

IRRIGATION & CAD Department

Government of Andhra Pradesh

FIELD HAND BOOK



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Note: Initially defects will be categorized based on the test name and later based on the site conditions provision will be given escalate from C to B to A etc.

9	Water	Concrete	Concrete	Compressive Strength	C
10	Mortar	Concrete	Core Test	Slump	A
11	Mortar	Bricks	Permeability	Slump	B
12	Rough Stone	Bricks	Water Absorption	Compressive Strength	B
13	Reinforcement	Bricks	Compressive Strength	Water Absorption	B
14	Reinforcement	Bricks	Compressive Strength	Water Absorption	B
15	Foundation Earth	Bricks	Compressive Strength	Water Absorption	B
16	Gates	Bricks	Compressive Strength	Water Absorption	B
17	Gates	Bricks	Compressive Strength	Water Absorption	B
18	Gates	Bricks	Compressive Strength	Water Absorption	B
19	Gates	Bricks	Compressive Strength	Water Absorption	B
20	Gates	Bricks	Compressive Strength	Water Absorption	B

R. Lakshmana Rao
Deputy Engineer

DO'S AND DO NOT'S OF WORKS OF IMPORTANT SPECIFICATIONS OF EARTH WORK
(IS CODES, 2720, 4701, 8237, 9451, 4081, 1200)

EXCAVATION OF CANALS :

DO'S

1. Fix up the centre line and set the curves correctly.
2. Take working levels, real variation in ground levels and classification of soils as per Govt.Memo No.1970-12/72-11, dated 4-7-1994.
3. Get top soil vegetation (organic / inorganic) etc. removed.
4. Provide treatment with C.N.S. Soils in B.C. Reaches (expansive soils)
5. Form spoil bank as per drawing and away from side drain with suitable gaps for drainage into the valley.
6. Form Dowel Bank, as per drawing.
7. Form Inspection path to a uniform longitudinal gradient and with gentle transverse slope towards drains.
8. Compact over excavation/breakage portion with suitable soils, gravel, spalls.

DO NOTS

1. Do not avoid approval of the deviation statement.
2. Avoid over break and loosening of canal.
3. Do not mix up useful soils with other soil of cutting.

Peddapondla Reservoir

Vijayanagara Dist.



Creating New Ayacut of 7,500 Acres & Stabilising 4,500 Acres

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EXISTING TEST DETAILS IN QUALITY MONITORING SYSTEM

S.No	Material Name	Test Name	Category of Defect
1	Borrow Soils ✓	OMC ✓	A
	Borrow Soils ✓	Soils Classifications - EE Certificate	B
2	Soils	Attenerg limits	C
	Soils	Permeability test	B
	Soils	Shear Test	B
3	Embankment ✓	OMC ✓	B
	Embankment ✓	Proctor Density ✓	B
	Embankment	Cut-off permeability	B
	Embankment	Filters	B
	Embankment	Shrinkage, Swel etc.	B
4	Lining	CNS Soils	B
	Lining	Filter in expansion joint	B
	Lining	Morrum Back fill behind revetment	C
5	Foundation Earth ✓	Safe bearing capacity ✓ New notes	A
6	Cement	Specific Gravity	B
	Cement	Cubes Strength	B
7	Coarse Aggregate	Flakiness	C
	Coarse Aggregate ✓	Gradation ✓	C
	Coarse Aggregate	Impact Test	C
	Coarse Aggregate	Abrasion	C
	Coarse Aggregate	Soundness	C
	Coarse Aggregate	Crushing	C
8.	Fine Aggregate	Slit Content	C
	Fine Aggregate ✓	Gradation ✓	C
	Fine Aggregate	Bulkage	C
	Fine Aggregate	Silt & Clay content	C
	Fine Aggregate	Soundness	C

Category B: Non Confirming to specified limits but scope for rectification.

Action:

1. Analyse and go for remedy action within the time frame.
2. Remedy action out timed, then to be escalated to category A, for action from the agreement concluding Authority.

3. If escalation from Category C then unit officer in coordination with Superintendent Engineer, Quality Control to study the impact and propose recovery accordingly.
4. If the above beyond rectification, immediate stopage of payment and to escalate it to category A from agreement concluding authority to initiate necessary action.

Example:

1. Tests for cement, OMC for embankment, P.D. test etc.

Category C:

Non conformity of initial tests for materials, preparatory tests, linear measurements etc.

Action:

1. To be rejected and removal of the same from the site to be ensured.
2. After rejection if used, then to escalate to category B for unit officer to take to necessary action in coordination with Superintending Engineer, Quality Control.

