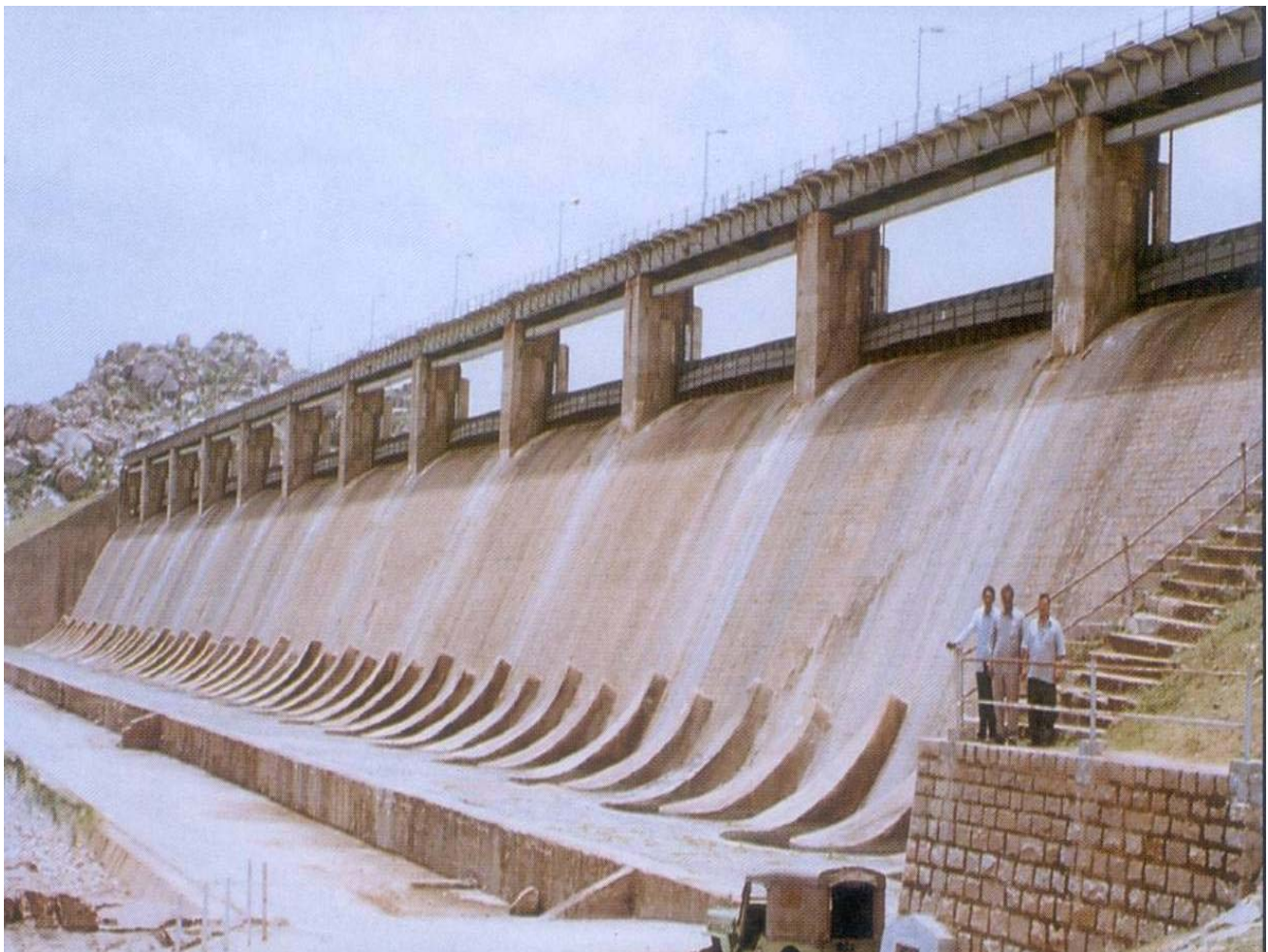




GOVERNMENT OF ANDHRA PRADESH  
WATER RESOURCES DEPARTMENT

## GUIDE LINES FOR PREPARATION OF DESIGNS AND DRAWINGS OF IRRIGATION STRUCTURES



**CENTRAL DESIGNS ORGANISATION**

MAY-2015

V. Sudhakara Rao  
DEE



# **INDEX**

<b>S.NO.</b>	<b>NAME OF STRUCTURE</b>
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**GOVERNMENT OF ANDHRA PRADESH  
WATER RESOURCES DEPARTMENT**

# **GUIDE LINES FOR SPILLWAY AND NON OVER FLOW DAMS**

**CENTRAL DESIGNS ORGANISATION  
HYDERABAD  
MAY-2015**



## **DAMS ( SPILLWAYS & NON – OVER FLOW ) – GUIDE LINES**

### **GENERAL**

1. A detailed report indicating the proposals with the deviations, if any, should be furnished.
2. A detailed report should accompany the design calculations and drawings and this shall contain.
  - (a) Index Plan showing the location of Project, Towns and Cites nearby, Railways and Road ways, Canal system and Command Area.
  - (b) Report on Hydrology of the Project containing the computation of the Design Flood (PMF/SPF/1000 year/500 year Flood as the case may be ) and the detailed calculations along with the catchments Area Plan.
  - (c) Tail water Rating Curve / Stage Discharge Curve along with longitudinal and cross sections of the river / Stream at closer intervals duly indicating the MFL and OMFL
  - ( d ) Reservoir Standards
  - ( e ) Seismic Zone – Standing committee’s Recommendations on seismic coefficients
  - ( f ) Geological Report along with the Logging of bores, permeability test results etc from the Geological Survey of India.
  - ( g ) General Layout of the Head works.
3. A proper sequence shall be followed while submitting the designs and drawings for clearance.

## **SPILLWAYS – DESIGNS AND DRAWINGS.**

- 1. Design Proposals.**
- 2. Tail water rating curve with Longitudinal sections, cross sections at closer intervals duly marking MFL and OMFL. Computations of flood upto PMF/SPF/MF Discharge including flood routing, if any**
- 3. Spillway cross section ( Maximum Height ) confirmed by model studies ( for Ogee Profile and 'Cd' values )**
- 4. Spillway cross sections at different elevations.**
- 5. (a) General Layout Plan showing all the components of the project and m/s Elevation indicating Tentative Foundation level, Ground Levels, Galleries, Adits, Sump Well and Pump Chambers etc.,  
(b) Sections of Abutments, Wings, returns and Core walls.**
- 6. Foundation Treatment Plan showing**
  - (i) Consolidation Grouting.**
  - (ii) Curtain Grouting – Primary, Secondary, Tertiary**
  - (iii) Filling of Crevices, if any.**
- 7. Energy Dissipation arrangement confirmed by model studies ( at APERL, Hyderabad or CWPRS, PUNE, M.R )**
  - ( i ) R.C.C. Details.**
  - ( ii ) Leading Channel.**
  - ( iii ) Tail Channel.**
  - ( iv ) Drainage arrangement of Energy Dissipators.**
- 8. Foundation Gallery / Inspection Gallery – R.C.C. Details.**
- 9. Transverse Contraction Joint Details.**
- 10. Sump Wells and Pump Chambers – R.C.C. Details.**
- 11. Adits – R.C.C. Details.**
- 12. Stair case Well and Lift Chambers – R.C.C. Details**
- 13. Instrumentation Gallery.**
  - ( i ) General arrangement of instrument viz strain meters, Thermo meters, plumb Bobs, Pore pressure Meters etc.,**
  - ( ii ) R.C.C. Details**
- 14. Embedded parts and Groove sizes / Details for service Gates / Stop log Gates**



**15. River Sluices, if any.**

- ( I ) General Arrangement Plan and Sections.**
- ( ii ) R.C.C. Details.**
- ( iii ) Operation and maintenance Chamber – R.C.C. Details.**
- ( iv ) Embedded parts of Gate Grooves ( Service, Emergency / Stop log )**
- ( v ) Sluice Gate Details**

**16. Ventilation Pipes, formed Drains – Details.**

**17. R.C.C. Details of Intermediate Pier.**

**18. R.C.C. Details of End Pier.**

**19. R.C.C. Details of Pier Cap / Bed Blocks.**

**20. R.C.C. Details of Crest, Glacis**

**21. R.C.C. Details of Divide Walls, Guide Walls, if any.**

**22. R.C.C. Details of Trash Rack, pipe Barrel, Pen Stocks etc., if any.**

**23. Longitudinal Sections of Drainage and Inspection Galleries**

**24. Bank Connections.**

**25. Shot creting for Hill Slopes.**

**26. Walk way / Foot Bridge at Trunnion Level.**

**27. Radial Gates / Vertical Lift Gates.**

**28. Stop Log gates / Elements.**

**29. Hoist Plat form / Equipment Details**

**30. E.O.T / Gantry Crane Details.**

## SPILLWAY, NON-OVERFLOW DAMS

SL. NO	COMPONENT	I.S.CODE No.
1	Reservoir capacity-Maximum flood discharge SPF/PMF/500/1000/year flood and fixing of spillway capacity and considering gate inoperative condition.	5477-1971 11223-1985
2	Site Selection	6966-1989
3.	Permeability in rock below Gravity Dams	11216-1985
4.	In-situ Permeability test	5529-1985
5	Selection of Spill ways and dissipators	10137-1982
6	Foundation treatment –Consolidation Grouting- Pressure grouting	6066-1994
7	Design Criteria of solid Gravity Dams – stability analysis, Load combinations, Loads Factors of safety against sliding Fetch and free board computations	6512-1984
8	Hydraulic design of High Ogee Overflow Spillways Ogee Profile, U/S and D/S Quadrants, computation of Coefficient of discharge, provision of Breast wall etc.,	6934-1998
9	Hydraulic Design of Bucket type Energy dissipator (a) Solid Roller (b) Slotted Roller (c) Trajectory Bucket	7365-1985
10	Hydraulic jump type stilling basins	4997-1968
11	Structural arrangement of energy dissipator for spillways	11527-1985
12	Drainage arrangements of Energy Dissipators, Spacing of contraction joints, size and spacing of half round pipes-details of no fine concrete blocks.	11772-1986
13	Water stops at transverse contraction joints in Spillways, NOF dams and at junctions of galleries	12200-2001
14	Construction of Spill ways-preparation of foundations and anchorage, maximum size of aggregates for different components, blocks lengths etc.,	11155-1994
15	Galleries and other openings in dams –drainage gallery, inspection gallery, instrumentation gallery ,adits ,sump well and pump chambers ,stair wells, lift etc., general and structural design	12966-1990&1992 parts 1&2
16	Curtain Grouting from galleries –spacing ,depth of grouting ,size and inclination of grout holes-pressure of grouts etc.,	11293-1993 Part-2

17	Shear parameters at interface of foundations of Dam with Rock.In-situ shear test on rocks	7746-1991
18	General construction of plain and R.C.C.for dams	457-1957
19	Aggregates ,Fine and Coarse for concrete	383-1997 (reaffirmed)
20	HYSD bars and wires for concrete Reinforcement	1786-1990 (Reaffirmed)
21	Drainage system for gravity dams, their foundations and abutments (a)spacing ,size and depth of drainage holes (b)size of porous concrete and formed drains	10135-1985
22	Earth Quake resistant design of structures seismic zone, and computations, hydrodynamic forces and values at different elevations	1893 - <u>1984</u> part-1-2000
23	Dewatering during construction	9759-1981 (Reaffirmed-1998)
24	Extreme weather concreting (1)Hot weather (2) Cold weather	7861-1975 (Reaffirmed-2002)
25	Temperature control of mass concrete for dams	14591-1999
26	Computation of seepage –provision of sump well and pump chamber-size of sump etc.,	4721-2000
27	Radial gates –radius, trunion level etc.,	4623-2000
28	<u>Instrumentation</u>	
(a)	Location of measuring instruments in concrete & masonry dams.	7436(part-ii)-1997
(b)	Selection ,splicing,installationand providing protection to the open ends of cables used for connecting type measuring devices in concrete and masonry dams.	10334-1982
©	Pore pressure measuring devices Electrical Resistance type cell, Vibrating Wire type cell.	8282-1976,1996 (parts-1&2) (1998-Reaffirmed) (2001-Reaffirmed)
(d)	Deformation measuring devices in concrete and masonry dams: part-1 resistance type joint meters.	10434-1982 (part-1)
(e)	Seismic instrumentation for river valley projects	4967-1968 (2000-RA)
(f)	Instruments for temperature measurement inside dams –Resistance type thermometers	6524-1972 (1998-RA)

	<u>STRUCTURAL DESIGN</u>	
1	Pier,Crest	13551-1992
2	Bucket(roller/trajectory)	7365-1985 11772-1986
3	Galleries,Adits,Sump well and pump chamber Stair well and Lifts	12966-1990(part-2)
4	Stilling basin	11772-1986
5	Training walls and divide walls	12720-1993
6	Air vent pipes	
7	Walkway bridge-steel  Concrete	800-1984 (1998-Reaffirme)- 456-2000
8	Spillway bridge	IRC codes



**GOVERNMENT OF ANDHRA PRADESH  
WATER RESOURCES DEPARTMENT**

# **GUIDE LINES FOR EARTH DAMS**

**CENTRAL DESIGNS ORGANISATION  
HYDERABAD  
MAY-2015**



## **GUIDE LINES**

### **( A) FOR DESIGN OF EARTH DAM/ROCK FILL DAM:**

1. Design proposal with basic parameters /Hydrology
2. Location of the proposed project ,Index plan/Layout plan(For Global co-ordinates, Latitude/Longitude, Maximum wind velocity at project site and Identified Seismic Zone of the Project) Ref. BIS Code 875(Part III )- 1987 and 1893-1984/ (Reaffirmed 2002)
3. General Layout showing all the components of the project ,Geology of the project, Recommendations of GSI along with Log of Bore holes analysis and Permeability test results.
4. Free-Board requirements, Fetch-Fore shore area plan with FRL and MWL contours ( Ref BIS code 10635-1993/Reaffirmed 1998)
5. Maximum section of the proposed dam and cross sections for different heights of 5m along with recommended levels of C.O.T/Grouting pattern.
6. Longitudinal section of dam indicating TBL, Ground profile, Tentative Stripped profile, Reservoir levels, COT level and Grout line.
7. Certifying the suitability, availability of required quantities of soils ,Rip-Rap stone, Filter material etc.
8. Embankment soil properties based on the soil test reports from the Laboratory (APERL or Engineering Colleges ) in formats B1 to B4 in accordance with the Soil Classification (Ref- BIS code 1498-1970/Reaffirmed 2002)
9. Foundation soil properties based on the soil Test reports of the Laboratory (APERL or Engineering colleges in Formats F1 to F4 including Field permeability, Chemical analysis etc .in accordance with BIS Soil classification (Ref: BIS code.1498-1970/Reaffirmed 2002)
10. Design parameters considered in the analysis of section both embankment and foundation (Densities, Shear parameters at OMC/FMC and SMC conditions)
11. Stability of dam section ( U/S slope under Normal & Earth Quake conditions for Sudden Draw down and Down stream slope under Normal & Earth quake conditions for Steady seepage ) (Ref- BIS code no 7894-1975 / Reaffirmed 1997)  
Note: The relevant slope stability calculations shall be checked and furnished
12. Effect of TWL on D/S side of Earth dam and the measures proposed to protect D/S slope including adequate surplus arrangements proposed for the project up to safe distance based on the model studies
13. Slope protection to Earth/Rock fill dam.
  - a. Under seepage control measures (Cut-off trench, Grouting, diaphragm wall etc.) Ref.BIS code 8414-1977/Reaffirmed 1999
  - b. Drainage arrangements including Inclined /Horizontal filters within the dam and other drainage measures like Rock toe, Toe drain, Filters below UP stream rip-rap etc. Ref. BIS code 9429-1999
  - c. Slope protection measures (U/S rip-rap, D/S Turfing etc.) Ref BIS code 8237-1985/Reaffirmed 1999
14. Provision of additional measures of protection to earth/rock fill dam like Parapet, Guard stones at TDL, Chute drains on D/S slope profile walls on U/S, Measures of surface drainage like Longitudinal drains etc. (Ref BIS code 8237-1985/Reaffirmed 1999)
15. Designed section of Earth /Rock fill dam in drawing to a suitable scale showing all the features pattern of grouting etc. drawn in LS of the dam and Specification Notes
16. Necessity of Instrumentation in the dam ( Ref BIS 7436-(Part1) 1993/Reaffirmed 1998)

## **B FOR DESIGN OF HEAD SLUICE**

The following basic parameters are required to take up the design of head sluices in Earth/Rock fill dam.

