R & D Project
On

DEVELOPMENT OF STANDARDISED DESIGN AND DRAWINGS OF A BRIDGE CUM BANDHARA SYSTEM

Final Consolidated Report

Volume-I General Information

Submitted to

Director Project-II
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Content

“Development Of Standardized Design And Drawings of A Bridge Cum Bandhara System”

Preamble

Maharashtra has tradition of constructing Bridge Cum Bandhara (BcB). In such structures bridges are used for dual purpose of crossing the river and also create a limited storage. They are popular as they can serve dual purpose of crossing as well as a water storage structure. Such structures have been used to tap post monsoon flow to create storage not exceeding 3.50m. They are ideal structure for following situations.

i. To tap post monsoon flow to create storage up to 3.5 m The storage is created by fixing needles/gates between bandhara piers to tap last flow.

ii. Stored water is used for drinking and irrigation .

iii. It enhances the ground water which then is available for irrigation as well as for drinking water.

iv. Surplus percolated water out of irrigation activity again joins the river which is tapped and reused for irrigation.

v. Such stored water can be used for artificial recharging the nearby bore wells as well as open well to augment ground water.

The water is stored within the river banks hence does not require additional land acquisition and hence the scheme is popular. Few photographs of Bandhara are shown in Figure 1-5.

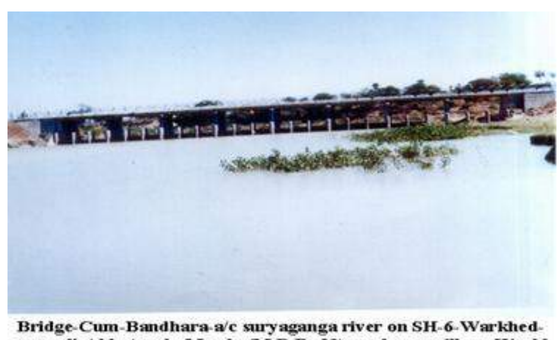
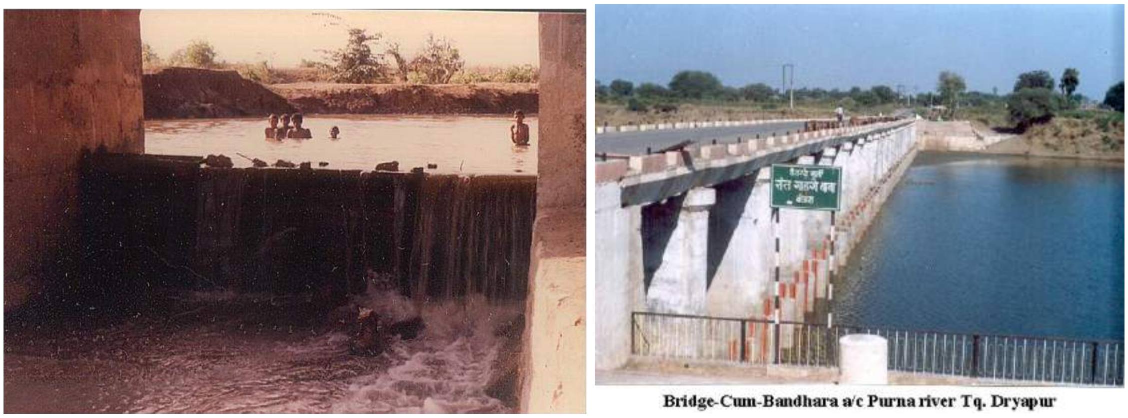


Figure 1 and 2 Bridge cum Bandhara on Rock



Bridge-Cum-Bandhara a/c Purna river Tq. Dryapur

Figure 3 & 4 Bridge cum Bandhara on soil

Bridge-Cum-Bandhara on Anjansingi-Kaundanyapur (MDR-38) road in Km. 1/100
(10 Spans @ 2.00 m. c/c)

Figure 5 Bridge cum Bandhara on on Anjansingi – Kaundanyapur Road

The report is divided in four parts as below.

Volume – I General Information : Volume I gives general information of Bridge cum bandhara, the structural details, various norms for operations, lifting and placing of gates, water recharging etc. and targeted to take policy decision.

Volume – II Analysis and Design : This volume gives general information of analysis and design of key elements of bandhara i.e. pier, raft, gates etc. for various loadings (dead load, water load, earthquake load). Flow charts for various steps are presented.

Volume – III Government GRs: This volume gives general information of Government (Maharashtra state) GRs on bandhara related works for information and further action. These GRs will help other states to prepare on similar lines.

Volume – IV Typical Drawings : This volume gives detailed structural drawings for all the types of Bandhara and Structural steel gates.

The sets of drawings available for converting the existing bridge into BCB can also be used for new proposed bridges or bridges under construction to be used as BCB.

2.0 Financial norms

It has been therefore proposed to adopt this system for PMGSY roads at such location where the same is technically feasible and financially justified when compared to norms of prescribed by the respective State Govt. In Maharashtra state, the Irrigation department has norms of cost of water storage projects such as percolation tank, minor, medium, major irrigation storage structure, cement plug, bridge cum bandhara etc. related to storage crated or irrigated area created and noting the purpose as drinking water or for irrigations. These norms are different for tribal area, backsword area etc. For every bridge cum bandhara , it is practice in Maharashtra to compare the additional cost which has to be compared with these norms and if the cost is within the norms, the project is sanctioned. The recant GR information is attached in Volume-III. In Maharashtra concurrence of state irrigation department is taken for creating such storage. Similar procedure perhaps will have to be followed by other states.

3.0 Type plans for Bridge Cum Bandhara

Type plans have been prepared for following situations.

a. Construction new bridge cum bandana when rock is exposed and storage targeted upto 3.5m
b. Converting existing bridge into Bridge cum Bandhara when rock is buried
    i. When rock is exposed with storage upto 3.5 m
    ii. When rock is buried with maximum depth of 5 m with storage upto 3.5 m
    iii. No rock but storage upto 2.5 m

The Figure 6 show general information on bandhara covered in this project.

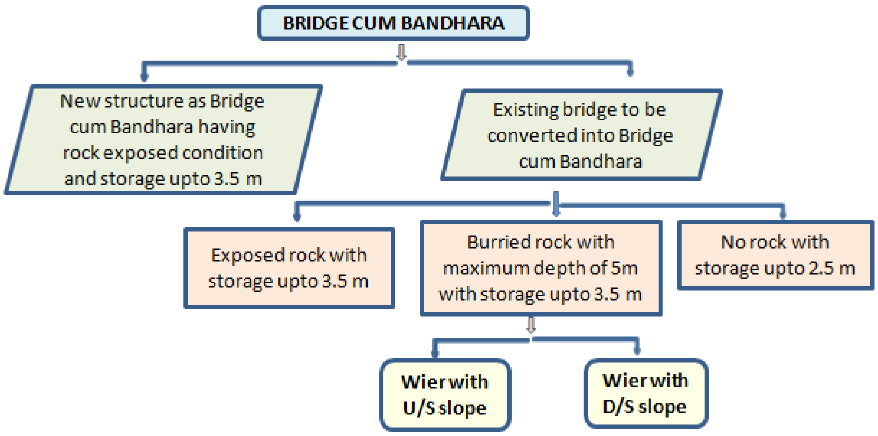


Figure 6 Flow chart showing types of bandhara covered

Presently type plans are prepared for above cases and drawings are given in Volume-IV and for other details Volume II may be referred. It may be noted that the set of plans prepared for converting existing bridge into Bridge Cum Bandhara can also be used for new proposed bridges or bridges under construction proposed to be used as Bridge Cum Bandhara.

4.0 Gates

The following material for the gates can be used.

i. Steel
ii. Fibre concrete
iii. FRC gates

Information on automatic gate (Godbole gate) is also presented in para 4.4.

4.1 steel gates

The steel gates (Figure 7) may consists of plates, angles, channels, RHS etc. The detailed analysis and design methodology is presented in Volume-II with various sizes and using different sections. The weight of steel gates depending upon the size may vary from 45-67 kg /sqm.   Irrigation departments has also evolved gate of curved shape as shown in Figure 8 with an objective to reduce the weight.

Figure 7 and 8 Steel gate

Figure 9   FRP gate

4.2 FRP gates

With an objective to prevent theft of steel gates and to reduce the weight, FRP gates (Figure 9) have been developed, tested by Central Design Organization of Irrigation department and now commercially produced. Typical photographs are given below and detailed technical information is given in Volume II.

4.3 Fibre concrete gate

With an objective to prevent theft of steel gates and to workout economical alternative, VNIT has developed thin fibre concrete gate (with steel fibres and providing minimum 8 diameter bars for lifting purpose) and tested successfully for 3.5m water pressure for a span of 2m. The thickness of these gates varies from 50mm (with angles) to 75mm (without angles) at edges (Figure 10a-10c). It is observed that the edges are protected with edges and it provides smooth surface for rubber seam. The average weight of such gate works out to be 200kg / sqm. The inquiry in the market has revealed that these gates (2.1x0.5m) can be produced @Rs 750/- to Rs 1,500 per gate, with and without edge angles. With the availability of simple lifting equipment handling such gate (having high weight / sqm) may not poses a serious problems. The cost being low, the damage to few gates may not affect the operation and maintenance cost substantially. As observed at site the joints can be sealed with ordinary cement mortar. Considering the cost advantage, state government may encourage such gates and may carry out few more lab and field studies.

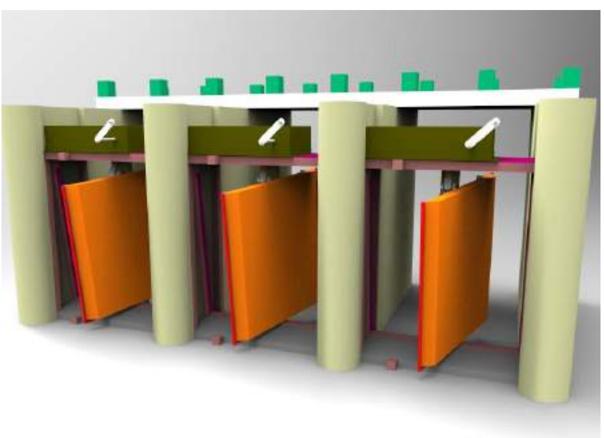
Figure 10a Fibre Reinforced Concrete gate

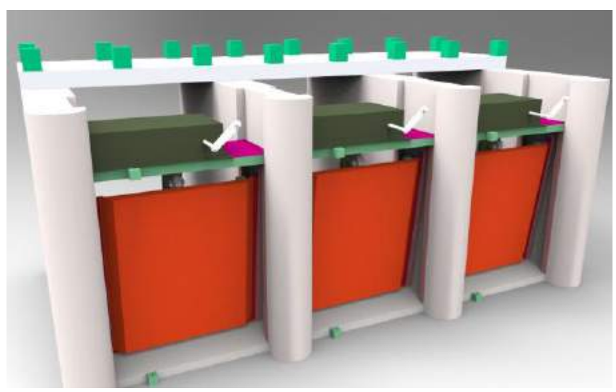
Figure 10b Cement plaster to gates

Figure 10c Testing of Fibre Reinforced Concrete gate in laboratory

4.4. Godbole gates

M/s Godbole gates has developed a patented system called "Godbole gates", which are being used from last 30 years on various irrigation projects. These gates have the specialty that the gates should open automatically once the level in the lake / dam (designed level) is exceeded. It works on simple works of statics where the hydraulic static pressure, weight of gate and fulcrum position of the gate is so adjusted that the hydraulic force is enough to open the gate once the water level which is targeted as flood level is achieved. Several new models with vertical opening or horizontal opening are developed. Typical photographs are shown in Figure 10d.





Gate open position

Gate close positon

Figure 10d Godbole Gates

Presently the costs of these gates are prohibitive for BCB structures but after further research, the cost can be substantially reduced. There are several areas in the country where the rains are scanty and the total rainfall may not exceed 300-400mm per year in such a situation these gates may prove as ideal as each and every rainfall can be tapped and storage is created.

5.0 Operation and Maintenance

There is a need for proper operation and maintenance manual. Following are few guidelines which can be updated from time to time.

5.1 Storage and protection of the gates

It is necessary to have small storage godowns or some protected open plot (with watch and ward) where these gates can be stored during the monsoon. This can be near the bridge structure or near gram panchayat office / government / private premises. It is advisable to make necessary provision in budget. Figure 11 shows a simple layout plan for storage of needles.

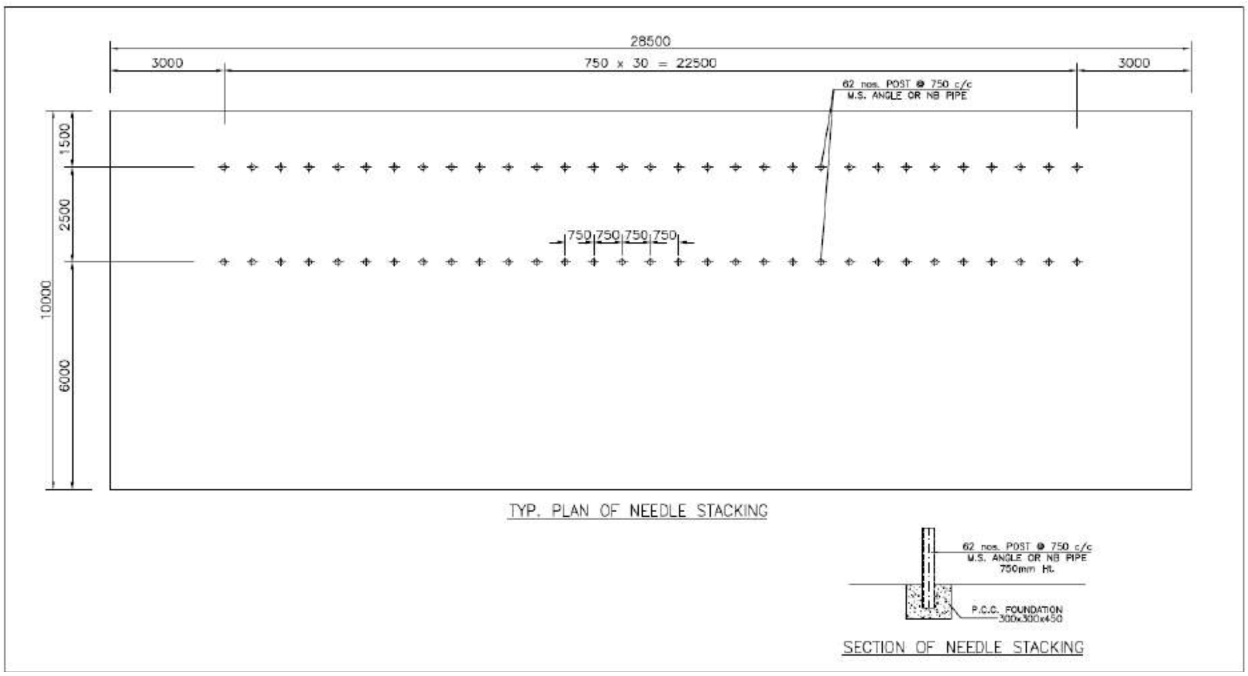


Figure 11 Typical layout plan for needle stacking

5.2 Damage to rubber seal

Rubber seal provided at the base and side to prevent leakage as shown in Figure-12. This may require changes at frequent interval as a result of damage caused due to handling. The figure also shows the bottom channel for proper fixing of the first gate.


Photo-12 Rubber gaskets for fixing gates and bottom channel

5.3 Damage to Gates

The gates may get damaged / warped due to bad handling and may need replacement.

5.4 Guiding angle at base

It is practice to fix guiding angles or channel at base to ensure that the gates would seat properly and does not lead to leakage of water. These angles may require minor repairs. It is observed that the channel at base needs frequent cleaning though it helps in proper placement of gates. (Figure 12)

5.5 Angle in gate slot

Water may leak through the slot in bandhara piers. A simple steel angle or cold form channel is fixed to cover profile of slot. This is an important operation during construction. Field engineers need to evolve suitable methodology

5.6 Temporary removable bridge

A simple lightweight bridge for a length of appropriate length is proposed which can span at least 4 needle pier. During the operation of lowering or lifting the gates, the removable foot bridge can be placed and few labors can seat on this bridge to guide the lifting/fixing operation. This can then be shifted to next unit

5.7 Average cost of operation and maintenance

Irrigation department based on their experience has worked out the average cost of the operation and maintenance and included in DSR. It is revealed that the average rate of removing the needles, and keeping in godown, re-fixing the same and to carry out repairs to gates including rubber seals comes out to be Rs 500/- per sqm. The typical rate analysis and the wording of the relevant items obtained from irrigation department are attached in Volume-IV.

6.0 Mechanical equipment

It was a practice to restrict the size of steel gate to 2 m x 0.5 so that the average weight of gate doesn't exceed 80 kg per gate and the lifting and re-fixing the gate was therefore done manually. This is a time consuming job and for a long river may require 10 to 15 days. Any mechanical device such as Mathura crane, hydra available in market can be used for placing and removing of the gates. (Figure 13 and 14)

Figure -13 Placing of Gates

Figure 14 Mathura crane in lifting position

Tailor-made economical alternative

VNIT with the help of local unit has developed a most economical equipment to meet the need operation of fixing and removing needles of bandhara. It consists of hydraulically operated mechanical equipment mounted on four wheel tractor trolley. Equipment has got arrangement of 360 degree rotation with lifting arm of 5m and capacity of 500kg per trip. The equipment is operated on diesel or electrical prime mover. A small generator of small capacity is adequate to give power to this electrical unit. Such equipment can be used to lift the gates from gowdon, keep in tractor / truss and lower at site (Refer Figure 15). The expected cost of such unit is not likely to exceed Rs 5 Lakhs and it should be included as part of project cost. Such simple equipment may be used for other agricultural activities i.e. lifting of grain bags and placing in truck.

Figure 15 Newly developed tractor trolley

For Maharathwada region, where the rainfall is very low and rainy days are limited, Mr V B Kotecha, Executive Engineer, Irrigation department, Usmanabad, Maharashtra, has developed a simple mechanical system which allows lower or lifting of the gates in 3-5 minutes. Refer Figure 16. This enables him to tap each and every fall and create a storage which helps in ground water recharging.