FORMATION OF EMBANKMENTS

DO'S		DO NOTS	
1.	Get the top spoil, vegetation and sand patches removed to complete depth.	1.	Do not raise the bank in piecemeal.
2.	Scarify the ground and wet properly.	2.	Do not allow new layer without scarification and wetting of old layer.
3.	Obtain P.D. OMC for the useful soils and borrow soils.	3.	Do not allow new layer unless required degree of compaction is achieved.
4.	Provide C.O.T.s according to height of bank.	4.	Don't leave any loose layer un-rolled at the end of the day in rainy season.
5.	Raise embankment to full width with uniform horizontal layer of 25cm thickness.	5.	Don't allow compacted layer to be more than 150mm.
6.	Break clods, remove roots, big boulders other materials etc, larger than 80mm from the soils used in embankment.	6.	No new layer to be laid unless the over moistured layer is either completely removed or allowed to dry.
7.	Supplement deficit moisture whenever required.	7.	Don't dump soils in heaps.
8.	Provide 0.45 Mtr. Extra offset on both sides of bank.	8.	Don't dump the soils in water and slush
9.	Compaction with 8 to 10 tonnes power roller, vibro max roller	9.	No. of roller passes should not be less than 10.
10.	Conduct field compaction tests and determine compaction efficiency.	10.	Do not forget to provide settlement allowance of 2cm/mtr. Height of bank.
11.	Check embankment profiles periodically.	11.	Don't use expansive soils in banking.
12.	Ensure 8 minimum No. of Passes.		
13.	Provide 10% allowance in setting profile of the embankment.		

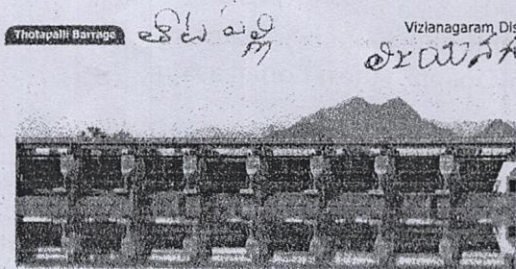
CANAL LINING	
DO'S	DO NOTS
1. Check the canal prism and verify the bed levels. 2. Check the gradation analysis of fine and coarse aggregates to the requirement of mix at batching plant. 3. Allow the ingredients of fine and coarse aggregate as per required mix by weigh batching. 4. Check the calibration of weighing machine at batching plant. 5. Check the water meter and its discharge. 6. Check the batch of cement, its make and test results. 7. Check the water cement ratio and record the slump. 8. Check whether any retarders and air entraining agents are added. 9. Maintain load register. 10. Record the No. CC Cubes cast and its compressive strength. 11. Cure CC Lining with water for 28 days. 12. Ensure smooth surface with paver roller passes. 13. Ensure the contraction and construction joints as per approved drawing. 14. Check the thickness of C.C. Lining for each panels. 15. Checking placing of mastic pad at structures of construction joints. 16. Allow concrete lining at temperature between 15°C and 32°C. 17. Check periodically the coefficient of variation in the compressive strength of cement. 18. The batching plant to be used shall confirm to the requirements of IS 4925-1968.	1. Do not allow the concrete over loose subgrade 2. Do not allow lining without wetting subgrade. 3. Do not allow C.C. Lining manually without vibration. 4. Do not allow segregation of concrete while laying through discharge conveyor. 5. Do not allow concrete directly on subgrade from transit mixer. 6. Do not form contraction joints over longitudinal drains. 7. Do not fill up contraction joints with sealing compound without cleaning with air water jet or sand blast. 8. Do not allow any projections or contraction joint over the surface of the lining. 9. Do not allow the C.C. Lining without applying suitable primer to sides. 10. Do not remove the channels immediately before setting of C.C. 11. Do not use untested cement. 12. Do not allow to sink the porous plugs in the drains. 13. Do not allow lining without making proper arrangements for curing with water. 14. The Co-efficient of variation in the compressive strength of cement should not be more than 8%.

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2. Similarly for borrow area conveyance for earth work, CNS soils etc. upon testing if found not suitable shall not be allowed. If already used, the earth, shall be removed if it is detrimental else suitable recovery as penalty to be imposed duly carrying out the rectification.

Only Agreement concluding Authority is authenticated for necessary action.

Note: Certain tests categorized under category B will also be escalate to under this category, based on the site conditions. The Head of the department is the authority to take necessary action.



Creating New Ayacut of 1,20,000 Acres & Stabilising 64,000 Acres



Creating New Ayacut of 62,280 Acres

ANNEXURE - VI

CATEGORIZATION OF DEFECTS OF TESTS RESULTS FOR ANALYSIS

In general the defects/short comings for not confirming to the required standards of the tests performed or ensuring QA/QC of the works both in-situ and in the laboratory, may be placed under the following category depending upon the type of tests and the site conditions.

Category A: Failure of tests and no scope for rectification.