1. Hydraulic particulars of the main canal in the head reach up to 1000m
2. MDDL of the reservoir to check the availability of minimum driving head
3. SILL level of the sluice in conformity with canal bed level
4. Highest command level to examine the suitability of SILL level of the sluice proposed
5. Location of the sluice to study whether the barrel is in cutting or not.
6. Discharge required to be taken for fixing vent size of the sluice
7. Trail pit details along the axis of sluice to study foundation stratification
8. Cross section of Earth dam at Location of the sluice
9. Net-level plan at sluice location for a grid of 200X200 m (i.e 100m to Left & Right and 100m U/S & D/S of sluice)

## **C REFERENCE BIS CODES**

1. BIS Code no 875-(Part III) 1987 and 1893-1984 (Reaffirmed 2002) Design Loads other than Earth Quake for Buildings and Structures and Earth quake analysis of the structures
2. BIS Code no 10635-1993/Reaffirmed 1998-Guide Line for Free-board requirements in Embankment dams-Guide Lines
3. BIS Code 1498-1970/ Reaffirmed 2002/ Classification and Identification of soils for General Engineering purposes
4. BIS Code no 7894-1975 ( Reaffirmed 1997)- Code of practice for stability analysis of earth dams
5. BIS Code 8414-1977 (Reaffirmed 1999) Guide Lines for Design of Under seepage control measures for earth and rock fill dams
6. BIS Code 9429-1999. Drainage system for Earth and Rock fill dams- Code of practice.
7. BIS Code no 8237-1985/ (Reaffirmed 1999) Code of practice for Protection of Slope for Reservoir Embankment.
8. BIS Code no 7436(Part I)-1993/ (Reaffirmed 1998) Guide for Types of measurements or structures in River Valley projects and criteria for choice and location measuring instruments Part I – For Earth and Rock fill dams
9. BIS Code 7356(Part I) -1992/Reaffirmed 2002- Code of Practice for Installation, Maintenance and Observations for pore pressure measurements in Earth dams and Rock fill dams Part I- Porous tube piezometers and Part II. Twin tube hydraulic piezometers BIS Code 7356(Part II) - 1993/Reaffirmed 1998.
10. BIS Code no 7500-2000 – Code of Practice for installation and observation of cross arms for measurement of internal vertical movement of instruments in Earth dams.





**GOVERNMENT OF ANDHRA PRADESH  
WATER RESOURCES DEPARTMENT**

## **GUIDE LINES FOR APPROVAL OF CANAL ALIGNMENT AND HYDRAULIC PARTICULARS**



**CENTRAL DESIGNS ORGANISATION  
HYDERABAD  
MAY-2015**



## **GUIDE LINES FOR APPROVAL OF CANAL ALIGNMENT AND HYDRAULIC PARTICULARS**

S.No. 1	ITEM/COMPONENT 2	REFERENCE 3
<b>I</b>	<b><u>GENERAL:</u></b>	
1	A brief note on original proposals and Agency's modification if any.	
2	The canal alignment shall be submitted after thorough examination of the alternatives duly marked with the recommended alignment and certificate to that effect shall be issued by the concerned SE/CE.	
3	Index plan showing the head works and canal alignment depicting on S.I sheets.	
4	H Ps at beginning and at reach end of canal in case of packages. The HPs must be submitted in sequence starting from head reach to subsequent packages.	
5	All the proposals must be scrutinised and verified in respect of levels and relevant information before communicating to CDO by the CE/SE. (A check slip is enclosed for guidance).	
6	Catchment Area of drains/rivers and the assessed MFD shall be indicated at CD works in the LS.	
<b>II</b>	<b><u>SITE SURVEY:</u></b>	
1	Site survey shall be furnished as per the stipulated check slip (copy enclosed) with Report accompanying the alignment & H.Ps .	Check slip & IS:5968-1987
<b>III</b>	<b><u>DESIGN CONSIDERATIONS &amp; DESIGN CALCULATIONS:</u></b>	
1	<b>CANAL DISCHARGE:</b>	
a	Authenticity /supporting calculations for arriving at canal discharge considering seepage & transmission losses as per Modified penman method.	IS:7112-1973 & IS:10430-2000, CBIP Publication No.171
b	If there is any provision for drinking and industrial water supply, along its service line (canal alignment) the same may be added duly considering losses.	
2	<b>CANAL SECTION:</b>	
a	b/d ratio:	
i	Simple conveyor system( where there is no command), it is preferably of range 2 to 3 .	CWC recommendations in Technical Report No.7 of C.B.I.P and IS-7112-1973
ii	Canal with command, the b/d ratio is preferably of range 5 to 8 or even higher depending on the terrain.	
b	critical velocity ratio $V/V_o$ :	C.B.I.P 171, IS-10430-2000
i)	Diversions, silt carrying unlined canals $V/V_o$ shall be 1.1 - 0.90 ( head - tail end).	
(ii)	Lined canals, $V/V_o$ higher than unity is preferable to avoid any silting.	
c	coefficient of rugosity 'n' (Irrespective of the discharge): The following values are recommended : Lined canal- 0.018 Normal alluvial soils- 0.0225 Murum- 0.025 Rocky strata- 0.03-0.035	IS-7112-1973 and IS-10430-2000

1	2	3
d	Allowable velocities:-	C.B.I.P 171
I	Unlined canals - Recommended Velocities :	Technical Report No.7 of C.B.I.P
1	All Soils 0.6 to 1.1m/sec	
2	Hard clay or grit 1.0 to 1.5m/sec	
3	Gravel and shingle 1.5 to 1.8m/sec	
4	Cemented gravel conglomerite,hard pan 1.8 m/sec	
5	Soft Rock 1.4 m/sec	
6	Hard rock 2.4 m/sec	
7	Very Hard Rock 4.5m/sec.	
II	Lined canals- For CC lining max. permissible velocity- 2.7m/s	IS-10430-2000
e	side slopes:inner and outer a)canal in cutting 1.5:1 b)canal in banking 2:1(inner)/2:1(outer) c)canal in rock 0.5:1/0.25:1 (According to classification of rock)	IS-7112-1973 and IS-10430-2000
f	Free Board:	IS-7112-1973 and IS-10430-2000
g	Berms:In deep cut reaches, it is desirable to have 1st berm at FSL+FB and at around 5m ht. for the subsequent depth. A minimum berm of 3m. Wide on each side shall be desirable to reduce bank loads, for stability, facility of maintenance, silt clearance etc. preferably at 5m depth intervals which can be upto 7.5m at the ground level.	IS-7112-1973 and IS-10430-2000
h	Dowels:Dowel banks are recommended on both the banks and it shall be as per IS standards	IS-7112-1973 and IS-10430-2000
i	Bank Top Widths: Unlined and Lined canals : Discharge(m <sup>3</sup> /sec) Minimum Bank Top Width ( m ) Inspection bank/ wider bank Non Inspection bank /Other bank ( including dowel ) 0.15 to 3.0 4.0 2.5 3.0 to 10.0 4.0+dowel 2.5 10.0 to 30.0 5.0+dowel 4 30.0 and above 6.0+dowel 5	IS-10430-2000
3	Radii of curvature:may be adopted as per IS 5968-1987. In difficult reaches, 20 times the width of water at FSL is recommended.	IS-5968-1987
4	Hydraulic Grade Line:	IS-7112-1973
5	Catch Water Drains:	IS-7112-1973
6	Roadway and Drainage:	IS-10430-2000
7	Typical Cross Section a) Full Cutting: As per IS code b) Full embankment: As per IS code If the height of embankment is more than 6m, the stability of the bank should be checked by the slope stability analysis as per IS:12169-1987,IS:826-1978,IS:7894-1975 etc. c) Partial cutting & banking: It is recommended to avoid berms but the banking shall be well compacted to the required standards.In case where the GL is at less than or equal to 1/2 FSD, the embankment slopes shall be adopted.	IS:7112-1973 & IS:10430-2000

1	2	3
8	ALIGNMENT:	
a	As far as possible, the alignment may be taken along the FSL contour avoiding higher embankments and deep cuts.	IS:5968-1987,CBIP Publication No:171
b	Change of canal section after 10 to 20% reduction in canal discharge followed by a Cross Regulator.	
c	Propose Cross Regulator / Drop @ change of section or change of bed fall or at maximum interval of 40 km to take care breaching at embankment sections	IS:5968-1987
d	Avoid number of Interchange Points/curves in the alignment so as to have straight alignment.	C.B.I.P Publication No.171
e	Canal drops are recommended where the canal bed slope is flatter than the slope of the ridge.Drops may be located where the canal cutting comes to 1.25 BDC or FSL cutting.	
f	The Sluices at the head of the large distribution channel are recommended to be capable of passing full supply into the distributory with three fourth discharge at head to half supply in the tail end i.e when the parent canal discharge is about 20%. The driving head should not be less than 15cms.. The sill level of the sluice should also be fixed such that they get lower and lower as the location go towards the tail end.	
g	As far as possible, avoid CM and CD works in curves.	
h	As far as possible, avoid canal syphons.	
i	As far as possible, avoid flume sections.	
j	As far as possible, Inlets into canal may be avoided.	
k	Avoid skew crossings of bridges/CM and CD works wherever possible.	
l	No. of Bridges have to be proposed at designated roads, without foregoing the available facility.	
m	Reduce number of CM and CD works by diversions /combining/combining SLBs&DLBs with Regulators/ super passages etc.	
n	The loss of heads recommended for the CM & CD works are as follows (i) Cross Regulators-0.075 to 0.15m. (ii) Aqueducts-0.075mts. to 0.15mts or as per calculations for major drain crossings. (iii) Canal syphons-0.075 to 0.15mts. or as per calculations for major drain crossings. (iv) For bridges (SLB/DLB) & SPs-Loss of head is not permitted. (v) Measuring devices-0.075m.	
o	To finalise type of structure i.e UT/SP/Aqueduct/Viaduct/ Syphon/Inlet with reference to CBL,DBL and ground levels.	
p	To finalise mileage/length of canal along the curve.	
q	To propose Canal Escapes on U/S of embankment reach near river/drain course combined with a Cross Regulator for 50% canal discharge.	IS-6936-1992,C.B.I.P publication No.171

1	2	3
r	Measuring devices are suggested at 40 Km. (where there are no Regulators) for effective water management.	
s	To finalise salient features of drain/river like catchment area, MFD,DBL,MFL,OMFL and bed width of drain/river. The MFD may be finalised as per the formula indicated in the Tender Document / agreement or in general the M F D of drain/river may be finalised as per Dicken's formula/Ryve's or Mithra committee report for upland and deltaic catchments.	
<b>IV</b>	<b>Statements and Drawings:</b>	
a	Hydraulic Particulars Statements:	
1	Detailed Discharge Calculations reachwise.	
2	Design of canal sections reachwise.	
3	Reach wise ayacut statement	
4	HPs statement-Reachwise and structure wise	Proformas of statements enclosed
5	Curves statement	
6	Statement showing Regulators	
7	Statement showing Offtakes	
8	Statement showing Drops	
9	Statement showing Surplus/canal escapes	
10	Statement showing Cross Masonry works	
11	Statement showing Cross Drainage works	
b	LS sheets together with contour site plan indicating TBL/ FSL/CBL/ GL.Reachwise canal sections,T.Ps,H.Ps Reachwise, village boundaries etc. as indicated in the tender schedule or as indicated below.	
	<u>L S Sheets</u>	
	<u>(i)L.S:</u>	
	Horizontal scale        1cm = 20m or 25m	
	Vertical scale        1cm = 1m & 2m in deep cut.	
	In L.S, levels shall be given at 20m or 25m.In structure portion , the levels shall be at closer intervals of 5m.	
	<u>(ii)Site Plan:</u>	
	(1)same as horizontal scale of L.S.	
	(2)contours shall be at 2m interval in hilly areas & 0.3m in plains	
	(3)C/S shall be at 20m or 25m interval with levels at 3m to 5m interval upto a distance of 100m on either side.	
c	Condensed Longitudinal sections in case of Main Canal of Major Projects.	

sd/- 7.01.05  
( I.S.N.Raju )  
Chief Engineer  
Central Designs Organisation

..... PROJECT- HYDRAULIC PARTICULARS OF ..... MAIN CANAL  
FROM KM..... TO KM.....

### CURVE STATEMENT

[illegible]

.....PROJECT - HYDRAULIC PARTICULARS OF ..... MAIN CANAL  
FROM KM. .... TO KM.....

### STATEMENT SHOWING THE DETAILS OF REGULATORS

[illegible]



..... PROJECT - HYDRAULIC PARTICULARS OF ..... MAIN CANAL  
FROM KM..... TO KM.....

**STATEMENT SHOWING THE CROSS MASONRY WORKS**

[illegible]

..... PROJECT - HYDRAULIC PARTICULARS OF ..... MAIN CANAL  
FROM KM..... TO KM.....

**STATEMENT SHOWING THE CROSS DRAINAGE WORKS**

[illegible]

..... PROJECT - HYDRAULIC PARTICULARS OF ..... MAIN CANAL  
FROM KM. .... TO KM.....

**STATEMENT SHOWING THE DETAILS OF DROPS**

[illegible]

..... PROJECT - HYDRAULIC PARTICULARS OF ..... MAIN CANAL  
FROM KM. .... TO KM. ....

### STATEMENT SHOWING THE DETAILS OF OFF TAKES

PARENT CANAL DISCHARGE = CUMECS

BED FALL =

[illegible]

—

CHECK (First F.S.L - Last F.S.L) = Total loss of head

CHECK (First F.S.L - Last F.S.L) = Total loss of head





**GOVERNMENT OF ANDHRA PRADESH  
WATER RESOURCES DEPARTMENT**

**GUIDE LINES FOR PREPARATION OF DESIGNS  
AND DRAWINGS OF CROSS MASONRY AND  
CROSS DRAINAGE WORKS ON CANALS**



**CENTRAL DESIGNS ORGANISATION  
HYDERABAD  
MAY-2015**





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	<b>D)</b> Check Slip to accompany the Site Survey of Infall & Out fall Regulators	35 to 36
	<b>E) i)</b> Table I of APERL Test results.	37
	<b>ii)</b> Table II of APERL Test results	38
	<b>F)</b> CE/CDO's Lr. No. CDO/EEC1/1084/83-3. Dt: 28-03-83.	39
	<b>G)</b> List of reference IS Codes, IRC codes, etc.	40 to 42



# 1. BRIDGES

S.No.	ITEM / COMPONENT	REFERENCE
I	<b><u>GENERAL:</u></b>	
1	The proposals , be scrutinised and verified by the Unit Officers before communicating to CDO for vetting.	
2	Normal Section of Canal to be maintained to the extent possible.	
II	<b><u>SITE SURVEY:</u></b>	
1	Site survey should be furnished as per check slip for Bridges enclosed with the following details.	Check Slip enclosed.
a	Report accompanying the Site survey along with HPs of canal with road details.	As per approved HPs.
b	Site plan along with flow direction of canal, road way angle and direction of skew if any, net levels @10 M intervals and also covering the approaches to a sufficient distance not less than 1/4 km on either side.	IS : 7784 (Part I) : 1993
c	i) LS of canal as per approved HPs ii) L.S of Road Covering 500 metres on U/S & D/S with levels @ 10m intervals.	
d	Important details of road bridge and type of road bridge with carriage way width	
e	Bore hole data / TPs upto Hard strata or for min. depth of 2m for shallow foundations & upto 1/3rd embedment depth below maximum scour depth along the Centre Line @ suitable intervals depending upon the importance of the structure with minimum 3 Nos covering Canal @ centre, right and left sides. Also the safe bearing capacity of foundation strata be furnished.	Table I & II of APERL for test results of foundation soils enclosed. IRC78:2000.
III	<b><u>DESIGN :</u></b>	
a	Note on Principles of Design, the assumptions made & the general features of the structure.	
b	<b><u>HYDRAULIC DESIGN :</u></b>	
1)	Design of ventway	IRC: 5 -1998
2)	The bridge crust level shall be either natural GL or existing road crust level which ever is higher	
3)	Afflux calculations by Molesworth's formula (Max-50mm)	IRC: 5 -1998
	$h = \left[ \frac{v^2}{17.85} + 0.0152 \right] \left[ \frac{A^2}{a^2} - 1 \right]$	

S.No.	ITEM / COMPONENT	REFERENCE
4)	Scour depth calculations $R = 1.34 \left[ \frac{q^2}{f} \right]^{1/3}$ using relevant factor of safety	IRC: 5 -1998
5)	Proposal Sketch.	
<b>c</b>	<b><u>STRUCTURAL DESIGN :</u></b>	
<b>i)</b>	<b><u>SUPER STRUCTURE</u></b>	
a)	Design of Deck slab / Girder	IRC: 6-2000 IRC: 21-2000 For DLRB and Girder bridges adopt MOST drgs / plates
<b>ii)</b>	<b><u>SUB STRUCTURE</u></b>	
1	Piers: Minimum Thickness of Pier shall be 1m.	IRC: 6 - 2000
2	Abutments,Wings / Returns be designed adopting TVA procedure/Coulomb's theory/Rankine's theory adopting top width of 500 mm.	IRC: 78-2000,TVA Hand book, IRC:40-1995
3	Bed blocks in RCC M20 grade (minimum)	IRC :21-2000
4	Type of foundation based on foundation strata available -open/ Raft / Piles	IRC: 78-2000
5	Unless otherwise metioned, the following minimum grades of Concrete are recommended i) RCC - M 20 Grade ii) For DLRB RCC Deck / Girder - M25 Grade iii) CC - M 15 Grade iv) Levelling course - CC M 10 Grade	IRC: 21-2000
5	Protection works on either side of Bridge 100 mm thick CC lining in M10 grade for bed & sides shall be proposed & for a minimum length of 10m on either side of the structure.	
<b>d</b>	<b><u>MISCELLANEOUS ITEMS :-</u></b>	
a)	Approach slab & approaches	IRC: 5-1998 and MOST Drgs.
b)	RCC Kerbs	MOST Drgs
c)	Railling	MOST Drgs
d)	Expansion joints, Constructon & Contraction Joints	MOST Drgs
e)	Drainage spouts	MOST Drgs
f)	Wearing coat (Next higher grade than Deck slab )	MOST Drgs
g)	Ornamental pillaster	
h)	Guide posts or parapets	
i)	Design of Bearings	IRC: 5-1998,IRC:83 Part-I & II

S.No.	ITEM / COMPONENT	REFERENCE
<b>IV</b>	<b><u>DRAWINGS</u></b>	
1	General Layout on net level plan duly showing contours. General Plan, Sectional Elevation & End View - Plan indicating Half plan @Top & Half plan @ bottom & Sectional elevation along the LS & End view along the cross section.	Scale : 1:50, 1:100, (or) 1:200
2	Sections of Piers, Abutments, Wings & Returns	Scale 1:50
3	RCC Slab,Girder details	Scale 1:50 (or) 1: 25 (or) 1: 10
4	Miscellaneous details viz duct wall, railings, drainage spouts,bed blocks,bearings etc.,	Scale 1: 20 (or) 1: 10
5	The Drawings shall contain assumptions made,TPs, specifications HPs of Canal, Bar bending schedule, stress table etc.	

