GOVERNMENT OF ANDHRA PRADESH
IRRIGATION & C.A.D. DEPARTMENT

GUIDE LINES FOR PREPARATION OF PROJECT REPORTS FOR SURFACE WATER MINOR IRRIGATION WORKS

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FOREWARD

It gives me great pleasure to note that the Irrigation Department has modernized the design concepts of Minor Irrigation Schemes (surface water). Several innovative concepts including preparation of ready reckoner tables for earthen dams, surplus weirs, etc., have been evolved which has facilitated the quick preparation of plans and estimates. Latest technologies on hydrology, earthen dams, water management, crop water requirement, etc., have been adopted while formulating these guidelines.

Mr. T. Hanumabtha Rao, Chief Engineer, Minor Irrigation has done innovative work in standardization of designs, preparation of ready reckoner tables and issuing guidelines in the shape of a manual for preparation of detailed project reports for minor irrigation works. I appreciate this pioneering activity in the sphere of minor irrigation. I hope that this effort will result in many benefits and economies. Apart from quick preparation of plans and estimates, the standardization and guidelines now given w2ill improve the quality content and also result in considerable savings. I am sure that this manual on minor irrigation projects would not only be beneficial to A.P. State, but also to other states in the country. This is all the more relevant in the present context of increased importance being given by the State Government to the Minor Irrigation Sector in the VII Five Year Plan.

(N.T.RAMA RAO)

MINOR IRRIGATION PROJECTS
DESIGN CIRCULAR

There is a long felt need to up date the design circulars pertaining to minor irrigation works (surface water) issued from time to time. The field engineer as well as the office staff will have to refer to nearly 80 circulars in order to properly investigate, design and estimate minor irrigation schemes. Thus the need for compiling all the circular instructions into one master circular needs no emphasis. This is particularly relevant in view of adopting several innovative concepts in minor irrigation especially during the past one year. To give a few examples, crop water requirements which were hither to assumed on thumb rule basis are now to be designed based on the Agroclimatological data using modified pen man method. Evaporation from small open lake bodies have been rationally assessed under different climatic zones within the State for different periods of the year. Computation of maximum flood discharge hitherto done based upon thumb rule methods is now being done by a rational method taking into account the maximum daily precipitation, type of soils, land use pattern, soil cover, shape of basin etc. Design of earthen dams has been rationalized for different types of soil classification and ready reckoner tables for determining the quantities of component works and ready evolved. Field classification of soils and techniques pertaining to this have been introduced. These techniques have resulted in quick preparation of detailed plans and estimates for earthen dams and other minor irrigation projects. Drudgery of repetitive work is avoided and this standardization has resulted in a certain amount of precision in the whole process. Due to adopting improved technologies savings to the extent of about 10% could be achieved.

It will be rather difficult to have access to the various circulars and instructions issued from time to time. During the past one year (1985-86) as many as 50 design circulars were issued to streamline, rationalize and also improve the technology content of the same. The sun and substance of these circulars have been incorporated in this booklet. However, wherever detailed references to such of the important circulars is needed the same are appended as annexures in this booklet.

It is a common experience of almost all the Engineering Offices to receive Project Reports of minor irrigation schemes in an incomplete format requiring frequent correspondence at various levels to obtain full information.

In order to facilitate submission of the Project Reports, plans and estimates in full shape a format of check list has been prepared and is included in this booklet. A quick review of this check list which may perhaps take about 15 minutes to half-an-hour, would clearly bring out whether all the details required to be sent along with Project estimate has been enclosed or not. It is expected that the officer before dispatching the Project Report to the next higher officer may go through this check list personally and satisfy himself that all the required information is enclosed.

A modified format of salient features of the project has been prepared and enclosed. This simple format would give all the hydrological, engineering financial and administrative details.

Preparation of a narrative report describing details of the project is an art by itself. Several format for this have been devised in the case of major and medium irrigation projects. I.S.I and Central Water Commission have also brought out formats for major irrigation projects. No such format seems to have been evolved in the case of surface water, minor irrigation schemes. An attempt has been made in this booklet to standardize this format of writing the narrative report. This would facilitate the field engineers to prepare the each para have been specified. In a way this speeds up preparation of such narrative reports and bring certain amount of uniformity and precision.

Certain general circulars which are of frequent references pertaining to investigation, execution and maintenance have also been included in this booklet so that the same can be referred to easily by the Field Engineers. It is felt that ready access to such important circulars will be an asset in discharging several functions in the Department.

I acknowledge with thanks the efforts of the staff of Minor Irrigation Wing of Chief Engineer's Office and particularly Sri. N. Suryanarayana Murthy, Deputy Executive Engineer and Sri. N. Lavakumar, Assistant Engineer for proof Corrections, compiling and assisting in preparation of the guidelines.

Any omissions or suggestions may please be sent by the officers of the Irrigation Department directly to the chief Engineer, Minor Irrigation, Errammanzil, Hyderabad, Andhra Pradesh.

T. HANUMANTHA RAO,
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GUIDELINES FOR PREARATION OF PROJECT REPORTS FOR SURFACE WATER MINOR IRRIGATION WORKS

INTRODUCTION

Irrigation projects in Andhra Pradesh are dealt under 3 categories:

a) Major Irrigation Projects (above 10,000 Ha ayacut)

b) Medium Irrigation Projects (between 2000 Ha to 10,000 Ha ayacut)

c) Minor Irrigation Projects (less than 2,000 Ha ayacut)

For Major and Medium Projects Central Water Commission has published the working group report "Guide lines for preparation of Detailed Project reports of Irrigation and Multipurpose Projects". Such a report is also found necessary in the case of minor irrigation projects so is to have an uniform procedure for preparing project reports in respect of this sector. An attempt is made in bringing out this booklet to meet this demand. Also several designs circulars were issued on Minor Irrigation Projects from time to time **d**uring the past several years and more so (nearly 50) during the past one year (1985-86). It will be difficult to refer to them since they could be in different files and unless to the same. The design circular now issued in manner it becomes impossible to have a ready access to the same. The design circular now issued in this booklet brings out substance of all the earlier circulars and modifications issued from time to time, and as such this master circular has to be adopted for all future designs and estimates. Also copies of circulars which need reference are appended at the end. Some of the circulars which are now corrected and serve as detailed guidance have been appended for ready reference. Certain circulars which are of practical importance during execution and general circulars regarding preparation of drawings, using stencils, use of S.I. sheets etc., have also been added. Design circulars regarding percolation tanks and check dams are also appended in this booklet so as to cover all the subjects under Minor Irrigation.

General guide lines were given earlier for the preparation of scheme reports. But they are being followed varyingly from one Irrigation circle to another circle and the reports are being prepared depending on the expertise of the persons dealing with the subject. To have an uniform procedure, the details which are to be enlightened in the project report are also mentioned in this booklet.

Whenever a scheme has been found viable, the proposals should be informed to the Agriculture, Roads and Buildings and Panchayat Raj Departments requesting them to give priority for allotting sufficient funds for the soil conservation, improvements to the existing important roads and village roads nearby and to provide communication facility to the villages to the nearest market centre in the project area. At places where shallow water table is available, whenever Irrigated paddy (wet) crops are proposed provision for deep drainage within the ayacut area should also be made in the estimate.

2. MAIN DESIGN CIRCULAR

DESIGN PRINCIPLES OF MINOR IRRIGATION WORKS

1. ESTIMATION OF YIELD

(a) CATCHMENT AREA:

Minor Irrigation Storage schemes can be proposed at sites where free catchment area is generally more than 0.5Sq.miles. However for lesser than 0.5 Sq.m catchments, M.I.Scheme can be proposed under Tribal sub-plan and special component plan for S.C and S.T. Programme and also under special circumstances of rainfall occurrence etc. The proposals for any Minor Irrigation scheme should not involve in acquisition of Forest land for any of the construction activities or for submersion. Whenever a site has been finalized and taken up for execution it is quite necessary that the name board has to be kept on the main road, giving direction to the work site. Names of streams may be noted at the points of bridges and causeways as indicated in circular No. 5.

Instead of applying arbitrarily any factor of conversion from intercepted catchment to equivalent free catchment, assume the whole C.A. to be free and deduct the actual upper utilizations, since the Master Plan of each basin has already been prepared, this should be applied to in all cases. The upper and lower utilizations may be calculated on the basis indicated below. The same basis was adopted while calculating yields in the Master Plan records of various basins.

(i) For Irrigated wet crops (Khariff)

(a)	Upto 15” Mansoon Rainfall	..	..	3½ Acre/Mcft	(50Ha./Mcum.)
(b)	Above 15” and upto 20”	..	..	4 Acre/Mcft	(57 Ha./Mcum.)
(c)	Above 20” and upto 25”	..	..	4½ Acre/Mcft	(64 Ha./Mcum.)
(d)	Above 25” and upto 30”	..	..	5 Acre/Mcft	(71 Ha./Mcum.)
(e)	Above 30” and upto 32.5”	..	..	5½ Acre/Mcft	(79 Ha./Mcum.)
(f)	Above 32.5” and upto 35”	..	..	6 Acre/Mcft	(86 Ha./Mcum.)
(g)	Above 35” and upto 37.5”	..	..	7 Acre/Mcft	(100 Ha./Mcum.)
(h)	Above 37.5” and upto 40”	..	..	7½ Acre/Mcft	(107 Ha./Mcum.)
(i)	Above 40” and above	..	..	8 Acre/Mcft	(114 Ha./Mcum.)
(j)	Above for irrigated Dry crops (Khariff) upto 25” monsoon rainfall	..	..	15 Acre/Mcft	(214 Ha./Mcum.)
	Above 25” monsoon rainfall	..	..	20 Acre/Mcft	(285 Ha./Mcum.)

(Monsoon rainfall relates to rainfall occurring between months June to December both months inclusive).

Any higher duty adopted should be substantiated by the performance of neighbouring sources in the vicinity. Lower ripariar rights, (L.R.Rs.) are to be worked out upto tail end if

there are direct drawals. If there are series of lower down tanks, the L.R.R. is to be checked upto lowest tank, till its surplus meets with the main river on which the medium and major projects are constructed.

While working out the balance yields, they are to be compared with the Master Plan record yields, and a judicious decisions is to be taken for proposing the new M.I.Schemes, with out adversely affecting the projects lower down.

(b) Computation of yields.

As per Master Plan, when the catchment area is under the influence of 2 or more rain gauge stations the 75% confidence limit of rainfall for the individual rain guage stations were hitherto considered and the yields worked out. It is seen that yields based on the 75% confidence limit for each rainguage station, when summed up will statistically give an un-reaslistic lower value of yields when compared to the yield of the whole catchment considered year wise.

Hence, the following procedure may please be followed for the computation of 75% confidence limit of yield for any catchment under operation when the C.A. is imder the influence of 2 or more rain guage stations.

(i). Continuous monsoon rainfall data of 40 years or more for all the rain guage stations having influence on the catchment may be gathered.

(ii). Year-wise yields for each of the rain guage influencing area (as per Strange's tables and Thiesson Polygon method as adopted in Master Plan records) may be calculated.

(iii). The above year-wise yields may be summed up so as to obtain the yield of the entire catchment in each year.

(iv). Yields may be tabulated as per (iii) above in descending order and the 75% confidence value may be considered as the yield of the basin for estimation purposes.

A worked out example as per this concept is enclosed to the circular No.11 for general guidance.

In case daily rainfall records are not readily available then the existing procedure of adopting 75% C.L. of total monsoon rainfall may be tentatively followed and efforts should be made to collect the daily rainfall records of the rain guage stations situated in their jurisdictions, within a period of 3 months and the particulars there of submitted to the Chief Engineer Irrigation. For prediction of the yields a copy of the paper on "Prediction of yields in semi arid areas of Andhra Pradesh" published in the Journal of Andhra Pradesh may be referred vide circular No.3. Yields may be calculated using the equation in respect of MI. Schemes in red soil areas and this may be compared with that of yield calculated as per Stranges table and a critical assessment made.

Regeneration of 10% of wet ayacut may be considered if the ayacut is located in the free catchment area of the proposed scheme.

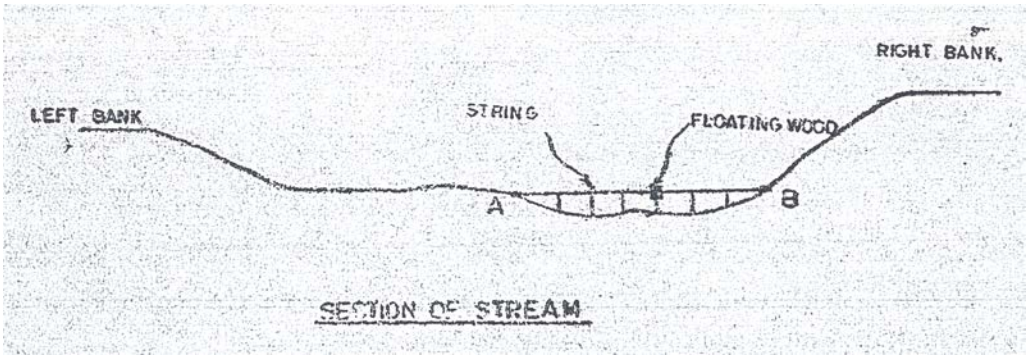
After arriving the yield proposed for the schemes a preliminary report is to be sent for

according Hydrological clearance. The proposals can be filled in the prescribed proforma statement No.1 enclosed & submitted for approval of the Chief Engineer, Minor Irrigation.

2. DIVERSION WORKS-DIRECT IRRIGATION

Whenever direct irrigation is proposed in any anicut scheme, the proposal should invariably be substantiated with gauged data observing flows for a minimum period of 2 years during the crop period, for all the minor irrigation schemes. Since our interest is to find out the minimum flows in the stream, these minimum flows should be measured by means of finding out cross section (string & depth) ad velocity of flow through a floating body. This should be measured in a straight reach of 10m length and observations recorded by the Section Officer once a week. There is no need to measure flood flows when direct irrigation is contemplated.

For flows occurring within the week, the Section Officer has to assess whether the stream has dried up or continuous to have a flow higher than that measured by him. In case the stream has dried up for more than 7 days, during the crop period no direct irrigation should be proposed, irrespective of the quantity of flows in flood period. The conventional guage flow data will only project the flood flows but not give a correct indication of low flows of the stream. Measuring tape may be stretched across the flow section AB for measuring the minimum flows.



Depth of flow section may be measured at closed intervals and cross section areas of flow calculated. A wooden floating piece may be used to measure the surface velocities at minimum three places along the cross section and average surface velocity calculated. In order to obtain average flow section velocity, the surface velocity may be multiple with a factor of 0.8. The observed flow data of 2 years may be correlated with the rainfall of these 2 years so as to obtain a projection of flow for the 40 years period under consideration. 75% dependable flow may be worked out based on these projected figures. The concept of percentage diversion is not valid in the case of direct irrigation taking off from anicut schemes.

If any of the 2 years happen to be drought years, the guagings will have to be continued for some more years so as to have at least data for 2 years with more than 75% C.L. Rainfall.

3. INDIRECT IRRIGATION (i.e., FILLING TANKS)

Regarding percentage diversion for the anicut schemes to fill up tanks, the table given below may be taken for guidance in the case of indirect irrigation (i.e., filling tanks & Irrigating through tanks). This table should not be considered for direct irrigation.

Catchment area in Sq. miles (Free + 1/5 th intercepted)	**Diversion for filling tanks in percentage (Maximum limit)**
1-15	20
15-50	25
Above 50	30

The design of the channel should be on the basis of flood days, i.e., days with a rainfall of 1" or more. ¾" to 1" per day may be treated as ½ flood day. These flood days may be calculated for a 40 years period and 75% dependable flood days worked out and channel capacity determine for the quantity proposed to be diverted.

4. **STORAGE TANKS:**

PROCEDURE TO BE FOLLOWED WHILE FIXING CAPACITY OF TANKS.

The capacity of Minor Irrigation tank used to be fixed by working table method. Inflow were getting distributed over a period of about 5 months based on average monthly rainfall figure during these months for the past about 40 years. Average inflow figures may not reflect true inflow conditions. By the average method it is seen that in several cases the inflows are taken occurring in all the 5 months of the crop period whereas the inflows mostly occur in one two months in most of the drought prone areas. Hence it is required to fix the capacity and F.T.L. as per working tables method and also based on the fillings method for both vet an I.D. Crops as per the table given below (vide circular No.17). The rational approach colour be by the method of continuous working table, but this is time consuming and can be resorted only selected important schemes.

Monsoon rainfall	No. of fillings	Other area in A.P.	Remarks
	Areas influenced by N.E Monsoon (eastern area of Chittoor, Nellore, Prakasam, Krishna, Guntur, West Godavari and East Godavari)		
15”	1	1	
15”- 20	1 ¼	1 ¼	
20”- 25”	1 ½	1 ½	
25”- 30”	1 ¾	1 ¾	
30”- 35”	2	2	
35”- 40”	2 ½	2	
Above 40”	3	2	

The higher capacity as worked out by (a) working tables method and (b) by the above filling table method may be adopted for fixing capacity. The Ayacut under Kharif I.D. and Rabi I.D. may be fixed in the ration of 2:1. Where Kharif wet crop is chosen as the cropping pattern, the monsoon rainfall should be more than 35”. Rabi wet or Rabi I.D., Crops should not be proposed, for the same Kharif wet area. Kharif I.D. may be proposed for area having less than 30” monsoon rainfall. In such a case Rabi I.D. to an extent of 50% of the same area may be proposed. Rabi wet crop should not be proposed under any project. If the monsoon rainfall varies from 30” to 35”, Kharif I.D. or wet may be proposed depending upon nature of soils, existing cropping pattern & farmers preference. As far as possible it should be ensured that Ayacut is equally distributed on the right & left side of the stream instead of concentrating on one side only. This will ensure easy operation for Rabi I.D. crop by closing sluice of the canal in alternate years. In the drought prone areas the cropping pattern of Kharif I.D. (Protective irrigation to rainfed crops) and Rabi I.D in the ration of 2:1 may be followed invariably.

Continuous working table for a period of at least 12 years may be prepared for Ayacut more than 500 ha. and cropping pattern & capacity of tank determined.

EARTH BUND STANDARDS:

The standards of earth bunds for M.I. Schemes have been communicated in circular no.33 in the shape of printed booklets. These may please be followed. In the same booklet

ready reckoned table were also prepared for calculating various quantities of work for Zonal & homogeneous sections upto 16.00 m ht. of bunds. Thickness of revetment is indicated as 0.30 m. This may be considered for estimation purpose and ready reckoner tables were worked out on this basis. However actual thickness of revetment can vary from 0.25 m. to 0.30 m depending upon the size of stone available and actual thickness has to be measured and paid for. Ready reckoner tables may be considered for estimation purposes only. Various items of work have to be actually measured & paid for. For bunds more than 16M ht, the sections are to be finalized based on soil test results & actual design. The stability of bund sections have to be checked up with slip circle method. For this, the site details & bund proposals with soil test results may be sent to Central Designs Organization and sections finalized taking the help of C.D.O.

EVAPORATION LOSSES IN TANKS

While calculating the working tables of M.I. tanks evaporation losses are to be considered based on the open pan evaporation meter, data available in the near by I.M.D station, research Institutions of A.P. Agricultural University, Educational institutions, Engineering College etc., instead of using empirical formula or the old conventional method as suggested in the Ellis Irrigation manual. The actual evaporation from lake bodies were calculated from 41 stations in A.P. and detailed in circular no. 25. The data of the nearest station to the proposed project can be taken into consideration for working out evaporation from the proposed reservoir while working out the regime tables.

IRRIGATION DEMAND/METHOD OF CALCULATIONS/POTENTIAL – EVAPOTRANSPIRATION MODIFIED PEN MAN FORMULA:-

For working out demand tables for all M.I. Schemes the following method may be adopted.

(a) Potential evapotranspiration (PET) of the area based on Agro Meteorology of the nearest station may be considered. Values of the evapotranspiration for various stations in A.P. month wise are indicated in the statement (1) in circular no. 19, values of the nearest station may be considered for the M.I. Project in question. Monthly values of Irrigation Demand may be worked out based on the crop factor, useful rainfall, and ET values making use of Modified pen man formula, Sample calculations for protective Irrigation for rainfed crops Rabi, I.D., Irrigated wet area enclosed in the statement 2,3 and 4 in the circular no. 19.

As the method of assuming number of Wettings for Kharif I.D. and Rabi I.D. and adopting the same for all areas is having the risk of un-realistic assumptions, the method given above is a very rational and simple one and the same may be adopted for all schemes under Minor Irrigation.

DESIGN FLOOD

1. In the earlier circulars instructions were given to adopt Dicken's formula for calculating maximum flood discharge from catchments, taking the value of 'C' varying from 900 to 1200. This empirical formula, though serves the purpose in a limited way does take into consideration the factors like the nature of the catchment, length/width of the catchment, time of storm to peak etc. and there fore lacks precision.

In recent times, Hydrographs are being used for estimating the maximum flood discharge. Which will take into consideration all factors as far as possible to arrive at more realistic figures. Much theoretical work was done in hydrology during the past 5 decades. Correlation with practical field data was also done in selected catchments in India. Detailed hydrological studies were done elsewhere in the world. The Ministry of Agriculture, Central unit for soil conservation (Hydrology and Sedimentation) Government of India has also brought out a "Hand Book of Hydrology".

Based on a study of the existing works, a similar method is now worked out and suggested for arriving at the maximum flood discharge (M.F.D) from catchment in all Minor Irrigation schemes. This method (C.E's rational formula) takes care of important features of Hydrological nature but reduces the rigorous methods to simpler steps clubbed together so as to make easy application to minor irrigation schemes.

This method is explained the circular no.13 along with sample calculation (which can be easily followed) and M.F.D. at 25 years frequency can be arrived at. In circular no. 13, 2 graphs were given and in circular no. 21 two more graphs with rainfall chart (for 25 years 1 day rainfall) are give for calculating the flood discharge, for higher rainfalls. The M.F.D. as worked out above should be cross checked with the value arrived at by area slope method, as per observed Maximum flood level (M.F.L.) and the higher of the two values may be adopted, after critically examining the problem and the accuracy of observed maximum flood level. While working out the M.F.D. by area slope method with the observed M.F.L. the L.S and Survey plan of the stream should be taken. Three cross sections of the stream one at the proposed site one on U/s site (min. 100 M) and one on D/s in a well defined course of stream (at the proposed project site) may be taken. The cross sections at each point may have to be

extended on either side upto M.F.L. enquired locally, or on observed. Flood marks available if any, in the vicinity. Manning's formula may be adopted for computing the velocity in M/sec. (i.e., V= 1/n R 2/3 S ½). Where "n" is the Co-efficient of, rugocity, "R" is the hydraulic mean radius and "S" surface fall, slope of the stream.

The value of "n" may be taken as follows:-

a. Rivers and canals om earth below the average in fair order 0.030
b. B Rivers and canals in earth obstructed by detritus and in bad order and regime .. 0.035
c. Rivers and canals in earth obstructed by detritus and in rock cutting 0.035

9. DESIGN OF WEIR APRONS AND SURPLUS ARRANGEMENTS FOR TANK WEIRS:

(i) To have an uniform procedure and easy execution type design for the weir communicated in circular No. 35 can be adopted for disposing off the max. flood. This has a co-efficient of discharge of 4.1 and is simple to construct.

(ii) the obstruction removal in the foreshore should be done to a minimum depth h/2 in case of all weirs. On the rear side of weir, the obstruction should be removed upto top level of proposed apron.

When there are chain of tanks in cyclone prone areas and the scheme under investigation falls in this category, the 4^{th} tank in the series may be given special consideration and necessary additional surplus arrangements including breaching section provided, so that the hazards in cyclone can be avoided. Instructions given in circular No. 7 may be kept in view. Similarly for improving the capacity of old silted tank the M.W.L. and F.T.L. can be made same by providing suitable gated weirs, thus avoiding the costly land acquisition problems. The instructions given in circular No. 7 may be followed.

For small catchments where paved bye wash and rough stone escapes are proposed, depending on site conditions, the head of discharge should in no case be more than 0.5M in case of hard and Gravelly soils and 0.3M in other types of soft soils. The aprons and protective arrangements may be designed suitably.

10. ANICUTS :

For the design of anicuts, the first essential thing is to construct a stage discharge curve, covering the full range of discharge including the M.F.D Manning's formula may be used for arriving discharges. For knowing the mean slope at least 3 cross sections in a well defined stream should be taken. The value of Co-efficient of rugosity (n) may be adopted as

specified in para 8 . the section of weir dissipation arrangements may be followed as per the type design in Circular No.35.

11. SURPLUS COURSE :-

For the protection of weir on D/S side the cut off of solid apron is to be taken upto hard strata beyond scour depth, and rough stone aprons are to be suitably provided. The scour depth may be calculated as indicated below.

The scour depth below the maximum water level is given by

R = 1.374 {

Where R = Normal scour depth in Metres

Q = Discharge in cubic metres per sec per Meter length of the weir at the end of impervious apron.

F = Lacey's silt factor

Normally 1.00 for standard silt

2.00 for coarse sands

3.00 to 4.00 for gravelly soils.

For the design of cut offs, the upstream cut off c an be taken to 1.25 R in straight reach and 1.50 R in curved reach, below the upstream M. W. L.

Similarly for the down stream side cut offs, they are to be extended to 1.50 R in straight reach and 2.00 R in case of curve portion having cross flows.

Details of weir and aprons as given in Circular No. 20 may be adopted. Sketch showing the arrangements are given in this circular. The idea of extensive drop wall structures to reduce the velocity of flow in steeply falling terrain is good but is very expensive. Cheaper alternatives by having rubble cut off walls, for mation of regime and stabilition of flow in harder soils in surplus course will have to be explored as detailed in this circular.

Hence it should be noted that no footings are to be laid for the concrete cut off and as well as for rough stone wall as they will entail filling up on the sides with earth, which may settle later on. This was explained in circular No. 28.

For surplus course, the entire width of weir portion also need not be excavated. Instead, pilot channels of 10 M width X 0.5 M depth at 25 M intervals can be excavated and the surplus course can be safely led into existing valley. For this, the instructions given in circular No. 6 can be also applied to the Minor Irrigation Tanks.

12. CHANNELS:

(i) Design capacity of channels:

The General practice hitherto followed for design of irrigation water supply is based on the average duty concept. In some major irrigation projects for wet (Paddy) crops 914 Ha/cumec or 64 acres/cusec was considered and canals designed accordingly. For light irrigated crops (I.D.) 2071 Ha/cumec or 145 acres/cusec was considered. This method results in several bottlenecks and difficulties in water management.

(a) Kharif Paddy:- Water requirements for paddy (wet) crops will have to be calculated as per the agroclimatical considerations and irrigation needs determined by one of the standard methods (Modified Penman etc.) Vide circular No. 19.

(b) Kharif I.D. Crops:- During the kharif season farmers do not require water for irrigated dry crops when there are rains in the ayacut area. There is no need to give water supply during rains and also for a period of 10 to 15 days after a good rain. But every farmer will be very eager to have irrigation water after a period of 10 to 15 days after rain, and during such a dryspell all the farmers in the tank command need water almost simultaneously. A three day rotation interval for covering the entire kharif I.D. ayacut may perhaps be alright if wilt point is not reached by the time the farmers having third day turn get their share of water. If a longer rotation interval is chosen (say 7 to 10 days) tail end farmers interests will get effected and they may disturb the distribution system by breach irrigation etc.

This aspect has to be thought of and taken into consideration for design of channels to supply water to the entire ayacut within 3 days rotation interval upto tail end. This realistic approach works out to having the correct and required capacity for canals to supply water in a Kharif season than by the method of assuming the average duty. Actual peak discharge has to be worked out on the basis of 50mm per wetting (including losses) for wetting the entire ayacut in a period of 3 days and the canal has to be suitably designed. This works out 17 mm per day for the entire ayacut or 2.0 lit/sec/Ha for the entire ayacut (Duty of 36 Ac/Cusec)

Though the discharge of canal will be high and higher than even the flow required for wet, crops, yet quantity of water supplied for the entire kharif I.D. Crop period will be very low. This is on account of the fact that 3 to 5 irrigations may be needed, the exact quantity, depending upon the crops, soil moisture condition, intensity of drought etc. During such drought spells on an average 8” of water may be required and this will be supplied to the ayacut in a period of 12 days, in a crop period of about 100 days. In order to rush the supplies to tail end ayacut within a short time, the canals have to be lined. Such lining will also reduce the seepage losses.

For Rabi I.D.Crops:- For rabi irrigated dry ayacut, wettings can be at 7 to 10 days rotation intervals depending upon the nature of the crops, soil moisture, field capacity and the atomospheric conditions.

On an average 5mm of wetting (including losses) will have to be given in a rotation interval of 7 days for Rabi. I.D. Crops during hot spells and irrigation water supplied through out the crop period as per crop water requirements. Since there will be no rainfall during crop period irrigation water will have to be supplied for the entire crop requirement. The maximum requirement may be designed for a discharge of 1.0lit/sec/ha for entire ayacut (duty 75 Ac/cusec). This may be compared with the modified penman method (circular No. 19) and the higher of the two values adopted for design of canals.

(ii) Design of Channel section:-

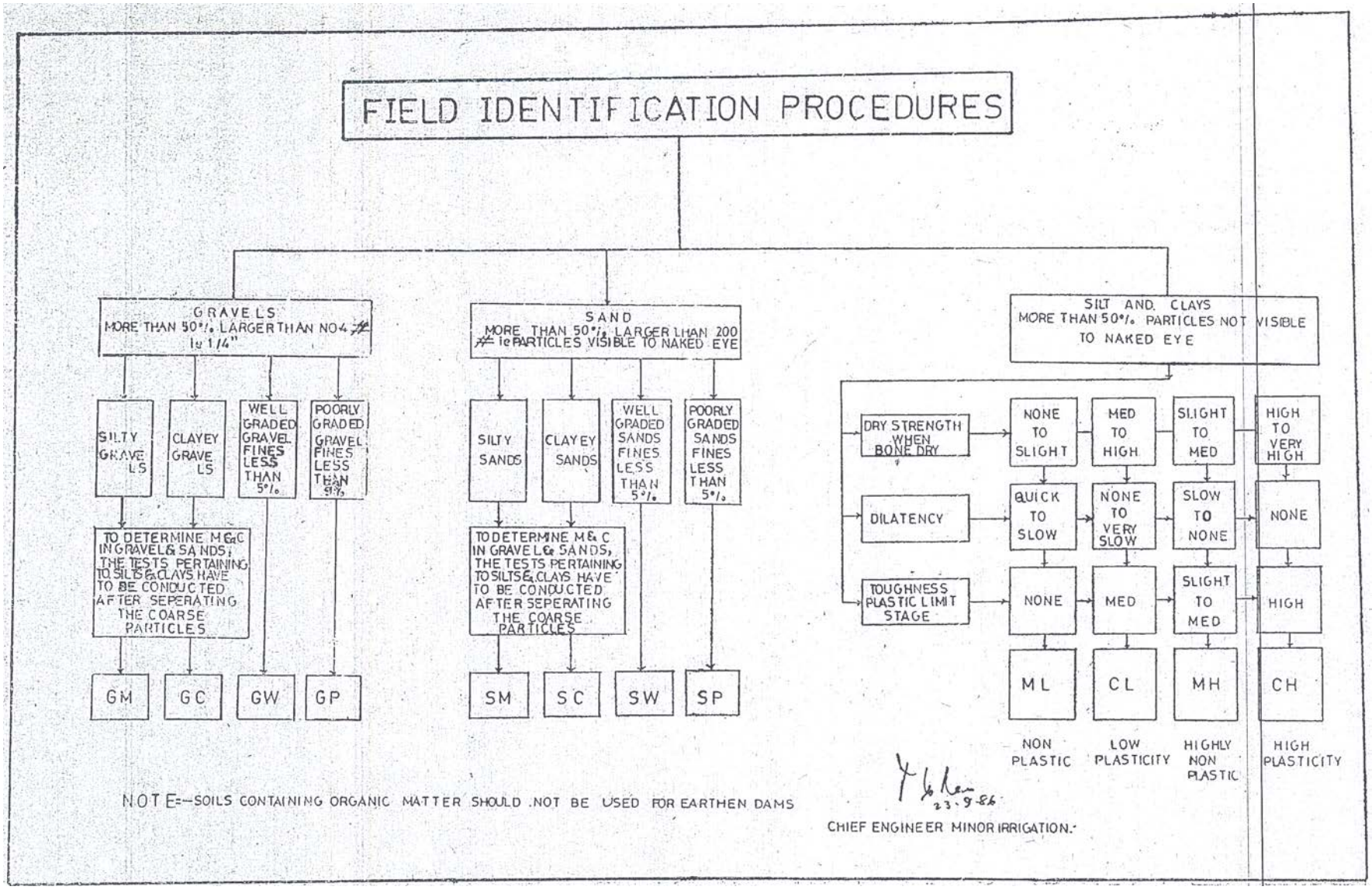
The permissible velocity in B.C. soils generally can be upto 0.5 m/sec and in harder soils upto 1.0 m/sec.

The following depth of flow can be assumed for designed channels.

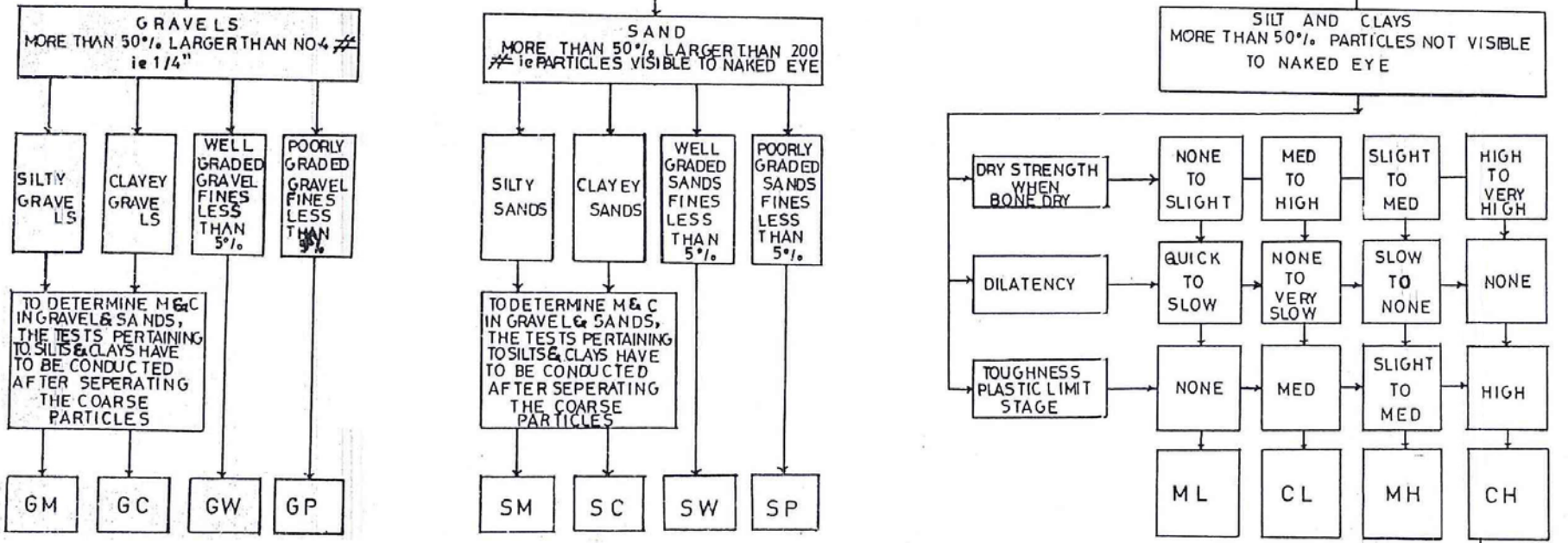
q in litres/sec	d in cm	q in cumecs	d in metre
(1)	(2)	(3)	(4)
20	20	4	1.1
80	30	5	1.2
200	40	6	1.3
400	50	8	1.4
600	60	10	1.5
1000	70		
1500	80		
2100	90		
3000	1000		

Bed with to depth ratio as suggested by C.W.P.C for design of channels can be adopted and can be modified as per site conditions.

q in litres/sec	b/d	q in cumecs	b/d
(1)	(2)	(3)	(4)
300	2.9	2	4
400	3.0	4	4.9
600	3.2	10	5.4
900	3.4		
1000	3.5		


FIELD IDENTIFICATION PROCEDURES
GRAVELS
MORE THAN 50% LARGER THAN NO4 # ie 1/4"
SAND
MORE THAN 50% LARGER THAN 200 # ie PARTICLES VISIBLE TO NAKED EYE
SILT AND CLAYS
MORE THAN 50% PARTICLES NOT VISIBLE TO NAKED EYE
SILTY GRAVELS
CLAYEY GRAVELS
WELL GRADED GRAVEL FINES LESS THAN 5%
POORLY GRADED GRAVEL FINES LESS THAN 5%
SILTY SANDS
CLAYEY SANDS
WELL GRADED SANDS FINES LESS THAN 5%
POORLY GRADED SANDS FINES LESS THAN 5%
TO DETERMINE M&C IN GRAVEL & SANDS; THE TESTS PERTAINING TO SILTS & CLAYS HAVE TO BE CONDUCTED AFTER SEPERATING THE COARSE PARTICLES
TO DETERMINE M&C IN GRAVEL & SANDS, THE TESTS PERTAINING TO SILTS & CLAYS HAVE TO BE CONDUCTED AFTER SEPERATING THE COARSE PARTICLES
GM
GC
GW
GP
SM
SC
SW
SP
DRY STRENGTH WHEN BONE DRY
DILATENCY
TOUGHNESS PLASTIC LIMIT STAGE
NONE TO SLIGHT
MED TO HIGH
SLIGHT TO MED
HIGH TO VERY HIGH
QUICK TO SLOW
NONE TO VERY SLOW
SLOW TO NONE
NONE
MED
SLIGHT TO MED
HIGH
ML
CL
MH
CH
NON PLASTIC
LOW PLASTICITY
HIGHLY NON PLASTIC
HIGH PLASTICITY
NOTE:—SOILS CONTAINING ORGANIC MATTER SHOULD NOT BE USED FOR EARTHEN DAMS
23-9-86
CHIEF ENGINEER MINOR IRRIGATION.

FIELD IDENTIFICATION PROCEDURES



NOTE:—SOILS CONTAINING ORGANIC MATTER SHOULD NOT BE USED FOR EARTHEN DAMS

23.9.86

CHIEF ENGINEER, MINOR IRRIGATION

The channel sections may be designed to ½:1 side slopes for designed discharge-

The channels can be executed with 1:1 slope in cutting and 1½ or flatter slopes in embankment (as per site conditions) provision for canal lining may be incorporated in the estimates, the execution of lining work to be carried separately, only after observing the performance of the distribution system for a period of one year.

All canals & field channels have to be lined wherever I.D. Cropping pattern is followed. The lining can be done as per any approved specifications using mostly local materials (Example…. R.R.Masonry etc.) Provision for this lining including incidental cost and price fluctuation may be made in the estimate while calling for tenders for execution of works items pertaining to canal lining may be deleted. After one year of functioning of the canal system the lining work may be executed at the required places depending upon the exact lengths requiring lining, based upon the ayacut developed and other relevant factors.

13. TRIAL PITS :

The finalized bund alignment should be fixed with reference to existing permanent features.

(a) The trial pits along the bund line:

(i) The trial pits along the bund line are to be taken at minimum of 100m. intervals and at close intervals where the ground terrain steeply changes or where the soils classifications are suddenly varying;

(ii) The purpose of trial pits is to ascertain the strata upto atleast ½ F.R.L. depth and also to know the depth of impermeable strata.

(iii) In certain Sedimentary, metamorphic formations, river bouldary strata etc., it is likely that the stream bed may have boulders shingles etc. even deeper than ½ F.R.L. depth. In such cases, it is essential to have the trial pits excavated further deeper than ½ F.R.L. depth till impervious strata is met with.

(b) The trial pits along weir sluice and for aprons etc :

The trial pits along the weir line are to be taken at minimum of 15m. intervals. The trial pits should be taken at the abutments and the central trial pits are suitably located not exceeding 15m. intervals.

Similarly one trial pit at the proposed sluice is to be taken. The same is to be taken. The same is to be followed for the trial pits in the apron portion and in the fore-shore (fore bay over burden clearance)

The trial pits are to be extended upto harder strata with minimum of 0.8M depth below ground, or upto foundation level for the masonry structures.

The position of trial pits to be certified both by the Assistant Engineer/Asst. Executive Engineer and Deputy Executive Engineer and are to be invariably verified by the Executive Engineer Countersignature by the Superintending Engineer would be necessary for schemes requiring sanction by the Chief Engineer.

Index Plan to a scale of 1:50,000 (Xerox copy) is to be furnished showing alignment of bund submersion area, catchment area, ayacut area, suplus weir, surplus course quarries etc.

14. BORROW AREA & IMPROVEMENTS TO BUND :

No borrow pits should be closer than 10 times height of bund (H) from upstream and 5(H) from downstream toes. In the case of existing tank bunds wherever recognized cattle track or footpath run, across the bund, revetment may be provided on the upstream side from T.R.L. to T.B.L. (and also top width) and down stream side from T.B.L. to toe, for a width of 3m.

15. FIELD TESTS & CLASSIFICATION OF SOILS FOR TANKS :

Circular No.16 explains fully the field identification procedures or the soils available in borrow are proposed for forming tank bunds. The details of stable slopes for forming the bunds with reference to the various soils are noted in type designs, circular No.33. A chart of procedures to determine the classification of soils is noted below to serve as a guide while conducting the field tests (Vide Chart). In case of doubt about the field tests & classifications, the samples are to be collected and sent tot A.P.E.R.L or near by Engineering College Laboratories and detailed analysis may be done and soil mechanics parameters may be determined to design the bund sections.

16. SURVEYS :- As per circular No.27. All the levels taken are to be connected to G.T.S benchmark values (corrected to M.K.S. System)

In the new formation of tanks the interval of L.S.points should be 30M and Cross sections should be taken at 30m intervals duly extending the levels to a distance of 100M on either side of the axis line. The interval along cross section, levels should be at 30M or at closer intervals wherever necessary.

Block levels in a grid of 60M may be taken for arriving at the submersion area contours including F.T.L. & M.W.L Block levels in a grid of 60M may be taken for ayacut also. L.S. for main canal may be taken at salient points and at 60M intervals. Cross sections for main canal may be taken at 120M intervals for a length of 30M on either side at interval of 30M or closer if necessary.

Block levels may be taken for net levels plan of C.M. & C.D. works earth dam head sluices, weirs, surplus courses etc. at intervals of 10M grid.

17. PREPARATON OF PLANS & ESTIMATES AND CERTIFICATES TO BE ENCLOSED

Plan should be drawn to the scales noted as under :

a.	Index Plan			1:50,000
b.	Theisson Polygon showing rainguage stations.			1:2,50,000
c.	L.S.of stream	Horizontal Vertical		1:5,000 1:50
d.	Anicut site surveys head works with levels 100M upstream & 100M downstream including flood banks			1:500 or 1:1000 or 1:2000 As per site conditions
e.	Bund	(i) L.S.	Horizontal Vertical	1:2000 1:200
		(ii). Cross Sections		1:100 Natural 1:2000
f.	Foreshore Plan			
g.	Weir.	(i) L.S. & Plan	Horizontal Vertical	1:1000 1:100
		(ii) Weir Plan	1:200 por	1:300
		(iii) Net levels @ 10M squares	1:500	Contours to be drawn at 0.5M intervals depending upon slope of the country.
h.	Sluice	(i) L.S. & Plan (ii) Weir Plan (iii). Cross Sections		1:100
i.	Channels	(iii) L.S.	Horizontal Vertical	1:2000 1:200
		(ii). Cross Sections		1:100 Natural
		(iii) Net levels for C.D.& C.M. works		1:500
		(iv) Plan for C.M.& C.D.works		1:100 Natural

All the Engineering drawings have to be prepared in pencil on polyster films now available in market (Gar film etc.) Photo copies on plan paper copier or ammonia prints may be prepared from the pencil drawings for the purpose of sending from one office to another office the original pencil drawings have to be retained in the concerned division. It is seen that even the pencil drawings on polyster films can be photocopied or ammonia printed and hence inking the same is not a must and the drawing can be inked only after the same is finally approved in a sanctioned estimate.

Graph sheets are to be used only when there are applications making use of x-axis and y-axis (example area capacity curves etc.) and should not be used for preparing Engineering drawings.

18. CERTIFICATES TO BE ENCLOSED ALONG WITH THE ESTIMATE

(a) CERTIFICATE For L.I & L.A. :

The Executive Engineer should invariably furnish on certificate to admit the provisions of L.I & L.A. in the data as per G.O.Ms.No. 1452 dated: 29th August, 1970 and the G.O.Ms.No. 1894 dated: 20th December, 1971 as follows.

"Certified that local labour available is not adequate and hence labour has to be imported for execution of this work.

