.7. *Compaction and finishing* :—

1515.7.7.1. *Compaction* :—The surface of the pavement shall be compacted by means of a vibrating screed. For areas where the width of the slab is very small as at the corners of the street junctions, etc., hand compaction and finishing may be adopted subject to the approval of the Executive Engineer. However, in no case, hand compaction shall be permitted for slab thickness beyond 100mm. in normal course. All compaction and finishing shall be done in accordance with the following requirements.

Compaction by hand tampers :

(i) Concrete as soon as placed shall be struck off uniformly and screeded to the crown and cross-section shown on the plans and to such level above the base that when compacted and finished the pavement shall conform to the grade and cross-section as indicated in the plans. The entire surface shall then be tamped and the tamping operation continued until a close knit dense surface is obtained.

(ii) The tamper shall rest on the side forms and shall be drawn ahead with a sawing motion in combination with a series of lifts and drops alternating with lateral shifts the aim of this operation being compaction and screening to the appropriate level required. Subsequent tamping shall advance about 75mm. at a time in the direction in which the work is proceeding and in the final stages tamping shall be closer about 12mm. at a time until a level and dense surface is obtained.

Compaction by vibrating screed :

(iii) Hand-operated vibrating screed consisting of a normal type of hand tamper to which are attached pneumatic or electric vibrating units shall be used for compaction. It shall rest on side forms. Such screed when used shall be lowered vertically on to the concrete surface evenly spread to the required level above the base making due allowance for compaction and allowed to remain in position for a few seconds until compaction is complete and then lifted vertically and lowered on to the adjacent strips of uncompacted concrete. The screed shall again be taken slowly over the surface sliding wit its axis slightly tilted away from the direction of sliding and operation repeated until the required dense, close knit textured surface

is obtained. Compaction of concrete slabs upto 125mm. thickness may be done by means of vibrating screed alone while for thickness greater than 125mm. both internal vibrators and vibrating screeds shall be used. Even in the case of slabs of 125mm. thickness internal vibrators may be used with advantage for compacting the slab corners and edges.

(iv) Segregated particles of coarse aggregate which collect in front of the tamper or screed shall be thrown outside the forms or thoroughly mixed by hand with the mass of concrete already on the base. Under no circumstances shall such segregated particles be carried forward and pushed on to the base in front of the mass.

(v) Compaction by tamping or screeding shall be carried on till the mortar in the mix just works up to the surface. Care shall be exercised and the operation of tamping so controller as to prevent an excess of mortar and water from being worked up to the top. Repeated operations other than to secure the necessary compaction and eliminate voids shall be avoided.

1515.7.7.2. *Floating* :—As soon as practicable after the concrete has been struck off and compacted it shall further be smoothed and compacted by means of a longitudinal float 1200mm. long and 75mm. wide operated from a foot-bridge. The longitudinal floot shall be worked with a sawing motion while held in floating position parallel to the carriage way centre line and passed gradually from one side of the pavement to the other. Movements ahead along the centre line of the carriage-way shall be in successive advances of not more than one-half of the length of the float.

1515.7.7.3. *Straight edging* :—After the longitudinal floating has been completed and the excess water has disappeared but while the concrete is still plastic the slab surfaces shall be tested for trueness with a 3m. straight edge swung from handles 1m. longer than one-half of the width of the slab. The straight edge shall be held in successive position parallel to the road central line in contact with the surface and the whole area gone over from one side of the slab to the other. Advances along the road shall be in successive stage of not more than one-half length of the straight edge. Any depressions found shall be filled immediately with freshly mixed concrete struck, compacted and refinished. High areas shall be cut down and refinished. The straight edging and refloating shall continue until the entire surface is found to be free from observable departures from the straight edge and the slab has the required grade and camber.

The slab surface shall be retested for trueness before the concrete begins to set with a 3m. straight edge and wedge gauge. The straight edge shall be placed on the surface in successive positions parallel to the carriage-way centre line. Irregularities shall be measured with the help of the wedge moved transversely at various points until it touches both the straight edge and the concrete surface. At any point tested the concrete shall not show a departure from the true surface greater than 3mm. If at any place the tolerance is greater than this not more than 3 passes

of the vibrating machine shall be allowed and the surface tested again in the specified manner.

If the irregularity still exceeds the limit aforesaid the concrete shall be removed to a depth of 50mm. or to the level of the top surface of the reinforcement, if any.

The area to be removed shall be that represented by the length of the straight edge in the position of measurement across the full width of slab. Where the point of measurement in default is less than 4.5m. from the transverse expansion joint the whole area upto the joint shall be removed to the required depth. The concrete so removed shall not be reused in the carriage-way.

Fresh concrete shall be placed, compacted and finished in the manner already described in these specifications and shall be subject to test for accuracy of finish.

The foregoing procedure shall be adopted at each shifting of the straight edge and the whole area shall be gone over from one side of the slab to the other. The straight edge shall advance longitudinally in successive stages of not more than one-half the length of the straight edge.

No extra payment shall be made for the removal of the rejected concrete for laying fresh concrete.

1515.7.7.4. *Belting* :—Just before the concrete becomes non-plastic the surface shall be belted with a two-ply canvas belt not less than 200mm. wide and at least 1m. longer than the width of the slab. Hand belts shall have suitable handles to permit controlled and uniform manipulation. The belt shall be operated with short strokes transverse to the carriage-way centre line and with a rapid advance parallel to the centre line.

1515.7.7.5. *Brooming* :—After belting and as soon as surplus water, if any, has risen to the surface the pavement shall be given a broom finish with an approved steel or fibre broom not less than 450mm. wide. The broom shall be pulled gently over the surface of the pavement from edge to edge. Adjacent strokes shall be slightly overlapped. Brooming shall be perpendicular to the centre line of the pavement and so executed that the corrugations thus produced will be uniform in character and width and not more than 1.5mm. deep. Brooming shall be completed before concrete reaches such a stage that the surface is likely to be torn or unduly roughened by the operation. The broomed surface shall be free from porous or rough pots, irregularities, depressions and small pockets such as may be caused by accidental disturbing of the coarse aggregate particles embodied near the surface.

1515.7.7.6. *Edging* :—After belting and/or brooming have been completed but before the concrete has taken its initial set all the edges of the slab including joints shall be carefully finished with an edge of 6mm. radius and the pavement edge shall be left smooth and true to line.

1515.7.8. *Curing* :—Curing shall be conform to clause 402.8. Where there is scarcity of water and in that sections curing shall be done by using an approved curing compound.

1515.7.9. *Removing forms* :—Forms shall not be removed from freshly placed concrete until it has set at least for 12 hours. Forms shall be carefully removed and in such a manner that not damage will be done to the edge of the pavement. After the forms has been removed the ends of the joints shall be cleaned and any honeycombed areas touched up with (1 : 2) cement mortar after which the sides of the slab shall be covered with earth to the level of the top of the slab.

1515.7.10. *Concreting during monsoon months* :—When concrete is being placed during monsoon months and when it may be expected to rain sufficient supply of tarpaulins or other water-proof cloth shall be provided along the line of the work. Any time when it rains all freshly laid concrete which has not been covered for curing purposes shall be adequately protected by means of tarpaulins or other water-proof cloth. Any concrete damaged by rain shall be removed and replaced.

1515.7.11. *Concreting in hot weather* :—As placing of concrete at temperature above 40°C is attended with defects like loss of workability through accelerated setting, formation of plastic shrinkage cracks etc., it is recommended that unless adequate precautions as detailed below are arranged no concreting shall be done in temperatures exceeding 40°C.

Aggregates, cement and water shall be protected from the direct sun and mixing operations shall also be carried out in shade. In addition portable shelters shall be provided to protect the concrete during placing and finishing operations. This may be in the form of gable frames to cover at least a length of 12 metres of the roadway. The surfaces of the forms and sub-grade coming in contact with concrete shall be moistened prior to placing of the concrete to prevent absorption of the mixing water. Since the setting time of concrete is considerably reduced under such temperatures reinforcements to labour shall be made to minimise the time between the mixing and the placing of concrete. The protective cover shall be adequate to exclude exposure of the concrete directly to the sun and also eliminate contract with drying winds. Prior to removal of the portable shelters the hardened concrete shall be covered with wet hessian followed by one of the usual methods of curing like ponding, wet earth covering, etc.

1515.7.12. *Work on gradients* :—The progress on gradient of all operations of placing, compacting and finishing of concrete should proceed from the lower to the higher reaches. The concrete mix shall be stiffer than that used on level reaches.

1515.7.13. *Sealing of joints* :—After the curing period is over and before the pavement is opened to traffic the temporary seal or other intruded materials of all transverse expansion and contraction joints shall be removed completely and the slots filled up with the approved joint sealing compound. The joint opening shall be thoroughly cleared of all foreign matter before the sealing material is placed. If necessary the foreign matter shall be blown out. All contract faces of the joint shall be cleaned with a wire brush to remove loose material and the surface shall dried before the sealing compound is poured.

The edge of joints shall be primed with a thin bituminous paint which shall be allowed to dry before the sealing compound is applied. The primer shall be applied with a brush. The composition of the primer shall be as follows :

		Percentage by weight	
(i)	200-penetration bitumen	66	Blended hot
(ii)	Light creosote oil	14	Blended cold
(iii)	Solvent Naphtha	20	

The bitumen shall be melted and fluxed with the oil. When cold solvent naphtha shall be added. Bituminous emulsions shall not be used as primers.

Care shall be taken to ensure that the sealing compound is not heated above 200°C and the temperature does not exceed 180°C (or other temperatures as specified by the manufacturer of the compound) for long periods.

Sealing compound shall be poured into the joint opening in such a manner that the material will not be spilled on the exposed surface of the concrete. Any excess filler on the surface of the concrete pavement shall be removed immediately and the pavement surface cleaned.

When required to prevent tackiness or pick up under traffic the exposed surfaces of the sealing compound shall be dusted with hydrated lime. Other methods of preventing pick-up under traffic may be used when approved by the Executive Engineer.

1515.7.14. *Quality control of works* :—This shall conform to clause 1515.4.

1515.7.15. *Opening of traffic* :—Traffic shall be excluded from the newly constructed pavement for a period of 28 days where ordinary portland cement, portland Blast Furnace Slag Cement and Portland Pozzolana Cement are used or for a period of 7 days where rapid hardening cement is used. In all cases before the pavement is opened to traffic it shall be cleaned and the joints shall be filled and trimmed or topped out as required. The joint or line of separation between adjacent strips or slabs of concrete when the pavement is constructed in lanes or strips shall be cleaned and filled with bituminous materials as prescribed.

1515.8. *Arrangements for traffic* :—This shall conform to clause 1501.3

1515.9. *Measurement* :—This shall conform to the relevant portion of clause 1501.2.1.4.

1515.10. *Rate* :—The unit rate shall be per 10 sq.m. unless otherwise specified. The rate shall include the cost of labour and materials involved in all the operations described herein above but excluding the cost of dowel bars, tie bars, reinforcement and the expansion joint filler which shall be paid for separately unless specified otherwise.

Specification No. 1516

Shoulder Construction

1516.1. Description :—The work shall consist of constructing shoulders on either side of the pavement in accordance with the requirements of the specifications and in conformity with the lines, grades and cross sections shown on the drawings or as directed by the Executive Engineer.

1516.2. Materials :—Shoulder construction may be selected soil, moorum, sand moorum or stabilised soil. The actual material to be used shall be specified.

1516.3. Construction operations :—This shall conform to the relevant Specifications 1503 to 1505.

Any spilled materials dragged on to the pavement surface shall be immediately removed without damage to the pavement and the area so affected thoroughly cleaned. During all stages of shoulder construction the required cross fall shall be maintained to drain off surface water.

1516.4. Measurement :—This shall conform to clause 1501.2.1.4.

1516.5. Rate :—The unit rate shall be per cubic metre for finished work in accordance with the above specifications.

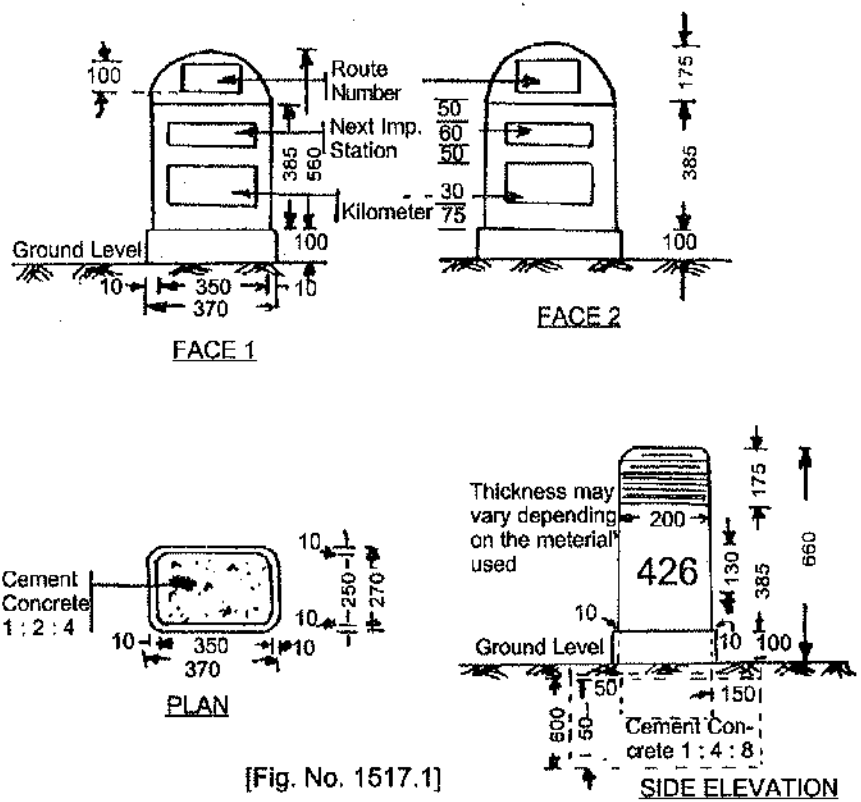
Specification No. 1517

Providing and fixing K.M. Stones

1517.1. Kilometre stones (kilometres and 5th kilometre stone) :

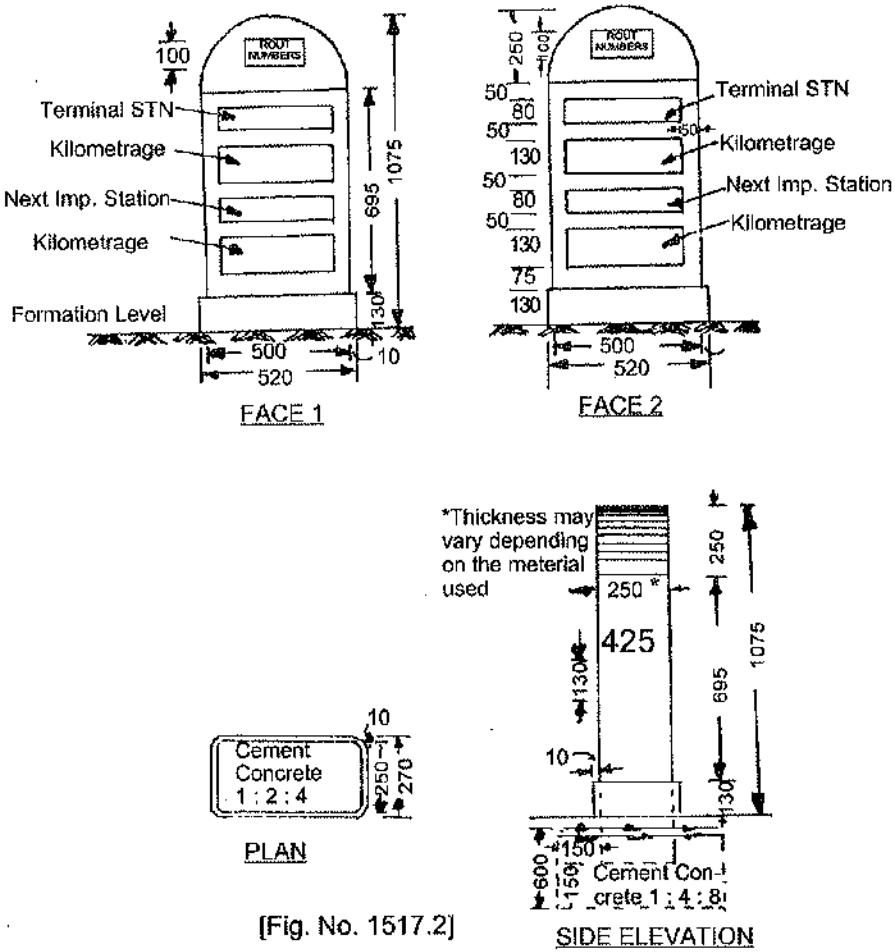
1517.1.1. *General* :—The kilometre stone shall be of standard design as prescribed by IRC : 8-1969. The stones shall be shown in Fig. Nos. 1517.1 to 1517.3.