## 2. REGULATORS

S. NO.	ITEM / COMPONENT	REFERENCE
<b>I</b>	<b>GENERAL:</b>	
a	The proposals be scrutinized & verified in respect of levels & relevant information by the concerned Unit Officers before communicating to CDO for vetting.	
b	Location & ayacut details have to be ascertained & confirmed by the concerned Unit Officers.	
<b>II</b>	<b>SITE SURVEY:</b>	
1	The Site survey be furnished as per the check slip	Check slip enclosed.
a	Report accompanying the site survey along with approved HPs of the canal on U/S & D/S of Regulator with typical canal section, list of structures on either side of structure for 3 Kms.	
b	L.S. of the canal for a distance of 1.0 Km.	
c	If the Regulator is clubbed with Road Bridge, mention the Road level and type of bridge i.e., Single Lane or Double Lane bridge.	
d	Approved HPs of off taking distributary in case of O.T. sluice combined with Regulator & mention the ayacut for the O.T., sill level proposed and the heighest field level.	
e	Borehole data / Trial pit particulars up to hard strata or for minimum depth of 2.0m for shallow foundations & up to 1/3 <sup>rd</sup> embedment depth below maximum scour depth for deep foundations with minimum 3 nos T.Ps covering Abutment, Pier and Stilling Basin.	Table I&II of APERL for test results of foundation soils enclosed. IRC: 78 -2000;
<b>III</b>	<b>HYDRAULIC DESIGN :</b>	
a	Note on design features indicating the vents proposed and design considerations etc., for all the components of the structure.	
b 1.	H.Ps of canal on both U/S & D/S.	
2	(i) Fixation of crest level, vent way calculations and crest width, Glacis profile with U/S & D/S slopes with radius of curves.  (ii) Minimum thickness of Pier shall be 1000 mm to 1500 mm.	
	(a) For Head Regulator	IS:6531-1994
	(b) For Cross regulator	IS:7114-1993
	(c) For Escape regulator	IS:6936-1992
	(d) For Bed regulator	Text book of Irrigation Manual by W.M.Ellis

S. NO.	ITEM / COMPONENT	REFERENCE
3	Energy dissipation calculations for determining the cistern level and length of Stilling Basin. These calculations are to be done for various discharge conditions namely for 100%, 75%, 50%, 25%, 15%, 10% and 5% for one gate open, two gates open etc., conditions.	IS: 4997-1968
4	Scour depth calculations  $R = 1.34 (q^2/f)^{1/3}$ with relevant factor of safety	IS:7784 (Part-I)-1993
5	If Road Bridge is combined refer IRC code also.	IRC:78-2000
6	Exit gradient calculations $G_E = (H/d) \times [1/(\pi\sqrt{\lambda})]$ ; Where $\lambda = [1 + \sqrt{(1+\alpha^2)}]/2$ ; $\alpha = b/d$ ;	CBIP-12 & IS:7114 - 1973
7	Design of floor thickness as per Khosla's theory	CBIP-12 & IS:7114 – 1973
8	Protection works on U/S and D/S side.  In case of regulator combined with offtake / surplus escape refer offtake / surplus escape design guidelines issued separately.	IS:7784 (Part-I)-1993
<b>IV</b>	<b>SUPERSTRUCTURE:</b> <ol style="list-style-type: none"> <li>1. D.L.Bridge (OR)</li> <li>2. S.L.Bridge (OR)</li> <li>3. Hoist bridge slab</li> </ol> <p>The top of hoist bridge level shall be tentatively finalized considering crest level + 2 x Ht of gate + free board (0.6 to 0.9m) + thickness of hoist slab subject to confirmation of mechanical drawings.</p> <ol style="list-style-type: none"> <li>4. Design of bearing as given in MOST drawings</li> <li>5. Breast wall wherever necessary.</li> </ol>	MOST drawings, IRC:5-1998, IRC:6-2000, IRC:21-2000
<b>V</b>	<b>SUB STRUCTURE:</b> <ol style="list-style-type: none"> <li>1. Pier, abutment, wings &amp; Returns (with bridge)</li> <li>2. Pier, abutment, wings &amp; Returns (without bridge) and hoist portion</li> <li>3. Wings and returns be designed adopting TVA procedure/Coloumb's theory/ Rankine's theory adopting top width of 500 mm</li> </ol>	IRC:5-1998 IRC:6-2000 IRC:21-2000 and IRC:78-2000  IS: 456-2000, IS: 3370(Part-I&II)-1965  TVA Hand book

S. NO.	ITEM / COMPONENT	REFERENCE
	4 Adequate gate grooves in pier & abutment and provision of sill beam and embedded metal parts shall be made keeping in view Hydro Mechanical Guidelines issued by CDO.	Hydro Mechanical guidelines by CDO.
	5 Foundations for pier, abutment, wings & Returns etc	
	(i) For shallow and open foundation	IS:1904-1986
	(ii) For raft foundation	IS: 2950-1981,Part-I
	(iii) For pile foundation	IS: 2911-1979(part-I Sec 1, 2, 3, 4) IS:2911-1980 (part-II) IS:2911-1980 (Part-III) IS:2911-1985 (Part IV)
	Unless otherwise mentioned, the minimum grade of concrete shall be M 10 for PCC, M 20 for RCC.	
	6.Miscellaneous Items:	
	a) weep holes in retaining walls	IS:7784(part I)-1993
	b) Bearings	IS:7784(part I)-1993
	c) Expansion, contraction & construction joints	IS:3370(part I)-1965
<b>VI</b>	<b>DRAWINGS</b>	
	a) General Layout on net level plan duly showing contours.	
	b) General plan and sectional elevations, plan indicating half plan at top & half plan at foundation level, L.S. along the canal & C/S across the canal along with T.P. particulars.	Scale 1:50 or 1:100 or 1:200
	c) Sections of Pier, abutment, wings and Returns .	Scale 1:25 or 1:50
	d) R.C.C.details of deck slab, hoist slab and other miscellaneous items.	Scale 1:25 or 1:20 or 1:10
	e)The drawing shall contain assumptions made, TPs, specifications, HPs of canal, bar bending schedule (wherever applicable) , stress table etc.,	
	f)To be mentioned specially Hoist Bridge level, gate grooves. A special note shall be inscribed duly mentioning that the gate grooves are indicative and separate Hydro Mechanical Drawing shall be referred for details of Embedded Metal parts and Secondary Concreting.	



### **3. AQUEDUCTS / VIADUCTS**

S.No.	ITEM / COMPONENT	REFERENCE						
I	<p><b><u>GENERAL:</u></b></p> <p>1.The proposals, be scrutinised and verified by the Unit Officers before communicating to CDO for vetting.</p> <p>2.Catchment Area (C.A.) of drains/rivers and the assessed MFD/OMFL be scrutinised, verified and confirmed by the Unit Officers.</p>							
II	<p><b><u>SITE SURVEY:</u></b></p> <p>1 Site Survey to be furnished as per check slip for CM &amp; CD works with the following details.</p> <p>a I ) Report accompanying the Site survey ii ) HPs of canal &amp; drain / river.</p> <p>b Site plan with flow direction of canal &amp; drain with net levels @ 10 m interval &amp; contours.</p> <p>c LS of drain / river.</p> <p>i) Covering 500 metres on U/S &amp; D/S.</p> <p>ii) The LS with levels @ 10m to 20m interval with Cross sections of drain on U/S, D/S @ centre line, 10 m, 25m, 50m,100m, &amp; @ 100m interval beyond for a length of 500m.</p> <p>iii) The Cross section levels shall be @ 3m to 5m interval in the gorge portion and 10m intervals in the flanks extended upto MFL touching the ground.</p> <p>d The catchment area(C.A.) shall be marked on the Topo Sheet for all the C.A.s more than 2.5 Sq. Km. If the C.A. is less than 2.5 Sq.km., the C.A. is to be traversed on ground and to be furnished.</p> <p>e <b><u>M.F.D.CALCULATIONS:</u></b></p> <p>The MFD may be computed as per the following formula.</p> <p><b>1.IN UPLAND AREAS:</b></p> <p>Dicken's Formula, <math>Q = CM^{3/4}</math> where Q = Discharge in Cusecs. M = Catchment area in sq.miles C = Coefficient depending on Catchment area.</p> <table><tr><td>C.A. upto 1 Sq.mile.</td><td>C=1400</td></tr><tr><td>CA from 1 Sq.mile to 30 Sq.miles</td><td>C=1200</td></tr><tr><td>CA more than 30 Sq.miles</td><td>C=1060</td></tr></table> <p><b>(2) IN DELTAIC AREAS :</b></p> <p>Ryve's Formula <math>Q = CM^{2/3}</math> C = 1000 for Q more than 500 cusecs C = 750 for Q less than 500 cusecs</p>	C.A. upto 1 Sq.mile.	C=1400	CA from 1 Sq.mile to 30 Sq.miles	C=1200	CA more than 30 Sq.miles	C=1060	<p>Check Slip enclosed.</p> <p>IS : 7784 (Part I) : 1993</p> <p>CE/CDO Lr No:CDO/EEC1/1084/83-3 Dt.28/3/83.</p>
C.A. upto 1 Sq.mile.	C=1400							
CA from 1 Sq.mile to 30 Sq.miles	C=1200							
CA more than 30 Sq.miles	C=1060							

S.No.	ITEM / COMPONENT	REFERENCE
	iii) For deltaic catchment areas of Krishna & Godavari, the formula shall be Ryve's formula adopting 'c' value as per Mitra Committee Report for Upland & Deltaic Catchments.	Mitra Committee Report
f	Observed MFD may be computed from the observed MFL and shown on the LS & CSs.	
g	Bore hole data / TPs upto Hard strata or for min. depth of 2m for shallow foundations & upto 1/3rd embedment depth below maximum scour depth, along the Centre Line @ suitable intervals depending upon the importance of the structure with minimum 5 Nos. of TPs covering both the Drain & Canal @ centre, U/S & D/S sides.	Table I & II of APERL for test results of foundation soils enclosed. IRC 78:2000.
<b>III</b>	<b>DESIGN :</b>	
<b>a</b>	Note on Principles of Design, the assumptions made & the general features of the structure.	
<b>b</b>	<b>HYDRAULIC DESIGN :</b>	
	1. MFL computations adopting Step by Step method.	Design of Small Dams by USBR.
	2. (a) Design of ventway for the Drain / river in Aqueduct limiting allowable velocity with minimum 1200 mm vent height in case of barrel.	IS ; 7784 (Part II / section1) :1995, IS : 7784 (part I) - 1993
	(b) For small discharge of Drain, Pipes can be proposed limiting the velocity with minimum 900 mm dia.	IS 458 -1988, IS :783 - 1985
	(c) In case of viaduct irrespective of drain ventway- number of vents for the viaduct have to be finalised keeping the limiting velocity in view.	
	(d) In case of canal trough, a fluming ratio less than 70% may not be advisable considering the width at mid depth.	IS : 7784 (part - I) - 1993
	3. Design of Tail channel & Approach channel keeping in view the Lacey's Formula for Wetted perimeter & velocity limits depending on stratification.	IS : 7784 (part - I) - 1993
	4. Lift Wall on D/S side of the structure may be avoided.	
	5. Transition lengths on U/S & D/S of drain.	IS ; 7784 (part 2/sec1) : 1995
	6. TEL calculations for the Drain considering eddy loss coefficients as per IS code along with flow diagram with dimensions and levels.	IS : 7784 (part - I) - 1993
	7. Scour depth calculations of drain. $R = 1.34 (q^2/f)^{1/3}$ with relevant factor of safety.	IS : 7784 (part - I) - 1993
	8. Uplift calculations for the floor of the barrel and U/S & D/S side aprons	IS : 7784 (part - 2 / sec 2) - 2000
	9. Exit gradient calculations $G_E = (H/d) \times [1/(\pi \sqrt{\lambda})]$ ; Where $\lambda = [1 + \sqrt{(1 + \alpha^2)}]/2$ ; $\alpha = b/d$ ;	IS : 7784 (part - I) - 1993
	10. Proposal Sketch.	
<b>c</b>	<b>STRUCTURAL DESIGN :</b>	
	<b>i) SUPER STRUCTURE</b>	
	a) Design of Slab under canal trough & under earth bank / RCC Box for critical load combinations.	IS : 3370 - 1965 part I & part II, IS : 7784 (Part 2 / sec I) : 1995
	b) Design of Head wall on U/S & D/S by adopting TVA procedure / Coulomb's Theory / Rankine's Theory with a top width of 500mm.	TVA Hand Book
	c) In case the structure is clubbed with Single lane / Double lane bridge refer guidelines for Bridges	

S.No.	ITEM / COMPONENT	REFERENCE
d	<b>ii) SUB STRUCTURE</b>	
	<b>I a) CONVENTIONAL TYPE :-</b>	
	1. Design of Pier under canal trough & earth bank	TVA Hand Book, IS - 7784 (part 2 / sec- I): 1995.
	2. Design of Abutment under canal trough and earth bank.	TVA Hand Book, IS - 7784 (part 2 / sec- I): 1995.
	3. Abutment and Pier foundations shall be Isolated Footing / RCC raft as the case may be.	1) IRC - 78- 2000 2) SP - 16 ; 3) SP 34
	<b>I b) RCC BOX :-</b>	
	RCC box under canal trough, earth bank and Head wall	IS : 7784 (Part 2 / sec I) : 1995
	<b>I c) PIPE :-</b>	
	Pipe details	IS 458 : 1988 , IS 783 - 1985
	<b>II Design of Wing walls &amp; Return walls both on U/S &amp; D/S of drain -</b> The walls adopting TVA procedure / Coulomb's Theory / Rankine's Theory with a top width of 500mm.	TVA Hand book
IV	<b>III Tabulation of stress table :-</b> A consolidated stress table has to be furnished indicating the stress in concrete & stress on soil for the Head wall, Abutment, Piers, Wings & Returns.	
	<b>IV Unless otherwise mentioned, minimum Grade of concrete for PCC - M10 and for RCC- M20</b>	IS - 456 : 2000
	<b>MISCELLANEOUS ITEMS :-</b>	
	a) Water stops	IS : 7784 (part I) :1993
	b) Weep holes in the Retaining walls	IS : 7784 (part I) :1993
	c) Bearings	IS : 7784 (part I) :1993
	d) Expansion , Contraction & Construction Joints	IS : 3370 (part I) - 1965, IS : 7784 (part 2/Section 3) :1996
	e) Bell Mouth on U/S side	
	f) Cut & Ease waters	IS : 7784 (part 2/Section 3) :1996
	<b><u>DRAWINGS</u></b>	
	a) General Layout on net level plan duly showing contours.	
	b) General Plan, Sectional Elevation & End View - Plan indicating Half plan @Top & Half plan @ bottom & Sectional elevation along the LS of the drain & End view along the cross section of the drain.	Scale : 1:50, 1:100 (or) 1:200
	c) Wall Sections, RCC Details & Details of miscellaneous items.	i) Scale : 1:50 (or) 1:100 for sections ii) Scale : 1:25 (or) 1:20/1:10 for RCC details.
	The Drawings shall contain assumptions made, TPs, Specifications, HPs of canals, Hydrology of the drain, Bar bending schedule, Stress table etc.	