(b) CERTIFICATE FOR LEADS OF MATERIALS :

"Certified that I have inspected the quarries of materials on date …….. and verified the quarried with regard to their quality, workability, adequacy and correctness of the leads of all the materials provided in the estimate".

(c) CERTIFICATE FOR L.R.R. AND U.R.R. :

It is certified that the proposals under consideration duly involving an utilization of …….. Mcft. Shall not effect lower riparian rights and upper riparian rights.

(d) CERTIFICATE OF TRIAL PITS RESULTS :

A certificate to the effect that "the classification of soils as shown in the trial pits are verified by me and found to be correct" is to be furnished duly signed by Deputy Executive Engineer/Executive Engineer on the plans.

19. GENERAL :

(a) Soon after the scheme estimate is completed in all respects the details of salient features (one page) should be prepared as per the Circular No. 23 for information of field inspecting Officers. However the detailed salient features as finalized now in this booklet should be enclosed with the estimate vide chapter-4.

(b) The cost of the Project should be analysed and the Gross Irrigated area (G.I.A) is to be arrived duly totaling the ayacut in khariff and Rabi as per circular No. 22 and intensity of irrigation is to be worked out as (G.I.A. x 100)/CCA=….%. Where C.C>A is the Culturable command area. The cost per hectare of irrigation is to be calculated based on the Gross area Irrigated.

(c) Depending upon the importance of project, provision for approach roads are to be made. For guidance Circular No.4 may be kept in view.

(d) The B.C. Ratio calculation statements are enclosed in Circular No.1 which may be carefully filled in after obtaining the relevant figures from the Agriculture Department.

The following B.C. Ratio have been fixed for the Irrigation Schemes in G.O.Ms.No.482, dated: 14th July, 1978. Vide general Circular No. 5G.

	B.C. Ratio	
	@5% interest	@10% interest
(i) Scarcity area.. …. …. ….	1.5	1.4
(ii) Non Scarcity areas …. …. ….	1.5	1.5

The details of scarcity areas are detailed in General Circular No. 1G.

The B.C. Ratio has been exempted for the tribal schemes. Vide Government Memo 1536/Irr.VI.2/80-4, dt:23.03.1981 (Circular No. 6G). The General G.Os relating to criteria for selection of tribal schemes 2G,3G,4G, & 8G are also appended.

T. HANUMANTHA RAO,
Chief Engineer, Minor Irrigation.

STATEMNET NO.I

SCRUTINY NOTE AND CHECK SLIP ON PRELIMINARY INVESTIGATION REPORTS ON RESERVIOR SCHEMES

(a). Name of the scheme :

(b). Reference :

(c). Amount of estimate Rs. On works
& Rs. Including Direct & Indirect charges.

(d). Ayacut proposed.

(e). Percentage Return/Cost per acre.

(f). If it is a Normal/CAP/DPAP/Tribal Scheme.

1. Hydrology :	As submitted by the S.E.	As verified in C.E's office

Location : Latitude :
: Longitude:
S.I. Sheet No.

2. Catchment area in square Miles:

i). Free
ii). Intercepted
iii).Combined
iv). Nature of C.A

N.B. (a). The particulars should be compared with Master plan records and also as per S.I. Sheet etc.
(b). C.S. of the stream across which a cross-bunding is proposed should be taken out and tentative cost arrived approximately.

3. Rain Fall and yield :

	As submitted by the S.E.	As verified in C.E's office

(i). Influencing R.G.S as per Theisson's polygon…

(ii). Average Monsoon Rainfall and period considered….

(iii). R.F. at 75% C.L. and the year of occurance…

(iv). Yield per Sq.m mile (as per Stranges table)

(v). Total yield (treating the entire C.A. as free).

(vi). Comments, if any…..

4. i). The scheme is included / not included in M.P. record under the category to utilize and mcft for development of an ayacut of …… acres.

   ii). Total yield available in the Basin, Sub-basin or group….

   (ii) (a). Available at the proposed site.
   (b). Now proposed for utilization
   (c). If there is deficit yield at the proposed site, the yield from free C.A. of the schme.
   (d). Effect of the scheme on L.R.R.s. & U.R.R.,Rs.
   (e) Is the surplus yield proposed to be utilized lower down, if so, where & t he name of the scheme.

5. Suitability of soil for :

   (i). Crop
   (ii) Embankment

6. Suitability of water for Irrigation.

3. CHECK LIST

Name of the scheme:…….

I. SURVEYS & PLANS.

Are the following plans appended?

1. Index map of the project (scale 1:50,000) (Xerox copy of S.I. sheet extract), showing catchment area. Submersion area, ayacut area, surplus wier, surplus course, canals, and approach road to the dam site.
2. Thiesson paygon map of the area showing the location of rainguage stations, guage discharge stations if any and project area (Scale 1:2,50,000).
3. Reservoir contour plan (Scale 1:50,000)
4. L.S.of stream (Scale Hor 1:50,000 Vert. 1:50)
5. Anicut site surveys showing head works with levels 100M U/S & 1:500, 1:1000 or 1:2000, as per site conditions.
6. (i). L.S. of bund section or anicut section showing T.B.L.,M.W.L.,F.R.L., sill level and 100M D/S including flood banks 1:500, 1:1000 or 1:2000, as per site conditions.

   (ii). Cross section of bund, in deep portion with all its appurtenances. Scale Hor. 1:2000 ver. 1:200
7. Foreshore plan showing the contours at close intervals. Scale 1:2000
8. Borrow area map showing the quarries for different earth full materials, for rock aggregate, sand etc., along with layout of haul roads etc. scale 1:8000 or (Village map scale)
9. Weir plans:

   (i) Net levels plan showing contours at closer interval showing the surplus course Scale: 1:500 or 1:1000

   (ii). L.S. & Plan of weir : Scale : 1:200 or 1:300
10. Head sluice or regulator L.S.Plan & Cross section Scale : 1:100 Natural
11. Canal:

    (a). Canal layout plan including head works position, water conveyance system with command area details showing the contours, proposed alignment of channels with H.P. Details tabulated and attached there on to the map.

    (b). (i). L.S. and survey plan of the canal showing the T.P. results-marking the proposals there on with C.M. & C.D. works details with H.P. Details reach wise.

    Scale Hor. 1:2000, Ver. 1:200

    (ii). Typical cross section of canal in (i). deep cutting

    (ii). Maximum embankment.

    (iii). Vulnerable reaches if any.
12. Contour capacity curves.

II. FOUNDATION INVESTIGATIONS.

(a) Was trail pit excavated for the Earthdam at deep valley below bed of stream to a depth of H/2 or lower?

(b) Was permeability test for cut off trench conducted : and results enclosed ?

III. MATERIAL SURVEYS :

(a). Have the field identification of soil tests conducted and results appended ?

(b). Is the quality of flood water and normal water flowing at site tested and results appended ?

IV. HYDROLOGY:

1. Is rainfall datafurnished and yield worked at site ?
2. Flood discharge
   (a) Is gauged data furnished in case of diversion flows from stream ?
   (b) Is the design flood calculated as per latest C.E's Circular (3-3-1986)
   (c) Is it compared with the observed H.F.L?
3. Storage capacity :
   (a). Are the working tables prepared and conclusion if any made ?
   (b). What is the percentage of dead storage with reference to F.R.L.Storage?
   ©. Any number of failures detected in a continuous period of working tables? (Relevant only for schemes having more than 500 ha. Ayacut?)
4. Has the back water effects due to this scheme proposals looked into? (For anicut schemes only)
5. Are the upper and lower riparian rights discussed in the report?

V. LAND ACQUISITION :

(a). Is the type and quantum of land proposed to be acquired for the entire scheme such as submergence area, project area, land for canal system, details?

(b). Is the land required for amenities etc. as suggestion in the C.E's circular Nos. 4 & 10 taken into account ?

(c) What is the basis forcost of land acquisition ? is it got confirmed by the Revenue authorities ?

VI. DESIGN OF HEAD WORKS & CANALS :

(a). Has the final location of head works and appurtenances in preference to other sites investigated and discussed ?

(b). Is No. of flood days calculated (for 40 years rainfall) with 75% PL, for finalizing the channels capacity ?

©. Is the canal and distribution system proposed with lining ?

(d) Is loss of head at C.M & C.D. works considered in the channel system ?

(e) Is it ensured that M.W. Ls. In tanks does not effect the channel banks wherever channel passes through tanks ?

VII. GROUND WATER :

(a) Are there any potential ground water zones in the ayacut ?

(b) Is any conjunctive utilization of ground water planned ?

VIII. CROPPING PATTERN :

Is the cropping pattern proposed based on the existing practices in the area ?

IX. FINANCIAL :

Has the Collector given concurrence on F & A Aspects of the scheme ?

X. ESTIMATE :

Are the provisions made on the basis of sample survey and sub-estimate for canal system for case, L.S. Provisions are made for the channel system ?

(a). Distributaries, minors, and sub minors.
(b). Water courses, C.M. & C.D. Works
(c). Drainage.

XI. B.C. RATIO :

Have the crop-wise benefits been worked out before irrigation and after irrigation for crops in consultation with the agriculture department and statement furnished ?

XII. STAFF QUARTERS AND BUILDINGS.

(a). Does the scheme provide the minimum facility of buildings both for supervisory and no technical staff and for carrying out and field lab tests. Are the instructions contained C.E's circular No.10 followed and adopted ?

----------:O:----------

4. SALIENT FEATURES

4.1. Name of the Scheme.

4.2.Cost.

Ayacut.

B.C.Ratio

4.3. General.

4.3.1. River basin.

(i). Name of River.

(ii). Sub basin

(iii). Minor basin.

4.4. Location.	Village Limits.	Ref.to topo-sheet	Longitude	Longitude

4.5.Irrigation (ha)

(a). Area proposed under Irrigation (Ha)

		Left canal.	Rt. Canal	Total.
(i)	Kharif (wet).			
(ii)	Kharif (ID)			
(iii)	Rabi (ID)			

(b). Cost per hectare of irrigated area:

(c). Cost per (i). 1 Mcft of gross storage.
(ii). 1000 cum of gross storage.

4.6.Hydrology :

(a). Catchment area.
(i). Free.
(ii). Intercepted.
(iii). Gross.

(b). Precipitation-Rainfall Influencing RGS in the catchments. (i)……
(ii)……

(i). Period of records –Last 40 years from ……. To …….

(ii). Average annual rainfall.

(iii). Average Monsoon rainfall (June to December).

					Utilisation
(c). Upper ayacut:	Kharif (Wet)	---	Ha.	---	Mcft.
	Kharif (ID)	---	Ha.	---	Mcft.
(d). Lower riparian rights:	Kharif (Wet)	---	Ha.	---	Mcft.
	Kharif (ID)	---	Ha.	---	Mcft.

The total yield required for upper abstractions & lower riparian rights.----------

(e). (i). Total yield from the Gross catchment …… Meft as per stranges table.

(ii) Deduct the yield required for upper abstractions & riparian rights as in C & D above (--) ……

(iii). Balance yield available at head works site (i-ii) ……..

(iv). Commitments for the scheme under contemplation and under investigation …….

(v). yield available as per Master Plan records ……. Mcft.

(vi). Hydrologic clearance was accorded by the Chief Engineer Minor Irrigation …… for …… Mcft in No. …….

4.7.Surplus weir :

(a). Max. flood discharge (as per 25 years frequency as per latest C.E's rational method)

(b). Observed Max. flood discharge (if any) …….. Cumecs.

(c). Design flood proposed for the scheme ……. Cumecs.

(d). Length of weir proposed :

(e) Head of discharge :

(f) Length of surplus course :

4.8 Reservoir/tank

4.8.1. Water levels & storage Storage

(a). Max. water level + ……(…… Mcum)

(b). Full tank level+ ……(…… Mcum)

(c). Dead storage level (sill of sluice) + …….

(d). Number of fillings (yield utilised item 4.6 e (vi) ÷ gross storage at FTL.

4.8.2. Live storage (Mcum).

4.9. Submergence Area.

4.9.1. Land & Property submerged ……. @ FPL/FTL

(i). Land .. .. Ha.

(ii). Houses. .. .. Nos.

(iii) Wells .. .. Nos.

(iv) Roads .. .. Km.

(v) Any others effected. ..

4.9.2. Submergence ratio (with reference to cultivable command area) …….

4.10. Length of earthen dam anicut

4.11. Canals system, & ayacut.			Left Canal.	Right canal	Left canal
Discharge (at Head)			……	……..	……..
Length.	……..		……	……..	……..
Ayacut.	……..	Kharif (Wet)	…. Ha.	..…. Ha.	..…. Ha.
	……..	Kharif (ID)	…. Ha.	..…. Ha.	..…. Ha
	……..	Rabi (ID)	…. Ha.	..…. Ha.	..…. Ha

4.12. General

5. PROJECT REPORT PREPARATION

5.1. INTRODUCTION.

The following important items and additional items if any as relevant to the scheme shall be discussed briefly under this chapter.

5.1.1. Aim of the scheme and description of work

5.1.2. Location of scheme area including Longitude, Latitude, district, taluk/mandal benefitted.

5.1.3. Access by air/rail/road and other communication facilities available in the area.

5.1.4. General climatic conditions of the scheme area in particular.

5.1.5. General description of topography, Physiography and geology of the area.

5.1.6. Population.

(a). Affected and benefited.

(b). Occupation.

(i) Agriculture.

(ii). Other than agriculture etc.

5.1.7. Natural Resources. (Brief description of stream & Waters available)

5.1.8. Land-use and socio-ecnomic aspects (including tribal, backward and drought areas etc.)

5.1.9. History.

(a). Earlier proposals

(b) Present proposals.

5.1.10. Choice of the scheme: Alternative studies and final decision

5.1.11. Fitment of the scheme in overall development of the basin

5.1.12. Cost and Benefits of the scheme.

5.1.13. Public Co-operation and participation.

5.1.14. Public views on benefits and proposed levies.

5.2. HYDROLOGY :

The details of Hydrology inputs actual observations if any, with rainfall records yield calculations (inputs), reservoir working tables, FRL fixing, Max. flood discharge calculation. Design flood calculation to be followed as per the circulars and they are to be prepared as a separate chapter and enclosed to the report. The main features are to be discussed in the report briefly. The sanction No. of Hydrologic clearance is to be furnished.

5.2.1. River or stream system and basin characteristics, raingauge station influence, rainfall.

5.3. YIELD .

5.3.1. Yield availability at site.

5.3.2. Quantity of water proposed for the scheme

5.3.3. Upper riparian rights.

5.3.4. Lower riparian rights.

5.4. SURVEYS AND INVESTIGATIONS.

The surveys and investigation carried out justifying the site for proposed scheme is to be discussed. The scales of maps contour intervals etc., shall be as per standards.

5.4.1. Topographical surveys.

Details of surveys conducted shall be furnished. i.e. Block level maps with contours. Cross section. details etc.

(a). Stream

(b). Reservoir or anicut site.

(c). Canal & Water conductor system (for water supply if any)

(d). Scheme lay out with appurtenant works, approach roads, buildings and field laboratory tests.

(e). Command area ayacut details & Sample for branches and distributaries.

5.4.2. Any other surveys.

(a). Drainage survey : Where sub surface drainage is necessary for the ayacut.

(b). Soil surveys-As per the suggestions of the agriculture department

5.4.3. Geology –Geo-technical features:

(i). The results of exploration tests shall include details of the observation in the field as well as results of the laboratory/field tests, datas, interpolation and suggested treatments.

(ii). Verification of soils and rock types at site, possibilities of land slides by construction of reservoir particularly in hilly areas and locating structurally weak zones. Where doubt arises during inspection, the site should be got investigated by the Geological Department.

(iii). Sources of construction material like soil, sand, gravel aggregate, rock etc. shall be identified and their mode of occurrence indicated and leads to be noted.

5.4.4. Foundation-Investigation.

Report for the foundations of the following may be discussed in brief.

(a) Main dam (earth)

(b) Weir or anicut including aprons.

5.5. DESIGN FEATURES.

All design calculations in respect of head works, foundation treatment etc. are to be worked out separately in a chapter and enclosed to the report. The details of the structures for which designs are enclosed or circulars followed are to be noted in this para.

The design sections communicated for the earth bunds in circular memo No.33 to be followed . weir Design : Design circular No. 35 is to be followed.

For sluices and outlets. They must be designed to draw the requisite peak flow with 0.10 to 0.15m. driving heads Screw gearing operations may be provided.

5.6. CANALS.

This should mainly cover

(a) Description of canal system including ridge/contour and consideration for fixing alignment etc.

(b) Study of net work of canal system and utilization of water potential streams etc.

(c) Description of soil profile along the canal alignment based on trial pits.

(d) Evaluation of design parameters based on the samples collected along the canal alignment borrow area and suggested treatment for problematic reaches.

(e) Details of lining proposed.

(f) Transmission losses assumed for lined & unlined and canals.

(g) Design calculations of canal discussing…….

(i) Formula used and value of constants, bed slopes
(ii) Design of canal in various reaches

(iii)Velocities allowed
(iv) F.S.D. and Free board.

5.6.1. Canal structure : C.M. & C.D. works:

(a) List of canal structures with salient features, location, type, capacities etc. with brief description.

5.7. RESERVIOR :

The following points with additional details if any relevant to the scheme shall be discussed briefly in this chapter.

5.7.1. Criteria for fixation of reservoir levels and capacities : Level Capacity

(a) Dead storage level (sill level of sluices) …. .. MCUM

(b) F.R.L. (EL.M) …. .. MCUM

(c) Max. Water level (FL.M) …. .. MCUM

(d) Live storage …. .. MCUM

(e) Gross annual utilization and dependability for use

(f) Max. back water level at FRL & M.W.L. and its effect. Points to which back water effect is felt in case of anicuts

5.7.2. Annual losses.

(a) Evaporation

(b) Seepage losses in reservoir (assumed)

5.7.3. Area of submergence at.

(a) M.W.L.

(b) F.R.L.

(c). Submergence ratio = $\frac{\text{Submerged area}}{\text{Ayacut area}}$

5.7.4. Land acquisition and property submerged details (upto F.T.L. only, land will be acquired since it is an M.I.Scheme)

5.7.5. Any other relevant information

5.8. IRRIGATION PLANNING:

5.8.1. Existing cropping pattern

5.8.2. Soil surveys
Soil capability classification
Land Irrigability classification

5.8.3. Proposed Cropping pattern

(a) Details of area proposed under irrigation Kharif, Rabi.

(b) Scope for further extension such as conjunctive usage of water by using Ground Water potential.

5.9. ESTIMATES

Detailed estimate are to be prepared for Head Works, including weir, chl. System L.A. details & other under separate volume and the abstract only is to be described in brief.

(a) Thus the cost of scheme on works Rs. …….. lakhs excluding L. A.

(b) L.A.Charges Rs. ……lakhs.

Total estimate amount on works Rs. ……... lakhs.

Cost of scheme including D & I charges

The indirect charges may be worked out separately and abstract enclosed to the report. The details may be furnished in the report briefly.

Cost of scheme on works including L.A. Rs. …….. Lakhs
Indirect charges Rs. ……... Lakhs

Total Rs. …… Lakhs

5.10. REVENUES :

The expected benefits in revenue due to the scheme may be given (the details may be worked out and abstract enclosed to the report). The revenue opinion on F&A aspects on scheme should be obtained from the Dist. Collector & enclosed to the report and details noted here.

5.11. B.C. RATIO :

The statements relevant to working put of B.C. Ratio @ 10% interest may be enclosed separately. The B.C. Ratio worked out may be narrated here with its justification implementing the scheme.

5.12. CONCLUSION :

Any other important details recommending the proposals may be furnished.

LIST OF CIRCULARS

Circular No	Subject	Reference to circular Memorandum	Page	Remarks
(1)	(2)	(3)	(4)	(5)
1	Guidelines for Minor Irrigation scraping of extent of % of return and taking up of MI.. Schemes on B.C. Ratio furnishing proforma of B.C. Ratio statement-Reg.	P2/OT4-T4/24011/77 dt:18.10.1978	36 to 38	
2	Minor Irrigation-Approval of Head Works-Alignment &Hydraulic Particulars of canal-Designs of C.M. & C.D. Works in Minor irrigation Scheme	DCE/MI/OT1/T4/28556/84 dt:12.10.1984	39 to 40	
3	Minor Irrigation Tanks-Calculation of yield	P/OT1-T4/28556/65/Vol.III dt:16.05.1985	41 to 51	
4	Investigation of Minor Irrigation tanks – Preparation of Project Estimates-Provisions of approach road to the Project site-Reg.	DCE/MI/OT1/T4/28556/65 dt:15.06.1985	52	
5	Important streams and rivers – Name Tablets in Important Brides and causeways providing – Reg	DCE(MI)/OT1/T4/61826/85 dt:05.07.1985	53	
6	Percolation tanks-Surplus weir, surplus course training arrangement -Reg	DCE(MI)/OT1/T4/61826/85-2 dt:13.07.1985	54	
7	Providing increased surplussing arrangement for minor irrigation chain of tanks 4th tank in the chain – Reg.	DCE(MI)/OT1/T4/61826/85-3 dt:13.07.1985	55	
8	Computerisation of minor irrigation sources.	DCE(MI)/OT1/T4/Comp/85 dt:14.08.1985	56 – 60	
9	Design principles of Minor Irrigation Schemes – Procedure to be followed while fixing capacity of tanks – Reg.	DCE(MI)/OT1-T4/28556/65 dt:14.08.1985	61	
10.	Preparation of estimates for new minor irrigation sources-Reg.	DCE(MI)/OT1-T4/28556/85 dt:23.08.1985	62 – 63	
11	MI Schemes-Hydrology – Computation of yields-Reg	DCE(MI)/OT1-T4/61826/85 dt:30.08.1985	64 - 71	
12	Minor Irrigation – Guidelines for check dams or mini percolation tanks – Design Criteria – Reg.	DCE(MI)/OT1-T2/28556/65 dt:14.08.1985	72 - 73	
13	Design principle of Minor Irrigation Schemes – Procedure to be followed for calculating maximum flood discharge from catchments to design surplus weirs.	DCE(MI)/OT1-T4/28556/65 dt:25.9.1985	74 to 79	

(1)	(2)	(3)	(4)	(5)
14	Mini Percolation tanks (checkdams) Trenches in submersion area – Arrangements to enchance deep percolation – Reg.	DCE(MI)/OT1-T2/82930/85 dt:14.10.1985	80	
15	Mini Irrigation Projects – Preparation and formulation of plans and estimates – Administrative & technical sanction – Preparation of Project reports – Guidelines communicated from Govt. of India (plg. Commission) Instructions – Issued – Reg.	DCE(MI)/OT1-T2/32930/85 dt:02.12.1985	81	
16	Investigation of earthen dams – Construction classification of soils in borrow areas field instructions – Tests – Reg.	DCE(MI)/OT1/T4/28556/65 dt:02.12.1985	82 - 87	
17	Storing capacity of Minor Irrigation Tanks – No. of fillings – Reg	DCE(MI)/OT1/T4/28556/65 dt:24.12.1985	88	
18	Preparation of Project reports for E.E.C. Aided Schemes – Lumpsum Provisions – Economizing the cost for Hectare – Instructions - Reg	DCE(MI)/OT1/T2/82885/85 dt:16.1.1986	89 - 91	
19	Irrigation Demand – Method of Calculation – Potential Evapotranspiration – Modified Pen-Man formula – Reg.	DCE(MI)/OT1/T4/28556/65 dt:16.1.1986	92 - 97	
20	Surplus weir aprons – Dissipation arrangements – Rough stone aprons (Talus) Retaining Wall	DCE(MI)/OT1/T4/61826/85 dt:21.1.1986	98 – 100	
21	Design principles of MI Schemes – Procedure to be followed for calculating maximum flood discharge from catchments to design surplus weirs.	DCE(MI)/OT1/T4/28556/65 dt:29.1.1986/3.3.1986	101 - 103	
22	New Minor Irrigation Projects – Per hectare cost – Reg.	DCE(MI)/OT2/T4/61826/85 dt:5.3.1986	104 - 105	
23	Inspection of works – Salient features of Schemes – Proforma – Reg.	DCE(MI)/OT1/T4/61826/86 dt:29.3.1986	106	
24	Design of Percolation tanks – Increasing deep percolation in submersion area – Excavation of trench – Reg.	DCE(MI)/OT1/T4/61826/85 dt:6.4.1986/11.4.1986	107 - 109	
25	Evaporation from open tank surface – Preparation of working tables for Minor Irrigation Works – Meteorological data for Agro–Meteorological stations – Evaporimeter data – Adoption in Minor Irrigation works – Reg.	DCE(MI)/OT1/T2/82059/85 dt:15.4.1986	110 - 114	

(1)	(2)	(3)	(4)	(5)
26	Positive blanket cut-off walls – Hydrological surveys – Opinion of State Ground Water Department – Reg.	DCE(MI)/OT1/T4-61826/85 dt:18.4.1986	115	
27	Surveying MI schemes – Assuming Bench Marks – Connected GTs Bench Mark or known lands with reference to M.S.L. – Instructions – Reg.	DCE(MI)/OT1/T4/61826/85 dt:30.4.1986	116	
28	Surplus arrangements – Minor irrigation Tanks – Cut off walls for solid aprons – Dispensing with footing – Reg.	DCE(MI)/OT1/T4/61826/85 dt:02.05.1986	117	
29	Minor Irrigation – Guidelines for Minor Irrigation Schemes – Procedure to be followed while fixing the sill level of Irrigation sluice – Reg.	DCE(MI)/OT1/T4/28556/65 dt:20.05.1986	118	
30	Formation of Minor Irrigation Tank bunds – Hilly areas – Borrow Area Soils in submersion areas-Reg	DCE(MI)/OT1/T4/28556/65 dt:21.05.1986	119	
31	Maximum Flood Discharge – Procedure to be followed as per rational formula – Reg.	DCE(MI)/OT1/T4/28556/65 dt:28.05.1986	120	
32	Minor Irrigation Tanks – Cut-off trenches – Inspection of Executive Engineers – Report of Field Conditions – Reg	DCE(MI)/OT1/T4/61826/85 dt:04.6.1986	121	
33	Guidelines for Minor Irrigation Schemes – Revised Standard Type Design and Ready-reckoner table for small erthen dams – Reg.	DCE(MI)/OT1/T4/28556/65 dt:29.7.1986	122 – 140	
34	E.E.C.Schemes – Calculation of yield –Dry Damp Wet Method – Reg	DCE(MI)/OT1/T4/61826/85 dt:11.8.1986	141	
35	Minor Irrigations Schemes – Design of weirs in Minor irrigation tanks – Standardization – Reg.	DCE(MI)/OT1/T4/61826/85 dt:23.10.1986	142 - 155	

CIRCULAR NO. 1

OFFICE OF THE CHIEF ENGINEER, IRRIGATION, ANDHRAPRADESH, HYDERABAD-500 481.

Circular Memo No. P2/OT4/T4/24011/77, dated: 18.10.1978

Sub:- Irrigation – Minor Irrigation – Scraping of criteria of percentage of return and taking up Minor Irrigation Schemes on Benefit Cost Ratio – Furnishing of the proforma of B.C. Ratio statement – Regarding.

Ref:- (i). G.O.Ms.No. 482, I&P, dated: 14.7.1978 communicated in Chief Engineer (MI) endorsement No.P2/11219/75, dated: 20.07.1978.

(ii) This Office D.O.Lr.No. P2/11219/75, dated: 21.9.1978 addressed to all the Superintending Engineers of the Irrigation Circles.

In order to have an uniform procedure in the preparation of benefit cost ratio statements for the Minor Irrigation Schemes a standard proforma devised for working out the Benefit Cost Ratio is herewith enclosed to all the Superintending Engineers of Irrigation Circle in continuation of this Office D.O. Letter 2nd cited.

The receipt of the same may please be acknowledged.

Enclosures
Proforma Statement-2.

T.K. MOHANA RAO
Chief Engineer (Minor Irrigation)

NAME OF WORK :

I. Estimate Value of Procedure before Irrigation

CROP	Ayacut in acres	Yield per acre in quintals	Gross yield in quintals	Rate per quintal	Value of produce	Fodder receipt @ Rs.6.00 per acre	Gross value produced clos. (6)+(7)	Seeds @ Rs. Per acre for dry/wet crops	Manure @ Rs. Per acre for dry/wet crops	Hired Bullocks @ Rs. Per acre for dry/wet crops	Manual labour @ Rs. Per acre for dry/wet crops	Other expenditure @ Rs. Per acre	Land Tax @ Rs. Per acre	Total of columns (9 to 14)	Net value of Produce Col. 8 – Col. 15
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
Rain Fed															

II. Estimate Value of Produce after Irrigation

I.D. Crops	Land tax @ Rs…. Per acre + Water cess@ Rs…. Per acre.
Wet Crops	

A. BENEFIT (PRELIMINARY)

I.	(a). Total agricultural production before irrigation.	Column 8
	(b) Cost of cultivation inputs for Agricultural operation	Column 15
	(c) Net Agricultural Production	Column 16
II.	(a). Total agricultural production after Irrigation	Column 8
	(b). Cost of cultivation inputs for Agricultural operation	Column 15
	(c). Net Agricultural Production	Column 16

B. COST OF THE SCHEME INCLUDING DIRECT AND INDIRECT CHARGES Rs. ……

	Interest @ 5%	Interest @ 10%
1. Interest on Cost		
2. Depreciation @2%		
3. Maintenance and administrative expenses @ Rs.20 per acre		
Total Cost i.e. (1+2+3)	…… (X)	……..(Y)

III. BENEFIT COST RATIO

@ 5% Interest = $\frac{B(c)-I(c)}{Total\ of\ B with\ interest\ @\ 5\%\ (x)} = \cdots Number$

@ 10% Interest = $\frac{B(c)-I(c)}{Total\ of\ B with\ interest\ @\ 10\%\ (x)} = \cdots Number$

T.K. MOHANA RAO
Chief Engineer (Minor Irrigation)

Date : 20.10.1978

CIRCULAR NO. 2

OFFICE OF THE ENGINEER-IN-CHIEF (IW), ANDHRA PRADESH, HYDERABAD

Circular Memo No. DCE/MI/OT1-T4/28556/24, dated: 12th October, 1984

Sub:- Minor Irrigation – Approval of Head Works, Alignment and Hydraulic particulars of Canals, Designs of cross-Masonry and cross drainage works in Minor Irrigation Schemes – Reg.

From the Minor Irrigation scheme estimates that are being received from the Superintending Engineers for technical sanction it is observed that the designs, drawings and estimates are not properly prepared for various component of works thereby giving scope for revision of the estimates during execution due to inadequacy of provisions. Further, it is noticed that revision of the, design, drawings of estimates at the time of according technical sanction in Chief Engineer's office is always not practicable and time consuming.

In view of the above, the procedure indicated in the statement enclosed may be adopted for approval of the design of Head Works and alignment. Hydraulic particulars of canals, designs of Cross Masonry and Cross drainage works in Minor Irrigation schemes with immediate effect.

The Superintending Engineers should prepared and sent to this Office the designs, detailed drawings for various components of Minor Irrigation schemes costing more than Rs. 10.00 lakhs in advance before sending the estimate for technical sanction to this office for getting them approved by the Chief Engineer . The Superintending Engineers are requested to sent the proposals of alignment & Hydraulic particulars of the canals which come under the purview of Chief Engineer well in advance for getting them finalized to facilitate taking up the estimates at the appropriate time. The provisions made in the estimate should not be deviated in execution without specific prior approval of the Chief Engineer once the estimate is technically sanctioned by the Chief Engineer, Minor Irrigation on investigation.

The receipt of this circular memo, should be acknowledged.

Encl : Statement.

RAGHUVEER CHANDER,
Chief Engineer, Minor Irrigation.

STATEMENT

POWERS OF APPROVAL FOR HEAD WORKS AND IRRIGATION CHANNELS IN MINOR IRRIGATION SCHEME ESTIMATES TO BE SANCTIONED TECNICALLY BY THE CHIEF ENGINEER

Sl.No	**Name of the structure for which designs have to be approved**	**To be approved by the Chief Engineer**	**To be approved by the Superintending Engineer**
(1)	**(2)**	**(3)**	**(4)**
I	HEAD WORKS:		
1.	Earth Dam	Yes	…
2	Surplus weir or anicut	Yes	…
3.	Head sluices	Yes	…
4.	Surplus course	Yes	…
II.	IRRIGATION CHANNELS		
1.	Alignment and Hydraulic particulars of Main canal and branches	For head discharges above 0.28 cumecs (10 c/s)	For head discharge below 0.28 cumecs (10c/s) including 0.28 cumecs
2.	Designs of cross masonry of cross drainage works on canals	Passing discharge above 0.71 cumecs (25c/s) in the canal	Passing a discharge upto and inclusive of 0.71 cumecs (25c/s) in the canal
3.	The off-take position in respect of branches and distributaries	Off-take located on the canal carrying above 0.28 cumecs (10 c/s)	Off-take located on the canal carrying upto and inclusive of 0.28 cumecs (10 c/s)

RAGHUVEER CHANDER,
Chief Engineer, Minor Irrigation.

CIRCULAR NO. 3

OFFICE OF THE CHIEF ENGINEER, IRRIGATION, ERRUMANZI, HYDERABAD ANDHRA PRADESH,

Circular Memo No. p/OT1-T4/28556/85-Vol.III, dated: 16th May, 1985

Sub:- Minor Irrigation tanks – Calculation of yield – Regarding.

As present the computation of yields for M.I. Schemes are being done using stranges tables in the journal of Institution of Engineers, is enclosed. All the Superintending Engineers and Executive Engineers of Irrigation Department are requested to study this and also calculate the yields using the equation given under the sub-head of "Minor Watersheds" in respect of Minor Irrigation schemes. This may also be compared, with that of the yields calculated using stranges table, and a critical assessment of the same may be made.

The receipt of this Circular memo, may please be acknowledged.

Encl : "Paper on Prediction of Yields"

T. HANUMANTHA RAO,
Chief Engineer, Minor Irrigation.

PREDICTRION OF YIELDS IN SEMI-ARID AREAS OF ANDHRA PRADESH

T. HANUMANTHA RAO, FELLOW

Computation of yields (runoff) from catchments in South India are being carried out on a method formulated by Strange nearly a century ago. The prediction of yields depends not only rainfall but also on basin characteristics, especially soil cover, anticipated precipitation index and other meteorological data of the basin.this paper deals with graphical curvilinear regression analysis of watersheds and also development of a mathematical model using a computer for runoff prediction. A general model for all types of catchments in this area is evolved for runoff predicition and its application for a minor watershed has been found useful for minor irrigation projects.

NOTATIONS :

A = area of catchment, km^2

API or I = antecedent precipitation index, mm

C.H.F = percentages of clayey soils, hilly area, and forest area in the ctchment, respectively

D = number of days of storm duration

M = weightage for month of year varying from 12-25%

R = rainfall during storm duration

S = average slope of catchment, %

U = utilization in minor irrigation tanks, etc., in mm, over the catchment area.

Y = yield over the catchment, mm

INTRODUCTION :

Computation of yields (runoff) from catchments in South India are being carried out on the method formulated by Strange nearly a century ago. The prediction of yields depends not only on rainfall but also on basin characteristics, especially soil cover, anticipated precipitation index and other meteorological data of the basin. Most of these variables are not considered for want of sufficient data and also modeling. Though much technological advancement has been made in hydrology in recent years, practical use of such studies is insignificant in South India. For planning the storage and utilization systems a fairly accurate method is essential for successful management of reservoir systems.

The method proposed by Strange requires refinement taking into account other important characteristics. A graphical method of curvilinear regression analysis is done for four watersheds in semi-arid areas of Andhra Pradesh with catchment areas ranging from 380-1660 Km^2. This paper deals with graphical curvilinear regression analysis of these watersheds and also development of a mathematical model using a computer for runoff prediction. A general model for all types of catchments in this area is evolved. Runoff prediction model for a minor watershed of 5.39 km^2 was found to be extremely useful in calculating runoffs for minor irrigation projects.

IMPORTANCE OF THE STUDY

There exists a vast gap between scientific discoveries and their applications, especially in the field of hydrology, than in any other field of engineering. A cursory glance at the current practice of computing yields of watershed now being followed in Andhra Pradesh indicates that no deterministic or stochastic models are applied in this area of hydrology. Research institutes, teaching institutions and scientists working in the field of hydrology are partly to be blamed for this situation in theory and practice. It must be recognized that theoretical hydrologists all over the world are continuously developing new models with increasing degree of mathematical precision. This trend in mathematics or pure hydrology can be utilized in the planning and development of water resources on a long term basis. Since the practicing

engineer cannot wiat, used-oriented models have to be formulated. Flow prediction in minor and medium watershed in Andhra Pradesh is now being done using the “Strange tables” and the dry-damp-wet method developed nearly a century ago. The main reason for lack of study in this area is due to inadequate data for sufficiently long periods of rainfall and runoff. Also, not much effort has been put in to improve the present for casing methods.

This paper gives a brief description of the mid-Pennar, Bahuda, Zurreru and Hundri watersheds in Andhra Pradesh and graphical coaxial curvilinear regression analysis for predicting the runoff and finalizing the mathematical models developed by the comuter. A minor watershed near krishnamreddypalle is also analysed and a mathematical model developed for predicting the runoff.

METHODOLOGY :

DESCRIPTION OF WATERSHEDS AND DATA USED FOR COMPUTATION :

Table 1 gives details of watersheds considered for the regression analysis and the computer programme. Catchments of different characteristics and areas were considered for this study. Rainfall was observed by ordinary rain-guages in catchments areas. Weighted average rainfall was calculated using the Theison polygon method. Runoff from the stream was observed from water level of reservoirs located on these streams, inflows were computed based upon changes in daily water levels and outflows through sluices and surplus, duly taking into account evaporation losses and other data at dam sites. It is possible to have a fairly accurate idea of inflow from the depth storage curves of the reservoir. Since hourly rainfall data were not available and also not likely to be available in the future for most of the catchment areas, daily rainfall only was considered. Instead of considering weekly or monthly runoff, the duration pertaining to a storm of a day or several days was taken, It was observed that storms of duration ranging from one day to six days were prevalent in these areas. Corresponding runoffs were calculated at the observation point in the reservoir site and used in this computation. The volume of runoff is influenced by storm duration total precipitation, antecedent precipitation, basin cover and other characteristics.

GRAPHICAL COAXIAL CURVILINEAR REGRESSION ANALYSIS :

In this method, the four quadrants of a graph are made use of. In the first quadrant (Fig.1) the observed values are compared with the predicted values which lie on a 45° –line. Antecedent precipitation index (API) is marked on the Y-axis of the first quadrant. A family of curves depicting the month of the year are drawn on the second quadrant. A set of straight lines depicting the number of days of storm are drawn on the third quadrant. A family of curves indicating the total amount of precipitation during the storm duration are drawn on the fourth quadrant. In this method only four variables are used in arriving at the run off figures. It is preferable to increase the number of variables so as to depict other relevant characteristics but it would be difficult to solve them by such a graphical method.

As such, only most important influencing variables are considered in this analysis. API gives the condition of soil moisture at the time of precipitation and is an important parameter influencing the runoff for a given rainfall. A recognized and practical method of calculating API is described in the paper.

The same basin yields different runoffs for the same storm intensity and API depends upon the condition of the soil and its cover. The month of the year is expected to reasonably depict the condition of the soil (ploughed, unploughed, cropped etc.), growth of crop, condition of vegetation on hills, etc. The month of the year also gives an indication of other meteorological variables such as evaporation transpiration, radiation, wind velocity, etc. The family of curves fitted in the second quadrant takes care of various months of the year thus accounting for the variable parameters approximately. Basin characteristics such as percentage of hilly area, percentage of forest area, percentage of clayey area, average slope of the terrain, existing utilization of runoff, etc. could be included in this graphical analysis. As such this analysis holds good only for the neighbouring basins of similar characteristics.

TABLE 1 : WATERSHED DETAILS

Name of Watershed	Area of catchment K.m²	Number of rain gauges observed	Hilly area in catchment, %	Forest area in catchment, %	Clayey area of catchment, %	Average slope of catchment, %	Existing utilization of runoff, mm	Year of study	Number of storms analyzed
Mid-Pennar	1660	4	2.02	0	20	0.583	1.032	1966-74	67
Zurreru	375	2	41.037	50	5	1.127	4.7	1968-74	67
Bahuda	435	6	17.22	0	0	1.910	5.05	1973-74	20
Hundri	1274	4	0	0	35	0.617	6.19	1969-74	40

T. Hanumantha Rao is with the Andhra Pradesh State Co-operative Rural Irrigation Corporation ltd., Hyderabad.

This paper was received on September 16, 1982. Written discussion on the paper will be received until January 31, 1984.

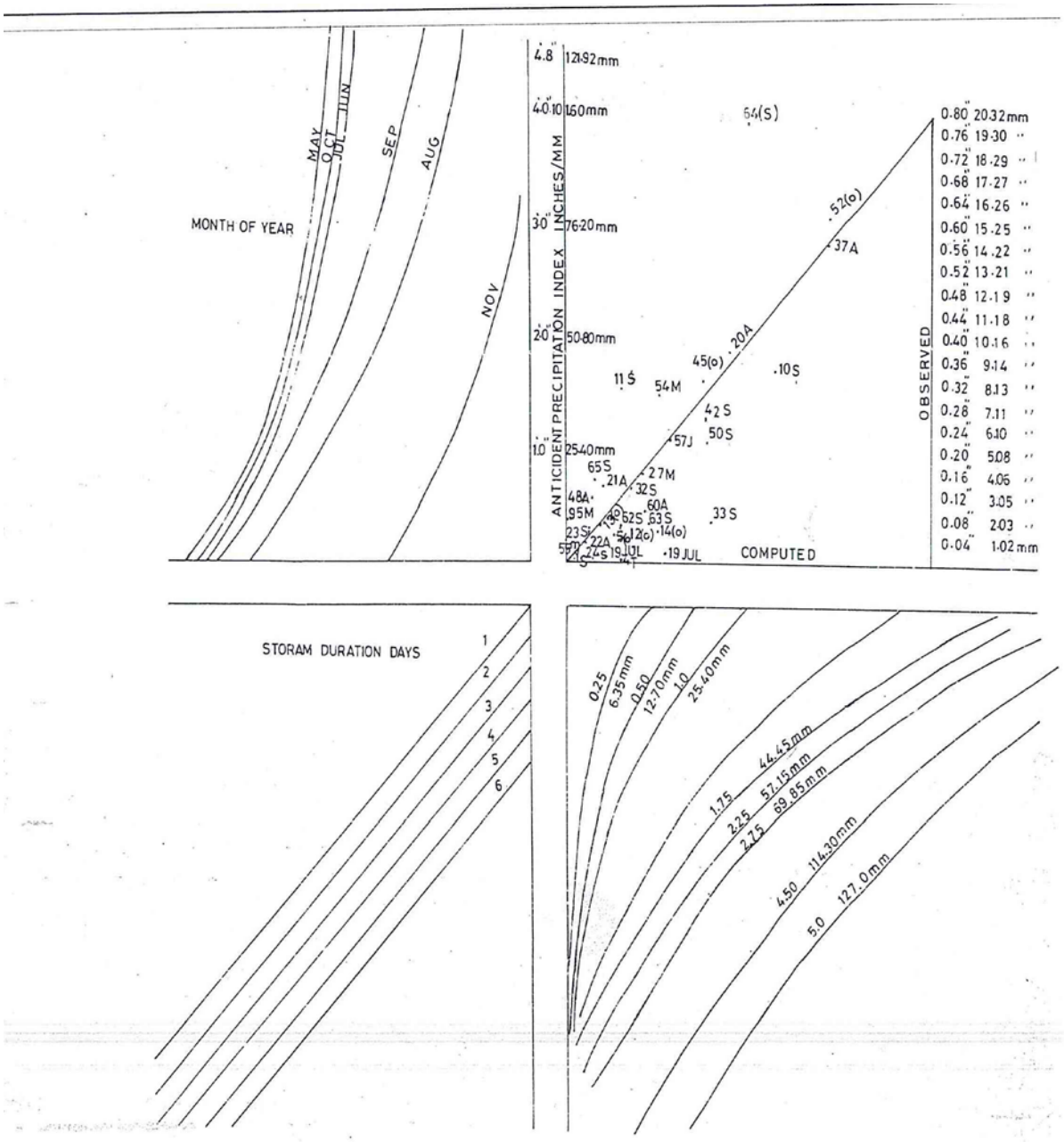


FIG. 1. ZURRERU WATER SHED — HYDROLOGICAL STUDIES OF RAINFALL RUNOFF CORRELATION MULTIPLE CURVILINEAR REGRESSION AND CORRELATION BY Coaxial GRAPHICAL METHOD

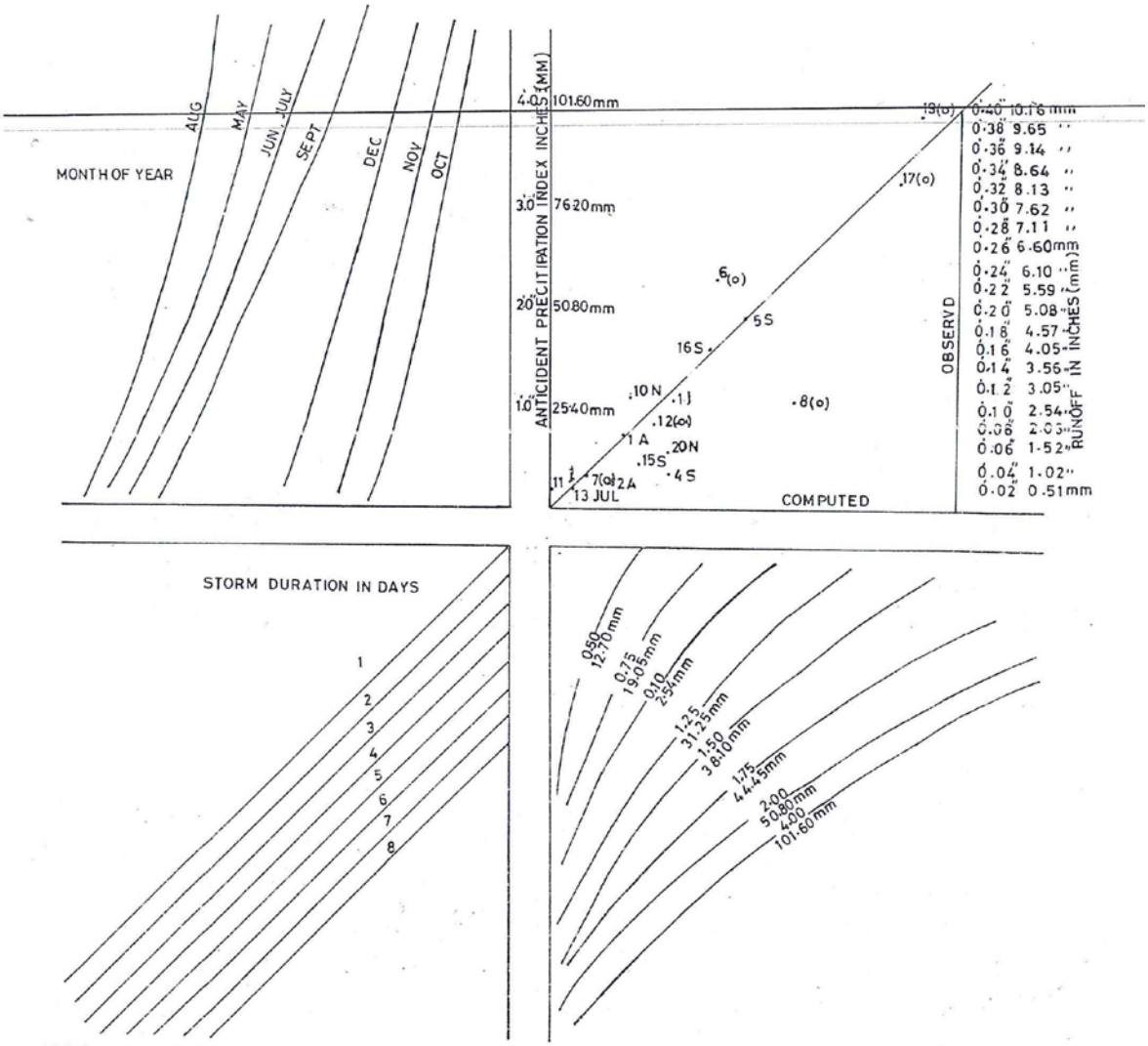


FIG.2. BAHUDA WATER SHED—HYDROLOGICAL STUDIES OF RAINFALL RUNOFF CORRELATION MULTIPLE CURVILINEAR REGRESSION AND CORRELATION BY COAXIAL GRAPHICAL METHOD

These variables have also been taken into account in the computer programme and models developed. The duration of storm is represented by a set of straight lines (number of days) in the third quadrant. Total precipitation during the storm period is depicted by a family of curves in the fourth quadrant.