TYPE DESIGN FOR ORDINARY KILOMETRE STONE ON N.H.S., S.H.S. AND M.D.R.S.



[Fig. No. 1517.1]

TYPE DESIGN FOR THE 55 KILOMETRE STONE ON N.H.S., H.S. AND M.D.R.S.



[Fig. No. 1517.2]

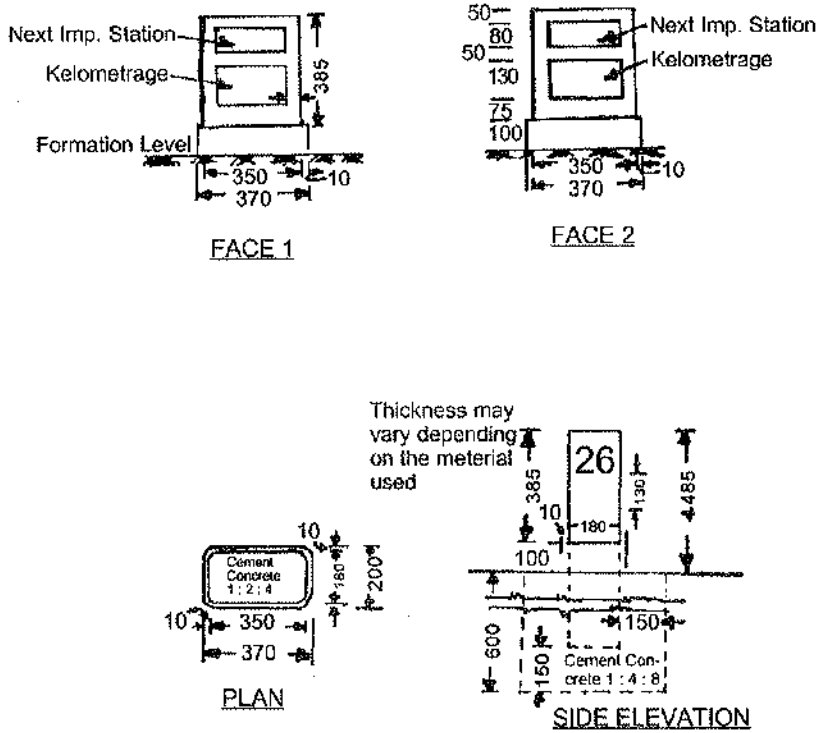
[All Dimensions in MM]

1517.1.2. *Location* :—The kilometre stones shall be fixed at the edge of the road way outside the shoulder on specifically erected platforms, if necessary. In cuttings these shall be fixed clear of the shoulder and the side drains as per Fig. No. 1517.4. These shall be located on the left hand side of the road as one proceeds from the station from which kilometre count starts.

1517.1.3. *Kilometre stones* :—K.M. stone shall be of R.C.C. or stone slabs.

1517.1.3.1. *Kilometre stones, of R.C.C.* :—These shall be cast in cement concrete (1 : 2 : 4) with 20mm. stone aggregate and reinforcement as directed and finished smooth with cement mortar (1 : 3) on exposed surfaces. The specification for R.C.C. work shall conform to SS : 403.

TYPE DESIGN FOR KELOMETRE STONE ON O.D.R.S. and VILLAGE ROADS



[Fig. No. 1517.3]

1517.1.3.2. *Kilometre stones of, stone* :—These shall be hard, even, sound and durable. The stones shall be cut or chiselled in a plane parallel to the natural bed of the stone. The slabs shall be chisel dressed on the exposed surface facing road side so that the dressed face shall not be more than 3mm. from a straight edge placed on it. The thickness of the slab shall be uniform and as specified with a permissible tolerance of 1.5mm. The thickness shall be measure correct of 3mm.

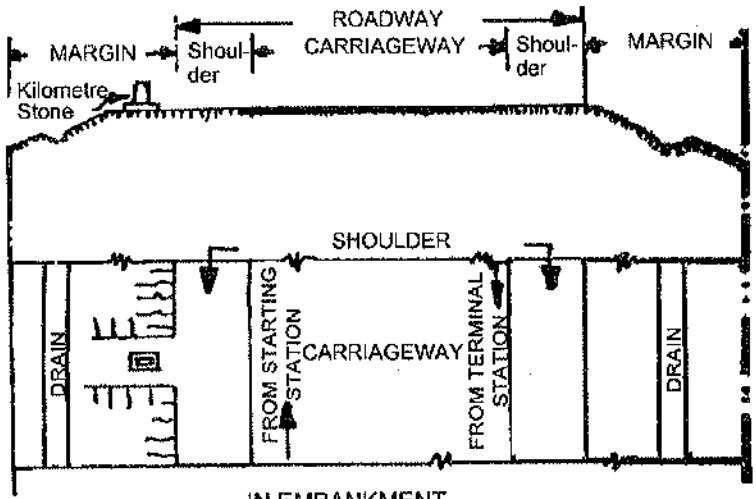
1517.1.4. *Fixing* :—Fixing of kilometre stones shall be done as per Fig. 1517.4. Pits of suitable dimensions shall be excavated to receive the kilometre stones. The kilometre stones shall then be firmly fixed in position in ground and the sides filled with earth, thoroughly watered and consolidated.

Where so specified the kilometre stone shall be fixed in cement concrete of specified mix with 40mm. stone aggregate so that there is 150mm. thick concrete in the bottom and 150mm. thick concrete all round upto formation level.

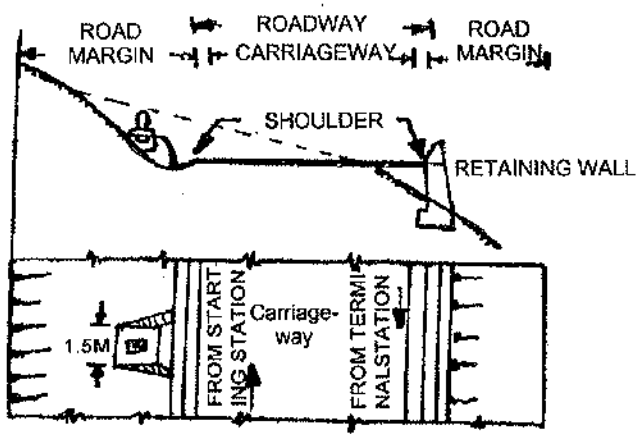
1517.1.5. *Finishing* :—The exposed surfaces above the ground shall be painted with two or more coats of required colour or as specified over a coat of primer as for new work.

LOCATION OF KELOMETRE STONE

[Fig. No. 1517.4]



IN EMBANKMENT



IN CUTTING

Where so specified the kilometre stone shall be fixed in cement concrete of specified mix with 40mm. stone aggregate so that there is 150mm. thick concrete in the bottom and 150mm. thick concrete all round upto formation level.

1517.1.5. *Finishing* :—The exposed surfaces above the ground shall be painted with two or more coats of required colour or as specified over a coat of primer as for new work.

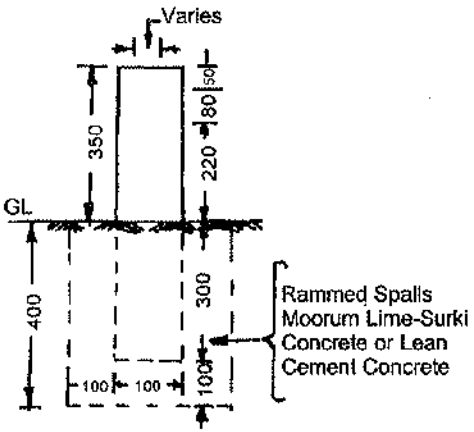
1517.1.6. *Measurement* :—Kilometre stones shall be measured in numbers.

1517.1.7. *Rate* :—The unit rate shall be per each Km. stone which shall include the cost of materials and labour involved in all the operations described above, but excluding the cost of excavation, concrete in foundations, painting and lettering for which pavement shall be made separately.

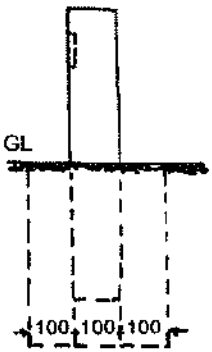
1517.2. 200 metres stones :

1517.2.1. *General* :—200 metres stone shall be standard design as prescribed by the IRC : 26-1967. The stones shall be as shown in Fig. No. 1517.5.

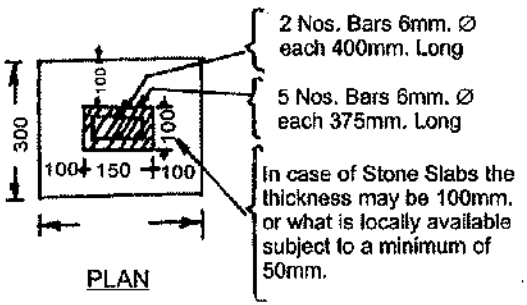
TYPE DESIGN FOR 200 METRE STONES
[Fig. No. 1517.5]



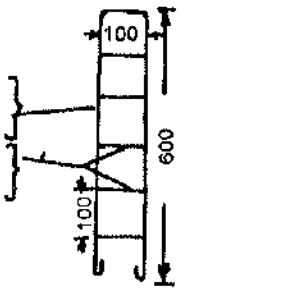
FRONT ELEVATION



SIDE ELEVATION



PLAN



SCHEDULE OF REINFORCEMENT WHEN R.C.C. IS USED

All Dimensions in Millimetres

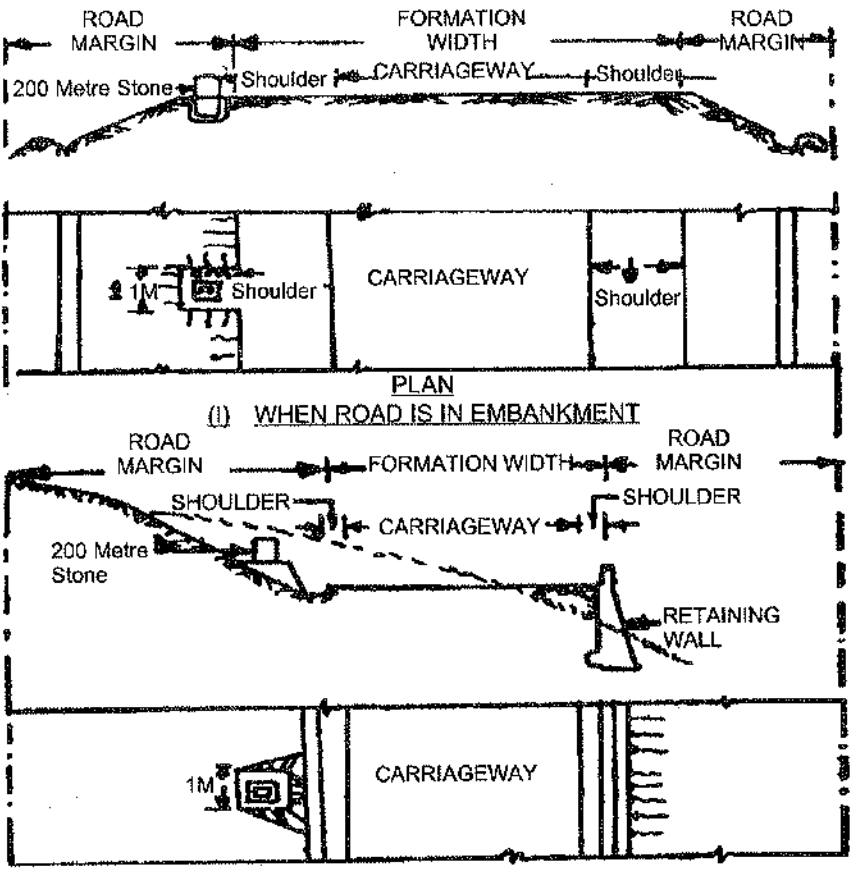
1517.2.2. 200 metre stones shall be of locally available hard stone well dressed or of reinforced cement concrete and shall conform to clauses 1527.1.3.1 and 1517.1.3.2.

1517.2.3. *Finishing* :—The exposed surfaces shall be painted white with two or more coats over a coat of primer as for new work. The colour of the numerals shall be black.

1517.2.4. *Location and fixing* :—200 metre stones are to be located on the same side of the road where the kilometres stones are fixed. The stone may be fixed in position with rammed spalls in moorum, lime-surki concrete or lean cement concrete alround. Both the faces shall bear the inscription and the stones shall be planted securely just beyond the edge of the formation with their faces perpendicular to the centre line of the carriageway. The manner of locating the stones when the road may be in embankment or in cutting is illustrated in Fig. No. 1517-6.

MANNER OF LOCATING 200 METRE STONES

[Fig. No. 1517.6]



1517.2.5. *Measurement* :—This shall conform to clause 1517.1.6.

1517.2.6. *Rate* :—This shall conform to clause 1517.1.7.

Specification No. 1518

Providing & Fixing Boundary, Guide and Guard Stones

1518.1. Boundary Stones :—

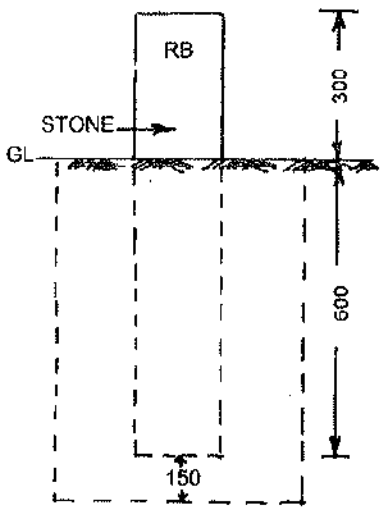
1518.1.1. *General* :—The boundary stones shall be of standard design as prescribed by the IRC : 25-1967.

1518.1.2. *Materials* :—Boundary stones shall be of locally available hard stone well dressed or of reinforced cement concrete.

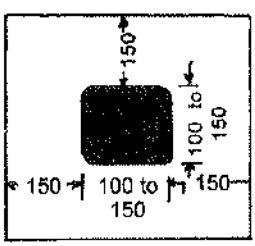
1518.1.3. *Boundary stones, of stones* :—these shall be chisel dressed on all the four sides and on the top as shown in Fig. No. 1518.1.

TYPE DESIGN WITH STONE AS MATERIALS

[Fig. No. 1518.1]



ELEVATION

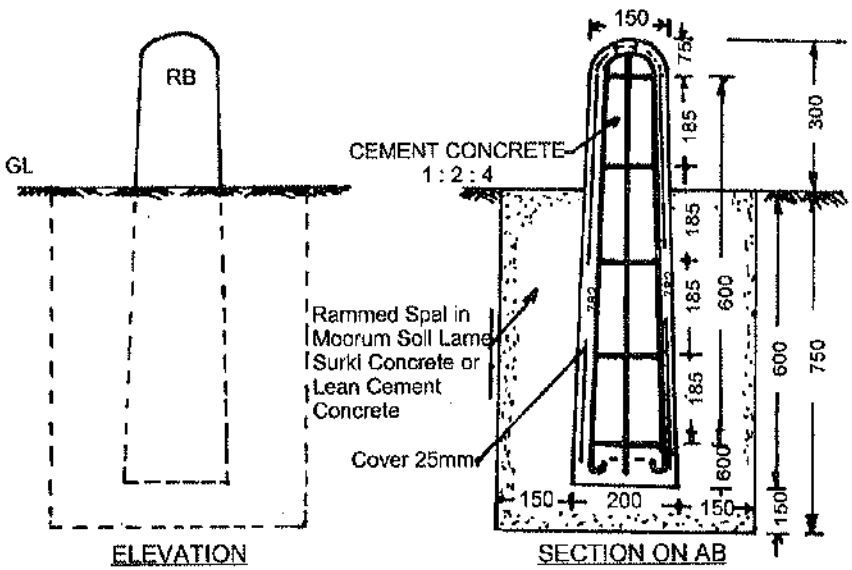


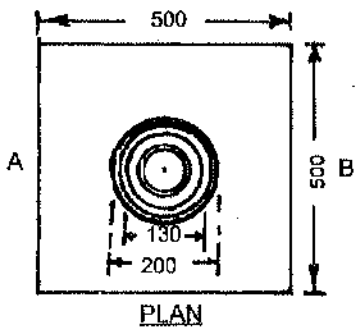
PLAN

1518.1.4. *Boundary stones, of R.C.C.* :—These shall be cast in cement concrete (1 : 2 : 4) with 20mm stone aggregate and reinforced suitably as directed and finished smooth with cement mortar (1 : 3) as shown in Fig.No. 1518.2. The specification for R.C.C. work shall conform to SS : 403.