Figure 16 Lifting Arrangement

7.0 Working of Bandhara Scheme

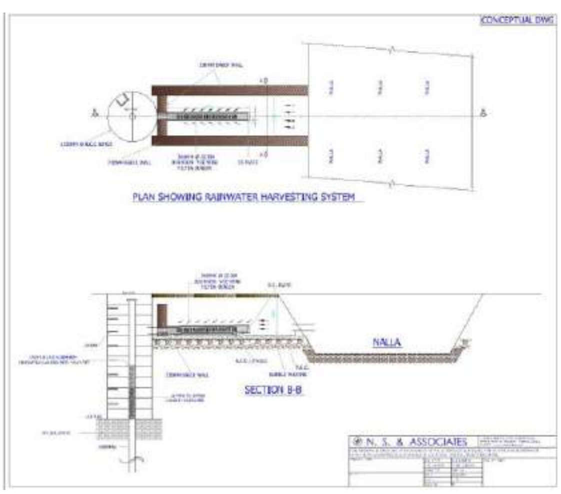
The success of the bandhara scheme will depend upon the active participation of local peoples. Government of Maharashtra has already framed guidelines under which irrigation department is already encouraging formation of society of beneficiaries. Such society takes the job of operation and maintenance and has been empowered to collect the charges as prescribed by Govt from the beneficiaries to meet the operation and maintenance. The information on relevant GRs is given in Volume-III.

8.0 Water Recharging

The main advantage of the storage is to allow water to seep into the ground thus recharging the upper ground water table. The water recharging can be accelerated by adopting artificial recharging there by recharge the ground by bore well, tube well or open well (Figure 17 -21). For this purpose we need surplus water and good filtering system. Various filtering systems such as VEE WIRE or natural gravels have been developed and some typical photographs are attached. A policy decision has been taken by Government of Maharashtra to implement various water conservation measures in scarcity affected villages and making additional funds for such areas. Artificial water charging is encouraged in this scheme. There are several villages in Maharashtra which need tanker water in summer for drinking purpose. For such villages more funding intend to be made available by Govt of Maharashtra. It is now proposed by us that the gates may be fixed in month of September upto 1.5m depth so that such stored water is available from first week of September. For the purpose of artificial recharging, help of ground water survey department may be taken to identify such hungry aquifer and such bore well where rates of acceptability is much more.

Figure 17 Raising of water table

Figure 18 Recharging Tube well



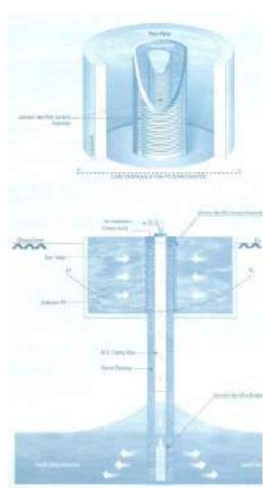


Figure 19 Typical rainwater harvesting system

Figure 20 Raising of water table

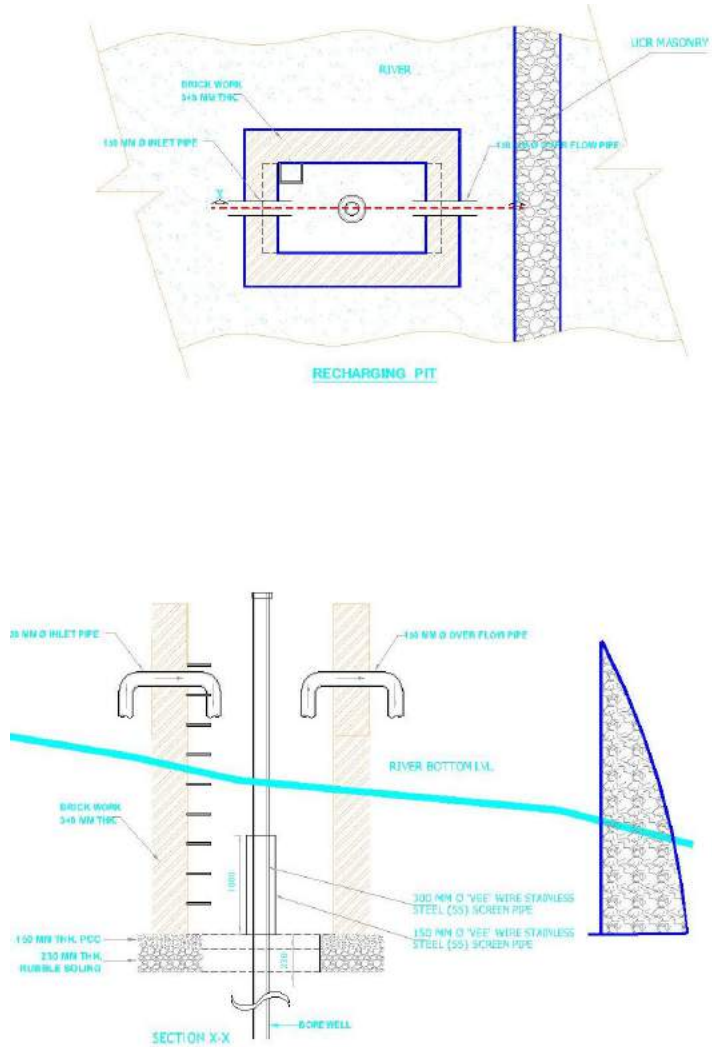


Figure 21 Recharging Pit in River

The science of artificial recharging and rainwater harvesting is well developed in urban areas and also in rural areas. Lots of references are available on internet and there are various agencies and consultants to give proper advices.

9.0 Debris Arrester

Agricultural waste such as dried bushes or branches of trees get carried away may choke up the vents of the bandhara. A system of debris arrester as shown in Figure 22 and 23 is successful in Maharashtra to arrest such floating debris much away from bandhara structure thereby ensuring smooth functioning of bandhara system.   In some places it may be necessary to provide debris arrester in some form such as closed spaced vertical poles, concrete columns etc. so as to arrest the floating debris much away from the structure and there by ensure the smooth functioning of the bandhara. It was a practice to restrict the size of the gate to 2m so that the fixing and removal of the gate is done manually which was possible as average weight of such gate is usually less than 80 kg, however as we are recommending mechanical system, gate size can be increased to 3 m which itself would reduce the phenomena of choking of vents due to floating trees.

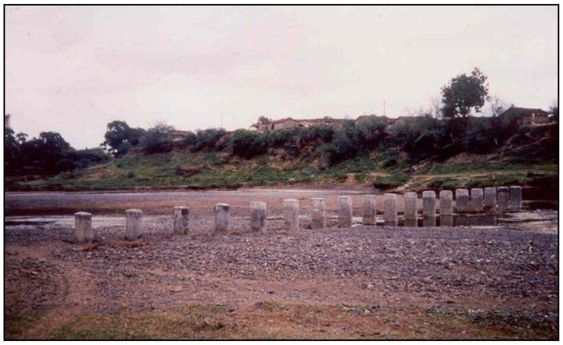
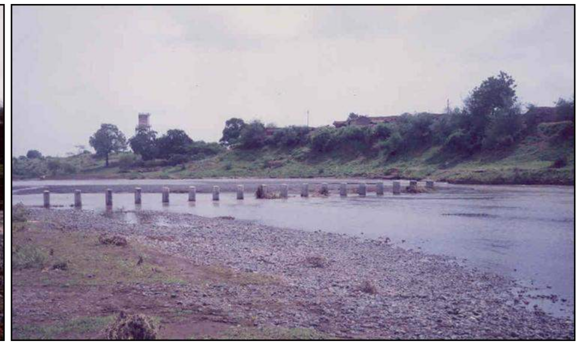
 

Figure 22 Debris Arrester Figure 23 Debris Arrester

10.0 Provision of Overflow weir

Few end spans depending upon the location can be converted as overflow weirs (Figure 24) having lowered weir top by about 100mm. This will ensure that even in accidental cases water will not spill over the gates and thus damage the gates and also further bed level.

Figure 24 Bandhara with side weir

11.0 Placing of needles

The needles are removed and stacked suitably before the start of rainy season. The placing of needles starts after receding of the major floods. In Maharashtra the needles are normally fixed in the month of September end. The plates are also fixed in stages till October end. It has been observed that this practice has not caused any damage to structures due to floods. It is however advisable to study the rainfall patter of last three years to decide ideal time of fixing of needles. It is observed that in south India, the south east monsoon, heavy rains occur in month of November – December, hence in these are the placing of needles will vary.

12.0 Mitigated measures

A structure planned to create storage of 3.5m depth may have backwater of 2.5 to 4 kM depending upon the slope of the river. There may be a need of simple foot bridge at upstream for peoples crossing the river. Depending upon the local condition, appropriate provision may be made. Few cautionary boards may have to be fixed to warn peoples and specially children.

13. Design of structure

Volume II of the report gives the detailed report on the philosophy of the design and evolved technic are also elaborated. It is noted that user can considered several parameters to evolve most cost effective optimum design. It can also be noted that the design does not requires use of complicated software. The type planes developed by us is using simple excel sheets.

Reference:

1. Bongirwar, Namjoshi A G , Jaiswal M M, " Dual purpose bridge structures – Crossings and storage – need of the day', Journal of the Indian Road Congress, Vol 64-3, December 2003.
2. Ingle R K, Jaiswal M M,' A Bridge Cum Bandhara System **'**, IRC journal, Indian Highway, Volume no 29
3. IRC: 5 General features of Design
4. IRC: 6 Loads and Stresses
5. IRC: 21 Reinforced Concrete Bridges
6. Irrigation / PWD Maharashtra circulars

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DEVELOPMENT OF STANDARDISED DESIGN AND DRAWINGS OF A BRIDGE CUM BANDHARA SYSTEM

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Content

Introduction

The general analysis and design principals are presented in this volume. The load calculation and analysis is briefed for following structures.

a. Gravity Bandhara
b. Sill beam type bandhara
c. Steel gates
d. Miscellaneous arrangements

2.0 Design assumption and data

The straight length of pier is taken as 1.8 m for storage upto 2.5 m and 2.2 m for storage upto 2.5 to 3.5m. While lowering the gates they are required to be properly oriented towards slot. The straight length is decided to ensure this operation safely and conveniently. This is normally done manually by labors sitting on bandhara pier. It is proposed to place a temporary light bridge facilitate this operation (Volumn-I, section 5.6).

The analysis and design methodology of the above is briefed below.

3.0 ANALYSIS AND DESIGN OF BANDHARA

This part deals with design of bandhara independent of main piers suitable for either intermediate part of bridge cum bandhara or separate.

The following cases are considered:

i. Intermediate piers on raft resting on hard starta
ii. Intermediate piers on PCC raft resting on soft starta (batter on D/S side) for rock at shallow depth
iii. Intermediate piers on PCC raft resting on soft starta (batter on U/S side) for rock at shallow depth
iv. Intermediate piers on raft resting on soft starta with cutoff wall on U/S and D/S

The above cases are designed with needles placed on D/S. The following load are considered for calculation of vertical force (P), horizontal force (H) and Moment (M).

- Dead Load calculating stabilizing vertical load (P) and stabilizing moment (M)
- Shear Key supporting stabilization P, H and M for shear key
- Uplift generating Vertical upward P and negative moment M to be considered for case when water is standing i.e. gates are closed. Uplift is considered 100% at u/s and zero or equal to water depth at d/s
- Passive resistance i.e. horizontal H and resisting Moment M in few cases
- Static weight of Water when gates are closed (P and M)
- Buoyancy is considered when water is at HFL and no gates (negative P and M)
- Moving water case simulates water moving at HFL without gates (H and overturning M)
- Earthquake forces when water depth is 50% of total depth, with assumption that tank full condition and earthquake may not occur simultaneously

The following critical cases are considered.

- Without Gates Full Water
- With Gates Water up to FTL (without earthquake)
- With gates water upto half depth of water (with earthquake)

It is noticed that the design of Bandhara pier is critical when the water is full i.e. static case and the moving water case or earth quake case is not governing. Needle size are kept variables so that within the existing span fixed number of bandhara piers can be accommodated

The analysis and design steps are briefed below for all the cases.

3.1 Intermediate piers on raft resting on hard starta

Figure 1 shows the sketch of bandhara with raft on hard soil strata.

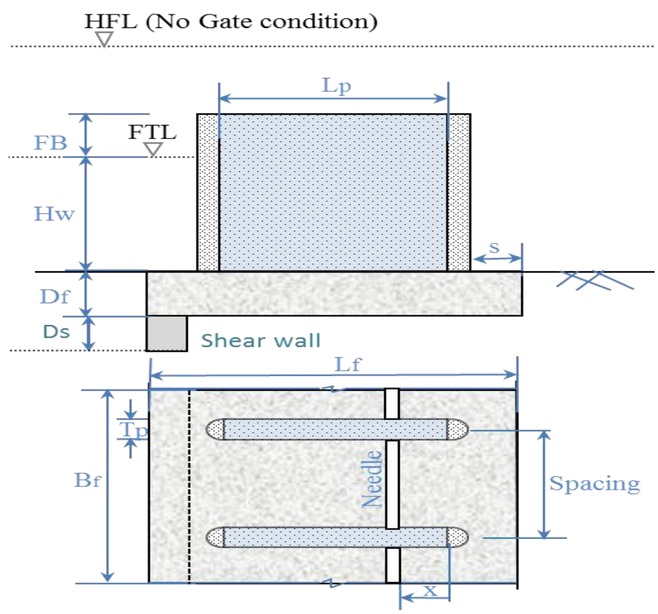


Figure -1 Bandhara of hard soil showing various parts of bandhara

The flow chart for various calculations is shown in Figure 2a to Figure 2g.

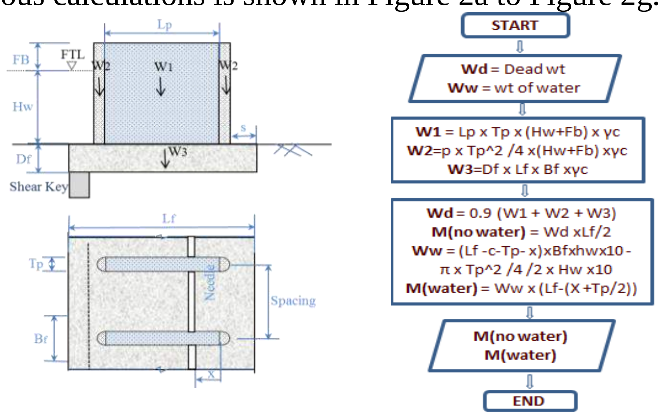


Figure 2a Dead load calculations

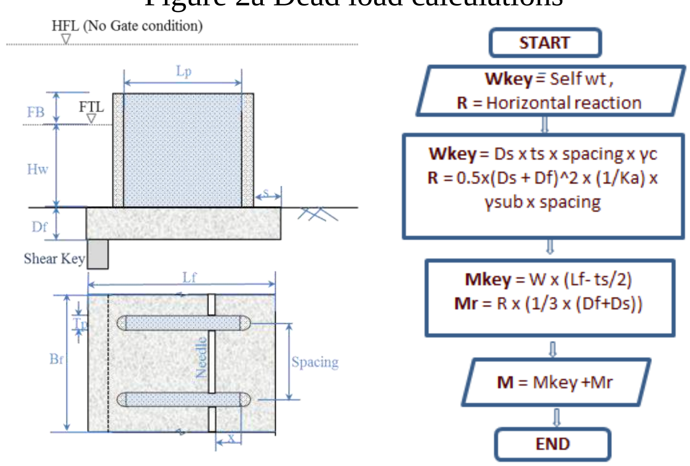


Figure 2b Shear key load calculations

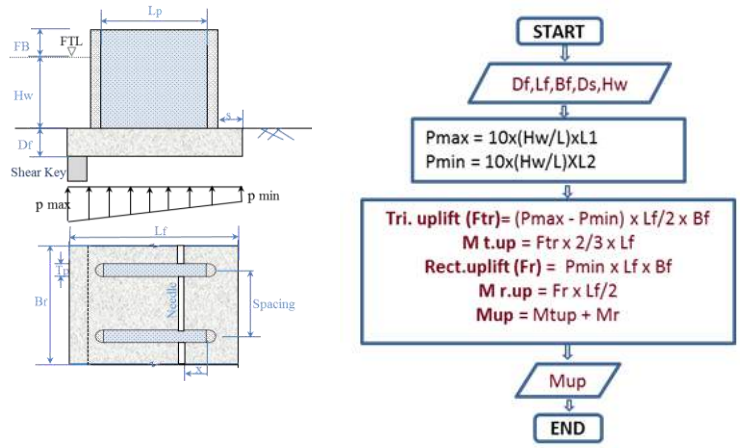


Figure 2c Uplift load calculations

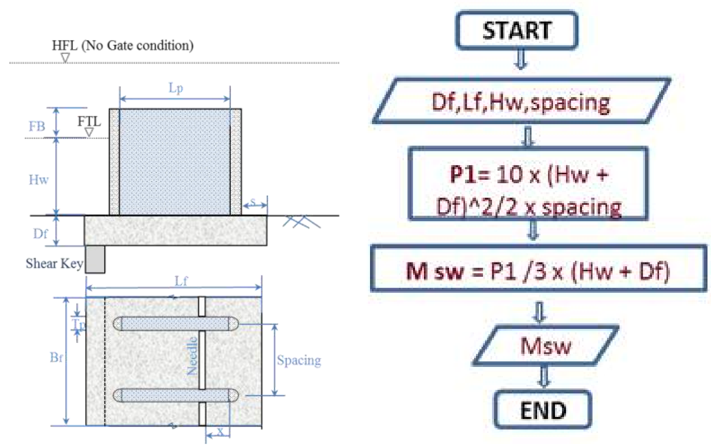


Figure 2d Static weight of water load calculations

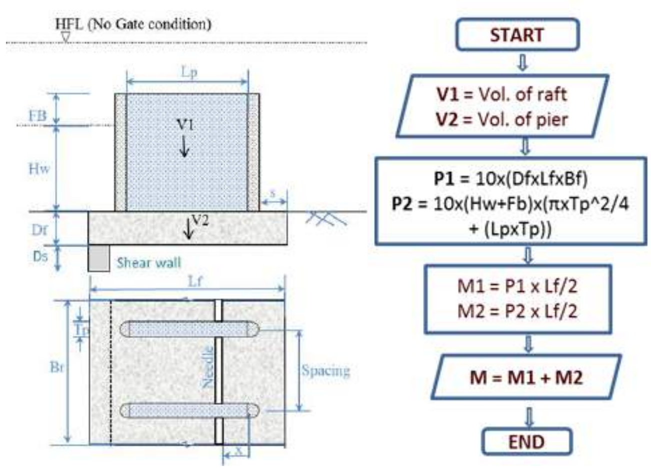


Figure 2e Buoyancy load calculations (No gates and Water at HFL Condition)