#### **4. UNDER TUNNELS (TYPE II AQUEDUCTS) / PIPE UTs**

S.No.	ITEM / COMPONENT	REFERENCE						
I	<p><b><u>GENERAL:</u></b></p> <p>1.The proposals , be scrutinised and verified by the Unit Officers before communicating to CDO for vetting.</p> <p>2.Catchment Area (C.A.) of drains/rivers and the assessed MFD/OMFL be scrutinised,verified and confirmed by the Unit Officers.</p>							
II	<p><b><u>SITE SURVEY:</u></b></p>							
1	Site Survey to be furnished as per check slip for CM & CD works with the following details.	Check Slip enclosed.						
a	<p>I ) Report accompanying the Site survey</p> <p>ii ) HPs of canal &amp; drain / river.</p>	IS ; 7784 (Part I) : 1993						
b	Site plan with flow direction of canal & drain with net levels at 10m intervals & contours							
c	<p>LS of drain / river :</p> <p>i) Covering 500 metres on U/S &amp; D/S.</p> <p>ii) The LS with levels @ 10m to 20m interval with Cross sections of drain on U/S, D/S @ centre line, 10 m, 25m, 50m,100m, &amp; @ 100m interval beyond for a length of 500m.</p> <p>iii) The Cross section levels shall be @ 3m to 5m interval in the gorge portion and 10m intervals in the flanks extended upto MFL touching the ground.</p>							
d	The catchment area shall be marked on the Topo Sheet for all the CAs more than 2.5 Sq. Km.If the C.A. is less than 2.5 Sq.km.,the C.A. is to be traversed on ground and to be furnished.							
e	<p><b><u>M.F.D.CALCULATIONS:</u></b></p> <p>The MFD may be computed as per the following formula.</p> <p>1.IN UPLAND AREAS:</p> <p>Dicken's Formula, <math>Q = CM^{3/4}</math></p> <p>where Q = Discharge in Cusecs.</p> <p>M = Catchment area in sq.miles</p> <p>C = Coefficient depending on Catchment area.</p> <table><tr><td>CA upto 1 Sq.mile.</td><td>C=1400</td></tr><tr><td>CA from 1 Sq.mile to 30 Sq.miles</td><td>C=1200</td></tr><tr><td>CA more than 30 Sq.miles</td><td>C=1060</td></tr></table> <p>(2) IN DELTAIC AREAS :</p> <p>Ryve's Formula <math>Q = CM^{2/3}</math></p> <p>C = 1000 for Q more than 500 cusecs</p> <p>C = 750 for Q less than 500 cusecs</p> <p>iii) For deltaic catchment areas of Krishna &amp; Godavari, the formula shall be Ryve's formula adopting 'c' value as per Mitra Committee Report for Upland &amp; Deltaic Catchments.</p>	CA upto 1 Sq.mile.	C=1400	CA from 1 Sq.mile to 30 Sq.miles	C=1200	CA more than 30 Sq.miles	C=1060	<p>CE/CDO</p> <p>Lr No:CDO/EEC1/1084/83-3</p> <p>Dt.28/3/83.</p>
CA upto 1 Sq.mile.	C=1400							
CA from 1 Sq.mile to 30 Sq.miles	C=1200							
CA more than 30 Sq.miles	C=1060							
f	Observed MFD may be computed from the observed MFL and shown on the LS & CSs.	Mitra Committee Report						

S.No.	ITEM / COMPONENT	REFERENCE
g	Bore hole data / TPs upto Hard strata or for min. depth of 2m for shallow foundations & upto 1/3rd embedment depth below maximum scour depth, along the Centre Line @ suitable intervals depending upon the importance of the structure with minimum 5 Nos. of TPs covering both the Drain & Canal @ centre, U/S & D/S sides. Also the Safe Bearing Capacity of foundation strata be furnished.	Table I & II of APERL for test results of foundation soils enclosed., IRC 78:2000.
<b>III</b>	<b><u>DESIGN :</u></b>	
<b>a</b>	Note on Principles of Design, the assumptions made & the general features of the structure.	
<b>b</b>	<b>HYDRAULIC DESIGN :</b>	
	1. MFL computations adopting Step by Step method.	Design of Small Dams by USBR.
	2. (a) Design of ventway for the Drain / river in UT / Pipe UT limiting allowable velocity. Pipe conduit with minimum of 900mm dia and barrel of 1.2m minimum height may be provided.	IS:7784 (Part 2 / section1):1995, IS : 7784 (part I) - 1993
	(b) For small discharge of Drain, Pipes can be proposed limiting the velocity.	IS 458 -1988, IS :783 - 1985
	3. Design of Tail channel & Approach channel keeping in view the Lacey's Formula for Wetted perimeter & velocity limits depending on stratification.	IS : 7784 (part - I) - 1993
	4. Lift Wall on D/S side of the structure may be avoided.	
	5. Transition lengths on U/S & D/S of drain.	IS ; 7784 (part 2/sec1) : 1995
	6. TEL calculations for the Drain considering eddy loss coefficients as per IS code along with flow diagram with dimensions and levels.	IS : 7784 (part - I) - 1993
	7. Scour depth calculations of drain. $R=1.34 (q^2 / f)^{1/3}$ with relevant factor of safety.	IS : 7784 (part - I) - 1993
	8. Uplift calculations for the floor of the barrel and U/S & D/S side aprons	IS : 7784 (part - 2 / sec 2) - 2000
	9. Exit gradient calculations $G_E = (H/d) \times [1/(\pi \sqrt{\lambda})]$ ; Where $\lambda = [1 + \sqrt{(1+\alpha^2)}]/2$ ; $\alpha = b/d$ ;	IS : 7784 (part - I) - 1993, CBI Publication 12
	10. Proposal Sketch.	
<b>c</b>	<b>STRUCTURAL DESIGN :</b>	
	<b>i) SUPER STRUCTURE</b>	
	a. Design of Slab under canal trough & under earth bank / RCC Box for critical load combinations.	IS : 3370 - 1965 part I & part II, IS : 7784 (Part 2 / sec I) : 1995
	b. Design of Head wall on U/S & D/S by adopting TVA procedure/ Coulomb's Theory / Rankine's Theory with a top width of 500mm.	TVA Hand Book
	<b>ii) SUB STRUCTURE</b>	
	<b>I a) CONVENTIONAL TYPE :-</b>	
	1. Design of Pier under canal trough & earth bank	TVA Hand Book, IS - 7784 (part 2 / sec- I): 1995.
	2. Design of Abutment under canal trough and earth bank.	TVA Hand Book, IS - 7784 (part 2 / sec- I): 1995.
	3. Abutment and Pier foundations shall be Isolated Footing / RCC raft as the case may be.	IRC - 78- 2000 ; SP - 16 ; SP 34
	4. Design of Holding down bolts where ever applicable.	
	<b>I b) RCC BOX :-</b>	
	RCC box under canal trough, earth bank and Head wall.	IS : 7784 (Part 2 / sec I) : 1995

S.No.	ITEM / COMPONENT	REFERENCE
	<p>I c) PIPE UTs :- Pipe details</p> <p>II Design of Wing walls &amp; Return walls both on U/S &amp; D/S of drain - The walls adopting TVA procedure / Coulomb's Theory / Rankine's Theory with a top width of 500mm.</p> <p>III Tabulation of stress table :- A consolidated stress table has to be furnished indicating the stress on concrete &amp; stress on soil for the Head wall, Abutment, Piers, Wings &amp; Returns.</p> <p>IV Unless otherwise mentioned, the minimum grade of PCC shall be M10 Grade and the minimum grade of RCC shall be M20 grade.</p>	<p>IS 458 : 1988 , IS 783 - 1985</p> <p>TVA Hand book</p> <p>IS - 456 : 2000</p>
<b>d</b>	<p><b>MISCELLANEOUS ITEMS :-</b></p> <p>a) Water stops</p> <p>b) Weep holes in the Retaining walls</p> <p>c) Bearings</p> <p>d) Expansion , Contraction &amp; Construction Joints</p> <p>e) Bell Mouth on U/S side</p> <p>f) Cut &amp; Ease waters</p>	<p>IS : 7784 (part I) :1993</p> <p>IS : 7784 (part I) :1993</p> <p>IS : 7784 (part I) :1993</p> <p>IS : 3370 (part I) - 1965, IS : 7784 (part 2/Section 3) :1996</p>
<b>IV</b>	<p><b><u>DRAWINGS</u></b></p> <p>a) General Layout on net level plan duly showing contours.</p> <p>b) General Plan, Sectional Elevation &amp; End View - Plan indicating Half plan @Top &amp; Half plan @ bottom &amp; Sectional elevation along the LS of the drain &amp; End view along the cross section of the drain.</p> <p>c) Wall Sections, RCC Details &amp; Details of miscellaneous items.</p> <p>The Drawings shall contain assumptions made, TPs, Specifications, HPs of canal, Hydrology of the drain, Bar bending schedule, Stress table etc.</p>	<p>Scale : 1:50, 1:100 (or) 1:200</p> <p>Scale : 1:50 (or) 1:100 for sections</p> <p>Scale : 1:25 (or) 1:20/1:10 for Rcc details.</p>

## 5. SUPER PASSAGES

S.No.	ITEM/COMPONENT	REFERENCE
I	<p><b><u>GENERAL:</u></b></p> <p>1.The proposals,be scrutinised and verified by the unit officers before communicating to the C.D.O for vetting.</p> <p>2.catchment Area(C.A)of drain/river and the assessed MFD/OMFL be scrutinised,verified and confirmed by the Unit officers.</p>	
II	<p><b><u>SITE SURVEY:</u></b></p> <p>1 Site survey should be furnished as per check slip for CM &amp; CD works with the following details.</p> <p>a i) Report accompanying the Site survey ii) H.Ps of canal &amp; drain / river.</p> <p>b Site plan with flow direction of canal &amp; drain along with net levels @ 10m interval &amp; contours.</p> <p>c LS of drain / river i) covering 500 metres on U/S &amp; D/S with levels @ 10m interval.  ii)The L.S with levels @10m to 20m interval with cross sections of drain on U/S, D/S @ centre line,10m,25m,50m,100m,&amp; @100m interval beyond for a length of 500m.  iii)The cross section levels shall be @ 3m to 5m interval in the gorge portion and 10m intervals in the flanks extended up to MFL touching the ground.</p> <p>d The catchment area shall be marked on the Topo sheet for all the C.A's more than 2.5sq. Km. If the C.A. is less than 2.5sq.Km.,the C.A. is to be traversed on ground and to be furnished The MFD may be computed as per the following formula. 1.IN UPLAND AREAS: Dicken's Formula. <math>Q = CM^{3/4}</math> where Q = Discharge in Cusecs. M = Catchment area in sq.miles C = Coefficient depending on Catchment area. CA upto 1 Sq.mile. C=1400 CA from 1 Sq.mile to 30 Sq.miles C=1200 CA more than 30 Sq.miles C=1060  (2) IN DELTAIC AREAS : Rvve's Formula <math>Q = CM^{2/3}</math> C = 1000 for Q more than 500 cusecs C = 750 for Q less than 500 cusecs For deltaic catchment of Krishna &amp; Godavari the formula shall be Ryve's formula adopting 'c' value as per the Mitra Committee Report for Upland &amp; Deltaic Catchments.</p> <p>f Observed MFD may be computed from the observed MFL and shown on the LS &amp; CSs.</p> <p>g Details of Tank such as FTL, distance from the structure etc., if there is any tank on D/S on Vagu course.</p> <p>h Bore hole data /TPs upto Hard strata or for min. depth of 2m for shallow foundations &amp; upto 1/3rd embedment depth below maximum scour depth along the Centre line @ suitable intervals depending upon the importance of structure with minimum 5 Nos covering both the Drain &amp; Canal @ centre, U/S &amp; D/S sides.</p>	<p>check slip enclosed.</p> <p>IS ; 7784 (Part I) : 1993</p> <p>CE/CDO Lr No:CDO/EEC1/1084/83-3 Dt.28/3/83.</p> <p>Mitra Committee Report</p> <p>Table I &amp; II of APERL for test results of foundation soils enclosed. IRC 78 : 2000</p>

S.No.	ITEM/COMPONENT	REFERENCE
III	<b>DESIGN:</b>	
a	Note on Principles of Design, the assumptions made & the general features of the structure.	
b	<p>HYDRAULIC DESIGN</p> <p>1.MFL computations adopting Step by Step method.</p> <p>2.(a)Design of ventway(or size of pipe) for the Drain/river limiting allowable velocity.</p> <p>(b). For small discharge of Drain, pipes can be proposed limiting the velocity .</p> <p>(c)The Drain bed level can be raised upto 600mm above the natural bed level to achieve vertical clearance in the canal.</p> <p>3. Design of Tail channel &amp; approach channel keeping in view the Lacey's formula for Wetted perimeter &amp; velocity limits depending on stratification.</p> <p>4. Transition lengths on U/S &amp; D/S of drain</p> <p>5. TEL calculations for the Drain considering eddy loss coefficients as per IS code along with flow diagram with dimensions and levels.</p> <p>6.Scour depth calculations of Drain:  <math>R = 1.34 (q^2/f)^{1/3}</math> with relevant factor of safety.</p> <p>7. Checking of Thickness of Apron</p> <p>8.Exit gradient calculations:  <math>G_E = (H/d) \times [1/(\pi\sqrt{\lambda})]</math> ; Where <math>\lambda = [1 + \sqrt{(1+\alpha^2)}]/2</math> ; <math>\alpha = b/d</math></p> <p>9. Proposal sketch</p>	<p>Design of Small Dams by USBR.</p> <p>IS:7784(part ii / section 2):  IS 458 -1988 IS :783 - 1985</p> <p>IS : 7784 (part - I) - 1993</p> <p>IS ; 7784 (part 2/sec2)  IS : 7784 (part - I) - 1993</p> <p>IS : 7784 (part - I) - 1993</p> <p>IS : 7784 (part - 2 / sec 2) - 2000</p> <p>IS : 7784 (part - I) - 1993</p>
c	<p><b>STRUCTURAL DESIGN</b></p> <p><b>i)SUPER STRUCTURE</b></p> <p>a. Design of trough</p> <p>b. Design of head wall on U/S &amp; D/S by adopting TVA procedure / Coulomb's Theory/ Rankine's theory with a top width of 500mm.</p> <p><b>ii)SUB STRUCTURE</b></p> <p>1. Design of pier</p> <p>2.Design of Abutment</p> <p>3. Abutment and Pier foundations shall be isolated footing/ RCC raft as the case may be.</p> <p>4. FOR PIPE TYPE :-</p> <p>Pipe details</p> <p>a) Design of wing walls &amp; return wall both on U/S &amp; D/S of drain - The walls are to be designed adopting TVA procedure /Coulomb's Theory / Rankine's Theory with a top width of 500mm.</p> <p>b) Tabulation of stress table :- A consolidated stress table has to be furnished indicating the stress on concrete &amp; stress on soil for the Abutment, Piers, Wings &amp;Returns.</p> <p>c) Minimum grade of PCC shall be M10 Grade, unless otherwise specified.</p>	<p>As per IS:456-2000 and IS: 3370-1965</p> <p>TVA Hand book</p> <p>IRC- 78-2000; SP-16; SP-34</p> <p>IS 458 : 1988 , IS 783 - 1985</p> <p>TVA Hand book ; IS 1904 - 1966</p> <p>IS-456:2000</p>



S.No.	ITEM/COMPONENT	REFERENCE
	d) Minimum grade of concrete for RCC shall be M20 Grade,unless otherwise specified.	IS-456:2000
<b>d</b>	<b>MISCELLANEOUS ITEMS :-</b>	
	a) Water stops	IS : 7784 :1993
	b) Weep holes in the Retaining walls	IS : 7784 :1993
	c) Bearings	IS : 7784 :1993
	d) Expansion , Contraction & Construction Joints	IS : 3370 - 1965
	e) Cut & Ease waters	IS:7784
<b>III</b>	<b>DRAWINGS</b>	
	a)General Layout on net level plan duly showing contours.	
	b) General plan,Sectional elevation & End View - Plan indicating Half plan @Top &Half plan @ bottom & Sectional Elevation along the LS of the drain & End View along the cross section of the drain.	Scale : 1:50, 1:100, (or) 1:200
	c)Wall Sections, RCC Details & Details of miscellaneous items.	i)Scale : 1:50,(or) 1:100 for sections
		ii)Scale : 1:25 (or) 1:20 for Rcc details.
	The Drawings shall contain assumptions made, TPs, Specifications,HPs of canal,Hydrology of the Drain, Bar bending schedule,Stress table etc.	

## **6. SYPHON AQUEDUCTS**

S.No.	ITEM / COMPONENT	REFERENCE						
I	<p><b><u>GENERAL:</u></b></p> <p>1.The proposals, be scrutinised and verified by the Unit Officers before communicating to CDO for vetting.</p> <p>2.Catchment Area (C.A.) of drains/rivers and the assessed MFD/OMFL be scrutinised, verified and confirmed by the Unit Officers.</p>							
II	<p><b><u>SITE SURVEY:</u></b></p> <p>1 Site Survey to be furnished as per check slip for CM &amp; CD works with the following details.</p> <p>a i ) Report accompanying the Site survey ii ) HPs of canal &amp; drain / river.</p> <p>b Site plan with flow direction of canal &amp; drain with net levels @ 10 mts interval &amp; contours.</p> <p>c LS of drain / river. i) Covering 500 metres on U/S &amp; D/S. ii) The LS with levels @ 10m to 20m interval with Cross sections of drain on U/S, D/S @ centre line, 10 m, 25m, 50m,100m, &amp; @ 100m interval beyond for a length of 500m. iii) The Cross section levels shall be @ 3m to 5m interval in the gorge portion and 10m intervals in the flanks extended upto MFL touching the ground.</p> <p>d The catchment area shall be marked on the Topo Sheet for all the C.As more than 2.5 Sq. Km. If the C.A. is less than 2.5 Sq.km., the C.A. is to be traversed on ground and to be furnished.</p> <p>e <b><u>M.F.D.CALCULATIONS:</u></b> The MFD may be computed as per the following formula.</p> <p><b><u>1.IN UPLAND AREAS:</u></b> Dicken's Formula, <math>Q = CM^{3/4}</math> where Q = Discharge in Cusecs. M = Catchment area in sq.miles C = Coefficient depending on Catchment area.</p> <table><tr><td>CA upto 1 Sq.mile.</td><td>C=1400</td></tr><tr><td>CA from 1 Sq.mile to 30 Sq.miles</td><td>C=1200</td></tr><tr><td>CA more than 30 Sq.miles</td><td>C=1060</td></tr></table>	CA upto 1 Sq.mile.	C=1400	CA from 1 Sq.mile to 30 Sq.miles	C=1200	CA more than 30 Sq.miles	C=1060	<p>Check Slip enclosed.</p> <p>IS ; 7784 (Part I) : 1993</p> <p>CE/CDO Lr No:CDO/EEC1/1084/83-3 Dt.28/3/83.</p>
CA upto 1 Sq.mile.	C=1400							
CA from 1 Sq.mile to 30 Sq.miles	C=1200							
CA more than 30 Sq.miles	C=1060							

S.No.	ITEM / COMPONENT	REFERENCE
	<p><b>(2) IN DELTAIC AREAS :</b></p> <p>Ryve's Formula <math>Q = CM^{2/3}</math></p> <p>C = 1000 for Q more than 500 cusecs</p> <p>C = 750 for Q less than 500 cusecs</p> <p>iii) For deltaic catchment areas of Krishna &amp; Godavari, the formula shall be Ryve's formula adopting 'c' value as per Mitra Committee Report for Upland &amp; Deltaic Catchments.</p> <p>f Observed MFD may be computed from the observed MFL and shown on the LS &amp; CSs.</p> <p>g Bore hole data / TPs upto Hard strata or for min. depth of 2m for shallow foundations &amp; upto 1/3rd embedment depth below maximum scour depth, along the Centre Line @ suitable intervals depending upon the importance of the structure with minimum 5 Nos. of TPs covering both the Drain &amp; Canal @ centre, U/S &amp; D/S sides.</p>	<p>Mitra Committee Report</p> <p>Table I &amp; II of APERL for test results of foundation soils, IRC 78:2000.</p>
<b>III</b>	<b><u>DESIGN :</u></b>	
<b>a</b>	Note on Principles of Design, the assumptions made & the general features of the structure.	
<b>b</b>	<b>HYDRAULIC DESIGN :</b>	
	1. MFL computations adopting Step by Step method.	Design of Small Dams by USBR.
	2. (a) Design of ventway for the Drain / river in Aqueduct limiting allowable velocity with minimum 1200 mm height of vent in case of barrel.	IS : 7784 (Part II / section5) :1995, IS : 7784 (part I) - 1993
	(b) For small discharge of Drain, Pipes can be proposed limiting the velocity with minimum 900 mm dia.	IS 458 -1988, IS :783 - 1985
	3. Design of Tail channel & Approach channel keeping in view the Lacey's Formula for Wetted perimeter & velocity limits depending on stratification.	IS : 7784 (part - I) - 1993
	4.Lift Wall on D/S side of the structure may be avoided.	
	5. Transition lengths on U/S & D/S of drain.	IS ; 7784 (part 2/sec5) : 1995
	6. TEL calculations for the Drain considering eddy loss coefficients as per IS code along with flow diagram with dimensions and levels.	IS : 7784 (part - I) - 1993
	7. Scour depth calculations of drain.	IS : 7784 (part - I) - 1993
	$R = 1.34 (q^2/f)^{1/3}$ with relevant factor of safety.	
	8. Uplift calculations for the floor of the barrel and U/S & D/S side aprons	IS : 7784 (part - 2 / sec 5) - 2000
	9. Exit gradient calculations	IS : 7784 (part - I) - 1993
	$G_E = (H/d) \times [1/(\pi\sqrt{\lambda})]$ ; Where $\lambda = [1 + \sqrt{1+\alpha^2}]/2$ ; $\alpha = b/d$	
	10.Proposal Sketch.	