TYPE DESIGN OF BOUNDARY STONES

[Fig. No. 1518.2]





BAR BENDING SCHEDULE

Sl. No.	Type of M.S. Bar	No. of Bars	Shape of Bar	Dia in mm.	Length of one Bar Moduling Hooks
1.	Main Bars	2		6	1.04m.
2.	Top Most Stirrup	1		6	370mm.
3.	Stirrup first from top	1		6	400mm.
4.	Stirrup second from top	1		6	440mm.
5.	Stirrup third from top	1		6	475mm.
6.	Bottom most stirrup	1		6	510mm.

1518.1.5. *Location* :—Boundary stone shall be fixed on either side of the road and opposite to every 200 metre stones and kilometre stone. In addition these shall be fixed at all angular points of the boundary. Where the boundary is on a curve or the land is costly and likely to be encroached upon these shall be planted closer as necessary for each boundary stone.

1518.1.6. *Inscription* :—The letters R.B. indicating Road Boundary, shall be inscribed on each stone.

1518.1.7. *Fixing* :—Boundary stones shall project 30mm. above ground level. Where the natural soil at the base is good the stones may be fixed in position by ramming spalls and moorum or soil all round. But these shall be encased in at least 150mm. of lime-surki concrete or lean cement concrete in the following cases :

(i) Where wet cultivation abuts the road limits and the boundary stones are apt to be displaced ;

(ii) Where the road runs in built up areas ; and

(iii) Where the boundary stones, are intended to serve as permanent land marks.

1518.1.8. *Measurement* :—This shall conform to clause 1517.1.6.

1518.1.9. *Rate* :—This shall conform to clause 1517.1.7.

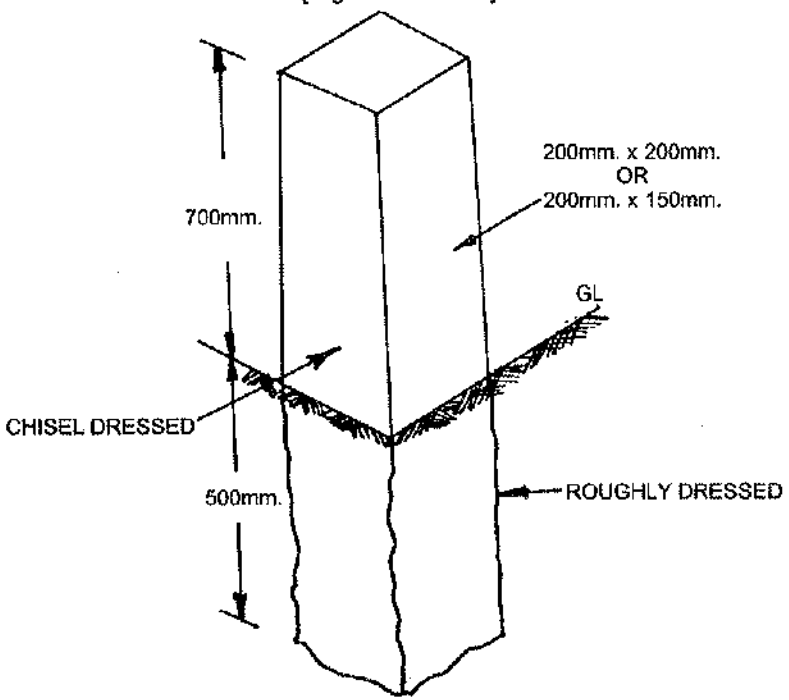
1518.2. Guide Stones :

1518.2.1. *General* :—The guide stones shall be of standard size, in stone or R.C.C.

1518.2.2. *Guide stones, of stone* :—The guide stones of stone shall be as shown in Fig.No. 1518.3. The stone shall be locally available, hard, even, sound and durable. The faces of the stone shall be chisel dressed on the exposed surface and shall be roughly dressed below ground level as shown in Fig.No. 1518.3.

STANDARD GUIDE STONE (Stone)

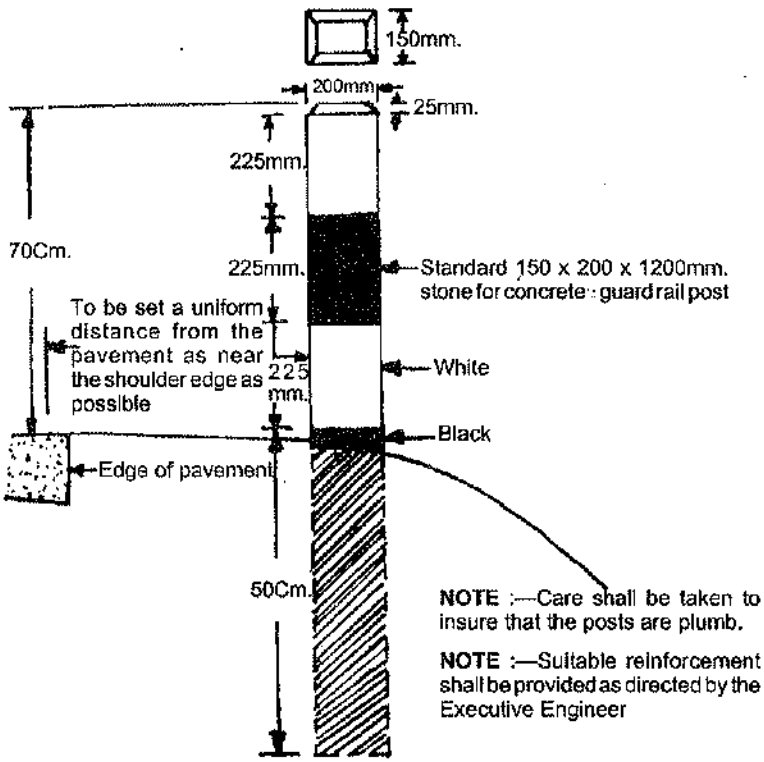
[Fig. No. 1518.3]



1518.2.3. *Guide stones, of R.C.C.* :—These shall be cast in cement concrete (1 : 2 : 4) with 20mm. stone aggregate and reinforcement as directed and finished smooth with cement mortar (1 : 3) on exposed surfaces as shown in Fig.No. 1518.4. The specifications for R.C.C. work shall be in accordance with SS : 403.

STANDARD GUIDE STONE REINFORCED CEMENT CONCRETE

[Fig. No. 1518.4]



1518.2.4. *Fixing* :—Fixing of the guide stone shall be done as per figures 1518.3 and 1518.4 at the edges of all high embankments and along the outer edges of sharp curves. They shall be planted at a height such that the top is 700mm. above the edge of the nearer pavement or roadway. They shall be in no case be more than 3 metres nor less than 600mm. outside the roadway or pavement edge. The most desirable location being uniformly 2.5 metres to allow a clear shoulder, wide enough for the parking of a vehicle. Along kerbed sections of roadway guide stones, if used, shall be planted at a distance of not more than 1.5 metres nor less than 600mm. from the kerb face.

The guide stones shall not be placed more than 6 metres apart.

The guide stones shall be painted in white and black as shown in Fig.No. 1518.4.

1518.2.5. *Measurement* :—This shall conform to clause 1517.1.6.

1518.2.6. *Rate* :—This shall conform to clause 1517.1.7.

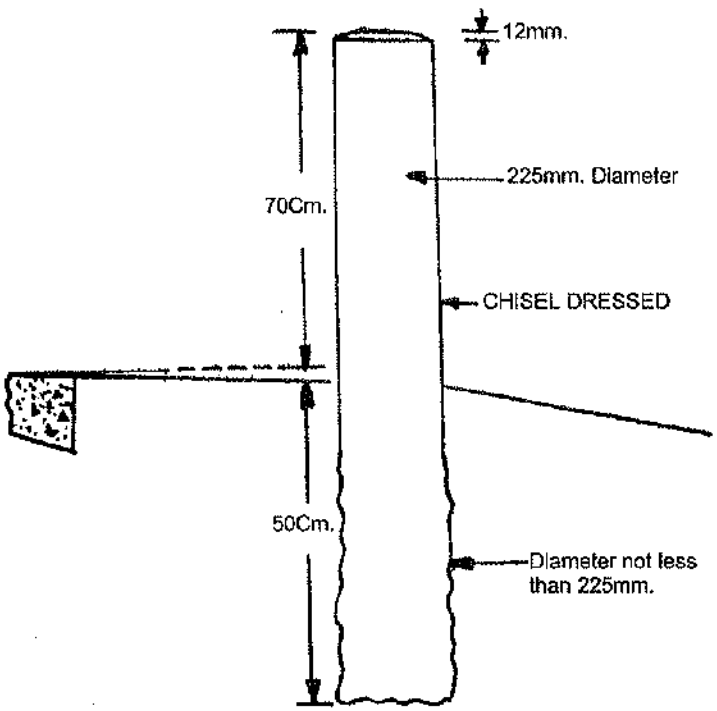
1518.3. Guard stones :

1518.3.1. *General* :—The guard stones shall be standard size in stone or R.C.C.

1518.3.2. *Guard stones of stone* :—These shall be as shown in Fig.No. 1518.5. The stone shall be locally available, hard, even, sound and durable. The exposed surface of the stone shall be chisel dressed.

STANDARD GUARD STONE

[Fig. No. 1518.5]



1518.3.3. *Guard stones of R.C.C.* :—These shall conform to clause 1518.2.3 and as shown in Fig. No. 1518.6.

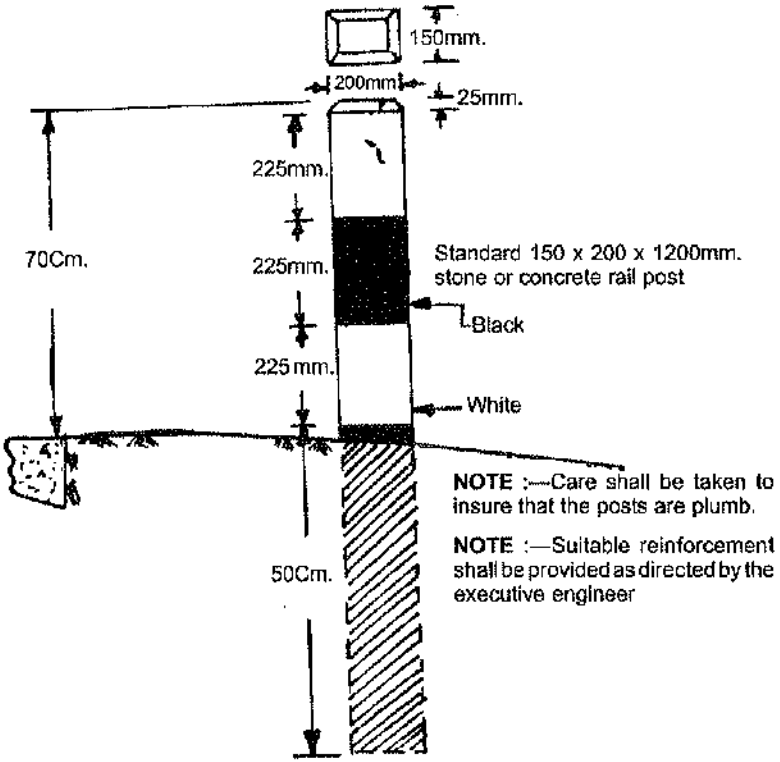
1518.3.4. *Fixing* :—The guard stones shall be fixed in positions as directed by the Executive Engineer at culverts and bridges.

1518.3.5. *Measurement* :—This shall conform to clause 1517.1.6.

1518.3.6. *Rate* :—This shall conform to clause 1517.3.7.

STANDARD GUARD STONES REINFORCED CEMENT CONCRETE

[Fig. No. 1518.6]



NOTE :—Care shall be taken to insure that the posts are plumb.

NOTE :—Suitable reinforcement shall be provided as directed by the executive engineer

SECTION 16

STANDARD SPECIFICATIONS FOR MISCELLANEOUS ITEMS

CONTENTS

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2.	1602	Teak wood trellis work for verandahs	601
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Specification No. 1601

Bamboo Chicks with Blue Dungary Cloth, Pulleys, Rings, Ropes, Hooks, Staples, etc., Complete including Painting Two Coats

1601.1. Materials :—All the materials shall be of approved quality.

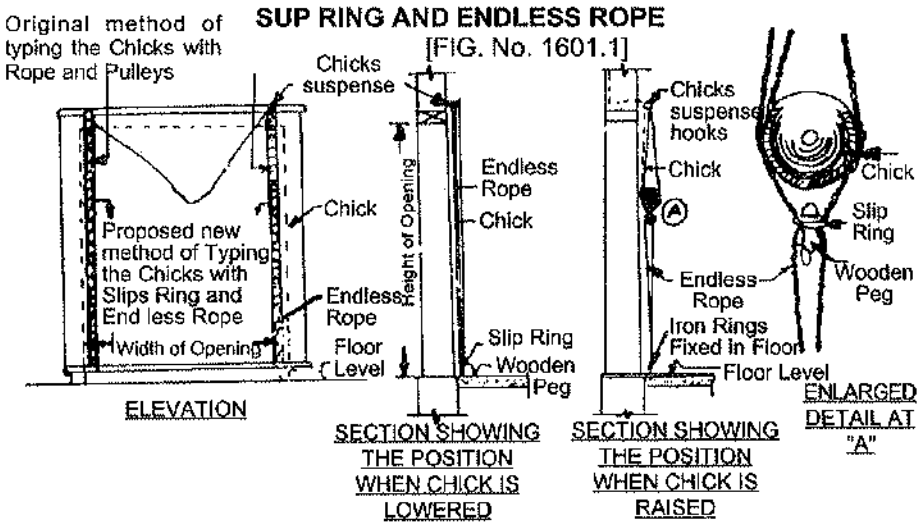
1601.2. Good bamboos shall be spliced into single laths of uniform size for the entire width of the chick. These shall be 6mm. to 10mm. in width and not less than 3mm. in thickness and shall be free from all projecting knots, etc., planed smooth with a knife. There shall be no fibres coming out. They shall then be laid on the ground and closely bound together by country twine, in straight lines not more than 200mm. apart. The binding shall be so done that the splices cannot be removed, while at the same time freedom for rolling the chick is present. Two straight solid bamboos, 50mm. in diameter shall be tied to top and bottom of the chick. The chick so made shall then be painted in accordance with the Standard Specifications with two coats of approved green paint on both sides. After the plaint is completely dry, best blue dungary cloth shall be spread over the chick so as to cover the whole of the chick and folded round to a width of about 40mm. on the sides and 80mm. on the top and bottom. White tape is approved guilty 80mm. wide, shall now be placed at the ends in such a way that it covers 40mm on either side

and shall be stitched on to the chick with strong white twine. Similarly tape 40mm. wide shall be put on both sides of the chick at intermediate distances of not more than 1.25 metres and then stitched on. The cloth shall cover the bamboos and be stitched round them.

1601.3. Two wooden pulleys shall be securely tied near the end of the top bamboo with galvanized iron wire and 12mm. dia. cotton rope shall be so passed round as to enable the chick to be lifted and lowered, rolling and unrolling the chicks. Provision shall also be made for fixing the chicks to the floor or side walls as instructed so as not to allow them to beat about in the wind. This may be made by letting in iron hooks or rings into wooden plugs fixed into the walls or floor vertically below the hools at top, to which the chicks may be tied by endless ropes passing round the chicks and through the hooks at top and the hooks or rings at bottom. A slip ring with a wooden peg tied to it with a string may also be provided to keep the chick in any desired position as per sketch appended. (See Fig. No. 1601.1).

SKETCH SHOWING THE METHOD OF TYPING CHICKS WITH SUP RING AND ENDLESS ROPE

[FIG. No. 1601.1]



The above arrangement applies to chicks of more than 3 metres height only. Chicks of 3 metres height and less shall have no lifting or lowering ropes but only endless ropes with slip rings. The lowering and lifting shall be done by hand.