PROCEDURE FOR GRAPHICAL ANALYSIS :

After knowing API for a particular day, a horizontal line from this point on the Y-axis drawn to meet the corresponding monthly curve in the second quadrant (Fig. 1). A vertical line from this point on the month is drawn to the straight line indicating the number of days of storm. A horizontal line from this intersection point has to be drawn to the corresponding point of precipitation in the fourth quadrant. A vertical line from this point is to be drawn to the 45° line in the first quadrant. The value of this point of the 45º line is the predicted yield over the entire catchment area. In this method, curve fitting exercises in the second, third and fourth quadrants are done by trial and error so as to see that the observed runoff points in the first quadrant are as close to the 45º line in as many cases as possible. Rainfalls producing runoffs only are considered in this analysis. Relatively small amounts of precipitation having no effect on the storm runoff are not considered. However, small amounts of precipitation immediately before the main storm are included in the computation of API. Long complex storms are sub-divided and analyzed.

Antecedent Precipitation Index (API)

The index of soil moisture currently used in practically all forecasting operations by the US Weather Bureau is the antecedent precipitation index which is expressed by

$$I=b_1p_1+b_2p_2+b_3p_3\ldots\ldots+b_ip_i \qquad (1)$$

Where b is a constant, and p the basin precipitation occurred in 1 day before the storm under consideration. Such an equation is inconvenient for day-to-day use in forecasting. A more usable form of this equation can be derived if it is assumed that b decreases with time before the storm being considered according to a logarithmic recession during times of no precipitation. The following equation can then be considered

$$I_t = I_o K^t \qquad (2)$$

Where I_o is the initial value of API, I_t the reduced value after t days, and Ka recession factor.

It t=1, then $I_t = KI_o$ (3)

API for any day is equal to that of the day before and multiplied by K. When rain occurs on any day the amount is added to the index. The value of K is a function of the physiographic, climatic and vegetative characteristics of the basin and the actual

evapotranspiration. Normally, K is assumed constant between 0.85 and 0.95, 0.9 is the most commonly used value. When K=0.9, the computation of API for a day is simply a matter of subtracting 10% from API of the previous day and adding the rainfall of the day.

CURVE FITTING

DERIVATION OF INITIAL CURVES :

In applying the coaxial method to the selected parameters, a three-variable relationship is first developed (fig. 1) by: (a) Plotting antecedent precipitation against observed runoff in the second quadrant, (b) labeling the points with monthly members, and (c) fitting a family of smooth curves representing various months.

Points labelled with duration are then plotted in the third quadrant at the observed runoff on the vertical scale and at a computed value on the horizontal scale, corresponding to that determined by entering the second quadrant with antecedent index. A set of straight lines are drawn to represent the days of duration of storm. The combination of the second and third quadrants constitutes a graphical relationship for estimating runoff from antecedent index, month and storm duration. Storm precipitation is then introduced in the fourth quadrant by : (i) Plotting computed runoff (From the second and third quadrants) against observes runoff on horizontal scale, (ii) labeling the points with rainfall amount, and (iii) fitting the family of curves for precipitation amounts. The second, third and fourth quadrants constitute the first approximation of the relationship involving selected parameters in the first quadrant plotting of observed runoff against that computed from second, third and fourth quadrants (45^{o} - line) is shown to indicate the overall correlation of this relationship.

REFINEMENT BY SUCCESSIVE APPROXIMATIONS

Since the parameters are inter-correlated and since the first charts are developed independent of factors subsequently introduced, tests have been conducted to determine if revisions of the charts could improve the relationship. The process is necessarily one of successive approximation. To check the curves of the second quadrant, the assumption is made that the other charts are correct. The horizontal co-ordinate for an adjusted point in the second quadrant is determined by entering the third and the fourth quadrants in reverse order with observed runoff, rainfall amount and duration. The ordinate of the adjusted point corresponds to observed API. In other words, the monthly curves are revised to fit the point adjusted in this manner if the relationship is to yield a computed value equal to the observed one.

The second approximation curves for duration and storm precipitation and all subsequent approximations are made in a similar manner. In each case the points are plotted by entering the chart sequence from both ends with observed value to determine the adjusted co-ordinates. Using this method of runoff computation curve fitting is done for Zurreru watershed (Fig. 1) and Bahuda watershed (Fig. 2)

COMPUTER PROGRAMME :

ZURRERU BASIN:

A ECIL Micro-78 computer was used to develop the regression equation for rainfall against runoff. The following equation was considered for the Zurreru watershed.

$Y=a+bI+cM-dD+oR$

Where a, b, c, d and o are constants of the independent variables I, M, D and R, respectively, which are determined by the computer programme. Data of 67 storms were fed into the computer and the following model was evolved.

$Y=0.1+0.044\ I+0.00002\ M-0.0432\ D+0.0610\ R$

The correlation coefficient for the above analysis is 0.6735. The fitness of the analysis is quite reasonable for small data. Also the result of a negative value for the constant associated with the number of days of storm duration is quite significant. This explains that for greater duration of storm, the runoff is less for the same precipitation. The values of constants for I and H are positive indicating that yields increase with increasing value of API and rainfall. The regression analysis thus stands good for logical reasoning. This equation can be used for neighboring catchments having similar characteristics. This also can serve as a much needed improved method for predicting runoffs in dryland red soil areas of Andhra Pradesh. Obviously this is a more reliable tool than the presently used Strange Tables Method.

GENERAL MODEL FOR ALL BASINS :

Data of the four basins can be fitted in one regression equation, depending the various basin characteristics by

$Y=a+bI+cM^2-dD+oR^2-fC+hS-iF-jA-kU$

Where a, b, c, d, e, f, g, h, i, j, k are constants of the independent variables which are determined by the computer programme.

Data of 194 storms evolved the model

$Y=0.000010+0.060I+0.000037M^2--0.0089D-0.000062R^2+0.00008C--0.0000124H+0.0137S--0.00056F--0.000235A--0.041U$

This equation has a major drawback in that there is decrease in yield with increase in rainfall and, as such, certain modifications have been contemplated and a revised model formulated replacing that variable, D with 1/D and 1/A since the values of runoff are expected to be inversely to the values of D and A. also, since the value assumed for M is arbitrary, it is omitted. The regression thus obtained is

$Y= -0.0388 + 0.0591 + 0.00003M^2 + 0.138/D + 0.0001R^2 + 0.0008C + 0.0022H – 0.1528S – 0.0034F + 1.5/A + 0.6914U$

The correlation coefficient is 0.5930.

The model is defective for two reasons : (i) the runoff is decreasing with increase in slope whereas it should be the reverse, and (ii) the runoff is increasing with increase in utilization of water in interepting tanks, whereas it should be reverse. The program was

subsequently run removing the variable S at one time and also alternately removing the variable (U) at another time, but none of these models were found to be logically correct and hence a revised model is run removing both the variable S and U

The final model obtained is

I= -0.3036 + 0.0361I + 0.2562ID+0.0346R + 0.009C – 0.0013F + 33.37/A

Correlation coefficient is 0.5708
Data coefficients are
I=0.2342, I/D=0.088, R=0.2053, C=0.4936, 1/A=0.3725

These seem to be logical and the coefficients have signs according to known facts. This model is recommended for adoption for different watersheds in drought prone areas of Andhra Pradesh. The correlation coefficient obtained is 0.57 and is reasonably accurate. Since without a regression equation the water shed is giving a higher correlation coefficient, the above model is recommended for adoption for catchments in South India. In this model, API, number of days and extent of rainfall percentage of clayey soils, forest area and area of catchment are to be gathered. This can be easily done for all catchment areas and hence the runoff can be predicted with reasonable accuracy without waiting for collection of data for longer or shorter periods. Percentage of hilly and forest areas can be calculated from topo sheets. Percentage of clayey soil areas of the catchment can be calculated from the soil map prepared for the state concerned.

MINOR WATERSHEDS

A minor watershed with a catchment area of 5.39km² near Krishnamreddipalle, a red soil area in Anantapur District of Andhra Pradesh, has been analyzed for estimating the yields. A total number of 88 storms during 1978-79 has been analyzed which shows

Y=--0.602 + 0.1491 + 0.456R
Correlation coefficient is 0.7228.

The parameters considered in this model and the coefficients obtained are logical and the model is found to be reliable with a correlation coefficient of 0.7228. It is, therefore, suggested that this model may be used for all red soil areas having slopes of 1 to 2% in the drought prone areas of Andhra Pradesh. By making use of this model, it is found that fairly correct results could be obtained when tested with different data of neighbouring watersheds with observed discharges. It is emphasized that in this analysis no extra data other than what are available now are needed. API can be calculated on any based on equations (1), (2) and (3). The number of days of storm and precipitation are already available in the rainfall data. Thus it is possible to predict the runoff (yields) with reasonable accuracy based on available data making use of the above regression equation.

COMPARISON WITH STRANGE TABLES

The next point that naturally occurs is how do the results of runoff arrived by this method compare with those arrived from Strange tables. Strange tables give results from one

extreme to the other, depending upon the assumption of the type of catchment (bad, average and good), varying almost two-fold and hence the values of runoff worked out by any improved method will still be within the limits given in the Strange tables. It all depends on what type of catchment-bad, average or good-one selects in arriving at the yield figures. The definitions of catchments are vague and therefore lead to misleading results. This also does not lead to any rational predictions, since the periodical changes in soil structure, soil intensity of precipitation, etc. are not taken into account. In several catchments, yields calculated by strange tables are not realized. These anomalies can be minimized if a rational approach is made and correct identification of the problem is done. It is thus not possible to compare the results of the proposed model with those of strange tables since it can always be worked back and the type of catchment reclassified to suit the values obtained by the models developed in the paper.

CONCLUSIONS:

A graphical co-axial curvilinear regression analysis for prediction of runoff is done for four watersheds having different areas and characteristics in the semi-arid areas of Andhra Pradesh. These models can be used for predicting yields of similarly situated neighboring watersheds. Computer modeling are also made for individual watersheds of minor and medium size. A general computer model to cover different types of catchments has also been evolved. The computer model developed for the Zurreru watershed is simple in nature and can be used for similar catchments in neighboring areas. These models take into account the various influencing parameters and their usage may lead to fairly realistic runoff prediction. Yields of basins so made available with this mode is that the existing data in presently available from can be made use of for predicting the yields without waiting for collection of additional data for a along or short period.

ACKNOWLEDGEMENTS :

The author acknowledges the assistance rendered by Andhra Pradesh Engineering Research Laboratories, Hyderabad, in running the computer programme for developing the mathematical modeling described in the paper. The author also acknowledges the assistance rendered by Sarvashri K.Venkateswara Rao. T.S. Nageswarta Rao and P. Satyanarayana Murthy, junior engineers, in processing the data for the computer programme.

RREFERENCES :

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2. ‘Irrigation and Drainage Series’ no. 24. Food and Agricultural Organization.

CIRCULAR NO. 4

OFFICE OF THE ENGINEER-IN-CHIEF,

MINOR IRRIGATION WING, ANDHRA PRADESH, HYDERABAD

CIRCULAR No. DCE/MI/OT1-T4/28556/65, Dated:15.06.1985

Sub:- Investigation of Minor Irrigation tanks – Preparation of project estimates – Provision of approach Road to the Project site – Regarding.

In some of the project reports prepared for Minor Irrigation tanks, it is seen that suitable roach is not provided for in the project estimates. Construction of a Minor Irrigation project costing Rs. 20 to 30 lakhs without a proper approach may lead to problems during execution as well as in maintainance a[art from causing inconvenience to the ayacutdars for their land development, agricultural production etc.

As a general guideline it is suggested that a single lane metal approach road is provided from the nearest road to the Minor Irrigation tank site. Acquisition for the road, may be done on the basis of a two lane traffic but metalling can be restricted to a single lane in the first instance. The cost of the Road may be provided specifically in the project report since this is a necessary provision to successfully complete the project as well as to serve as an ayacut road later on during the agricultural production stage.

The canals from the tank taken on either side should also have the provision for vehicles to go along these canals. Though a regular road need not be provided in the project report, it is still required that necessary land acquisition is provided to accommodate a single lane traffic. In case of black cotton soil areas, gravel cover may be provided for this cart track. In other soils it may be sufficient that excavated soil from the road side trench at the demarcating boundary is dumped roughly leveling the car track width. Unless provision is made for carts to go along in the ayacut area, especially along the canals it would be difficult for the farmers in the command to conduct their agricultural operations. In a study conducted by the ICRISAT, Hyderabad, it iwas found that ayacut roads played an important role in agricultural production and ayacut development for irrigation projects. It is therefore, necessary that a minimum provision is made for enabling carts and vehicles to go atleast along the canals excavated. This in turn will also facilitate access for the Departmental OIfficers for inspection of the canal as well as the structures on the canal.

Dated:15-6-1985

T. HANUMANTHA RAO,
Chief Engineer, Minor Irrigation.

CIRCULAR NO. 5

OFFICE OF THE ENGINEER-IN-CHIEF, I.D.,

MINOR IRRIGATION WING, ANDHRA PRADESH, HYDERABAD

CIRCULAR No. DCE/MI/OT1-T4/61826/85, Dated:5.7.1985

Sub:- Important streams and rivers – Name tablets on important Bridges and Causeways – Providing – Regarding.

Ref:- This Office Circular No. ----------

The State Irrigation Department is incharge of all Irrigation Projects, Water Resources Schemes, Hydrology clearance etc., including maintaining Water Storage or Diversion systems for irrigation in the State. Many of the important streams are not having proper identification by the public and in certain cases more than one name is being used for a stream. In order to have clarity on the names of the streams and also to give a proper idea of the stream to the public and officials it is suggested that names if important streams and rivers may be exhibited on either side of the causeway or bridge constructed across the streams.

The name tablet may be of a suitable size giving the name of the stream in Telugu and English in bold letters. Details pertaining to catchment area at the point of the bridge and maximum discharge at the bridge site may be shown in small letters in English. This tablet can be on one side of the bridge or causeway and constructed in masonry and plastered. Letters can be sunk in plaster and also painted. These tablets can be of a size similar to village direction tablets usually fixed on roads.

The painting of the tablet could be in yellow colour and letters in black colour. Easy to read letters form may please be used.

The expenditure required for these boards may be incurred out of the schemes under investigation in the river basin. For the present these tablets may be erected on streams where minor irrigation works are either in progress or under investigation.

T. HANUMATHA RAO
Chief Engineer, Minor Irrigation

Date : 5-7-1985.

CIRCULAR No. 6

OFFICE OF THE ENGINEER-IN-CHIEF, I.D.,

MINOR IRRIGATION WING, ANDHRA PRADESH, HYDERABAD

CIRCULAR No. DCE/MI/OT1/T1/61826/85-2, Dated:13.7.1985

Sub:- Percolation tanks – Surplus weir – Surplus course Training arrangements – Regarding.

It is seen that in several surplus courses, lengthy training bunds with revetments have been provided for many of the percolation tanks. The training bund located on the bund side with revetment would be necessary to keep the surplus course away from toe of the bund and prevent scouring the same. The length of the bund may be kept to the minimum since there is no need to take all the way till it joins the deep course. The training bund located on the other side of the weir may not be necessary for protecting the tank bund. However this would be needed to initially divert the surplus flows of the stream course and prevent damaging of the neighboruing fields. Since steep sloped would be available, excavated earth in the course may be sufficient for forming these bunds. In any case high training bunds would not be required since the tail water build up will not be much in view of the steep terrain and steep slope of the surplus course in most of the cases.

Instead of executing the entire width for the surplus course it would be enough in most cases to partially excavate the same and allow the course to form its own regime. To facilitate this pilot channels of section 10 m width and 0.5 m depth can be considered at spacing of 25 m centre to centre along the length of weir and starting from end of aprons.

T. HANUMATHA RAO
Chief Engineer, Minor Irrigation

Date : 5-7-1985.

CIRCULAR No. 7

OFFICE OF THE ENGINEER-IN-CHIEF, I.D.,

MINOR IRRIGATION WING, ANDHRA PRADESH, HYDERABAD

CIRCULAR No. DCE/MI/OT1-T4/61826/85-3, Dated:13.7.1985

Sub:- Providing increased surplusing arrangements for Minor Irrigation – Chain of tanks – 4th tank in the chain – Regarding.

In number of sub-basins it is seen that Minor Irrigation tanks are located in chain system. Of such chain of tanks are located in cyclone prone areas, it is an usual feature to have series of breaches whenever a server cyclone storm passes the area. In the event of any of the upper tanks breaching it results in series of breaches down below. In order to solve this problem it may be necessary to provide extra surplussing arrangements, regulator type of shutters, breaching section etc., for atleast a few important tanks in this chain. Such important tanks could be located in the chain series at the rate of one every three or four tanks considering the importance of the tank, extent of availablility of ayacut, seriousness of damage etc. The Superintending Engineers are requested to examine this aspect and identify the tanks in the chain where such works are to be executed and send proposals for the same.

The above can be on similar analogy of constructing buttress pier/abutment pier for every 10 piers in the case of continuous arch bridges. While formulating the proposals a combination of breaching section and increased wier length may suit in most cases. However due to proximity of location to a nearby village or facility of operation it would also be considered for providing a regulatory type of gates where F.T.L. and M.W.L. can be at the same level and sill of the gate control of gates is feasible due to tank being located in close proximity of village etc.

There are several major tanks in Rayalaseema region having a few thousands of acres of ayacut under each tank. Most of such tanks were constructed a few centuries back in the conventional manner. These tanks are now heavily silted up. In order to make full utilization of yield in the stream and increase the capacity of these tanks, it will be worthwhile to examine the possibility of keeping the M.W.L. and F.T.L at the same level by providing shutters. In certain big tanks it is seen that the present storage capacity can be almost doubled if the F.T.L. is kept at MWL. The Superintending Engineers may examine this and suggest proposals for improving the existing big tanks and making the best use of the same.

T. HANUMATHA RAO
Chief Engineer, Minor Irrigation

Date : 5-7-1985.

CIRCULAR No. 8

OFFICE OF THE CHIEF ENGINEER : MINOR IRRIGATION, ANDHRA PRADESH : ERRUMANZIL, HYDERABAD

CIRCULAR No. DCE/MI/OT-T1 COMPT/85, Dated: 27th July 1985

Sub:- Computerization of Minor Irrigation Sources – Regarding.

Ref:- DCE/MI/OT1-T4/28556/65, Dt:1-5-1985.

The attention of all the Superintending Engineers is invited to the reference cited. The proforma in which the information has to be furnished is since revised consulting the specialists in soft ware in computerization. The revised proforma is enclosed.

This proforma is self explanatory and the information to be noted is also clearly indicated under each item. The unit in which information is to be noted has also been indicated. For example under item 25 area of submersion has to be noted in Hectares. The information under this would just indicate the number and it need not once again be written as Hectares. All reduced levels may please be given in Metric units only. For purposes of clarity and convenience some items are discussed below:-

Item No. (1) : Sl.No. may be given reference to numbers within the section for existing sources under maintenance. For new sources under construction, investigation, proposals etc. the division will be the unit.

Item No. (2): Seven categories of M.I. Schemes are noted. Depending upon the type of minor under maintenance source, the relevant item may be ticked against each classification. In the case of 2 (g) the exact classification may be noted.

Item No. (3) : If there is no separate name for the tank this need not be noted. Noting the name of the village where the sources is located is superfluous and hence need not be noted.

Item No. (4) : A tick mark may be indicated against the applicable classification. In the case of 4(e) classification may please be noted in details.

Item No. (5) : This need not be noted for old Zamindari tanks and hundreds of year old tanks and tanks constructed before independence.

Item No. (6)& (7) : These items are not applicable if the works are completed.

Item No. (22) : Ayacut may be noted according to sanction/revised sanctioned proposals in the scheme estimate.

Item No. (23) : Ayacut developed during the past 5 years may be indicated for the schemes now functioning. This Item is ovbviously not applicable when questions 6 or 7 are answered.

Item No. (28) : These details is apply to feeder supply channels feeding minor irrigation tanks.

Regarding existing tanks the information may be furnished section-wise enclosing a plan showing the jurisdiction of the section. with regard to on going schemes under Investigation, yet to be investigated etc., division can be taken as unit and the jurisdiction of the Division indicated in a plan.

The Superintending Engineers may give a list of section Division-wise incharge of maintenance of M.I. Schemes. This may please be done in the first instance.

T. HANUMATHA RAO
Chief Engineer, Minor Irrigation

Date : One copy of revised proforma.

FOR THE DEPARTMENT OF MINOR IRRIGATION GOVERNMENT OF ANDHRA PRADESH

I. GENERAL :

SECTION :

1. SL. No.

2. Type of Minor Irrigation Scheme

   (a) M.I. Tank
   (b) Percolation tank
   (c) Restoration of tank
   (d) Check Dam
   (e) Anicut
   (f) Supply channel
   (g) others

3. Name of the tank etc., if any:

4. Scheme Code.

   (a) Existing
   (b) Under construction (85-86)
   (c) Under detailed investigation
   (d) Yet to be investigated
   (e) Other if any

5. If completed, month and year of completion and cost (Rs. In lakhs) for post independence Schemes only.

6. If under detailed investigation – (a) When started, (b) When it will be completed

7. If not yet investigated when will it be (a) taken up (B) completed.

8. Code :

9. Reduced level (RL)
   (a) F.T.L

   (Tanks)
   (b) Sill level

   (Anicut)
   (c) F.S.L.

   (Canals)

(d) Sill level

Sluice.

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10. Hamlet :

11. Village :

12. Madal/Taluk :

13. District:

14. Circle:

15. (a) Division.

(b) Sub-division:

(c) Section:

16. Latitude : Degrees.
Minutes.

17. Longitude : Degrees.
Minutes.

18. Basin Code.

19. Sub-Basin Code:

20. Minor-Basin Code.

21. Name of the stream if any:

II. DETAILS

22. Ayacut approved:

(a) Kharif Wet (Ha)
(b) Kharif ID (Ha)
(c) Rabi Wet (Ha)
(d) Rabi I.D. (Ha)

23. Ayacut served (Ha) 198, 1981, 1982, 1983, 1984.

24. No. of Irrigation wells in the command area

(a) Existing : (Nos)
(b) Future.

25. Area of submersion at FTL (Ha)

26. Live storage of tank : M.Cum.

27. Yield (a) available M.Cum
(b) Utilised M.Cum.

28. Feeder supply channel :

(a) Designed discharge (Cumecs)
(b) Present discharge (Cumecs)

29. Designed discharge over Weirs/anicuts (Cumecs)

III. COSTS : (for on going Schemes under Construction)

30. When (a) started : (Month & Year)
(b) Programmed for completion (Month & Year)
31. Cost of Scheme latest technically sanctioned (Rs. in lakhs)

32. Expenditure upto March, 1985 (Rs. in lakhs)

33. Revised cost if any (yet to be sanctioned) (Rs. in lakhs)

34. Amount required for 1985-86 (Rs. in lakhs)

35. Balance amount required for completion of work (Rs. in lakhs)

IV. MAINTENANCE DETAILS (If programmed beyond 3/87 …….. for existing schemes).

36. Recent breach if any :

(month, year)

37. Earlier breaches if known (nos.)

38. When maintained last (year)

39. If so, type of maintenance done last time.

(a) Maintaining the bund section .. Yes/No
(b) Repairs to weir .. .. Yes/No
(c) Repairs to channels .. Yes/No
(d) Others .. .. .. Yes/No
40. When maintained during past 10 years (if any, years only)

V. REMARKS : (including information not covered above, special problems etc.)

CIRCULAR No. 9

OFFICE OF THE ENGINEER-IN-CHIEF (IW),
MINOR IRRIGATION WING : A. P., HYDERABAD
Memo No. DCE/MI/OT1-T4/28556/65, Dated:14.8.1985

Sub:- Designs principles of Minor Irrigation Schemes – Procedure to be followed while fixing capacity of tanks – Regarding.

Ref:- 1. Circular Memo No. Y2/28556/65, dt: 22-9-1972
2. T.O. memo No. P1/OT3/T1/11263/76, dt:17-5-1976.

At present the capacity of minor irrigation tank for I.D. cropping pattern is fixed by working table method by distributing the 75% dependable yield as inflow (disctributed over a period of 5 or 6 months period) based on average monthly rainfall figures during these months for the past about 40 years. Empirical fillings method in adopted for wet crops. Average figures may not reflect true in flow conditions. By the average method it is seen that in several cases the inflows are taken as occurring in all the 5 or 6 months whereas the inflows mostly occur in two or three months in most of the drought prone areas. Hence fillings method as per the table given below:

Average monsoon rainfall				No. of fillings to be adopted
Upto 15”	..	..	..	One
15” to 20”	..	..	..	1 ½
25” to 30”	..	..	..	1 ½
30” to 35”	..	..	..	1 ½
35” to 40”	..	..	..	2
Above 40”	..	..	..	2 ½

The higher capacity as worked out by (a) working tables method (as per present practice) and (b) by the above fillings table method may be adopted for fixing capacity where I.D. cropping pattern is involved. The ayacut under Kharif I.D. and Rabi I.D., may be fixed in the ratio of 2:1. In case Kharif we ayacut, is chosen as the cropping pattern the above filling table method may be adopted for determine the capacity of tank and in such a case Rabi wet crops should not be proposed. If water is available after a kharif wet crop, in certain coastal areas having predominant inflows due to good rainfall in North East Monsoom (Nov. to Jan.) the possibility of having Rabi I.D. (Protective irrigation to rainfed crops) and Rabi I.D. in the ratio of 2:1 may be followed invariably.

This is modification of circular memos issued in the reference cited.

T. HANUMATHA RAO
Chief Engineer, Minor Irrigation

CIRCULAR No. 10

OFFICE OF THE CHIEF ENGINEER : MINOR IRRIGATION WING ,
A. P., ERRUMANZIL, HYDERABAD

Circular No. DCE/MI/OT1/T4/28556/65, Dated:23.8.1985

Sub:- Preparation of estimates for new Minor Irrigation sources – Regarding.

Ref:- Circular Memo No. DCE/MI/OT1/T4/28556/65, dated: 15-6-1985

Instructions were already issued that for all new Minor Irrigation tanks suitable provisions have to be made for approach road, cart track for all distributaries and field channels.

In addition to the above it would be necessary to male the following provisions in the estimates and comply with the during execution in order that the ayacut development and benefits to the farmers may accrue in as short a time as possible.

(a) Suitable area as indicated below may be acquired for common utilities and project purpose at a suitable place at the head works (Tank, Anicuts etc.)

Works costing upto Rs. 10 lakhs	..	..	..	..	2 Hectares
Works costing upto Rs. 10 to 30 lakhs	..	..	..	..	4 Hectares
Works costing above Rs. 10 to 30 lakhs	..	..	..	..	8 Hectares

The purpose of this land is to make use of the same for providing project construction facilities as well as to serve the needs of the ayacutdars, later on. The acquired site can preferably be so located that it may be possible to obtain the tank water for irrigation purposes to raise demonstration plots. This land would serve as nucleus for furthering growth in the Command area and provide infrastructure facilities for developing the ayacut by other sectors such as Agriculture Department, Animal Husbandry Department, Dairy Development, Seri-culture, Co-operative banks etc., For example when farmers come here for purchasing fertilizers etc., in such small demonstration plots. It is easy formance of improved programmes of Agriculture Department, since demonstration plots would also be available in the same complex. This will also serve as nucleus for attracting dairy development, linkage with milj route, improving live stock etc., suitable ground area can be located, within this complex to serve the future needs of the various other Departments involved in the command area activities, when such a need for them arise later on.

If this land is acquired during the construction phase, the cost of it would be minimum. It is a common experience when sites are required by other Departments, it becomes rather impossible and prohibitive in cost to acquire the same at a alter date for the command area development.

(b). During construction phase certain minimum facilities of a camp office with one room and a arrest shed with one room with attached bath and fielkd stores etc., would be needed for proper supervision and quality control. These can be provided with R.C.C. Flat roops of the Design adooted in Weaker Section Housing Programmes. This would also give facility for the inspecting and check measuring Officers to stay over night whenever required in the interest of Quality Control and good supervision. Suitable provision for this may be made in the estimate.

(c). Line fencing in the entire area may be proposed during the construction phase and trees planted in all the open areas to have a good ecological balance. Advise of the Forest Department may be taken for selecting the species of trees and a good combination of fruit bearing trees also planted. These provisions can be made under M.Plantation.

(d). Wherever facilities exists for rural Telephone in that area, a Telephone connection may be taken for office purpose and installed at the field office. Provision for this may also be made in the estimate.

(e). Wherever facilities exists power connection under L.T.load may be taken for running pump sets during construction and maintenance stages.

T. HANUMATHA RAO
Chief Engineer, Minor Irrigation

CIRCULAR NO. 11

OFFICE OF THE ENGINEER IN CHIEF,

IRRIGATION WING, HYDERABAD, A.P.

Circular Memo No. DCE/MI/OT1-T4/61826/85, dated: 30th August.1985

Sub:- Minor Irrigation Schemes – Hydrology – Computation of yields – Regarding.

Ref:- Arising

As per Master Plan, when the catchment area is under the influence of 2 or more rainguage stations, the 75% confidence limit of rainfall for the individual rainguage stations are being considered and the yields are being worked out. As verified, this 75% confidence limit years of the individual rainguage stations are not the same for all the stations and as such a computation of yield will not be realistic when more than one rainguage station is involved.

Hence the following procedure may please be followed for the computation of 75% confidence limit of yield for any catchment under operation when the catchment area is under the influence of 2 or more rainguage stations.

a. Continuous rainfall data of 40 years or more for all the rainguage stations having influence on the catchment may be gathered.
b. Yearwise yields for each of the rainguage influencing areas (as per stranges tables method) may be calculated.
c. The above year wise yields may be summed up so as to obtain the yield of the entire catchment in each year.
d. Yields may be tabulated as per (c) above in a descending order and the 75% confidence value may be considered as the yield of the basin for estimation purpose.

A worked out example as per this is concept enclosed for guidance.

T. HANUMATHA RAO
Chief Engineer, Minor Irrigation

WORKED OUT EXAMPLE

Influencing Rainguage Stations = (1) Bhadrachalam, (2) Dummugudem

CATCHMENT AREA AT SITE = 25SQ.MILES.

S. No	Year	Bhadrachalam, Good Catchment area (15Sq.M) C.A. =20.00 Sq.miles			Dummugudem			Cumulative total Yield in Mcft.Col.	Yield arranged in descending order in Mcft.	Year corresponding to Col.	Remarks
		Rainfall in inches	Yield in Mcft for good C.A. per Sq.mile	Total yield in Mcft Col. 3 x 4	Rainfall in inches	Yield in Mcft. For good C.A. per Sq.miles	Total Yield Mcft.col 6 x 7				
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
1	.. 1938	53.43	65.32	979.76	53.43	65.32	1306.64	2286.13	2710.07	1959	
2.	.. 1939	17.87	5.25	78.78	17.87	2.25	105.00	183.78	2680.88	1963	
3.	.. 1940	31.62	20.63	309.52	31.62	20.63	412.06	722.12	2643.85	1947	
4.	.. 1941	21.72	8.56	128.48	21.72	8.56	171.20	299.68	2393.17	1969	
5.	.. 1942	38.38	31.853	477.80	36.38	28.25	565.00	1042.80	2286.13	1938	
6.	.. 1943	40.48	35.76	536.54	37.44	30.13	302.60	1139.14	2226.41	1961	
7.	.. 1944	43.90	42.72	640.88	35.75	27.18	543.70	1184.58	2020.54	1945	
8.	.. 1945	58.54	79.42	1191.34	43.29	41.46	829.20	2020.54	2014.97	1953	
9.	.. 1946	35.22	26.30	394.57	30.10	18.51	370.29	764.86	1993.80	1955	
10.	.. 1947	57.68	76.94	1154.17	56.83	74.48	1489.68	2643.85	1975.42	1954	
11.	.. 1948	43.11	41.08	616.29	40.89	36.56	731.12	1347.41	1958.16	1951	
12.	.. 1949	39.82	34.51	517.67	37.97	31.11	622.15	1139.82	1928.98	1975	
13.	.. 1950	37.56	30.35	455.23	39.17	33.30	666.00	1121.23	1804.01	1970	
14.	.. 1951	60.65	85.55	1283.24	39.41	33.75	674.92	1958.16	1752.95	1958	
15.	.. 1952	36.73	28.85	432.75	40.97	36.71	734.19	1166.94	1724.64	1956	

16.	..	1953	46.88	49.30	739.57	52.85	63.77	1275.40	2014.97	1502.25	1973	
17.	..	1954	38.50	30.22	453.31	48.68	53.44	1068.80	1975.42	1440.05	1966	
18.	..	1955	52.10	67.86	1017.97	45.65	48.79	975.83	1993.80	1347.41	1948	
19.	..	1956	37.93	31.03	465.50	52.53	62.96	1259.14	1724.64	1281.60	1967	
20.	..	1957	37.96	31.09	466.33	40.69	36.11	722.10	1188.43	1209.89	1962	
21.	..	1958	39.24	33.42	501.42	52.38	62.57	1251.52	1752.94	1198.88	1964	
22.	..	1959	52.54	62.98	944.74	61.56	88.27	1765.33	2710.07	1188.43	1957	
23.	..	1960	29.37	17.62	264.31	35.31	26.45	529.07	793.38	1184.58	1944	
24.	..	1961	43.22	41.31	619.72	58.86	80.33	1606.69	2226.41	1166.94	1952	
25.	..	1962	43.87	42.66	634.95	36.67	28.75	574.94	1209.89	1139.82	1949	
26.	..	1963	50.43	57.73	866.01	62.29	90.74	1814.87	2680.88	1139.14	1943	..
27.	..	1964	46.73	48.97	734.55	33.32	23.22	464.33	1198.88	1121.23	1950	..
28.	..	1965	33.40	23.35	350.19	37.69	30.59	611.78	961.97	1118.43	1976	..
29.	..	1966	38.88	32.76	491.43	46.04	47.43	948.62	1440.05	1058.38	1974	..
30.	..	1967	43.34	41.56	623.45	38.96	32.91	658.15	1281.60	1042.80	1942	75% confidence limit of yield
31.	..	1968	27.58	15.00	226.32	33.32	23.32	464.33	690.65	961.97	1965	..
32.	..	1969	44.23	43.42	651.33	61.17	87.09	1741.84	2393.17	867.85	1977	..
33.	..	1970	43.31	41.50	622.52	50.98	59.07	1181.49	1804.01	793.38	1960	..
34.	..	1971	31.29	20.15	302.22	36.49	28.44	568.78	302.20	764.86	1946	..
35.	..	1972	25.40	12.15	168.64	23.05	9.88	197.68	384.32	722.12	1940	..
36.	..	1973	41.87	38.57	578.49	45.50	46.20	924.00	1502.25	690.65	1968	..
37.	..	1974	35.71	27.12	406.77	38.78	32.58	651.61	1058.38	384.32	1972	..
39.	..	1975	49.99	56.66	849.92	48.90	53.95	1079.06	1928.98	302.20	1971	..
39.	..	1976	37.86	30.90	463.56	38.87	32.74	654.875	118.43	299.68	1941	..
40	..	1977	39.21	33.43	501.42	29.96	18.32	366.43	867.85	183.78	1939	..

WORKED OUT EXAMPLE

CATCHMENT AREA AT SITE = 35SQ.MILES.

Influencing Rainguage Stations : Bhadrachalam

Influencing Catchment 15 Sq.miles

S. No	Year	Bhadrachalam, Good Catchment area (15Sq.miles) Rainfall in inches	Yield in Mcft for good C.A. per Sq.mile	Total yield in Mcft Col. 4 x 15.0	Yield arranged in descending order in Mcft.	Year corresponding to Col.	Remarks
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1	1938	53.43	65.32	979.76	1283.24	..	..
2.	1939	17.87	5.25	78.78	1191.34	..	..
3.	1940	31.62	20.63	309.52	1154.17	..	..
4.	1941	21.72	8.56	128.48	1017.97	..	..
5.	1942	38.38	31.853	477.80	979.76	..	..
6.	1943	40.48	35.76	536.54	944.74	..	..
7.	1944	43.90	42.72	640.88	866.01	..	..
8.	1945	58.54	79.42	1191.34	849.92	..	..
9.	1946	35.22	26.30	394.57	739.57	..	..
10.	1947	57.68	76.94	1154.17	734.55	..	..
11.	1948	43.11	41.08	616.29	651.33	..	..
12.	1949	39.82	34.51	517.67	640.88	..	..
13.	1950	37.56	30.35	455.23	634.95	..	..
14.	1951	60.65	85.55	1283.24	623.45	..	..
15.	1952	36.73	28.85	432.75	622.52	..	..
16.	1953	46.88	49.30	739.57	619.72	..	..
17.	1954	38.50	30.22	453.31	616.29	..	..
18.	1955	52.10	67.86	1017.97	578.49	..	..
19.	1956	37.93	31.03	465.50	536.54	..	..
20.	1957	37.96	31.09	466.33	517.62	..	..
21.	1958	39.24	33.42	501.42	501.42	..	..
22.	1959	52.54	62.98	944.74	501.42	..	..
23.	1960	29.37	17.62	264.31	491.43	..	..
24.	1961	43.22	41.31	619.72	477.80	..	..
25.	1962	43.87	42.66	634.95	466.33	..	..
26.	1963	50.43	57.73	866.01	465.50	..	..
27.	1964	46.73	48.97	734.55	463.56	..	..
28.	1965	33.40	23.35	350.19	455.23	..	..
29.	1966	38.88	32.76	491.43	453.31	..	..
30.	1967	43.34	41.56	623.45	432.75	..	..
31.	1968	27.58	15.08	226.32	406.77	1952 year (¾) 75% Confidence limit.	
32.	1969	44.23	43.42	651.33	394.57		
33.	1970	43.31	41.50	622.52	350.19	..	..
34.	1971	31.29	20.15	302.22	309.52	..	..