- Action :**
1. To be rejected.
 2. If already used – **Agreement concluding Authority** to assess the impact and initiate action either by recovery if not detrimental else reconstruction by removing the same at the cost of the agency.
- Example:**
1. In case of foundations, SBC not confirming but foundations already executed, then no payment, immediate analysis of impact, alteration of design if possible, recovery as penalty else reconstruction of the work component at the cost of the agency.
- Only Agreement concluding Authority is authenticated for necessary action.**

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FOR FOUNDATION	
DO'S	DO NOTS
1. Verify dimensions and foundation levels as per drawing. 2. Wet the foundation surface to a depth of 150mm or to impermeable material. 3. Ensure the rock surface free from oil, objectionable coating unsound fragments. 4. Check-up correct batching of ingredients. 5. Check the batch of cements and its make. 6. Check-up water cement ratio and slump test. 7. Ensure uniform mixing. 8. Ensure proper compaction with vibrators and keep stand-by vibrator and needles. 9. Operate immersion type vibrators nearly in vertical position to vertical drain. 10. Cure with water for 28 Days. 11. Compact with suitable bedding materials in case of over excavations and with M-5 grade concrete in case of rock. 12. Allow admixtures as per I.S. 9103-1979.	1. Do not forget to compare bearing capacity of actual soils met with design strength. 2. Don't lay the foundation concrete without wetting the surface. 3. Do not lay the concrete under water and over slush. 4. The minimum mixing time should not be less than 2 min. 5. Do not forget to keep stand by vibrator and needles. 6. Do not place concrete in raw in sufficiently heavy to wash mortar from concrete. 7. Do not forget to cast the cubes. 8. Do not allow segregation of concrete. 9. Do not use unsatisfactory mix. 10. Don't allow admixtures which will harm the strength of concrete.

FOR STRUCTURE:

DO'S	DO NOTS
1. Check the form work. 2. Apply cement slurry after cleaning the surface at vertical joints. 3. Clean and cover with a layer of 10 to 15 mm thick mortar of the same proportion of concrete mix for horizontal joints. 4. Place the concrete at temperature between 15°C to 30°C. 5. The concrete shall be discharged with in half an hour after introduction of the mix water and cement.	1. Avoid abrupt surface irregularities 2. Do not deviate from specified dimensions of cross section from -6mm to +12mm. 3. Do not allow concreting until all form work installation of items to be embedded and preparation of surface involved are approved.
Gandaria - Ruddevagu Adilabad Dist.  Creating New Ayacut of 14,000 Acres	Vijayanagaram Dist.  Creating New Ayacut of 19,235 Acres & Stabilising 5,405 Acres

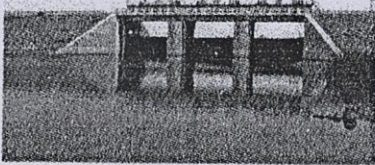
4. IS code - 7861 (part 1) for extreme weather concrete

Mechanical tests	MANUFACTURING STAGE	Remarks
b) Motor 1) HV tests 2) Impedence & voltage test 3) Static flux test 4) Calibration of over speed devices 5) Insulation resistance test 6) Type Tests:	- HV tests on field coils assembled on poles. - Impedence & voltage test on field coils. - Static flux test. - Calibration of over speed devices. - Insulation resistance test for accuracy of stator and rotor windings RTD & BTD tests on excitation & Regulation equipments - Testing of all electromagnetic valves and pressure switches. - On the completely assembled motor and associated auxiliaries shall be carried out at works.	
C) Earthing & lightening & protection	Type tests, Galvanizing tests, Welding tests, Earth continuity test, Earth resistance tests of total system.	As per relevant BIS Specifications. IS: 2309 - 1989, IS 3043-1987 IS: 2633 - 1986 IS: 4759 - 1984 IS: 3725 - 1966
D) Switchgear , Power & control cables-instrumentation and controls - data Communication systems-other required equipment.	As per specifications & standards	As per relevant BIS Specifications

Mechanical tests	MANUFACTURING STAGE	Remarks
IV) Lift Irrigation machinery a) Pump sets 1) Standard running test 2) NPSH test 3) DP tests on shaft and impeller 4) Noise & vibration 5) Non-destructive test 6) Field Testing	Drain holes to horizontal beams, trunnion brackets hoists bridges. Alignment of gears & shafts. Sand blasting and painting (IS 14177-1994) standards: S.A2.5 white/rough) and or IS: 5905-1989) paint specification binder solids, pigments, additives, solvents, driers etc: - Thickness of paint in microns. Pumps shall be tested in accordance with stipulations of Hydraulic Institute standards as applicable. Mechanical Balancing, Visual Inspection. Noise and vibration shall be measured at shop and to be repeated at site also. After installation, the pumps shall be operated to prove satisfactory performance.	As per relevant BIS Specifications.