Two or three firm iron hooks 10mm. diameter shall be fixed to the joists, bressummer or ceiling as instructed so that the chicks may be hung from them by the top bamboo. In cases where suspension is to be from chick hooks fixed in masonry, the hooks shall be 10mm. diametre with a 50mm. bend in opposite directions at each end and set with one end 150mm. into the masonry and the other end projecting 50mm. from the wall face with the bent end upwards to receive the top bamboo. The upper end of the hook shall be rounded off with a file. The hooks shall be in a horizontal line.

1601.4. Measurement :—All linear measurements shall be in metres, correct to 0.01 of a metre. Areas shall be worked out in square metres, correct to 0.01 of a sq.m.

1601.5. Rate :—The unit rate shall be per 10 sq.metres. The rate shall include supplying, fixing, fittings, paintings, etc., complete.

Specification No. 1602

Teak Wood Trellis Work for Verandahs

1602.1. All the timber used shall conform to SS : 130.

1602.2. Teak wood battens 25mm. x 12mm. shall be crossed diagonally in opposite directions at an angle of 45" with the floor leaving 50mm. square openings between the battens. The battens shall be screwed together where they cross at intervals of approximately one metre in each direction, all other crossings of battens being nailed together. A teak wood floor rail 100mm. x 50mm. shall be screwed on the sides) with a teak wood from 50mm. x 25mm. and on the side (on three inside of the trellis. The outside of the trellis shall be provided (on all four sides) the trellings shall be provided with battens 25mm. x 12mm. The framing shall be secured to the trellis with screws at 0.75 metre intervals.

The completed trellis shall be secured at the floor and to the inner sides of the pillars with screws passing through the floor rail and the side frame.

In the case of wooden verandah posts the trellis shall be screwed directly to the posts. For securing trellis to the floor and to the masonry or concrete pillars or walls, suitable wooden plugs shall be embedded.

1602.3. The trellis shall be painted in accordance with Standard Specifications with two coats of approved paint of the specified colour,

1602.4. Measurement :—This shall conform to clause 1001.4.

1602.5. Rate :—The rate shall be per 10 square metres and shall include the cost of fixing of the battens, frame, floor rail, plugs, screws, painting, etc., complete.

Specification No. 1603

Forming Black Boards on Walls

1603.1. If there are bushings on stone walls to receive the plaster, they shall be removed to within 12mm. projections before plastering is done. All joints in masonry shall be raked out at least 20mm. deep. The wall shall be washed with fresh water and thoroughly wetted for six hours before plastering is commenced.

1603.2. The plaster shall consist of 2 coats. The first coat of plaster shall consist of 16mm. thickness of Standard Specification cement mortar (1 : 3). The surface shall be left rough to receive the second coat. The second coat shall consist of 6mm thickness of Standard Specification C.M. (1 : 2), floated and rubbed to a smooth surface. Cement mortar beadings 25mm. wide and 12mm. thick, (that is, projection from the wall) shall be formed all round the black board in standard cement mortar (1 : 3).

1603.3. After the surface is completely dry, an approved black board paint shall be applied in 2 coats as per Standard Specification for painting.

1603.4. Measurement :—This shall conform to clause 1601.4.

1603.5. Rate :—The unit rate shall be per 10 square metres. The rate shall include the preparation of wall surface, plastering, beading, painting, etc., complete.

Specification No. 1604

Barbed Wire for Fencing

1604.1. Materials :

1604.1.1. The wire used for fencing shall conform to IS : 278-1969 and shall not contain sulphur and phosphorus exceeding 0.065 per cent. The wire shall be coated with zinc of grade Zn 98 of IS : 209-1966.

1604.1.2. The line and paint wires shall be circular in section free from scales and other defects and shall be uniformly galvanized.

1604.1.3. The line wire shall be in continuous lengths and shall not contain any welds other than those in the rod before it is drawn. The distance between two successive splices shall not be less than 15 metres.

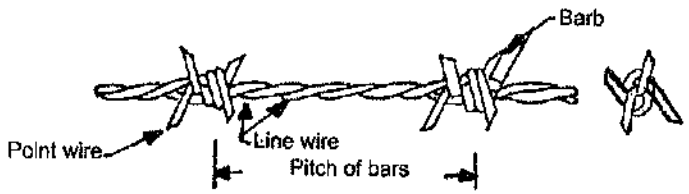
1604.2. Types and Sizes :

1604.2.1. *Types* :—The galvanized steel barbed wires shall be of two types : Type A (Iowa type) and type B (Glidden type).

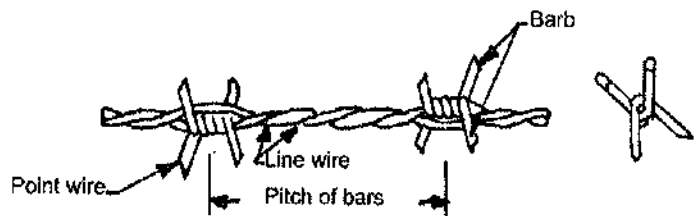
1604.2.1.1. *Type A (Iowa type)* :—The barbs shall have four points and shall be formed by twisting two points wires, each two turns slightly around both line wires making altogether four complete turns. (See Fig. 1604.1A).

1604.2.1.2. *Type B (Glidden type)* :—The barbs shall have four points and shall be formed by twisting two point wires, each two turns tightly around one line wire making altogether four complete turns. (See Fig. 1604.1B).

DETAILS OF BARBED WIRE



TYPE – A [Fig. No. 1604.1A]



TYPE – B [Fig. No. 1604.1B]

1604.2.2. *Sizes* :—The galvanized steel barbed wire shall be of the size designations given below.

Size designation	Nominal diameter of wire		Weight of completed barbed wire		Distance between two barbs mm.
	Line wire mm.	Point wire mm.	Max. g./m.	Mini. g./m.	
1.	2.50	2.00	125	108	75 ± 12
2.	2.50	2.00	103	89	150 ± 12
3.	2.24	2.00	106	97	75 ± 12
4.	2.24	2.00	86	78	150 ± 12

1604.2.3. The barbed wire shall be formed by twisting together two line wires, one or both containing the barbs. The sizes of the line and point wires and barb spacings shall be as specified in clause 1604.2.2 above.

1604.2.4. The barbs shall be so finished that the four points are set and locked at right angles to each other. The barbs shall have a length of not less than 13mm. and not more than 18mm. The points shall be sharp and cut at an angle not greater than 35° to the axis of the wire forming the barb.

1604.3. Tolerances :—The permissible deviation from the nominal diameter of the line wire and the point wire shall not exceed ± 0.08mm.

1604.4. Marking, coiling and packing :—Every reel of barbed wire shall have legibly marked on it, the name of the manufacturer, the type of the barbed wire, the diametres of the line and point wires, barb spacing and length of wire on the reel.

The barbed wire shall be supplied in metal or wooden reels and each reel of barbed wire shall be wound and fastened compactly.

1604.5. Measurement :—This shall be by weight in quintals, correct to 0.01 of a quintal.

1604.6. Rate :—The unit rate shall be per quintal or tonne.

Specification No. 1605

Reinforced Concrete Fence Posts

1605.1. Materials :—All the materials used for the manufacture of reinforced concrete fence posts shall conform to the relevant Standard Specifications of Section 1, materials.

1605.1.1. The aggregate used shall consist of a graded mixture of clean, coarse and fine aggregates. The nominal maximum size of coarse aggregate shall not exceed 12.5mm.

1605.1.2. *Concrete* :—Concrete shall have a water/cement ratio not exceeding 0.5 by weight. The mix proportions shall be such as to produce dense concrete not weaker than grade M 150 (1 : 2 : 4) for use under ordinary conditions and M 200 (1 : 1½ : 3) for posts used in coastal areas.

1605.1.3. *Reinforcement* :—Reinforcement shall be clean and free from loose mill scale, loose rust, mud, oil, grease and any other coating which reduces the bond between the concrete and the steel.

1605.2. Classification :—R.C. fence posts are of three categories.

(i) *Line posts* :—Line posts are intermediate posts forming the majority of posts in a post and wire system and are intended to carry and retain the fencing wires between the strainer posts at the required vertical spacings.

(ii) *Strainer posts* :—Posts notched on three sides and used with struts or brace as strainers at the corners or ends or at intermediate positions in a line of fence.

(iii) *Strut or brace* :—Member used in inclined position for supporting the strainer post.

1605.3. Shape and dimensions :

1605.3.1. The fence posts shall generally be square in cross section. They shall be of uniform section throughout their length or tapering on two sides or tapering on all four sides. The cross-sectional dimensions and the reinforcement shall be adequate to conform to the strength requirements given in clause 7 of IS : 4996-1968. Unless otherwise specified, the following lengths, dimensions and reinforcement shall be adopted.

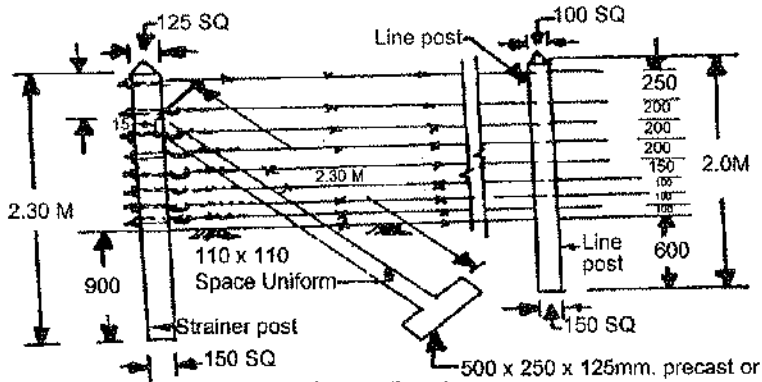
Table 1605-A

Sl. No.	Type of post	Cross Section		Length	
		Bottom	Top	Total	above ground level
		mm.	mm.	m.	m.
I. (i)	Line post	150 x 150	100 x 100	2.0	1.4
(ii)	Strainer or corner post	150 x 150	125 x 125	2.3	1.4
(iii)	Strut or brace	110 x 110	110 x 110	2.3	—
II. (i)	Line post	150 x 150	100 x 100	3.6	3.0
(ii)	Strainer or corner post	150 x 150	100 x 100	3.6	3.0
(iii)	Strut or brace	150 x 150	150 x 150	—	—

Sl. No.	Types of post	Reinforcement		Remarks
		Longitudinal	Transverse	
I. (i)	Line post	100mm. dia 4 Nos.	6mm. dia at 150mm. c/c	Used for heavy stocks & Estate fencing. See fig. 1605.1.
(ii)	Strainer or corner post	—		
II. (i)	Line post	10mm. dia 4 Nos.	6mm. dia. at 150mm. c/c	(Goose neck posts) Used for security fencing.
(ii)	Strainer or corner post			
(iii)	Strut or brace			See Fig. 1605.2.

Note :—For other requirements refer to Appendix 'B' of I.S. 4996—1968.

TYPICAL DETAILS AND DIMENSIONS OF LINE POST STRAINER POST AND BRACE FOR FENCING INTENDED FOR HEAVY STOCKS AND ESTATES



All divisions in millimetres unless otherwise mentioned

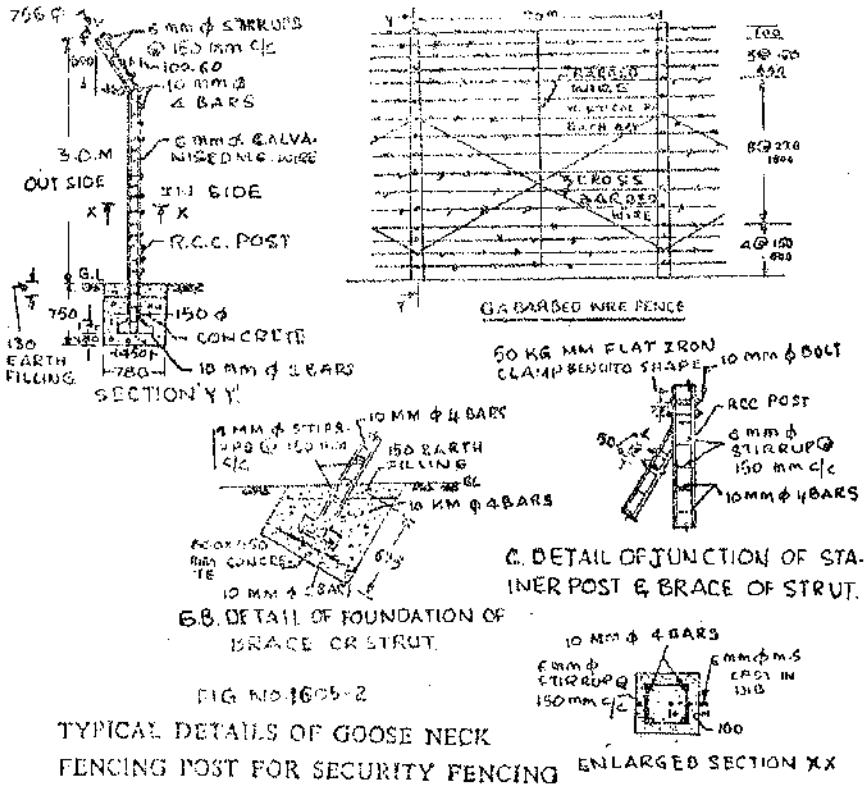
[Fig. No. 1605.1]

1605.3.2. **Tolerance** :—The tolerance on the overall length of the fence posts shall be ± 15mm. The tolerance on cross-sectional dimensions shall be ± 3mm. The tolerance on the straightness of the fence post shall be 0.5 per cent.

1605.4. Manufacture :

1605.4.1. *Positioning* :—R.C. posts of rectangular cross section shall be reinforced with a minimum of one longitudinal bar in each corner and posts which are circular in cross-section shall have at least four bars spaced equidistant around the circumference. The longitudinal reinforcing steel shall be in one piece. The longitudinal bars shall be firmly held by means of atleast 3mm. dia. steel ties or spacers spaced at not more than 200mm., so that they are not displaced from their correct position during placing and compaction of concrete.

1605.4.2. *Anchorage* :—Adequate hooks or other form of anchorage shall be provided to the main reinforcement at the bottom end of the posts.



C. DETAIL OF JUNCTION OF STAINER POST & BRACE OF STRUT.

B.B. DETAIL OF FOUNDATION OF BRACE OR STRUT.

ENLARGED SECTION XX

FIG NO 1605-2

TYPICAL DETAILS OF GOOSE NECK FENCING POST FOR SECURITY FENCING

1605.4.3. *Cover* :—To ensure durability of the finished posts, the longitudinal reinforcement shall have a minimum concrete cover of 20mm. or twice the diametere of the main reinforcement whichever the greater. The minimum cover shall be provided at the bottom of any corrugations and at any holes in the posts and also at the top and bottom of all reinforced concrete posts and struts. Where the posts and struts are to be used in coastal areas, the minimum concrete cover over the longitudinal reinforcement shall be increased to 25mm.

1605.4.4. Each post shall be cast of concrete proportioned, mixed placed and compacted to give a dense concrete free from voids.

1605.4.5. Each post shall have a dense surface finish showing no coarse aggregate and shall have no crevices likely to assist in the disintegration of concrete or rusting of the steel by the action of natural agencies.

1605.4.6. The required fixing arrangements for drawing the line wire either through clips or through the fence posts or around them shall be made before the posts are cast. For details refer clause 1606.4 on fixing of barbed wire and chain link mesh.

1605.5. Curing and maturing :—After casting the fense posts shall be adequately protected during setting (and in the first stages of hardening), from

shocks, running or surface water, the harmful effects of sunshine, drying winds and cold. The concrete shall be cured for at least 7 days unless special curing methods are adopted.

The poles shall be matured for the following periods counted from the dates of casting :

(a)	Posts cast with ordinary Portland cement or Portland blast furnace slag cement, Portland Pozzolana cement.	28 days
(b)	Posts cast with rapid hardening Portland cement.	14 days

1605.6. The fence posts shall withstand the tests done as per clause 7 of IS : 4996-1968.

1605.7. Measurement :

1605.7.1. All linear measurements, of concrete fencing posts, corner posts, strainer or terminal posts and struts shall be measured in metres, correct to 0.01 of a metre and their volumes shall be worked out in cubic metres, correct to 0.01 of cubic metre, (including reinforcement) and classified according to the sizes as follows :

1. Posts having an average sectional area not exceeding 0.01 sq.m.

2. Posts having an average sectional area exceeding 0.01 sq.m. but not exceeding 0.025 sq.m., and

3. Posts having an average sectional area over 0.025 sq.m.

1605.8. Rate :—The unit rate shall be per cubic metre. The rate shall include all items such as form work, finishing, chamfered or rounded angles and flats, splayed, rounded or mitred tops, holes for wire or rails and the building in of fastening etc., and completion in all respects.