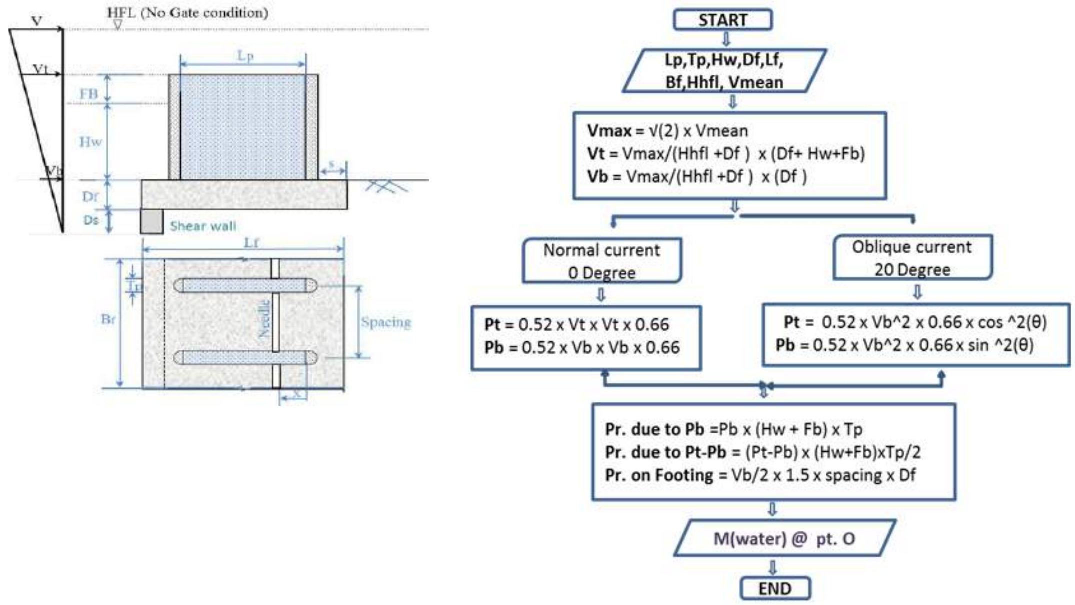


Figure 2f Moving Water load calculations

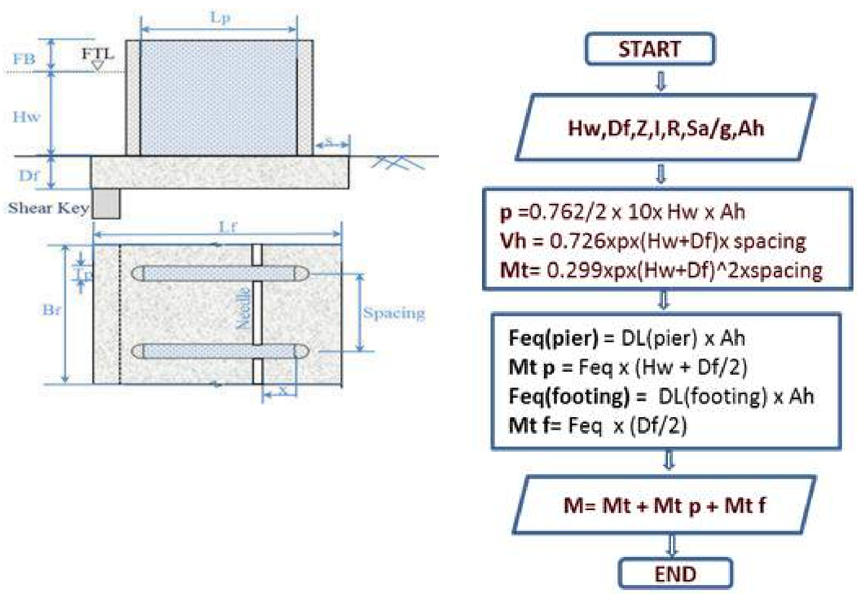


Figure 2g Earthquake load calculations

3.2 Intermediate piers on PCC raft resting on soft strata (batter on D/S side)

Figure 3 shows bandhara system on PCC raft resting on soft strata having batter on D/S side.

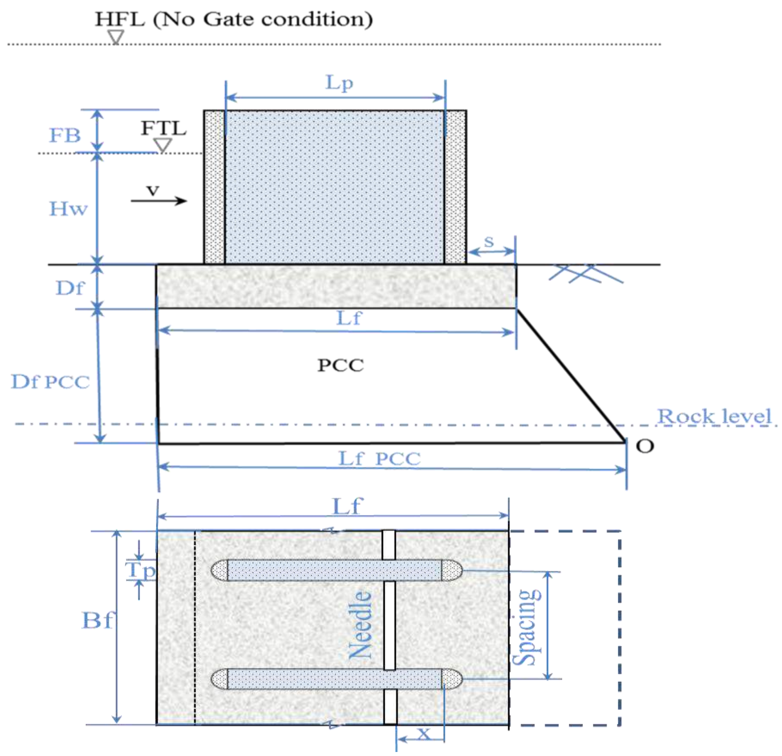


Figure -3 Bandhara of soft soil showing various parts of bandhara

The flow chart for various calculations is shown in Figure 4a to Figure 4g.

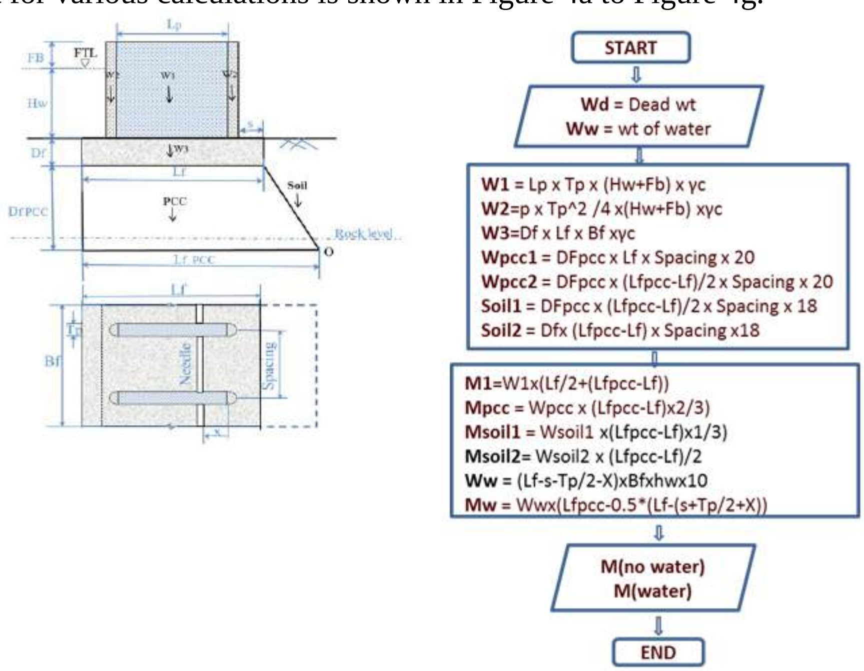


Figure 4a Dead load calculations

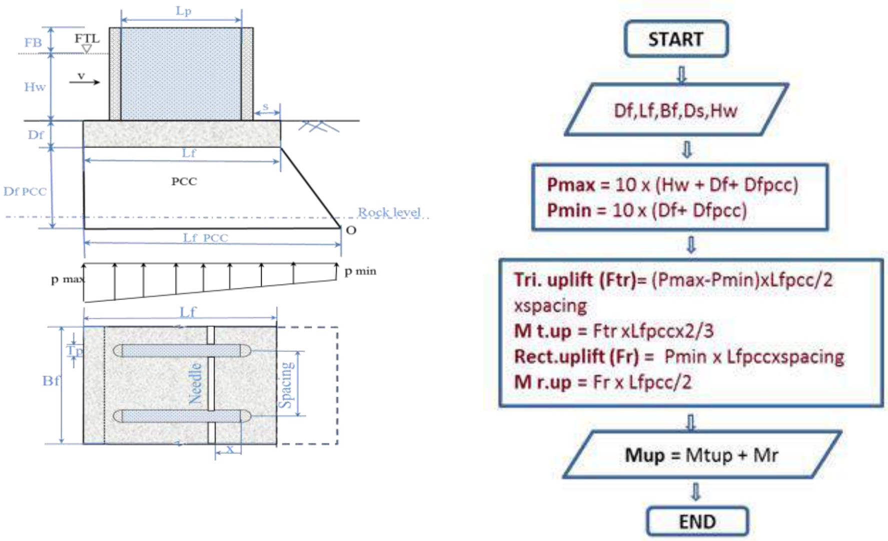


Figure 4b Uplift load calculations

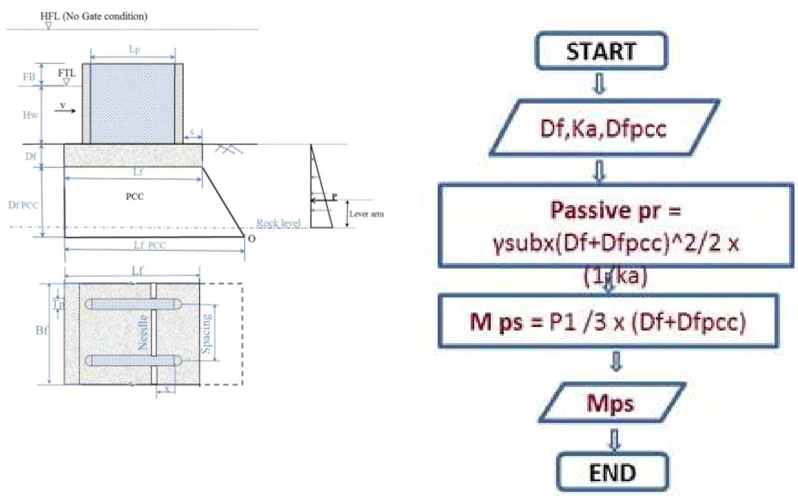


Figure 4c Passive load calculations

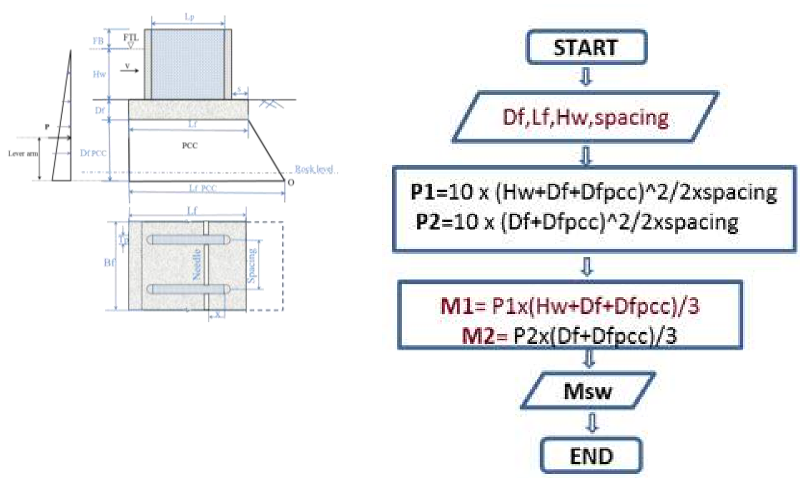


Figure 4d Static weight of water load calculations

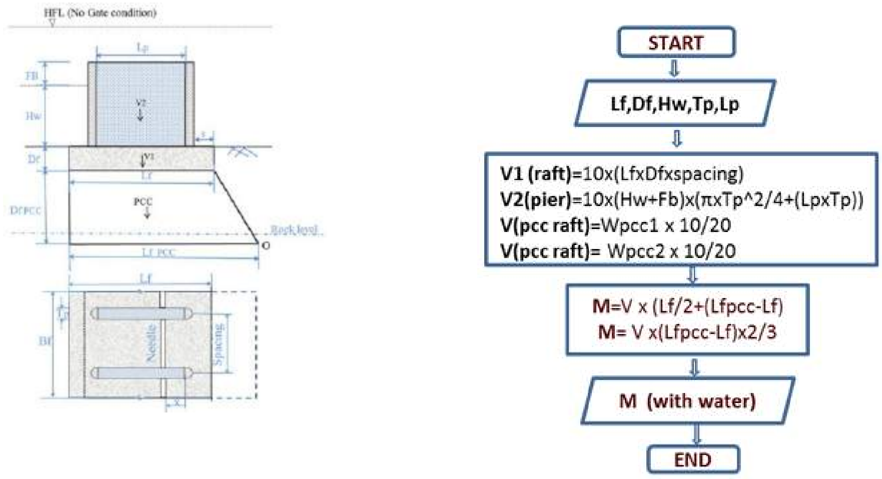


Figure 4e Buoyancy load calculations (No gates and Water at HFL Condition)

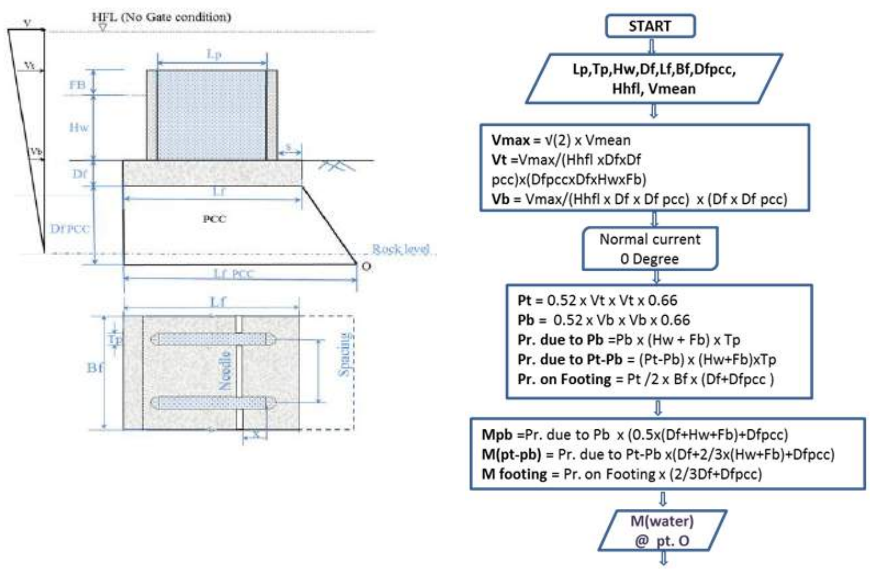


Figure 4f Moving Water load calculations

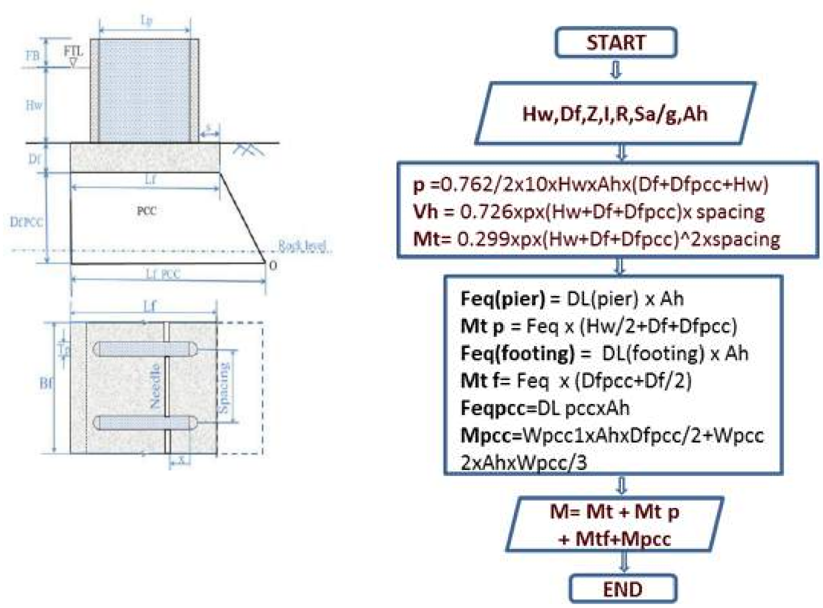


Figure 4g Earthquake load calculations

3.3 Intermediate piers on PCC raft resting on soft starta (batter on U/S side)

Figure 5 shows the sketch of bandhara with raft on on PCC raft resting on soft starta (batter on U/S side).

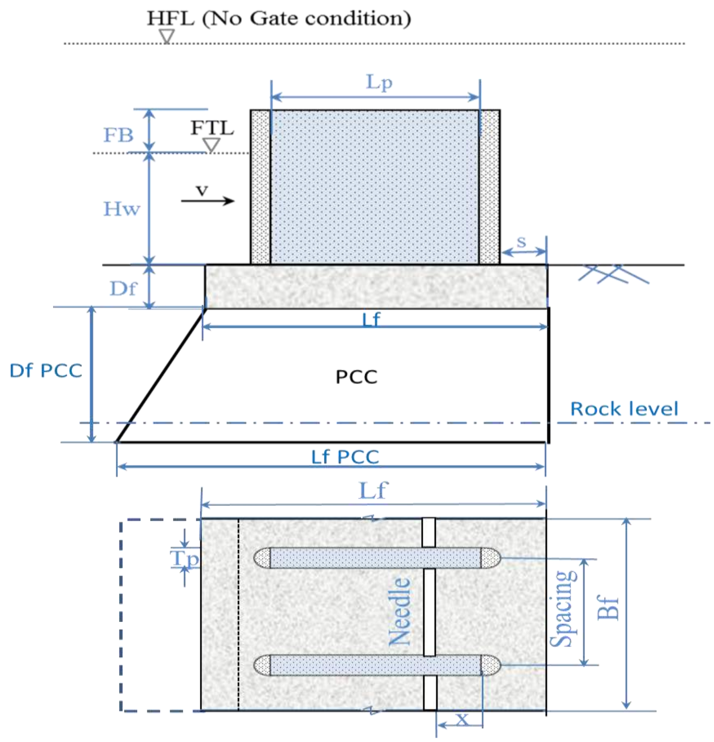


Figure 5 Bandhara with raft on on PCC raft resting on soft starta (batter on U/S side).