35.	1972	25.40	12.15	168.64	302.22	··	··
36.	1973	41.87	38.57	578.49	264.31	··	··
37.	1974	35.71	27.12	406.77	226.32	··	··
38.	1975	49.99	56.66	849.92	186.64	··	··
39.	1976	37.86	30.90	463.56	128.48	··	··
40.	1977	39.21	33.43	501.42	78.78	··	··

WORKED OUT EXAMPLE
CATCHMENT AREA AT SITE = 35SQ.MILES.
DUMMUGUDEM RAINGUAGE STATIONS

Influencing Catchment = 20 Sq.Miles

S. No	Year			Dummugudem C.A. = 20.00 Sq.miles Rainfall in inches	Yield in Mcft for good C.A. per Sq.mile	Total yield in Mcft Col. 4 x 15.0		
(1)	(2)			(3)	(4)	(5)	(6)	(7)
1	1938	..	..	53.43	65.32	1306.64	1814.87	
2.	1939	..	..	17.87	5.25	105.00	1765.33	
3.	1940	..	..	31.62	20.63	412.60	1741.84	
4.	1941	..	..	21.72	8.56	171.20	1606.09	
5.	1942	..	..	36.38	28.25	565.00	1489.68	
6.	1943	..	..	37.44	30.13	602.60	1306.64	
7.	1944	..	..	35.75	27.18	543.70	1275.40	
8.	1945	..	..	43.29	41.46	829.20	1259.14	
9.	1946	..	..	30.10	18.51	370.29	1251.51	
10.	1947	..	..	56.83	74.48	1489.68	1181.49	
11.	1948	..	..	40.89	36.56	731.12	1079.06	
12.	1949	..	..	37.97	31.11	622.15	1068.80	
13.	1950	..	..	39.17	33.30	666.00	975.83	
14.	1951	..	..	39.41	33.75	674.92	948.62	
15.	1952	..	..	40.97	36.71	734.19	924.00	
16.	1953	..	..	52.85	63.77	1275.40	829.20	
17.	1954	..	..	48.68	53.44	1068.80	734.19	
18.	1955	..	..	46.65	48.77	975.83	731.12	
19.	1956	..	..	52.53	62.96	1259.14	722.10	
20.	1957	..	..	40.69	36.11	722.10	974.92	
21.	1958	..	..	52.38	62.57	1251.52	666.00	
22.	1959	..	..	61.56	88.27	1765.33	658.15	
23.	1960	..	..	35.31	26.45	529.07	654.85	
24.	1961	..	..	58.86	80.33	1606.69	651.61	
25.	1962	..	..	36.67	28.75	547.94	622.15	
26.	1963	..	..	62.29	90.74	1814.87	611.78	
27.	1964	..	..	33.32	23.22	464.33	602.60	
28.	1965	..	..	37.69	30.59	611.78	574.94	
29.	1966	..	..	46.04	47.43	948.62	568.75	
30.	1967	..	..	38.96	32.91	658.15	565.00	Year of 1942 Confidence 75% Limit
31.	1968	..	..	33.32	23.22	464.33	534.70	
32.	1969	..	..	61.17	87.09	1741.84	529.07	
33.	1970	..	..	50.98	59.07	1181.49	464.33	

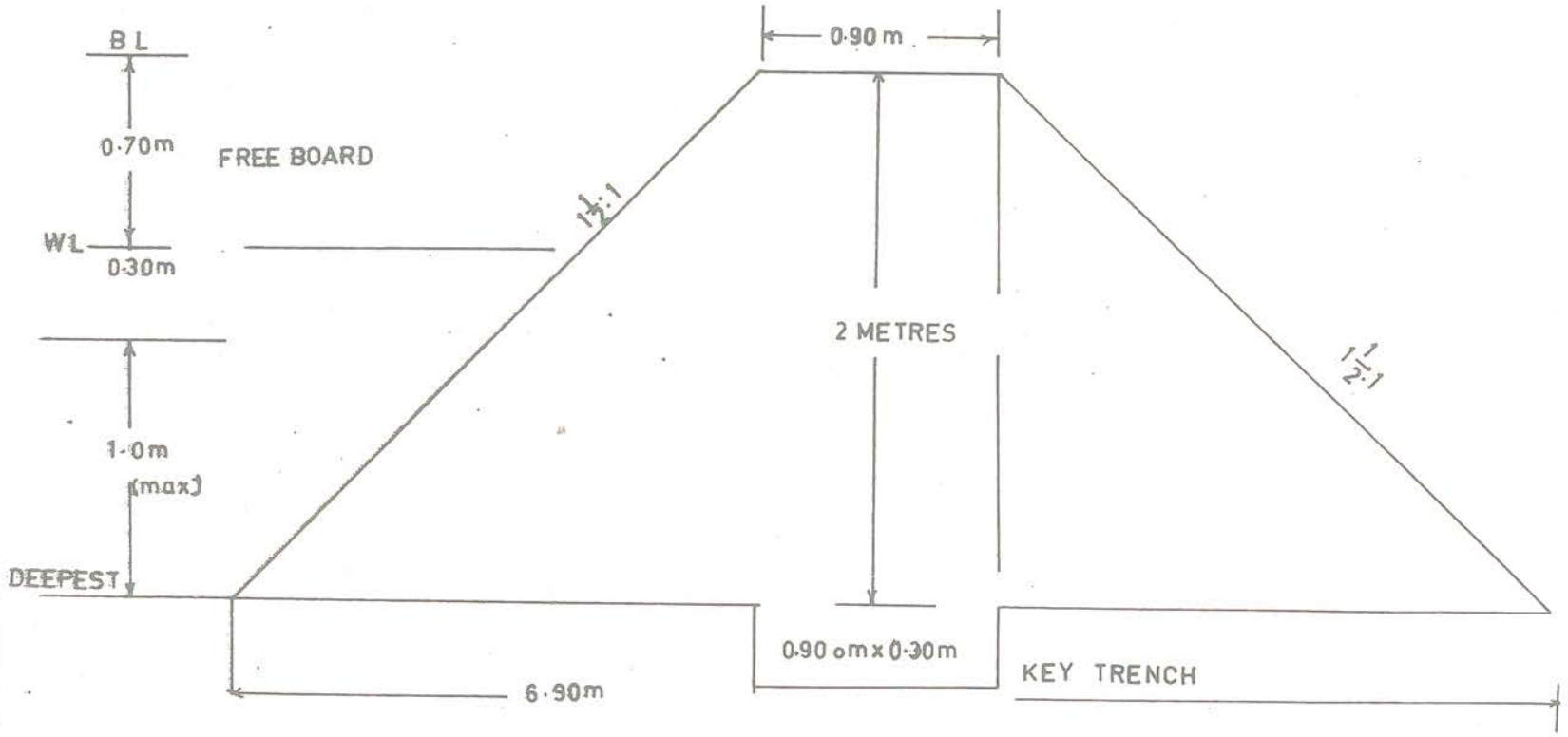
34.	1971	..	..	36.49	28.44	568.78	464.33
35.	1972	..	..	23.05	9.88	197.68	412.60
36.	1973	..	..	45.50	46.20	924.00	370.29
37.	1974	..	..	38.78	32.58	651.61	366.43
38.	1975	..	..	48.90	53.95	1079.06	197.68
39.	1976	..	..	38.87	32.74	654.875	171.20
40.	1977	..	..	29.96	18.32	366.48	105.00

The yield under a catchment, when the yield based on the 75% confidence limits for each raingauge station is considered, the yield of entire catchment in the sample problem will be 432.75+565.00=997.75 Mcft as against 1042.80 Mcft. Arrived by the method suggested in the Circular.

The difference will be much more in the cases of catchments having influence of more than 2 Rain gauge stations.

CROSS SECTION OF CHECK DAMS (MINI PERCOLATION TANKS)

Scale: 1m : 5cm



CHIEF ENGINEER
MINOR IRRIGATION

CIRCULAR NO. 12

OFFICE OF THE ENGINEER IN CHIEF, IRRIGATION WING, HYDERABAD, A.P.

Circular No. D.C.E.(M.I)/O.T./1-T2/82930/85, dated: 25.9.1985

Sub:- Minor Irrigation Guide-lines for check-dams or Mini-percolation tanks – Design criteria – Regarding.

Ref:- (1) G.O.Ms.No. 236, dated: 4-4-1979
(2) This office Circular No. Y/D.P.A.P./9744/79, dated: 21-2-1981
(3) G.O.Ms.No. 1464, dated: 26-9-1984
(4) G.O.Ms.No.1179, Irrign. (IV) Department, dated: 12-11-1984

The following guide-lines issued for formation of Mini percolation tanks (check-dams) along with design criteria. These Mini-percolation tanks will have most of the features of percolation tanks will have most of the features of percolation tanks but will be much smaller in size. These will be having very little submersion and also very small depth of storage. No sluice pipe need be provided for percolation tanks at the deepest portion.

Check dams can be suggested for dips (which can normally be located in Village Plans) for small catchment areas of about 20 hectares. Most of those check-dams would be requiring small bunds of height not exceeding 2.00 Metres at the deepest section. They can be constructed in large numbers mostly in the outer half of catchment areas of minor irrigation/percolation tanks. A typical section of the same is enclosed for general guidance. Those guide-lines may be adopted generally while sanctioning these mini percolation tanks (check-dams).

(a) The free C.A. is to be about 20 hectares :
(b) Check-dams should not be proposed on intercepted catchments i.e., they should not be located in a chain. This is with a view to economize on the cost of surplus arrangements and also to facilitate ground water recharge in the recharge zones:
(c) The depth of water stored @ F.T.L. may be upto a maximum of 1metre at the deepest point:
(d) The maximum height of bund may be about 2 metres
(e) The depth of over flow over the weir may be about 0.30 metres
(f) The free board may be about 0.70 metres
(g) A paved bye-wash with nosing may be provided for surplus arrangements at one end of the bund:

(h) The surplus course may be provided with normal and minimum revetment. The depth of flow over paved bye-wash may be limited to 0.15m in the case of black-soils and 0.3m in the case red-soils

(i) The submersion area may be about 0.50 hectares. It is preferable to construct these check-dams on Government land wherever feasible.

(j) Consolidation of bund may be done with hand rammer or two Tone animal drawn Roller. Conveyance of water for consolidation has to be provided from the nearest well.

Comprehensive proposals of all the mini-percolation tanks and check dams in any water shed and programme of work is to be furnished periodically to the Chief Engineer, Minor Irrigation for approval. After the same is approved in principle, the technical sanction can be accorded by Superintending Engineer, if the same is within his powers.

T. HANUMATHA RAO
Chief Engineer, Minor Irrigation

Encls:- Typical Section of the Bund.

CIRCULAR NO. 13

OFFICE OF THE ENGINEER IN CHIEF, IRRIGATION WING, HYDERABAD, A.P.

Circular No. D.C.E.(M.I)/O.T./1-T4/28556/65, dated: 25.9.1985

Sub:- Design principles of Minor Irrigation Schemes – Procedure to be followed for calculating maximum flood discharge from catchments to Design surplus weirs – Regarding.

Ref:- This office Circular Memo No. Y2/28556/65, dated:22.9.1972

In this office Memo cited, instructions were given to adopt Dickens Formula for calculating maximum flood discharge from catchments taking the value of 'C' varying from 900 to 200. This empirical formula though serves the purpose in a limited way does not take into consideration the factors like the nature of the catchment, length width of the catchment, time of storm to peak etc. and therefore, lacks precision.

In recent times, hydrographs are being used for estimating the maximum flood discharge which will take into consideration all factors as for as possible to arrive at more realistic figures. Much theoretical work was done in hydrology during the past 5 decades. Correlation with practical field data was also done in selected catchments in India. Detailed hydrology studies were done elsewhere in the World. The Ministry of Agriculture, Central Unit for Soil conservation (Hydrology and Sedimentation), Government of India had also brought out a "Hand Book of Hydrology".

Based on a study of the existing works, a simpler method is now worked out and suggested for arriving at the maximum flood discharge from catchments in all Minor Irrigation Schemes. This method takes care of important features of hydrological nature but reduces the rigorous method to simpler steps clubbed together so as to make easy application to minor irrigation schemes.

The method is briefly indicated below :-

Step I:- The catchment area in Sq.km. (A) length of the stream in km. (L) and the width of the catchment in Km. (W) are arrived at from the catchment area Map (s.I. Sheet 1:50,000 scale). L/w is then worked out.

Step II:- Choosing run-off curve :-

Table of Run-off curve numbers for Hydrologic soil groups :-

	Land use				Run-off curve number	
					Red Soils (Alfisols)	Black soils (Vertisoils)
1	Cultivated crops	..	..	..	75	85
2	Cultivated paddy	..	..	..	95	95
3	Forests/Gardens	..	..	..	50	70
4	Waste lands..	..	..	..	80	90

In case of mixture, of Red soils and black soils in a minor irrigation catchment area, the curve number can be choosen pertaining to the predominant type of soils. In the case of different land uses and crops in catchment area, the method illustrated in example may be followed. The different land uses can also be estimated approximately from the latest 1:50,000 S.I. Sheets or by reconnection or enquiry.

Step-III :- In a frequency period of 25 years, the maximum rainfall 'P' (mm) recorded in a single day (24 hours) is taken out from the daily rain-fall records of the particular rain gauge station influencing the catchment area. With the already arrived curve number (from step-II) and the rain-fall 'P', the direct run-off 'Q' in mm, is read from the Graph-I (Red soils) or II (Black soils) enclosed.

STEP-IV:- Time to reach Peak (Tp) in hours is calculated from the formulae given below, duly choosing the relevant formula suitable to the given catchment area.

When: (i) L/W > 4:1 Formula for $Tp = 0.76A^{0.28}$

(ii) L/W < 4:1 Formula for $Tp = 0.48A^{0.28}$

STEP V:- After arriving at the values of Q (mm), Tp (hours), the maximum discharge (cumecs) is then calculated from the formula

$$q = \frac{0.146\ X\ A\ X\ Q}{Tp}\ cumecs$$

An example is worked out and enclosed for ready reference.

The above procedure may be adopted for arriving at the maximum flood discharge from catchments in all Minor Irrigation Schemes for designing surplus weir. In respect of existing M.I. Tanks, the surplus weir may be re-designed adopting this method whenever estimates for M.I. Tanks are prepared for improvements, restoration etc.

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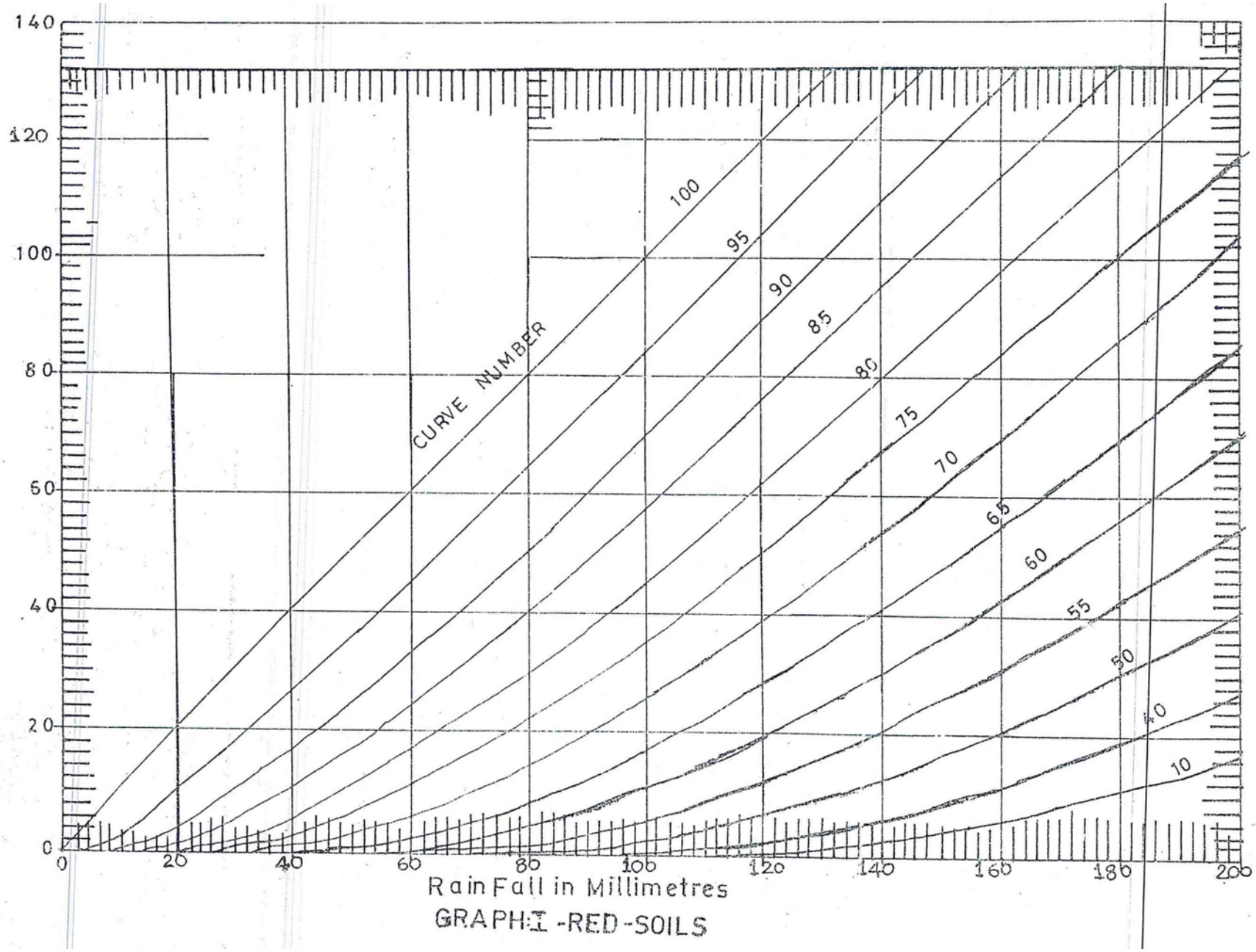
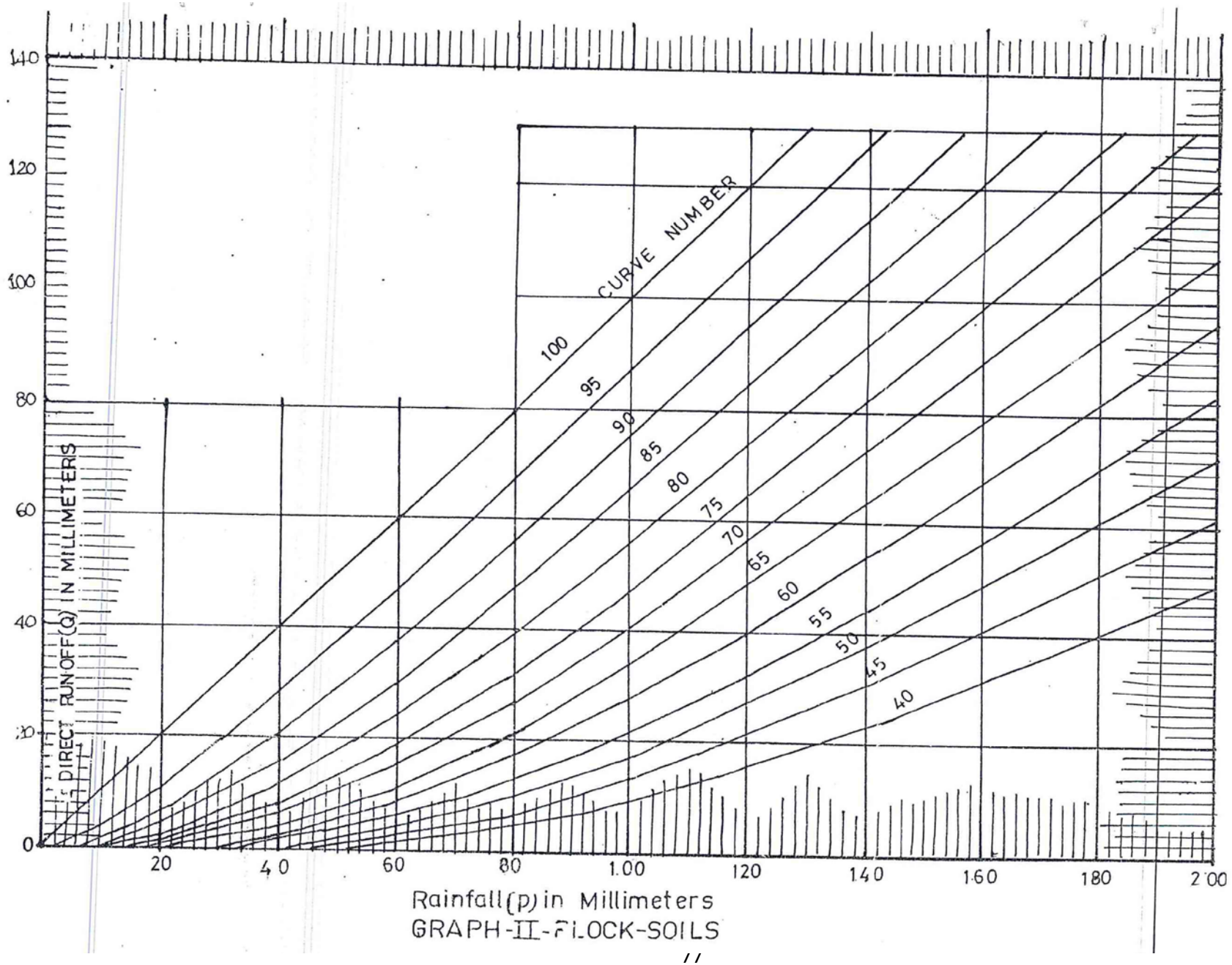
Encls: 1) Example-1
2) Graph-2 Nos



GRAPH:I -RED-SOILS



GRAPH-II-FLOCK-SOILS

EXAMPLE :

Given a 20 Sq.KM catchment area. The catchment area has a length and width ratio of 6:1 and the maximum rainfall recorded in a day far the last 25 years period is 150 milli-metres. The soil group of the catchment is Red soils. The land uses are :-

Cultivated lands with crops is 60% and waste lands 40%. Compute the maximum flood discharge from the catchment.

SOLUTION :

Step-I : Given A -= 20 Sq.KM
L/W = 6:1
Hydraulic soil group – Red soils.

Step-II :

Land use	% of area of catchment	Curve number according to circular Memo	Number times percent
1). Cultivated crops	60	75	4500
2). Waste lands	40	80	3200
	100		7700

$$weighted\ curve\ number = \frac{7700}{100} = 77$$

Adopt curve = 80

Step-III :

Given P= 150 mm, to find 'Q' read from Graph-I (Red soils) for the curve number -80. The value of 'Q' is read as 89 mm, from Graph-I.

Step-IV :

Tp can be completed by the formula

$Tp = 0.76A^{0.28}$ (Since L/W > 4:1)

For the given catchment area of 20Sq.Km

$Tp = 0.76\ X\ (20)^{0.28}$ = 1.758 hours.

q is computed by the formula

$$q = \frac{0.146\ X\ A\ X\ Q}{Tp}\ cumecs$$

$$q = \frac{0.146\ X\ 20\ X\ 89}{1.758}$$

= 148 Cumes.

(This corresponds to a ‘C’ value of 1130 in Dicken’s Formula Q= CM¾ when the same is calculated as per Ali Nawab Jung Formula, it works out to 262 Cumecs.)

Result:- Provide the surplus weir for a discharge of 148 Cumecs.

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(Note:- Please refer to circular No.21,P… for further Computations in higher rainfall areas and Isohyet map of A.P.)

CIRCULAR NO. 14

OFFICE OF THE ENGINEER IN CHIEF : IRRIGATION WING : HYDERABAD, A.P.

Design Circular No. D.C.E.(M.I)/O.T.1-T2/82930/85, dated: 14.10.1985

Sub:- Mini Percolation Tanks (Check Dams) – Trenches in submersion area – Arrangement to enhance deep percolation – Regarding.

Ref:- This office Circular No. D.C.E.(M.I)/O.T.1-T2/82930/85, dated:25.09.1985.

In this reference cited, guide-lines issued with regard to Design criteria for mini-percolation tanks (check dams). The soils required for forming the bund should normally be obtained from borrow areas within the submersion zone. In order to increase the percolation to deeper layers and facilitate recharge of ground water in the horizontal direction, it would be necessary to create suitable facilities for the same. As a first step in this direction a trench of one meter width and 1 ½ meter depth may be excavated at a distance of 15 meters from the up-stream toe of the bund. The length of the trench can be limited to the extent wherer water level is 0.3meters below F.T.L.

It is likely that this trench may get filed up with silt in due course of time. However, percolation can still take place horizontally across the vertical faces, though the see-page through the bottom of trench may get reduced in due course. Excavated soils from this trench should be used for the formation of bund. Depending upon the type of soils in the trench, the same can be used for upstream (S.C.Type soils) or down-stream (G.C., S.D.R. etc) sides of the bund.

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CIRCULAR NO. 15

OFFICE OF THE ENGINEER IN CHIEF : IRRIGATION WING : HYDERABAD, A.P.

Circular No. D.C.E.(M.I)/O.T.1-T2/82930/85, dated: 02.12.1985

Sub:- Minor Irrigation Projects – Preparatrion and Formulation of Plans and Estimates – Administrative and Technical sanction – Preparation of Project Reports – Guidelines communicated from Governemnt of India (Planning Commission) – Instructions – Issued – Regarding.

Ref:- This office Circular No. D.C.E.(M.I)/O.T.1-T2/82930/85, dated:25.09.1985.

The question of catchment area treatment as an integral principal of the irrigation projects was considered by the Committee of Central Government Secretaries recently and it was decided to take immediate necessary action on this aspect while formulating Project proposals. It was decided in that Meeting that preparation of Project Reports may include catchment area, treatment soil conservation, command area development, afforestation etc. Agricultural production and Rural Development are the ultimate goals for any Irrigation project and several departmental activities are, therefore, sought to be harmonized to achieve these goals.

As first step in the above direction, it is desirable that certain soil conservation and treatment measures for reducing siltation and maintenance of ecological balance resorted to in certain critical areas of the catchment of Minor Irrigation Projects. While preparing detailed plans and Estimates this aspect has to be taken into account and Project proposals formulated. Prevention of silt or silt arresting in the catchment area would in turn increase the life of the Minor Irrigation source therefore, beneficial for irrigation projects as such. The following procedure may, therefore, please be followed while preparing minor irrigation project estimates :

(a) For catchment areas exceeding 5 Square Kilo meters (free catchment area) mini percolation ponds may be planned in the catchment area where there are erosion problems. Principles of Design of mini-percolation tanks (check-dams) were already communicated in the reference cited.
(b) Cost of mini-percolation ponds, which serve as silt arresting tanks also may be limited to 5% of the total cost of the minor irrigation project.
(c) Wherever such mini-percolation ponds contemplated the concerned wings of rural development viz., Agricultural Department; Animal Husbandry Department, Panchayat Raj Department, Forest Department etc., may be informed regarding their locations so that they can in turn take follow up measures for exploiting for these resources.

T. HANUMATHA RAO
Chief Engineer, Minor Irrigation

CIRCULAR NO. 16

OFFICE OF THE ENGINEER IN CHIEF : MINOR IRRIGATION : HYDERABAD, A.P.

[CIRCULAR NO. D.C.E.(M.I)/O.T.1-T2/28556/65, dated: 02.12.1985]

Sub:- Investigation Of Earthen Dams – Construction – Classification of soils in borrow areas – Field Identification Tests – Regarding.

Large number of Minor Irrigation tanks, percolation tanks, check dams etc., are now under construction due to intensifying programmes in Minor Irrigation so far. In order to have a reasonable technical data pertaining to Engineering properties of soils for such small works, it would be adequate to resort to field identification tests for classifying the soils beased upon their engineering properties. In the case of important works, high earthen dams, it would still be necessary to send soil samples to A.P. Engineering Research Labs., for obtaining various parameters pertaining to soil mechanics to enable designing the earthen bunds. Such extensive testing of soils in Research Laboratories can be avoided in the case of small works of minor nature without sacrificing the quality content or design aspects in case the soils can be classified under the unified classification of casagrande (ISI Classification).

After classifiying the soils according to unified classification, principle of design of slopes for various heights of earthen dams for homogenous soils or zonal sections can be followed based on the tables enclosed, which are extracted from design of small dams published by USBR. Such classification of soils based upon engineering properties would also be useful during execution to select borrow areas for hearting, soils, casing soils, homogenous soils etc. Thus, it would be seen that field classification of soils would lead to better investigation of Minor Irrigation Schemes as well as to maintain the quality during execution of works.

Engineering propertied of soils are described briefly in Annexure I (extract from Design of small Dams-USBR). The field test comprises of certain basic visual and physical tests which can be done without any equipment. The only requirement is a small quantity of water and a pair of hands. After visual classification of grain sizes, there are basically three tests viz. (a) Dilatancy; (b) Dry strength; and (c) Toughness. Based upon the data of these three tests, classification of soils with regard to clay with regard to clay, silt, high plasticity, low plasticity, poor gradation etc., can be determined. Based on the classification of soils, suitable coils have to be used for zonal sections and homogenous sections as per (Table I and II enclosed)

In order to make the procedures conversant to the Section Officers on the field and to enable the Deputy Executive Engineers to have a through first hand knowledge it is considered necessary that field demonstrations are given by Staff Members of A.P.Engineering Research Lans in each district headquarters an at other suitable places. Three Assistants from the Laboratories are being arranged to cover three regions furing the course of the next forth fortnight. The Executive Engineers are requested to avail this opportunity and make the Section Officers acquainted with the field test procedures.

While submitting Estimates for earthen bunds in future, the same should include classification of soils according to field tests conducted. Sometimes it could happen that souls nearby can be discarded if knowledge of the properties of the same is not available. Field tests of soils will be of great technical advantage and will also lead to economizing the project proposals.

Encls : Tables I & II

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TABLE I

HOMOGENOUS EARTH FILL DAMS STABLE FOUNDATIONS

Sl.No	**Soils classification**	**Remarks**
1	GW., GP., SW., SP	Previous not suitable
2	GC., GM., SC., SM	Suitable
3	CL., ML	To be used with caution
4	CH., MH	Not suitable.

For saturated silt and clay foundations (at GL) soils classifications and slopes of earthen bund have to be specially designed taking care to provide stabilizing fills as given in P.187 (Fig. 112 & Table 13 of Design of Small Dams – USBR)

TABLE II

ZONAL SECTIONS EARTH FILL DAMS ON STABLE FOUNDATIONS

Sl.No	**Soils classification**		**Remarks**
	Casing	**Hearting**	
1	GW, GP, SW, SP, SC	GC., GM., SC, SM, CL., ML	Suitable
2	--- --- ---- ----	CH., MH	To be used with caution Suitable

The hearting section should have slopes of ½ Horizontal : 1 vertical.

UNIFIED SOIL CLASSIFICATION INCLUDING IDENTIFICATION & DESCRIPTION.

FIELD IDENTIFICATION PROCEDURES (Excluding particles larger than 3 inches and basing fractions estimated on weights).				GROUP SYMBOLS.	TYPICAL NAMES	INFORMATION REQUIRED FOR DESCRIBING SOILS
COARSE GRAINED SOILS More than half of material is *larger* than No. 200 sieve size 12. (The No. 200 sieve size is about the smallest particle visible to the naked eye).	GRAVELS More than half of coarse fraction is larger than No. 4 is eve size. (For visual classifications the 1/4" size may be used as equivalent to the No. 4 sieve size.)	CLEAN GRAVELS (Little or no fines.)	Wide range in grain size and substantial amounts of all intermediate particle sizes	GW	Well graded gravels, gravel - sand mixtures, little or no fines.	Give typical name, indicate approximate percentages of sand and gravel, max. size, ; angularity, surface condition, and hardness of the coarse grains ; local or geologic name and other perineal descriptive information; and symbol in parenthesis.
			Predominantly one size or a range of sizes with some intermediate sizes missing.	GP	Poorly graded gravels, gravel - sand mixtures, little or no fines.	
		GRAVELS WITH FINES (Appreciable amount of fines)	Non-plastic fines (for identification procedures see ML below).	GM	Silty gravels, poorly graded gravel - sand - silt mixtures.	
			Plastic fines (for identification procedures see CL below).	GC	Clayey gravels, poorly graded gravel - sand - clay mixtures.	For undisturbed soils add information on stratification, degree of compact - ness, cementation, moisture conditions and drainage characteristics.
	SANDS More than half of coarse fraction is smaller than No. 4 Sieve size	CLEAN SANDS (Littleor no fines.)	Wide range in grain sizes and substantial amounts of all intermediate particle sizes.	SW	Well graded sands, gravelly sands, little or no fines,	
			Predominantly one size or a range of sizes with some intermediate sizes missing.	SP	Poorly graded sands, gravelly sands , little or no fines.	EXAMPLE :- *Silty sand*, gravelly ; about 20% hard, angular gravel particles 1/2"-in maximum size, ; rounded and subangular sand grains coarse to fine , about 15% nonplastic fines with low dry strength ; well compacted and moist in place ; alluvial sand ; (SM)
		SANDS WITH FINES (Appreciable amount of fines)	Non-plastic fines for (identification procedures see ML below).	SM	Silty sands, poorly graded sand - silt mixtures.	
			Plastic fines (for identification 'procedures see CL below).	SC	Clayey sands, poorly graded sand - clay mixtures.	
FINE GRAINED SOILS More than half of material is *smaller* than No. 200 sieve size.	IDENTIFICATION PROCEDURES ON FRACTION SMALLER THAN NO. 40 SIEVE SIZE.					
	SLITS AND CLAYS Liquid limit less than 50.	*Dry Strength (Crushing Characteristics)*	*Dilatancy (Reaction To Shanking)*	*Toughness Consistency Near Plastic Limit*		
		None to slight	Quick to slow	None	ML	Inorganic, silts and very fine sands, rock flour, silty or clayey fine sands with slight plasticity.
		Medium to high	None to very slow	Medium	CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.
		Slight to medium	Slow	Slight	OL	Organic silts and Organic silt - clays of low, plasticity.
	SILTS AND CLAYS Liquid limit greater than 50	Slight to medium	Slow to none	Slight to medium	MH	Inorganic silts, micaceous or diafomaceous fine sandy or silty soils elastic silts.
		High to very high	None	High	CH	Inorganic clays of high plasticity, fat clays.
		Medium to high	None to very slow	Slight to medium	OH	Organic clays of medium to high plasticity.
HIGHLY ORGANIC SOILS		Readily identified by colour, odor, spongy feel and frequently by fibrous texture.			Pt	Peat at - and other highly organic soils.

Give typical name ; indicate degree and character of plasticity, amount and maximum size of coarse grains ; colour in wet condition, odor if any, local or geologic name, and other pertinent descriptive information, and symbol in parentheses.

For undisturbed soils add information on structure, stratification, consistency in undisturbed and remolded states, moisture and drainage conditions.

EXAMPLE :-

Clayey silt, brown slighly platic; small percentage of fine sand: numerous vertifical root holes; firm and dry in place, loess; (ML).

Boundary Classifications : Soils possessing characteristics of two groups are designated by combination of group symbols. For example GW-GC. well graded gravel-sand mixture with

*8—1003

FIELD IDENTIFICATION PROCEDURES FOR FINE GRAINED SOILS OR FRACTIONS

These procedures are to be performed on the minus No.40 sieve size particles, approximately 1/64” in. For field classification purposes screening is not intended, simply removed by hand the coarse particles that interfere with the tests.

DILATANCY (Reaction to shaking)

After removing particles larger than No. 40 sieve size, prepare a pat of moist soil with a volume of about one -half cubic inch. Add enough water if necessary to make the soil soft but not sticky. Place the pat in the open palm of one hand and shake horizontally striking vigorously against the other hand several times. A positive reaction consists of the appearance of water on the surface of the pat which changes to a livery consistency and becomes glossy. When the sample is squeezed between the fingers, the water and gloss disappear from the surface, the pat stiffens and finally it cracks or crumbles. The rapidity of appearance of water during shaking and of its disappearance during squeezing assist in identifying the character of the fines, in a soil.

Very fine clean sands give the quickest and most distinct reaction whereas a plastic clay has no reaction. Inorganic silts, such as a typical rock flour show a moderately quick reaction.

DRY STRENGTH : (Crushing characteristics)

After removing particles larger than No.40 sieve size mould a pat of soil to the consistency of putty, adding water, if necessary. Allow the pat to dry completely by oven, sun or air drying and then test its strength by breaking and crumbling between the fingers. This strength is a measure of the character and quantity of the colloidal fraction contained in the soil. The dry strength increases with increasing plasticity.

High dry strength is characteristic for clays of the CH group. A typical inorganic silt possesses only very slight dry strength Silty fine sands silts have about the same slight dry strength, but can be distinguished by the feel when powdering the dried specimen. Fine sand feels gritty whereas a typical silt has the smooth feel of flour.

TOUGHNESS : (Consistency near plastic limit)

After removing particles larger than a No. 40sieve size a specimen of soil about one-half inch cube in size is moulded to the consistency of putty. If too dry, water must be added and if sticky, the specimen should be spread out in a thin layer and allowed to lose some moisture by evaporation. Then the specimen is rolled out by hand on a smooth surface or between the palms

into a thread about one-eighth inch in diameter. The thread is then folded and rerolled repeatedly. During this manipulation the moisture content is gradually reduced and the specimen stiffens, finally loses its plasticity and crumbles when the plastic limit is reached.

After the thread crumbles, the pieces should be lumped together and a slight kneading action continued until the lump crumbles.

The tougher the thread near the plastic limit and the stiffer the lump when it finally crumbles' more potent is the colloidal clay fraction in the soil;. Weakness of the thread of the plastic limit and quick loss of coherence of the lump below the plastic limit indicate either inorganic clay of low plasticity or materials such as kaolin-type clays and organic clays which occur below the A-line.

Highly organic clays have a very weak and spongy feel at the plastic limit.

CIRCULAR NO. 17

OFFICE OF THE CHIEF ENGINEER : MINOR IRRIGATION : HYDERABAD, A.P.

CIRCULAR NO. D.C.E.(M.I)/O.T.1-T4/28556/65, dated: 24.12.1985

Sub:- Storage capacity of Minor Irrigation Tanks – No. of fillings – Regarding.
Ref:- Memo No. DCE(MI)/OT1-T4/28556/65, dated: 14-8-1985.

In the reference cited design guidelines for fixing storage capacity of Minor Irrigation tanks were issued. It was stated therein that if the rainfall is over and above 30 inches the number of fillings varies from two fillings to 3 fillings depending upon the total monsoon rainfall.

It is seen that 2 to 3 fillings are thus being provided depending upon this circular even for areas where there is no influence of North-East monsoon rainfall. It would be impracticable to assume more than two number of fillings in areas where there is no significant influence of North-East monsoon. Coastal Districts of Andhra Pradesh such as Nellore, Prakasham, Krishna, Guntur, West Godavari and East Godavari have influence of the North-East monsoon in the Coastal belt of these districts. Again the interior western portions of these districts may not have significant influence of North-East monsoon.

While calculating the storage capacity of Minor Irrigation tanks even though, it may work out as more than 2 fillings, yet the capacity may be designed for two fillings only for areas not influenced by North-East monsoon. for the purpose of this design, the districts above mentioned may be considered as having influence of North-East monsoon i.e. Eastern portions of these districts as indicated from rainfall particulars. The guidelines issued are applicable for such areas in these districts. All other districts may be considered as not having appreciable influence of North-East monsoon and hence the storage capacity has to be designed only for two fillings even though it may work out as more than 2 fillings. The following tabular statement is given for ready guidance.

Monsoon rainfall	No. of fillings		Remarks
	Areas influenced by N.E.Monsoon (Eastern areas of Chittoor, Nellore, Prakasham, Krishna, Guntur, West Godavari and East Godavari)	Other areas in A.P.	
15”	1	1	
15”– 20”	1 ¼	1 ¼	
20”-25”	1½	1½	
25”-30”	1¾	1¾	
30”-35”	2	2	
35”-40”	2½	2	
Above 40”	3½	2	

Dt:24-12-1985

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Chief Engineer, Minor Irrigation

CIRCULAR NO. 18

OFFICE OF THE ENGINEER–IN-CHIEF: IRRIGATION WING: HYDERABAD, A.P.

CIRCULAR NO. DCE(MI)/OT1-T2/52885/85, dated: 16-1-1986

Sub:- Preparation of Project Reports for E.E.C Aided Schemes – Lumpsum provisions – Economizing the cost per Hectare – Instructions – Regarding.

It is quite desirable that the over all cost per hectare for all EEC aided Schemes should as far as possible be within Rs. 30,000/- though project Reports received so far, it is seen that the average per hectare cost is working out to Rs. 50,000/- though in Minor Irrigation normal component plan Schemes (other than EEC Aided), the per hectare cost is working out to around Rs. 20,000/-. It is, provisions for various infrastructure and supporting works. Even in the Normal Minor Irrigation Schemes provisions for such infrastructure are also being made.

The Project Appraisal Committee constituted under EEC aided schemes had taken a view that if the schemes work out extremely expensive especially in tribal areas, possibilities of creating alternative resources for the development of that area can be considered, such as exploitation of ground water, lift irrigation from flowing rivers, streams etc. The concept of Minor Irrigation storage tanks expensive storage works would appear to be diversion schemes such as anicuyt and canals. Lift irrigation, percolation tanks clubbed with well can constiuction programme etc can also be considered.

The following LS provisions and percentages may be adopted while pricing the Estimates for all EEC aided schemes and normal schemes. This is with a view to ensure uniformity and standardization.

1. Approach road to site :- Metelled road single lane, but land acquisition for two lane traffic and earth work done (sketch enclosed)
2. Store-sited, implement shed:
3. L.A. for C.T. along channels 7 Meters width (as per sketch enclosed)
4. Land acquisition for infrastructure etc., at Head Works (as per Circular instructions issued)

Attempts have been made during the past few months for standardizing the Design data and estimation procedures keeping the same common for all EEC aided schemes and other plan schemes. Now that normal plan schemes also are being designed following the same pattern and infrastructure of EEC Schemes, the only difference appears to be in the following design aspects.

1. Calculation of yield of the basin is done by following dry damp wet method for 12 years for the EEC Schemes. The same procedure may be continued. The 75% dependable yield as calculated by the dry damp wet method for 12 years and as arrived at by the usual stranges Table method for 40 years may be compared and higher of the two may be adopted for project Formulation in Drought Prone areas. This need not be followed for normal plan schenes,

strange Tables may be used for computations of yield for Normal Plan, Minor Irrigation Schemes.

2. Computing the demand tables upon modified Pen Man formula using the data of potential evapo transpiration of that area. This method now being followed for all EEC Schemes may also be followed for all Normal Plan, Minor Irrigation Schemes.

3. Design of Minor Irrigation Tanks under EEC Aided Programme excepting item (1) above would exactly be the same as normal Plan Minor Irrigation Schemes, this will facilitate easy switching of schemes from one funding programme to the other without the time consuming exercise of revising the plans and Estimates. Also certain amount of radical and improved Design practices would uniformly be followed for all Minor Irrigation Schemes irrespective of their sources funding.

The following guide-lines may please be followed while locating Minor Irrigation Schemes wherever inter action with the forest boundaries are involved.

4. No portion of the tank surplus weir, O.R. in front of surplus weir, surplus course, canals etc., should be located within the forest area. Even if a small extent of less than one acre of forest area is involved directly under any one of the component works, it requires alienation of forest land and this in turn entails elaborate exercise in ultimately obtaining sanction from Government of India.

(b) If it is inevitable to have a portion of submersion of the tank under F.T.L. conditions in forest area, it should be seen that only minor fraction of the total submersion land is within the forest boundaries. It would be possible for the Principal Chief Conservator of Forests, Hyderabad to accord permission for such submersion within the forest boundaries, since this does not involve in any alienation of Forest land to the Irrigation Department. Also such submersion would help forest growth in view of better soil moisture conditions and also encourage wild life.

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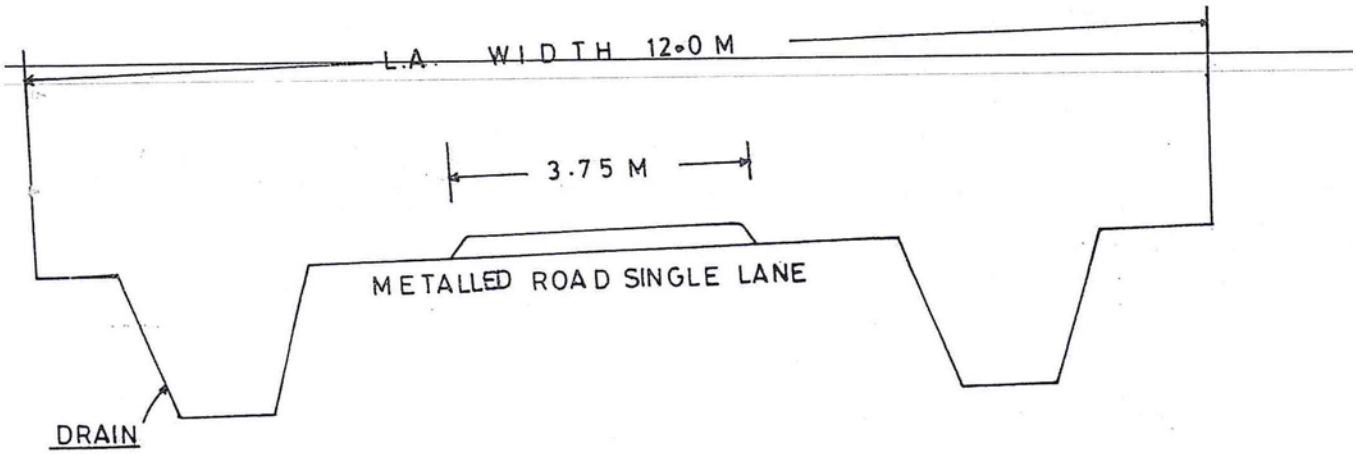
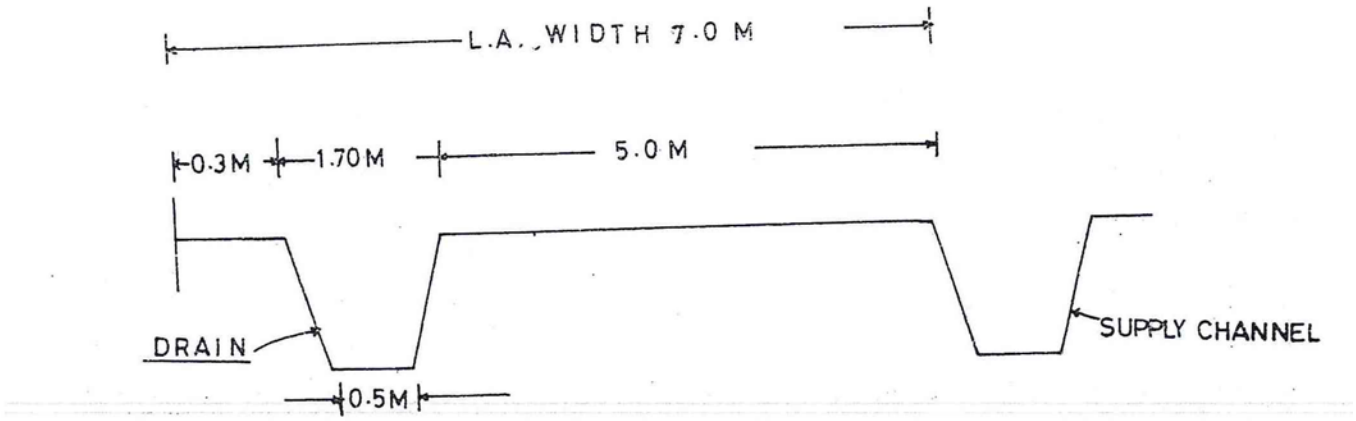


SKETCH FOR APPROACH ROAD FOR TWO LANE



SKETCH FOR C.T ALONG CHANNEL

CIRCULAR NO. 19

OFFICE OF THE ENGINEER-IN-CHIEF : IRRIGATION WING : HYDERABAD A.P.