Specification No. 1606

Fencing with Barbed Wire or Chain Link Mesh

1606.1. Materials :

1606.1.1. *Reinforced concrete fence posts* :—Reinforced concrete fence posts to be used shall conform to SS : 1605.

1606.1.2. *Galvanized steel barbed wire* :—Galvanized steel barbed wire to be used shall conform to SS : 1604.

1606.1.3. *Chain link mesh* :—The chain link mesh shall be manufactured from galvanized steel and shall conform to IS : 2721-1964.

1606.1.4. *Dimensions* :—Dimensions of chain link fencing for different purposes shall conform to IS : 2721-1964.

1606.2. Erection of fence posts :

1606.2.1. Pits of specified dimensions shall be excavated true to line and level to receive the reinforced concrete fence posts. The pit shall be filled upto 150mm. depth with (1 : 5 : 10) cement concrete and properly compacted. Then

the reinforced concrete fence posts shall be erected in the pits with depths of embedment as worked out from clause 1605.3.1. (Table 1605-A), by deducting the lengths above ground level from the total lengths of the posts. Cement concrete (1 : 5 : 10) shall be filled in and properly compacted upto a depth of 150mm. below the ground level. The concrete shall be cured for atleast 7 days. The remaining depth of the pits shall be filled up with excavated earth and well rammed and the surplus earth disposed off as directed by the Executive Engineer.

Posts with rectangular sections when used shall be set with their shorter faces perpendicular to the line of the fencing.

1606.2.2. Proper functioning and appearance of the post and wire fence depends upon the stability of the posts as well as the tightens and tautness of the barbed wires and chain link mesh and on the firmness and stability of the end, corner and strainer posts, which shall be provided with suitable braces set in a block of concrete. The brace shall be placed in line with the fence so that it bears at a point not more than two-thirds of the distance from the ground level to the top of the post. The foot of the brace may bear against the adjacent line post provided this is set at a distance closer than the normal, alternatively it may be set in a block of concrete below ground level.

1606.3. Spacing of posts :—Line posts shall normally be spaced 3 metres apart unless otherwise specified and the strainer posts spaced 30 metres apart. The last but one end posts and the corner posts shall be strutted on both sides and the end posts on one side only.

1606.4. Fixing of barbed wire and chain link mesh :—Posts shall be designed for the attachment of the fencing wire by one of the following methods :

(a) ***Using cast-in metal projections or clips*** :—Holes for cast-in metal projections or clips shall be located at distances from the end of the post varying not more than ± 6mm from the positions specified. Clips shall be embedded in the fence posts along the centre line of the post at right angle to one face of post during casting. They shall however invariably be of galvanized steel or of a suitable corrosion resisting material and the inner ends shall be bent or hooked to prevent extraction. The clips shall be sufficiently robust to withstand service conditions and repeated fixing and unfixing of wires. A single wire clip shall not be used for this purpose as it may be too easily broken. In coastal climates however this method is not recommended because even the galvanized steel staples may be subject to corrosion. (See Fig. 1606.IA).

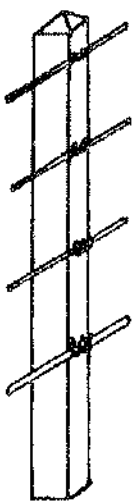
(b) *Attaching fencing with galvanized wire* :—Fencing wire shall be tried to the fence posts with a short piece of light wire. (See Fig. 1606.1B). One end of short wire shall be twisted round the line wire and brought around the back of the fence post, the other end shall then be pulled tight and twisted around the fencing wire on the other side of the post. If the edges of the post are chamfered, this will enable the tying wire to be pulled tighter. Shallow notches 5mm. deep shall also be cast in the two back edges of the posts so that these will firmly house the galvanized wire and prevent any possibility of its slipping own the post.

(c) *Using holes in the posts* :—Holes shall be cast in the fencing posts through which the fencing wire could be passed. (See Fig. 1606-IC). The holes shall

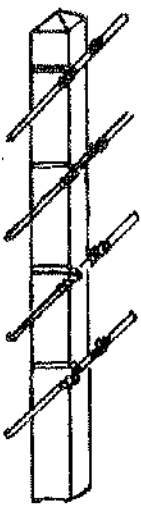
be formed by inserting steel rods (slightly greased), horizontally the holes in the divisions of the mould and withdrawing them before the concrete sets too hard, say 4 or 5 hours after it has been placed. Holes shall have a uniform diameter of not less than 10mm. and shall be along the centre line of the post. All arises shall be removed from the edges of the holes to prevent chaffing of the fencing wire. Holes shall not be provided in struts unless specified by the Executive Engineer and when so specified the holes shall take the form of long slots so that the fencing wires shall not be kinked as they pass through.

In the case of barbed wire fencing holes shall be cast in the fence posts in a direction from front to back with an indent at one end. To attach the barbed wire a piece of plain wire shaped like a hair pin shall be passed over the barbed wire and through the hole in the post. The ends of the hair pin wire shall be twisted around a short piece of rod placed in the indent. (See Fig. 1606.1D).

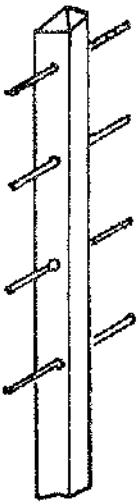
TYPICAL ARRANGEMENT FOR FIXING FENCING WIRES



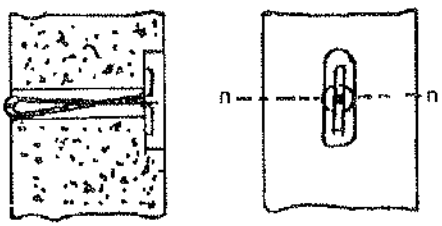
[Fig. 1606.1A]



[Fig. 1606.1B]



[Fig. 1606.1C]



[Fig. 1606.1D]

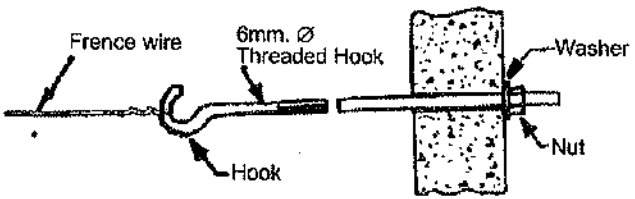
[Fig. 1606.1]

1606.5. Spacing of barbed wire :—Spacing of barbed wire shall vary with the uses for which the fencing is required. Unless otherwise specified the following spacings shall be adopted.

	Particulars of work	*Barbed wire spacing from ground level in mm.*
(a)	Fencing for heavy stock and estate work	100, 200 300, 450, 650, 850, 1050 and 1300
(b)	For security fencing (Goose neck posts)	150, 300, 450, 600, 825, 1050, 1275, 1500, 1725, 1950, 2175, 2400, 2550, 2700, 2850 and 2950.

1606.6. Fence wire shall be tightened by using the devices shown in Fig. 1606.2. One end of each wire shall be attached to length of 5mm. diameter mild steel bar having a hook at one end and threaded at the other. The thread end shall be passed through the holes in the strainer post and a washer and nut shall then be put on. The nut shall be turned on with a spanner until the wife is sufficiently tant. Alternatively, turn buckle straining screw arrangement shown in Fig. 1606.3 shall be used.

DEVICE FOR TIGHTENING FENCE WIRE
[Fig. No. 1606.2]



STRAINING SCREW FOR TIGHTENING FENCE WIRE
[Fig. No. 1606.3]



In the case of chain link fencing an M.S. flat of size 40mm. x 6mm. shall be taken through the mesh wires and the flats fixed to every fourth fence post by suitably bolting the flats to the posts.

1606.7. Measurement :—All linear measurements shall be in metres, to 0.01 of a metre.

1606.8. Rate :—The unit rate shall be per 10 running metres of the length of fencing and shall include the cost of fencing wire, erection of posts, curing, strutting, bracing, fixing of fencing wire and completion in all respects (including all other sundry items) but excluding the cost of fencing posts, excavation and foundation concrete.

Specification No. 1607

Protection of Buildings and Allied Structures against Lightning

1607.1. Terminology :—For the purpose of this specification the following definitions shall apply.

1607.1.1. *Air termination or air termination networks* :—These parts of a lightning protective system that are intended to distribute the lightning discharges into or to collect the lightning discharges from the atmosphere.

1607.1.2. *Bonds* :—Short lengths of conductor intended to provide electrical connections between the lightning protective system and other metal work and between various portions of the later.

1607.1.3. *Down conductors* :—Conductors which connect the air terminations with the earth terminations.

1607.1.4. *Earth terminations* :—These parts of the lightning protective system which are intended to collect the lightning discharges from or to distribute the lightning discharge into the general mass of the earth. All parts below the testing point in a down conductor are included in the term.

1607.1.5. *Earth electrodes* :—Those portions of the earth terminations that make direct electrical contact with the earth.

1607.1.6. *Fasteners* :—Devices used to secure the conductor to the structures which support them.

1607.1.7. *Joints* :—The mechanical and electrical junctions between two or more portions of the lightning protective system or other metal bonded to the system or both.

1607.1.8. *Lightning protective system* :—The whole system of inter-connected conductors used to protect a structure from the effects of lightning.

1607.1.9. *Roof conductors* :—Conductors which inter-connect the various air terminations in order to extend the zone of protection.

1607.1.10. *Testing points* :—Joint in down conductors or in bonds, earth leads or conductors connecting earth electrodes, so designed and situated as to enable resistance measurements to be made.

1607.1.11. *Zone of protection* :—The zone of protection of a single vertical conductor is taken as the cone with its apex at the highest point of the conductor and with a base or radius equal to the height, that is, the zone of protection may be thought of as a bell tent with its apex at the top of the air termination.

1607.2. Protection :

1607.2.1. *Principle of Protection* :—Protection against effects of lightning discharges can be obtained by providing a conducting path between the general mass of earth and the atmosphere above the structure and *vice versa* so that the discharges can pass without producing dangerous potential differences in, on or near the structure.

1607.2.2. Any protective system must be simple, mechanically strong and permanent. This applies particularly to the every important earth termination which is hidden from the view. Adequate safe guards shall always be provided against mechanical damage.

1607.3. Conductor materials and dimensions :

1607.3.1. The materials of which the protective system i.e., made shall be reliably resistance to corrosion or be acceptably protected against corrosion. The following materials are recommended :

(a) *Copper* :—When solid or standard copper wire is used, it shall be of the grade ordinarily required for commercial electrical work, generally designated as being of 98 per cent conductivity when annealed. Copper strip made from sheet metal shall conform to relevant Indian Standard Specifications.

(b) *Copper clad steel* :—Where copper clad steel is used the copper covering shall be permanently and effectively welded to the steel core and the proportion shall be such that the conductance is not less than 30 per cent of the conductance of an equivalent cross section of solid copper.

(c) *Galvanized steel* :—Where steel is used it shall be thoroughly protected against corrosion by a zinc coating which will satisfactorily withstand the test specified in Appendix B of IS : 2309-1969.

Copper is preferred against galvanized iron where corrosive gases or industrial pollution or salt-laden atmospheric condition are encountered.

(d) *Aluminium* :—Aluminium wire and strips, when used shall be at least 99 per cent pure, of sufficient mechanical strength and effectively protected against corrosion.

(e) *Alloys* :—Where alloys of metals are used, they shall be substantially as resistance to corrosion as copper under similar conditions.

1607.3.2. *Form and size* :—Table 1607-A given below gives the recommended shapes and minimum sizes of conductors.

Table 1607-A

Shapes and Minimum sizes of Conductors

Material	*Above ground*	*Below ground*
Round galvanized iron wire	8mm. diameter	13mm. diameter
Galvanized iron strip	(20 x 3) mm.	(23 x 6) mm.

Round copper wire or Copper clad steel wire	6mm. diameter	8mm. diameter
Stranded copper wire	50mm2 or 7/3.00 diameter	Not allowed
Copper strip	(20 x 3) mm.	(32 x 6) mm.
Round aluminium wire	9mm. diameter	Not allowed
Alluminium strip	(25 x 3.15) mm.	Do.

1607.4. Interceptors or air terminations :

1607.4.1. An air termination need not have more than one point and shall project atleast 300mm. above the object salient point or net work on which it is fixed. If an extended zone of protection is desired, an air termination net work shall be made by connecting two or more air terminations about (15 to 23) metres apart until the desired area is covered. Salient points, even if less than 15m. apart, shall each be provided with an air termination.

1607.4.2. All metallic finials, chimneys, ducts, vent pipes, railings, gutters and the like on or above the surface of the main roof of the structure shall be bonded to and form part of the air termination net work. The method and nature of the fixing shall be simple, solid and permanent, due attention being given to climatic conditions and possible corrosion.

1607.5. Roof conductors :

1607.5.1. Roof conductors shall interconnect the air terminations so as to form a conducting air termination net work covering the area to be protected with closed metal loops having about 15m. to 23m. mesh. The layout of the net work may be designed to suit the shape of the roof and architectural features of the buildings.

1607.5.2. Roof conductors shall be coursed along contours, such as ridges, parapets and edges of flat roofs and where necessary over flat surfaces in such a way as to joint each air termination to the rest.

1607.5.3. Roof conductors surrounding decks, flat surfaces and flat roofs shall be connected to form a closed net work.

1607.5.4. Horizontal conductors shall be coursed in a horizontal plane and without abrupt turns around chimneys, ventilators and similar obstructions.

1607.5.5. In general conductors shall be coursed over roofs and down the corners and sides of buildings in such a way as to constitute, as far as local conditions will permit, an enclosing net work.

1607.6. Down conductors :

1607.6.1. The numbers and spacings of down conductors shall largely depend upon the size and shape of the building and upon aesthetic considerations.

1607.6.2. Structures with a base area of upto and including 90 square metres may if the height of the air termination gives sufficient protection be

equipped with one down conductor only. It is however, advisable to have at least two down conductors except for very small buildings.

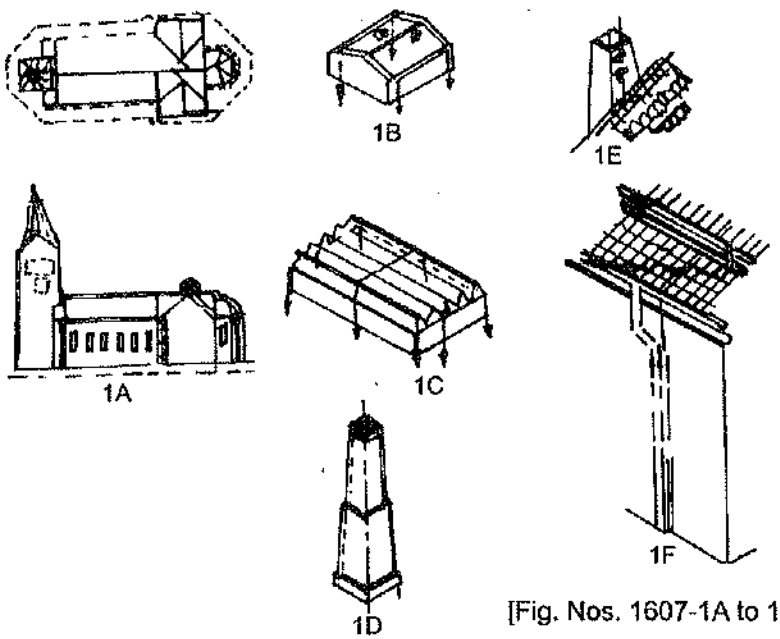
1607.6.3. There shall be at least one additional down conductor for every 270 square metres or part thereof in excess of 90 square metres or at least one down conductor per 30m. of perimeter whichever is less.

1607.6.4. Down conductors shall be spaced equally around the outside walls of the structures and shall preferably be run along corners and other projections, due consideration being given to the location of air terminations and earth terminations. (See Figs. 1607-1A to 1E).

1607.6.5. It is very important that the down conductors shall follow the most direct path possible between the air termination and the earth termination, without sharp bends, upturns and kinks. Joints shall as far as possible be avoided in down conductors. Adequate protection may be provided to the conductors against damages from mechanical causes. Metallic pipes shall not be used as protection for the conductors.