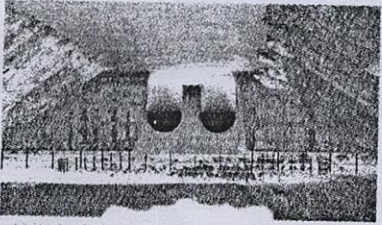
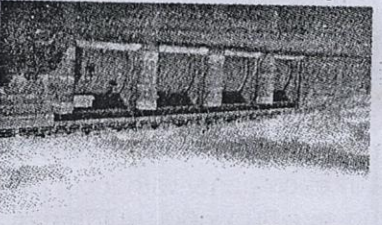
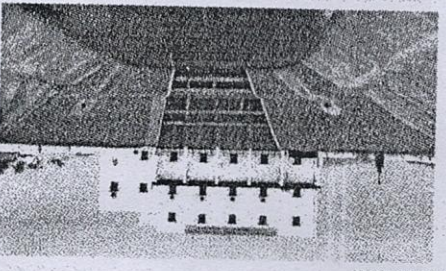
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MASONRY (IS CODES 1597, 1812, 1200, 383, 269, 2116)	
DO'S	DO NOTS
- The stone shall be of uniform colour, texture, strong, hard durable. - Dressing of C.R.S. Stone to a depth of 75mm on all four sides. - Wet the stones before placing in position clean and cover with fresh mortar. - Place stones in layers to the line and plumb. - Provide weep holes at 2 mtrs interval staggered as per drawing. - Chisel dress the corner stones. - Face stones shall be laid alternately in headers and stretchers. - Provide bond stones at 2 mtrs. Interval in each layer and mark. - Place the hearing stones on its broadest face. - Ensure perfect hearing to make the masonry water tight. - Mortar shall be used within 30min. after discharged from mixer.	- Do not use stones other than granite of crushing strength less than 1000 kgs/sq.cm. - Do not allow brushing more than 40mm on the face. - Do not allow stones of length more than 3 times the height. - Do not allow stone of breadth less than height of ¾ of thickness of wall. - Do not allow breaking of vertical joints less than 75mm. - Header shall not project not less than 10 cm beyond stretcher. - Do not place stones in position without cleaning and wetting. - Do not allow skin stones, weathered stones. - Do not place stone in position without wetting.

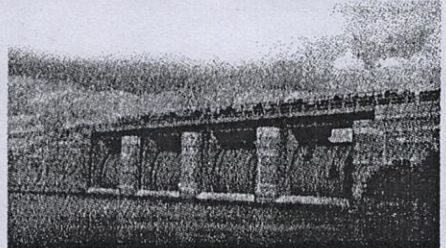
DO'S	DO NOTS														
12. Sieve analysis for sand shall be done periodically which confirm to: <table> <tr> <th>I.S. Sieve Designation</th><th>% of passing</th></tr> <tr> <td>4.75 mm</td><td>100</td></tr> <tr> <td>2.36 mm</td><td>90 to 100</td></tr> <tr> <td>1.18 mm</td><td>70 to 100</td></tr> <tr> <td>600 micron</td><td>40 to 100</td></tr> <tr> <td>300 micron</td><td>5 to 70</td></tr> <tr> <td>150 micron</td><td>0 to 15</td></tr> </table> 13. For flush pointing the mortar shall be finished off flush and level with edges of the stones. 14. Joints shall be racked out to minimum depth of 12 mm when the mortar is green. 15. Cure the masonry with water for 2 weeks. 16. Cure the plastered surface with water for 14 days. 17. Cure the pointing surface with water for 7 days.	I.S. Sieve Designation	% of passing	4.75 mm	100	2.36 mm	90 to 100	1.18 mm	70 to 100	600 micron	40 to 100	300 micron	5 to 70	150 micron	0 to 15	10. Smaller stones shall not be placed in lower course. 11. Joints thickness should not be more than 12 mm. 12. Do not allow mixing less than 3 minutes for thorough mix. 13. Do not add more water than required to have a consistency of 90 mm to 130 mm. 14. Avoid spreading of mortar over the surface of the masonry. 15. No Pointing to be commenced without washing and wetting the joints thoroughly. S&SP Stage-11 Warangal Dist.  Creating New Ayacut of 40,000 Acres
I.S. Sieve Designation	% of passing														
4.75 mm	100														
2.36 mm	90 to 100														
1.18 mm	70 to 100														
600 micron	40 to 100														
300 micron	5 to 70														
150 micron	0 to 15														

Mechanical tests	MANUFACTURING STAGE	Remarks
	INSTALLATION / ERECTION - Thorough testing & check up of components for quality and dimensional accuracy be done on shifting to erection site. Ensure any defect unnoticed during fabrication should be rectified before installation. - Checking of critical dimensions of all E.M parts at least in 300mm intervals (on assembly and installation) during erection, before & after concreting, as per IS:4622, and 7718 etc. as applicable with in tolerance & limits. * roller track centre to centre - seal track centre to centre- side guide centre to centre * verticality of roller track seal track. Side guide track * co-planarity of roller track and seal track - horizontally of sill beam - levels of sill beam and hoist bridge * roller assembly and its alignment - side roller gaps. - Testing of welds- for strength and soundness- DPT. X rays and gamma ray. - Dry testing of rubber sealing and pre-compression. - Alignment of line shafts.	