Circular Memo No. DCE(MI)/OT.1-T4/28556/65, Dated:16-1-86

Sub:- Irrigation Demand – Method of Calculation – Potential evapo transpiration Modified Pen – Man formula

While calculating irrigation demands for Minor Irrigation Schemes certain imperial procedures pertaining to protective irrigation to rain fed crops, Rabi / I.D. Wet crops are being adopted. A rational method would be to work out the crop water requirements based on potential evapo-transpiration of the area and making use of modified pen man formula taking into account crop factor, useful rainfall etc. This is fairly a simple method and can easily be made applicable for all Minor Irrigation Schemes.

For working out demand tables for all future Minor Irrigation Schemes, the following method may be adopted:-

(a) Potential evape-transpiration (PET) of the area based on agro meteorology of the nearest station may be considered. Values of the evape-transpiration for various stations in Andhra Pradesh month-wise are indicated in the Statement (1) enclosed. Values of the nearest station may be considered for the M.I. Project in question. Monthly values of Irrigation Demand may be worked out based on the crop factor, useful rain fall, making use of the modified Pen Man formula. Sample calculations for protective irrigation for rain fed crops, Rabi, I.D., Irrigated wet are enclosed in the Statements in 2, 3 &4.

The method of considering number of wettings for Khariff I.D. and Rabi I.D. and adopting the same for all areas is having the risk of upunrealistic assumptions and hence this requires modification. The method suggested above is a very simple one and is already being adopted for the E.E.C. sponsored Schemes. The same may be adopted for all schemes under Minor Irrigation.

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Encls: 1. Statements 1,2, 3 &4
2. K C value statement

STATEMENT – I

NORMAL MONTHLY POTENTIAL EVAPORATION TRANSPIRATION VALUES

Sl. No	Station		Jan	Feb	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
						Coastal Andhra Pradesh								
1.	kalingapatnam	..	101.6	113.0	156.0	164.5	173.5	143.4	127.7	124.3	114.1	116.2	106.5	99.0
2.	Visakhapatnam	..	95.2	109.3	154.7	162.8	166.2	128.3	118.4	120.0	110.0	116.3	105.7	94.4
3.	Kakinada	..	111.9	123.4	167.7	176.3	194.0	169.0	136.0	137.2	124.5	124.9	116.1	107.9
4.	Nidadavolu	..	106.1	116.4	149.7	151.1	162.3	150.2	114.3	109.8	105.4	100.2	101.9	98.9
5.	Renta Chintala	..	110.9	131.8	184.5	195.8	214.0	187.5	151.9	150.8	127.1	120.5	101.8	98.0
6.	Gannavaram	..	125.1	136.3	181.1	197.1	227.0	198.7	147.5	138.5	120.8	120.8	121.2	115.9
7.	Machilipatnam	..	111.7	120.8	161.9	177.0	205.0	181.4	114.0	140.0	124.6	121.3	109.2	106.5
8.	Ongole	..	110.1	124.0	162.9	172.0	193.7	171.0	139.7	146.1	130.0	116.6	107.0	101.4
9.	Nellore	..	110.7	126.4	172.5	184.3	197.0	169.5	152.2	152.9	142.1	122.2	99.2	98.8
						Statement No.1 Telangana :								
1.	Ramagundam	..	107.8	128.4	178.9	199.2	224.3	183.5	124.4	117.2	115.3	123.2	101.4	92.5
2.	Nizzamabad	..	98.8	115.6	157.6	176.6	201.8	168.0	126.6	124.3	114.9	120.9	97.9	87.6
3.	Hanumakonda	..	113.3	134.6	184.0	204.8	233.5	185.7	136.7	134.7	123.6	131.8	106.5	97.6
4.	Bhadrachalam	..	106.5	125.9	176.3	191.8	205.0	165.3	166.5	108.9	105.8	108.9	99.6	91.5
5.	Hyderabad	..	109.8	129.5	181.5	197.8	219.9	196.4	140.4	135.5	119.3	123.6	194.1	98.6
6.	Khammam	..	111.8	131.4	179.7	191.0	211.0	168.7	129.0	122.9	115.1	115.6	102.0	97.9
7.	Mahaboobnagar	..	119.5	133.1	176.8	182.1	198.0	157.5	123.9	119.1	116.7	120.5	116.7	110.5
						Rayalaseema :								
1.	Kurnool	..	117.6	134.8	180.8	194.7	221.4	189.8	161.4	154.6	133.5	123.7	108.3	104.1
2.	Ananrhapur	..	131.0	142.6	190.4	196.7	199.0	178.5	160.9	158.1	142.7	124.8	117.8	114.5
3.	Cuddapah	..	131.0	156.0	208.8	209.5	205.1	167.1	118.0	143.9	131.7	124.0	104.8	103.0
4.	Arogyavaram	..	102.6	122.4	168.8	162.4	167.45	149.5	137.0	139.1	125.1	101.4	91.1	88.7

STATEMENT SHOWING CROP-COEFFICENT VALUES (Kc.) (MODIFIECD PEN-MAN METHOD)

Sl.No	Name of the crop.	Crop co-efficient (Kc ValueS)					
		1st Month	2nd Month	3rd Month	4th Month	5th Month	6th Month
1.	Paddy	1.10	1.10	1.10	0.95	--	--
2.	Groundnut ..	0.40	0.70	0.95	0.75	--	--
3.	Chillies	0.30	0.60	0.60	0.95	0.60	0.35 (15 days)
4.	Cotton	0.40	0.70	0.70	1.05	1.05	0.80 (15 days)
5.	Hybrid Sajja (Bajra Pearl Millet) ..	0.30	0.90	0.70 (15 days)	--	--	--
6.	Hybrid Jonna (Sorghum, jowar) ..	0.30	0.70	0.70	0.75	--	--

STATEMENT – II

FORMATION OF NEW TANK ACROSS PADMARAJUVAGU NEAR IDIRESWARAM (V) ATMAKUR TALUK KURNOOL DIST.

Crop Period : 120 days Crop water requirement by Modified Pen-Man Method: I.D. Groundnut (Rabi)

S.No	Description of item	December	January	February	March	Total
1	S.T.Value in mm	104.10	117.60	134.80	180.8	
2.	Kc Crop coefficient Value	0.40	0.70	0.95	0.75	
3.	Monthly Water requirement (1x2)	41.64	82.32	128.06	135.60	
4.	Add for Initial Watering	10.00	..	..	..	
5.	Gross Monthly Water requirement	51.64	82.32	128.06	135.60	397.62
6.	Monthly Rainfall at 50%PL	3.20	..	..	..	3.20
7.	Effective rainfall@50% of 50%P.L.	1.60	..	..	..	1.60
8.	Net irrigation requirement	50.04	82.32	128.06	135.60	396.02
9.	Requirement with 70% field efficiency	71.48	117.60	182.94	193.71	565.73
10.	Monthly requirement at Canal Head with 85% conveyance efficiency	84.09	138.35	215.22	227.90	665.56
11.	Total requirement in mm	84 mm	139 mm	215 mm	228 mm	666 mm
12.	Total requirement per Ha.	840 mm	1390 cum	2150 cum	2280 cum	6660 cum

STATEMENT-III

FARMATION OF NEW TANK ACROSS VANKA NEAR PULAKUNTA (V) RAYADURG TQ. ANANTHAPUR DISTRICT.

Crop Period : 120 days Crop water requirement by Modified Pen-Man Method: I.D. Groundnut (Khariff)

S.No	Description of item	July	August	September	October	Total
1	E.T.Value in mm	160.90	158.10	142.10	124.20	
2.	Kc (Crop Co-efficient Value)	0.40	0.70	0.95	0.75	
3.	Monthly Water requirement (1x2)	64.36	110.67	135.57	93.15	
4.	Add for Initial Watering	10.00	..	..	..	
5.	Monthly (Gross) Water requirement in mm	74.36	110.67	135.50	93.15	413.75
6.	Monthly Rainfall at 50%PL	35.49	64.88	124.42	148.77	373.50
7.	Effective rainfall@50% of 50%P.L.Rainfall	17.75	32.44	62.21	74.39	186.79
8.	Net water requirement	56.61	78.23	73.35	18.76	226.96
9.	Requirement with 70% field efficiency	80.87	117.76	104.80	26.80	330.23
10.	Requirement at Canal Head with 85% conveyance efficiency	95.14	135.54	123.29	31.53	385.50
11.	Total requirement in mm	95	136	123	32	386
12.	Total requirement per Ha.	950 cum	1360 cum	1230 cum	320 cum	3860 cum

STATEMENT – IV

FORMATION OF TANK ACROSS CHITYAL TALUQ : WARANGAL DISTRICT

Crop Period : 120 days Crop water requirement by Modified Pen-Man Method: I.D. Groundnut (Rabi)

S.No	Description of item	July	August	September	October	Total
1	E.T. Value in mm. (Hanumakonda)	136.70	134.70	123.06	131.80	
2.	Kc (Crop coefficient) Value	1.10	1.10	1.10	0.95	
3.	Monthly Water requirement (1x2)	150.37	148.17	135.96	125.21	
4.	Add for Nursery	40	..	..	..	
5.	Add for land preparation	160	..	..	..	
6.	Add for deep percolation (3mm. per day)	90	90	90	90	
7.	Add for minimum depth	50	..	50	..	
8.	Gross total monthly requirement in mm	490.37	238.17	275.96	215.21	1219.71
9.	Monthly Rainfall at 50%PL	297.52	242.71	171.30	95.93	..
10.	Effective rainfall 50% of 50% P.L.	148.76	121.35	85.65	47.97	403.73
11.	Net irrigation requirement	341.61	116.82	190.31	167.24	815.98
12.	Requirement at 90% field efficiency	379.57	129.80	211.46	185.82	906.65
13.	Monthly requirement at Canal Head at 85% conveyance efficiency	446.55	152.71	248.78	218.61	1066.65
14.	Total requirement in mm	447 mm	153 mm	249 mm	219 mm	1068 mm
15.	Total requirement per Ha.	4470 mm	1530 cum	2490 cum	2190 cum	10680 cum

CIRCULAR No. 20

OFFICE OF THE CHIEF ENGINEER : MINOR IRRIGATOPM : HYDERABAD-A.P.

Design Circular No. DCE (MI)/OT1-T4/61826/85, dated: 21-1-1986

Sub:- Surplus weir – Aprons – Dissipation arrangements Rough stone aprons (Talus) Retaining Wall – Reg.

In most of the Minor Irrigation Schemes, surplus weir has to be provided on one flank of the tank bund. Selection of site for surplus weir, aprons is so done as to keep the cost of this as low as possible. In order to facilitate this, suitable rock out crops, hard soils, S.D.R., H.D.R etc., are normally preferred. However, in several surplus courses, it is seen that hard soils are just not available and expensive treatment works are being designed with several drop walls provided in the surplus course to minimize the velocity of flow. In some tank proposals, it is seen that the cost of drop walls is by far exceeding ever the cost of surplus weir and aprons. The concept of providing number of such drop walls has originated keeping in view the velocity of flow and restricting the same to permissible limits to the erodible velocity, which the soils can safely take. However, such a concept is leading to raising the water level unduly above the natural ground and allowing it to drop steeply at one concreted place all along the drop wall. Also such raising the water levels and dropping the same is done at three to four places. This requires once again energy dissipation arrangements of an elaborate nature at the places of such drops. If there are 3 or 4 such drop walls, cost of these alone will be manifold of the cost of main weir and aprons. For Minor Irrigation Tanks, such a methodology would prove to be highly prohibitive in cost and in the process of solving one problem, we have to handle several other problems of scour at every drop wall. Though such a principle was not adopted form any of the existing old weirs and surplus courses constructed in red soils and black cotton soil areas, still most of them are functioning satisfactorily. This is due to the scour pattern having been established and regime of surplus course getting stabilized over a long period of functioning of the surplus course. In order to have an effective solution to this problem and also to reduce the costs without increasing any risk, the following method is suggested for adoption.

In the concept of Minor Irrigation Tanks, economy should be one of the important concerns and at the same time, there should not be any risk whatsoever to the structure or lands downstream. Damage, if any, caused in surplus course and aprons due to a rare occurrence of a peak flood, can be repaired easily at very low cost and it may not be prudent to initially invest very heavy amounts (in certain cases this is as high as 50% of cost of Project) to take care of such a contingency. The natural formation, stabilization and regime of surplus course have to be taken advantage of and surplus course designed suitably. This concept was also explained in Design of small dams U.S.B.R.P 248 Para 180. Any scour in the course can easily be repaired and managed suitably by dumping of stones, pitching etc., as shown in Sketch enclosed.

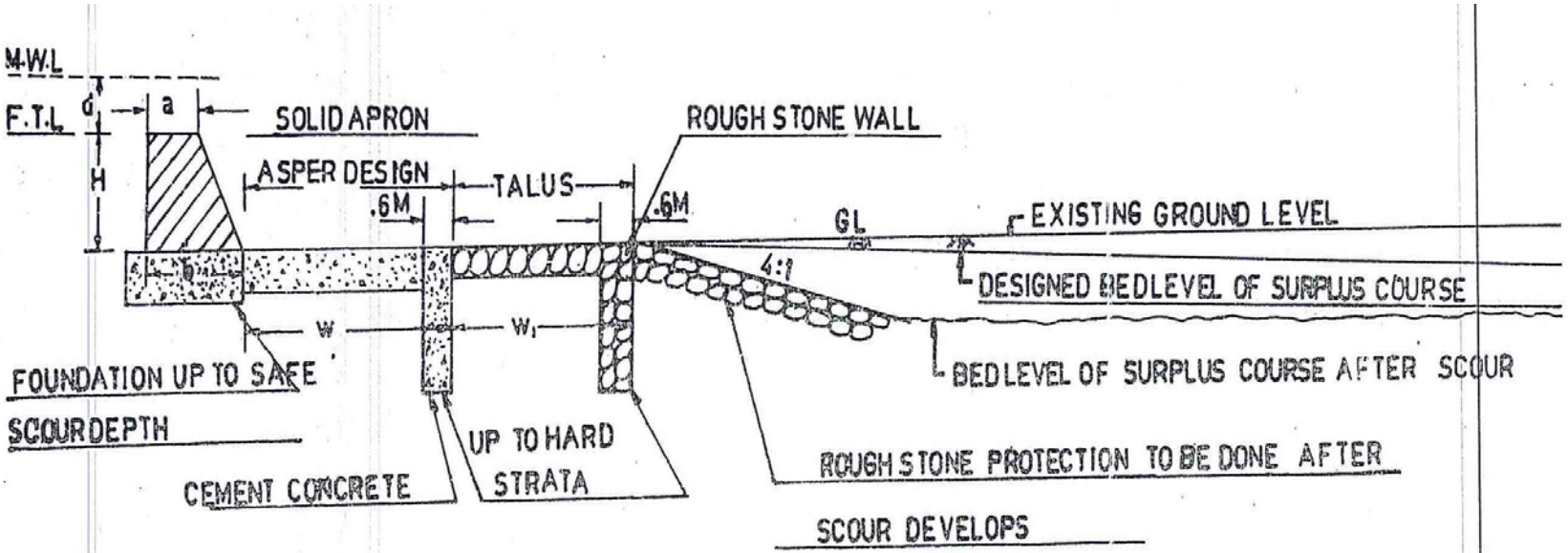
In essence, the surplus course should be allowed to develop its regime and scour matter upto hard sol levels. The conventional solid aprons should be provided upto the length required for, Hydraulic jump considerations and should terminate with a solid concrete retaining wall going upto hard soils.

Continuation of this solid apron, rough stone apron (Talus) has to be provided to the required lengths and protected by a rough stone retaining wall taken upto hard soils. This retaining wall, should not be with masonry or concrete but should be with mere rough stone, well packed and wedged. The idea in providing such a type of retaining wall is that it should adjust to the scour patterns developing below it. If a solid wall is provided the same will resist adjustments and will crack or, crumple giving rise to some more scours. Any scours developed down below such rough stone cut-off can be treated by demoting rough stone by the side of the drop wall along the course to a slope of 4 horizontal to 1 vertical as shown in Sketch. Such dumpting of stone after the first flood discharge would protect the talus and also facilitates development of suitable regime for the surplus course. The concept of cut-off on down-stream side of surplus weir is explained in para-211-page 342 of Design of small USBR. The Superintending Engineer should satisfy himself about the proposal on the above lines and the Executive Engineer should certify about the availability of hard strata along with T.P. particulars while submitting proposals for sanction.

A sketch showing the arrangement of Talus, Cut-off rubble wall etc., is enclosed for guidance and adoption.

T. HANUMATHA RAO
Chief Engineer, Minor Irrigation.

Encls: 1. Sketch.



W = WIDTH OF SOLID APRON

W_1 = WIDTH OF TALUS

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MINOR IRRIGATION

CIRCULAR No. 21

OFFICE OF THE CHIEF ENGINEER : MINOR IRRIGATON : HYDERABAD-A.P.

Design Circular No. DCE (MI)/OT1-T4/28556/65, dated: 291-1-1986

Sub:- Design principles of Minor Irrigation Schemes – Procedure to be followed for calculating maximum flood discharge from catchments to Design surplus weirs – Reg.

Ref:- This office Circular Memo No. DCE (MI)/OT.2-T4/28556/65, dated: 25.9.1985. (Circular No.13.)

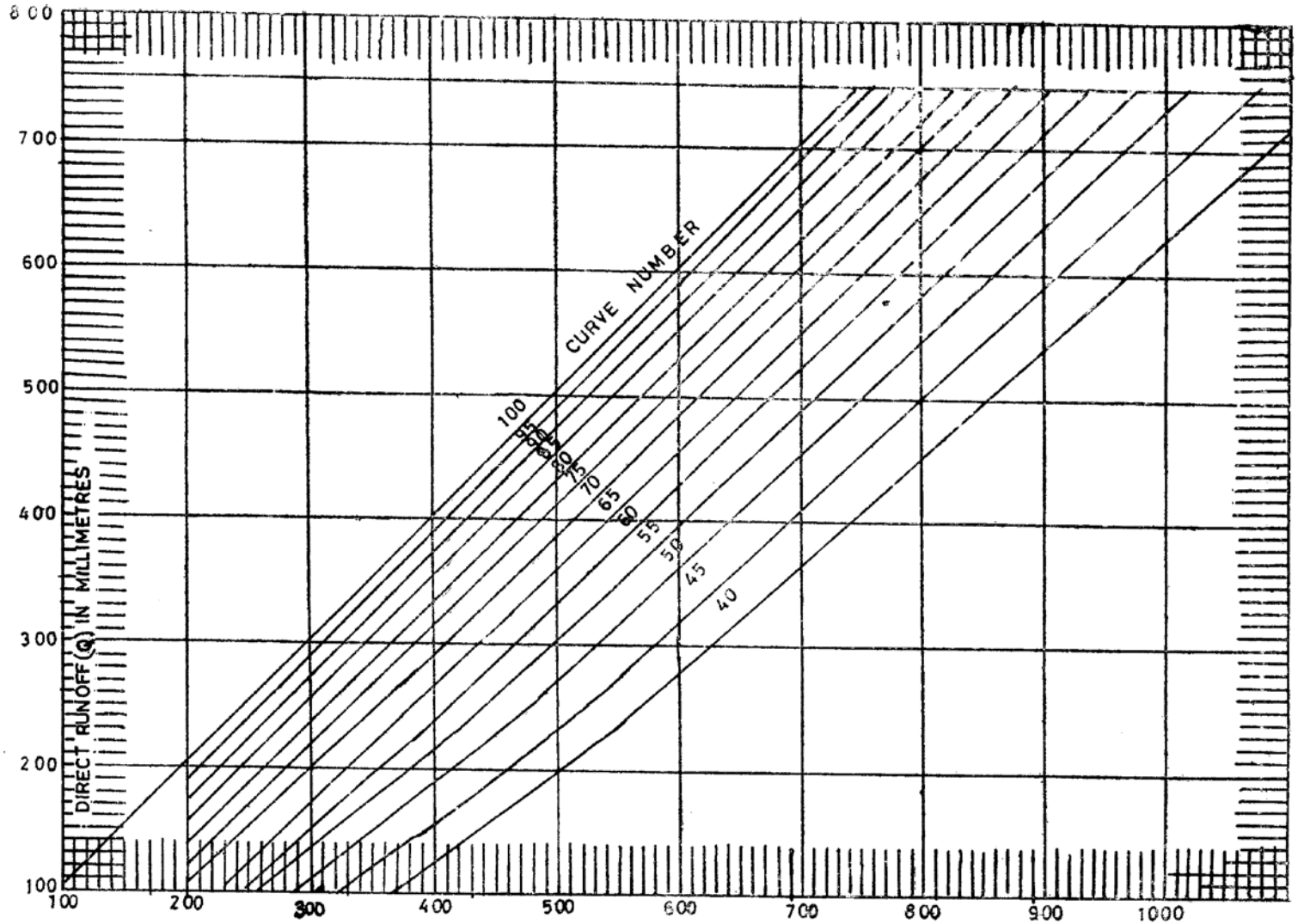
It is observed that in certain areas like Nellore and Chittoor Districts, the maximum daily rainfall (P) recorded over a period of 25 years is more than 200mm. for reading the direct run-off (Q) in such cases, two more graphs are enclosed for reference as indicated below for rain-fall intensities 200 mm to 100 mm, in addition to two graphs already enclosed to this office Memo. Cited.

Graph-III …For Red soils.
Graph-IV …For black soils.

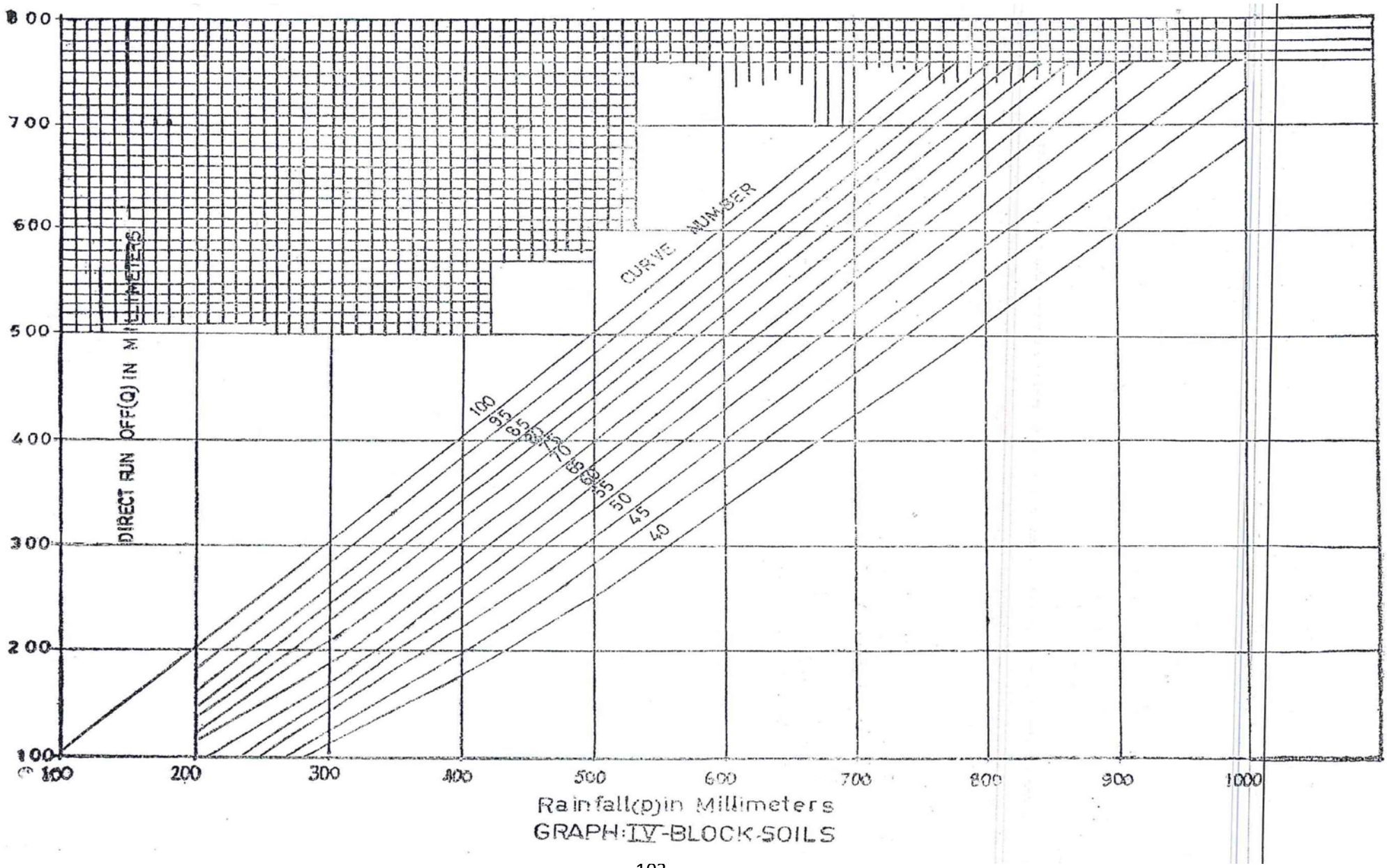
Further, it is noticed that the value of maximum daily rain-fall (P is not readily available and this is resulting in delays as well as computations in some cases. In order to have a correct idea of 25 years, one-day rainfall in a particular area, a Map of Andhra Pradesh showing the isohyets of 25 years one-day maximum rainfall is enclosed. This is prepared based on the Map published by Indian Meteorological Department. The Field Officers are requested to make use of this MAP, and do interpolation, for arriving at the value of maximum daily rain-fall in the Project Catchment area. Since this Map is based upon statistical analysis done by Indian Meteorological Department this can be straight-away adopted and there is no need for further gathering daily rain-fall data for 25 years.

T. HANUMATHA RAO
Chief Engineer, Minor Irrigation.

Encls: 1. Graphs-III &IV
2. Map of Andhra Pradesh showing Isohyets.



GRAPH III RED-SOILS



GRAPH:IV-BLOCK-SOILS

CIRCULAR No. 22

CIRCULAR No. DCE (M.I)/OT1-T4/61826/85, DATED:5-3-1986

Sub:- New Minor Irrigation Projects – Per hectare cost – Reg.

While evaluating financially the cost of Minor Irrigation Projects taking into account ayacut, cropping pattern, yield etc., the norm now being used is based on the B.C. Ratio concept. In case of more than one crop in the same ayacut (Two crops), the second crop being in a portion of the same ayacut or entirely different ayacut (two crops), the second crop being in a portion of the same ayacut or entirely different ayacut, the method of calculation of B.C. Ratio is on the basis of yields that will be obtained from the gross ayacut namely the total produce derived from both the crops.

It is necessary to adopt a suitable yardstick for working out the cost per Hectare to have a general idea as to how much it costs to give irrigation to one Hectare. The cost per hectare can be worked out taking into account the gross ayacut of first and second crops for which irrigation water is supplied. Thus if the per hectare Kharif I.D. is 500 hectare and Rabi I.D. is 250Hectares the per hectare cost irrigation has to be calculated on the basis of 750 hectares, irrespective of whether the second crop is in the same ayacut or entirely different ayacut. Per hectare cost is not recognized normally for evaluating a minor irrigation project, but yet this will give a general financial idea as to how much capital investment is required to give irrigation to one hectare. Such an idea though gives a rough financial appraisal may not be used as a yardstick for sanctioning a Minor Irrigation Project.

This method may please be followed while submitting the figures of financial analysis for new schemes in future.

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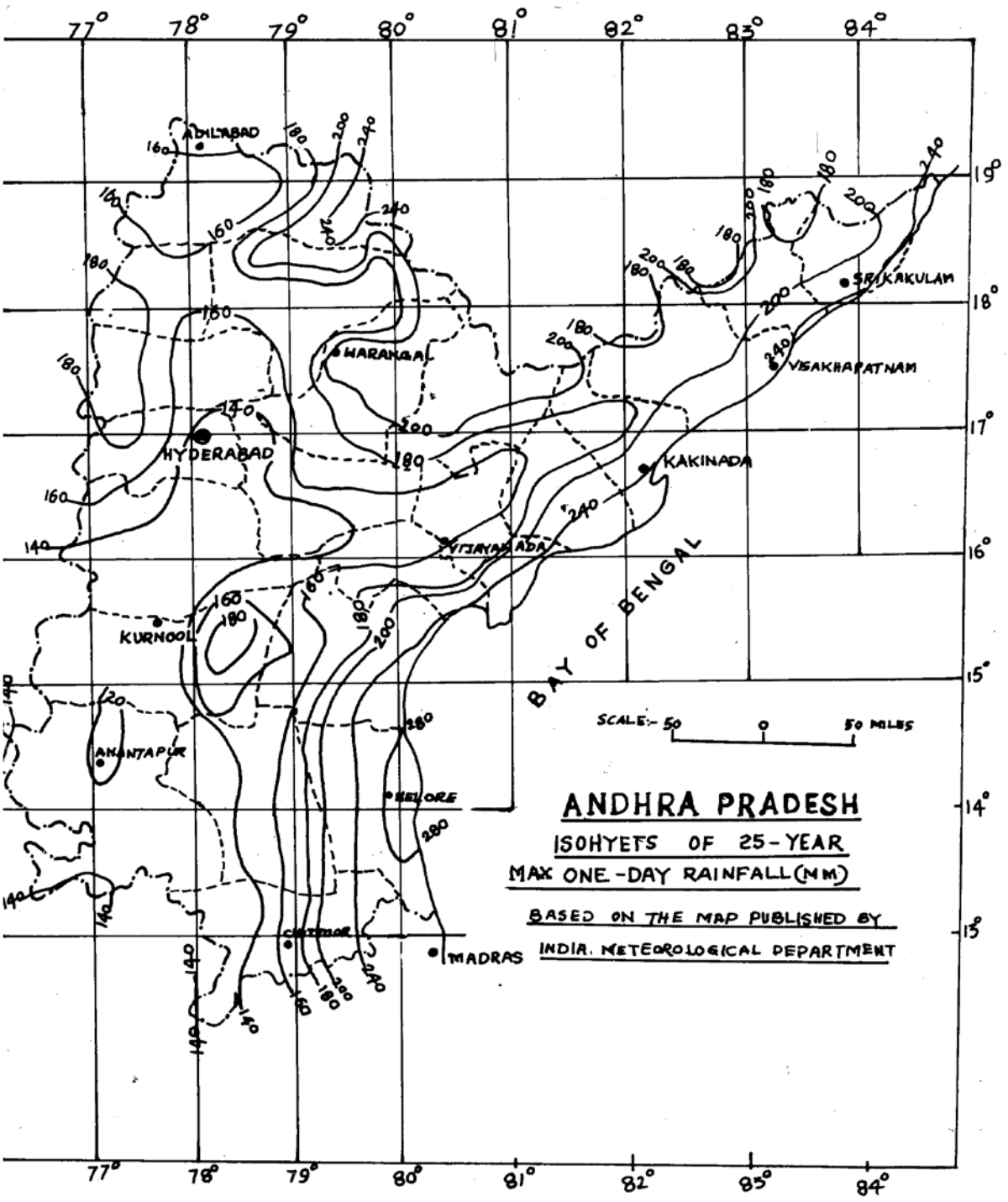
77°
78°
79°
80°
81°
82°
83°
84°
19°
18°
17°
16°
15°
14°
13°
ADILABAD
WARANGAL
HYDERABAD
KURNOOL
ANANTAPUR
NELLORE
MADRAS
SRIKAKULAM
VISAKHAPATNAM
KAKINADA
VIJAYAWADA
BAY OF BENGAL
SCALE:- 50 0 50 MILES
ANDHRA PRADESH
ISOHYETS OF 25-YEAR
MAX ONE-DAY RAINFALL (MM)
BASED ON THE MAP PUBLISHED BY
INDIA METEOROLOGICAL DEPARTMENT

CIRCULAR No. 23

GOVERNMENT OF ANDHRA PRADESH IRRIGATION DEPARTMENT

OFFICER OF THE ENGINEER-IN-CHIEF,
MINOR IRRIGATION, ERRUMANZIL,
ANDHRA PRADESH, HYDERABAD.
PIN CODE NO. 500 482.

Circular No.DCE/MI/OT-T4/61826/85, Dt: 29-3-1986

Sub:- Inspection of works – Salient features of Schemes – Proforma – Reg.

During field inspections of Chief Engineer, Minor Irrigation, it is noticed that certain field officers are preparing detailed notes for inspection and yet certain other officers are listing out only salient features. In a few cases it is seen that no such effort is made. In order to have uniformity and to have a ready grasp of the field situation a simple proforma of just one page would be adequate. For details of any individual item, the estimates and plans can be referred to at the site. The following proforma may please be followed while presenting details at site during field inspections.

1. Name of Scheme.
2. Mandal, Taluk, District.
3. Catchment Area.
4. (a).Average Monsoon rain-fall;
   (b).Yield in Mcft per Sq.M
5. Net available yield.
6. (a) Hydrology clearance given for;
   (b) Date of Clearance;
7. Yield proposed to be utilized
8. (a) Gross storage;
   (b) Number of fillings
9. Ayacut in Ha.

	Kharif		Rabi
	Wet	I.D.	I.D.
(a) Right Canal	..	..	..
(b) Left Canal	..	..	..
Total in Ha.	..	..	..

10. (a) Maximum Flood discharge;
    (b). Head of flow;
11. (a) F.R.L
    (b) Sill level. *
12. Cost of Project including indirect charges. Rs.
13. Cost per Ha. Rs.
14. Benefit cost ratio
15. General .

T. HANUMATHA RAO
Chief Engineer, Minor Irrigation

CIRCULAR No. 24

OFFICER OF THE ENGINEER-IN-CHIEF, MINOR IRRIGATION,
ERRUMANZIL, ANDHRA PRADESH, HYDERABAD.

Design Circular No.DCE/MI/OT1-T4/61826/85, Dt: 11-4-1986

Sub:- Design of Percolation Tanks – Increasing deep percolation in submersion area – Excavation of trench – Reg.

Design of percolation tanks needs optimization to achieve the maximum benefits. The ideal case may be where the surface area is minimum and depth appreciable for a given storage. This limiting case (first case) would be when the entire storage is held in excavated in large rectangular or square shaped pit. In such a case the volume of the tank would almost be the same as the volume of earth excavated. Excavated earth will be thrown on the sides of such large pits and this will not form a bund to impound any surface storages. The other extreme (second case) is the conventional storage will mostly be by way of impounding storage over the ground levels and such impounding being achieved by a tank bund formed for this purpose.

It is generally seen that in the first case if 1 Mcft. of earth work is excavated, it gives a storage of only 1 Mcft. Whereas in the second case the same 1 Mcft. Excavated earth if consolidated and formed in the shape of tank bund, it will impound about 12 Mcft of water. Thus the second case is having a high productivity of storage of water per unit earth work excavated, as high as 12 times more than the first one. The cost of the second case would be ⅛th of the cost of the first proposal, since it would cost extra for consolidation and other components that go into the construction of the tank bund. Given that the second proposal is ⅛th of the cost of the first proposal per 1 Mcft of storage this has certain dis-advantages as indicated below:

a. Land under submergence will be 3 to 4 times more than the first proposal;

b. Land acquisition cost will also be several fold more than the first proposal;

c. Evaporation losses will be higher due to larghe surface area of submersion;

Since deep percolation has to be increased and evaporation losses minimized, an optimization technique is to be resorted to while designing percolation tanks. Such techniques would be situation specific depending upon type of soils, sub strata, slope of the open lands, shape of sub-mergence etc. officers engaged on planning , Design and Construction of Percolation Tanks are requested to give thought to these problems and come forward with proposals which would specifically suit the areas in which these programmes have to be formulated.

As a first step in this direction the following procedure may please be adopted for all the percolation tanks, yet to be started and wherever possible for works in progress. All future proposals nay please be formulated on this basis. In the submersion area at a distance of 3H from the toe of bund, a deep trench may be excavated parallel to the bund (H=height of bund above ground level). The length of this trench may be limited upto the point where ground level is 0.5Mtrs. below F.T.L. The depth of trench may be limited upto H/2 where width of trench can be

about 1 Metre at bottom. Side slopes may be ¼:1 in S.D.R and above and ½:1 in gravel and red soils. The excavated soils from the trench may be used for the formation of the bund at the appropriate places. For example, if gravelly type of soils S.D.R etc., is met with, the same can be used for down-stream side of the casing zone of earthen embankment. In case, S.C. Type of soils are met with, they can be used for up-stream side casing zone. In case of clayey soils such as, C.L. C.H., etc., the same can be used in the hearting portion of the tank bund.

Though siltation may take place eventually at the bottom of such s trench still seepage is possible at the sides of the trench. However, such seepage is also likely to eventually get reduced as the trench gets filled up with silt. However, since this proposal does not cost any extra financial commitment, this may please be implemented immediately.

Encl: Sketch

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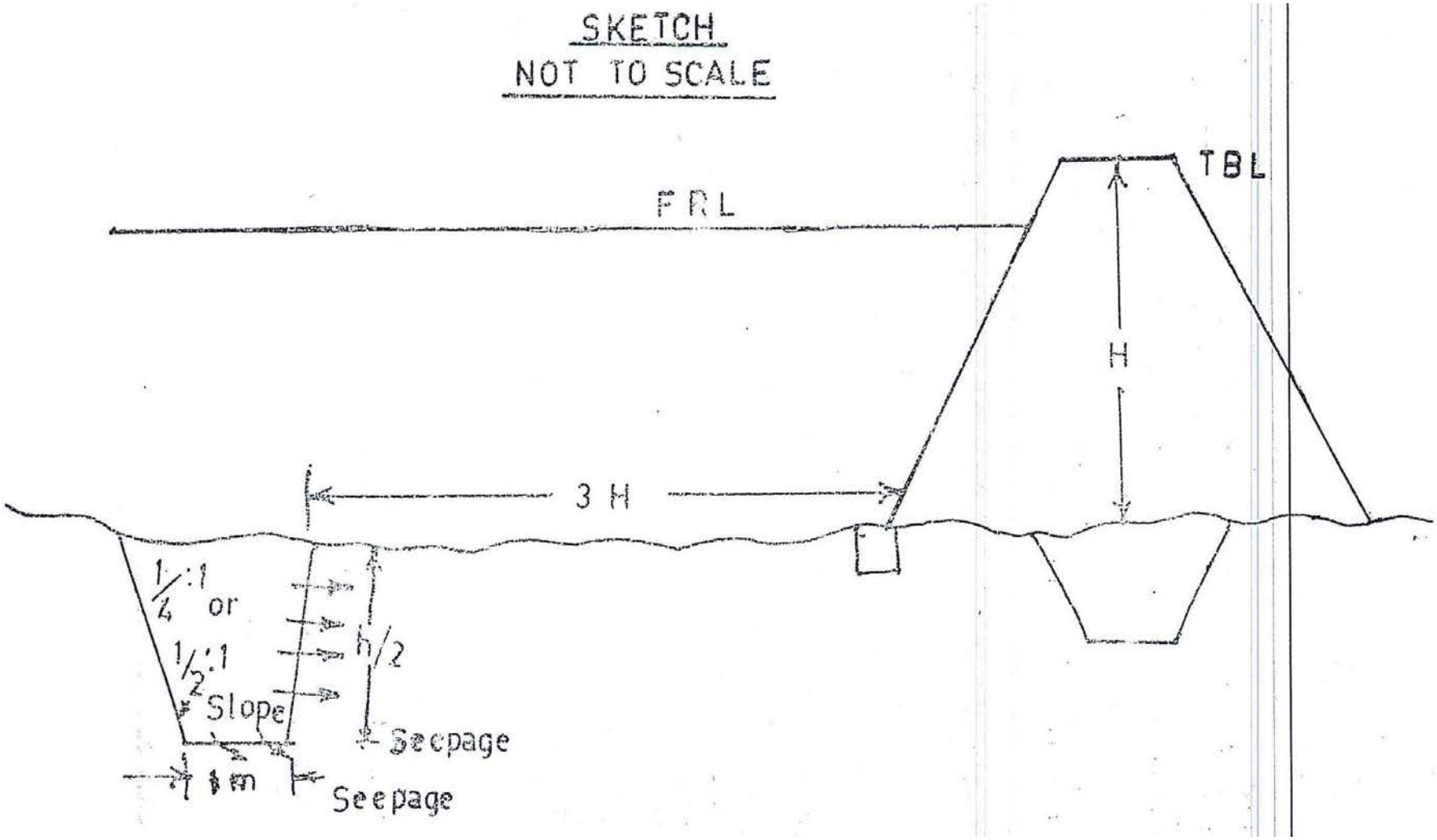
Chief Engineer, Minor Irrigation


SKETCH
NOT TO SCALE
FRL
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H
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or
1/2 :1
Slope
h/2
Seepage
1 m
Seepage

CIRCULAR No. 25

OFFICER OF THE CHIEF ENGINEER : MINOR IRRIGATION :ERRUMANZIL: HYDERABAD.

Technical Circular No.DCE/MI/OT1-T2/820556/85, Dt: 15-4-1986

Sub:- Evaporation from open tank surface – Preparation of working tables for Minor Irrigation Works – Meteorological Data of Agro-meteorological Stations – Evaporimeter Data – Adoption in Minor Irrigation Works – Regarding

Ref:- 1. This Office Circular No. DEC(MI)/O.T.1-T4/61826/85, dated:19-8-1985
2. This Office Circular No. DEC(MI)/O.T.1-T4/61826/85, dated:17-9-1985

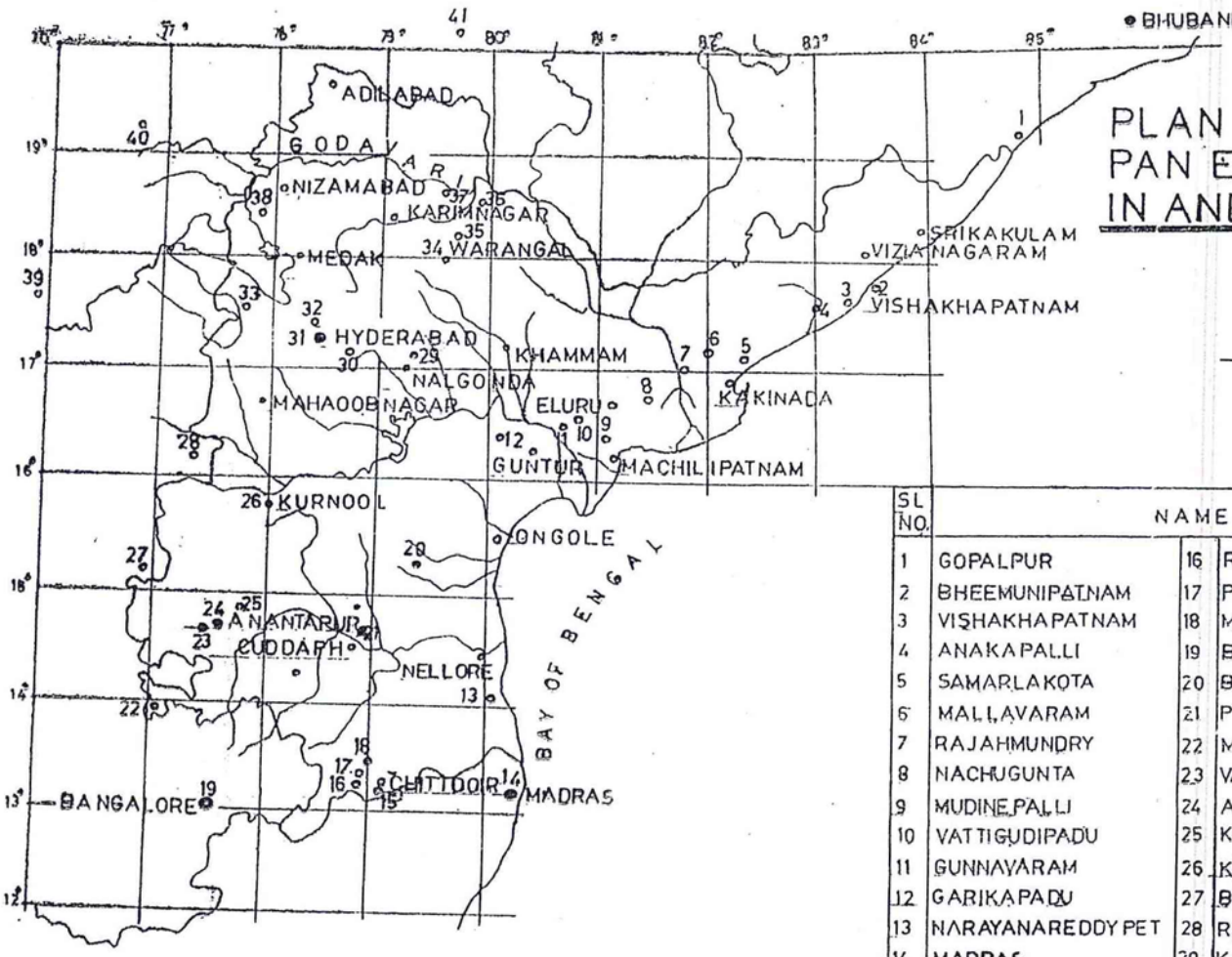
In this Office Circulars cited, instructions were given to calculate evaporation losses for open tank surface adopting a multiplying factor 0.7 for the data obtained from open-pan evaporimeter to the nearest meteorological stations.