The flow chart for various calculations is shown in Figure 6a to Figure 6g.

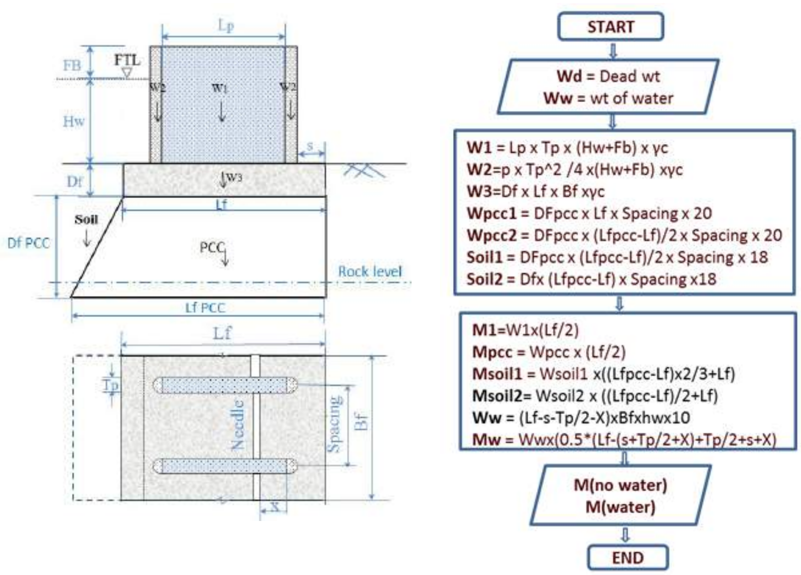


Figure 6a Dead load calculations

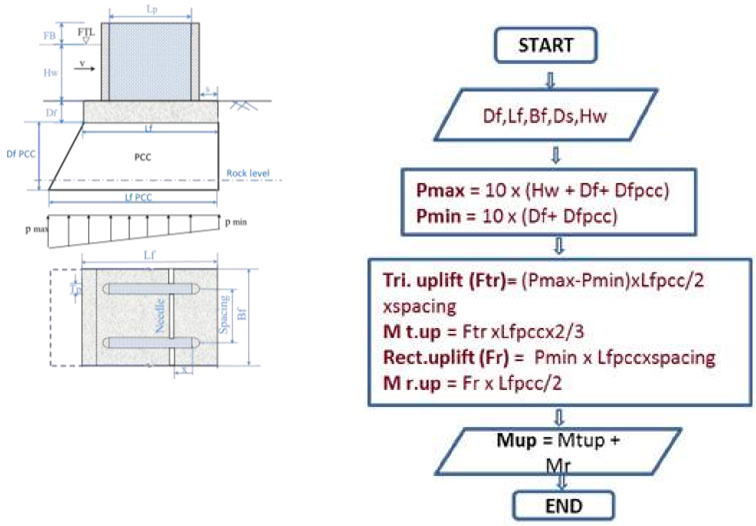


Figure 6b Uplift load calculations

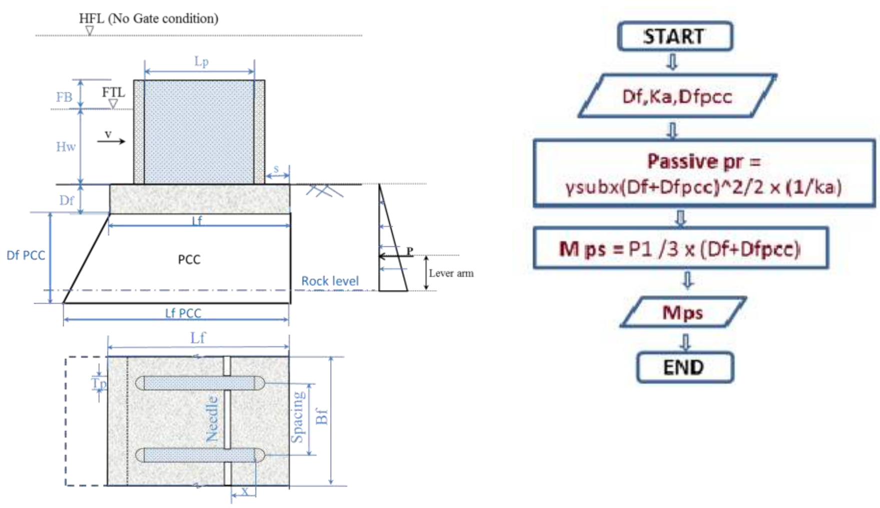


Figure 6c Passive load calculations

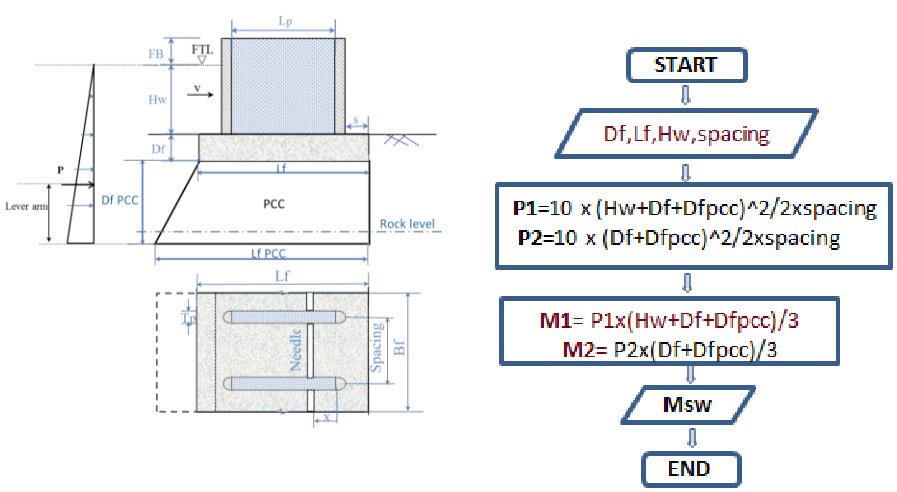


Figure 6d Static weight of water load calculations

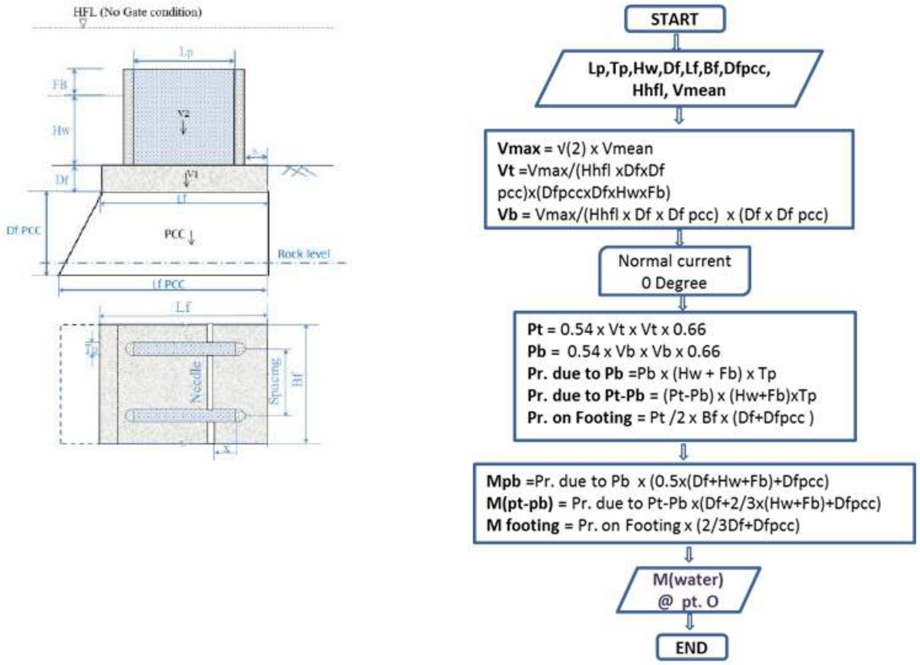


Figure 6e Buoyancy load calculations (No gates and Water at HFL Condition)

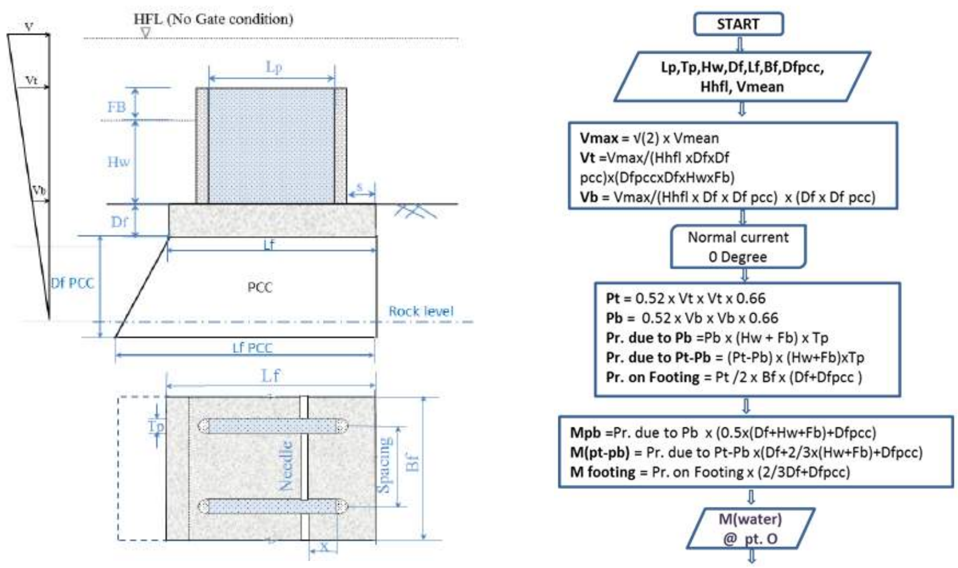


Figure 6f Moving Water load calculations

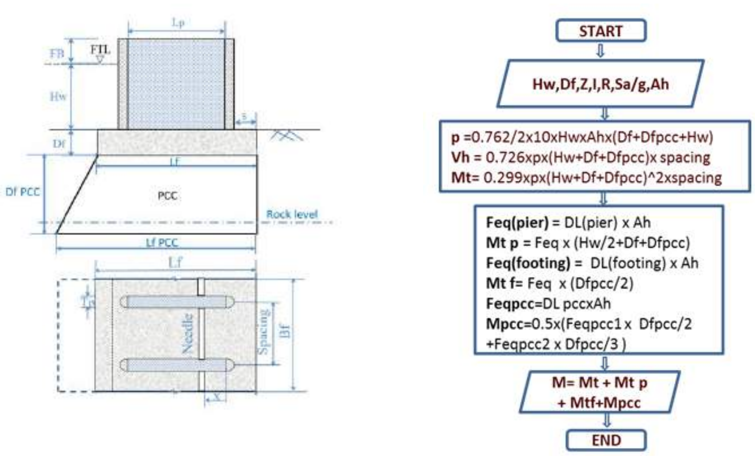


Figure 6g Earthquake load calculations

3.4 Intermediate piers on raft resting on soft starta with cutoff wall on U/S and D/s

The case is restricted for water depth of 2.5m only. Cut off is taken as minimum equal to depth of water. This is the criterion normally adopted for percolation tank to minimize percolation. Exit velocity is restricted as per guidelines given by Lanes weighted creep Theory, which suggests the weighted creep length lw = 1/3 N + V, (N is sum of all horizontal contacts and V is sum of all vertical contacts). To ensure safety against piping Lw must not be less than C times Hw, where Hw is depth of water and C is empirical coefficient depending upon the nature of soil as per Table 1.

Table 1 Lane's Creep Coefficient

SN	Material	C (safe weighted creep ratio)
1	Very fine sand or silt	8.5
2	Fine sand	7
3	Course sand	5
4	Gravel and sand	3-3.5
5	Boulders, gravel and sand	2.5-3
6	Clayey soils	1.6-3

In the above if we substitute Aus=3m, Ad/s =5, Ds=2.5m and Lf = 4.9, we get 2.5(Hw)/(3+5+4.9)/3+4x2.5 = 2.5/14.3 =1/5.72 i.e. suitable for course sand onward however for smaller Hw the Lw will be enough for other soil types also.

Khosla's theory also used in evaluating the depth of cutoff and length of concrete apron to keep exit velocity within acceptable limit.

Figure 7 shows the sketch of bandhara with raft on soft strata with cutoff wall on U/S and D/s.

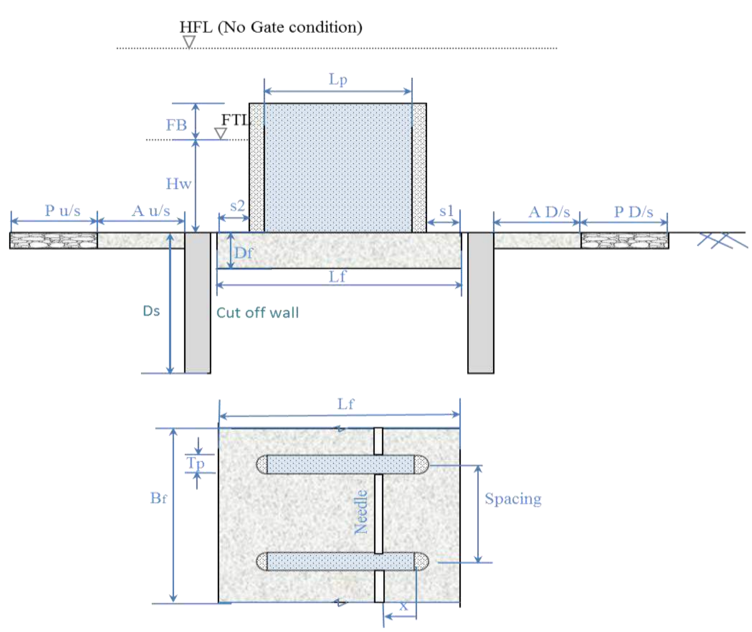


Figure -7 Bandhara of on soft starta with cutoff wall on U/S and D/s showing various parts of bandhara

The flow chart for various calculations is shown in Figure 8a to Figure 8g.