Mechanical tests	Additional tests for Radial Gates
	III) water conductor and penstocks a) Raw material tests - tensile, bend physical tests etc. b) Welding tests. c) NDT d) Hydrostatic test e) Paint test
MANUFACTURING STAGE	Remarks
* Pre tensioning of anchor rods * trunnion centres: co-planer and parallel to sill * chair level/rest plate: co-planer and parallel to sill * inclination of yoke and anchor girders and its co-planar accuracy * radius of skin plate and wall plate * side seal face to face * level of horizontal girder * radius of skin plate and wall plate * pre tension of anchorages * site weld design and sequence * site weld testing for strength and quality as per IS codes. • Only one longitudinal joint permissible. • Welding shall be tested @ 5% by radiography and 95% by ultrasound testing. • Checks of dimensional accuracy (Cylinder dimensions, angle incase of bends, coplanar accuracy of flanges after welding and/or joining shells/ pipes etc. • Welding - submerged arc/manual arc welding of shells and bends. • DPT, RT, UT etc. • Hydro static test - 2 times of working pressure. • Painting: surface preparation, sand blasting & painting as per specification.	IS 800-1984, IS 226-1975, IS 2062-1992, IS 814-1991, IS 816-1969, IS 3589-2001, IS 5822-1994, IS 4353, IS 2825, IS 4225, IS 823, IS 2595 & IS 1182, IS 3664 - 1981, IS 3658-1980, IS 3703-1980

REINFORCED CEMENT CONCRETE SLABS (IS CODES 2502, 1786)	
DO'S	DO NOTS
1. Check the reinforcement as per drawing. 2. Provide asphaltic pad and water stopper as per drawing.	1. Do not pass without proper cover. 2. Do not allow less lengths in over laps.
 Stabilising Ayacut of 53.793 Acres  Creating of New Ayacut of 23.992 Acres	 Stabilising Ayacut of 53.793 Acres  Creating New Ayacut of 23.992 Acres

LINING SUBGRADE

DO'S	DO NOTS
1. Check the model section to the canal profile i.e., bottom or lining. 2. Check the canal profile with reference to model sections. 3. Remove roots and stumps completely from sub-grade. 4. Compact over-excavation in soils with gravel duly wetted. 5. Compact over-excavation in rocky area with gravel spalls and aggregate spalls and aggregate duly wetted. 6. Provide treatment with C.N.S. Soils in expansive soils i.e., 0.6 mtrs., thick for discharge up to 50 cusecs. 7. Provide porous plugs of size 375 mm long x 100 mm dia in each panel with local filters of graded metal and sand size 600 x 600 x 750 mm. 8. Provide longitudinal and transverse drain of size 600 x 750 mm filled up with graded metal and sand as per drawing. 9. Check whether porous plugs are freely draining or not. 10. Note down December water table for providing longitudinal drains and other relief measures (as per drawing).	1. Do not allow concrete lining on loose subgrade. 2. Do not allow any root or stumps to be on sub-grade. 3. Do not allow lining in expansive soils without treatment with C.N.S. Soils. 4. Do not place the porous plug below the surface of the lining. 5. Do not allow lining without wetting the sub-grade suitably.  Surampalem Reservoir East Godavari Dist. Creating New Ayacut of 23,992 Acres

Mechanical tests	MANUFACTURING STAGE	Remarks
c) Inclinations of yoke and anchor girder and its co-plane accuracy d) Radius of skin plate & wall plate e) Side seal face to face f) Level of horizontal girder g) Site weld testing strength	☛ Dimensional accuracy and critical dimensions of E.M parts at least in 300mm intervals on assembly. ☛ Assemblies and sub-assemblies as per drawings and specified tolerances (IS codes 7718.10096-1986, etc) ☛ Dimensional accuracy and critical parameters of components / assembly of gates as per IS codes. gate assembly * roller assembly * scale assembly * guide roller assembly * roller cage assembly * trunnions and pins assembly * yoke girder assembly * support/ chair * end gear box units. assembly. Central drive units assembly * control panels * wire rope and lifting socket assembly * gate lifting measuring dial indicator gauge. ☛ shop painting - surface preparation - painting process ☛ Tests after Heat treatment of specified components.	