1607.6.6. Metal pipes leading rain water from the roof to the ground may be connected to the down conductors but cannot replace them. Such connections shall have disconnecting joints for testing purposes. (See Fig 1607.1F).

SOME BUILDINGS OR PARTS OF BUILDINGS ILLUSTRATING HOW LIGHTNING PROTECTIVE SYSTEM IS ADOPTED



[Fig. Nos. 1607-1A to 1F]

1607.7. Joints and bonds :

1607.7.1. The lightning protective system shall have as few joints in it as possible. In the down conductors below ground level, there shall be no joints. Where

joints are necessary they shall be mechanically and electrically effective and shall be so made as to exclude moisture completely. Joints and bonds other than at testing points shall be protected by suitable material against corrosion, for example, protecting the joints between the earth plate and the down conductor by wrapping with several layers of tarred cloth and painted with bitumen. Bonds shall be protected by suitable material against corrosion. Bonds shall be as short as possible.

1607.7.2. In general, joints for strip shall be tinned, soldered, welded or brazed and atleast double-riveted. Clamped or bolted joints shall only be used on test points or on bonds to existing metal, but joints for rod may be of the clamped or screwed type. Electrical resistance of joints shall be less than 0.5 milli ohm.

1607.8. Testing points :

1607.8.1. Each down conductor shall be provided with a testing point in a position convenient for testing but inaccessible for interference. No connection other than the one direct to an earth electrode shall be made below a testing point. Testing points shall be of phosporbronze, gunmetal or copper.

1607.9. Earth termination :

1607.9.1. Each down conductor shall preferably have an independent earth termination.

1607.9.2. Suitable location for the earth termination shall be selected after testing and assessing the specific resistivity of the soil and with due regard to reliability of the subsoil water to ensure minimum soil moistness.

1607.9.3. The lower the ohmic resistance of the earth termination the greater is the protective value of the lightning protective system. If low earth resistance can not be obtained by means of a single electrode, additional electrodes may be connected in parallel. In no case shall the resistance to earth exceeds 5 ohms and in the case of rock soils it shall not exceed 8 ohms.

1607.9.4. The terminations may be connected to water pipe systems in the vicinity, such connections being capable of isolation for testing purposes.

1607.9.5. Common grounding is always desirable as its purpose is to equalize the various groundings in or about a protected structure to minimise the possibilities of a side flash from one grounding system to another.

1607.10. Fasteners :

1607.10.1. Conductors shall be securely attached to the building or other object to be protected by fasteners, which shall be substantial in construction, not subject to breakage and made of galvanized steel. Some samples of fasteners are shown in Figures 1607.2A to 2J. To protect the copper conductors against corrosion, a liner of lead shall be used between the conductors and the fasteners.

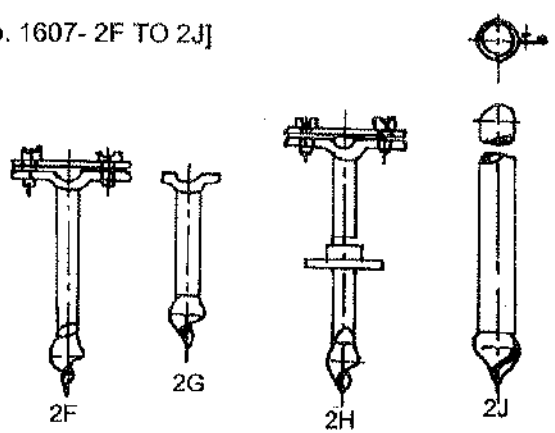
1607.11. Corrosion :

1607.11.1. If the roof or walls or ornamental features of the building to be protected consist of copper, the lightning conductor shall be of copper.

1607.11.2. If the roof, walls etc., are made of zinc or galvanized iron, the lightning conductors shall be of tinned copper, galvanized iron or bare aluminium.

SOME TYPES OF FASTNERS SUITABLE FOR FIXING TO MASONRY
[Fig. Nos. 1607-2A to 1J]

[Fig. No. 1607- 2F TO 2J]



1607.11.3. Aluminium conductors shall be connected to copper conductors only by a thick layer of lead between the two conductors or by special bi-metallic connectors.

1607.11.4. Conductors above ground may be given a coating of paint. Galvanized wires and galvanized fasteners shall have a protective coating of paint.

1607.11.5. If the roof or walls are of aluminium, aluminium down conductors shall be used.

1607.12. Metal parts in building :

1607.12.1. A conductor of the lightning protective system shall be so laid that it is not parallel to any electric conductor and as far as possible crosses the later at right angles. Where this is not possible, a separation distance exceeding 2m. shall be maintained between them.

1607.12.2. Cable sheaths, metal conduits and metal cases of electrical installations shall not normally be connected to the lightning protective system. In special cases where it is impossible to maintain this isolation, they may be electrically bonded at a number of points along their length, special care being taken to ensure the efficiency of such bonding.

1607.12.3. Metal objects such as water tanks, iron stair cases, water or gas pipes, on top of, inside or by the side of a building shall be atleast two metres away from the lightning conductor system. If this is not possible they shall be provided with a separate grounding conductor. Connections to the lightning conductor system shall be along the shortest possible route.

1607.12.4. The steel frame work, if any in the structure may be used in place of lightning conductors provided it is effectively bonded by welding into a continuous conducting net work and equipped with external earthing connections, otherwise it is safer to leave it entirely isolated.

1607.13. Protection of special structures :

1607.13.1. *Tall structures, chimneys, spires steeples, flag poles :*

1607.13.1.1. The materials, equipment and ground connections used for the protection of all structures shall comply with the requirements of this standard in general.

1607.13.1.2. *Air terminations* :—A single air termination may be used, which elevates tip by a distance of not less than 250mm. above the upper most point of structure provided that a single air termination will give the desired zone of protection. In case the height of the structure is 36 metes or more with at the top 1.5 metres or more a minimum of two air terminations shall be provided.

1607.13.1.3. *Down conductors* :—A single down conductor may be used, which if the structure is isolated, shall be extended directly to a ground connection. If the structure is an adjunct of a building and near or touching the perimeter, the down conductor shall be extended directly to a ground connection and shall also be connected to the lightning conductor system on the building. If it is set well within the perimeter, the descending conductor shall be connected to the nearest roof conductor.

1607.13.1.4. *Grounding of metallic spires and flag poles* :—Spires and flag poles composed entirely of or covered entirely with metal and resting on foundations of non-conducting material with the top so constructed as to receive a stock of lightning without appreciable damage, need not be provided with air terminations of down conductors but shall be grounded or connected to the nearest lightning conductor or both according as the structure is isolated, set within the perimeter of a building or respectively.

1607.13.2. *Building with unflammable roofs* :—All parts of a lightning protective system installed on structures with weak roofs made of inflammable materials such as straw, reeds or grass, shall be separated by non-metallic supports at least 30mm. from the roofing materials, to eliminate fire risk. Care shall be taken in fixing such supports to see that rain water does not get access into the building.

1607.13.3. *Protection of fences* :—The following recommendations are made for the safety of live-stock where wire fences extend for long distances.

1607.13.3.1. The wires shall be earthed at intervals by clamping them to metal uprights or suitable conductors. The interval shall be about 150 metres where the soil is permanently damp and 75 metres where the soil is dry.

1607.13.3.2. The continuity of the wires of any fence shall be broken at intervals not exceeding 300 metres by wooden gates or by gaps at least 600mm. wide filled with non-metallic of adequate strength. Drinking or feeding troughs reasonable distance from fences or if near fences, that section of the fence shall be adequately isolated and earthed.

1607.13.3.2. The earth termination of the fence at such gap shall be at least 7.5 metres away from either side of the gap or gate.

1607.13.4. *Structures with explosive or inflammable contents* :

1607.13.4.1. Such structures shall not have spires or flag stave as they impair the efficiency of air termination. Radio Serials shall not be provided within 15 metres of the structures. In addition to protecting each separate structure in accordance with this specification, provisions (i) or (ii) of clause 16.7.13.4.2 shall also be applicable depending on the importance of the building.

1607.13.4.2. *Systems of protection* :

(i) One or more tall supports each equipped with a lightning protective system shall be provided in such a way that the structure falls within the zone or zones of protection.

(ii) A net work of horizontal conductors of about (7.50 to 10) metres mesh shall be suspended at a suitable height above the structures, on supports spaced at similar intervals forming a canopy of metal work. Each of these supports shall be equipped with an efficient lightning protective system consisting of air terminations, down conductors and earth terminations. The suspended net work shall be ejjectly bonded to these protective systems. The earth terminations shall preferably be interconnected by a buried ring conductor.

1607.13.4.3. The over head line for electric supply to the structure shall be terminated at a point about 15 metres away from the structure, hence the supply may be taken by under ground cable. Electrical cables entering the structure shall be metal sheathed, the sheathed being electrically continuous and earthed at the point of entry outside the structure. Other metallic objects like water pipes, wires, ropes, rails etc., entering the structures shall also be earthed at the point of entry and also at a few more points to a distance of about 150 meters. Over head lines shall also be protected against the effects of lightning.

1607.13.4.4. Radio aerials, when required shall be placed atleast 15 metres away from the building.

1607.13.4.5. All metal forming part of the structure shall be bonded or welded together and connected to the ring conductor atleast at two points. All metal supports or stands on which inflammable or explosive materials are placed shall be electrically connected to the metal forming part of the structure.

1607.13.4.6. Structures wholly under-ground and housing explosive or inflammable contents may be protected in general as in sub-clause (i) of clause 1607.13.4.2 above by similar network buried at least 450mm. below the ground level and above the structure.

1607.13.5. *Structure with radio aerials* :—Structures with indoor radio aerials need no extra protection over that given in this specification.

Structures with out-door aerials may be protected in accordance with this specification provided that the zone of protection covers or is extended to cover the aerial wholly.

1607.14. Earth electrode systems :

1607.14.1. Methods of providing earth electrode system and connection to the earth terminations of the lightning protective systems are :

(a) Drive pipe or rod,

(b) Buried metal strip, and

(c) Buried metal plate.

The choice of the type of earth electrode system for any particular application is determined to a great extent by local conditions. In general, if the subsoil can be penetrated and is of reasonably low resistivity, the driven pipe system will prove economical.

1607.14.2. *Driven pipe or rod electrodes* :—Consistent with mechanical considerations, a minimum rod diameter of 13mm. is recommended.

1607.14.2.1. When driving a ground rod it is desirable to avoid using too heavy blows which might cause bending of the rod. It is desirable to use a steel cap over the top of the pipe electrode to prevent damage to the end.

1607.14.2.2. The position of the pipe or rod shall be marked out on the site and an earth trench not wider than is necessary shall be excavated to take the earth terminations which will be used to connect all the pipes or rods together. This trench shall be 450mm. deep if dug in ground within the walls of the buildings, or 750mm. deep if dug in the year or in spare ground. The pipes or rods shall be driven vertically into the trench at 2.5 metre spacing until the top of the driving head is 300mm. above the bottom of the excavation.

1607.14.2.3. The pipes or rods shall be connected together by a continuation of the earth termination conductor by means of clamps.

1607.14.3. *Buried strip electrodes* :

1607.14.3.1. Where bed rock is found near the surface, ground connections may be made by digging trenches radially from the building and burying in them the conductors or their equivalents in the form of metal strips or wires. Where the soil is very dry, in addition to the conductors laid radially, a ring conductor shall be buried which encircles the structure to be protected and connects all the down conductors together. The depth of the trench shall be 0.75m. to 100m.

1607.14.3.2. For a building resting on bare solid rock it would be preferable to provide a wire net work laid on the surface of the rock surrounding the building to which the down conductors shall be connected. The resistance to earth at some distance point of such an arrangement would be high, but at the same time the potential distribution about the building would be substantially the same as though it were resting on conducting soil and the resulting protective effect would also be substantially the same. When such a network is required, it shall be buried as well as possible, as this adds to its effectiveness. Its extent will be determined largely by the height of the building and as a rule its radius shall be equal to the height of the building.

1607.14.4. *Buried plate electrode* :

1607.14.4.1. The material employed is generally cast iron or copper. In soil the longest life is attained by copper and it has the advantage that dissimilar metal corrosion does not occur at the connection. Coke shall not be used with copper plates. Two metre square plate shall be buried at least 1.5m. below the natural surface of the ground.

1607.14.4.2. The earth resistance of the plate electrode varies with the size of the plate, its depth of burial and the type of soil. Where the resistivity is 1000 ohm-cm, a one metre square plate has a resistance of about 3 ohms, when buried on edge with its centre one metre below the surface. At 2 metres below the surface, resistance falls only to about 2.7ohms. A two metre square plate has a resistance of about 1.5 ohms when its centre is 1.5 metres below the surface.

1607.14.4.3. The plates may be buried either horizontally or vertically, but the vertical method is widely considered to be the better practice on account of the smaller excavation required and the difficulty of obtaining a sufficiently good contact with the soil underneath a horizontal plate. The copper conductor is riveted or welded to the plate.

1607.15. Inspection and testing :

1607.15.1. *Inspection* :—All lightning protective system shall be examined by the Executive Engineer after completion, alteration or extension in order to verify that they are in accordance with this specification. A routine inspection shall be made at least once a year.

1607.15.2. *Testing* :

1607.15.2.1. On completion of the installation or of any modification, the resistance of each earth termination or section thereof shall if possible be measured and the continuity of all conductors and the efficiency of all joints shall be verified.

1607.15.2.2. This test shall be repeated at intervals of one year preferably before monsoon. In the case of structures housing explosive of inflammable materials, the interval shall be six months.

1607.15.2.3. Methods of measuring earth resistance shall be followed as per Appendix E of IS : 2309-1969.

1607.15.2.4. The actual procedure adopted for the test shall be recorded in detail so that future tests may be carried out under similar conditions. The highest

value of resistance measured shall be noted as the resistance of the earth termination. The results of the test together with the condition of the soil and details of salting or other soil treatment shall be recorded.

1607.15.2.5. The record shall also contain particulars of the engineer, contractor or owner responsible for the installation and or upkeep of the lightning protective system. Details of additions or alterations to the system and dates of testing together with the test results and reports shall be carefully recorded.

1607.15.2.6. *Deterioration* :—If the resistance to earth of a lightning protective system or any section of it exceeds the lowest value obtained at the first installation by more than 100 per cent, appropriate steps shall be taken to ascertain the causes and to remedy defects, if any.

1607.15.2.7. *Testing continuity and efficacy of conductors and joints* :

1607.15.2.7.1. The ohmic resistance of the lightning conductor system complete with air termination, but without the earth connection shall be measured and this shall be a fraction of an ohm. If it exceeds one ohm, then there shall be some fault either electrical or mechanical, which shall be inspected and the defect rectified.

1607.15.2.7.2. For this the system is best divided into convenient sections at testing points by suitable joints. A continuous current of about 10 amperes shall be passed through the portion of the system under test and the resistance verified against its calculated or recorded value. Suitable portable precision testing sets for this purpose shall be used.

1607.15.2.7.3. Greatest care shall be taken for the condition of joints and to measure the resistance accurately. The resistance of a joint shall not exceed 0.5 milli-ohm.

1607.16. Measurement :—This shall be in numbers of each lightning conductor system completely installed as per this specification.

1607.17. Rate :—The rate shall be per each lightning conductor system completely installed in place inclusive of all joints, terminals, conductors, earth connections and electrode system and painting complete including cost of initial testing after installation as per this specification.