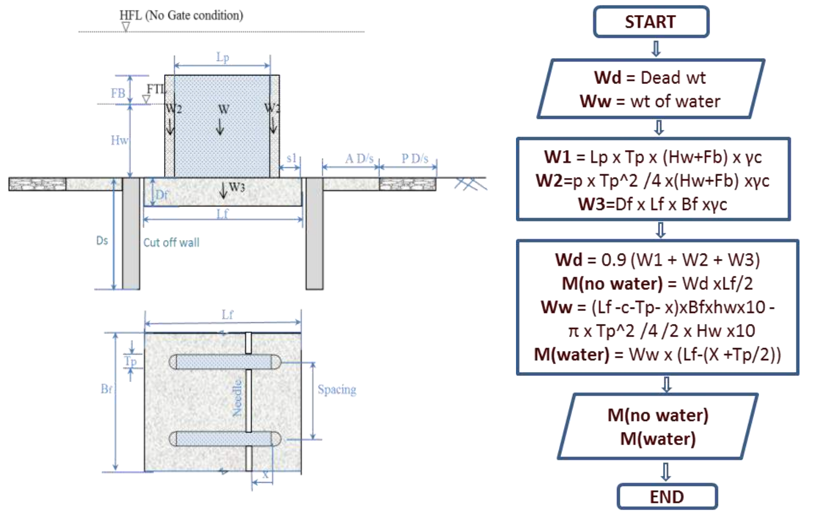


Figure 8a Dead load calculations

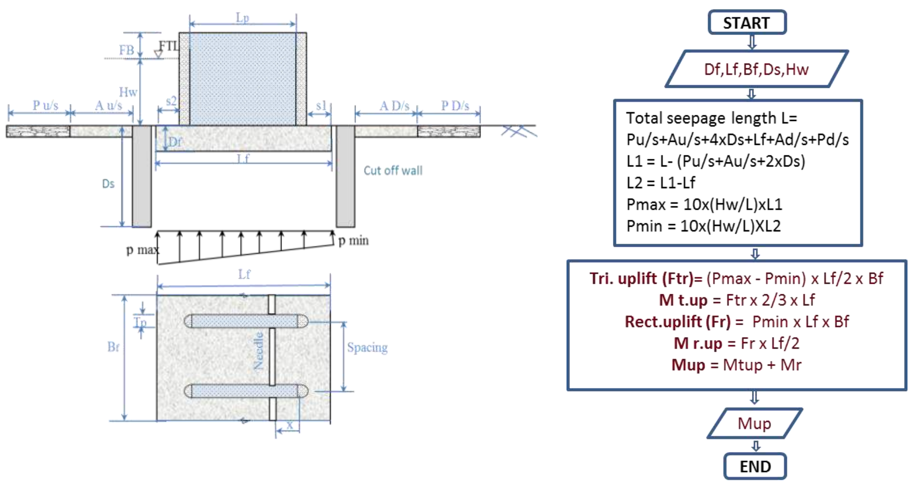


Figure 8b Uplift load calculations

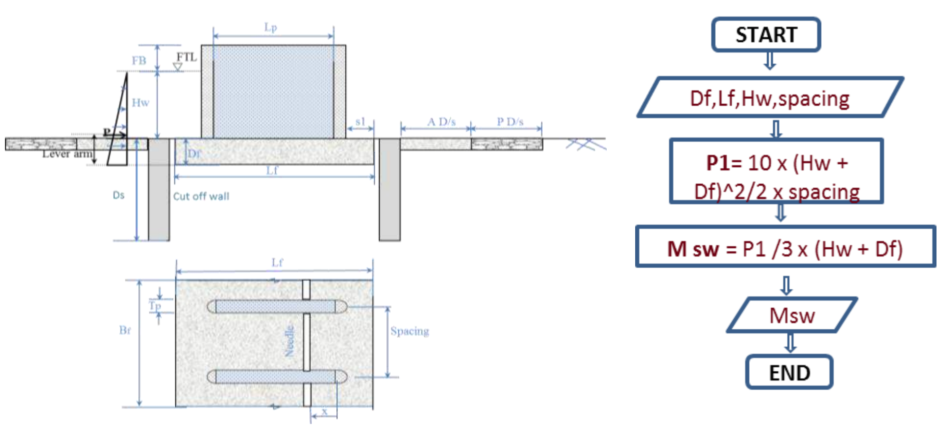


Figure 8c Static weight of water load calculations

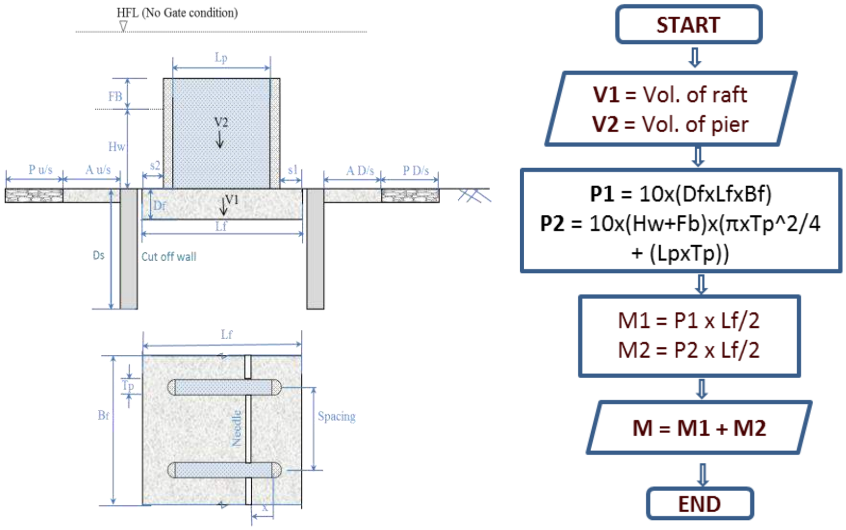


Figure 8d Buoyancy load calculations

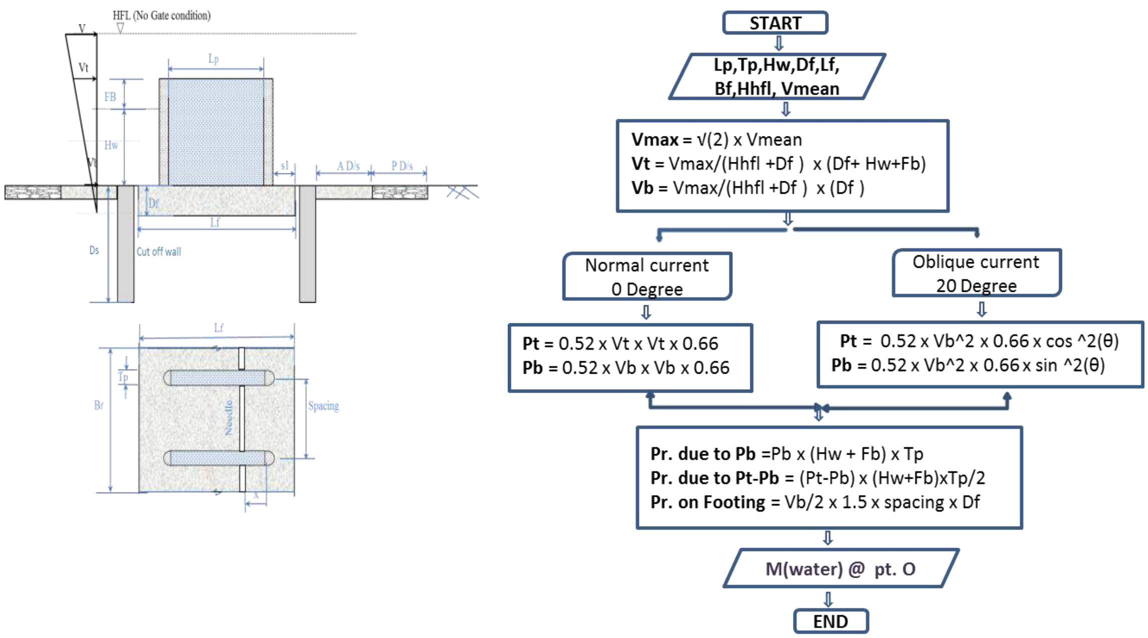


Figure 8f Moving Water load calculations

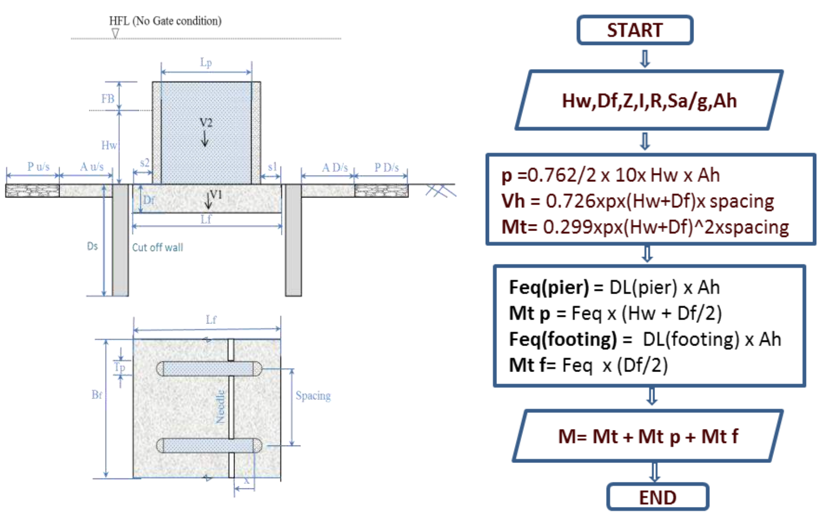


Figure 8g Earthquake load calculations

4.0 ANALYSIS OF BRIDGE CUM BANDHARA SYSTEM WITH SILL BEAM USING FEM

Bandhara System With Sill Beam

This system utilizes the massive piers of the bridge and thus can act as two in one system. This system consists of main piers of bridge (may be 8m c/c) and intermediate piers of bandhara connected by sill beam. A longitudinal sill beam, placed on upstream side of pier, connecting all the intermediate and main piers is used. (Ref. Figure 9-11) The tension arising on upstream side is transferred to the sill beam, which acts as upward force at intermediate pier levels and transferred to major piers by means of bending. The main piers are designed as gravity piers. The analysis of this system is presented in this section.

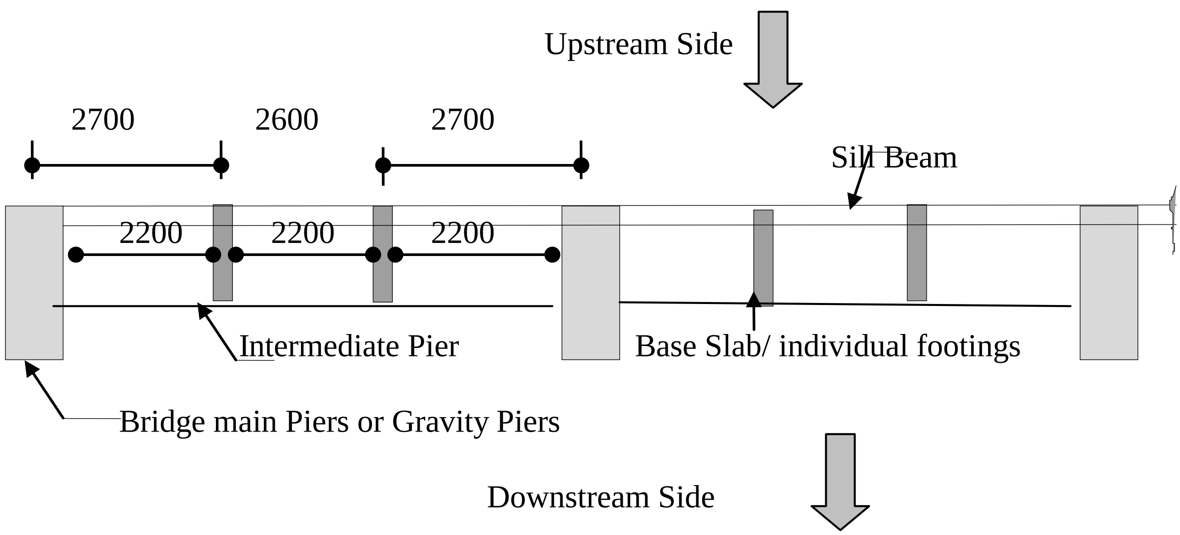


Figure 9 PLAN OF BANDHARA SYSTEM

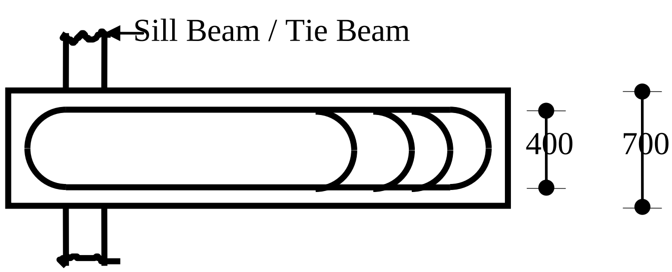


Figure 10 Plan of Intermediate Pier

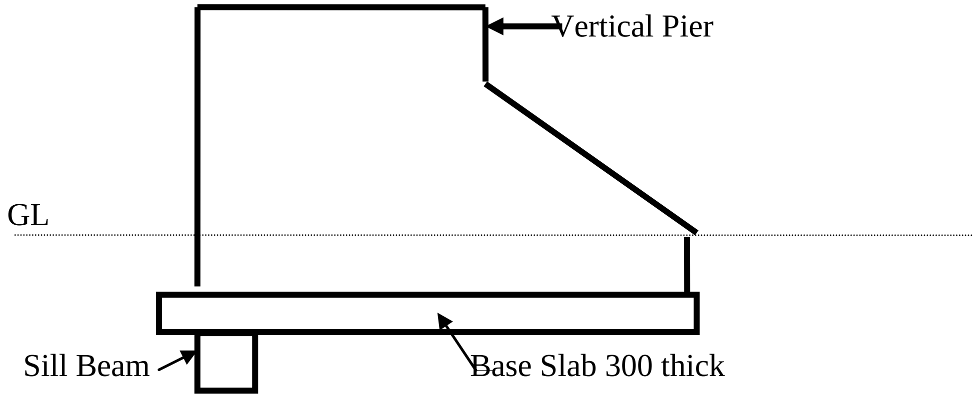


Figure 11 Sections through Intermediate Pier

ANALYSIS

Salient Data

A Section of bandhara pier and sill beam is given in Figure 12. The Pier of size 1.9m x 0.4m with bracket of 1.5m height and Base slab of 0.7 x 0.3 (thick) x varied Length for single / multiple piers is used. The size of sill beam is 0.75x0.60m. Height of water and free board is 3.5m/3.0m/2.5m and 0.5 respectively. M 30 grade of concrete is considered for this construction. The soil strata assumed to be Hard Rock/ soft rock with Modulus of Subgrade Reaction (Ks) as 1.0×10^5 kN/cum, to be on conservative side.

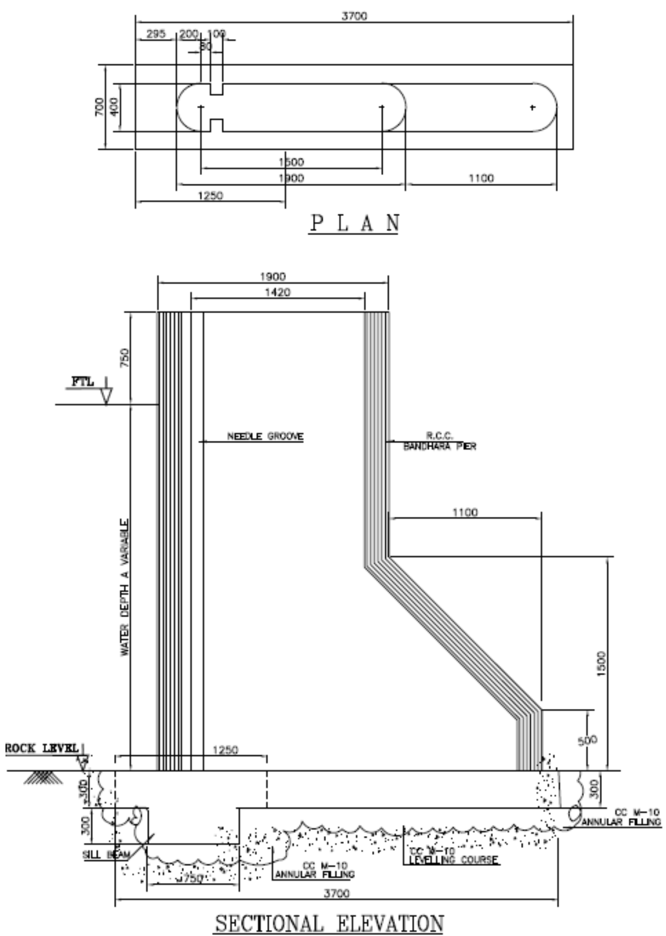


Figure 12 Details of Intermediate Pier

Assumptions

i. Sill beam, base slab and vertical pier are well connected by reinforcement e.g. all these substructures shall act as one at bandhara pier.
ii. Uplift as density of water times height of water is considered.
iii. Winkler model is used to include soil structure interaction effect.
iv. Sill beam is assumed fixed at end pied. This assumption is valid as end pier is massive and very rigid.
v. Annular filling is to be done for all side of sill beam with concrete to prevent percolation. It will also give fixity to beam from all sides and will not allow to rotate

Detailed FEM Analysis

Finite Element method can be used for analysis of bandhara pier system along with sill beam including soil structure interaction, to achieve more appropriate results. The analysis can be carried out considering the structure as space frame with six degree of freedoms at each node. Structures of bandhara system e.g. sill beam, vertical pier and base slab are discretized into small shell / 3-D BEAM elements. However to account for fixity of beam caused due to annular concrete filling appropriate spring values be considered

Material Used

Concrete: M30
Steel : Fe415
Bending compressive stress = 6cbc = 8.5 Mpa
Tensile stress in steel = 6st = 230 Mpa
M=280/3 6cbc =11
N = 1 / (1+ (6st / m 6cbc)) = 0.29
J = 1- N/3 = 0.903
K = (1/2) 6cbc N J = 1.11

Multiple Intermediate Pier

Figure 13a and Figure 13b shows the discretization of a pier, base slab and sill beam where nodes and elements are indicated. The sill beam is assumed to be fixed in the main bridge pier. The soil below base slab is idealized as horizontal and vertical springs. Vertical Soil springs are attached to nodes of sill beam and base slab. Horizontal soil springs are attached to nodes of sill beam and downstream node of base slab.

The analysis is carried out by using computer program SAP2000 with shell elements to mode vertical pier, base slab and 3-D beam element to model the sill beam. Spring elements are used to model soil structure interaction effect.

Soil springs as per Winkler model are attached at nodes of sill beam and base slab, in horizontal and vertical direction, having stiffness, contributory area times modulus of subgrade reaction. Vertical springs that are in tension are removed in next cycle of analysis and the iterative analysis is repeated until all springs comes under compression.

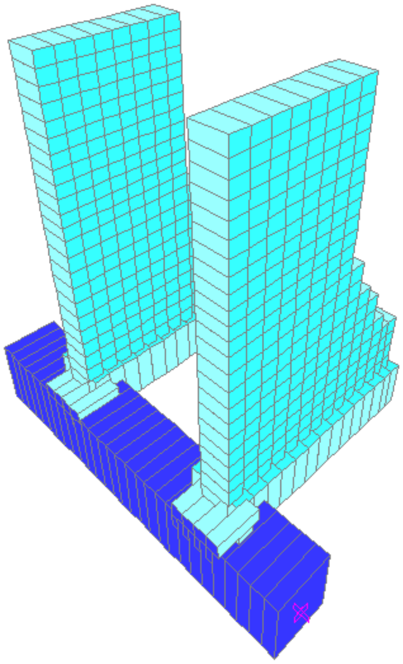


Figure 13a Mathematical Model (in 3-D Extrude view)

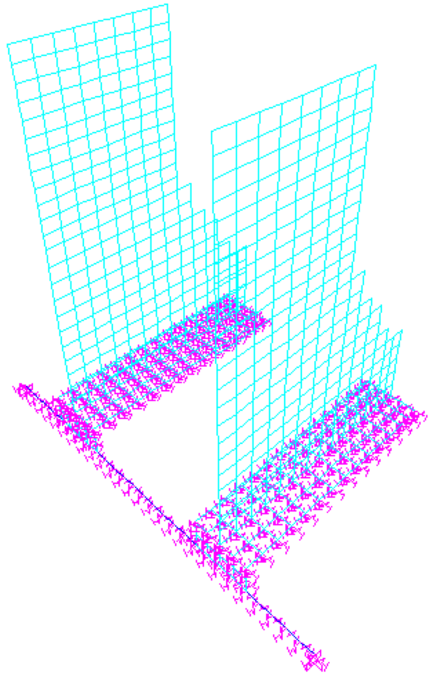


Figure 13b Mathematical Model (in 3-D line view)

The FEM analysis can give all the forces, displacements and reactions. The analysis need to be checked for Ks/2 and 2Ks to allow variation in assumed modulus of subgrade reaction of the strata (Ks).

Typical Calculations for Design of sill Beam (3.5m water depth)

Size = 750 wide x 600depth

It is seen that majority of cases, the minimum reinforcements governs.

Minimum Steel for Flexure
Min steel = 0.85 / fy bd = 0.2% bd = 900 sqmm
Provide at least 4-20ϕ (1256 sqmm) bars on each face at top and bottom.

It can be seen that depending upon the span (2.4 to 3.4m) / number of intermediate piers, the sill beam may needs additional steel at support on U/S of beam along vertical face (up to end span/2) and at centre on top face.