Mechanical Tests	MANUFACTURING STAGE	Remarks
f) Destructive testing 1) Physical properties 2) Chemical properties g) Rubber seals: h) Steel wire ropes i) Welding electrodes j) Paint Tests ii) Tests for Radial Gates a) Pre tensioning in anchor rod b) Trunnion centre: coplanar and parallel to sill	f) (1): tensile, compression, elongation, hardness, impact, torsion etc., f) (2): wet analysis, spectra analysis. g) Shore's hardness and water absorption h) wire rope and lifting socket assembly, load testing of rope and socket assembly. i) As per IS codes. j) Surface preparation sand blasting and painting as per specification. ii) Tests for machined items: test for allowances and tolerances as per drawings BIS specifications for all items and components for which machining operations are involved (such as: turning, planing, grinding, milling, gear, hobbing, drum scouring, drilling, boring and slotting etc.	IS: 3400-1980 IS: 2365-1977 & 2226 IS: 1442-1964, IS: 814-1974, IS: 815-1974/E-7018 IS: 14177-1994

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CHECKING SLIP TO ACCOMPANY THE PROPOSALS FOR DESIGN MIX CONCRETE:			
Package No:	Circle:	Division	
1	Grade of concrete	M20/M15/Other	
2	Whether PCC/RCC	PCC/RCC	
3	Maximum size of coarse aggregate	mm	
4	Intended use and exposure:		
5	Exposure condition	if not 'moderate' reasons for the same	
6	Degree of Quality control	if not 'good' reasons for same	
7	Required slump	mm	
8	Sand grade		
9	Max W/C ratio permitted as per agreement:	0.55 for RCC & 0.60 for PCC	
10	whether air-entrained OR nor-air entrained	if air-entrained reasons for same	

11. PROPOSED MIX DESIGN:		
	W/C Ratio	
	Water	Ltrs
	Cement	Kgs
	Sand	Kgs
	Coarse aggregate	Kgs
	Total	Kgs
	Air-Content	%
12	If air-entrained concrete whether W/C ratio increased accordingly?	
	Reasons for adopting air-entrained concrete:	
	Recommended air-entrained agent:	
13	Whether W/C ratio comply with agreement?	
14	Recommendation	Accepted / not-accepted

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↓ ✓ (4) 10% of the tests conducted by the EPC agency should be got checked by the 3rd Party - QC Agency apart from conducting independent tests

16	Mechanical tests	MANUFACTURING STAGE	Remarks
	I. HYDRAULIC GATES AND HOISTS & ALLIED EQUIPMENT a) Manufacturing & installation stage b) Straight & co-planary accuracy c) Fabrication tolerances d) weldments e) NDT Testing 1) liquid penetrate testing (IS 3658-1980) 2) magnetic particle testing (IS 3703-1980) 3) ultrasonic testing (IS 3664-1981) 4) radiographic testing (IS 2595 & IS 1182)	a) E.M parts, gates and hoists. b) Straightness and co-planary accuracy be checked for all materials and its components - jigs. c) Fabrication tolerances checked and maintained as per IS 7215-1974 etc. d) inspection and testing of weldments (as per IS 822:823-1964:816 3658-1980:8780-1978; 3664-1981; 2595-1978 and ASME- Section. 8) And latest addition for size of welds. Edge preparation - weld procedures for various joints. Joint preparation- type of electrodes- root gap. Selection of electrodes for each component as per the standards and recommendation of manufactures for its load bearing capacity and strength of welds. Preheating of electrodes weld travels speed for automatic welds and manual & ensure follow of weld designs and procedures. e) Testing for soundness and strength of welds (DPT, X rays and gamma ray)	

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↓ (b) Tests conducted by EPC agency and 3rd Party QC Agency should further be checked by Department Quality Control Staff.

SNO	DESCRIPTION OF TESTS	PERMISSIBLE VALUES	FREQUENCIES	REMARKS
1	Cement	a) Specific Gravity Greater than 3 b) Initial Setting Time Less than 30 minutes = 1 hr Greater than 600 minutes = 10 hr c) Final setting time Greater than 2250 cm ² / gr d) Specific surface OPC - Greater than 2250 cm ² / gr e) Cube strength 3 days, 7 days, 28 days	one test from consignment having same batch & No. of the same factory	For more details refer IS 269 & IS 1489
		Cement		
		Grade	3 days	28 days
		a) 43 Grade	220	290
		b) 53 Grade	270	370
			530	530
			Min. Compressive Strength (Kg/sqcm)	

Note: - Asper Engineer-in-Chief (Engineering) Circular Dec-1/07
 MP/AEE/29384/2005-1 dt 26-12-2005