Open Pan Evaporimeter (US-Class-A) Data from India Meteorological Department was obtained and Monthly evaporation from Lake bodies is calculated by adopting suitable variable factors and tabulated. The Data enclosed in the tabular statement may be utilized directly while working out evaporation losses from lakes. Cumberson=me calculations can now be avoided. Evaporimeter Data (Class-A-USA) of the Metorological Stations has been considered and Monthly correction factor applied to these Evaporimeter Data and a ready reckoner table is enclosed for direct adaptation. These correction factors vary from month to month and also from location to location. The correction factors given by Shri S.Venkataraman and Shri V.Krishna Murthy of IMD have been adopted. By this method monthly evaporation losses can be worked out and used while preparing working tables for tanks. The Data required for these calculations are gathered from Indian Meteorological Department and State Ground Water Department. The evaporation observations are recorded in various Agro-meteorological Stations using standard Class-A(USA) Pan Evaporimeter covered with wiremesh.

The information given in the Table enclosed can be adopted directly for obtaining monthly evaporation losses in Lakes. A Map showing the locations of 41 Stations in Andhra Pradesh is enclosed. The Data of the nearest station to the proposed M.I. Scheme may be adapted in the calculations.

Encl: 1. Plan-1.
2. Tabular Statement-1.

T. HANUMATHA RAO
Chief Engineer, Minor Irrigation



PLAN SHOWING THE CLASS 'A' PAN EVAPORATION STATIONS IN ANDHRA PRADESH

SCALE:—1CM=45KM

SL NO.	NAME OF THE STATIONS				
1	GOPALPUR	16	RAMAPURAM	30	IBRAHIMPATNAM
2	BHEEMUNIPATNAM	17	PINCHA	31	HYDERABAD
3	VISHAKHAPATNAM	18	MORAVAPALLI	32	DULAPALLY
4	ANAKAPALLI	19	BANGALORE	33	KAMCOL
5	SAMARLAKOTA	20	BRAHMANAPALLI	34	WARANGAL
6	MALLAVARAM	21	PEDDASETTIPALLI	35	PARKAL
7	RAJAHMUNDRY	22	MADHUDI	36	BHUPALPALLY
8	NACHUGUNTA	23	VADDUPALLI	37	RAMAGUNDAM
9	MUDINEPALLI	24	ANANTAPUR	38	RUDRUR
10	VATTIGUDIPADU	25	KORRAPADU	39	SHOLAPUR
11	GUNNAVARAM	26	KURNOOL	40	PARBHANI
12	GARIKAPADU	27	BELLARY	41	SINDEWAHI
13	NARAYANAREDDY PET	28	RAICHUR		
14	MADRAS	29	KANCHANAPALLI		
15	DASARAPALLI				

15-4-86

CHIEF ENGINEER,
MINOR IRRIGATION.

MONTHLY EVAPORATION FROM LAKE BODIES IN MM

(COMPUTED FROM PAN EVAPORATION DATA AFTER APPLYING COEFFICIENTS GIVEN BY IMD.)

COASTAL DISTRICTS :

Sl. No	Name of the station	Name of the District	Jan.	Feb.	March	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1	Gopalapur (ORISSA)	..	108.8	110.9	124.0	135.2	163.40	135.2	104.20	120.0	134.0	142.6	124.2	122.80
2	Bheemunipatnam	Vizag	117.2	138.6	183.5	224.4	234.5	193.8	141.4	136.7	145.4	158.1	116.1	111.6
3	Vizag	Do	153.5	163.8	195.9	224.4	237.2	204.0	153.8	164.6	148.2	155.0	156.6	159.0
4	Anakapalli	Do	103.2	121.0	148.8	170.8	176.5	137.7	116.6	128.3	114.0	108.5	102.6	103.2
5	Samarlakota	East Godavari	108.8	118.4	124.0	150.5	176.5	147.9	114.1	131.1	108.3	108.5	105.3	89.30
6	Mallavaram	Do	97.7	116.0	158.7	188.7	200.3	155.5	104.2	103.2	105.4	124.0	94.5	89.30
7	Rajahmundry	Do	147.9	166.3	195.9	219.3	271.4	224.4	173.6	153.4	151.0	161.2	145.8	145.1
8	Nachugunta (Tadepalligudem)	West Godavari	103.2	116.0	136.4	165.7	189.7	150.4	119.0	122.8	136.8	158.1	121.5	114.4
9	Mudinepally	Krishna	69.8	78.1	96.7	127.5	173.9	153.0	99.2	92.1	91.2	96.1	75.6	75.3
10	Vattigudipadu	Do	117.2	113.4	186.0	227.0	279.3	244.8	148.8	147.9	136.8	145.7	110.7	111.6
11	Gannavaram	Do	113.9	138.6	168.6	206.6	239.8	198.9	121.5	139.5	116.9	114.7	102.6	108.8
12	Garikapadu	Guntur	125.6	161.3	200.8	257.6	289.9	247.4	173.6	156.2	151.0	151.9	121.5	106.0
13	Narayanareddypet	Nellore	122.8	148.7	178.6	232.0	292.5	265.2	215.8	237.2	222.3	164.3	94.5	103.2
14	Madras	Tamilnadu	114.4	126.0	148.8	176.0	216.1	209.1	163.7	170.2	153.9	130.2	99.9	94.9

T. HANUMANTHA RAO,
Chief Engineer, Minor Irrigation

MONTHLY EVAPORATION FROM SMALL LAKE BODIES IN MM

(COMPUTED FROM PAN EVAPORATION DATA AFTER APPLYING COEFFICIENTS GIVEN BY IMD.)

ROYALASEEMA DISTRICTS :

Sl. No	Name of the station	Name of the District	Jan.	Feb.	March	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
15	Dasarapally	Chittoor	127.1	136.0	192.5	175.2	169.3	162.0	172.8	170.5	153.0	145.7	100.0	105.4
16	Ramapuram	Do	145.7	161.3	223.2	208.8	182.3	195.8	228.8	229.4	192.0	220.1	117.0	114.7
17	Pincha	Do	130.2	138.6	189.8	175.2	158.4	150.8	161.8	167.4	144.0	120.9	96.0	99.2
18	Moravapaly	Do	136.4	146.2	198.1	187.2	188.8	182.3	203.7	204.6	180.0	151.9	132.0	114.7
19	Bangalore	Karnataka	142.6	156.2	217.6	175.2	128.0	98.3	108.8	111.6	111.0	108.5	132.0	114.7
20	Brahmanapalli	Prakasam	117.8	136.1	212.0	235.2	230.0	220.5	212.0	195.3	189.0	179.8	123.0	105.4
21	Poddasettipalli	Cuddapah	145.7	146.2	217.6	220.8	206.2	193.5	192.5	186.0	165.0	155.0	114.0	117.82
22	Madhudi	Ananthapur	148.8	158.8	228.8	218.4	175.8	141.8	170.2	161.2	153.0	158.1	129.0	127.1
23	Vaddupalli	Do	210.8	231.8	315.3	300.0	275.6	256.5	312.5	313.1	234.0	217.0	171.0	189.2
24	Ananthapur	Do	158.1	178.9	240.0	232.8	210.5	173.3	170.2	173.6	156.0	155.0	129.0	124.0
25	Korrapadu	Do	220.1	211.7	267.8	165.6	134.5	195.8	189.8	204.6	162.0	167.4	159.0	155.0
26	Kurnool	Kurnool	153.2	173.9	240.0	217.6	232.2	182.3	186.9	148.8	150.0	151.9	135.0	139.5
27	Bellary	Karnataka	204.6	236.9	318.1	290.4	266.9	243.0	259.5	285.2	225.0	189.1	168.0	161.2

T. HANUMANTHA RAO,
Chief Engineer, Minor Irrigation

MONTHLY EVAPORATION FROM SMALL LAKE BODIES IN MM

(COMPUTED FROM PAN EVAPORATION DATA AFTER APPLYING COEFFICIENTS GIVEN BY IMD.)

TELANGANA DISTRICTS :

Sl. No	Name of the station	Name of the District	Jan.	Feb.	March	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
28	Raichur	Karnataka	201.5	226.8	298.5	283.2	288.6	222.8	220.4	251.1	195.0	127.0	183.0	178.8
29	Kanchanapalli	Nalgonda	133.9	141.1	212.0	228.0	236.5	209.3	178.6	167.4	159.0	167.4	132.0	130.2
30	Ibrahimpatnam	Ranga Reddy	179.8	221.8	306.9	285.6	290.8	220.5	217.6	213.9	165.0	167.4	147.0	145.7
31	Hyderabad	Hyderabad	186.0	191.5	270.6	249.6	256.0	198.0	189.8	189.1	177.0	179.8	171.0	167.4
32	Dulapally	Ranga Reddy	124.0	133.6	198.1	194.4	193.1	157.5	125.6	123.0	126.0	133.5	105.0	114.7
33	Kamkol	Medak	167.4	181.4	270.6	278.4	269.1	213.8	170.2	158.1	147.0	170.5	150.0	161.2
34	Warangal	Warangal	145.7	163.8	237.2	249.6	271.3	207.0	178.6	161.2	150.0	151.9	141.0	130.2
35	Parkal	Do	136.4	141.1	245.5	268.8	260.4	216.0	147.9	139.5	153.0	189.1	126.0	133.0
36	Bhupalapally	Do	117.8	126.0	203.7	232.8	230.3	193.5	125.6	127.1	132.0	151.9	108.0	116.6
37	Ramagundam	Karimnagar	85.6	116.4	175.8	191.5	199.6	150.8	114.4	102.8	99.0	99.2	82.8	77.5
38	Rudrur	Nizamabad	148.8	168.8	245.5	237.6	238.7	186.8	156.3	136.4	129.0	142.6	126.0	127.1
39	Sholapur	Maharastra	201.5	234.4	329.2	316.8	293.0	220.5	198.1	192.2	186.0	204.6	192.0	195.3
40	Parbhani	Do	158.1	189.0	265.0	292.8	297.3	225.0	200.9	198.4	168.0	167.4	132.0	120.9
41	Sindewahi	Do	127.1	148.7	237.2	256.8	280.0	198.0	136.7	124.0	126.0	136.4	123.0	105.4

T. HANUMANTHA RAO,
Chief Engineer, Minor Irrigation

CIRCULAR NO. 26

OFFICE OF THE ENGINEER-IN-CHIEF : IRRIGATION WING : HYDERABAD-A.P.

[Circular No. DEC(MI)/OT. 1-T4/61826/85, Dated: 18-4-1986.]

SUB: - positive blanket cut-off walls – Hydrogeological Surveys – Opinion of State Ground Water Department – Regarding.

While proposing positive blanket cutoff walls across streams it would be necessary to have full details of hydrogeology of that area. During the past few months, some proposals were received for constructing these cutoffs in the river bed portions, without giving the bed rock profiles on the flanks. It would be necessary to extend the cutoffs on either flank till rock level is reached at a level higher than the bed of the river. This is with a view to avoid outflanking of ground water due to ground water gradient set up between upstream and down-stream of cutoffs.

It would also be necessary to associate the officials of the State ground water Department during the reconnaissance stage itself, so that the hydrogeological aspects of the area nay get reflected properly while selecting the site. Opinion of Ground Water Department may be obtained for the selected site and forwarded along with the plans and Estimates.

Dt: 17/4/86

T. HANUMATHA RAO
Chief Engineer, Minor Irrigation

CIRCULAR NO. 27

OFFICE OF THE ENGINEER-IN-CHIEF : IRRIGATION WING : HYDERABAD-A.P.

[Circular No. DEC(MI)/OT. 1-T4/61826/85, Dated: 18-4-1986.]

SUB: - Surveying for Minor Irrigation Schemes – assuming Bench Marks connected G.T.S Bench Marks or known levels with reference to M.S.L. Instructions – Regarding.

It is seen that Survey for certain Irrigation Schemes is presently being done assuming a bench mark arbitrarily as 100.00 on any near by fixed point in the location of the project. Such an arbitrary level defeats the very purpose of Scientific study Survey integrating of resources and management since no tank can be considered in desolation. Several proposals pertaining to Minor Irrigation tanks have to be integrated and at a future date improvements with regard to source of supply to the tank may also have to be considered. For any activity of such a nature, it is necessary to have a correct knowledge of levels of the location of the Minor Irrigation tank with reference to mean sea level.

Before survey is commenced for any Minor Irrigation Project, it may be ensured that levels are carried out from a known bench mark in the nearest vicinity of the project. In future no arbitrary level should be assumed for any project. The Field Officers are aware that data base management pertaining to surface water resources and integration Sector. For such a data base management, it is essential to have the levels with reference to mean sea level. Also such an idea of elevation would give a better topographical feature of the project and appreciation of the surroundings.

It would also be necessary to associate the officials of the State ground water Department during the reconnaissance stage itself, so that the hydrogeological aspects of the area nay get reflected properly while selecting the site. Opinion of Ground Water Department may be obtained for the selected site and forwarded along with the plans and Estimates.

Dt: 30/4/86

T. HANUMATHA RAO
Chief Engineer, Minor Irrigation

CIRCULAR NO. 28

OFFICE OF THE ENGINEER-IN-CHIEF, IRRIGATION WING, ERRUMANZIL, A.P., HYDERABAD.

Designs Circular No. DEC/MI/OT1-T4/61826/85, Dated: 2-5-1986.

SUB: - Surplus arrangements – Minor Irrigation tanks – Cutoff walls for solid aprons – Dispensing with footing – Regarding.

At the end of soild aprons the customary practice is to provide masonry or concrete cut off walls and take it up to scour depth or rock level in case rock is met at higher levels. In some of the designs shown at site, it is seen that a footing is provided for such cut off walls. Since the purpose of cut off walls only to protect the apron in the case of scours and retrogressions, there is no vertical and as such that has to be distributed to the foundations. Also providing such a footing would involve in excavating for a greater width than the cut off wall and later filling up the extra excavated portion with loose soils. Such a fill on both the sides of cut off wall would actually be a negative aspect and hence not desirable. It is therefore, desired that sketch enclosed to this office Circular cited.

With regard to excavation for cut off wall it is to be ensured that the excavation is done vertically and the entire excavated portion filled up with concrete/masonry. This is to ensure that no earth or loose filling is involved in making up the extra excavated cross section. In order that excavated faces may not crumble or slip, it would be necessary to tackle this work in short reaches and complete the concrete/masonry within the trench with a day or two after it is excavated. The instructions with regards to providing rough stone retaining wall at the end of talus may be followed as already indicated in this office circular cited.

T. HANUMATHA RAO
Chief Engineer, Minor Irrigation

CIRCULAR NO. 29

OFFICE OF THE ENGINEER-IN-CHIEF, IRRIGATION WING, HYDERABAD, A.P.

Circular No. DEC(MI)/OT.1-T4/28556/65, Dated: 20-5-1986.

SUB: - Minor Irrigation – Guidelines for minor Irrigation Schemes – Procedure to be followed while fixing the sill level of irrigation – Sluice – Regarding.

Ref:- This Office Circular No. DCE(MI)/OT1-T4/28556/65, dt: 24-5-1985

In this circular cited, guidelines for fixing the storage capacity of Minor Irrigation tanks were issued based on the No. of fillings to be adopted for a particular area.

It has come to notice that for EEC aid Schemes the minimum draw down level (MDDL) is being considered for utilization of storage in a Minor Irrigation tank. Generally this MDDL is fixed taking into consideration the sill level of the irrigation sluice and adding it, the FSD of the channels at starting point, plus a minimum driving head of say 15 cums. In such a case, the MDDL will be at a level higher than the sill level of the irrigation sluice. It is considered that such a practice is not necessary, as the storage between the sill level and MDDL will not be taken into account in the working of the reservoir, whereas it is actually being utilized in practice. Also under such low water conditions, the F.S depth in canal will not be maintained and hence there is no need to design for full discharged in Canal. Since all water above sill level of sluice will be practically utilized in MI Tanks, it is realistic to take the same into account and design.

For all EEC Aid Schemes also, the working tables may be prepared just as in the case of normal M.I. Schemes considering that the storage is available for utilization upto sill level of the irrigation sluice.

T. HANUMATHA RAO
Chief Engineer, Minor Irrigation

CIRCULAR NO. 30

OFFICE OF THE ENGINEER-IN-CHIEF, IRRIGATION WING, HYDERABAD.

Circular No. DEC(MI)/OT.1-T4/28556/65, Dated: 21-5-1986.

SUB: - Formation of Minor Irrigation Tank Bunds – Hilly areas – Borrow area soils in submersion areas – Regarding.

Ref:- Circular No. DCE(MI)/OT1-T4/28556/65, dt: 21-2-1985

Several Minor Irrigation Tank proposals are now being formulated in hilly areas especially at the foot of the hills. In several cases, it is seen that in the submersion area of such tanks, the SC, SM Type of soils are available for about one metre depth and below these soils, generally gravely type of soils SDR etc., are met with. In certain cases, dis-integrated formation of rock and fissured formations of rock are also met with.

If the soils in the submersion area pertaining to SC/SM and clayey types are available only for a shallow depth and when the same has to be excavated for formation of the bund this would result in removing away the impervious layers of soils and exposing the porous gravelly and disintergrated rock type of terrain to have direct contract with stored water. This will lead to leakage of water through the relatively porous soils and apart from loosing storage, it may result undesirable seepage in the down-stream of the bund.

In such cases, where gravel and SDR type of formations are covered with thin layers of soils, it may be ensured that borrow areas are not provided in the submersion zone close to the tank bund. The nearest available and suitable soils either in the fore-shore area or elsewhere may be investigated and provided for. In order to decide this issue the trial puts in the submersion area should be excavated to sufficiently deeper depths (2 to 3M) to determine the nature of substrata.

T. HANUMATHA RAO
Chief Engineer, Minor Irrigation

CIRCULAR NO. 31

OFFICE OF THE ENGINEER-IN-CHIEF : IRRIGATION WING : HYDERABAD-A.P.

Circular No. DEC(MI)/OT. 1-T4/28556/65, *Dated: 28-5-1986.*

SUB: - Maximum Flood Discharge – Procedure to be followed as per Rational Formula – Regarding.

REF: - Circular No. DEC(MI)/OT. 1-T4/28556/65, Dated: 25-9-1985.

While computing the maximum flood discharge based upon the rational new formula (already communicated to all the Field Officers), the following aspects require careful consideration.

The rain-fall run-off curve for paddy fields was mentioned as 95 considering that the paddy fields bunds would be about 6” to 9” in height. Most of the paddy fields of Krishna, Godavari and Pennar Deltas, have bunds of this height. In the case of paddy fields of Srikakulam and Vizianagaram districts, it is seen that in several places the bunds are ranging from 1” – 6” to 2 ft. in height. Under such conditions, the rain-fall run-off would be stored to some extent due to interceptions and this would result in lesser run-offs. For such cases, the rainfall run-off curve of No. 50 similar to that of garden crops would perhaps be appropriate. These aspects may be considered while computing the maximum flood discharge wherever paddy fields occur in the catchment area.

T.HANUMANTHA RAO,
Chief Engineer : Minor Irrigation

CIRCULAR No. 32

OFFICE OF THE ENGINEER-IN-CHIEF : IRRIGATION WING : HYDERABAD – A.P.

Circular No. DCE(MI)/OT. 1-T4/61826/85, *Dated: 4-6-1986.*

SUB: - Minor Irrigation Tanks – Cut-off trench – Inspection of Executive Engineers – Report on field conditions – Regarding.

The item of cut-off trench work is an important component of Minor Irrigation tanks. Proper execution of this component of work would lead to satisfactory performance of the tank and stability. In cases where cut-off trench is not taken to impermeable soils, it would lead to piping action below the tank bund and failure in foundations. The Thumb Rule Norm of execution of cut-off trench to a depth of II/2 is mostly for estimation purposes and should not be taken as a technically supreme solution. If permeable layer such as sand, boulders, loose soils etc., occur even below 1/2 F.R.L. depth, to cut-off trench has to be taken to a lower level till impermeable soils are met with. Also as a quantitative check, it is directed that the cut-off trenches and the bottom levels should invariably be inspected and checked by the Executive Engineer and duly certified before filling up with clayey soils and rolled. Since most of the minor irrigation works are working out rather costly (average cost Rs. 50.00 lakhs), it would be necessary as an abundant precaution to exercise this qualitative and quantitative check at the level of Executive Engineer.

The receipt of this Circular may please be acknowledged.

T.HANUMANTHA RAO,
Chief Engineer : Minor Irrigation

CIRCULAR No. 33

OFFICE OF THE CHIEF ENGINEER : MINOR IRRIGATION,
ANDHRA PRADESH : ERRUM MANZIL, HYDERABAD.

Circular No. DCE(MI)/OT1-T4/28556/65, *Dated: 29-07-1986*

SUB: - Guidelines for Minor Irrigation Schemes – Revised Standards Type Design and Ready Reckoner table for small Earthen Dams – Regarding.

REF: - (1) Chief Engineer, Minor Irrigation's Circular Mo. DCE(MI)/OTI-T4/28556/65, Dated: 4-2-1985.

(2) Chief Engineer, Minor Irrigation's Circular Mo. DCE(MI)/OTI-T4/28556/65, Dated: 3-10-1985.

In supersession of the standards of bund sections for earthen embankments of Minor Irrigation schemes issued in the Circulars cited, standards are now revised to have uniform standards with European Economic Community Schemes.

A type design and Ready Recokner Tables for Small Earthen Dams Booklet is prepared to facilitate speedy preparation of Project Estimates and at the same time to maintain accuracy and uniformity in standards. These tables may be used for estimation purposes only. For purposes of payments, actual measurements including taken levels etc., as per the procedures laid down will have to be followed.

The main features of the standards are explained on pages 3 to 5 of the Booklet. All the Superintending Engineers/Executive Engineers, were already requested to collect the copies of the Booklet in this office in Memo. No. DCE(MI)/OTI-T2/184/86, dated 24-6-1986. Some of them had already collected the copies as per their requirements. Those who have not yet collected are requested collect them immediately.

Under item 7 at page 3 and Col. 8 of the tabular statement in the Booklet the revetment thickness is shown as 0.3M and the same may be considered for estimation purposes only. Actual thickness as per work done may be measured and recorded for making payments. The thickness of revetment can vary from 0.25 m to 0.30 m depending upon the sizes of stones locally available.

T.HANUMANTHA RAO,
Chief Engineer : Minor Irrigation

TYPE DESIGN AND READY RECKONER TABLES

FOR

SMALL EARTHEN DAMS

TYPE DESIGNS & READY RECKONER TABLES FOR SMALL DAMS

Large number of Minor Irrigation tanks are now under construction in Andhra Pradesh. This programme is being further intensified during the VII Plan and it is proposed to take up for execution most of the feasible schemes in the State. In the VII Plan document, priority was given for Minor Irrigation sector since the benefits are wide-spread and distributed throughout the State and also the gestation period for achieving results is very short. Several Minor Irrigation Schemes are under investigation and it would be desirable if there is a certain amount of standardization in designs. Also methods for quickening the preparation of estimates will go a long way in implementing the programme speedily. Earlier, several type designs for tank bund sections were issued. Since free board was varying from once tank to the other depending upon wave height, each tank proposal had to be designed separately and estimated. Since the variation in wave height for Minor Irrigation tanks is within a very small range, it is proposed to have the same free-board for all Minor Irrigation tanks taking into account the most severe condition. Increase in cost if any by adopting such a method, will be marginal and hence negligible. Any marginal increase in free-board (by 0.1 or 0.2 m) will have additional factor of safety in Cyclones and in the event of any breach of tank on the upstream side.

Type designs for tank bund sections for various heights are enclosed for adoption. Importance is given for power roller consolidation of bund upto Top of Bund Level (TBL), providing revetment upto TBL providing 3m. top width and having 0.15m. thick rolled gravel pathway at TBL. This is with a view to provide sufficient safety during times of Cyclones, heavy rains, etc., and also will facilitate maintenance of TBL at a later date.

The pathway at TBL will facilitate easy maintenance, inspections and conveyance facility to farmers. The increase in cost in such a proposal is marginal, but the benefits are far more when viewed from the safety of the dam. Economies are now made in sand chimney, horizontal sand blankets, rock toe, toe drain and upstream toe wall of revetment. The designs are economised so as to take care of the utility and yet without sacrificing any factor of safety or stability.

The drudgery of preparing drawing of tank bund section for every cross section of earthen bund at regular intervals computation of cross section areas, and the quantities can be saved by using ready reckoner tables. For various heights of dam in increments of 0.1 m (from 0 to 16 mts) tables of quantities of various works involved have been prepared and enclosed herewith. These tables may be followed with advantage. It can be seen that for any particular

height of bund, quantities pertaining to Earth Work Excavation, casing soils, hearting soils, rock toe, revetment, sand filter etc., can be obtained directly from these tables. The same can be adopted straight-away and quantities calculated. Thus a work which normally takes about one S.O. month is reduced to 1 S.O. hour. Apart from this savings in times, it facilitates accurate preparation of estimate since calculation errors are eliminated. This will also give relief to the field staff from the monotony and drudgery of voluminous calculations and gives them sufficient time to concentrate on other items of investigation thus speeding up preparation of project reports.

Average ground level for any particular cross section may be calculated and height of dam upto TBL obtained. For this height the corresponding quantities may be read from the tabular statements. In case the soils met with at site are different from those noted in the type design drawings, the upstream and downstream slopes of bund will have to be altered suitably to conform to the slopes given in the tabular statements 'A' & 'B' for the particular type of soil actually met with at site. For such altered slopes, quantities of various items of work will have to be calculated in the conventional manner, since the ready reckoner tables will not hold good for these altered slopes. Even in such cases where the slopes are altered, design, details of revetment, rock toe, filters etc., will be the same as shown in the type design.

It is hoped that the tabular statements and type designs now provided would facilitate works in the department and speed up preparation of project reports and at the same time will maintain accuracy and uniformity in standards.

T.HANUMANTHA RAO,
Chief Engineer : Minor Irrigation

HYDERABAD

Dated: *June 1986.*

STANDARDS FOR EARTHEN EMBANKMENTS FOR MINOR IRRIGATION TANKS

Sl.No	Description	HEIGHT OF BUND IN METRES				Remarks
		0.0 M to 3.40 M	3.50 M to 7.40 M	7.50 M to 10.40 M	10.5 M to 16.00 M	
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1.	Top-Width	3.00 M	3.00 M	3.00 M	3.00 M	
2.	Nature of Section	Homogeneous	Homogeneous	Zonal	zonal	
3.	Free-Board	1.50 M	1.50 M	1.50 M	1.50 M	
4.	Slopes on U/S	2:1	2:1	2:1	2½:1	
	Slopes on D/S	2:1	2:1	2:1	2:1	
5	Hearting –Zone					
	(a) Top-Width	..	..	2.40 M	2.40 M	
	(b) Side slopes	..	..	½:1	½:1	
	(c) Top-Level	..	..	At M.W.L	At M.W.L	
6.	Cut Off-Trench					
	(a) Bottom Width	3.00 M	3.00 M	3.00 M	3.00 M	
	(b) Side slopes	½:1	½:1	½:1	½:1	
	(c) Depth	Half F.R.L. depth with a minimum of 0.60m. in case hard rock is met with at higher levels, the cut off trench will be limited to this level.				
7.	Revetment thickness	0.30 M	0.30 M	0.30 M	0.30 M	Revetment along the bund should be restricted upto the section where M.W.L touches the ground level only.
8.	Gravel Cover under revetment ..	0.30 M	0.30 M	0.30 M	0.30 M	With power roller consolidation and trimmed to obtain the gravel face.

(1)	(2)	(3)	(4)	(5)	(6)	(7)
9.	Toe-Wall	0.60 M X 0.60 M	0.60 M X 0.60 M	0.60 M X 0.60 M	0.60 M X 0.60 M	From stripped level 0.60 M Depth.
10.	Rock-Toe :					
	(a) Top-Width	..	1.00 M	1.00 M	1.00 M	
	(b) Height	..	1.20 M	1.20 M	1.50 M	
11	Toe Drain :					
	(a) Bed-Width	..	1.00 M	1.00 M	1.00 M	
	(b) Depth	..	0.30 M	0.30 M	0.30 M	Below stripped level
	(c) Side slopes	..	1:1	1:1	1:1	
	(d) Width of berms on either side	..	1.00 M	1.00 M	1.00 M	
	(e) Thickness of revetment	..	0.225 M	0.225 M	0.225 M	
12.	Horizontal Sand Blanket	..	0.90 M Depth	0.90 M Depth	0.90 M Depth	
13.	Sand Chimney	..	..	0.90 M Thick	0.90 M Thick	
14.	Inverted filter with graded metal of size 25mm to 50mm at the end of Horizontal filter adjoining the rock-toe.	..	0.30 M Thick	0.30 M Thick	0.30 M Thick	
15.	150 mm thick Gravel cover for top of bund (Just below T.B.L)	..	Provided	Provided	Provided	

TABLE - A

RECOMMENDED SLOPES FOR SMALL HOMOGENEOUS EARTH FILL DAMS ON STABLE FOUDATIONS.

Soil classification	Up-stream slope	Down-stream slope
GW, GP, SW, SP	..	Pervious, not suitable
GC, GM, SC, SM	2:1 & 2½:1	2:1
CL, ML	2½:1 & 3:1	2½:1
CL, MH	3:1 & 3½:1	2½:1

TABLE - B

RECOMMENDED SLOPES FOR SMALL ZONED EARTH FILL DAMS ON STABLE FOUDATIONS

Sl.No	Case	Casing soil classification	Hearting soil classification	Up-stream slope	Down-stream slope
1.	Zonal section with ½:1 slopes for hearting soils ..	GW, GP, SW (Gravelly), SP (Gravelly), GC, SC	SC, SM, CL, ML, CH, MH	2:1	2:1
2.	Zonal section with 1:1 sloped for hearting soils ..	GW, GP, SW (Gravelly), SP (Gravelly), GC, SC	CL, ML	2½:1	2½:1
			CH, MH	3:1	3:1

STATEMENT OF QUANTITIES FOR STANDARD SECTIONS FOR MINOR IRRIGATION TANKS

FROM 0.1MTS. TO 16.0 MTS. HEIGHT OF BUND

Sl. No	Height of Bund above Ground Level	Width of Bund at Stripped Level	Earth work Excavation for stripping Toe-Wall and Toe drain	Earth work excavation for cut of Trench	Hearting Soils (Net)	Casing soils (net)	300 mm thick Revetment including Toe wall	300 mm thick Gravel cover under Revetment	Rock -Toe	150 mm thick gravel cover on top	Horizontal sand Blanket and sand chimney	300 mm Thick Graded metal	225 mm thick Revetment for Toe Drain	Trimming on U/S & D/S
	Mts.	Mts.	Sq.Mts.	Sq.Mts.	Sq.Mts	Sq.Mts.	Sq.Mts.	Sq.Mts.	Sq. Mts.	Sq.Mts.	Sq.Mts.	Sq.Mts.	Sq.Mts.	Sq.Mts.
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
1.	0.10	4.60	1.38			1.02				0.50				0.10
2.	0.20	5.00	1.50			1.50				0.50				0.20
3.	0.30	5.40	1.62			2.02				0.50				0.30
4.	0.40	5.80	1.74			2.58				0.50				0.40
5.	0.50	6.20	1.86			3.18				0.50				0.50
6.	0.60	6.60	1.98			3.82				0.50				0.60
7.	0.70	7.00	2.10			4.50				0.50				0.70
8.	0.80	7.40	2.22			5.22				0.50				0.80
9.	0.90	7.80	2.34			5.98				0.50				0.90
10.	1.00	8.20	2.46			6.78				0.50				1.00
11.	1.10	8.60	2.58			7.62				0.50				1.10

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
12.	1.20	9.00	2.70			8.50				0.50				1.20
13.	1.30	9.40	2.82			9.42				0.50				1.30
14.	1.40	9.80	2.94	1.98		10.38				0.50				1.40
15.	1.50	10.20	3.48	1.98		9.09	1.57	1.11		0.47				1.50
16.	1.60	10.60	3.60	1.98		10.00	1.64	1.17		0.47				1.60
17.	1.70	11.00	3.72	1.98		10.00	1.70	1.24		0.47				1.70
18.	1.80	11.40	3.84	1.98		11.93	1.77	1.31		0.47				1.80
19.	1.90	11.80	3.96	1.98		12.95	1.84	1.38		0.47				1.90
20.	2.00	12.20	4.08	1.98		14.03	1.90	1.44		0.47				2.00
21.	2.10	12.60	4.20	1.98		15.13	1.97	1.51		0.47				2.10
22.	2.20	13.00	4.32	1.98		16.27	2.04	1.58		0.47				2.20
23.	2.30	13.40	4.44	1.98		17.47	2.10	1.64		0.47				2.30
24.	2.40	13.80	4.56	1.98		18.69	2.17	1.71		0.47				2.40
25.	2.50	14.20	4.68	1.98		19.95	2.24	1.78		0.47				2.50
26.	2.60	14.60	4.80	1.98	..	21.25	2.31	1.85	..	0.47	..	..	..	2.60
27.	2.70	15.00	4.92	1.98	..	22.61	2.37	1.91	..	0.47	..	..	..	2.70
28.	2.80	15.40	5.04	2.16	..	24.10	2.44	1.98	..	0.47	..	..	..	2.80
29.	2.90	15.80	5.16	2.35	..	25.41	2.51	2.05	..	0.47	..	..	..	2.90
30.	3.00	16.20	5.28	2.53	..	26.89	2.57	2.11	..	0.47	..	..	..	3.00
31	3.10	16.60	5.40	2.72	..	28.29	2.64	2.18	..	0.47	..	..	..	3.10
32.	3.20	17.00	5.52	2.91	..	29.93	2.71	2.25	..	0.47	..	..	..	3.20
33.	3.30	17.40	5.64	3.11	..	31.53	2.77	2.31	..	0.47	..	..	..	3.30

34	3.40	17.80	5.76	3.30	..	33.15	2.84	2.38	..	0.47	..	..	..	3.40
35.	3.50	18.00	7.82	3.50	..	29.63	2.91	2.45	2.64	0.47	2.64	0.38	1.01	3.05
36.	3.60	18.40	7.94	3.70	..	31.17	2.98	2.52	2.64	0.47	2.80	0.38	1.01	3.15
37.	3.70	18.80	8.06	3.91	..	32.78	3.04	2.58	2.64	0.47	2.95	0.38	1.01	3.25
38	3.80	19.20	8.18	4.11	..	34.40	3.11	2.65	2.64	0.47	3.11	0.38	1.01	3.35
39	3.90	19.60	8.30	4.32	..	36.06	3.18	2.72	2.64	0.47	3.27	0.38	1.01	3.45
40.	4.00	20.00	8.42	4.53	..	37.79	3.24	2.78	2.64	0.47	3.42	0.38	1.01	3.55
41.	4.10	20.40	8.54	4.75	..	39.53	3.31	2.85	2.64	0.47	3.58	0.38	1.01	3.65
42.	4.20	20.80	8.66	4.96	..	41.31	3.38	2.92	2.64	0.47	3.74	0.38	1.01	3.75
43.	4.30	21.20	8.78	5.18	..	43.13	3.45	2.99	2.64	0.47	3.90	0.38	1.01	3.85
44.	4.40	21.60	8.90	5.40	..	45.02	3.51	3.05	2.64	0.47	4.05	0.38	1.01	3.95
45.	4.50	22.00	9.02	5.63	..	46.92	3.58	3.12	2.64	0.47	4.21	0.38	1.01	4.05
46.	4.60	22.40	9.14	5.85	..	48.86	3.65	3.19	2.64	0.47	4.37	0.38	1.01	4.15
47.	4.70	22.80	9.26	6.08	..	50.86	3.71	3.25	2.64	0.47	4.53	0.38	1.01	4.25
48.	4.80	23.20	9.38	6.31	..	52.89	3.78	3.32	2.64	0.47	4.68	0.38	1.01	4.35
49.	4.90	23.60	9.50	6.55	..	54.95	3.85	3.39	2.64	0.47	4.84	0.38	1.01	4.45
50.	5.00	24.00	9.62	6.78	..	57.05	3.92	3.46	2.64	0.47	5.00	0.38	1.01	4.55
51.	5.10	24.40	9.74	7.02	..	59.21	3.98	3.52	2.64	0.47	5.16	0.38	1.01	4.65
52.	5.20	24.80	9.86	7.26	..	61.40	4.05	3.59	2.64	0.47	5.31	0.38	1.01	4.75
53.	5.30	25.20	9.98	7.51	..	63.62	4.12	3.66	2.64	0.47	5.47	0.38	1.01	4.85
54.	5.40	25.60	10.10	7.75	..	65.89	4.19	3.72	2.64	0.47	5.63	0.38	1.01	4.95
55.	5.50	26.00	10.22	8.00	..	68.20	4.25	3.79	2.64	0.47	5.79	0.38	1.01	5.05

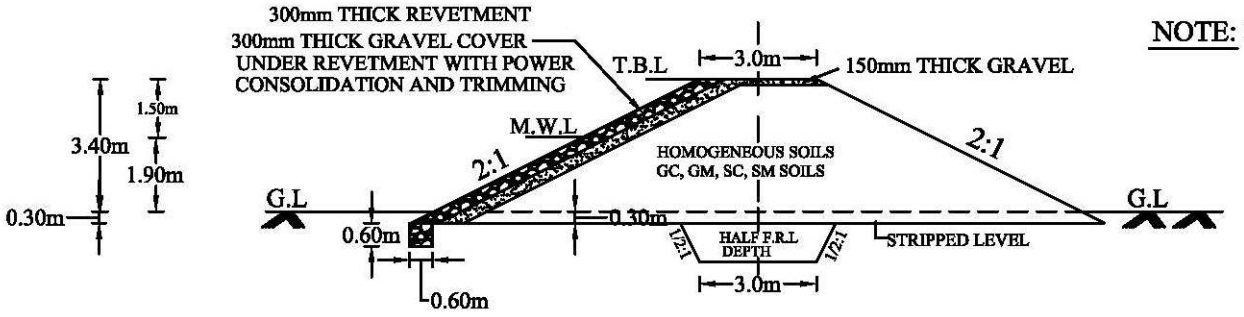
56.	5.60	26.40	10.34	8.25	..	70.55	4.32	3.86	2.64	0.47	5.94	0.38	1.01	5.15
57.	5.70	26.80	10.46	8.51	..	72.95	4.38	3.92	2.64	0.47	6.10	0.38	1.01	5.25
58.	5.80	27.20	10.58	8.76	..	75.35	4.45	3.99	2.64	0.47	6.26	0.38	1.01	5.35
59	5.90	27.60	10.70	9.02	..	77.83	4.52	4.06	2.64	0.47	6.42	0.38	1.01	5.45
60.	6.00	28.00	10.82	9.28	..	80.34	4.59	4.13	2.64	0.47	6.57	0.38	1.01	5.55
61.	6.10	28.40	10.94	9.55	..	82.90	4.65	4.19	2.64	0.47	6.73	0.38	1.01	5.65
62.	6.20	28.80	11.06	9.81	..	85.48	4.72	4.26	2.64	0.47	6.89	0.38	1.01	5.75
63.	6.30	29.20	11.18	10.08	..	88.10	4.79	4.33	2.64	0.47	7.05	0.38	1.01	5.85
64.	6.40	29.60	11.30	10.35	..	90.79	4.85	4.39	2.64	0.47	7.20	0.38	1.01	5.95
65.	6.50	30.00	11.42	10.63	..	93.50	4.92	4.46	2.64	0.47	7.36	0.38	1.01	6.05
66.	6.60	30.40	11.54	10.90	..	96.23	4.90	4.53	2.64	0.47	7.52	0.38	1.01	6.15
67.	6.70	30.80	11.66	11.18	..	99.01	5.06	4.60	2.64	0.47	7.68	0.38	1.01	6.25
68.	6.80	31.20	11.78	11.46	..	101.86	5.12	4.66	2.64	0.47	7.83	0.38	1.01	6.35
69	6.90	31.60	11.90	11.75	..	104.72	5.19	4.73	2.64	0.47	7.99	0.38	1.01	6.45
70.	7.00	32.00	12.02	12.03	..	107.62	5.26	4.80	2.64	0.47	8.15	0.38	1.01	6.55
71.	7.10	32.40	12.14	12.32	..	110.58	5.32	4.86	2.64	0.47	8.31	0.38	1.01	6.65
72.	7.20	32.80	12.26	12.61	..	113.57	5.39	4.93	2.64	0.47	8.46	0.38	1.01	6.75
73.	7.30	33.20	12.38	12.91	..	116.59	5.46	5.00	2.64	0.47	8.62	0.38	1.01	6.85
74.	7.40	33.60	12.50	13.20	..	119.65	5.53	5.07	2.64	0.47	8.78	0.38	1.01	6.95
75.	7.50	34.00	12.62	13.50	34.97	82.87	5.59	5.13	2.64	0.47	13.87	0.38	1.01	7.05
76.	7.60	34.40	12.74	13.80	35.84	85.07	5.66	5.20	2.64	0.47	14.10	0.38	1.01	7.15
77.	7.70	34.80	12.86	14.11	36.73	87.28	5.73	5.27	2.64	0.47	14.34	0.38	1.01	7.25
78.	7.80	35.20	12.98	14.41	37.62	89.56	5.79	5.33	2.64	0.47	14.57	0.38	1.01	7.35

79.	7.90	35.60	13.10	14.72	38.53	91.83	5.86	5.40	2.64	0.47	14.81	0.38	1.01	7.45
80.	8.00	36.00	13.22	15.03	39.44	94.15	5.93	5.47	2.64	0.47	15.04	0.38	1.01	7.55
81.	8.10	36.40	13.34	15.35	40.37	96.48	6.00	5.54	2.64	0.47	15.28	0.38	1.01	7.65
82.	8.20	36.80	13.46	15.66	41.30	98.88	6.06	5.60	2.64	0.47	15.51	0.38	1.01	7.75
83.	8.30	37.20	13.58	15.98	42.25	101.27	6.13	5.67	2.64	0.47	15.75	0.38	1.01	7.85
84.	8.40	37.60	13.70	16.30	43.20	103.71	6.20	5.74	2.64	0.47	15.98	0.38	1.01	7.95
85.	8.50	38.00	13.82	16.63	44.17	106.18	6.26	5.80	2.64	0.47	16.22	0.38	1.01	8.05
86.	8.60	38.40	13.94	16.95	45.15	108.67	6.33	5.87	2.64	0.47	16.45	0.38	1.01	8.15
87.	8.70	38.80	14.06	17.25	46.13	111.19	6.40	5.94	2.64	0.47	16.69	0.38	1.01	8.25
88.	8.80	39.20	14.18	17.61	47.12	113.69	6.46	6.00	2.64	0.47	16.92	0.38	1.01	8.35
89.	8.90	39.60	14.30	17.95	48.13	116.34	6.53	6.07	2.64	0.47	17.16	0.38	1.01	8.45
90.	9.00	40.00	14.42	18.28	49.14	118.96	6.60	6.14	2.64	0.47	17.39	0.38	1.01	8.55
91.	9.10	40.40	14.54	18.62	50.17	121.59	6.67	6.21	2.64	0.47	17.63	0.38	1.01	8.65
92.	9.20	40.80	14.66	18.96	51.20	124.29	6.73	6.27	2.64	0.47	17.86	0.38	1.01	8.75
93.	9.30	41.20	14.78	19.31	52.25	126.98	6.80	6.34	2.64	0.47	18.10	0.38	1.01	8.85
94.	9.40	41.60	14.90	19.65	53.30	129.72	6.87	6.41	2.64	0.47	18.33	0.38	1.01	8.95
95.	9.50	42.00	15.02	20.00	54.37	132.49	6.93	6.47	2.64	0.47	18.57	0.38	1.01	9.05
96.	9.60	42.40	15.14	20.35	55.44	135.29	7.00	6.54	2.64	0.47	18.80	0.38	1.01	9.15
97.	9.70	42.80	15.26	20.71	56.53	138.10	7.07	6.61	2.64	0.47	19.04	0.38	1.01	9.25
98.	9.80	43.20	15.38	21.06	57.62	140.96	7.14	6.68	2.64	0.47	19.27	0.38	1.01	9.35
99.	9.90	43.60	15.50	21.42	58.73	143.85	7.20	6.74	2.64	0.47	19.51	0.38	1.01	9.45
100.	10.00	44.00	15.62	21.78	59.84	146.77	7.27	6.81	2.64	0.47	19.74	0.38	1.01	9.55