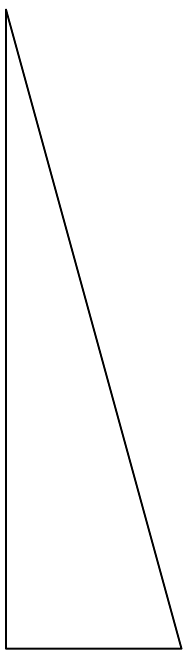
Minimum Steel for shear

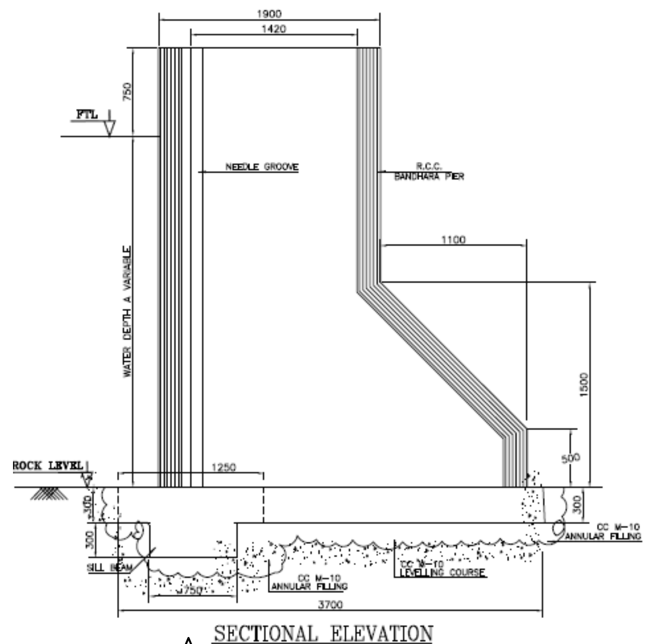
Asv > 0.4 b Sv / (0.87 fy)
> 0.4x750x200 / 0.87x415
> 166 sqmm

Let provide 2L -12 dia links @200c/c .

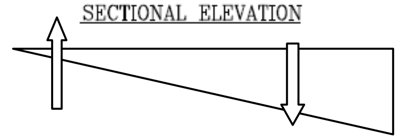
Approximate Analysis

It is necessary to have an approximate method for designing of such structure. The above detailed analysis is used in arriving at approximate analysis for such type of indeterminate structure. The approximate method is briefed below. It is assumed that sill beam is prevented from horizontal movement in plan due to restrain offered by rock. The annular filling of concrete will not allow it to rotate. However the movement in vertical plain is allowed noting that the side bond may break. Even with this assumption the minimum steel is found to be adequate





Water pressure =(3.5+0.6)x10=41 kN/sqm



U D

Figure 14 Water pressure and c/s of sill beam bandhara

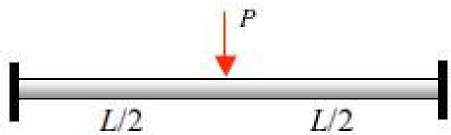
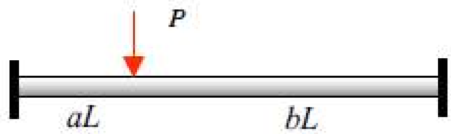
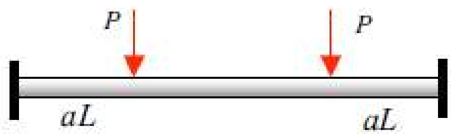
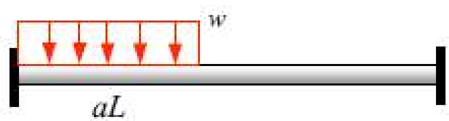
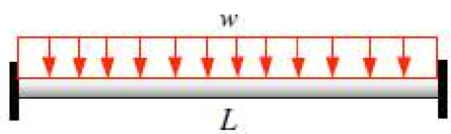
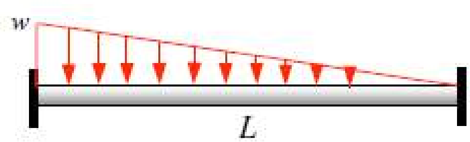
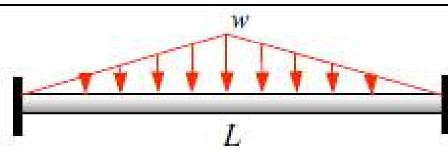
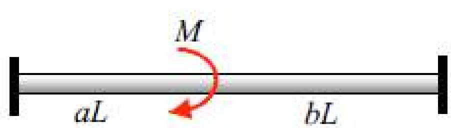
Assuming Span of bridge as 8m, the total horizontal moment (Figure 14) at central intermediate pier = 1/6 x 10 x 3.5x3.5x3.5 x 2.66 spacing = 190 kN. This moment can be converted into couple of vertical forces, upward at centre of sill beam and downward at CG of triangular distribution of vertical pressure on D/S side of sill beam. Moment due to this vertical force can be calculated using the expression given in Figure 15. Principal of superposition can be used to combine the effect of various loads.

CG between the U and D = 3.7x2/3 =2.46m
U = D = 190 / 2.46 = 78 kN
M = a (1-a) PL = 0.33 (1-0.33) 78 x 8 = 137 kNm
Ast reqd = 21 000000 / 550 x 200 x 0.9 = 1394 sqmm

The steel provided at bottom is 4-20Φ+ 2-12 Φ = 1480 > 1394sqmm.

Note: If the weight of the water, self weight of sill beam and part weight of Bandhara pier is considered then the force cause because of static water pressure gets compensated and the structure act similar to gravity structure, thus requiring minimum steel in sill beam.

Fixed-End Moments

M^F	Loads	M^F
$-\frac{PL}{8}$		$\frac{PL}{8}$
$-ab^2PL$		$-a^2bPL$
$-a(1\text{-}a)PL$		$a(1\text{-}a)PL$
$-(6-8a+3a^2)\frac{a^2wL^2}{12}$		$(4\text{-}3a)\frac{a^3wL^2}{12}$
$-\frac{wL^2}{12}$		$\frac{wL^2}{12}$
$-\frac{wL^2}{20}$		$\frac{wL^2}{12}$
$-\frac{5wL^2}{96}$		$\frac{5wL^2}{96}$
$-b(2a\text{-}b)M$		$a(2b\text{-}a)M$

Note: Positive moment acts clockwise.

Figure 15 End Moments for various loads

The downward load due to self-weight of sill beam and the water load on the sill beam can also be taken in to account assuming them as uniformly distributed loads. This will reduce the moment and shear due to the vertical reaction of pier.

This approximate analysis of the sill beam can be done using the above method for other spans. In case of detailed requirement, the same can be verified using FEM model.

The observations on such bandhara system are summarized below:

1. It is observed that there is considerable saving in material and excavation.
2. The torsion is less if we adopt only single intermediate pier.
3. Reduction in horizontal moment and shears in sill beam is observed when horizontal springs are considered. There is considerable increase in pressure without effect of horizontal springs. Thus economy can be achieved by considering horizontal springs.
4. Uplift affects the vertical moment and shear in sill beam. With uplift both the vertical moment and shear is less as compared with the results of without uplift.
5. Embedment of sill beam in rock shows reduction in forces and pressures with increase in embedment.
6. As these bandhara are situated near Bridges, they are easily accessible. This is added advantage of this system.

5.0 ANALYSIS AND DESIGN OF STEEL NEEDLES

The following needles are designed and drawings are prepared. Other sizes / configuration can be analysed and designed on similar lines.

1. Size 2.0 clear x0.5 m for 3.0 depth of water with angle and RHS sections
2. Size 2.0 clear x0.5 m for 2m depth of water with angle and RHS sections
3. Size 2.0 clear x1 m single gate for 1m depth of water with angle and RHS sections
4. Size 2.0 clear x 2m single gate for 2m depth of water with angle and RHS sections
5. Size 2.0 clear x 3m single gate for 3.0m depth of water with angle and RHS sections
6. Size 2.0 clear x0.5 m for 3.0m depth of water with angle and RHS sections spanning vertically between ISMB 100
7. Size 3.0 clear x 3m single gate for 3.0m depth of water with angle and RHS sections

The following material / sections are used.

i. 3mm plate (being considered as minor structures)
ii. Angle sections ISA 45454@2.7 kg/m ISA 45455@3.4 kg/m
iii. Channel section ISMC 75 @6.8 kg/m
iv. Rectangular Hollow section RHS 50x25x2@2.15 kg/m and RHS 80x40x3.2@5.5 kg/m

Mathematical model

The plate is provided with two side angles (ISA 45454 / RHS 50x25x2) and longitudinally at top and bottom either ISA 45455 / RHS 50x25x2 or channel ISMC75 / RHS 80x40x4/3.2.

The plate is further stiffened by vertical members ISA 45455 / RHS 50x25x2 spanning between two longitudinal members. The RHS sections will be of grade 310 Mpa and angles of grade 250 Mpa. A typical section of a needle is shown in Figure-16.

The mathematical model for bottom and second needle is shown in Figure-17. The plate is modeled with 4 noded plate elements. The longitudinal and end transverse members are modeled as continuous beam element. The central vertical stiffeners are modeled as beam elements simply supported between the two longitudinal members.

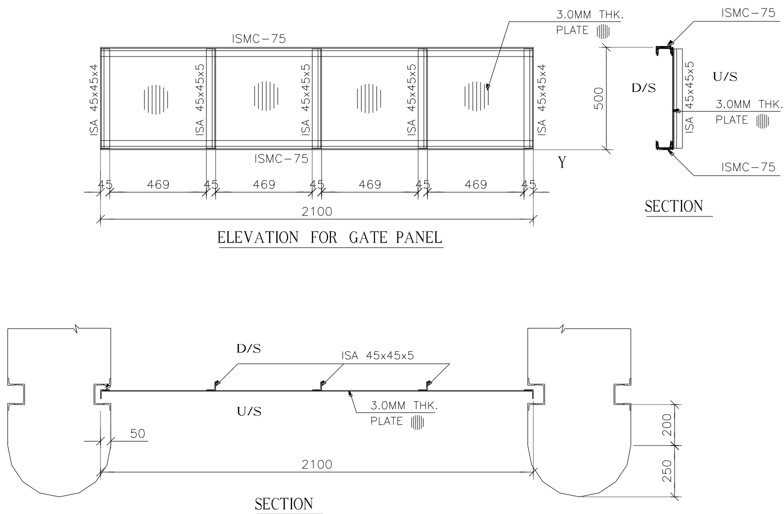


Figure-16 Section and plan of a typical Needle

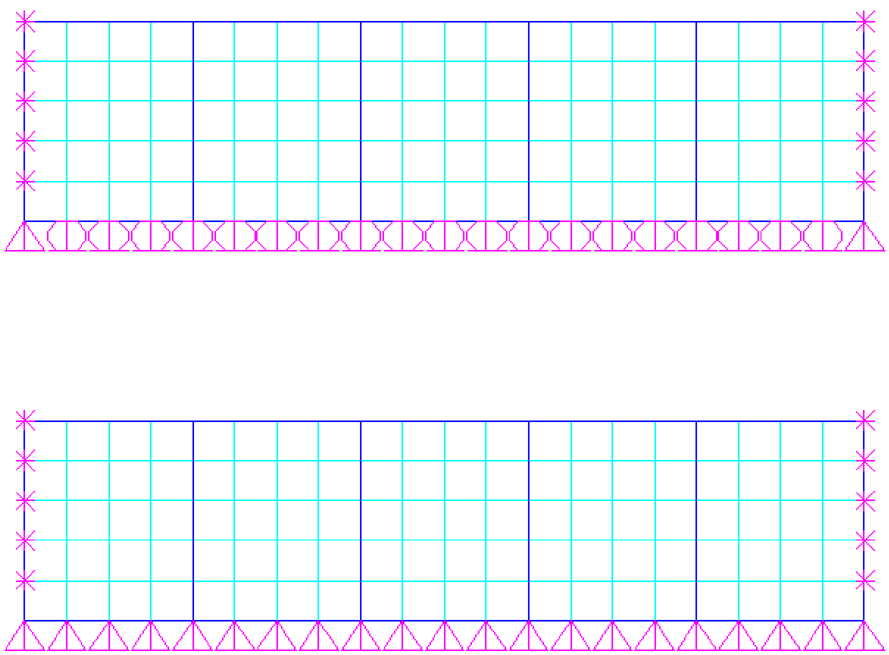


Figure-17 Mathematical model of needle (Bottom and other needle)

For the bottom needle, it is assumed that bottom long edge will fit into the grove of the pier floor and hence hinged boundary condition is assumed. The sides are also assumed as hinged. The top is assumed to be free. For the second gate, the bottom longitudinal edge is assumed to be on roller.

The water pressure is considered as triangular with zero at top and density of water times the height at bottom. The summary of the design of one gate using angles is given below for size 2.0x0.5 m for 3m depth of water with angle and RHS sections

Check for deflection

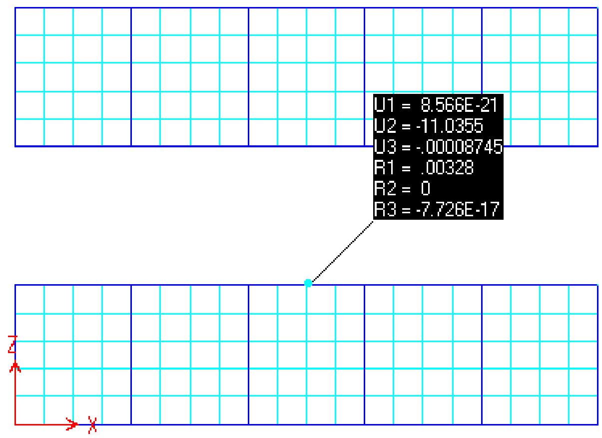


Figure 18 Deflection Diagram

Span = 2100mm
Permissible deflection as per purlin (Figure 18) = Span /150 = 14mm > 11mm OK

Check for Plate stress

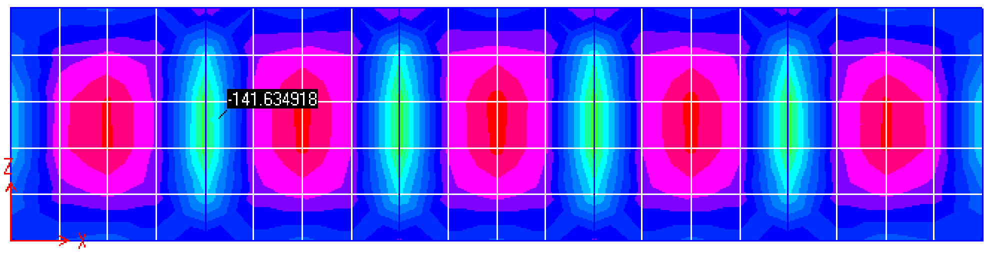


Figure 19a Stress σ_{11} diagram

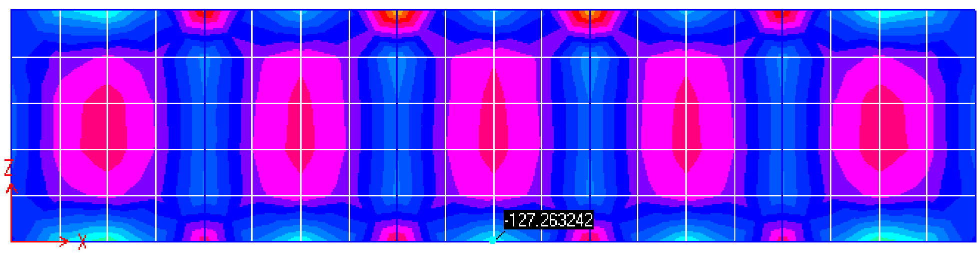


Figure 19b Stress σ_{22} diagram

Bending Stress (Figure 19a and 19b) = 141 Mpa < 165 Mpa Ok

Check for Longitudinal Member

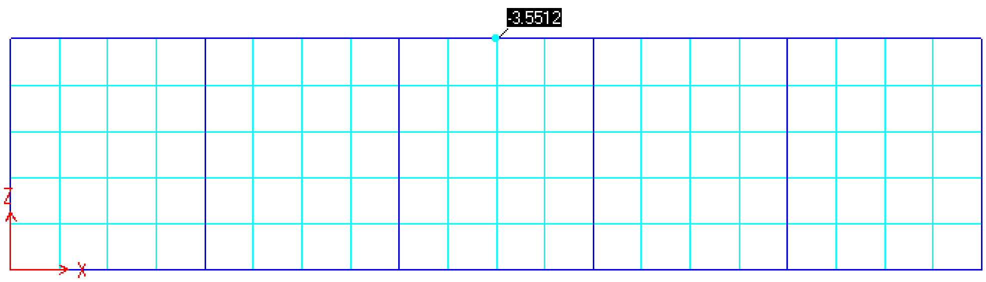


Figure 20 Moment Diagram

Bending moment = 3.55 kNm (Figure 20)
Bending stress = 3.55x1000000 / 20300 =174 Mpa > 165 Mpa but OK with the steel plate contribution.

Check for central vertical stiffeners

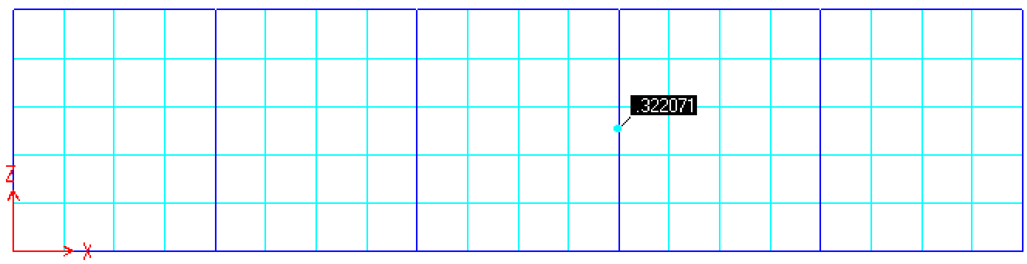


Figure 21 Moment Diagram

Bending moment =0.322 kNm (Figure 21)
Bending stress = 0.322x1000000 / 2500 = 129 Mpa < 165 Mpa OK

Similarly other gates are analyzed and designed. User can design the gates based on available section and various other sizes.

The details of FRP gates is given in Annexure-I for information.

6.0 Miscellaneous Structures

This section explains the design of overflow weir and lifting arrangement equipment etc.

Overflow weir

The overflow weir is suggested on both the abutment sides. On one side the height of weir can be 1.5m and other side it can be equal to FTL of the bandhara.