S.No.	ITEM / COMPONENT	REFERENCE
c	<p><b>STRUCTURAL DESIGN :</b></p> <p>i) <b>SUPER STRUCTURE</b></p> <p>a) Design of Slab under canal trough &amp; under earth bank / RCC Box for critical load combinations.</p> <p>b) Design of Head wall on U/S &amp; D/S by adopting TVA procedure / Coulomb's Theory / Rankine's Theory with a top width of 500mm.</p> <p>c) In case the structure is clubbed with Single lane / Double lane bridge refer guidelines for Bridges</p> <p>ii) <b>SUB STRUCTURE</b></p> <p>I a) <b>CONVENTIONAL TYPE :-</b></p> <p>1. Design of Pier under canal trough &amp; earth bank: Minimum thickness of pier shall be 1 M.</p> <p>2. Design of Abutment under canal trough and earth bank.</p> <p>3. Abutment and Pier foundations shall be Isolated Footing / RCC raft as the case may be.</p> <p>I b) <b>RCC BOX :-</b></p> <p>RCC box under canal trough, earth bank and Head wall.</p> <p>I c) <b>PIPE :-</b></p> <p>Pipe details</p> <p>II Design of Wing walls &amp; Return walls both on U/S &amp; D/S of drain - The walls adopting TVA procedure / Coulomb's Theory / Rankine's Theory with a top width of 500mm.</p> <p>III Tabulation of stress table :- A consolidated stress table has to be furnished indicating the stress in concrete &amp; stress on soil for the Head wall, Abutment, Piers, Wings &amp; Returns.</p> <p>IV Unless otherwise mentioned, minimum Grade of concrete for PCC- M10 and for RCC- M20</p>	<p>IS : 3370 - 1965 part I &amp; part II, IS : 7784 (Part 2 / sec 5) : 1995</p> <p>TVA Hand Book</p> <p>TVA Hand Book, IS - 7784 (part 2 / sec-5): 1995. TVA Hand Book, IS - 7784 (part 2 / sec- 5): 1995. 1) IRC - 78- 2000 2) SP - 16 ; 3) SP 34</p> <p>IS : 7784 (Part 2 / sec5) : 1995</p> <p>IS 458 : 1988 , IS 783 - 1985</p> <p>TVA Hand book</p> <p>IS - 456 : 2000</p>
d	<p><b>MISCELLANEOUS ITEMS :-</b></p> <p>a) Water stops</p> <p>b) Weep holes in the Retaining walls</p> <p>c) Bearings</p> <p>d) Expansion , Contraction &amp; Construction Joints</p> <p>e) Bell Mouth on U/S side</p> <p>f) Cut &amp; Ease waters</p>	<p>IS : 7784 (part I) :1993</p> <p>IS : 7784 (part I) :1993</p> <p>IS : 7784 (part I) :1993</p> <p>IS : 3370 (part I) - 1965,</p> <p>IS : 7784 (Part 2 / sec5) : 1995</p>

S.No.	ITEM / COMPONENT	REFERENCE
IV	<p><b><u>DRAWINGS</u></b></p> <p>a) General Layout on net level plan duly showing contours.</p> <p>b) General Plan, Sectional Elevation &amp; End View - Plan indicating Half plan @Top &amp; Half plan @ bottom &amp; Sectional elevation along the LS of the drain &amp; End view along the cross section of the drain.</p> <p>c) Wall Sections, RCC Details &amp; Details of miscellaneous items.</p> <p>The Drawings shall contain assumptions made, TPs, Specifications, HPs of canals, Hydrology of the drain, Bar bending schedule, Stress table etc.</p>	<p>Scale : 1:50, 1:100 (or) 1:200</p> <p>i)Scale : 1:50 (or) 1:100 for sections</p> <p>ii)Scale : 1:25 (or) 1:20/1:10 for RCC details.</p>

## 7. CANAL DROPS

S.No.	ITEM/COMPONENT	REFERENCE
I	<b><u>GENERAL</u></b> 1.The proposals,be scrutinised and verified by the Unit Officers before communicating to the C.D.O for vetting. 2.The Hydraulic Particulars of canal be scrutinised,verified and confirmed by the Unit Officers.	
II	<b><u>SITE SURVEY:</u></b>	
1	Site Survey to be furnished as per check slip for Drops with the following details	Check slip enclosed
a	i)Report accompanying the Site survey ii)H.P.s of canal.	
b	Site plan with flow direction of canal along with net levels @ 10m intervals & contours.	
c	LS of canal: i)covering 500 meters on U/S &D/S with levels @10m interval.	
d	Bore hole data /TPs upto Hard strata or for min. depth of 2m along the Centre line @ suitable intervals depending upon the importance of structure with minimum 2 Nos covering Canal @ centre & D/S sides.	Table I & II of APERL for test results of foundation soils enclosed. IRC 78 : 2000
II	<b><u>DESIGN :</u></b>	
a	Note on Principles of Design,the assumptions made & the general features of the structure.	
b	<b>HYDRAULIC DESIGN</b> 1.Fixation of crest ,Throat width of drop wall, Length of stilling basin and other components of stilling basin. 2.Design of Drop wall.  3.Transitions lengths on U/S & D/S . 4. Scour depth calculations. $R = 1.34 (q^2/f)^{1/3}$ with relevant factor of safety. 5. Checking of thickness of apron 6. Exit gradient calculations $G_E = (H/d) \times [1/(\pi \sqrt{\lambda})]$ ; Where $\lambda = [1 + \sqrt{(1 + \alpha^2)}]/2$ ; $\alpha = b/d$ 7. Proposal Sketch	Manual on canal falls,I.S:4997  Text Book of Irrigation Manual by W.M.Ellis. IS : 7784 (part - I) - 1993 IS : 7784 (part - I) - 1993  Publication No.12 of CBIP Publication No.12 of CBIP
c	<b>STRUCTURAL DESIGN</b> a. Design of Body wall ( Drop wall)  b. Design of stilling Basin.  c. Design of wing walls &Return walls both on U/S &D/S of canal - The walls are to be designed adopting TVA procedure/ Coulomb's Theory / Rankine's Theory with a top width of 500mm.  d) Tabulation of stress table :- A consolidated stress table has to be furnished indicating the stress on concrete & stress on soil for the Body wall& Wings  e)Minimum grade of PCC shall be M10 Grade,unless otherwise specified.  f) Wearing coat over Body wall & stilling basin minimum grade shall be CC M20 grade,unless otherwise specified.	As per IS: 456-2000 and IS: 3370-1965  IS: 4997- 1995  TVA Hand book , IS 1904-1966    IS-456:2000  IS-456:2000

S.No.	ITEM/COMPONENT	REFERENCE
d	<b>MISCELLANEOUS DETAILS:-</b> a)Water stops b)Weep holes in the Retaining walls c) Expansion , Contraction & Construction Joints	IS:7784-1993 IS:7784-1993 IS : 3370 (part I) - 1965
III	<b>DRAWINGS</b> a) General Layout on net level plan duly showing contours. b) General plan & Sectional elevation & End View- Plan indicating Half plan @Top &Half plan @ bottom & Sectional Elevation along the LS of the canal & End View along the cross section of the canal. c)Wall Sections & Details of miscellaneous items.  The drawings shall contain assumptions made,TPs,Specifications,HPs of canal,Bar bending schedule where-ever applicable, Stress table etc.	Scale : 1:50, 1:100, (or) 1:200  i)Scale : 1:50,(or) 1:100 for sections ii)Scale: 1:25(or)1:20 for Rcc details

## **8. INFALL AND OUT FALL REGULATORS**

S.No	ITEM / COMPONENT	REFERENCE
I	<b><u>GENERAL</u></b>	
	1) The proposals, be scrutinised and verified by the unit officers before communicating to CDO for vetting.	
II	<b><u>SITE SURVEY</u></b>	
	1) The site survey to be furnished as per check slip with the following details. a) Report accompanying the site survey b) HPs of canal. c) LS of canal for a distance of 1KM d) If the regulator is clubbed with a road bridge, mention the road level and type of bridge i.e. Single lane or Double lane bridge.  e) Salient features of Reservoir / Tank. f) Bore Hole data / TPs upto Hard strata or for min. depth of 2m for shallow foundations with min. 3 Nos covering canal @ centre.	Check slip enclosed       Table I & II of APERL for test results of foundation soils enclosed. IRC 78: 2000
III	<b><u>DESIGN</u></b>	
a	Note on principles of Design, the assumptions made and the general features of the structure	
b	The design shall be checked for the following two conditions: 1) canal full and reservoir/tank empty 2) canal empty and reservoir / tank full	
c	<b><u>HYDRAULIC DESIGN</u></b>	
1	i) Fixation of crest level, vent way calculations and crest width, Glacis profile with U/S & D/S slopes with radius of curve.  ii) The minimum thickness of pier shall be 1M to 1.5M	IS 6531-1994; IS 7114-1993.
2	Scour depth calculations: $R = 1.34 (q^2/f)^{1/3}$ with relevant factor of safety.  If road bridge is combined also refer IRC code	IS 7784 ( part I ) - 1993,  IRC : 78-2000
3	Energy Dissipation Calculation	IS 4997 - 1996 & CBIP No 179
4	Hydraulic jump Calculation	IS 4997 - 1963 / 1996 & CBIP No 179
5	Exit gradient calculations & cut - off $G_E = (H/d) \times [1/(\pi\sqrt{\lambda})]$ ; Where $\lambda = [1 + \sqrt{(1+\alpha^2)}]/2$ ; $\alpha = b/d$	CBIP - 12 & IS : 7114 - 1973.



S.No	ITEM / COMPONENT	REFERENCE
6	Uplift pressure Computations.	IS 6966 part I - 1989,1996 CBIP 12
7	Design of impervious floor thickness as per Khosla's Theory	CBIP - 12 & IS : 7114 - 1973.
8	Protection works	IS : 7784 (part - I ) - 1993
<b>IV</b>	<b><u>DESIGN OF SUPER STRUCTURE</u></b>	
	1. DL Bridge (or)	
	2. SL Bridge (or)	
	3. Hoist Bridge Slab	
	The Top of Hoist bridge level shall be tentatively finalised considering crest level + 2 x Ht of Gate + free board (0.6 to 0.9m) + thickness of Hoist slab subject to confirmation of Mechanical Drawings.	
	4. Design of Bearings as given in MOST drawings	IRC : 83 (part II ) - 1997
	5. Breast wall where ever necessary.	IS : 456 - 2000
<b>V</b>	<b><u>DESIGN OF SUB STRUCTURE</u></b>	
	1. Pier, Abutment, Wings & Returns : Minimum thickness of pier shall be 1.0 M to 1.5 M	IRC: 5-1998, IRC : 6-2000, IRC : 21-2000 & IRC : 78 - 2000.
	2. Hoist platform	IS : 456 - 2000
	3. Wings & Returns be designed adopting TVA procedure/Coulomb's Theory / Rankine's Theory adopting top width of 500mm.	
	4. Adequate gate grooves in pier and Abutment & provision of sill beam , embedded metal parts shall be made.	Hydro Mechanical Guide lines by CDO.
	5. Unless otherwise mentioned ,the grade of concrete shall be M10 for PCC & M20 for RCC.	
	6. A note shall be included duly mentioning that the groove sizes are indicative & a separate Hydro Mechanical drawing shall be referred for details of EM parts & secondary concrete.	
	7. Infall Refulator shall be provided with double seals.	

S.No	ITEM / COMPONENT	REFERENCE
<b>VI</b>	<b><u>DESIGN OF FOUNDATIONS:</u></b>  Foundations for Pier, Abutments, Wings & Returns.  i) For shallow & open foundations.  ii) For Raft foundations.  iii) For pile foundations	   IS : 1904 - 1986  IS : 2950 - 1981 Part - I  IS : 2911 - 1979 (Part - I, section 1,2,3,4) IS : 2911-1980 ( part-II) , IS : 2911-1980 (part-III) , IS : 2911 - 1985 (part - IV)
<b>VII</b>	<b><u>MISCELLANEOUS DETAILS:-</u></b> a) Weep holes in the Retaining walls b) Bearings c) Expansion , Contraction & Construction Joints  d) Size of grooves, hoist details, EM Parts, gates , slabs etc., gate shall be checked for the conditions as mentioned in III (b)	   IS : 7784 (part I) :1993 IS : 3370 ( PART I) -1965, IS : 7784 (part II/ SECTION III):1996  Hydro mechanical guidelines by cdo
<b>VIII</b>	<b><u>DRAWINGS</u></b>  a) General Plan & Sectional Elevation - Plan indicating Half plan @Top & Half plan @ foundation level, LS along the canal & C/S across the canal  b) Details of sections of Pier, Abutment, Wings  c) RCC details of deck slab, Hoist slab.  d) The drawings shall contain assumptions made, TPs, Specifications, HPs of canal, salient features of river/ tank , bar bending schedule ( if applicable) , stress table etc.,  A special note shall be inscribed duly mentioning that the groove sizes are indicative and a separate hydro mechanical drawing shall be referred for the details of EM parts and secondary concrete.	   Scale : 1:50, 1:100, (or) 1:200   Scale 1:25 (or) 1: 50 (or) any suitable scale.  Scale 1:25 (or) 1: 20 (or) any suitable scale.

## 9. OFFTAKE SLUICES

S.No.	ITEM / COMPONENT	REFERENCE
<b>I</b>	<b><u>GENERAL:</u></b>	
	1.The proposals, be scrutinised and verified by the Unit Officers before communicating to CDO for vetting.	
	2.Location of OT, ayacut & Discharge details be ascertained & confirmed by the Unit Officers.	
<b>II</b>	<b><u>SITE SURVEY:</u></b>	
1	Site survey to be furnished as per check slip	Check slip enclosed
a	Report accompanying the site survey	
b	Site plan along with flow direction of canal, location & alignment of O.T.	
c	Bore hole data / T.P.s upto hard strata or for a min depth of 2 m.	
<b>III</b>	<b><u>DESIGN:</u></b>	
a	Note on Principles of Design, the assumptions made & the general features of the structure	
b	<b><u>HYDRAULIC DESIGN :</u></b>	
a	HPs of parent canal and Distributory: Ayacut, Discharge and Highest Field Level to be irrigated be furnished.	
b	Discharge: Method of calculation of Discharge By modified penman method	
c	Distributory section: Fixation of distributory section adopting b/d ratio and satisfying critical velocity ratio	Technical Report no.7 of C.B.I.P, C.W.C Recommendations, & IS:7112-1973.
d	Sill level of OT Sluice: i ) Sill level be fixed based on 3/4 F.S.L.condition at head reach and half F.S.L condition at the tail reach where the Q of parent canal is less than 20 % with a min. driving head of 0.15 m above heighest field level. ii ) Sill level shall be invariably 300 mm above the Parent canal Bed Level.	Text book of Irrigation manual by W.M. Ellis, Civil Engg Hand Book by Association of Engineers
e	Ventway of sluice: i) Ventway calculations using orifice formula and vent may be proposed by Pipe / R.C.C.Box $Q = C_d A \sqrt{2gh}$ ii) The minimum size of pipe / box shall be 300 mm dia / 1200 mm ( to be restricted with suitable diaphragm )	
f	Scour depth calculations:	
		IS:7784(Part II):1993

S.No.	ITEM / COMPONENT	REFERENCE
h	Proposal sketch indicating the ventway proposed and other components:	
g	U/S and D/S Transitions.	IS:7784(Part2 / Sec I)
<b>c</b>	<b><u>STRUCTURAL DESIGN:</u></b>	
a	Design of Head walls,wings and returns (u/s and d/s) adopting TVA / Coulomb's / Rankine's Theory with minimum top width of 500 mm	TVA Handbook
b	Protection works on D/S.	Text book of Irrigation manual by W.M. Ellis,
c	Miscellaneous Details:	
	1 ) PIPE :-	
i	Calculation of required class of Hume pipe.	IS:783-1985
ii	Pipe, collar and related dimensions.	IS:458-1988
	2 ) RCC BOX :-	
	RCC box under Earth bank and Head wall.	IS:7784 part I - 1993
<b>d</b>	<b><u>MECHANICAL PARTS :</u></b>	
i	Shutters / Gates, embedded metal parts etc	Separate Guidelines issued
ii	Hoist / working platform arrangements	by C.D.O.
<b>IV</b>	<b><u>DRAWINGS :</u></b>	
a	General Layout on net level plan duly showing contours.	
b	General Plan, Sectional elevation and End View	Scale 1:200 or 1:100
c	Sections and RCC details.	i) Scale 1:50 or 1:100 for sections ii) Scale 1:25 or 1:20 or 1:10 for RCC details
d	The Drawings shall contain assumptions made, TPs,Specifications, HPs of parent canal& distributory, Bar bending schedule, stress table etc.	