101.	10.10	44.40	15.74	22.15	60.97	149.70	7.34	6.88	2.64	0.47	19.98	0.38	1.01	9.65
102	10.20	44.80	15.86	22.51	62.10	152.70	7.40	6.94	2.64	0.47	20.21	0.38	1.01	9.75
103.	10.30	45.20	15.98	22.88	63.25	155.69	7.47	7.01	2.64	0.47	20.45	0.38	1.01	9.85
104.	10.40	45.60	16.10	23.25	64.40	158.73	7.54	7.08	2.64	0.47	20.68	0.38	1.01	9.95
105.	10.50	45.70	16.13	23.63	65.67	161.29	7.60	7.15	3.75	0.47	20.11	0.38	1.01	9.90
106.	10.60	46.30	16.31	24.00	66.74	164.55	7.72	7.26	3.75	0.47	20.34	0.38	1.01	10.00
107.	10.70	46.75	16.45	24.38	67.93	167.67	7.80	7.34	3.75	0.47	20.58	0.38	1.01	10.10
108.	10.80	47.20	16.58	24.76	69.12	170.84	7.88	7.43	3.75	0.47	20.81	0.38	1.01	10.20
109.	10.90	47.65	16.72	25.15	70.33	174.02	7.97	7.51	3.75	0.47	21.05	0.38	1.01	10.30
110.	11.00	48.10	16.85	25.52	71.54	177.26	8.05	7.59	3.75	0.47	21.28	0.38	1.01	10.40
111.	11.10	48.55	16.99	25.92	72.77	180.80	8.13	7.67	3.75	0.47	21.52	0.38	1.01	10.50
112.	11.20	49.00	17.12	26.31	74.00	183.80	8.21	7.75	3.75	0.47	21.75	0.38	1.01	10.60
113.	11.30	49.45	17.25	26.71	75.25	187.11	8.29	7.83	3.75	0.47	21.79	0.38	1.01	10.70
114.	11.40	49.90	17.39	27.10	76.50	190.47	8.37	7.91	3.75	0.47	22.22	0.38	1.01	10.80
115.	11.50	50.35	17.53	27.50	77.77	193.83	8.45	7.99	3.75	0.47	22.46	0.38	1.01	10.90
116.	11.60	50.80	17.66	27.90	79.04	197.25	8.53	8.07	3.75	0.47	22.69	0.38	1.01	11.00
117.	11.70	51.25	17.80	28.31	80.33	200.68	8.61	8.15	3.75	0.47	22.93	0.38	1.01	11.10
118.	11.80	51.70	17.93	28.71	81.62	204.19	8.69	8.23	3.75	0.47	23.16	0.38	1.01	11.20
119.	11.90	52.15	18.07	29.12	82.93	207.73	8.77	8.31	3.75	0.47	23.40	0.38	1.01	11.30
120.	12.00	52.60	18.20	29.53	84.74	211.22	8.85	8.39	3.75	0.47	23.63	0.38	1.01	11.40
121.	12.10	53.05	18.34	29.95	85.57	214.90	8.94	8.48	3.75	0.47	23.87	0.38	1.01	11.50
122.	12.20	53.50	18.47	30.36	86.90	218.56	9.02	8.56	3.75	0.47	24.10	0.38	1.01	11.60
123.	12.30	53.95	18.61	30.78	88.25	222.23	9.10	8.64	3.75	0.47	24.34	0.34	1.01	11.70

124.	12.40	54.40	18.74	31.20	89.60	225.96	9.18	8.72	3.75	0.47	24.57	0.38	1.01	11.80
125.	12.50	54.85	18.88	31.63	90.97	229.71	9.26	8.80	3.75	0.47	24.81	0.38	1.01	11.90
126.	12.60	55.30	19.01	32.05	92.34	233.50	9.34	8.88	3.75	0.47	25.04	0.38	1.01	12.00
127.	12.70	55.75	19.15	32.48	93.73	237.32	9.42	8.96	3.75	0.47	25.28	0.38	1.01	12.10
128.	12.80	56.20	19.28	32.91	95.12	241.18	9.50	9.04	3.75	0.47	25.51	0.38	1.01	12.20
129.	12.90	56.65	19.42	33.35	96.53	245.07	9.58	9.12	3.75	0.47	25.75	0.38	1.01	12.30
130	13.00	57.10	19.55	33.78	97.94	249.00	9.66	9.20	3.75	0.47	25.98	0.38	1.01	12.40
131.	13.10	57.55	19.69	34.22	99.37	252.96	9.74	9.28	3.75	0.47	26.22	0.38	1.01	12.50
132.	13.20	58.00	19.82	34.66	100.80	256.96	9.82	9.36	3.75	0.47	26.45	0.38	1.01	12.60
133.	13.30	58.45	19.96	35.11	102.25	260.97	9.91	9.45	3.75	0.47	26.69	0.38	1.01	12.70
134.	13.40	58.90	20.09	35.55	103.70	265.04	9.99	9.53	3.75	0.47	26.92	0.38	1.01	12.80
135.	13.50	59.35	20.23	36.00	105.17	269.13	10.07	9.61	3.75	0.47	27.16	0.38	1.01	12.90
136.	13.60	59.80	20.36	36.45	106.64	273.28	10.15	9.69	3.75	0.47	27.39	0.38	1.01	13.00
137.	13.70	60.25	20.50	36.91	108.13	277.45	10.23	9.77	3.75	0.47	27.63	0.38	1.01	13.10
138.	13.80	60.70	20.63	37.36	109.62	281.66	10.31	9.85	3.75	0.47	27.86	0.38	1.01	13.20
139.	13.90	61.15	20.77	37.82	111.13	285.90	10.39	9.93	3.75	0.47	28.10	0.38	1.01	13.30
140.	14.00	61.60	20.90	38.28	112.64	290.18	10.47	10.01	3.75	0.47	28.33	0.38	1.01	13.40
141.	14.10	62.05	21.04	38.75	114.17	294.56	10.55	10.09	3.75	0.47	28.57	0.38	1.01	13.50
142.	14.20	62.30	21.17	39.21	115.70	298.84	10.63	10.17	3.75	0.47	28.80	0.38	1.01	13.60
143.	14.30	62.95	21.31	39.68	117.25	303.22	10.71	10.25	3.75	0.47	29.04	0.38	1.01	13.70
144.	14.40	63.40	21.44	40.15	118.80	307.64	10.79	10.33	3.75	0.47	29.27	0.38	1.01	13.80
145.	14.50	63.85	21.58	40.63	120.37	312.09	10.87	10.41	3.75	0.47	29.51	0.38	1.01	13.90

146.	14.60	64.30	21.71	41.10	121.94	316.94	10.96	10.50	3.75	0.47	29.74	0.38	1.01	14.00
147.	14.70	64.75	21.85	41.58	123.53	321.08	11.04	10.58	3.75	0.47	29.98	0.38	1.01	14.10
148.	14.80	65.20	21.90	42.06	125.12	325.64	11.12	10.66	3.75	0.47	30.21	0.38	1.01	14.20
149.	14.90	65.65	22.12	42.55	126.73	330.22	11.20	10.74	3.75	0.47	30.45	0.38	1.01	14.30
150.	15.00	66.10	22.25	43.03	128.34	334.86	11.28	10.820	3.75	0.47	30.68	0.38	1.01	14.40
151.	15.10	66.55	22.39	43.52	129.97	339.52	11.36	10.90	3.75	0.47	30.92	0.38	1.01	14.50
152.	15.20	67.00	22.52	44.01	131.60	344.22	11.44	10.98	3.75	0.47	31.15	0.38	1.01	14.60
153.	15.30	67.45	22.66	44.51	133.25	348.95	11.52	11.06	3.75	0.47	31.39	0.38	1.01	14.70
154.	15.40	67.90	22.79	45.00	134.90	353.72	11.60	11.14	3.75	0.47	31.62	0.38	1.01	14.80
155.	15.50	68.35	22.93	45.50	136.57	358.52	11.68	11.22	3.75	0.47	31.86	0.38	1.01	14.90
156.	15.60	68.80	23.06	46.00	138.34	363.26	11.76	11.30	3.75	0.47	32.09	0.38	1.01	15.00
157.	15.70	69.25	23.20	46.00	138.34	368.23	11.84	11.38	3.75	0.47	32.33	0.38	1.01	15.10
158.	15.80	69.70	23.33	47.01	141.62	373.14	11.92	11.46	3.75	0.47	32.56	0.38	1.01	15.20
159.	15.90	70.15	23.47	47.52	143.33	378.05	12.01	11.55	3.75	0.47	32.80	0.38	1.01	15.30
160.	16.00	70.60	23.60	48.03	145.04	383.03	12.09	11.63	3.75	0.47	33.03	0.38	1.01	15.40



NOTE: IF SOILS OTHER THAN THOSE MENTIONED HAVE TO BE USED FOR THE DAM SECTION THE SIDE SLOPES OF BUND HAVE TO BE DESIGNED AS PER TABLE "A".

TABLE-A RECOMMENDED SLOPES FOR SMALL HOMOGENEOUS EARTHFILL DAMS ON STABLE FOUNDATIONS			
S.NO	SOIL CLASSIFICATION	UP STREAM SLOPE	DOWN STREAM SLOPE
1.	GW, GP, SW, SP		PERVIOUS NOT SUITABLE
2.	GC, GM, SC, SM	2:1 and 2½ :1	2:1
3.	CL, ML	2½ :1 and 3:1	2½ :1
4.	CH, MM	3:1 and 3½ :1	2½ :1

EARTH DAM SECTION 0.0M TO 3.40M HEIGHT

2m 0m 2m 4m 6m

NOTE: IF SOILS OTHER THAN THOSE MENTIONED HAVE TO BE USED FOR THE DAM SECTIONS THE SIDE SLOPES OF BUND HAVE TO BE DESIGNED AS PER TABLE "B".

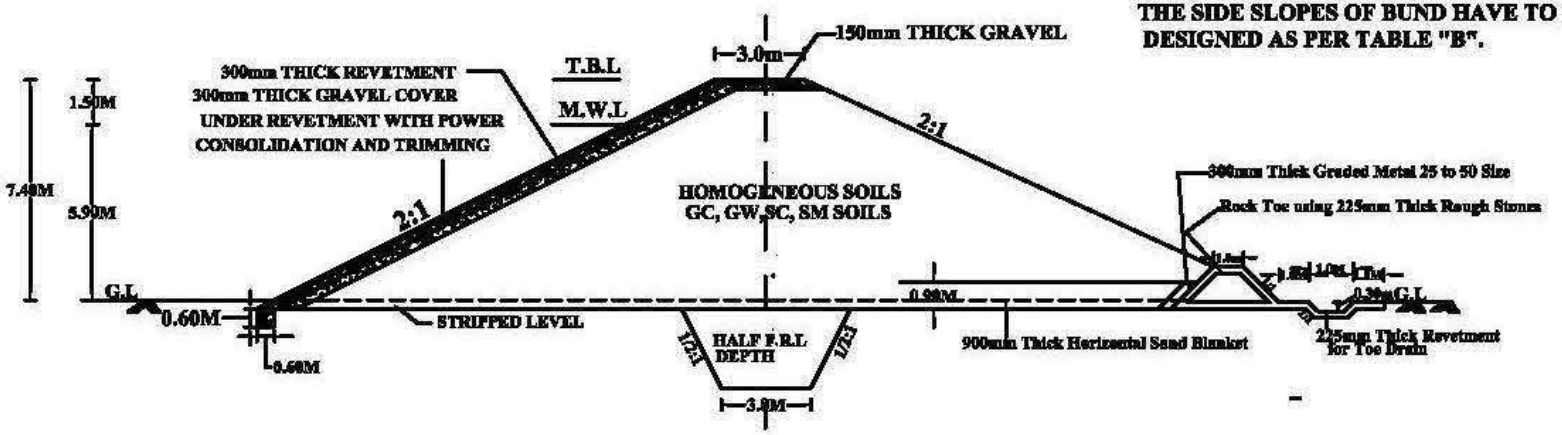


TABLE-B RECOMMENDED SLOPES FOR SMALL HOMOGENEOUS EARTHFILL DAMS ON STABLE FOUNDATIONS			
S.NO	SOIL CLASSIFICATION	UP STREAM SLOPE	DOWN STREAM SLOPE
1.	GW, GP, SW, SP	———	PERVIOUS NOT SUITABLE
2.	GC, GM, SC, SM	2:1 and 2½ :1	2:1
3.	CL, ML	2½ :1 and 3:1	2½ :1
4.	CH, MH	3:1 and 3½ :1	2½ :1

EARTH DAM SECTION 3.5M TO 7.40M HEIGHT

SCALE:

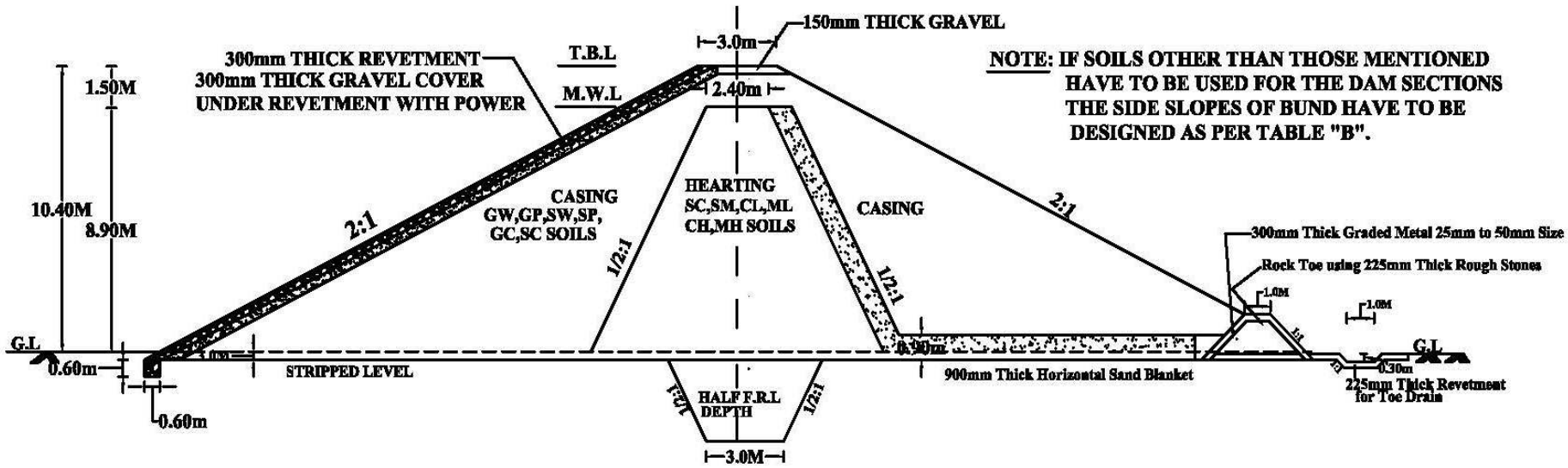


TABLE-B RECOMMENDED SLOPES FOR SMALL ZONED EARTHFILL DAMS ON STABLE FOUNDATIONS					
S.NO	CASE	CASING SOIL CLASSIFICATION	HEARTING SOIL CLASSIFICATION	UP STREAM SLOPE	DOWN STREAM SLOPE
1.	ZONEL SECTION WITH 1/2:1 SLOPES FOR HEARTING SOILS	GW,GP,SW (Gravelly) SP (Gravelly) GC,SC	SC, SM, CL ML, CH, MH	2:1	2:1
2.	ZONEL SECTION WITH 1:1 SLOPES FOR HEARTING SOILS	GW,GP,SW (Gravelly) SP (Gravelly) GC,SC	CL, ML CH, MH	2½ :1 3:1	2½ :1 3:1

SCALE: 2m 0m 2m 4m 6m

EARTH DAM SECTION 7.5M TO 10.40M

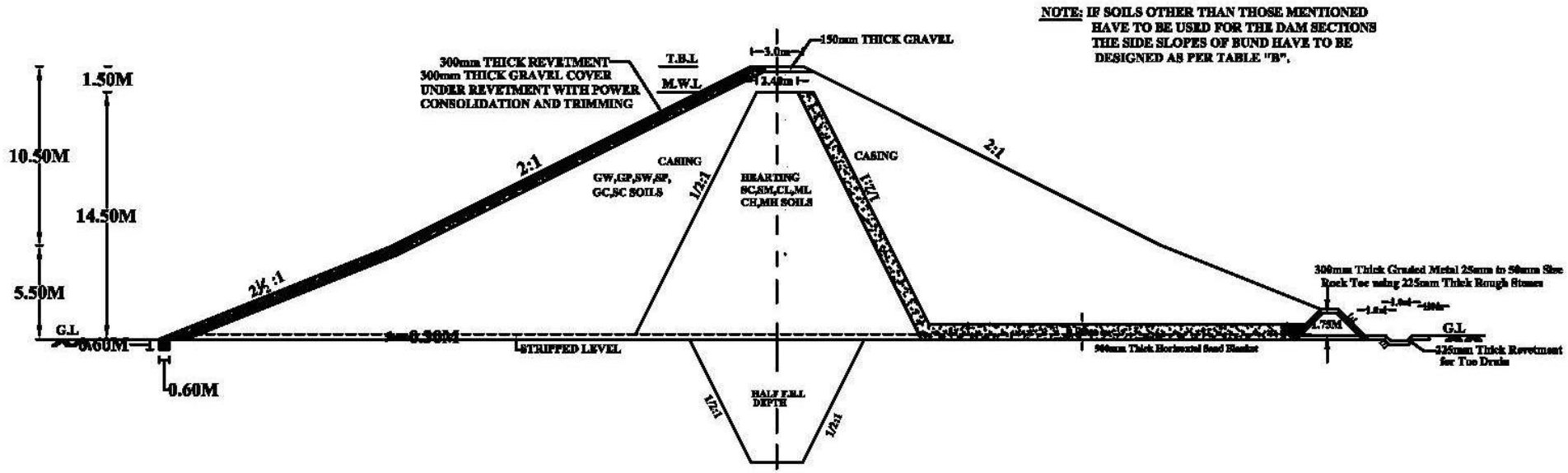


TABLE-B RECOMMENDED SLOPES FOR SMALL ZONED EARTHFILL DAMS ON STABLE FOUNDATIONS					
S.NO	CASE	CASING SOIL CLASSIFICATION	HEARTING SOIL CLASSIFICATION	UP STREAM SLOPE	DOWN STREAM SLOPE
1.	ZONEL SECTION WITH 1/2:1 SLOPES FOR HEARTING SOILS	GW,GP,SW (Gravelly) SP (Gravelly) GC,SC	SC, SM, CL ML, CH, MH	2:1	2:1
2.	ZONEL SECTION WITH 1:1 SLOPES FOR HEARTING SOILS	GW,GP,SW (Gravelly) SP (Gravelly) GC,SC	CL, ML CH, MH	2½ :1 3:1	2½ :1 3:1

SCALE:

EARTH DAM SECTION 10.50M TO 16.00M

CIRCULAR NO 34

Office of the Chief Engineer: Minor Irrigation,
A.P.. Errumanzil – Hyderabad

Circular No. DCE(MI)/OTI-T4/61826/85, dt. 11-8-1986.

Sub: E.E.C. Schemes – Calculation of yield – Dry damp wet method – Reg.

For all the E.E.C., aided schemes, it is contemplated to calculate the yield based on dry damp wet method for a period of 12 years. Computer programme for this is available in APERL and calculations are presently being made for some schemes making use of this programme. Off latel, it is seen that this procedure of the making use of the computer of the APERL is leading to several delays. It is also noticed that the time taken to get this done is amounting to two to three times more than what it would normally required for manual calculations, it is relevant to observe in this context that the computation portion of this exercise is relatively simple and the aid of a computer is not that essential in this case. Most of the time is taken for feeding the voluminous data in to this computer, the only calculation being adoption of a multiplying factor depending upon the dry, damd or wetness of the soil, so as to get the yield. This is a simple multiplying process of one step calculation which does not need the aid of a computer. A Section Officer can calculate the yields by the conventional manual method for a period of 12 years in a period of to 5 days.

It is therefore directed that all the future schemes to be posed of E.E.C. Aid., the dry damp wet method of calculation may be done manually for the latest period of 12 years (depending upon the records of the rainfall available) and yield calculation worked out.

T.HANUMANTHA RAO,
Chief Engineer : Minor Irrigation

CIRCULAR No.35

Office of the Engineer-in-Chief, Irrigation
Wing, A.P., Hyderabad

Circular Memo No.DCE/MI/OTI/T4/61826/85, dt. 23.10.86

Sub: Minor Irrigation schemes- Design of weirs in Minor Irrigation tanks – standardization – Reg.

Ref: T.O. Circular No. DCE/MI/OTI-T4/61826/85 – dt 21-1-86

The present practice of weir design is broad crested weir for low discharges, narrow crested weir for medium discharges and High Co-efficient weir for higher discharges. Similarly the length on solid Apron and rough stone talus are based on thumb rules given in "Manual on Irrigation" by Ellis.

The aim of this design circular is to stream line the design procedure of weir and issue standards for evolving uniform design in various Minor Irrigation Tanks. The shape of the weir body wall is as per the drawing given by the Poondi research station. Though it is mentioned that Cd value is 4.10 the value may be taken as 3.90 as the entire body wall is proposed in coursed rubble stone masonry second sort in cement mortar 1:5 proportion without plastering.

The length of solid apron is based on hydraulic jump consideration and the thickness is based on Khosla's theory. Similarly the length and thickness of protection works (rough stone apron) is in relation to scour depth consideration. All these are based on latest practices evolved and the data available in this regard. A statement of standards for different heights of body walls of weir for different heads of flow over weir is enclosed for adoption in estimation. A ready reckoner table of quantities is enclosed for quickly computing the items of work involved and estimating. A standard drawing showing the section of weir is also enclosed for guidance. These standards are issued for the purpose of estimation only. The Executive Engineers are requested to ensure the safety of structures based on the soil condition, foundation strata and other field conditions.

All the Superintending Engineers and Executive Engineers are requested to supply the copy of circular and tables to each Section Officer for immediate implementation.

T. HANUMANTHA RAO,
Chief Engineer, Minor Irrigation

MODEL CALCULATIONS FOR DESIGN OF H.C. WEIR:

Head of flow : 0.9 M or 2.953 Ft.

Height of body wall : 1.4 M.

Base width of body wall : 1.6 M.

The discharge per Meter length of weir is calculated as per the following formula :

$Q=Cd\ Lh^{3/2}$ where Q=discharge for 1M length

Cd=4.10 proposed by poondy research station.

L=Length of weir = 1 M or 3.28Ft.

h=0.9M or 2.953Ft.

$Q=4.1 \times 3.281 \times (2.953)^{3/2}$

= 68.263 C/S for 3.281 ft.

=1.933 Cumecs/Metre.

SCOUR DEPTH CALCULATIONS :-

Nominal scour depth = $R=1.35[\frac{Q^2}{F}]^{1/3}$

Where Q=discharge for 1M length = 1.933.M^2/S/M, f= Laceys silt factor =2

$R= 1.35[\frac{1.933^2}{2}]^{1/3}$ = 1.664 Mts.

Down stream cut –off is taken upto 2 R depth = 2 x 1.664 = 3.328 below maximum flood level.

Depth below apronlevel = 3.328-1.364=1.964

.. Provide : 2.20M. which is safe.

Top width of body wall is taken as 0.45 M for all heads of flow and height of body wall.

STABILITY CALCULATIONS:

CASE-I: Where there is water upto Crest level on up stream side and no water on down-stream. Figure-I

FIGURE NO·1

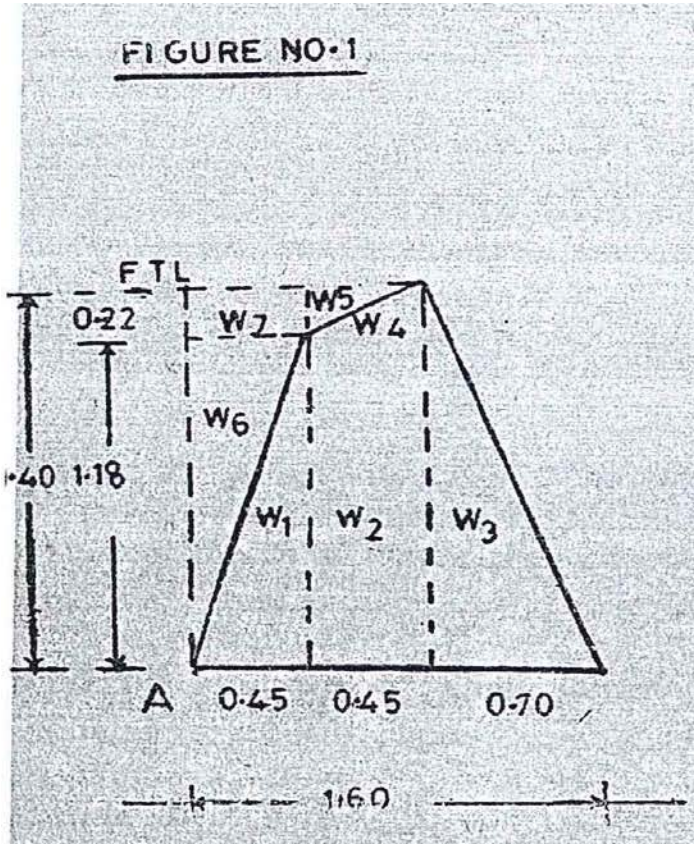
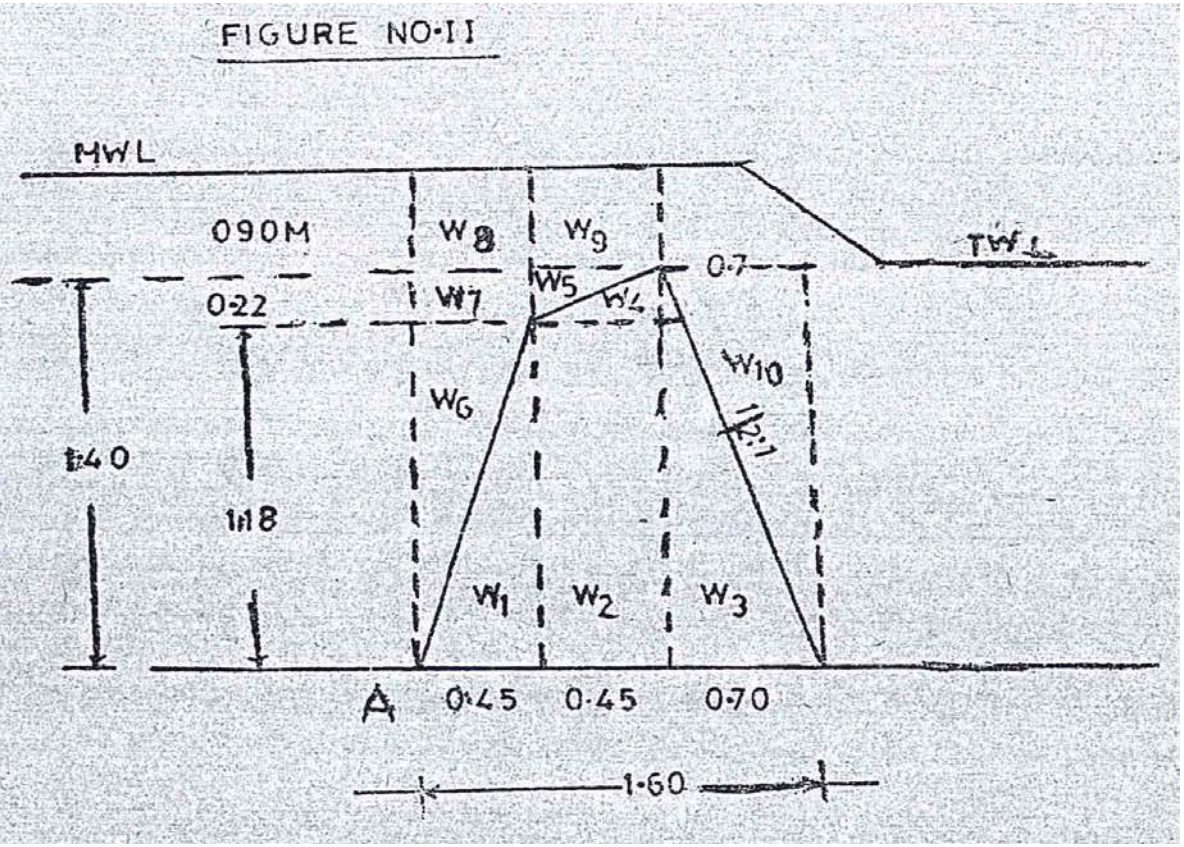


FIGURE NO·II



Taking moments about (A)

Sl. No	Force	Details	Magnitude	L.A.	Moment
1	W1	½ x 0.45 x 1.18 x 2.25	0.5974	0.30	0.1792
2.	W2	0.45 x 1.18 x 2.25	1.1948	0.675	0.8065
3.	W3	½ x 0.70 x 1.40 x 2.25	1.1025	1.13	1.2491
4.	W4	½ x 0.24 x 0.22 x 2.25	0.1002	0.75	0.0752
5.	W5	½ x 0.45 x 0.22 x 1.0	0.0495	0.60	0.0297
6.	W6	½ x 0.45 x 1.18 x 1.0	0.2655	0.15	0.0398
7.	W7	0.22 x 0.45 x 1.00	0.0990	0.225	0.0223
8.		$\frac{WH^2}{6} = \frac{1 x 1.4^2}{6}$			0.1306
		Total : ΣW =	3.4089	ΣW	2.5324

Position of Result = $\frac{\Sigma W}{\Sigma W} = \frac{2.5324}{3.4089} = 0.7429$

The resultant falls within middle third of 0.533 and 1.066 Hence safe.

Case II when there is water on upstream side into MWL

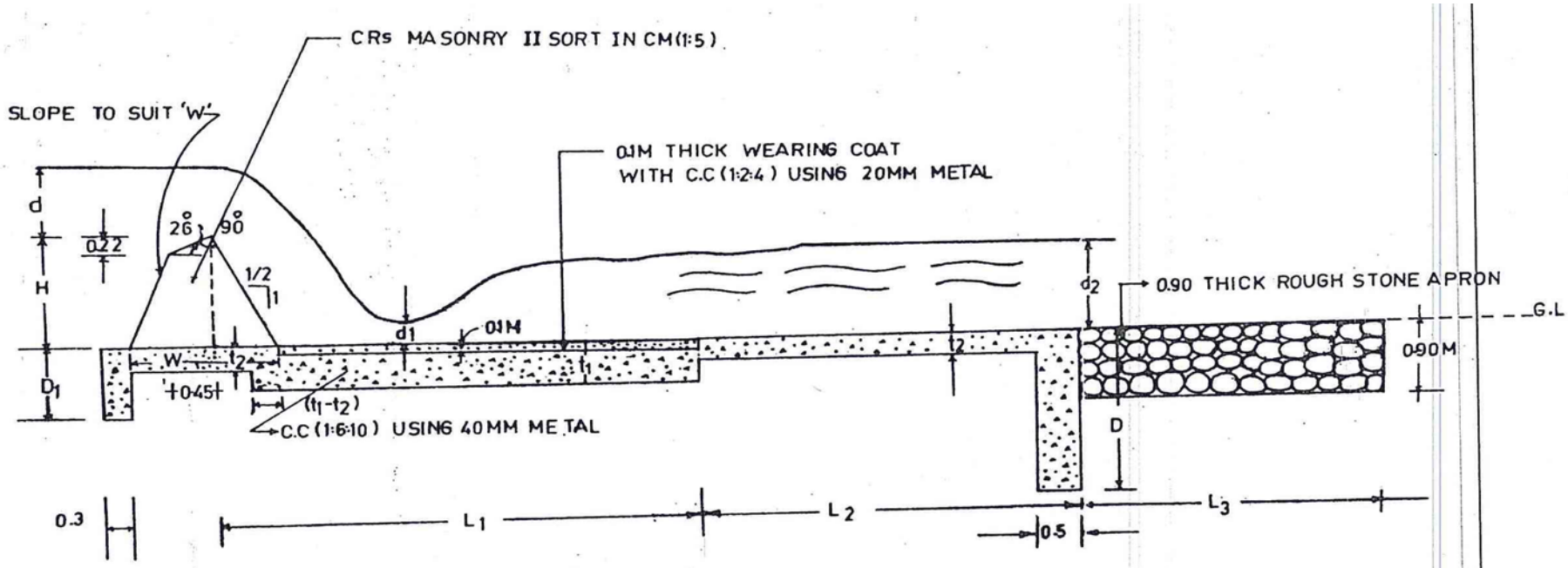
Considering moments @ (A)

Figure II

Sl. No	Force	Details	Magnitude	L.A.	Moment
1	W1	0.5 x 0.45 x 1.18 x 1.25	0.3318	0.30	0.0995
2.	W2	0.45 x 1.18 x 1.25	0.6638	0.675	0.4481
3.	W3	0.5 x 0.70 x 1.40 x 1.25	0.6125	1.1333	0.6941
4.	W4	0.5 x 0.45 x 0.22 x 1.25	0.0619	0.75	0.0464
5.	W5	0.5 x 0.45 x 0.22 x 1.0	0.0495	0.60	0.0297
6.	W6	0.5 x 0.45 x 1.18 x 1.0	0.2655	0.15	0.0398
7.	W7	0.45 x 0.22 x 1.00	0.0990	0.225	0.0228
8.	W8	0.45 x 0.90 x 1.00	0.4050	0.225	0.091
9.	W9	0.45 x 0.90 x 1.00	0.4050	0.675	0.2734
10.	W10	0.5 x 0.70 x 1.40 x 1.00	0.49	1.37	0.6713
		MD=⅙(H³+3d H²-D³) = ⅙(1.4³+3x0.9x1.4²-1.4³) ----------			0.882
		Total : ΣW =	3.384	ΣW	3.2982

Resultant = $\frac{\Sigma W}{\Sigma W} = \frac{3.2982}{3.3840} = 0.9746$

The resultant falls with in middle third of 0.5333 and 1.066



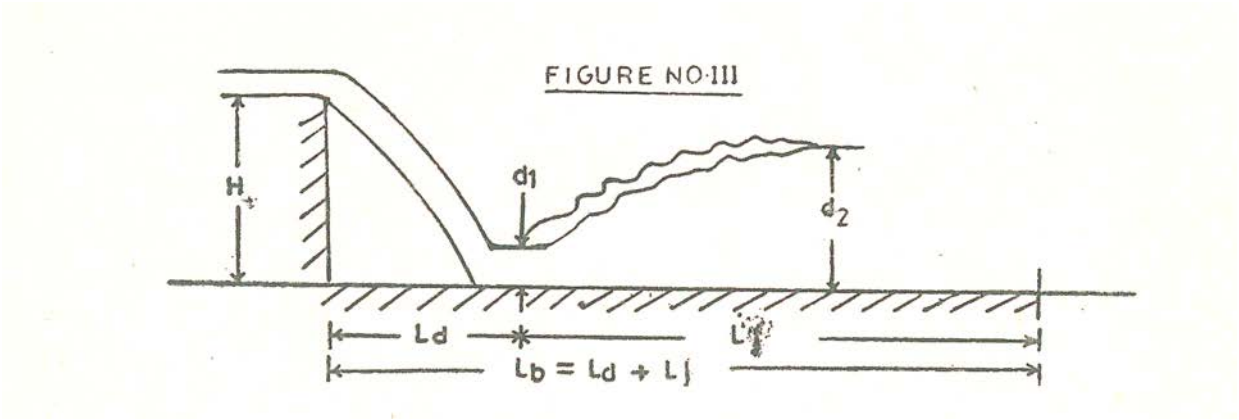
CROSS SECTION OF WEIR

SCALE :— 2 CM=1M

NOTE:—'D' LIMITED TO ROCK LEVEL OR HARD STRATA

CHIEF ENGINEER
MINOR IRRIGATION

Fixing of length of solid apron based on Hydraulic Jump theory.



In this type of drops the staring of the jump is arrived based on the experimental data of Rand, Moor Bahkmeteff and Feodoroff.

The drop number a non-dimensional co-efficient Dn is given by-

$$D_n = \frac{q^2}{gH^3}$$

Where q=discharge per unit width

G=Acceleration due to gravity

H=Height of wall

The length of apron before jump, Ld given by

$$\frac{Ld}{H} = 4.30Dn^{0.27}$$

The jump depth d1 & d2 are given by

$d1/H=0.54Dn^{0.245}$

$d2/H=1.66Dn^{0.27}$

The length of apron after the jump Lj is given by

Lj=5(d2-d1)

Therefore The length of apron Lb=Ld+Lj

Q=discharge per meter run=1.933 cumecs

H=1.4m

$$D_n = \frac{q^2}{gH^3} = \frac{1.933^2}{9.81 \times 1.4^3} = 1.390$$

Ld=H x4.3$(D_n)^{0.27}$ = 1.4 x 4.3 $(0.139)^{0.27}$ = 3.533 M

d1= H x0.54$(Dn)^{0.0.425}$ = 1.4 x 4.3 $(0.139)^{0.425}$ = 0.3268 M

=d2= H x1.66$(Dn)p^{0.27}$=1.4x1.66$(0.139)^{0.27}$ = 1.3641 M

LJ=5 x (d2-d1)-5 x (1.3641-0.3268) = 5.1865 M

Lb= Ld+Lj = 3.533 + 5.1865 = 8.795 M or say 8.80M

Hence L1=pre jump length = 4.60M

L2=post jump length = 8.80-4.60 = 4.20M

Calculation for thickness of apron based on Khosla's theory'U/s pile.

D=1.80m, D=2.20-0.5=1.70m

$$\frac{1}{\propto} = \frac{d}{b} = \frac{1.80}{10.0} = 0.18$$

From Khosla's graph

ΦD=25.50%

ΦE=37%

ΦD1=100-25.5=74.50%

Correction for 0.5m thickness under body wall

=11.5x $\frac{0.5}{1.8} = 3.19\%\ (Positive)$

<u>Interference of D/s pile on U/s pile</u>

$$correction\ c = 19\sqrt{\frac{D}{b1}}\ x\ \frac{(d+D)}{b}$$

$$C = 19\sqrt{\frac{1.70}{b101}}\ x\ \frac{(1.8+1.70)}{b10}$$

2.74% (Positive)

ΦC1=corrected = 63+3.19+2.74=68.93%

D/s pile d=2.20m, D=1.8-0.5=1.30m

$$\frac{1}{\propto} = \frac{d2.20}{b10} = \frac{0.22}{10}$$

ΦD=27.5%

ΦE=41.0%

ΦE-ΦD=41-27.5=13.5%

Correction for 0.5m thickness = 13.5 x 0.5/2.20 = 3.07% (Negative)

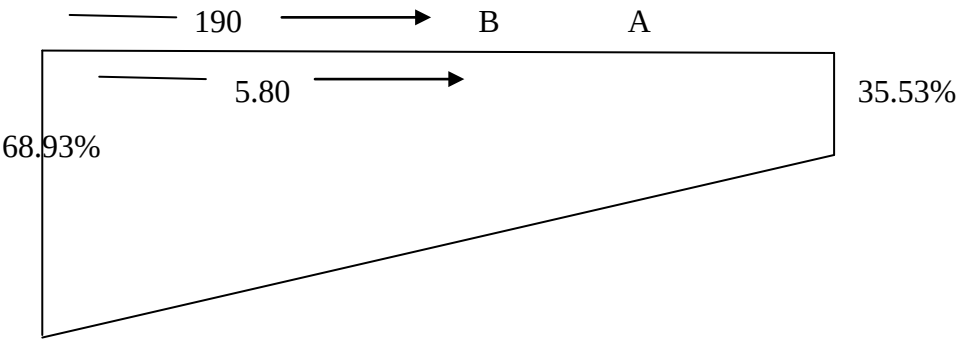
Interference of U/s pile on D/s pile

D=2.20m D=1.30m

$$C = 19\sqrt{\frac{D}{b1}}\ x\ \frac{(d+D)}{b}$$

$C = 19\sqrt{\frac{1.30}{b101}}\ x\ \frac{((2.20+1.30)}{10}$ = 2.4% (Negative)

ΦE corrected =41-3.07=35.53%



% pressure @ B=68.93 -$\frac{(68.93-35.53)1.90}{10}$ = 62.58%

Overflow condition

Pressure head = (H+d-d2)0.6258

Where H=Hieght of body wall

D=depth of flow

= (1.4+0.9-1.364)0.6258 = 0.586

Therefore Thickness = 0.586/1.25 = 0.47m

Non-overflow condition

Pressure head = H x 0.6258

=1.4 x 0.6258 = 0.876m

Thickness = 0.876/2.25 = 0.389m

Therefore thickness ti-0.47m (However a minimum of 0.6m may provided)

Thickness t2

% Pressure @ A = 68.93-$\frac{(68.93-35.53)5.8}{10}$ = 49.56%

Pressure head = (H+d-d2)0.4956 = 0.936 x 0.4956 = 0.4638

Thickness = 0.4638/1.25 = 0.37m

(however a minimum of 0.45 may be provided)

Calculation of Exit Gradient

Considering the D/s pile

$\propto = \frac{b}{d} = \frac{10.0}{2.20} = 4.55$

From the graph of $\left\{ \propto Vs \frac{1}{\pi v \bar{y}} \right\}$

For = $\propto$ 4.55

$= \frac{+1}{\pi v \bar{y}}$ = 0.195

Therefore Exit gradient = $\frac{H}{d} \; x \; \frac{1}{\pi v \bar{y}}$

$= \frac{14 \; x \; 0.195}{2.20} = 0.124$

= 1 in 8.06

Type of Soil	Permissible Exit gradient
1. Fine and	1/6 to 1/7
2. Coarse sand	1/5 To 1/6

3. Shingle 1/4 To 1/5

Rough stone apron

Scour depth D=2.2M

Length to be covered on a slope of 2:1 = √5D

=2.236 x 2.2

Thickness of settled stones after scour = 1.24 x 1.5' = 1.86' or 0.567m

(Assuming side slope thickness T=1.5')

Quantity /m run = 2.789 cum i.e. (2.236 x 2.20 x 0.567)

Length of launching apron = 1.5D=1.5 x 2.2 = 3.3m

Thickness = $\frac{2.789}{3.3} = 0.845 \; or \; 0.9 \; m$

T. HANUMANTHA RAO,
Chief Engineer, Minor Irrigation

STATEMENT OF STANDARDS FOR DIFFERENT HEIGHTS OF BODY WALL AND DIFFERENT HEADS OF FLOW OVER WEIR

			0.6 M Head of flow							0.9 M Head of flow						
S.No	Height of body wall	Base width for all heads of flow	Thickness of solid apron		Length of solid apron		Depth of solid apron		Length of Talus apron	Thickness of solid apron		Length of solid apron		Depth of cut-off		Length of talus.
	H	W	T1	T2	L1	L2	U/S D1	D/S D	L3	T1	T2	L1	L2D1	U/S D	U/S	L3
1.	0.6	0.6	0.60	0.45	3.00	2.15	1.20	1.50	2.25							
2.	0.8	1.00	0.60	0.45	3.30	2.30	1.20	1.50	2.25							
3.	1.00	1.20	0.60	0.45	3.40	2.50	1.20	1.50	2.25	0.60	0.45	4.30	3.70	1.80	2.20	3.30
4.	1.20	1.40	0.60	0.45	3.50	2.75	1.20	1.50	2.25	0.60	0.45	4.50	3.90	1.80	2.20	3.30
5.	1.40	1.60	0.60	0.45	3.60	2.90	1.20	1.50	2.25	0.60	0.45	4.60	4.20	1.80	2.20	3.30
6.	1.60	1.80	0.60	0.45	4.00	2.70	1.20	1.50	2.25	0.60	0.45	4.70	4.30	1.80	2.20	3.30
7.	1.80	2.00	0.70	0.55	4.00	3.00	1.20	1.50	2.25	0.65	0.55	4.80	4.60	1.80	2.20	3.30
8.	2.00	2.20	0.80	0.60	4.00	3.10	1.20	1.50	2.25	0.75	0.65	4.90	4.70	1.80	2.20	3.30
9.	2.20	2.40	0.85	0.65	4.00	3.30	1.20	1.50	2.25	0.80	0.65	5.00	4.85	1.80	2.20	3.30
10.	2.40	2.60								0.90	0.70	5.20	4.90	1.80	2.20	3.30
11.	2.60	2.80								1.00	0.75	5.50	4.80	1.80	2.20	3.30
12.	2.80	3.05								1.10	0.85	5.50	5.00	1.80	2.20	3.30
13.	3.00	3.25														

1.2 M Head of flow								1.5 M Head of flow								
Height of body wall	Base width for all heads of flow	Thickness of solid apron		Length of solid apron		Depth of solid apron		Length of Talus apron	Thickness of solid apron		Length of solid apron		Depth of cut-off		Length of talus.	Sl.No
H	W	T1	T2	L1	L2	U/S D1	D/S D	L3	T1	T2	L1	L2D1	U/S D	U/S	L3	
1.40	1.60	0.60	0.45	5.40	5.30	2.40	2.80	4.20	-	-	-	-	-	-	-	5
1.60	1.80	0.60	0.45	5.60	5.55	2.40	2.80	4.20	-	-	-	-	-	-	-	6
1.80	2.00	0.60	0.50	5.70	5.80	2.40	2.80	4.20	0.60	0.50	6.60	6.90	2.80	3.50	5.25	7
2.00	2.20	0.70	0.55	5.80	6.10	2.40	2.80	4.20	0.10	0.70	0.70	7.20	2.80	3.50	5.25	8
2.20	2.40	0.80	0.60	5.90	6.30	2.40	2.80	4.20	0.75	0.55	6.80	7.50	2.80	3.50	5.25	9
2.40	2.60	0.85	0.70	6.00	6.50	2.40	2.80	4.20	0.85	0.70	6.90	7.75	2.80	3.50	5.25	10
2.60	2.80	0.95	0.75	6.10	6.70	2.40	2.80	4.20	0.95	0.75	7.00	8.00	2.80	3.50	5.25	11
2.80	3.05	1.00	0.85	6.20	6.80	2.40	2.80	4.20	1.00	0.80	7.10	8.20	2.80	3.50	5.25	12
3.00	3.25	1.15	0.90	6.30	6.90	2.40	2.80	4.20	1.20	0.90	7.20	8.40	2.80	3.50	5.25	13

T. HANUMANTHA RAO,
Chief Engineer, Minor Irrigation

STATEMENT SHOWING THE READY RECKONER OF QUANTITIES FOR BODY HEIGHTS OF BODY WALL AND

S.No.	Height of body wall	Basic width of body wall	0.6 M Head of flow			0.9 M Head of flow	
			CC(1.6:10) with 40 mm metal	Wearing Coat CC (1.2.4) 20 mm metal coat)	Rough stone apron (launching)	CC (1:6:10) with 40 mm metal	Wearing coat CC (1.2.4) 20 mm metal
1.	0.60	0.60	3.60	0.29	2.025		
2.	0.80	1.00	3.84	0.29	2.025		
3.	1.00	1.20	3.97	0.28	2.025	5.54	0.38
4.	1.20	1.40	4.18	0.28	2.025	5.77	0.39
5.	1.40	1.60	4.52	0.28	2.025	5.99	0.39
6.	1.60	1.80	4.67	0.31	2.025	6.13	0.39
7.	1.80	2.00	5.41	0.30	2.025	7.15	0.39
8.	2.00	2.20	6.13	0.30	2.025	8.35	0.39
9.	2.20	2.40	7.61	0.29	2.025	8.78	0.39
10.	2.40	2.60				9.78	0.40
11.	2.60	2.80				10.81	0.42.
12.	2.80	3.05				12.22	0.41
13.	3.00	3.25					

(contd..)