On the side where the weir height is 1.5m, piers need to be given so that additional needles can be provided to lock this area. (Figure 22)

Pipes of 300mm diameter with operating valves can be provided at ground level in the weirs having depth of FTL so that these pipes can be operated to supply water to villages on D/S side as and when required.(Figure 23)

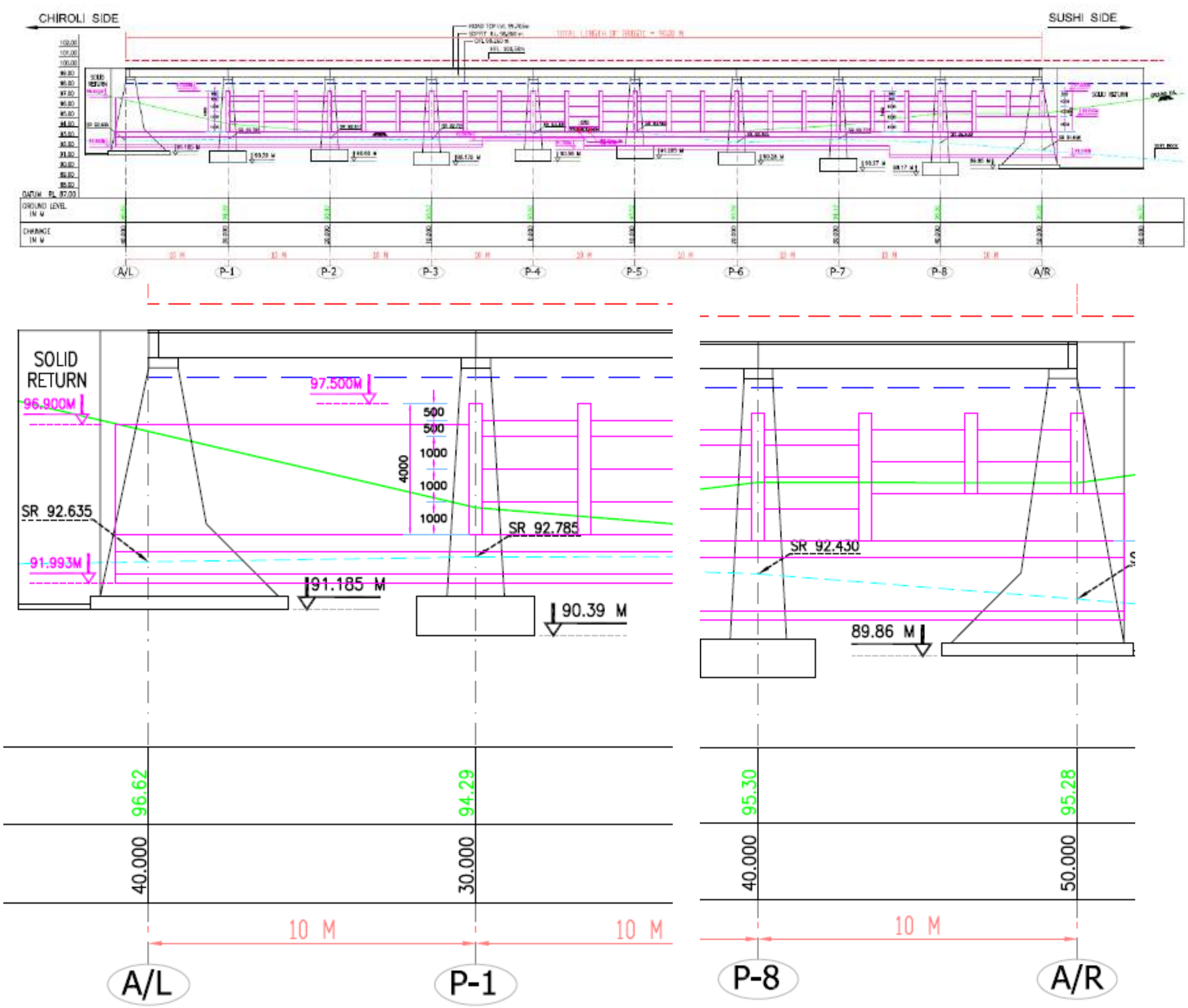


Figure 22 Proposed overflow weir between P8 and A/R with few gates and A/L to P1 full overflow weir

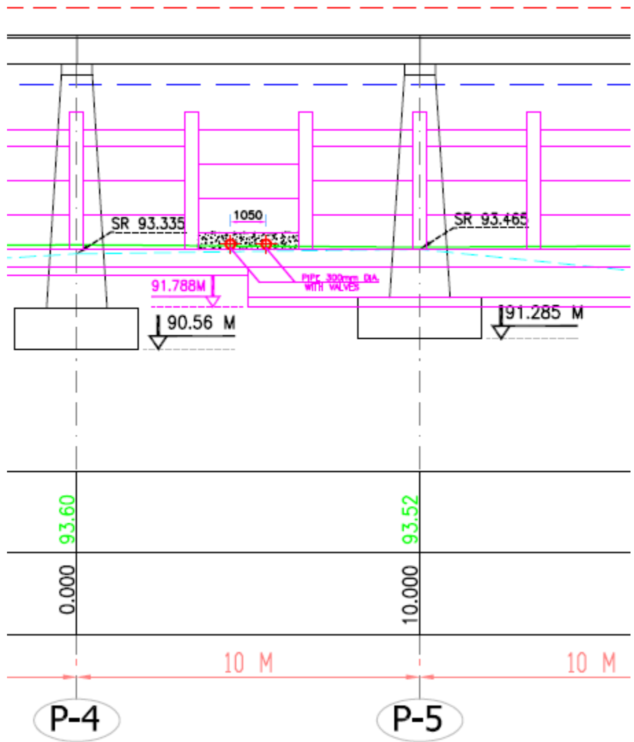


Figure 23 Pipes for outlet

Lifting arrangement equipment

Now a days, strong healthy labours are not available for handling material at the site in remote areas. The smallest equipment /crane available in the market for handling material is Hydra of 9 Mt or 12 Mt capacity. But this Hydra is not available in remote areas or in villages. The rent and consumption of fuel is also not affordable for small work and small weight handling.

Presently, following work needs small weight handling equipment.

1. Loading, unloading, transportation and insertion of steel needles in Bridge cum Bandhara.
2. Loading, unloading, transportation and insertion of precast pre-stressed concrete planks and columns for the construction of Boundary wall.
3. Loading, unloading, transportation and placing of concrete block in the construction of R.E. Wall.
4. Loading, unloading of agricultural bags etc.

Hence to cater the above need, we designed and manufactured Tractor trolley mounted equipment which can handle the load up to 200 kg. It is economical Speedy; easy Operation with Remote and 360 degree rotation is possible. (Refer Figure 24)

Figure 24 Stand alone lifting trolley (storage + placement) arrangement

Salient features:-

. Continuous Operation by Remote Control with only two persons
. Capacity - 200 Kg.
. Rotation - 360 degree
.Boom Length - 3.0 M.
. Lift Height – 2.5 M.
. Movable - Manually / With Tractor
. Grab – Simple as per element size.
. Maintenance :- Negligible
. Motor: - one H.P. 240 volts
. Operation: - On Generator

The gates can be stored on ground in temporary shade similar to cycle stand by placing two vertical posts / pipes at distance @ 150 mm c/c

NEW ERA IN IRRIGATION - USE OF ADVANCE MATERIALS

Sudhir Dabhadkar- B.E.(Mech), DBM, ICWA.MIE

In the recent developments in irrigation, the concept of building low height dam all along the river was introduced on the downstream of bigger dam .or along the river to store water after rainy season is over so can be used for agriculture purpose as well for drinking,

In India we have rains only 2-3 months and then it is dry weather, so water is needed during lean period. So all 12 months we can cultivate the land get more crops and yield .Also avoid shortage of water for other purposes.

In the past during rainy season and after rainy season the water poured by nature flown through river, nalas, and streams goes to the nearest sea. Almost 90 % of such water is wasted and gets un-utilized .as this water is does not accumulate at one place the capillary level of water remains unchanged.

So it was thought of well known kings, rulers of ancient days to find the ways and means to utilize this natural resource in proper way and at proper time. So the idea of small height dam /KT wier/ Bandharas emerged.

The small ht/stop dam with low cost is constructed all along the river and near/close point of village.

One river may consist of 300-400 such small height dam /stop dam. Such small height dam /stop dam may have small numbers of openings depending upon the width of river/depth of river.

Risk of the out planking, seasonal floods, and soil condition is taken into consideration.

There are small openings of 2.00 mtr wide and number of such openings may vary depending on the need, river width, and risk of outflanking and design of check dam and water required for full irrigation for nearby land/farms for cultivation and drinking.

Height of the dam is determined on storage capacity for required irrigation and for drinking in total lean period, with height varying from 1.5 mtrs to 4.50 mtrs. These openings will have grooves both side to fix the needles.

These barriers are fixed to store the water, to rear side during post monsoon session and during the scarcity of water. The water is released from the main dam during such period or stored when rains are diminishing. To facilitate the water storage, depending on water level required appropriate size gates/barriers (barge) are fixed into the slot / groove.

In olden days these barge/needles/ gates /barriers are made from wooden planks. These wooden planks are inserted in both the grooves and soil/mud is pressed between the gaps, which act as barrier prevents water flow to downstream .this is done at the end of rainy season period or on lean period. Nowadays scarcity of wood is always there and there is ban for cutting trees, as per environmental laws and rules. It is need have today retain jungles and forest to balance the nature. Some states already shifted to M. S. Fabricated gates with plates & angles/ bars. These are inserted in one of the grooves and as barrier.

Figure A1 FRP Gates in Position

Issues with existing gates in wood and MS:

- As scarcity of wood and Govt. ban on cutting trees for environmental reasons.
- In MS-fabricated gates,-Weight is – 70 kg -100 kg
- Short life -being in MS getting rusty over period of time.
- Due to polluted water getting corroded / eroded very fast.
- Due to heavy weight removing and fixing cumbersome.
- Storage problem.
- Chances of theft due to resale value.
- Repairs & maintenance every year for year for 30% qty
- Cost of replacement of 30% qty = @200 lacks in every circle.
- Heavy water loss from interface of two gates as its matching is lost due to rusting and wear and tear.

- More serious problem noticed was theft of MS gates and selling in scrap market, which is putting whole department's staff under problem.

With this various kinds of problems and the regular expenses on the repairs, maintenance and replacements of gates every year. Similarly the availability of funds is another issue, so most of such low height dams is either without gates or having major damages due to wear and tear.
The irrigation department was looking for the new and advance material.
In year 2009 in gathering of 12-14 Executives Engineers raised this issue was discussed and everybody urged to have some new concept, with some different material, also it was suggested new should have many fold advantages over the existing material. It should be:

- Durable.
- Cost effective
- Longer life.
- Prevention from loss & theft
- Chemically resistance
- Light weight.
- Easy to operate and store.

In recent years the Glass reinforced Plastics is catching the most of the areas where it has replaced MS/Aluminum/ material due to above advantages. Being experts in GRP/FRP manufacturing we suggested go for the FRP/GRP material, which is having all above properties and advantages.
With this in 2009, few of sites were visited and a proper design was made and manufactured similar to existing MS gates.
In order to gain confidence we started very small ht. dams 2.00 mtr high, watched the performance and then moved to 4.50 mtr height dam with high flowing water with heavy water current.
Both the places the performance was excellent and appreciated by the concerned division EE, SE, CE.
We had to wait till 2011 to gain confidence and prove the product viability. The Maharashtra Irrigation dept, well appreciated the concept and started demanding to change from MS to SMC-FRP gates on large scale.
As on date we have, 150 bandharas, where this new concept is introduced on full scale and giving desired performance.
Barring one or two cases, due to fitment error and bandhara is non aligned properly we got negative results.

These type of gates are already used in Japan since 1960. And proved it's utility. Today business in FRP gates in Japan is reduced due to no replacement required due to its enhance life and no theft; after first five years spent in full implementation.
Govt. of Maharashtra- Irrigation (Water Resources dept.) already given full fledge support and rate approvals and keenly introducing in new as well old bandharas.
We have also introduced this new concept in Kerala state.
First site where we have installed this shutter gates is in Trivandrum, (see photo graphs).and Trichi, (under construction).
Smc-FRP is widely accepted due to its life (no wear and tear), easy to handle, no weathering effect and threat to steal as zero scrap value.

What is – FRP?

- FRP is fiber reinforced plastics. Mixture of Glass Fiber matts# and Resin which gives high strength laminate.
- Light weight.
- Stronger in impact strength.

- Chemically resistance.
- Can be moulded in any shape.and colour.

Advantages

- Being light wt – removing and fixing is easy .
- As removing and fixing is easy number of labor required at site will be 2-3 nos.
- Saving in labor rate.
- As rubber sealing provided on FRP needle on downstream side, due to compression of rubber under water pressure and wedging from the back side the water tightness is insured.
- At joint a simple water base sealant is applied which make joints leak proof.
- Simple anchoring is required at rear side to hold the needle tight in the groove.(by way of wooden peg)

Proper rubber gasket between two needles /gates horizontally at interface of needle/gate and interlocking between two needles /gates insures proper fitment and desired water tightness.

ASSUMPTIONS IN DESIGNING THE FRP NEEDLES/GATES SHUTTER

1. General

There are many general differences between FRP and traditional metallic materials that have been established for many decades. While carbon steels, stainless steels, and copper-nickel are metals, isotropic, and homogenous, FRP is a composite, orthotropic, and heterogeneous.

Typical structural materials are normally divided into four basic categories: metals, polymers,

Ceramics, and composites. A composite is basically a combination of two or more other structural materials. FRP is a composite of a polymer (the resin) and a ceramic (the glass fibers). When we define composites in this manner, we are normally talking about composites formed on the macroscopic level. If we looked at it from the microscopic perspective, we would have to consider most materials to be composites.

By forming a composite such as FRP, an engineer can take advantage of the desirable properties of both constituent materials. In FRP, the glass fibers provide the strength and stiffness while the resin matrix acts as a binder providing impact resistance, compressive strength, and corrosion resistance.

One property of FRP that results from it being a composite is it is non-isotropic whereas traditional metallic materials such as carbon steel are isotropic. When we say isotropic, we mean that the mechanical properties, such as strength and modulus, are the same regardless of direction. In a non isotropic material, the properties associated with an axis passing through the material will depend on the direction it passes through the material.

Thus, when you look up the mechanical properties of FRP material, you will often find not one modulus value, but several modulus values, including axial tensile modulus, hoop tensile modulus, and axial compressive modulus. It is extremely important when designing with composites such as FRP that the designer understands the non-isotropic properties of the material and takes this into account in the design process. Treating FRP as an isotropic material would be a poor assumption to make as a design engineer.

A second property that results by forming a composite such as FRP is that the material is now heterogeneous. That is, its composition varies as you move from point to point through the material.

Traditional metallic materials, on the other hand, are homogenous. To overcome this, most

Mechanical properties are averaged. This is achieved by treating the composite as an equivalent

Homogeneous material and averaging the properties of the constituent materials. In other words,

Instead of examining the composite on a micromechanical level, we eliminate the in homogeneity by moving to the macro mechanical level. Thus mechanical properties such as axial tensile modulus are sometimes referred to as the “effective” axial tensile modulus.

2. Design Stresses

As with design temperature, there is a significant difference between typical allowable stresses in FRP and traditional metallic materials. With fiberglass, design stresses will vary depending on the type of stress. When designing based on short-term hoop strength against

Internal pressure, the design stress may vary from 950 kg/sq.cm to 1600 kg/sq.cm.

Typical Stresses

SMC-FRP Typically -950 kg/sq.cm to 1600 kg/sq.cm. (From various manufacturers’ data).

3. Design Pressure

Another design variable that differs greatly is the design pressure. Most FRP process needles/gates which are acting as simply supported beam .In low height dams gates or KT wiers the load or pressure depends on the height of water level stored.. While pressures in the thousands of kg-sq cm can be achieved with FRP, this is usually only seen are specialized applications such as flat surfaces and gates/needles.

Typical Design Pressures of Process / Material Typical Design Pressures

FRP Up to 50 -65 mm thickness can be used where uniform pressures are applied .typical example is the Check Dam gate R**emovable gates.** , canal gates,

3.1 Density

It is well known that fiberglass reinforced plastics are much lighter than carbon steels and other Metallic piping materials. Densities of these materials are provided in the table below.

FRP – 1.40---1.60 gms/cc.
Source: FRP data is from numerous fiberglass manufacturers.

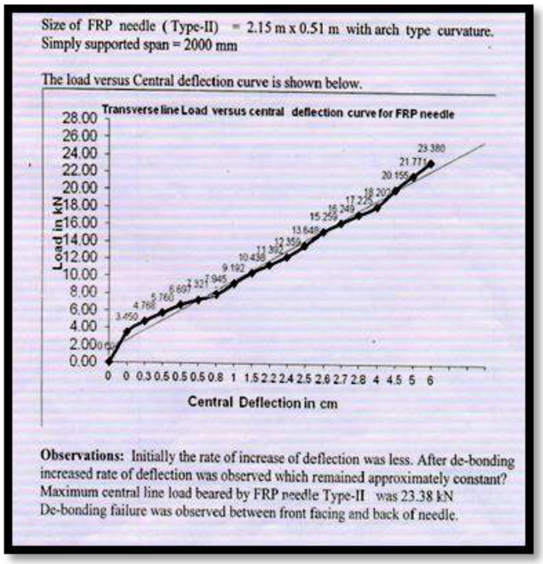
The FRP designed such way that it should take uniformly distributed load of 45 KN for the maximum water height of 4.50 meters.
A suitable M.S. frame is inside the FRP gates to give additional strength to avoid buckling effect as well flexing .Sufficient ribs are given both sides to form self - reinforcement.
Semi EPDM rubber strips are fixed on two sides and in between two needles/gates to act as seal.
Interlocking arrangement is provided to insure positive sealing between two needles/gates.
As it is proven concept in Maharashtra we also prove in Kerala state.
Composites are composed of:

- **Resins** - The primary functions of the resin are to transfer stress between the reinforcing fibers, act as a glue to hold the fibers together, and protect the fibers from mechanical and environmental damage. The most common resins used in the production of FRP are ISO (including orthophthalic-“ortho” and isophthalic-“iso”), ***vinyl esters*** and ***phenolics***.
- ***Reinforcements*** - The primary function of fibers or reinforcements is to carry load along the length of the fiber to provide strength and stiffness in one direction. Reinforcements can be oriented to provide tailored properties in the direction of the loads imparted on the end product. The largest volume reinforcement is glass fiber.
- ***Fillers*** - Fillers are used to improve performance and reduce the cost of a composite by lowering compound cost of the significantly more expensive resin and imparting benefits as shrinkage control, surface smoothness, and crack resistance.
- ***Additives*** - Additives and modifier ingredients expand the usefulness of polymers, enhance their process ability or extend product durability.
  Each of these constituent materials or ingredients plays an important role in the processing and final performance of the end product.

TYPICAL PHYSICAL PROPERTIES approved by CDA-wing of WRD, Maharashtra State, after Testing the gates , physically as well on stad pro- analysis

Chopped Strand Mat Reinforcement composite Properties	**Values**
Tensile Strength	1600 kg/ sq.cm
Flexural Strength	90-180
Compressive Strength	1850 kg / sq.cm
Shearing Strength	1945 kg/ sq.cm
Glass Content	Not less than 30%
Water Absorption	0.5% @ max-72°F/72 hrs.
Specific Gravity	1.6
Izod Impact	1.65 KG-M.
Water pressure bearing capacity	45 KN /M ^{2}.