## 10. CANAL SYPHONS

S.No.	ITEM / COMPONENT	REFERENCE
I	<p><b><u>GENERAL:</u></b></p> <p>1. This Proposal shall be for exceptional cases only.</p> <p>2. The proposals, be scrutinised and verified by the Unit Officers before communicating to CDO for vetting.</p> <p>3. Catchment Area (C.A.) of drains/rivers and the assessed MFD/OMFL be scrutinised, verified and confirmed by the Unit Officers.</p>	
II	<p><b><u>SITE SURVEY:</u></b></p> <p>1 Site Survey to be furnished as per check slip for CM &amp; CD works with the following details.</p> <p>a i ) Report accompanying the Site survey ii ) HPs of canal &amp; drain / river.</p> <p>b Site plan with flow direction of canal &amp; drain with net levels @ 10 mts interval &amp; contours.</p> <p>c LS of drain / river. i) Covering 500 metres on U/S &amp; D/S. ii) The LS with levels @ 10m to 20m interval with Cross sections of drain on U/S, D/S @ centre line, 10 m, 25m, 50m, 100m, &amp; @ 100m interval beyond for a length of 500m. iii) The Cross section levels shall be @ 3m to 5m interval in the gorge portion and 10m intervals in the flanks extended upto MFL touching the ground.</p> <p>d The catchment area shall be marked on the Topo Sheet for all the C.As more than 2.5 Sq. Km. If the C.A. is less than 2.5 Sq.km., the C.A. is to be traversed on ground and to be furnished.</p> <p>e <b><u>M.F.D.CALCULATIONS:</u></b> The MFD may be computed as per the following formula.</p> <p><b>1.IN UPLAND AREAS:</b> Dicken's Formula, <math>Q = CM^{3/4}</math> where Q = Discharge in Cusecs. M = Catchment area in sq.miles C = Coefficient depending on Catchment area. CA upto 1 Sq.mile. C=1400 CA from 1 Sq.mile to 30 Sq.miles C=1200 CA more than 30 Sq.miles C=1060</p> <p><b>(2) IN DELTAIC AREAS :</b> Ryve's Formula <math>Q = CM^{2/3}</math> C = 1000 for Q more than 500 cusecs C = 750 for Q less than 500 cusecs</p>	<p>Check Slip enclosed.</p> <p>IS ; 7784 (Part I) : 1993</p> <p>CE/CDO Lr No:CDO/EEC1/1084/83-3 Dt.28/3/83.</p>

S.No.	ITEM / COMPONENT	REFERENCE
	<p>iii) For deltaic catchment areas of Krishna &amp; Godavari, the formula shall be Ryve's formula adopting 'c' value as per Mitra Committee Report for Upland &amp; Deltaic Catchments.</p> <p>f Observed MFD may be computed from the observed MFL and shown on the LS &amp; CSs.</p> <p>g Bore hole data / TPs upto Hard strata or for min. depth of 2m for shallow foundations &amp; upto 1/3rd embedment depth below maximum scour depth, along the Centre Line @ suitable intervals depending upon the importance of the structure with minimum 5 Nos. of TPs covering both the Drain &amp; Canal @ centre, U/S &amp; D/S sides.</p>	<p>Mitra Committee Report</p> <p>Table I &amp; II of APERL for test results of foundation soils enclosed., IRC 78:2000.</p>
<b>III</b>	<b><u>DESIGN :</u></b>	
<b>a</b>	Note on Principles of Design, the assumptions made & the general features of the structure.	
<b>b</b>	<b>HYDRAULIC DESIGN :</b>	
	1. MFL computations adopting Step by Step method.	Design of Small Dams by USBR.
	2. (a) Design of ventway for the Canal with minimum 1200 mm height in case of barrel and 900 mm dia in case of pipe conduit, limiting allowable velocity.	IS : 7784 (Part II / section3) :1995, IS : 7784 (part I) - 1993
	(b) For small discharge of canal, Pipes can be proposed limiting the velocity with minimum 900 mm dia.	IS 458 -1988, IS :783 - 1985
	3. Design of Tail channel & Approach channel keeping in view the Lacey's Formula for Wetted perimeter & velocity limits depending on stratification.	IS : 7784 (part - I) - 1993
	4. Transition lengths on U/S & D/S of drain.	IS ; 7784 (part 2/sec3) : 1995
	5. TEL calculations for the canal considering Unwins Formula and eddy loss coefficients as per IS code along with flow diagram with dimensions and levels.	IS : 7784 (part - I) - 1993
	6. Scour depth calculations of drain.	IS : 7784 (part - I) - 1993
	$R = 1.34 (q^2/f)^{1/3}$ with relevant factor of safety.	
	7. Uplift calculations for the floor of the barrel and U/S & D/S side aprons	IS : 7784 (part - 2 / sec 3) - 2000
	8. Exit gradient calculations	IS : 7784 (part - I) - 1993
	$G_E = (H/d) \times [1/(\pi\sqrt{\lambda})]$ ; Where $\lambda = [1 + \sqrt{(1+\alpha^2)}]/2$ ; $\alpha = b/d$	
	9. Proposal Sketch.	
<b>c</b>	<b>STRUCTURAL DESIGN :</b>	
	<b>i) SUPER STRUCTURE</b>	
	a) Design of Slab / RCC Box for critical load combinations.	IS : 3370 - 1965 part I & part II, IS : 7784 (Part 2 / sec 3) : 1995
	b) Design of Head wall on U/S & D/S by adopting TVA procedure / Coulomb's Theory / Rankine's Theory with a top width of 500mm.	TVA Hand Book
	c) In case the structure is clubbed with Single lane / Double lane bridge refer guidelines for Bridges	

S.No.	ITEM / COMPONENT	REFERENCE
	<b>ii) SUB STRUCTURE</b> <b>I a) CONVENTIONAL TYPE :-</b> 1. Design of Pier : Minimum thickness of pier shall be 1 m. 2. Design of Abutment 3. Abutment and Pier foundations shall be Isolated Footing / RCC raft as the case may be. <b>I b) RCC BOX :-</b> RCC box (It is preferable to provide Inspection Chambers at 50 m interval in case of lengthy barrels.) <b>I c) PIPE :-</b> Pipe details II Design of Wing walls & Return walls both on U/S & D/S of drain - The walls adopting TVA procedure / Coulomb's Theory / Rankine's Theory with a top width of 500mm. III Tabulation of stress table :- A consolidated stress table has to be furnished indicating the stress in concrete & stress on soil for the Head wall, Abutment, Piers, Wings & Returns. IV Unless otherwise mentioned, Minimum Grade of concrete for PCC shall be M10 and for RCC M20.	TVA Hand Book, IS - 7784 (part 2 / sec-3): 1995. TVA Hand Book, IS - 7784 (part 2 / sec- 3): 1995. 1) IRC - 78- 2000 2) SP - 16 ; 3) SP 34 IS : 7784 (Part 2 / sec3) : 1995 IS 458 : 1988 , IS 783 - 1985 TVA Hand book IS - 456 : 2000
<b>d</b>	<b>MISCELLANEOUS ITEMS :-</b> a) Water stops b) Weep holes in the Retaining walls c) Bearings d) Expansion , Contraction & Construction Joints e) Bell Mouth on U/S side f) Cut & Ease waters	IS : 7784 (part I) :1993 IS : 7784 (part I) :1993 IS : 7784 (part I) :1993 IS : 3370 (part I) - 1965, IS : 7784 (Part 2 / sec3) : 1995
<b>IV</b>	<b><u>DRAWINGS</u></b> a) General Layout on net level plan duly showing contours. b) General Plan, Sectional Elevation & End View - Plan indicating Half plan @Top & Half plan @ bottom & Sectional elevation along the LS of the drain & End view along the cross section of the drain. c) Wall Sections, RCC Details & Details of miscellaneous items. The Drawings shall contain amade, TPs, Specifications, HPs of canals, Hydrology of the drain, Bar bending schedule, Stress table etc.	Scale : 1:50, 1:100 (or) 1:200 Scale : 1:50 (or) 1:100 for sections Scale : 1:25 (or) 1:20/1:10 for RCC details.

# **APPENDICES**



## **A. CHECK SLIP TO ACCOMPANY THE SITE SURVEY OF BRIDGES & REGULATORS**

- 1) Has an index map to a scale of 1:50,000 showing the proposed location of the bridge and the canal, alternative sites investigated and rejected with reasons and general topography of the country and the important towns and villages etc., in the vicinity been furnished?
- 2) Has a contour survey plan to a scale of 1:5000 (with 0.5m contours) showing all topographical features extending to a considerable distance all-round the structure, features that influence the location and design of the Bridge and its approaches been furnished?
  - a) Are all sites of crossing worth consideration shown in the plan?
- 3) Has a site plan to a scale of 1:500 showing details of the site selected and extending not less than 100m upstream and downstream from the center line of crossing and covering the approaches to a sufficient distance not less than 500m on either side and along with the following information been furnished?
  - a) Have the name of the road and its destinations on either side been noted?
  - b) Are the canal proposals showing banks indicated in red pencil?
  - c) Have the alignment of the existing approaches and proposed crossing and its approaches been shown?
  - d) Is the angle and direction of skew if the crossing is aligned on a skew been marked? If so, is it examined whether the skew crossing can be avoided?
  - e) Has the reference to the position (with description and reduced level) of the B.M. used as datum been furnished?
  - f) Have the lines and identification numbers of cross sections and longitudinal section taken within the scope of the site plan and the exact location of their extreme points been given?
  - g) Have the trial pits or boring particulars with ground levels been given? If so, do they satisfy the following conditions?
    - i) Has the location or identification of each trial pit been shown?
    - ii) Are the trial pits dug at suitable intervals so as to cover the entire area of structure?
    - iii) Have the trial pits been dug up to H.R, stratified rock or any hard soils suitable for foundations?
- 4) Has a cross section of the proposed canal site, of the proposed crossing (Scale 1:100 ,Horizontal 1:100 vertical) extended along the approach roads or railway line, showing the existing road formation levels been furnished?

- a) If so, are the hydraulic particulars of the canal viz., F.S.D, Maximum discharge longitudinal slope etc ., given
- 5) Has the L.S. of the canal showing site of crossing extending to 100m on either side been given?
- 6) Has a note on the important details of the Bridges if any for this road within a reasonable distance been furnished?
- 7) Has a condensed L.S. showing the lists of the bridges and other masonry works 3 kms upstream and downstream of the proposed crossing been enclosed?
- 8) Is the necessity for the present bridge and any possibility of diverting the road through near by bridge examined? If so, are the economics between diverting the road and constructing a new bridge studied?
- 9) Has the canal mileage to the center of bridge and road mileage to the center of canal been noted?
- 10) Has the class of loading expected on the bridge been furnished?
- 11) Has the cross-section of the road been taken 500m on either side? In case of railway embankment is it extended further?
- 12) Are the rough proposals depending on site conditions marked?
- 13) Have any special features and relevant information been furnished?

**B. CHECK SLIP TO ACCOMPANY THE SITE SURVEY OF CM & CD WORKS viz  
Aqueducts/ Viaducts/ UTs/ Pipe UTs/ SPs/ Syphon Aqueducts/ Canal Syphons.**

1. Has an Index Map showing the location and any alternatives been enclosed ?
2. Has site plan to a scale of 1:500 giving the following information been enclosed:
  - a) Has the names of roads or drains with direction been given ?
  - b) Had the canal proposals been shown ?
  - c) If the structure is in skew, have the angle and direction of skew been given?
  - d) Has the reference to B.M. been given?
  - e) Are the levels and identification number of C.S. given ?
  - f) Are the trial pit particulars given ?
  - g) Have the spot levels of adjacent country been given ?
- 3) i) Has the L.S. of the drain been given?  
ii) Are the scales adopted as 1:1000 and 1:100 ?
- 4) Has the L.S. of canal showing the site of crossing been enclosed ?
- 5) i) Has a note on the important details of masonry works along the drain  
Enclosed ?  
  
ii) If so, are the hydraulic particulars furnished ?
- 6) Is a list of Masonry works for 3 Kms U/S and D/S of structure furnished?
- 7) Is the necessity for the structure explained clearly?
- 8) Have the canal chainages been given ?
- 9) Have the leads for materials of construction been given ?
- 10) Has any proposal depending on site conditions been marked ?
- 11) If the structure is on a curve or skew is it possible to
  - i) to alter:
  - ii) If not have the reasons been furnished ?

- 12) Have the possibilities of diversion been examined ?
- 13) Has the catchment map of the drain been furnished ?
- 14) Have the Hydraulic particulars of the drain furnished ?
- 15) Has any special features or relevant information been furnished ?
- 16) Has certificate of levels given ?
- 17) Have plans been indexed ?
- 18) Are the L.S. and C.S. levels of corresponding points tallying ?
- 19) Are the north points and scales noted in the plans ?

**C. CHECK SLIP TO ACCOMPANY THE SITE SURVEY OF DROPS AND  
OFFTAKE SLUICES**

1. Has an Index Map to a scale of 1:50000 showing the location of the proposed work and the canal alternative site investigated and rejected with reasons, the general topography of the country and the important towns and villages in the vicinity been furnished ?
2. Has a contour survey plan to a scale of 1:5000 showing all topographical features extending to a considerable distance around the structure of other features that influence the location and design of the work been furnished?
3. Has a site plan to a scale of 1:500 showing details of site selected and extending not less than 100m upstream and downstream from the center of the sluice or drop been furnished with the following information.
  - a) Have canal proposals showing banks indicated in red pencil?
  - b) Has a reference to the position of B.M. used at datum with description and R.L. been given ?
  - c) Have the trial pits or boring particulars been given? If so, do they satisfy the following conditions?
    - i) the location or identification of trial pits been shown?
    - ii) Are the trial pits dug at suitable intervals so as to cover the entire area of structure.
    - iii) Have the trial pits been dug up to H.R, stratified rock or any hard soils suitable for foundation?
  - d) Have the spot levels of the adjacent country been given ?
4. Has a C.S. of the proposed canal at site of the proposed sluice or drop (Scale 1 : 1000 horizontal and 1 : 100 vertical) extended to a sufficient distance been furnished?  
If so, are the hydraulic particulars of the canal namely F.S.L, Maximum Discharge, longitudinal slope etc., given?
5. Has the L.S. of the canal showing the site of drop or sluice extending to 100 m on either side been given?
6. Are the rough proposals depending on the site conditions marked?
7. Have any special features and relevant information been furnished?

**D. CHECK SLIP TO ACCOMPANY THE SITE SURVEY OF INFALL & OUTFALL  
REGULATORS :**

- 1) Has an index map to a scale of 1:50,000 showing the proposed location of the bridge and the canal, alternative sites investigated and rejected with reasons and general topography of the country and the important towns and villages etc., in the vicinity been furnished?
- 2) Has a contour survey plan to a scale of 1:5000 (with 0.5m contours) showing all topographical features extending to a considerable distance alround the structure, features that influence the location and design of the Bridge and its approaches been furnished?
  - c) Are all sites of crossing worth consideration shown in the plan?
- 3) Has a site plan to a scale of 1:500 showing details of the site selected and extending not less than 100m upstream and downstream from the center line of crossing and covering the approaches to a sufficient distance not less than 500m on either side and along with the following information been furnished?
  - a) Have the name of the road and its destinations on either side been noted?
  - b) Are the canal proposals showing banks indicated in red pencil?
  - c) Have the alignment of the existing approaches and proposed crossing and its approaches been shown?
  - d) Is the angle and direction of skew if the crossing is aligned on a skew been marked? If so, is it examined whether the skew crossing can be avoided?
  - e) Has the reference to the position (with description and reduced level) of the B.M. used as datum been furnished?
  - f) Have the lines and identification numbers of cross sections and longitudinal section taken within the scope of the site plan and the exact location of their extreme points been given?
    - g) Salient features of Reservoir
      - 1) Has the catchment area plan for the vagu prepared to the scale of
      - 2) Has the standards of the Reservoir are furnished such as
        - a) TBL of the Reservoir
        - b) MWL/FRL of the Reservoir
        - c) Crest level of the Reservoir
        - d) MDDL of the Reservoir
      - 3) Has the available driving head furnished
      - 4) Has the submergence plan furnished
      - 5) Has the Earth bund section details furnished such as
        - (a) Top width
        - (b) Side slopes.