Specification No. 1608

Steel Doors, Windows and Ventilators

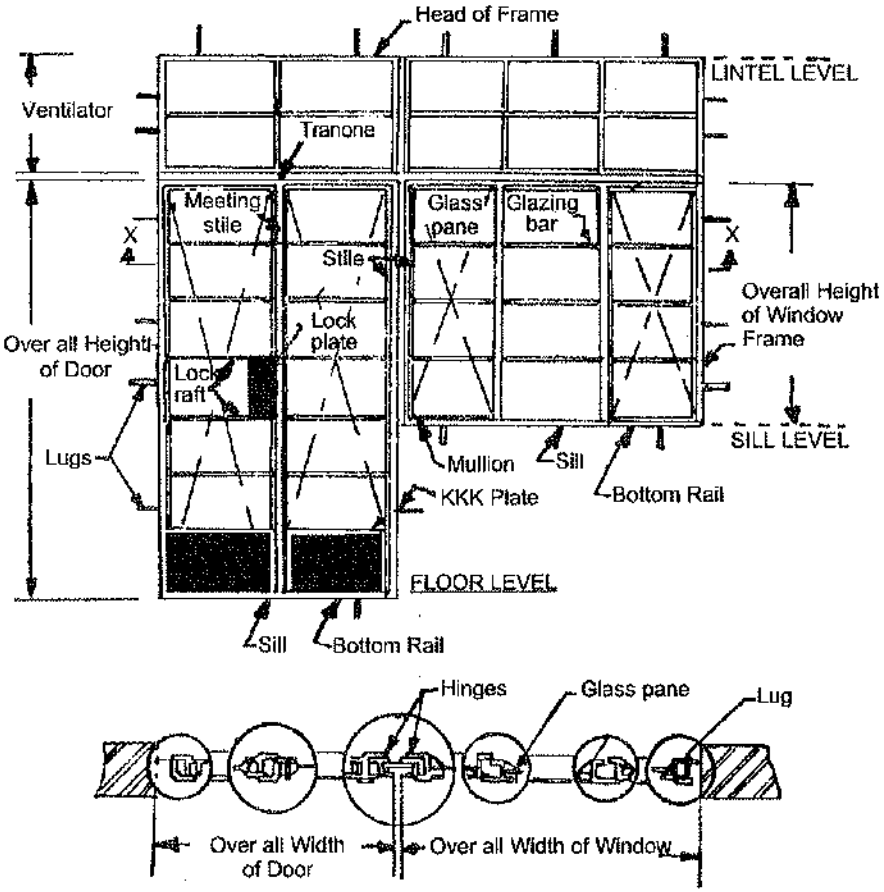
1608.1. Terminology :—The components of doors, windows and ventilators shall be as shown in Fig. 1608.1.

1608.2. Sizes :

1608.2.1. The overall sizes of various types of steel doors, windows and ventilators shall be as given in Figs. 1608-2A, 2B, 2C. These sizes are derived after allowing 3mm. clearance on all the four sides for the purposes of fitting the doors, windows, and ventilators into modular openings. (See Fig. 1608.3).

TERMINOLOGY FOR STEEL DOORS, WINDOWS AND VENTILATORS

[Fig. No. 1608.1]



ENLARGED SECTION XX

1608.2.2. *Tolerances* :—The sizes indicated in Figs. 1608-2A, 2B, 2C for doors, windows and ventilators frames shall not vary by more than + or – 1.5mm.

1608.3. Designation :

1608.3.1. Doors, windows and ventilators shall be designed by symbols denoting their width, type and height in succession in the following manner.

1608.3.1.1. *Width* :—It shall be indicated by the number of 100mm. modules in the width of opening.

1608.3.1.2. *Type* :—It shall be indicated by the following letters of alphabet :

C=Centre hung shutters.

F=Fixed glass panes.

H=With horizontal glazing bars.

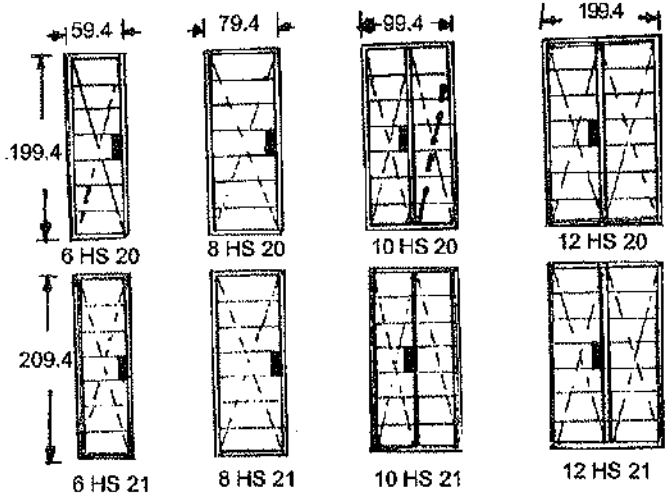
N=Without horizontal glazing bars.

S*=Side hung shutters.

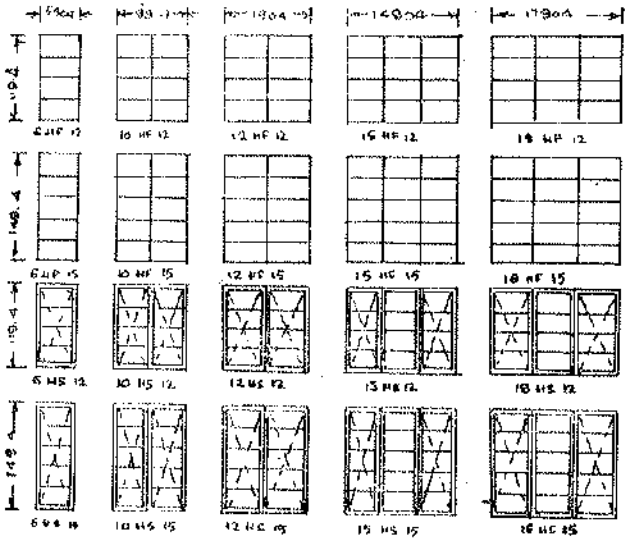
T=Top hung shutters.

**Note* :—Side hung shutters shall be termed as right hand or left hand according, as to the side on which they are hinged looking from the inside.

DOORS [Fig. 1608-2A]



All Dimensions in Centimeters

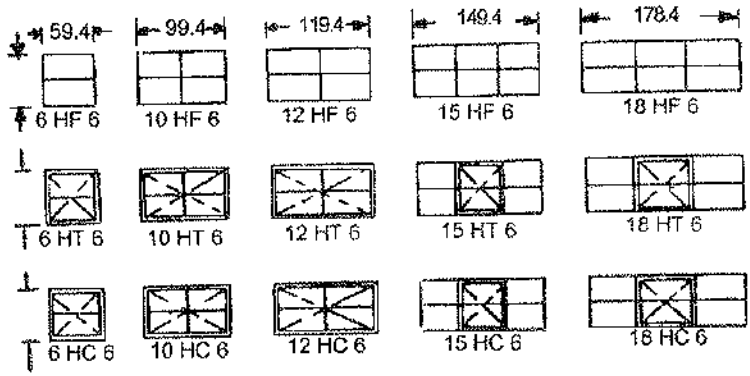


WINDOWS [Fig. 1608-2B]

All Dimensions in Centimeters

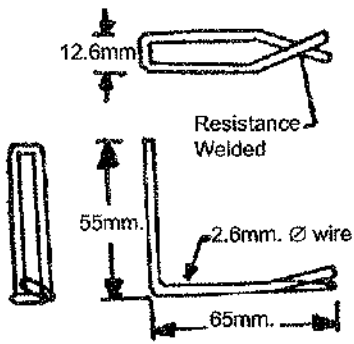
Note :— Windows with out Horizontal Glazing Bars shall be Designated 'N' in place of 'H' in its Range shown

VENTILATORS
[Fig. No. 1608.2C]

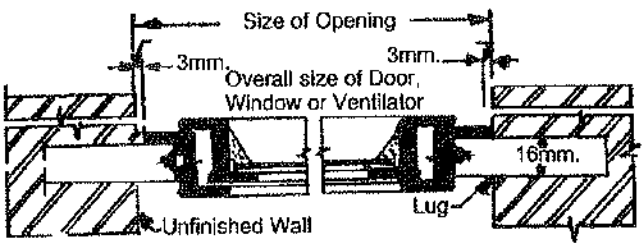


All Dimensions in Centimeters

SIZE OF STEEL DOORS, WINDOWS OR VENTILATORS IN RELATION TO SIZE OF OPENING
[Fig. No. 1608.3]



WIRE LUG



1608.3.1.3. *Height* :—It shall be indicated by the number of 100mm modules in the height of opening.

Example :—A window of width 10 modules and height 12 modules having horizontal glazing bars and side hung shutters is designated as 10 HS 12.

1608.3.1.4. Composite doors, windows or ventilators shall be designated as follows :

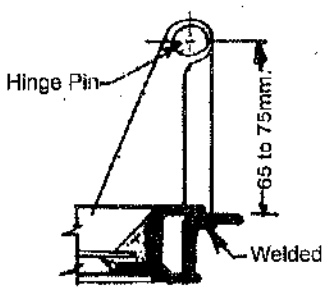
Example :—(a) A 12 module wide and 21 module high horizontally glazed side hung door coupled on its two sides with the side hung horizontally glazed window 6 module wide and 12 module high shall be designated as 6 HS 12/12HS 21/6 HS 12.

(b) Two 10 modules wide and 12 modules high horizontally glazed side-hung windows coupled side by side with two horizontally glazed fixed ventilators at top, each 10 modules wide and 6 modules high shall be designated as 10HF6/ 10HF6. 10HS12/10HS12.

1608.4. Materials :—The materials for rolled steel sections, coupling sections tubular sections, glass panes, screws, fixing lugs etc., shall conform to IS : 1038-1975, IS : 1977-1975, IS : 108-1962 & IS : 1362-1962 as the case may be.

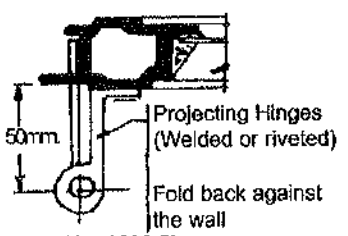
1608.5. Fabrication :—This shall conform to IS : 1038-1962.

1608.6. Hinges :—Hinges may be of projecting type (Fig. 1608.4 & Fig. 1608.5) or of non-projecting type (Fig. 1608.6). The hinges for doors shall be of the same type as for windows but of larger sizes. Where these hinges are of friction type no peg stays are required.



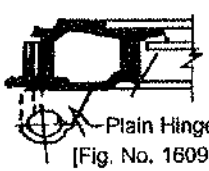
[Fig. No. 1609.4]

TYPICAL PROJECTING TYPE HINGE FOR SIDE HUNG SHUTTER



[Fig. No. 1609.5]

TYPICAL PROJECTING TYPE HINGE FOR DOOR



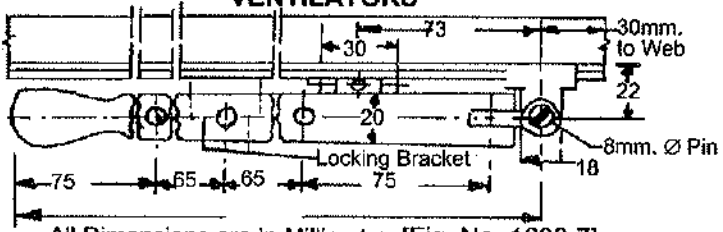
[Fig. No. 1609.6]

TYPICAL NON PROJECTING TYPE HINGE FOR WINDOW

1608.7. Peg-stays :—The peg stays shall be either of hot pressed brass, cast brass aluminium or steel protected against rusting and shall be 300mm. long with steel peg and locking bracket. (See. fig. 1608.7).

Any alternative device, if required, shall be as may be specified.

A TYPICAL PEG STAY FOR SIDE HUNG SHUTTERS & TOP HUNG VENTILATORS



All Dimensions are in Millimetre [Fig. No. 1608.7]

1608.8. Cup-pivots :—These shall be of brass or aluminium alloy and riveted to the inner and outer frames of the windows and ventilators to permit the window or ventilator to swing to an angle of approximately 85%.

1608.9. Finish :—Unless otherwise specified, doors, windows or composite unit shall be supplied treated with a suitable anti-corrosive priming coat.

1608.10. Marking :—All doors, windows and ventilators shall be suitably marked on the frames for identifying the manufacturer and the type.

1608.11. Packing :

1608.11.1. All doors, windows and ventilators shall be despatched with the opening parts suitably secured to preserve alignment when fixing and glazing.

1608.11.2. Fixing lugs, couplings, fittings and all hardware shall be packed separately.

1608.11.3. Composite windows shall be packed uncoupled.

1608.12. Measurement :—They shall be measured in numbers of completely fabricated doors, windows, and ventilators with all the necessary accessories and finish.

1608.13. Rate :—The unit rate for payment shall be per each complete unit of either doors, windows or ventilators.

Specification No. 1609

Aluminium Doors, Windows and Ventilators

1609.1. Terminology :

1609.1.1. The components of doors, windows and ventilators shall be as shown in Fig. 1608.1. "Specification on Steel Doors, Windows and Ventilators".

1609.2. Sizes :

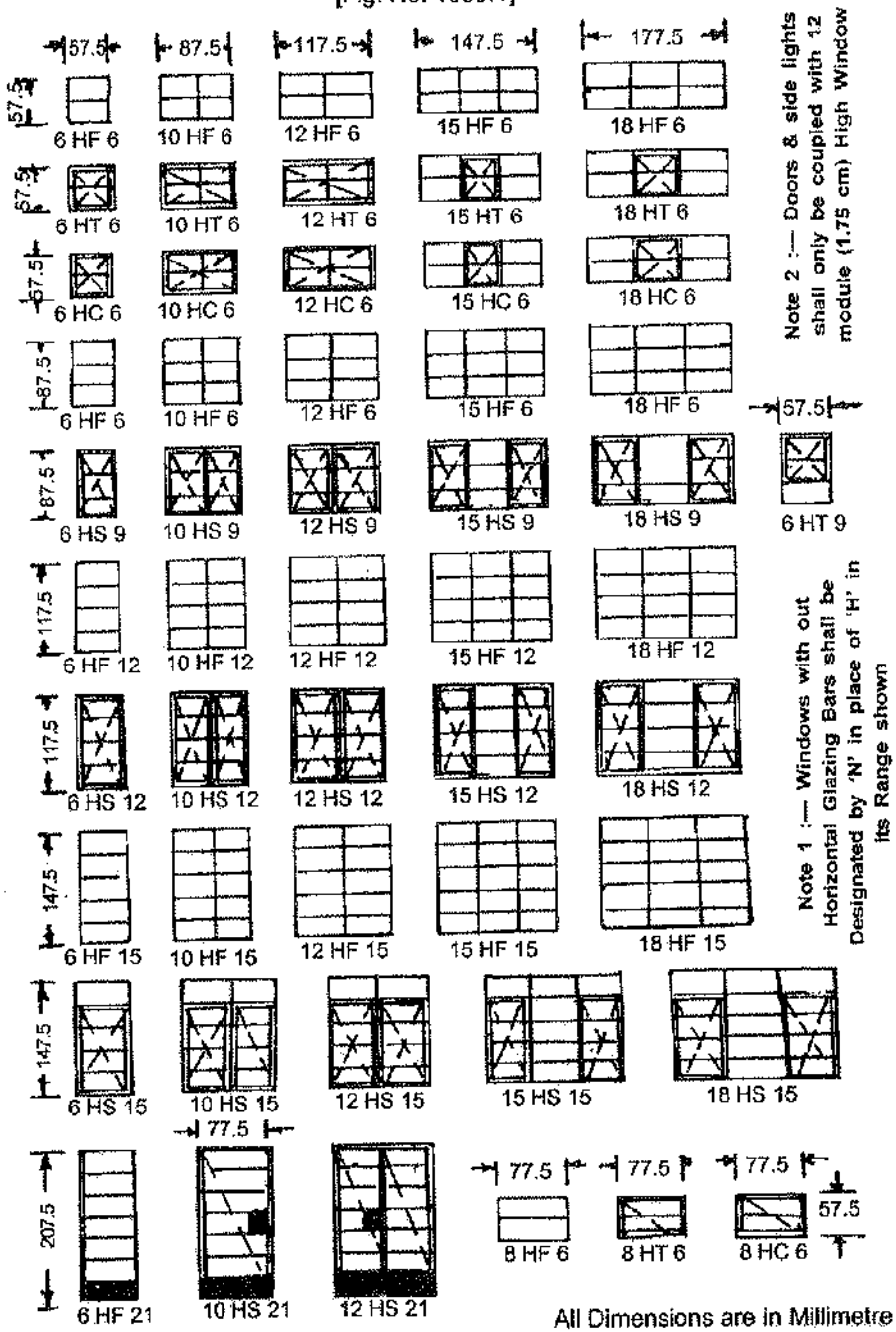
1609.2.1. The over all sizes of various types of aluminium doors, windows and ventilators shall be as given in Fig. 1609-1.

1609.2.2. The dimensions shown in Fig. 1609.2 overall heights and widths to the outside of frames of aluminium doors, windows and ventilators. These sizes

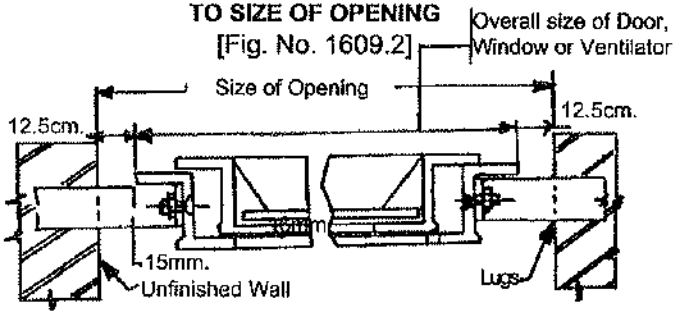
are derived after allowing 1.25mm. clearance on all the four sides for the purpose of fitting the doors, windows and ventilators into modular openings.