SNO	DESCRIPTION OF TESTS	PERMISSIBLE VALUES	FREQUENCIES	REMARKS
	g) Suitability of soils	Based on soil classification / designs	One test in one week	
	h) Stability of soils	Based on soil classification / designs	One test in one week	
	i) Permeability	Field permeability by Japanese method		
	j) Revetment, bed pitching & rock toe	as per item 2,3,8		
	k) Shrinkage factor			
	l) Triaxial shear test	Tested for C & ϕ values	One test in a week, every 3m of embankment	
	m) Std proctor test	Tested for 98% PD	One test per day for individual borrow area & moisture and content	

2.	Coarse Aggregate <i>Metall</i>					
	a) Gradation					
		IS sieve	% passing for graded aggregate of nominal size			
		Desg	40 mm	20 mm	16 mm	12.5 mm
		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				90-100
		10 mm	10-35	25-55	30-70	40-85
		4.75 mm	0-5	0-10	0-10	0-10
	b) Specific Gr.	Minimum - 2.6				
	c) Water absorption	less than 5% when immersed in water for 24 hours.				
	d) Aggregate crushing value	45 % for Mass Concrete, 30% for Wearing surfaces				one test whenever Quarry
	e) Aggregate impact value	45 % for Mass Concrete, 30% for Wearing surfaces				changes or strata change
	f) Abrasion value	50 % for Mass Concrete, 30% for Wearing surfaces				occurs
	g) Soundness test	Less than 12% when tested with Na_2SO_4				
		Less than 18% when tested with MgSO_4				
	h) Flakiness index	Less than 35%				
	i) Elongation index	Less than 35%				

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SNO	DESCRIPTION OF TESTS	PERMISSIBLE VALUES	FREQUENCIES	REMARKS
	vi) Relative Density	$RD = \frac{E_{\max} - E}{E_{\max} - E_{\min}}$ individual sample should not be less than 70% and average shall not be less than 85% $E_{\max}$ = voids ratio in loose state $E_{\min}$ = voids ratio in compacted state Thickness of each layer shall be less than 150 mm		
	c) Compaction		One test whenever borrow area changes	for more details IS 4701, IS 2720 (Part 1 to 30)
	1) Gradation using Hydrometer analysis			
	2) Attenberg limits	tested for suitability for casing and		
	3) Sp. Gr & voids ratio	heating soils as per design		
	4) Proctor compaction (Field density)	> 98% of Proctor density controlled within + or - 1% omc	For 1500Cu.m of Earthwork	
	d) Swell pressure	If swell pressure > 50 KN/Sqm, CNS layer shall be provided as per IS 3873, 9451	embankment	
	e) Difference free swell	If DFS > 50, swell pressure test shall be conducted		
	f) Total soluble solids present			

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SNO	DESCRIPTION OF TESTS	PERMISSIBLE VALUES	FREQUENCIES	REMARKS
3	a) Gradation Fine Aggregate <i>Stud</i> IS sieve	Percentage passing for grading Zone - I Zone - II Zone - III Zone - IV	One test in morning one test in Afternoon For more details 383 & IS 2383 (Part 1 to 8)	
		a) 4.75 mm b) 2.36 mm c) 1.18 mm d) 600 micron e) 300 micron	90-100 95-100 90-100 85-100 75-100 60-79 80-100 15-50	
		Note: Where the grading falls outside the limits of any particular grading of zone of sieves other than 600 micron IS sieve by a total amount not exceeding 5% it shall be regarded as falling within the grade.		
		Aggregate conforming to Grading Zone - should not be used in reinforced concrete.		
		b) Fineness Modulus	2.00 - 3.20	
		c) % silt & clay content	Less than 3%	
		d) % deleterious materials	Less than 5%	
		e) Soundness	Less than 10% when tested with Na_2SO_4 Less than 15% when tested with MgSO_4	As per requirement

SNO	DESCRIPTION OF TESTS	PERMISSIBLE VALUES	FREQUENCIES	REMARKS
15	Embankments a) Cut-off - Permeability Less than 10^{-7} cm / sec Filters - test for metal / sand Gradation for metal	IS Sieve % passing 80mm 100 40mm 80 - 56 20mm 84 - 24 10mm 64 - 8 4.25mm 25 - 0 Cu = D60 / D 10 > 6 for sand > 4 for metal Cc = D30 ² / (D10xD60) lies between 1 to 3	For more details refer IS USBR earth manual IS-1498, 1970, 6955 1973, IS-5529-1985, 11293, 11532, 14650, 14954	
		i) Uniformity Coefficient D 15 of filter D 15 base > 4 and < 20		
		iv) D 15 of filter D85 of base < 5		
		v) D50 offilter D50 of base < 25		