- h) Have the trial pits or boring particulars with ground levels been given? If so, do they satisfy the following conditions?
  - i) Has the location or identification of each trial pit been shown?
  - ii) Are the trial pits dug at suitable intervals so as to cover the entire area of structure?
  - iii) Have the trial pits been dug upto H.R. stratified rock or any hard soils suitable for foundations?
- 14) Has a cross section of the proposed canal site, of the proposed crossing (Scale 1:100 Horizontal 1:100 vertical) extended along the approach roads or railway line, showing the existing road formation levels been furnished?
  - a) If so are the hydraulic particulars of the canal Viz., F.S.D. maximum discharge longitudinal slope etc., given
- 15) Has the L.S. of the canal showing site of crossing extending to 100m on either side been given?
- 16) Has a note on the important details of the Bridges if any for this road within a reasonable distance been furnished?
- 17) Has a condensed L.S. showing the lists of the bridges and other masonry works 3 kms up and downstream of the proposed crossing been enclosed?
- 18) Is the necessity for the present bridge and any possibility of diverting the road through near by bridge examined? If so, are the economics between diverting the road and constructing a new bridge studied?
- 19) Has the canal mileage to the center of bridge and road mileage to the center of canal been noted?
- 20) Has the cases of loading expected on the bridge been furnished?
- 21) Has the cross-section of the road been taken 500 m on either side? In case of railway embankment is it extended further?
- 22) Are the rough proposals depending on site conditions marked?
- 23) Have any special features and relevant information been furnished?

Project : Construction of (Structure name)  
Soil Testing - Communication of test results of the samples collected at ---  
File No -

[illegible]



**F).** Copy of letter from Sri D. Rajendra Kumar , B.Sc., M.S.M.I.E., Engineer – IN – Chief, Central Designs Organisation , 158 Shops Complex, M.J Road ,Hyderabad 500001 addressed to the Chief Engineer , SRSP, 158 shopping complex M.J. road , Hyderabad – 500001.

Lr. No. CDO/EE-C1/1084/83-3,

Dated: 28-3-83.

Sir,

Sub: Computation of Maximum Flood Discharge for design of cross Drainage works on main canals Branches and Distributaries – Regarding

Ref: This Office Lr . No: CDO/DD.C2/AD2/F-20/82-2 dt:23-7-81

In continuation to this office letter cited, the formulae for computing M.F. Discharges for cross drainage works in respect of main canals, branch canals and distributaries are proposed to be adopted as given below.

S.No.	Type Of Canal	C.A. in upland Acres.	CA in deltaic Tracts
1.	MAIN CANAL	Where $Q=CM^{3/4}$ C=1400 for CA-1 Sq. Mile. C=1200 for CA between 1 to 30 Sq. Miles. C=1060 for CA 30 to 500 Sq. Miles. For CA more than 500 Sq. Miles $Q=7000 \sqrt{M}$ Velocity to be allowed in vents upto 12' to 13' / sec. depending on stream bed strata.	$Q=CM^{2/3}$ Value of C=1000 Velocities in vents restricted to 10 ft/sec
2.	BRANCH CANALS $Q > 500$ c/s	RYVE'S FORMULA $Q= CM^{2/3}$ Where C=1000 With Velocity in Vents upto only 10'/sec.	Same as for upland areas.
3.	DISTRIBUTARIES $Q < 500$ c/s	RYVE'S FORMULA $Q= CM^{2/3}$ Where C=750 Velocity upto only 10'/sec.	Same as for upland areas.

To have an uniform procedure, the field officers may be informed to workout the M.F. D. by adopting the above formulae in all the future designs.

Sd/-J.S.R. Mohan Rao.  
for Engineer-in-Chief  
Central Designs Organisation: Hyd.

**G) LIST OF I.S.CODES ON CANAL ALIGNMENT & DESIGN OF CM & CD  
WORKS AND OTHER IMPORTANT REFERENCE BOOKS**

<b>S.NO</b>	<b>DESCRIPTION</b>	<b>CODE NO / REFERENCE</b>
1	Guide for Planning and layout of Canal System for Irrigation	IS:5968-1987
2	Criteria for Design of Cross Section for Unlined Canals in alluvial soils	IS:7112-1973
3	Code of practice for Design of Cross Section of Lined Canals	IS:4745-1968
4	Code of practice for laying Cement Concrete/ Stone Slab lining on canals	IS:3873-1993
5	Guidelines for Lining of canals in Expansive soils	IS:9451-1994
6	Criteria for design of Hydraulic jump type stilling basins with horizontal and sloping apron.	IS:4997-1968
7	Criteria for hydraulic design of Cross Regulators for canals	IS:7114-1973
8	Guide for location, selection and hydraulic design of Canal Escapes	IS:6936-1992
9	Code of practice for design of cross drainage works : part - I, (General features)	IS:7784(part-I)-1993
10	Code of practice for design of cross drainage works :part - 2, (section -1,Aqueducts)	IS:7784 (part-2/section-1)-1995
11	Code of practice for design of cross drainage works: part -2, (section -2 super passages)	IS:7784 (part-2 / section-2)-2000
12	Code of practice for design of cross drainage works:part - 2, (section-3 canal Syphons)	IS:7784 (part2 / Section-3)-1996
13	Code of practice for design of cross drainage works: part - 2, (section-4 Level crossings)	IS:7784 (part-2/-section-4)-1999
14	Code of practice for design of cross drainage works:part - 2, (section-5 Syphon Aqueducts)	IS:7784 (part-2/-section-5)-2000
15	Code of practice for laying of concrete pipes	IS:783 - 1985
16	Specification for precast concrete pipes (with & without Reinforcement).	IS:458 - 1988

S.NO	DESCRIPTION	CODE NO / REFERENCE
17	Standard specifications and code of practice for road bridges, section - I, General features of Design	IRC : 5 - 1998
18	Standard specifications and code of practice for road bridges, section - II, Loads and Stresses.	IRC: 6 - 2000
19	Standard specifications and code of practice for road bridges, section -III, Cement Concrete (Plain and Reinforced).	IRC: 21 - 2000
20	Standard specifications and code of practice for road bridges section - IV, Brick, Stone and Block Masonry.	IRC : 40 - 1995
21	Standard specifications and code of practice for road bridges, section - VII, Foundations and Sub structure.	IRC : 78 - 2000
22	Standard specifications and code of practice for road bridges section - IX, Bearings, Part II : Elastomeric Bearings.	IRC : 83(Part II) - 1987
23	Pocket Book for Bridge Engineers 2000	MOST 2000
24	MOST Standard Plans	
	a) Standard plans for solid slab type high way bridges	MOST Standard plans of 1977, Volume - II
	b) Standard plans for high way bridges, Concrete T- Beam Bridges	MOST Standard plans of 1983, Volume - III
	c) Standard plans for 3.0 m to 10m span RCC Solid Slab Super Structure with & without foot paths.	MOST Standard plans of 1991
	d) Standard plans for High way Bridges RCC T-Beam & Slab Super Structure - Span from 10m to 24m with 12m width	MOST Standard plans of 1992
	e) Standard drawings for Road Bridges solid slab Super Structure (15° & 30° ) skew span 4m to 10m (with and without foot paths)	MOST Standard plans of 1992
	f) Standard drawings for Road Bridges solid slab Super structure (20°,25° &35° )skew span 4m to 10m (with and without foot paths)	MOST Standard plans of 1992

<b>S.NO</b>	<b>DESCRIPTION</b>	<b>CODE NO / REFERENCE</b>
25	Code of Practice for Concrete Structures for storage of liquids, Part - I(General requirement)	IS: 3370 - (part I)-1965
26	Code of Practice for Concrete Structures storage of liquids, Part - II (Reinforced Concrete Structure)	IS: 3370 - (part II)-1965
27	Code of Practice for Plain and Reinforced concrete	IS: 456 - 2000
28	Code of Practice for Design and Construction of Raft Foundations, Part I :Design.	IS:2950 (part I) - 1981
29	Code of Practice for Design and Construction of Pile Foundations, Part I :Concrete.	IS: 2911:Part I : 1979
30	Code of Practice for Design and Construction of Piles,Section I, Driven cast in situ Concrete Piles	IS: 2911:Part I : Section I: 1979
31	Code of Practice for Design and Construction of Piles,Section 2 , Bored cast in situ Concrete Piles	IS: 2911:Part I : Section 2: 1979
32	Code of Practice for Design and Construction of Piles,Part 3, Under reamed Piles	IS : 2911 : Part 3 : 1980
32(a)	Code of Practice for Design and Construction of foundations in Soils-Genreal Requirements	IS : 1904-1986 (RA 2000)
33	Design aids for Reinforced Concrete to IS:456 - 1978.	SP - 16 , 1980
34	Hand Book of Concrete Reinforcement and Detailing	SP - 34 (S&T) - 1987
35	Current Practices In Canal design in India	CBIP , Technical Report no - 3
36	Design practices for Unlined incised Canals	CBIP , Technical Report no - 7
37	Manual on Irrigation and Power Channels	CBI - Publication no: 171
38	Design of weirs on permeable foundation	CBI - Publication no: 12
39	Design of Small Dams	USBR
40	Manual on Canal Falls	CW & PC Publication
41	TVA Hand Book	
42	Test Book of Irrigation Manual	W.M.Ellis

Sd / - I.S.N. RAJU

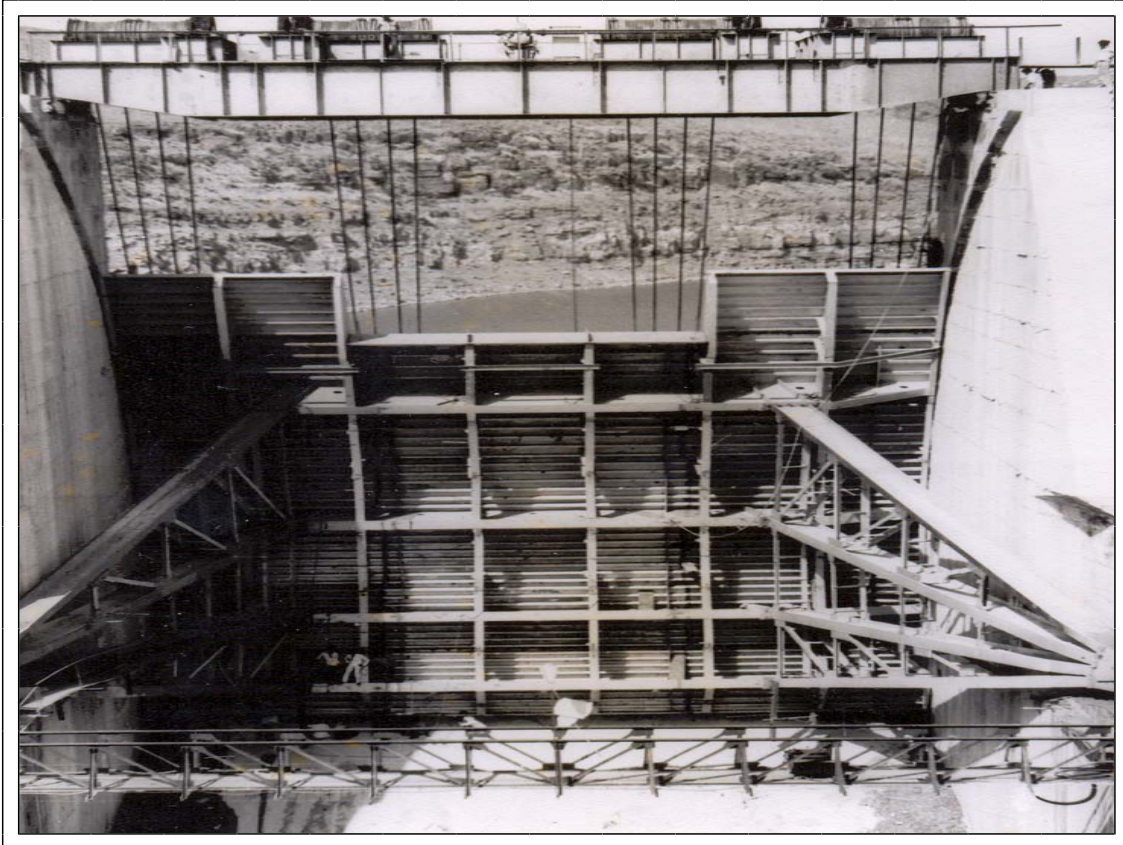
Dt : 7- 2- 2005

CHIEF ENGINEER

CENTRAL DESIGNS ORGANISATION  
HYDERABAD



GOVERNMENT OF ANDHRA PRADESH  
WATER RESOURCES DEPARTMENT



GUIDE LINES FOR PREPARATION OF DESIGNS AND  
DRAWINGS FOR HYDRO MECHANICAL EQUIPMENTS OF  
IRRIGATION PROJECTS FOR VETTING IN CENTRAL  
DESIGNS ORGANISATION

CENTRAL DESIGNS ORGANISATION  
HYDERABAD  
MAY-2015



# **GUIDE LINES FOR PREPERATION OF DESIGNS AND DRAWINGS FOR HYDRO MECHANICAL EQUIPMENTS OF IRRIGATION PROJECTS FOR VETTING IN C.D.O**

The irrigation projects in the state (AP) are presently constructed on turn key basis.

The firms entrusted with the work will be preparing designs and drawings of hydro mechanical equipments which are to be scrutinized. For speedy scrutiny of the works it is better if they are furnished in a standard format. For this general guidelines are prepared which may be followed. The guide lines indicated are suggestive and may be followed along with relevant IS codes and best engineering practices in vogue. The units furnishing the designs and drawings of Hydro Mechanical equipments are requested to check that the guide lines are followed before furnishing for vetting in Central Designs Organisation.

In the first instance, the type of gate may be selected based on the recommendation indicated vide latest IS code No: 13623:1993. (RA 1998), IS codes to be followed for preparation of designs and drawings for the gates are indicated in the annexure. The latest IS codes, with all the amendments updated, may be followed.

Designs shall reflect the codal references adopted and allowable stresses considered duly quoting the authority.

The drawings shall include all details with materials used along with properties like Ultimate Tensile Stress, Yield Point and hardness etc with the authority duly quoted.

## **Radial Gates**

1. Approved Civil Drawings showing the Cross-Section of Spillway and plan and shall include the all important details along with the following.
  - a) U/S and D/S equation of profile of ogee of Spillway and the coordinates.
  - b) Sill level of Radial and Stop log gates and its location with reference to crest.
  - c) Top of the gate.
  - d) Radius of the gate.
  - e) Trunnion level.
  - f) Hoist level and its location.

g) Road bridge level and all other important details.

The above may be adopted duly following the guidelines indicated in IS: 4623.

2. The thickness of piers proposed may be to suit the type of anchorages as per codal provisions.
3. Designs and drawings furnished for checking must be self explanatory, with detailed calculations duly indicating the formulae used and authority for its usage. Latest techniques using latest codes may be followed while designing.
4. For all the bought out items manufactures catalogues may be furnished.
5. The materials shall conform to those indicated in IS: 4623. The designs and drawings may be submitted in the following sequence with details indicated below and shall generally conform to the norms.
6. The welding shall conform to IS: 816 and other relevant IS codes.

**A. Design Of Embedded Metal Parts:-**

The design of embedded metal parts may be done for either Independent UnBonded type anchorages or combined bonded type anchorages. The former may be choosen for large size gates. The following are to be designed for Independent UnBonded type anchorages (As per IS 4623 latest code & other IS codes).

- i. Calculations of water thrust and working of inclination of resultant thrust and consequently inclination of anchor flats which shall be horizontal as far as possible.
- ii. Calculation of sill reaction.
- iii. Designs of anchor flats.
- iv. Design of trunnion girder. (Left hand & Right hand).
- v. Design of anchor girder.
- vi. Design of Rest chair.
- vii. Design of vertical anchorages.
- viii. Design of welds for the above.
- ix. Details of sill beam, wall plate assembly etc:.

The drawings are to be issued duly showing the above designed Components and the assemblies wherever required. Drawings showing the details of Block out and anchorages are to be issued duly showing primary and secondary concrete stages.

In case of combined bonded type anchorages the following are to be designed (As per IS 4623 latest code and other IS codes.)



- i. Calculations of water thrust and finalisation of inclination of resultant thrust and consequently inclination of anchor rods, which shall be horizontal as possible.
- ii. Calculations of sill reaction.
- iii. Design of anchor rods.
- iv. Design of trunnion girder (Abutment pier, Intermediate pier).
- v. Design of rest chair (Abutment pier, Intermediate pier).
- vi. Design of vertical anchorages.
- vii. Details of sill beam, wall plate assembly and others.
- viii. Design of welds for the above.

The drawings are to be issued duly showing the above designed components and the assemblies where ever required.

Drawings showing the details of Block out and anchorages are to be issued duly showing primary and secondary stages.

**B. Design of Gates:** (As per IS 4623 latest code and other relevant IS codes)

Detailed design of the following components may be furnished.

- i. Skin plate.
- ii. Verticals
- iii. Horizontal girders
- iv. Arms and Arms assembly. (including Bracings)
- v. Horizontal girder bracings
- vi. Design of prop (above top horizontal girder if required)
- vii. Design of trunnion, pin, Bush.
- viii. Design of trunnion Bracket.
- ix. Design of Guide Rollers and other Components.
- x. Design of welds and other Joints.
- xi. Design of Tie beam/ Thrust Block and others.
- xii. Seals may be provided as per IS: 11855.