WALL SOLID APRON ROUGH STONE APRON, WEARING COAT FOR DIFFERENT OF FLOW

1.2 M. Head of Flow					1.5 M Head of Flow		0.6 M. 0.9 M 1.20 M. 1.5 M Heads of Flow	
Sl. No.	Rough tone apron (launching	C.C. (1.6.10) with 40 mm metal	Wearing coat C.C.(1.2.4) 20 mm metal	Rough stone apron (launching)	C.C.(1.6. 10) with 40 mm metal	Wearing coat CC (1.2.4) 20 mm metal	Rough stone apron (launching)	CRS II Sort in CM (1.5)
1.								0.26
2.								0.51
3.	2.97							0.75
4.	2.97							1.02
5.	2.97	7.37	0.47	3.78				11.34
6.	2.97	7.63	0.48	3.78				1.69
7.	2.97	8.18	0.48	3.78	9.65	0.57	4.752	2.08
8.	2.97	9.31	0.48	3.78	10.93	0.57	4.752	2.52
9.	2.97	10.44	0.48	3.78	12.42	0.57	4.752	2.99
10.	2.97	11.76	0.48	3.78	13.78	0.57	4.752	3.51
11.	2.97	12.99	0.48	3.78	15.20	0.57	4.752	4.06
12.	2.97	14.41	0.48	3.78	16.36	0.57	4.752	4.72
13.		15.91	0.48	3.78	18.37	0.57	4.752	5.42

T.HANUMANTH RAO
Chief Engineer, Minor Irrigation

7. GENERAL CIRCULARS (1 TO 8 G)

INDEX

CIRCULAR NO.1.G

GOVERNMENT OF ANDHRA PRADESH

Irrigation Minor Criteria of Financial return for sanction of Irrigation Schemes – Revised Orders issued.

PUBLIC WORKS DEPARMENT

G.O.Ms.No.707 Public Works Dated the 20th May, 1971

Read the following:-

(1) G.O.Ms. No.799 PW&T dt. 24-3-1956
(2) G.O.Ms.No.100, dt.18-1-1663
(3) G.O.Ms.No.1246 PW dt. 22-5-1964
(4) G.O.Ms.No. 1636 PW dt. 6-7-1966
(5) G.O.Ms No. 1488 PW dt. 4-10-1968
(6) Govt. Memo No. 1328, Plg.XII/68-11 dt. 17-6-1969.
(7) From the C.E.MI. Lr. No.Y1/79527/66-1 dt. 23-9-1966.
(8) From the C.E.MI. Lr. No.Y1/79527/66-2 dt. 10-12-1966
(9) From the C.E.MI. Lr. No.P1/80741/66-2 dt. 29-8-1967.
(10) From the C.E.MI. Lr. No.Y2/52114/66-9 dt. 20-6-1970

ORDER:-

The policy of the Government has till now been that the Minor Irrigation Schemes to be taken up should yield a minimum return of 3% where such schemes are extensions of Minor Irrigation systems and 1.5% in all other cases, also in the case of restoration of breached or abandoned tanks to public Works Department standards, the financial ceiling has been fixed at Rs. 350 per acre.

2. In the context of the increase in costs of the construction of works and in the context of the emphasis placed on the development of economically backward areas, the Government have reviewed the above criteria in consultation with the Chief Engineer and direct that:-

(a) The existing criteria of 3% revenue return in respect of Minor Irrigation Schemes which are extensions of Major systems and 1.5% return in respect of other schemes should be reduced to 1% in respect of non-scarcity areas and 0.5% in the case of scarcity areas as listed in Government Memo No.1328-Plg. XII/68-11, planning Department, dt. 17-6-69. A list of

chronically drought affected areas which are considered as scarcity areas, is enclosed to this order.

(b) The Principle of cost benefit ratio in addition to financial return need not be applied to Minor Irrigation schemes and

(c)The present monetary limit of Rs. 350 per acre for tank restoration schemes under the Minor Irrigation schemes should be raised to Rs. 500 per acre.

The order issues with the concurrence of Finance (Exe.PW) Department vide their U.O.No. 1997/985-71-1, dt.18-5-1971.

(BY ORDER AND IN THE NAME OF THE GOVERNOR OF ANDHRA PRADESH)

V. SUNDARESAN,
Joint Secretary to Government

LIST OF CHRONICALLY DROUGHT AFFECTED TALUKS IN ANDHRA PRADESH

1. ANANTHAPUR

1) Ananthapur
2) Tadipatri
3) Dharmavaram
4) Kalyan Dur
5) Rayadurg
6) Madakasira
7) Hindupur
8) Kadiri
9) Gooty
10) Penukonda
11) Vivakonda

2. CHITTOOR

12) Chittoor
13) Chandragiri
14) Madanapally
15) Voyalapadu
16) Punganur
17) Palamanur
18) Kuppam
19) Puttur

3. CUDDAPPAH

20) Cuddapah
21) Kamalapuram
22) Rayachoti
23) Rajampet
24) Badvel
25) Jammalamadugu
26) Proddutur
27) Pulvendla

4. KURNOOL

28) Kurnool
29) Dhone
30) Nandikotkur
31) Adoni
32) Aluru
33) Pattikonda
34) Koilakuntla
35) Banganapalli
36) Allagadda
37) Atmakur
38) Nandyala

5. NELLORE

39) Udayagiri
40) Atmakur
41) Kavali

6. GUNTUR

42) Sattenapalli
43) Vinukonda
44) Palnadu

7. ONGOLE

45) Markapur
46) Giddaluru
47) Kandukuru
48) Kanigiri
49) Podili
50) Darsi
51) Ongole

8. HYDERABAD

52) Hyderabad (W)
53) Ibrahimpatnam
54) Hyderabad (E)

55) Chevella (Shabad)

9. MAHABUBNAGAR

56) Kalvakurthi
57) Nagarkurnool
58) Wanaparthi
59) Alampur
60) Makthal
61) Shadhnagar
62) Achampet
63) Kollapur
64) Gadwall
65) Atmakur

10. NALGONDA

66) Suryapet
67) Bhongir
68) Huzurnagar
69) Deverkonda
70) Miryalaguda
71) Ramannapet
72) Nalgonda

11. WARANGAL

73) Janagoan

12. MEDAK

74) Narayan Khed

CIRCULAR No.2G

Copy of

GOVERNMENT OF ANDHRA PRADESH

ABSTRACT

Tribal Welfare Schemes included in the Fourth Five Year Plan – Welfare of Scheduled Tribes – State Plan for 1972-73 – Administrative sanction for schemes and allocation of funds – Orders – Issued.

REVENUE (T.W.III) DEPARTMENT

[G.O.Ms.No.581, Dated: 31st May, 1972]

Read the following:

1) Govt. Lr. No.2309/Planning/IV/71-27, Planning and Co-operation, dated 30-11-1971.
2) Govt. D.O.Lr. No.2476/T.W.III-1/71-1, dated 31-12-1971.
3) Govt. D.O.Lr. No.3302/Planning/IV/71-7, Planning and Co-operation, dated 28-1-1972.
4) From the Director of Tribal Welfare Lr. No. D.O. 13955/71-GI, dated 7-3-1972.

ORDER :

1) Sanction is accorded to the implementation during 1972-73 of the schemes for the welfare of Scheduled Tribes and the development of Scheduled areas as specified in the Annexure to this order and to incur a total expenditure not exceeding Rs. 57 lakhs (Rupees fifty seven lakhs only) under State Plan schemes. The breakup of this amount shall be as shown against the respective schemes in the Annexure.

2) The Director of Tribal Welfare is requested to send detailed proposals on the scheme for Promotion cultural talents among tribals for approval of the Government.

3) The Government also agree with the Director of Tribal Welfare that the Collectors may arrange for the contribution from the beneficiaries or for loans from the Commercial or Co-operative Banks to meet the balance of expenditure over and above the subsidy

amount of 50% of the cost (subject to a maximum of Rs,. 400) towards the cost of plough bullocks under the scheme for supply of plough bullocks to Schedule Tribes.

4) The Government also direct that the Minor Irrigation schemes to be taken up from the Tribal Welfare funds should be such areas where the majority of the beneficiaries (ayacut dars) are tribals, and also that not less than 50% of the land benefitted should be owned by the scheduled tribes.

5) The expenditure on account of the scheme of "Assistance to Tribals to set up trades etc" mentioned as serial No.5 under "II Economic Uplift", in the Annexure shall be debited to a new detailed head of appropriation to be opened as "7. Loans relating to the Tribal Welfare Department Loans to tribal for setting up trades" under the Head "Q Loans and Advances by the State Government "Schemes included in the Fourth Five Year Plan—K. Misc. Loans and Advances-E. Miscellaneous". The Government direct that the additional Budget provision of Rs. 50,000 under the said Head of Account shall be made by re-appropriation of savings, if any, under the Grant No. LVI-Loans and Advances by the State Government, or by obtaining supplementary grant, in due course. The Director of Tribal Welfare should surrender the sum of Rs. 50,000 available under "39. Misc., Social and developmental Organizations'—d. Welfare of Scheduled Tribes Castes and other Backward Classes-Schemes included in the Fourth Five Year Plan-I. Scheduled Tribes-5. Misc.-(v) Assistance to Tribals to set up Trades", and submit necessary proposals accordingly.

6) This order issues with the concurrence of the Finance Department (vide their U.O.No.762/DPSE/72-1, dt. 18-5-1972).

(BY ORDER AND IN THE NAME OF THE GOVERNOR OF ANDHRA PRADESH)

G.R.KRISHNASWAMY RAO SAHIB
Secretary to Government

ANNEXURE-I

To G.O.581

Criteria for the qualification of funds into the Special Component Plan

The following criteria are the criteria for qualification of funds from the General Sector and their inclusion in the Special Component Plan.

a. X X X

b. X X X

c. X X X

d. There are certain schemes like minor irrigation which benefit a group of individuals. In such cases the entire outlay is qualified in the Special Component Plan, if 51% or more of the command area is comprised within the holdings of scheduled castes. Another examples environmental is improvement of slums with 51% or more of scheduled castes population. Furthermore, outlays for assisting cooperation and other such institutions are also included in the Special Component Plan provided at least 51% of the membership of such societies institutions is from among the scheduled castes and benefits will go the scheduled castes in no less proportion. In such cases, where the relevant S.C. proportion is less than 51% inclusion in the EGP is not made. It has also to be noted that where benefits clearly flow and can be made to flow to individuals, the criteria at (a) above will apply and not at (d) for example where assistance of Rs. 1,000/- per hectare is given for assigned lands, and 51% or more of the beneficiaries of this programme are all the scheduled castes, it will not be correct to include cent per cent total expenditure under this programme in the Special Component Plan

e. X X X

f. X X X

g. X X X

Circular No.3G

Copy of :

GOVERNMENT OF ANDHRA PRADESH

ABSTRACT

Irrigation – Integrated Tribal Development Agencies of Visakhapatnam, East Godavari, West Godavari, Khammam, Adilabad and Warangal Districts – Sanction of Minor Irrigation Schemes taken up by Integrated Tribal Development Agencies as full contribution works – Waiver of percentage return – Orders – Issued.

IRRIGATION AND POWER (IRR.I) DEPARTMENT

G.O.Rt.No. 1700 Dated: 16-12-1976.

Read the following

1) Govt. Memo No. 2500/Ir.I-1/73-7,dt. 1-12-1973.

ORDER:

1) The Government after careful consideration order that the Minor Irrigation Schemes proposal to be taken up and financed by the Integrated Tribal Development Agencies of Visakhapatnam, East Godavari, West Godavari, Khammam, Adilabad and Warangal District be treated as full contribution works and exempted from the financial return fixed in G.O.Ms.No.21 Irr.&Pr. Dept. dt. 16-1-1976 and G.O.Ms.No.218 Irr & Power Dept. dt. 23-3-1976 and that both administrative and technical sancation be accorded by the Chief Engineer (Minor Irrigation).

2) This order issues with the concurrence of Finance and Planning (Exp. PWD) Dept., vide U.O.No. 3970/2126/76-1 dt. 23-11-1976.

(By order and in the Name of the Governor of Andhra Pradesh)

M.V.S. PRASADA RAO,
Deputy Secretary to Government.

Circular No.4G

Copy of:

GOVERNMENT OF ANDHRA PRADESH

ABSTRACT

Irrigation – MI – Schemes taken up in Tribal Areas – Exemption from Financial return criteria – Orders – Issued.

IRRIGATION AND POWER (IRR.I) DEPARTMENT

G.O.Ms. No.370, Dated: 30-4-1977.

Read the following:

1) G.O.Rt. No.1700 Irr.&Pr.Dept., dt. 16-12-1976.
2) From the C.E.(M.I.) Lr. No. Spl. Cell/83298/76, dt. 17-1-1976.

ORDER :

1) The Government, after careful consideration, order that the orders issued in the G.O. read above be extended to all Minor Irrigation Schemes taken up in tribal areas

2) The Government further direct that both administrative and technical sanction to Minor Irrigation Schemes in tribal areas be accorded by the authority components under the rules in force in this regard.

3) This order issued with the concurrence of Finance and Planning (Exp. PWD) Department vide U.O.No. 1088/651/77-1 dt. 14-4-1977.

(By order and in the Name of the Governor of Andhra Pradesh)

M.V.S. PRASADA RAO,
Deputy Secretary to Government

Circular No.5 G

Copy of :

GOVERNMENT OF ANDHRA PRADESH

ABSTRACT

IRRIGATION – Minor irrigation –Scarping of criteria on percentage Revenue return and taking up of Minor Irrigation Schemes on benefit cost ratio – Orders – Issued.

IRRIGATION AND POWER (IR.VI) DEPARTMENT

G.O.Ms.NO. 482 Dated: 14th July, 1978

Read the following:

1) G.O.Ms.No. 707 Public Works Department dated 20-5-1971.
2) G.O.Ms.No. 21 Irrigation and Power Department dated 16-1-1976.
3) G.O.Ms.No. 218 Irrigation and Power Department dated 23-3-1976.
4) G.O.Ms.No. 134 Irrigation and Power Department dated 19-2-1977.
5) G.O.Ms.No. 135 Irrigation and Power Department dated 19-2-1977.
6) From the Chief Engineer (Minor Irrigation) letter No. P2/11219/75, dated 2-7-1977.
7) G.O.Ms.No. 958 Irrigation and Power Department dated 19-12-1977.
8) From the Commissioner of Land Revenue Letter No.21/834/77, dated 14-9-1977.

ORDERS :

1. In the Government orders cited, Government have issued orders from time to time prescribing rates of percentage of revenue returns as criteria for taking up Minor Irrigation Schemes both in scarcity and non-scarcity areas.

2. The Government have also prescribed Rs. 700 (Rupees seven hundreds only) per acre as monetary norm for the tank restoration schemes under the Minor Irrigation Programme.

3. The Chief Engineer, Minor Irrigation has suggested to Government that the Minor Irrigation Schemes may be ordered to be taken up based on benefit cost ratio scrapping the percentage of revenue return criteria as the benefit cost of ratio facilities taking up of more Minor Irrigation Schemes in future in the state. He has suggested the following benefit cost Ratio.

	At 5% Interest	at 10%
1) Scarcity areas	1.5	1
2) Non-scarcity areas	2.5	1.5

4. Regarding restoration of tanks, the Chief Engineer, Minor Irrigation has suggested the present norms of Rs. 700 per acre be raised to Rs. 1,000 (Rupees one thousand only) per acre as the labour charges cost of material and transportation charges have gone up further by about 20% to 30% in recent times.

5. The Government after careful examination of the proposals of the Chief Engineer (Minor Irrigation) in consultation with the Commissioner of Land Revenue direct.

(i) That the Minor Irrigation works be exempted from the criteria of minimum percentage of revenue return, and

(ii) That the cost benefit ratio, shall be at least 1.5 in non-scarcity areas and 1 (one) in scarcity areas adopting 10% as interest rate to be reckoned for calculating benefit cost ratio.

(iii) That in regard to restoration of Minor Irrigation Tanks, the present norm of Rs. 700/- (Rupees seven hundred only) per acre be raised to Rs. 1,000/- (Rupees one thousand only) per acre.

This order issues with the concurrence of Finance and Planning (Exp.P.W.) Department vide their U.O. No.1634/FRSE/78, dated 31-5-1978.

(By Order and in the Name of the Governor of Andhra Pradesh)

K. KOSALARAM,
Joint Secretary to Government

Circular No. 6G

GOVERNMENT OF ANDHRA PRADESH

IRRIGATION & POWER DEPARTMENT

Memo No. 1536/Irr.VI.2/80-4 Dt. 13-3-1981.

Sub:- Minor Irrigation – Mahabubnagar District – Achampet taluk Amarabad (V) restoring L.B. Lokeswaram tank – Revenue option clarification – Issued.

Ref: 1) G.O.Ms. NO. 1700. Irrgn. & Power dated 16-12-1976

2)G.O.Ms. NO. 370. Irrgn. & Power dated 30-4-1977

3) G.O.Ms. NO. 1700. Irrgn. & Power dated 14-7-1978

4)From the Collector, Mahabubnagar Lr. No.C7/737/79 dt. 11-8-1979.

5)From the Commissioner of Land Revenue, Hyd. Lr. No.Z1/2462/79 dt. 29-10-1979

In the G.O. first cited read with the G.O. second cited, Government have exempted all the Minor Irrigation schemes situated in Agency and Tribal areas in the State from the Criteria of minimum percentage of Revenue return. Subsequently in the G.O. third cited, Government issued orders disposing with the criteria of minimum percentage of Revenue return and introduced the criteria of cost benefit ratio for all Minor Irrigation schemes in the State. The Commissioner of Land Revenue has sought clarification whether the Minor Irrigation schemes in Tribal and Agency areas are exempted from the minimum cost benefit ratio or not and whether the norm of Rs. 1000 per acre in respect of tank restoration schemes is applicable to the Tribal and Agency areas or not.

Government have examined the point raised by the Commissioner of Land Revenue and hereby clarify that the orders issued in the G.O., third cited do not apply in the case of Minor Irrigation schemes proposed to be taken up on Tribal and Agency areas. The exemptions granted in the G.O. first and second cited shall continue to apply in respect of all Tribal schemes. The change being the cost benefit ratio instead of minimum percentage of revenue return.

R.K. SUROYA
Special Secretary to Government

CIRCULAR NO. 7G

GOVERNMENT OF ANDHRA PRADESH

Copy of

ABSTRACT

CODES – A.P.W. 'D' Code – Benefit cost ratio for taking up Minor Irrigation Schemes – Amendment to para 375 of the A.P.W. 'D' code – Issued.

TRANSPORT, ROADS AND BUILDINGS (CI) DEPARTMENT

G.O. Ms. No.216 Dated 30-6-1981.

Read the following:-

1) G.O.Ms.No.482, I&P Dept., dated 14-7-1978.
2) From A.G., A.P. Lr. No.WMC/A/15-243/232, dated 17-10-1978.
3) From C.E. (MI&GL) Lr. No. Rc. MS2/101978/79-1 dated 7-5-1980.
4) From A.G.,A.P. Lr. No. W. MC/A/15-243/171, dated 20-8-1980.

ORDER:

In pursuance of the orders issued in the G.O. first read above, the following amendment to para. 375 of the A.P.W. 'D' Code is issued:-

AMENDMENT

Insert the following as sub paras i. (a) and (b) under para 375 of the A.P.W. 'D' Code:-

i. (a) "Minor Irrigation works are exempted from the criterion of minimum percentage of revenue return. The benefit cost ratio In their cases shall be atleast 1.5 in non-Scarcity areas and one (1) in scarcity areas adopting 10% (ten percent) as interest rate to be reckoned for calculating benefit cost ratio.

j. (b) "In regard to restoration of Minor irrigation tanks, a maximum limit of Rs. 1,000 per acre shall be adopted for arriving at the cost of the estimate".

This order issues with the concurrence of Finance and Planning (Exp.P.W.D) vide-their U.O. Note 1061/405, dated 12-6-1981.

(BY ORDER AND IN THE NAME OF THE GOVERNOR OF ANDHRA PRADESH).

K. SATYA RAJU
Dy. Secretary to Government

CIRCULAR NO. 8G

Copy of

GOVERNMENT OF ANDHRA PRADESH

IRRIGATION DEPARTMENT

Memorandum No.2083/Irr.VI-1/83-3, Dated 25-1-1984.

Sub: PWD Review on implementation of Special Component plan by the High Level Co-ordination Committee on 12-10-1983 in the Committee Hall of Secretariat Schemes to be included in the Special Component Plan/Tribal sub-plan-clarification – Issued.

Ref: From the C.E., Medium & Minor Irrigation Lr. No. Spl. Cell/ MI. Tribal /AE1 /81561/Vol.14, dt. 22-10-1983.

1) The Chief Engineer (Medium Irrigation and Minor Irrigation) is informed that during discussions in the meetings on Special Component plan it was made clear that 15% funds have to be carmarked under Special Component Plan and to be spent fully. The allocation under Special component plan for 1938-84 is Rs. 150 Lakhs out of the plan provision of Rs. 1000 lakhs for Minor Irrigation. As thousands of acres of Government waste land have been assigned the S.Cs and large extent of surplus lands were also given to them in the Districts it is not too difficult to find out blocks of land with 51% extent of land owned by S.Cs.

2) There is a Speciall Cell in each district, headed by the District Collector, with Joint Collector as Vice-Chairman, and Heads of Departments at district level implementing Special component plan as Member. Therefore, the District Collectors, can be requested to co-ordinate the works at District level for finding out blocks of land belonging to S.Cs for providing Minor Irrigation facilities. The Officers of the Social Welfare Survey and Settlement Panchayat Raj and Revenue Department should also be involved in this work along with the Officers of Minor Irrigation Department.

3) It is found during the tours and field visits in the Districts that there is considerable demand for providing Irrigation facilities to the lands belonging to S.Cs. If the officers made effort and contact the Scheduled Caste Leaders, it is not difficult to find the blocks of lands for implementation of the scheme under Special Component Plan.

4) As regards the points raised by the Chief Engineer (Minor Irrigation) in his letter cited, the following clarifications are issued:-

Point I – Improvements, Special repairs, additions and alterations, in the existing irrigation system to stabilize the existing ayacut can be taken up under Special Component Plan provided 51% or more of the extent of the land belonging to Scheduled Castes, and benefits are accorded to them and in these works the following items can be taken up:-

i) If the entire ayacut is to be stabilized without new ayacut:

ii) If new ayacut is added to the stabilization of existing ayacut; and

iii) In case of item (ii) above, the extent of percentages of new ayacut, and existing ayacut be indicated for inclusion of the scheme in one of the two plants.

Point II: The ayacut can be treated as part of Special Component Plan if 51% benefits are accruing to Scheduled Castes whether it is located in the plains or in the Tribal Areas.

5. The receipt of this memo should be acknowledged.

K.V. NATARAJAN,
Secretary to Government

8. EXECUTION CIRCULARS (IE TO 13E)

CIRCULAR NO.1E

OFFICE OF THE ENGINEER-IN-CHIEF

IRRIGATION, A.P. HYDERABAD-500 482

Circular Memo No.DCE.II/OT4/SO.IV/Circulars/84, Dated11-10-1984.

Sub: Minor Irrigation – Maintaining Placement Registers at site – Regarding.

It is generally observed that records pertaining to consolidation to Proctor's density and quality control of various components of MI works are not being maintained properly. These are very essential records to check the compaction and quality of work.

The Superintending Engineers are therefore required to issue necessary instructions to field officers for proper maintenance of these records and to produce then during inspection of higher officers.

The Executive Engineers, before commencement of the formation of bunds, should decide the number of passes required by the roller to compact the earth, to Proctor's density, by forming a test bed, rolling the layer and ascertain the number of passes required to get the Proctor's density. This must be indicated in the placement register and signed by the Executive Engineer concerned.

The Section Officer in charge of the work should maintain the placement register wherein he records the number of passes made by the roller on each layer and signed in token of having passed the layer attaining the required compaction.

The Deputy Executive Engineer will test check at least 25% of the layers during his inspection and sign the Placement Register of the relevant place. The Executive Engineer should also check atrandom during his inspection for ascertaining the quality of work and material and note made in the register accordingly.

The Executive Engineer should Certify that only specified material is used for the construction and quality is maintained as per the specifications.

The above instructions are to be followed scrupulously.

The receipt of this Circular may be acknowledged in the 1st instance.

RAGHUVEER CHANDER
Chief Engineer/Minor Irrigation

Circular No.2E

OFFICE OF THE ENGINEER-IN-CHIEF
IRRIGATION WING:A.P.: HYDERABAD

Circular Memo NO. DCE:2/OT3/CHT/45790/84, Dated: 25-10-1984.

Sub: Minor Irrigation works – Execution-conducting permeability Tests – Regarding.

Ref:-

Instance have come to the Notice of the Chief Engineer (Minor and Investigation) that the botton strata of cut-off trenches is not being inspected be responsible officers of the Department before allowing the same to be filled up. As a result of this, seepage is observed after completion of the works.

In order to ensure, that the cut off trench is excavated upto impervious strata and as directed in the approved drawing, it essential to conducted permeability tests by adoption any method which is convenient, say for example, Japanies method which requires very little equipment. It is only after inspection and test by the Executive Engineer, clearance should be given to the field staff for filling up cut-off trench.

Similarly when the formation of bund work is in progress, proctor's density should also be tested properly. A certificate of having performed these tests should be recorded in the registers maintained at site by the Executive Engineer invariably and to be reviewed periodically by the Superintending Engineers.

The Executive Engineers may be directed to procure the equipments required for the above tests and carry with them whenever they go for inspection. The cost of the equipments may be debited to L.S. Provision of any one of the Minor Irrigation Schemes.

The Superintending Engineers should issue necessary instructions to all the Executive Engineers under their control.

The Receipt of this Memo may be acknowledged in the first instance.

RAGHUVEER CHANDER
Chief Engineer/Minor Irrigation

Circular No. 3E

OFFICE OF THE ENGINEER-IN-CHIEF IRRIGATION, A.P., HYDERABAD-500 482.

Circular Memo No.DCE2/OT4/SOIV/Circular/84, Dated: 20-11-1984.

Sub: MI – Review of expenditure on M.I. Works under execution – Regarding.

During review of the expenditure on M.I. works, the Secretary to Government, Irrigation Department, Andhra Pradesh has expressed his displeasure over the meager expenditure incurred in the execution of M.I. works so far, during the current year.

In order to spend the grants allotted, the Superintending Engineers are requested to instruct the field officers to take immediate necessary action and gear up the entire machinery so as to rise to the occasion. Any lapse of the grants under any head will not be tolerated and Superintending Engineers and Executive Engineers will be held responsible for any lapse.

To which the performance, the Superintending Engineers are requested to submit monthly progress reports (in the name cover of Deputy Chief Engineer II) in the following proforma.

Month:- District:-

Sl. No.	Head of Account	Amount allotted	Expr. Upto end of last month		Expr. During the month		Total Expenditure	
			On Estt	On works	On Estt	On works	On Estt	On works
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1.	506 Normal Plan							
2.	506 SC Schemes							
3.	506 Tribal Schemes							
4.	306 MI Schemes							
5.	306 Investigation							

The progress report should reach this office by 5th of the succeeding month, positively.

The receipt of this Circular Memo may be acknowledged.

RAGHUVEER CHANDER
Chief Engineer/Minor Irrigation

Circular No. 4E

OFFICE OF THE CHIEF ENGINEER, IRRIGATION ANDHRA PRADESH, HYDERABAD-500 402.

Circular Memo No. DCE.II/OT4/S.O.IV/Circular/84, Dated 24-11-1984.

Sub: M.I. – Progress on execution of Minor Irrigation – Works costing more than Rs. Ten lakhs – Regarding.

The Superintending Engineers are requested to furnish the physical progress achieved on each component of Minor Irrigation Schemes costing more than Rs. 10 lakhs in the charts enclosed here with. The components of work and other details are enlisted therein. Two charts are to be prepared for each scheme and made into 2 booklets having one chart of each scheme in a Division. One booklet is to be submitted to this office for permanent record and the other is to be submitted to this office by 5th of the succeeding month showing percentage of progress achieved on each component of the work during the month. After review in this office, the booklet will be referred to the Superintending Engineer, for submission of progress during the next month. The chart is divided ten parts into indicating the No.of components of a scheme. The percentage of progress achieved in a month on any component is to be shaded roughly proportionately in the space assigned for it.

It may be ensured that the booklet is submitted to this office by 5th of the succeeding Month, positively.

Receipt of the memo may be acknowledged.

RAGHUVEER CHANDER
Chief Engineer/Minor Irrigation

Circular No.5E

OFFICE OF THE ENGINEER-IN-CHIEF:IRRIGATION: A.P: HYDERABAD-500 482

Circular Memo No. DCE.2/OT4/SO.IV/Circulars/84, Dated: 29-11-1984.

Sub: Minor Irrigation – Verification of site details – Regarding.

It is generally observed that completion of Minor Irrigation Schemes is getting delayed and many deviations are creeping in against the sanctioned provisions mainly due to improper programming of execution and variation in field particulars subsequently.

In order to have a proper check over the progress of execution and to avoid deviation from the sanctioned estimate, following guide lines are herewith communicated.

(1) Immediately after any scheme is administratively sanctioned, the Executive Engineer who will execute the work will personally check G.Ls. of the bund, the leads, classification of soils as site and is borrow, areas and verify whether the same tally with the provisions made in the administrative sanctioned estimate. If any variations are noticed, same may be reported to the Superintending Engineer, for taking action to reconcile the variations.

(2) The estimates are generally prepared based on levels of the centre line of the bund. But before technical sanction, cross section at closer interval may be taken and quantities of all items worked out and incorporated for technical sanction. A certificate is to be issued by the Executive Engineer in the enclosed proforma.

The receipt of this Memo, may be acknowledged.

EMCL: Certificate

RAGHUVEERCHANDER,
Chief Engineer Minor Irrigation & Investigation

CERTIFICATE

Certified that the levels along the L.S. of bund, leads and clarification of soils along the bund and in the borrow areas have been personally checked by me and I find that the work can be completed with the stipulated provision in the estimate.

Executive Engineer

CIRCULAR NO. 6E.

OFFICE OF THE ENGINEER-IN-CHIEF:IRRIGATION : AP : HYDERABAD-500 482.

Circular Memo No. DCE.2/OT4/SO. IV/Circulars/84, Dated: 29.11.1984.

Sub : Minor Irrigation Programme and progress of Execution of Minor Irrigation works – Regarding.

The Superintending Engineers are informed that the programme of execution stipulated in the A.B. should reveal the percentage of work to be done in the particular month of Calendar year, rather than just some percentage for 1st three months etc

At the same time, the minimum labour required to achieve the programme should be worked out and indicated in the A.B. against each period. If there is any lapse on the part of the contractor to employ the required number of labour, necessary action in terms of A.B. should be taken.

On completion of any work, the concerned Revenue authorities should be notified, giving details S.No. wise particulars for which water is going to be released, for publication in the district gazette, under intimation to Chief Engineer Minor Irrigation.

The above instructions are to be followed strictly.

Receipt of the memo may be acknowledged.

RAGHUVEER CHANDER
Chief Engineer/Minor Irrigation

CIRCULAR NO. 7E.

OFFICE OF THE ENGINEER-IN-CHIEF:IRRIGATION : AP : HYDERABAD-500 482.

Circular Memo No. DCE.2/OT4/SO. IV/Circulars/84, Dated: 29.11.1984.

Sub : M.I-Inspection of M.I. works by Superintending Engineers and Executive Engineers during execution – Regarding.

The Superintending Engineers are requested to inspect atleast 4 different works in a month and issue inspection notes which should critically discuss the qualitative aspects and quantitative progress reasons and remedies.

Similarly the Executive Engineers are expected to inspect at least 8 different works in their jurisdiction and issue inspection notes which are to be marked to Chief Engineer for information.

The Superintending Engineers are requested to comply with the above instructions strictly and the Executive Engineers also may be instructed for strict compliance.

Receipt of the memo may be acknowledged.

RAGHUVEER CHANDER
Chief Engineer/Minor Irrigation

Circular No. 8E

OFFICE OF THE ENGINEER-IN-CHIEF, IRRIGATION WING-A-P., HYDERABAD

Memo No. DCE II/OT4/SO IV/Circular/84 Dated 13-7-1985

Sub: Monthly progress of ongoing Schemes (Proforma prescribed) – Regarding.

Ref: This Office Memo No.DCEII/OT4/SOIV/Circular/84, dated 24-11-1984.

In the reference cited a proforma was prescribed for submitting the monthly progress reports of ongoing Minor Irrigation Schemes. The field staff expressed that this could be simplified and the details obtained directly from the section Officer, level in order to have a promptness. A revised proforma in the formation enclosed may please be followed in future.

This proforma is rather simple and could be filed up by the Section Officer based on his assessment and sent to the Chief Engineer directly with copies to his Deputy Executive Engineer etc. Items 1 to 8 describe only details of the scheme and will not undergo any change month to month. Items 9 to 19 would indicate the percentage of progress till the end of the month (cumulative) and will have to be noted every month accordingly based on the assessment of the Section Officer. Items 20 to 22 pertain to dates of Inspection of the inspecting Officers and the same may be indicated, whenever such inspections are undertaken from the commencement of the work and also repeated in every monthly return. This information is not needed if the inspections are more than one year old.

CHIEF ENGINEER

Minor Irrigation

PPROGRESS ON ONGOING MI SCHEMES

1) Name of work
2) Name of the Executive Engineer
3) Name of Deputy Executive Engineer
4) Name of the Section Officer

5) Distance of work, from the headquarters of the S.O.

6) Date of commencement of work

7) Probable date of completion

8) Latest estimated cost

9) Ayacut contemplated

i) New
ii) Stabilizations

INDEX FOR COMPONENETS OF WORK :

10) Land acquisition

11) Obstruction removal

12) Completion of weir upto G.L.and sluices

13) Excavation of foundations for bund

14) Raising bund on flanks

15) Raising bund on gorge portion

16) Excavation of irrigation channels and distributories

17) Construction of weir above G.L.

18) Excavation of field channels

19) Expenditure incurred so far

20) Dates of inspection by SE

21) Date of inspection by EE

22) Dates of inspection by Dy.Executive Engineer.

Circular No. 9E

OFFICE OF THE ENGINEER-IN-CHIEF I.D. IRRIGATION WING ANDHRA PRADESH HYDERABAD-500 482

Memo NO. D.C.E.II/OT4/Circular/84, Dated: 23-9-1985.

Sub: Requires to Minor Irrigation sources making borrow area pits in the tank bed standard method – Regarding.

Ref: 1. A.P.S.S.NO. 303, 3.2.2.

2. Circular No. DCE/MI/OTI.T4/48369/85-8, dated 13-80-1985.

Repairs works for M.I. tanks are being carried in a turn of five years for every tank. These repairs frequently involve excavation of borrow pits in the tank bed for obtaining earth to make up to T.B.L. etc. In several cases, it is noticed that the borrow pits are located very close to the toe of the bund and at times right on the toe itself. A minimum clearance of 10 H may be provided as already circulated in this office Circular No. DCE. MI/OT1/T4/48369/85-8, dated 13-8-85 and as contained in A.P.S.S.NO 303,3.2.2. In order to check malpractices and confusion in measurements, the borrow area pits should be provided to conform to a standard size of 6 mx3 mx0.6m. These pits should not be made in already excavated pits and should be seen conspicuously. A diagonal thandu may be left in such pits in order to facilitate proper check measurements. In order to insist upon this instruction to be complied, a condition regarding this may be suitably incorporated in the agreement. For clarity sake this condition can be as indicated below:

"The borrow pits for the earth taken up from the bed of the tank, shouldbe at a distance of minimum of 10 times the height of the bund from the toe of the bund. The dimension of borrow pits should conform to the standard size of 6 m x 3mx 0.6m, with a diagonal thandu left in the pits for proper check measurements". Any borrow pit not conforming to the above standard pit size will not be measured.

T. HANUMANTHA RAO
Chief Engineer, Minor Irrigation

CIRCULAR NO. 10E

OFFICE OF THE ENGINEER-IN-CHIEF IRRIGATION, A.P., HYDERABAD.

Circular Memo. No. DCE.II/OT3/SOIII/75732/85, *Dated: 2-1-1986.*

SUB:- Minor Irrigation acceptance of tender other than lowest – Regarding.

The Superintending Engineer, Irrigation Circle, Nellore has recently accepted some tender other than lowest on the ground that rates quoted by the lowest tenderers are not workable and that the tenderers are not financially sound and capable to do the work and also on the ground that the lowest tenderers have not furnished the Addl. Security deposit etc.

In all such cases where the tenders other than lowest are accepted, it is observed that for financial issues are involved.

It is therefore suggested that the Superintending Engineers and Executive Engineers while accepting the tender other than lowest should follow the following instructions so as to safe guard the Government interest.

1. They should accept the 1st lowest tender as far as possible and if not:

2. They should negotiate with the 2nd lowest tender at least to that of the 1st lowest.

3. They should fully justify the financial capacity and workability of the contractor with reference to their earlier performances.

4. The tenderer who backed out after the acceptance of his tender should be dealt suitably interms of G.O.Ms.No. 524, Irrigation (Project Wing), dated 1-12-1984 and his record maintained.

5. The Superintending Enigneers should invariably notify in the tender notice with regard to the depositing of Addl. Security deposit as suggested in this office Memo.No. OT1/SOIII/33894/84, dated 10-10-1984, addressed to Superintending Engineer, Irrigation Circle, Nizamabad which reads as follows.

“The tenderer who quotes less than (-) 10% will have to deposit a further security deposit equal to the amount of difference between (-) 10% and the percentage quoted”.

The receipt of this Circular Memo. May be acknowledged in the first instance.

T.HANUMANTHA RAO
Chief Engineer : Minor Irrigation

Circular No. 11E

OFFICE OF THE CHIEF ENGINEER : MINOR IRRIGATION : HYDERABAD A.P.

NOTE

FIELD INSTRUCTIONS GIVEN BY THE CHIEF ENGINEER :

The Original copy pertaining to Field instructions will be handed over to the concerned Executive Engineer at site. The Executive Engineer will keep this in records of the Division Office and communicate copies of these instructions to Superintending Engineer, Executive Engineer, Deputy Executive Engineer and Section Office.

The carbon copy will be in the permanent record of the Chief Engineer's Office. Concerned Deputy Chief Engineer in Chief Engineer's Office will make copies for recording in the subject file. Inspection Notes File and also for sending one copy to the Secretary to Government, Irrigation Department. For all references, the machine printed serial number and date will be quoted.

T.HANUMANTHA RAO

Chief Engineer : Minor Irrigation

Endorsement No. DCE (MI)/OT.1 T4/61826/85, dated: 14-4-1986

Copy Communicated to all the Superintending Engineers and Executive Engineers.

Circular No. 12E

OFFICE OF THE ENGINEER-IN-CHIEF IRRIGATION WING-A.P.-HYDERABAD.

Circular Memo. No. DCE-II/OT3/SOIII/75732/85, Dated: 21-4-1986.

SUB:- Minor Irrigation – acceptance of tender other than lowest amendment issued – Reg.

REF:- 1. This Office Circular Memo. No. DCE-II/OT3/SOIII/75732/85, Dated: 2-1-1986.

2. This Office Circular Memo. No. DCE-II/OT3/SO-III/75732/85, Dated: 17-2-1986.

In para 5 of the circular 1st cited instruction were issued to collect further security deposit equal to the amount difference between (-) 10% and the percentage quoted.

Same of the Superintending Engineer have represented that the above limit of (-) 10% may be enhanced to (-) 15% or 20% for better competition. After examining the issue it is agreed to increase the limit to (-) 20%. Therefore the para 5 of the circular 1st cited is modified as follows the tender who quotes less than (-) 20% will have to deposit a further security deposit in the shape “demand draft or bank guarantee equal to the amount between (-) 20% and the percentage oted at the time of agreement”.

The receipt of this circular may be acknowledged.

T.HANUMANTHA RAO

Chief Engineer : Minor Irrigation.

CIRCULAR NO. 13E

OFFICE OF THE ENGINEER-IN-CHIEF IRRIGATION WING, A.P.-HYDERABAD.

Circular Memo. No. DCE.2/OT4/79126/75, dated: 16-6-1986.

SUB:- Minor Irrigation Tanks – Maintenance of works Non Plan Grant – Regarding.

REF:- This Office Circular Memo. No. OTI/79126/75-1, Dated: 9-12-1975.

Maintenance of Minor Irrigation Sources is an important activity to keep the structures in good condition for impounding the storage upto F.R.L. safety and to dispose off the flood discharge satisfactorily. Every year grants are allocated at the rate of Rs. 20/- per acre for carrying out the repairs and maintenance of these structures properly and in time. Instructions were also issued in this office reference cited to this effect. It may be ensured that proper maintenance schedule is drawn up such that each tank will have its maintenance at least once in 4 or 5 years. However breaches to bund, special repairs to weirs and surplus courses, may have to be attended to, out of turn, in order that these works are properly maintained and kept in good shape.

Of late it is noticed that there are several complaints from various sources including peoples representatives and important officials that the maintenance is not being carried out in several cases properly. Cases pertaining to fraud, over measurement on works, etc. are also being reported in quite a few instances. The maintenance works normally are petty and minor but yet the number of the same is very large and are located in a wide spread area and also in remote places. Proper supervision of these works will go a long way in maintaining the quality and quantity standards. The measuring officer and check-measuring officers have any way to inspect these works, before any payment can be made and hence it is imperative that frequent inspections are made by these officers to check the quality and quantity. In order to streamline these inspections it is proposed to evolve a proforma for the inspections of check-measuring officers. Whenever works are in progress, the Deputy Executive Engineers should frequently inspect & should record their observations in the cyclostyled proforma enclosed. Inspection notes regarding progress made, quality of work, remarks etc may be recorded by the S.D.O. in this cyclostyled proforma using carbon paper (one original and one copy). The original will be kept in the records of the Sub. Division and the copy would be enclosed by the Section Officer

along with the bill. The proforma should indicate the type of work in progress, quantity of work done, quality of each work, defects noticed, instructions regarding rectifications, remarks to be followed by the section officer for the further work and any other relevant details.

T.HANUMANTHA RAO

Chief Engineer : Minor Irrigation.

PROFORMA

1. Name of work:

2. Estimate sanctioned No. and amount:

3. Nature of repairs:

(a)

(b)

(c)

4. Date of Inspection by the S.D.O.

5. When work was started:

6. When expected to be completed:

7. Payment made so far if any:

8. Remarks on work in progress or to be done:

(a) Bund section
(b) Weir body wall
(c) Weir aprons
(d) Surplus course
(e) Head sluice/sluices
(f) Distributory /Field channels
(g) Cross masonry works
(h) General.