SNO	DESCRIPTION OF TESTS	PERMISSIBLE VALUES	FREQUENCIES	REMARKS
4	Water			
	a) PH	6 to 8		
	b) Suspended Matter	Less than 0.2%		
	c) Organic Matter	Less than 0.2%		
	d) Inorganic Matter	Less than 0.3%		
	e) Chlorides	Less than 0.2% for PCC		for more
		Less than 0.1% for RCC		details refer
	f) Sulphates	Less than 0.05%		IS 456
5	Concrete			
	a) Mix design	Cubes should satisfy the target strengths adopted in mix design		For more
	b) Slump	a) Road work 20 to 30 mm		details refer
		b) Beams and Slabs 50 to 100 mm		IS 456, IS 516
		c) Walls 75 to 150 mm		IS 9103, IS 6441
		d) Vibrated Concrete 15 to 25 mm	Twice for Shift	IS 1199, IS 3035
		e) Mass Concrete 25 to 25 mm		S.P 23
	c) Temperature	Between 15 to 32 deg C		
	d) Unit weight	2400 Kgs/cum for plain concrete, 2500 Kgs/cum RCC	For mass concrete one specimen for 150 Cum	
	e) Cube Strength	Minimum characteristic strength of proposed mix		
	f) Non destructive test	Minimum characteristic strength of proposed mix		
	by Rebound Hammer			
			For structural concrete four specimens upto 50 Cu.m and 12 cubes /Shift one each element of structure	
	g) Core test	not less than 75% of cube strength for individual sample and 85% on average of atleast 3 samples	one test for 2000 sqm of lining and one test for each element of structure	

SNO	DESCRIPTION OF TESTS	PERMISSIBLE VALUES	FREQUENCIES	REMARKS
12	Bearings			
	a) Hardness	60-5 IRHD		IS : 3400
	b) Min Tensile strength	17 Mpa		IS : 3400
	c) Min elongation at break	400%		IS : 3401
	d) Max compression at test			IS : 3402
	e) Accelerated aging			IS : 3403
	f) Max. change in Hardness	+ 15 IRHD		IS : 3404
	g) Max. change in tensile strength	-15%		IS : 3405
	h) Max. change in elongation	-40%		IS : 3406
13	Rubber water stop			
	a) Tensile strength	Min 116 kg/sqm		For more
	b) Ultimate elongation	Min 300 %		information
	c) Tear resistance	Min 49 kgs/sqm		refer IS 9766
	d) Stiffness flexure	Min 24.6 kgs/sqcm		
	e) Alkali test	After 7 days of immersion, weight shall increase by 0.25% and decrease by 0.1% After 28 days immersion. The weight shall not increase by 0.4% or decrease by 0.3%. The dimension shall not alter by 1.0%		
14	Bearing capacity of strata	Should be ensured for the stress indicated in design/drawings	For all the important structures	

S.No	DESCRIPTION OF TESTS	PERMISSIBLE VALUES	FREQUENCIES	REMARKS
6	Mortar			
	a) Slump test	for workability	Specimen to be cast at the	IS: 1597 (p1&p2)
	b) Unit weight for proportions		rate of one sample of	
	c) 50mm size of CM test specimen	tested for 28 days strength	3 cubes for 100Cu.m of	
	d) Permeability test for every 3M	3.0 Lugones limit for rear face	2.5 Lugones for front face	their 28 days strength
7	Bricks			
	a) Water absorption after 24 Hours	Less than 20%		
	b) Size	190x190x90mm		
	c) Density			
	d) Compressive strength	Greater than 40 kg/sqcm		IS 1077
8	Rough Stone			
	a) Soundness			
	b) Abrasion			
	c) Water absorption	Less than 5% when immersed in water for 24hours		IS 1121, IS 1124 &
	d) Density			IS 1126
	e) Crushing strength - Granite	Greater than or equal to 1000 Kg / cum		

SNO	DESCRIPTION OF TESTS	PERMISSIBLE VALUES	FREQUENCIES	REMARKS
11	Lining			
	a) No fine concrete and porous concrete	Compressive strength for cylinder 15cm dia & 30cm ht. shall not less than 70 kgs/sqcm		For more details refer IS 3873, IS 6509
	b) Filter in expansion joint	head of water		
	c) CNS soils for bed	Asphalt - 80 IW - 30% by Vol Sand 51% by Vol Cement 17% by Vol		
		Heap cut into length 2% by volume Proportion materials as per IS 3873 The soils to be used for CNS layers shall be tested for the following properties clay (< 2 micron) - 15 to 20% silt (0.06mm - 0.002mm) - 30 to 40% sand (2mm - 0.06mm) 30 to 40% grains (>2mm) 0 to 10% plasticity index less than 30% but > 15% It should have 'C' and ϕ ranging from 10.342 Kn/m ² and 25° to 20.684 to 27.579 Kn/m ² and 12° to 14°		IS:3873
	d) Mortar back fill behind revetment	The material shall be tested for the following properties Fine passing 75 micron < 10% Liquid limit < 20% Plasticity index < 6%		