Drawings furnished shall comprise of above items in detail. Each drawing shall indicate the key plan and critical dimensions. The Assembly drawings for the above components may be furnished in detail where ever necessary.

**C. Design of Hoist Mechanism:** (As per latest IS 6938 codes and other codes)

Hoist capacity may be calculated.

Type and location of the Hoist may be chosen. It is preferable to have U/S suspension of hoist mechanism so that hoist capacity gets reduced.

In case of Rope Drum Hoist the following components are to be designed.

- i. Design of Wire Rope.
- ii. Design of Rope Drum.
- iii. Design of Gear reduction mechanism Motor and Brake.
- iv. Design of Shafts.
- v. Selection of Bearings and plumber Blocks.
- vi. Dail indicator, Limit switch and turn buckle, lifting bracket etc.

All the above components are to be checked for Break Down Torque condition. (B.D.T) also.

- vii. Design of manual operation.

The Drawings shall indicate the above components in detail with all assemblies duly detailing the individual items. The exposed components may be covered suitably.

For high head gates and for higher capacity hoists hydraulic hoist may be adopted. The hoist may be designed as per IS 10210 and other relevant IS codes. The detailed designs and drawings may be furnished.

**D. Design of Hoist Bridge.** (As per latest IS 800 and other relevant latest IS codes)

The layout of the Hoist Bridge may be finalised and location of main bridge girders and cross girders for supporting motor, gear box, drum etc may be indicated in the design. All the cross girders and main girders may be designed for the loads coming over them. The detail design of welds may be furnished.

The drawings showing the details of Hoist bridge girders and cross girders may be furnished with all full details including welding and other joining methods. The Hoist bridge may be covered by not less than 6mm chequered plate and suitable railings may be provided.

The ladders may be provided for approach from sill to Hoist Bridge covering all the components. Walk Way Bridge may be provided at trunnion level connecting all the vents for inspection and maintenance.

All hydro mechanical components may be painted as per IS code 14177.

The location of grooves, gates, hoist mechanism and Hoist Bridge may be furnished with reference to the axis of dam/cut water edge.

### **STOP LOG GATES:**

The size of the stop logs may be finalised duly considering the Hoist capacity and storing arrangement. The numbers of sets of stop logs are to be proposed as per standard practice of 1 set per 10Nos of vents, subject to a maximum of 3 sets. The Bottom piece may be provided with suitable legs for resting over ogee of spill way.

The following items are to be designed as per IS 4622 latest code and other relevant IS codes.

- I. Calculation of Thrust over the stoplog element.
- II. Design of skin plate, Horizontal girders, verticals.
- III. Design of Rollers, pin and selection of Bearings.
- IV. Design of Roller supporting plate.
- V. Design of Roller Track, seal track.
- VI. Finalisations of Groove.
- VII. Design of Centre of Gravity and Hoist capacity.
- VIII. Design of lifting pin and Brackets.
- IX. Seals may be provided as per IS: 11855.

The drawings showing the details of sill beam, Guide Track, Roller Track, seal track and its anchorages (primary & secondary) are to be furnished.

The drawing showing the details of components and its assemblies in detail are to be furnished.

The drawings showing the details of storing arrangement for stop logs may have to be furnished.

Hydraulic model studies may have to be conducted to ascertain the uplift and down pull forces on stop log gates and report shall be furnished.

### **LIFTING BEAM:**

Lifting beam shall be designed and drawings prepared to suit the gantry and stop logs. IS 13591 (Latest along with amendments) and relevant IS codes may be followed while designing the lifting beam.

**Design of Gantry/ Electrically Operated Traveling Crane(E.O.T). for the operation of stop logs.**

The capacity of gantry/EOT required may be calculated duly considering all the forces including hydro dynamic forces that it has to encounter.

The type of lifting arrangement (Gantry/ E.O.T.) is to be selected suitably as per provisions available in civil structure.

The latest IS codes 6938, 807 and 3177 may be followed while designing Gantry/ E.O.T.

The Hoist mechanism, cross travel mechanism and long travel mechanism and its supporting structure, portal frame, legs Rails, Rails fixing arrangement, lifting Beam, wheel bogies and their assemblies etc are to be designed in detail and accordingly drawings are to be furnished. For all the bought out items the catalogue of the manufactures are to be furnished.

The gantry shall be designed keeping in view operation and storing of stop log elements. It shall also ensure that the civil structure takes the loads of the gantry (leg loads etc) and transmit the same without damaging the civil structure.

**Design of Hoist Mechanism:** The following components may be designed as per latest IS code 6938 & IS 3177 & IS 807 and other relevant codes..

- i. Design of wire Rope.
- ii. Design of Rope Drum.
- iii. Design of Gear reduction, mechanism, Motor and Brake.
- iv. Design of Shafts.
- v. Selection of Bearings and plumber Blocks.
- vi. Dail indicator, limit switch, Turn Buckle and lifting brackets etc.
- vii. Design of manual operation.

All the above components are to be checked for Break down Torque condition (B.D.T) also.

The Drawings shall indicate the above components in detail with all assemblies duly detailing the individual items. The components may be covered suitably.

### **Design Of Portal Frame**

1. Stability calculations.
2. Loading diagrams including the loads of portal frame and hoist Mechanism
3. Design of portals..
  - a) Wind load calculations on portal frame
  - b) Design of gantry rail girder.
  - c) Design of Upstream Side (U/S) and down Stream Side (D/S )columns.
  - d) Design of U/S & D/S girders.
  - e) Design of articulated bogie.
  - f) Design of wheel Bogie.
  - g) Design of long travel mechanism (Motor, Brake Wheel, Reduction unit etc).
  - h) Cross travel Mechanism.
  - i) Cabin Details.

Detailed drawing of gantry showing all the components along with assemblies.  
The designs & drawing shall be self explanatory with all relevant authorities indicated and supplied.

### **Vertical Fixed wheel/Slide Gates**

The following may be considered while taking up designs and drawings.

- 1) Inspection chamber, if required, is to be provided duly furnishing all its details along with dogging beam details.
- 2) Width of the hoist platform shall be suitably fixed to suit that type of hoist  
Provided considering maneuverability of man and machine. Pier thickness shall be suitably kept based on the type of gate provided to accommodate the depth of grooves primary and secondary and anchorages with suitable cover.
- 3) A minimum distance of 1200mm shall be provided between grooves of emergency and service gates.
- 4) For medium and high head gates model studies may be conducted to ascertain Hydrodynamic forces and same are to be taken into consideration for design of gate.

#### **A. E.M. PARTS AND GATE**

Vertical Gates are to be designed as per latest code of IS-4622/  
IS: 5620/IS: 9349 (vertical fixed wheel gates/ low head slide gates/ High head slide gates respectively).

The following items are to be designed.

- i. Calculation of Thrust coming over the gate.
- ii. Design of skin plate, Horizontal girders, Verticals etc.
- iii. Design of Rollers, Pin and selection of Bearing, Design of sliding bars
- iv. Design of Roller supporting plates.
- v. Design of Roller Track, seal track.
- vi. Finalisation of Groove.
- vii. C.G. of the Gate and Hoist capacity calculations.
- viii. Design of Lifting Pin and Bracket.
- ix. Seals may be provided as per IS: 11855.

The drawing showing the details of above components and its assemblies in detail are to be furnished.

The drawing showing the details of sill beam, Guide Track, Roller Track and its anchorages (Primary & Secondary) are to be furnished. The location

of groove with respect to the Hoist bridge level and axis of the dam/cut water edge may have to be furnished.

**B. Hoist Mechanism:-**

The type of Hoist mechanism may be decided as per the Hoist capacity, as per field conditions.

**I. Rope drum hoist** (As per latest IS 6938 & other IS codes).

The following components are to be designed.

- i. Design of Wire Rope.
- ii. Design of Rope Drum.
- iii. Design of Gear reduction mechanism Motor and Brake.
- iv. Design of Shafts.
- v. Selection of Bearings and plumber Blocks.
- vi. Dial indicator, Limit switch and turn buckle, lifting bracket etc.

All the above components are to be checked for Break Down Torque condition. (B.D.T) also.

- vii. Design of manual operation.

The Drawings shall indicate the above components in detail with all assemblies duly detailing the individual items. The exposed components may be covered suitably.

**II. For Screw Rod Hoist with power operation.**

The following components are to be designed following latest code of IS 11228.

- i. Design of Screw Rod.
- ii. Design of Nut.
- iii. Design of Worm & Worm Wheel mechanism/bevelgear mechanism
- iv. Calculation of Motor Capacity & its selection.
- v. Checking for B.D.T. conditions as per IS codes.
- vi. Design of Manual operation.

The drawings showing the details of above components including its assemblies in detail are to be provided with longitudinal girders and cross girders duly providing chequered plate of not less than 6mm over the bridge girders. Suitable railings may be provided.

**III. Screw Rod type Hoist (Manual):-** Latest IS code 11228 may be followed.

Design components are as detailed below.

- i. Design of Screw Rod.
- ii. Design of Nut, selection of Bearing
- iii. Design of Fork etc.

The drawings showing the details of above Components including its assemblies in detail are to be furnished. The supporting structure to carry the Hoist Mechanism may have to be provided with longitudinal girders and cross girders duly providing not less than 6mm chequered plate over the bridge girders. Suitable railings may be provided.

For high head gates and for higher capacity hoists hydraulic hoist may be adopted. The hoist may be designed as per IS 10210 and other relevant IS codes. The detailed designs and drawings may be furnished.

**C. Design of Hoist Bridge.** (As per latest IS 800 and other relevant latest IS codes)

The layout of the Hoist Bridge may be finalised and location of main bridge girders and cross girders for supporting motor, gear box, drum etc may be indicated in the design. All the cross girders and main girders may be designed for the loads coming over them. The detail design of welds may be furnished.

The drawings showing the details of Hoist bridge girders and cross girders may be furnished with all full details including welding and other jointing methods. The Hoist bridge may covered by not less than 6mm chequered plate and suitable railings may be provided.

The ladders may be provided for approach from sill to Hoist Bridge covering all the components.

All hydro mechanical components may be painted as per IS code 14177.

The location of grooves, gates, hoist mechanism and Hoist Bridge may be furnished with reference to the axis of dam/cut water edge.



**DESIGN OF TRASH RACKS:**

The trash racks may be designed following recommendations detailed in IS 11388 and other relevant IS codes.

### **RADIAL GATES:**

#### **I. Design of Embedded Metal Parts:-**

1. Calculation of water thrust and finalisation of unclothing of resultant and anchors.
2. Calculation of full reaction.
3. Design Horizontal anchor rods/ flats.
4. Design of trunnion girders for intermediate and Abutment piers.
5. Design of anchor girder (if provided)
6. Design of Rest Chair.
7. Design of Vertical anchorages.

#### **Drawing to be issued:-**

1. Details of Block out.
2. Details of Main anchor rods for intermediate and Abutment piers.
3. Details of Trunnion girder for intermediate and Abutment piers.
4. Details of Rest chair for intermediate and Abutment piers.

The Designs, Materials, welding and others shall confirm to the relevant IS codes indicated in the Annexure.

The Designs are to be furnished as detailed below for checking of Hydro Mechanical equipments. These are indicated for checking of designs only.

**Radial gates:**

**3. Embedded Metal Parts:-Design**

**Design Components:-**

Calculation of Thrust on the gate for FRI condition.

The Thrust may be calculated at one meter unlevels and water level raising.

The thrust is to be calculated for 1mt outerring (a) when the gate is rusting on sill and water level raising and (b) gate under max. Water level conductor and gate lifted by one meter successively.

If the anchors are kept uncovered the thrust parallel to the girder may be calculated for the cases (a) and (b) to determine wax vertical upward and downward forces.

ANNEXURE

	IS:CODE No.		
S. No.	YEAR (latest)	DESCRIPTION	REMARKS
1	IS:800-1994	General construction in steel code of practice	
2	IS:807-1976	Code of practice for Design,manufacture,erection and testing structural portion of cranes and hoists	
3	IS:3177-1999	Code of practice for Electric overhead traveling cranes and Gantry cranes other than steel work cranes	
4	IS:4622-1992	Recommendations for fixed wheel gates structural design	
5	IS:4623-2000	Recommendations for structural design of Radial gates	
6	IS:5620-1985	Recommendations for structural design criteria for low head slide gates	
7	IS:13591-1992	Criteria for design of Lifting Beams	
8	IS:6938-1989	Code of practice for design of Rope drum and chain Hoists for Hydraulic Gates	
9	Is:9349-1986	Recommendations for structural design of medium and high head slide gates	
10	IS:10210-1993	Criteria for design of hydraulic hoists for gates	
11	IS:11228-1985	Recommendations for design of screw hoist for hydraulic gates	
12	IS:11388-1985	Recommendations for design of Trash racks for intakes	
13	IS:11855-1986	General requirements for rubber seals for hydraulic gates	
14	IS:14177-1994	Guide lines for painting system for hydraulic gates and hoists	

1 Materials:- The materials to be adopted are as given the relevant IS codes for the type of gates

2 Welding:- Welding shall conform to IS:816 and other relevant IS codes.

Note:- BIS codes shown are indicative. Latest codes with updated amendments, if any, shall be followed

Chief Engineer  
Central Designs Organisation  
Hyderabad



**GOVERNMENT OF ANDHRA PRADESH  
WATER RESOURCES DEPARTMENT**

# **GUIDE LINES FOR LIFT IRRIGATION SCHEMES**

**CENTRAL DESIGNS ORGANISATION  
HYDERABAD  
MAY-2015**



## **GUIDELINES FOR LIFT IRRIGATION SCHEMES**

### **Stage wise requirement to CDO for vetting of L. I. Scheme Designs / Drawings**

- I.
  - a. Copy of Bid document with the scope of scheme
  - b. Comprehensive report of Scheme along with
    - i. Schematic diagram with plans, arrangements from Intake to ultimate delivery point.
    - ii. Index plan
    - iii. Ayacut particulars
    - iv. Longitudinal section along the Alignment of Pressure main and L.S & plans of Gravity canals with C/S@100m intervals covering levels 100m on either side.
    - v. River cross section at the Ist stage intake.
    - vi. H.P's of Gravity canals.
  - c. Site surveys
    - i. Site surveys at relevant location of structures with Borehole Data.
    - ii. Trial pits along alignment of pressure main.
- II.
  - a. Technical details of Pumps from Manufacturer of pumps and EOT / MOT crane details along with drawings.
  - b. Model studies report - Pump house layout and conceptual drawings.
- III.
  - a. Detail Design and drawings of Pump house – Sump – Delivery Cisterns in Parallel with stage of construction.
  - b. Design of Pressure main along with Transient analysis report – Water hammer devices – details.
- IV. Designs and Drawings shall be in conformity with relevant I.S Codes / BHRA / HIS / AWWA/ IWWA/CPHEEO'S Manual on water supply and treatment.

## Reference Codes / Manuals for L.I.Schemes(Excluding Drypit Type)

S.No	Code Number	Year	Code of practice for
1			BHRA Manual on " Hydraulic design of Pump sumps and intakes"
2			IDC Manual on L.I.Schemes
3		1999	Manual on water supply and treatment prepared by the Expert committee, Govt. of India, Ministry of Urban development, New Delhi determining the acceptability of Hazen-Williams Coefficient (Value of "C")
4	783	1985	Laying of concrete pipes
5	5822	1994	Code of practice for Laying of electrically welded steel pipes for water supply
6	784	2001	Pre-stressed concrete pipes ( Including fittings)
7	458	1988	Per-cast concrete pipes(with and without Reinforcement)
8	456	2000	Plain and Reinforced Concrete
9	1916	1989	Specifications for steel cylinder pipe with concrete lining and coating
10	3589	2001	Specifications for steel pipe for water and sewerage (168.3 to 2540 mm Outside Diameter)
11	11639 (p -1&2)	1986	Criteria for design of surface penstocks
12	800	1984	steel structures
13	822	1970	Code of procedure for inspection of Welds
14	4853	1982	Recommended practice for Radiographic inspection of fusion welded butt joints in steel pipes
15	1182	1983	Recommended practice for Radiographic inspection of fusion welded butt joints in steel plates
16	2062	1999	Steel for general structural purposes - specifications
17	5504	1997	Specifications for spiral welded pipes
18	5330	1984	Design of Anchor or thrust blocks
19	SP 16	1980	Design Aids for IS - 456
20	SP34		Hand Book on concrete reinforcement detailing
21	875(1 - 5)	1987	Dead Loads; Imposed Loads; Wind Loads Snow Loads; Spl and Combination Loads
22	1893(part -1)	2002	Earthquake Resistant Design of Structures - General provisions and Buildings
23	2911	1979	Design and construction of Pile Foundations



24	IRC - 78	2000	Standard specifications for road bridges - Foundations and Sub-structures
25	2950	1981	Design and construction of Raft foundations
26	6403	1981	Determination of Bearing Capacity of shallow foundations
27	2720(1-41)	1987	Methods of test for soils
28	2131	1981	Methods of SPT for soils
29	8009(p2)	1980	Calculation of settlements of foundations
30	10262	1982	Recommended guidelines for concrete mix design
31	383	1970	Coarse and fine aggregates from natural sources for concrete
32	1786	1985	HYSD Bars and Wires for concrete reinforcement
33	2974 (P -5)		Design and construction of Machine foundations
34	4326	1993	Earthquake Resistant Design and construction of buildings
35	13920	1993	Ductile detailing for R.C.C structures subjected to Seismic forces
36	11908	1988	Recommendations for cement mortar lining for cast iron , mild steel and ductile - iron pipes (Fittings for transportation of water)