TYPES AND SIZE OF ALUMINIUM DOORS WINDOWS AND VENTILATORS

[Fig. No. 1609.1]



SIZE OF ALUMINIUM DOORS, WINDOWS OR VENTILATORS IN RELATION TO SIZE OF OPENING
[Fig. No. 1609.2]



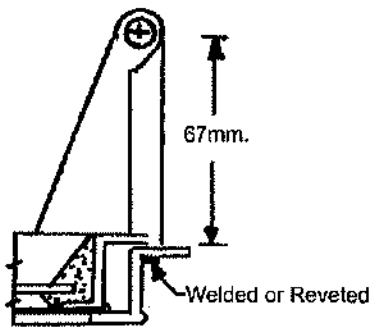
1609.2.3. *Tolerances* :—The sizes for door, window, or ventilator frames shall not vary by more than + or – 1.5mm.

1609.3. Designation :—This shall conform to clause 1608.3.

1609.4. Materials :—The materials such as aluminium alloy, glass panes and screws, etc., used for the fabrication of doors, windows and ventilators shall conform to the requirements of IS : 1948-1961, IS : 733-1967 and IS :1362-1962 as the case may be.

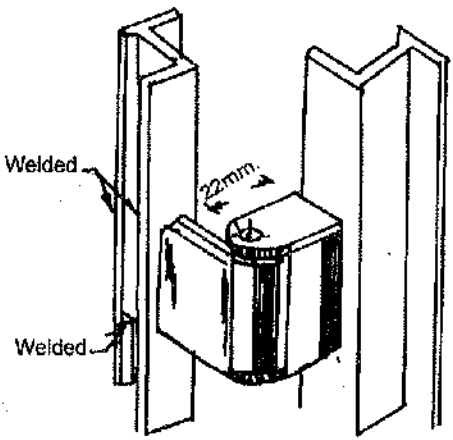
1609.5. Fabrication :—This shall conform to IS : 1948-1961.

1609.6. Hinges :—These shall conform to clause 1608.6, "Specification on steel doors, windows and ventilators." (See Fig. 1609.3, 1609.4, 1609.5 and 1609.6).



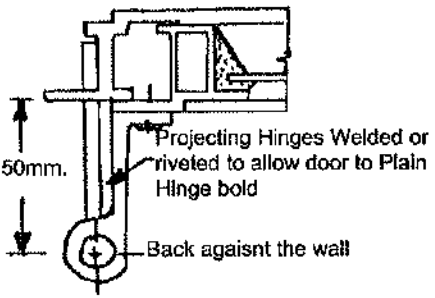
[Fig. No. 1609.3]
TYPICAL PROJECTING TYPE HINGE FOR SIDE HUNG SHUTTER

TYPICAL NON-PROJECTING TYPE HINGE FOR SIDE HUNG SHUTTER
[Fig. No. 1609.4]



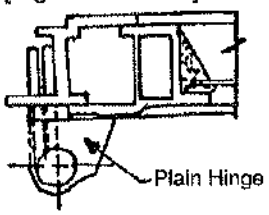
TYPICAL PROJECTING TYPE HINGE FOR DOOR

[Fig. No. 1609.5]



TYPICAL NON-PROJECTING TYPE HINGE FOR DOOR

[Fig. No. 1609.6]



1609.7. Peg stays :—The peg stays shall be made of cast aluminium or folded from aluminium alloy sheets. Stays shall be complete with pegs and locking brackets and shall be 300mm. in lengths (Fig. 1601.7). Any alternative device if required shall be as may be specified.

1609.8. Cup-pivots :—These are made of aluminium alloy or brass, bronze and shall be either chromium or cadmium plated. These shall be riveted to the inner or outer frames of the ventilators to permit the ventilators to swing through an angle of approximately 85°.

1609.9. Finish :

1609.9.1. Aluminium doors, windows and ventilators shall be supplied in either matt, scratch-brush, or polished finish and may also be anodized if so required.

1609.9.2. A thick layer of clear transparent lacquer based on methacrylates or cellulose butyrate shall be applied on aluminium doors, windows and ventilators by the suppliers to protect the surface from wet cement during installation. This lacuqer coating shall be removed after installation is completed.

1609.10. Marking, packing, measurement and rate shall be as per Specification No. 1608.

1609.11. Measurement :—This shall conform to clause 1608.4.2.

1609.12. Rate :—This shall conform to clause 1608.13.

Specification No. 1610

Fixing & Glazing of Metal (Steel & Aluminium) Doors, Windows & Ventilators

1610.1. Handling of doors, windows and ventilators :

1610.1.1. Care shall be taken in unloading and stacking windows and ventilators at site. They shall be examined for any damage that might have occurred in transit and shall then be stacked upright (on their sills) on level ground, preferably on wooden battens and shall not come into contact with dirt or ashes. Doors shall be stacked upside down with the kick plates at the top. Doors shall not be allowed to stand for long, the right way up, before being fixed, so as to avoid the doors getting out of true and the hinges being strained and the shutters dropping.

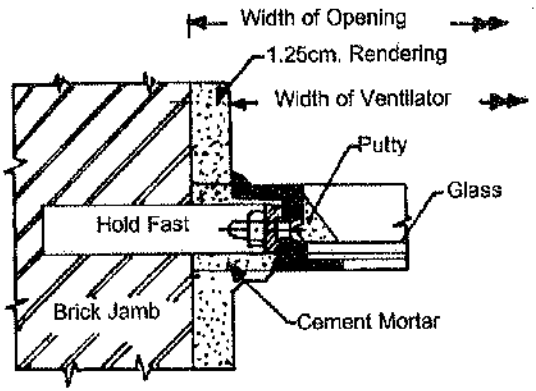
1610.1.2. Care shall be taken in ensuring that aluminium frames are not allowed to get into direct contact with wet cement and mortar. During the period of storage aluminium shall be protected from loose cement and mortar by means of suitable coverings.

1610.2. Fixing :—This shall be done generally in accordance with IS : 1081-1960 etc. Relevant details for fixing in various types of openings are given Figures 1610-1A, 1610-1B, 1610-2, 1610-3A, 1610-3B. 1610-4, 1610-5, 1610-6A, 1610-6B, 1610-7A and 1610-7B.

1610.3. Glazing :

1610.3.1. Before glazing, all opening parts shall be checked to see that they are closing correctly and are well bedded and not twisted in any way.

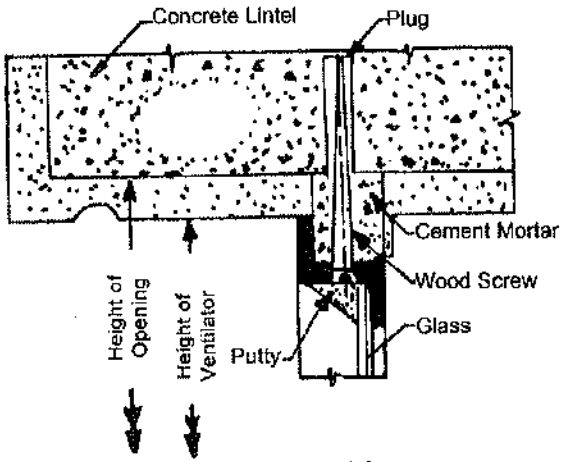
MASONRY OPENINGS FLUSH WITH RENDERING



[Fig. No. 1610.1A]

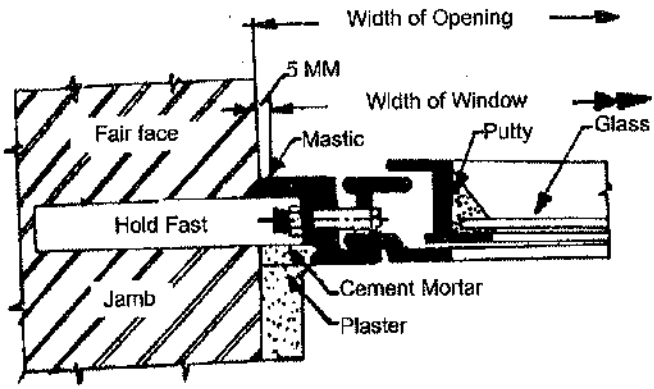
1610.3.2. The weight of glass in a side hung casement causes it to drop slightly on its hinges. Before glazing, therefore, the casement shall be set in a slightly high position in its frame. The glass shall also be set slightly out of square in the frame, that is high and towards the outside (handle) jamb. This can be effected by using little springs of wood to wedge the glass at certain points. (See Fig. 1610-8).

MASONRY OPENINGS FLUSH WITH RENDERING



[Fig. No. 1610.1B]

MASONRY OPENINGS FLUSH WITHOUT RENDERING



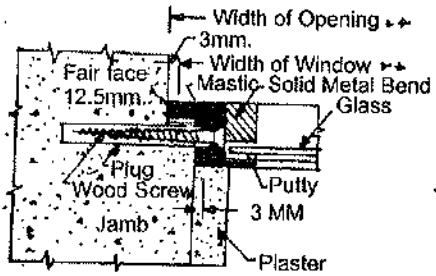
[Fig. No. 1610.2]

1610.3.3. In case of newly galvanized doors, windows or ventilators not exposed to the weather for atleast three months, difficulty may be experienced when glazing as the putty may fail to stick to the frames. To overcome this, a thin film of raw linseed oil shall be applied to the glazing rebate with cloth soaked in linseed oil.

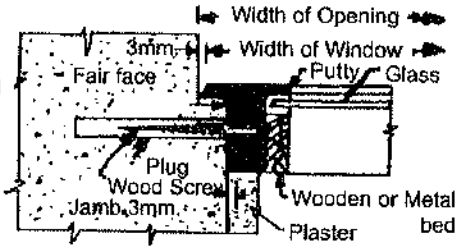
1610.3.4. The frame shall be completely cleaned and bedding putty shall be placed in the rebate before glazing. Glass shall then be cushioned into this bedding putty properly and shall be fronted with front putty which shall stop 2 to 3mm. from the sight line of the back rebate to enable the painting to be done up to the sight line, to seal the edge of the putty to the glass. The back putty which has oozed out over the glazing rebate shall then be cut off square and smoothed down. This back putty is necessary as apart from preventing contact of the glass

with the steel at any point, it will also prevent glass rattle and the ingress of moisture which may corrode the steel frame.

MASONRY OPENINGS REBATED WITHOUT RENDERING

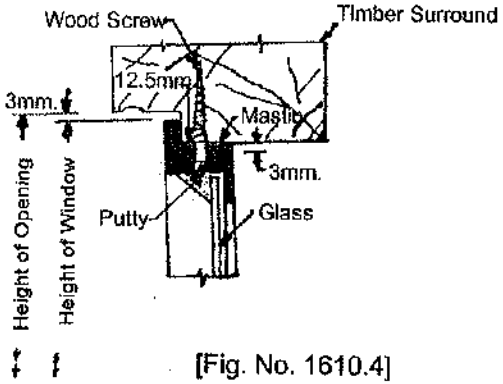


[Fig. No. 1610.3A]



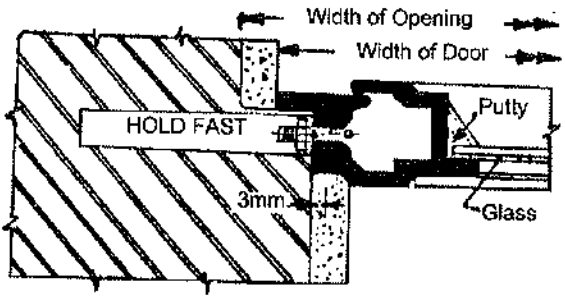
[Fig. No. 1610.3B]

FIXING TO WOOD SURROUND



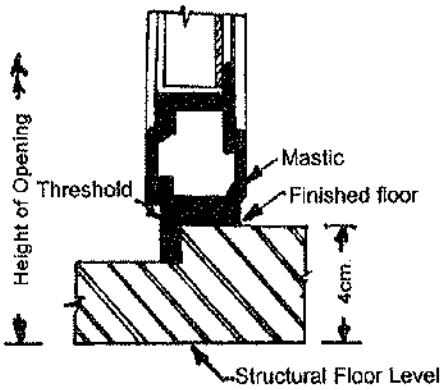
[Fig. No. 1610.4]

MASONRY OPENINGS REBATED WITH RENDERING



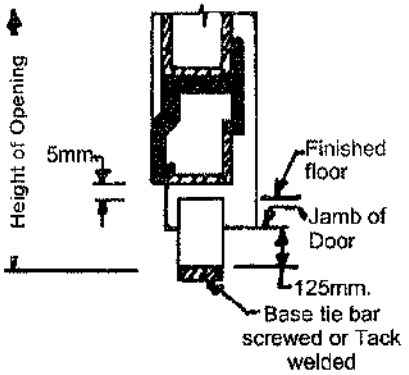
[Fig. No. 1610.5]

THRESHOLD DETAILS FOR EXTERNAL DOOR



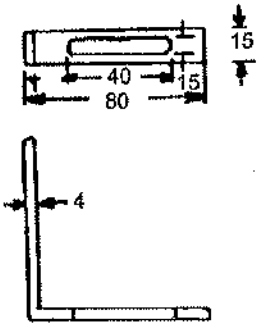
[Fig. No. 1610.6A]

THRESHOLD DETAILS FOR INTERNAL DOOR



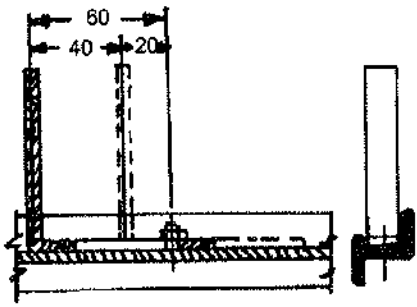
[Fig. No. 1610.6B]

SLOTTED RIVERSIBLE FIXING LUG



[Fig. No. 1610.7A]

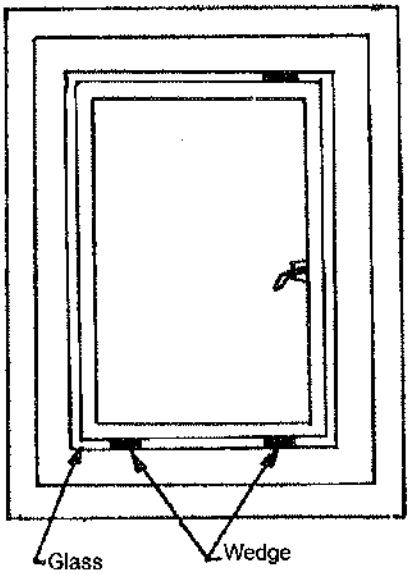
FIXING LUG IN POSITION



[Fig. No. 1610.7B]

ALL DIMENSIONS ARE IN MILLIMETRES

POSITION OF GLASS INSIDE HUNG CASEMENT



[Fig. No. 1610.8]

1610.3.5. For doors and windows where pane size exceeds 600mm. x 300mm., glass shall be secured by special spring glazing clips which shall be inserted in holes already provided in the steel doors or windows before applying the front putty.

1610.3.6. For outside glazed windows where pane sizes do not exceed 600 x 300mm. spring glazing clips are not considered necessary.

1610.3.7. When glazing very large panes of glass or when heavy wind pressure may be experienced or in any case where specially desired by the Executive Engineer glazing bead may be used instead of front putty.

1610.3.8. When glazing with bead instead of front putty, the putty shall be applied to the face of the bead which is in contact with glass and back putty would also be necessary.

1610.3.8.1. Beads shall be of durable timbers of Class I, Class II specified in IS : 410-1967 or of rust-proof steel or of aluminium. The bead shall have mitred corners.

1610.3.8.2. The position and size of the head may depend on the thickness of glass used. The bead shall be fixed with screws spaced not more than 100mm. from each corner and not more than 200mm. apart and doors or windows shall be drilled during manufacture with holes accordingly.

1610.4. Measurement :—They shall be in numbers of fixed and glazed units of doors, windows or ventilators.

1610.5. Rate :—The unit rate shall be per each completely fixed unit of a door, window or a ventilator, including cost to glazing.