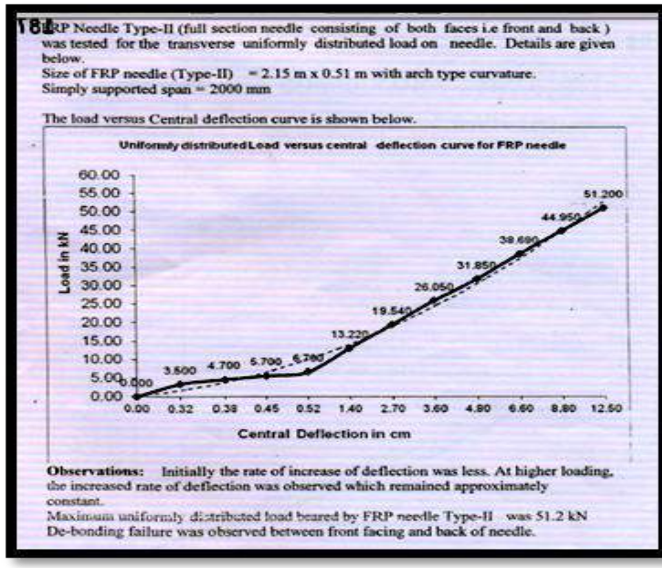
Also the graph showing the Uniform load testing at College of Engineering- Pune, Hydraulic Civil Eng. Lab. Periodically the gates are tested for above value and also for UDL in College Of Engineering-Pune to insure the end performance is satisfactory. The performances at various places is found satisfactory and are having long term advantages so in Maharashtra it is being used widely. Following tests conducted at College of Engineering Pune, for UDL .found results are encouraging.



Size of FRP needle (Type-II) = 2.15 m x 0.51 m with arch type curvature.
Simply supported span = 2000 mm

The load versus Central deflection curve is shown below.

Observations: Initially the rate of increase of deflection was less. After de-bonding increased rate of deflection was observed which remained approximately constant?
Maximum central line load beared by FRP needle Type-II was 23.38 kN
De-bonding failure was observed between front facing and back of needle.



FRP Needle Type-II (full section needle consisting of both faces i.e front and back) was tested for the transverse uniformly distributed load on needle. Details are given below.
Size of FRP needle (Type-II) = 2.15 m x 0.51 m with arch type curvature.
Simply supported span = 2000 mm

The load versus Central deflection curve is shown below.

Observations: Initially the rate of increase of deflection was less. At higher loading, the increased rate of deflection was observed which remained approximately constant.
Maximum uniformly distributed load beared by FRP needle Type-II was 51.2 kN
De-bonding failure was observed between front facing and back of needle.

R & D Project
On

DEVELOPMENT OF STANDARDISED DESIGN AND DRAWINGS OF A BRIDGE CUM BANDHARA SYSTEM

Final Consolidated Report

Volume-III Government GRs

Submitted to

Director Project-II
National Rural Roads Development Agency
5th floor, 15 –NBCC Tower, Bhikaji Cama Place
New Delhi -110066

Principal Investigator
Dr R K Ingle

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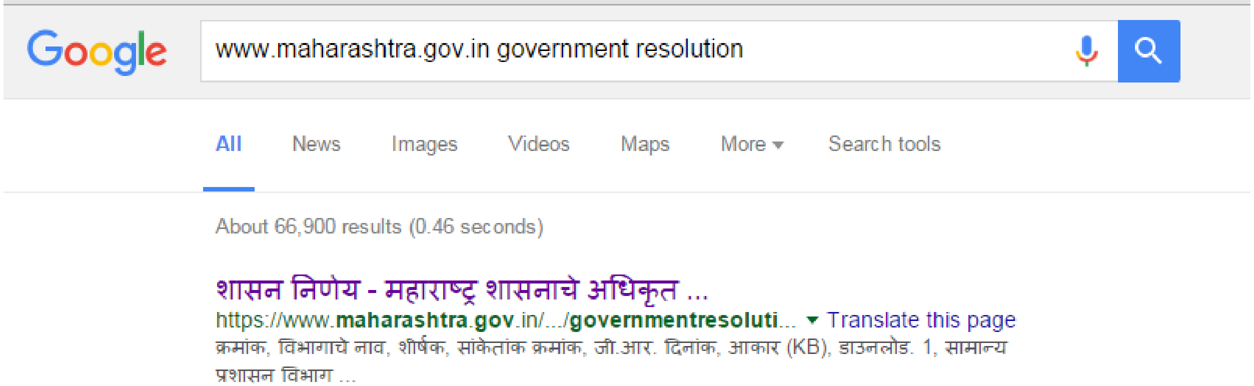
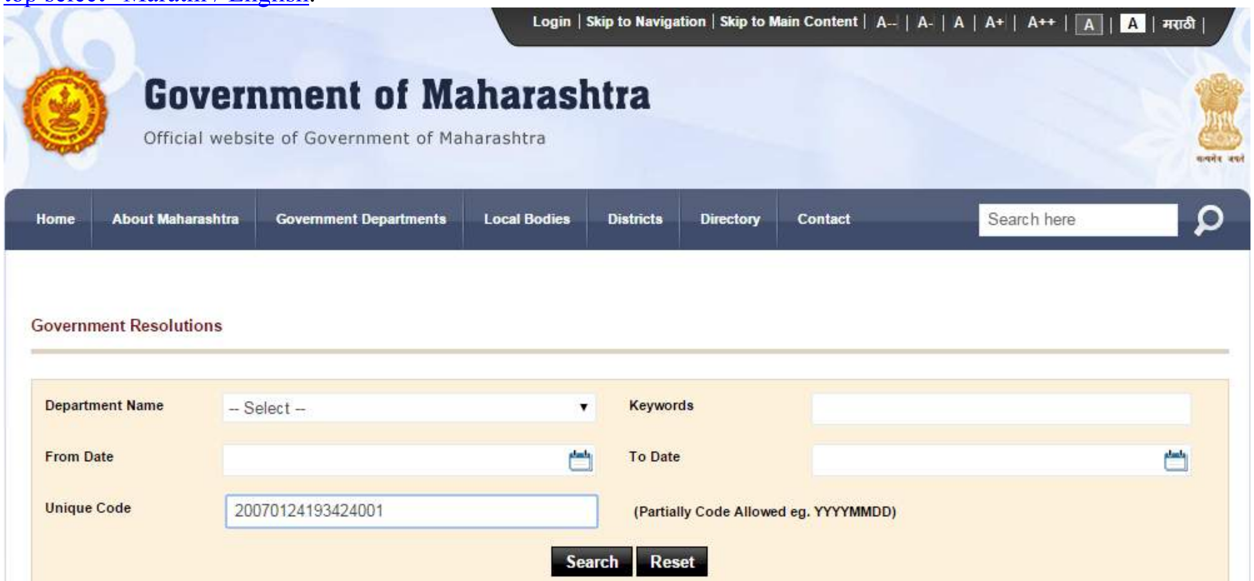
Department of Applied Mechanics
Visvesvaraya National Institute of Technology, Nagpur - 440 010

There are various GR from Maharashtra Government on water and bandhara systems and they are available on Govt web site www. Maharashtra.gov.in.   The informative step by step procedure on searching the GR is given below.

Step 1: Search in Google www.maharashtra.gov.in



Step 2; Click on the http://www.maharashtra.gov.in/../government resolution, we get the following screen. On right top select "Marathi / English.



Step 3: Enter GR no or search from department name or key wards etc. In the above the GR no 20070124193424001 has been searched.

Total Records : 1   Page No. : 1 / 1 Go   1

SN	Department Name	Title	Unique Code	G.R. Date	File Size (KB)	Download
1	Water Resources Department	NA	20070124193424001	24-01-2007	134	

Step 4: View / Download the required GR.

Information on few GR is given below.
GR NO. 20070124193424001

महाराष्ट्र सिंचन पध्दतीचे शेतकऱ्यांकडून व्यवस्थापन अधिनियम २००५ अंतर्गत स्थापन झालेल्या पाणी वापरसंस्थांपैकी ज्या संस्थांच्या व्यवस्थापन समितीच्या निवडणूका बिनविरोध झालेल्या आहेत, त्या संस्थांना अनुदान देणेबाबत.

महाराष्ट्र शासन

जलसंपदा विभाग,

शासन निर्णय क्र. मजसुप्र १००६/(५२५/२००६)/लाक्षेवि(कामे)

मंत्रालय, मुंबई ४०० ०३२.

दिनांक - २४.०१.२००७

शासन निर्णय

GR NO. 20070614121939001

लघुवितरीका स्तरीय पाणी वापर संस्थेच्या कार्यक्षेत्रातील हस्तांतरण पूर्व/ नविन दुरुस्ती बांधकामाचे कामासाठी कंत्राट व्यवस्थापन समिती (कॉन्ट्रक्ट मॅनेजमेंट कमिटी) स्थापन करण्याबाबत.

महाराष्ट्र शासन

जलसंपदा विभाग

शासन निर्णय क्रमांक महाराष्ट्र जलक्षेत्र सुधार प्रकल्प-१००६/(६८८/०६)/लाक्षेवि(कामे)

दिनांक १४ जून, २००७

GR NO.20070622172001001

“पाणी वापर संस्थांना देण्यात येणाऱ्या देखभाल दुरुस्तीचे अनुदानाबाबत”

महाराष्ट्र शासन
जलसंपदा विभाग
शासन निर्णय क्र. पावासं १००७/(३२३/२००७)/सिं.व्य. (धो.)
मंत्रालय, मुंबई ४०० ०३२.
दिनांक : २२ जून, २००७

पहा : पाटबंधारे विभागाचा शा.नि. क्र. पावासं-१००१/(४४२/२००१)/सिं.व्य.(धो), दि. २३.७.२००१

GR NO.20080512150030001

सिंचन व्यवस्थापनात शेतक-यांचा सहभाग
पाटबंधारे प्रकल्पावर शेतक-यांच्या सहकारी पाणी वापर संस्था स्थापन करुन सिंचन क्षेत्र सिंचन व्यवस्थापनासाठी संस्थाकडे हस्तांतरित करण्याबाबत.

महाराष्ट्र शासन
पाटबंधारे विभाग
शासन निर्णय क्र.पावसं/१००१/(४१७)/सिंव्य (धो)
मंत्रालय, मुंबई-४०० ०३२.
दिनांक :- ५ जुलै २००१.

GR NO. 20080527152353001

शासन निर्णय

महाराष्ट्र जलक्षेत्र सुधार प्रकल्पांतर्गत पाणीवापर संस्थांना कार्यालयीन इमारत बांधून देणे बाबत

महाराष्ट्र शासन
जलसंपदा विभाग,
मंत्रालय, मुंबई ४०० ०३२.
शा.नि.क्र.मजसुप्र १००७/(४६३/०७)/लाक्षेवि(कामे)
दिनांक २७ मे २००८

GR NO. 20090821163506001

महात्मा फुले पाणी वापर संस्था अभियान व त्या अंतर्गत पुण्यश्लोक अहिल्यादेवी होळकर पाणी वापर संस्था व्यवस्थापन पुरस्कार स्पर्धा -

महाराष्ट्र शासन
जलसंपदा विभाग
शासन निर्णय क्र.सीडीए-१००५/(४१७/२००५)/लाक्षेवि(कामे)
मंत्रालय, मुंबई-४०० ०३२
दिनांक : २१ ऑगस्ट, २००९

GR NO. 20090821164607001

महात्मा फुले पाणी वापर संस्था अभियान व त्या अंतर्गत पुण्यश्लोक अहिल्यादेवी होळकर पाणी वापर संस्था व्यवस्थापन पुरस्कार स्पर्धा प्रदेशस्तरीय कृती समिती गठीत करण्याबाबत

महाराष्ट्र शासन
जलसंपदा विभाग
शासन निर्णय क्र.सीडीए-१००५/(४१७/२००५)/लाक्षेवि(कामे)
मंत्रालय, मुंबई-४०० ०३२
दिनांक : २१ ऑगस्ट, २००९

वाचावे : जलसंपदा विभाग, शासन निर्णय क्र. सीडीए-१००५/(४१७/२००५)/ लाक्षेवि (कामे), दि. २१ ऑगस्ट, २००९

GR NO. 20090821170902001

महात्मा फुले पाणी वापर संस्था अभियान व त्या अंतर्गत पुण्यश्लोक अहिल्यादेवी होळकर पाणी वापर संस्था व्यवस्थापन पुरस्कार स्पर्धा राज्यस्तरीय व प्रदेशस्तरीय छाननी समिती गठीत करण्याबाबत

महाराष्ट्र शासन
जलसंपदा विभाग
शासन निर्णय क्र.सीडीए-१००५/(४१७/२००५)/लाक्षेवि(कामे)
मंत्रालय, मुंबई-४०० ०३२
दिनांक : २१ ऑगस्ट, २००९

वाचावे : जलसंपदा विभाग, शासन निर्णय क्र. सीडीए-१००५/(४१७/२००५)/ लाक्षेवि (कामे), दि. २१ ऑगस्ट, २००९

GR NO. 20100215144200001

महात्मा फुले पाणी वापर संस्था अभियान व त्या अंतर्गत पुण्यश्लोक अहिल्यादेवी होळकर पाणी वापर संस्था व्यवस्थापन पुरस्कार स्पर्धा -

महाराष्ट्र शासन
जलसंपदा विभाग

शासन निर्णय क्र.सीडीए-२०१०/(२८/२०१०)/लाक्षेवि(कामे)
मंत्रालय, मुंबई-४०० ०३२
दिनांक : १५ फेब्रुवारी, २०१०

वाचा : शासन निर्णय, जलसंपदा विभाग, क्र.सीडीए-१००५/ (४१७/०५)/ लाक्षेवि(कामे),दि,२१.८.२००९

GR NO. 201406251513139627

एक घन मीटर प्रति सेकंद किंवा त्यापेक्षा कमी विसर्ग क्षमतेच्या वितरीका/उपवितरीका/लघुवितरीकांची कामे पाणी वापर संस्था स्थापन झाल्यावर हाती घेणेबाबत.

महाराष्ट्र शासन
पाटबंधारे विभाग

शासन परिपत्रक क्रमांक : सीडीए १००२/(२३८/२००२)/लाक्षेवि(कामे)
दिनांक :- १२/१२/२००२

वाचा :- १) शासन निर्णय क्र.पावासं/१००१/(४४२/२००१)/सिं.व्य.(धोरण), दिनांक २३.७.२००१.
२) शासन परिपत्रक क्र.सीडीए १००२/(१३८/२००२)/लाक्षेवि(कामे), दिनांक १३.८.२००२.

GR NO. 201412061015068426

सर्वांसाठी पाणी - टंचाईमुक्त महाराष्ट्र २०१९ अंतर्गत टंचाई परिस्थितीवर कायमस्वरुपी मात करण्यासाठी जलयुक्त शिवार अभियान राबविणेबाबत.

महाराष्ट्रशासन
जलसंधारण विभाग

शासन निर्णय क्रमांकः जलअ-२०१४/प्र.क्र.२०३/जल-७
मंत्रालय, मुंबई-४०० ०३२.
तारीख: ५ डिसेंबर, २०१४

R & D Project
On

DEVELOPMENT OF STANDARDISED DESIGN AND DRAWINGS OF A BRIDGE CUM BANDHARA SYSTEM

Final Consolidated Report

Volume-IV Typical Drawings

Submitted to

Director Project-II
National Rural Roads Development Agency
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General Notes for Guidance of Engineers

Introduction

Bridge Cum Bandhara- Maharashtra and few states have tradition of Bridge Cum Bandhara. It is a dual purpose structure which can be used to cross the river and as water storage structure to create storage up to 3.5 m by tapping the post monsoon flow. Typical Bridge cum Bandhara Structure are shown below.

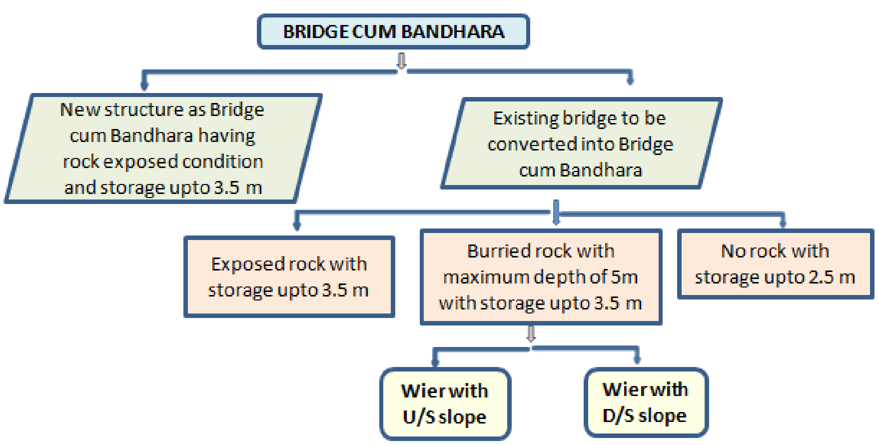
Bridge-Cum-Bandhara-a/c suryaganga river on SH-6-Warkhed-
...arswadi-Akhatwada-Marda (M.D.R.-39) road near village-Warkh...

The objectives of these structures are

i. To tap post monsoon flow to create storage up to 3.5 m The storage is created by fixing needles/gates between bandhara piers to tap last flow
ii. Stored water is used for drinking and irrigation
iii. It enhances the ground water which then is available for irrigation as well as for drinking water
iv. Surplus percolated water out of irrigation activity again joins the river which is tapped and reused for irrigation
v. Such stored water can be used for artificial recharging the nearby bore wells as well as open well to augment ground water

Content of this booklet

The booklet contains set of drawings for the following cases.



The above set of drawings evolved for converting existing bridge into bridge cum bandhara can also be used for the new bridge which is planned or under construction .Bandhara in these drawings are secondary structure hence stability of main bridge will not be affected. However additional obstruction created has to be considered.

This booklet contains following drawings:

i. Standard design of Bandhara structure for above cases
ii. Set of drawings for needles /gates etc

Additional instructions

i. The permission from irrigation department/competent authority be taken so that there is no duplication of storage structure.
ii. The incremental cost should be within the financial norms.
iii. we have proposed steel gates but alternate to this FRP gates are also developed.
iv. The gates must be fixed in the last phase of monsoon and must be removed much before onset of monsoon to avoid damage to main structure. Study of rainfall pattern is done to decide time table for placing of gates.
v. It is advised to use mechanical simple equipment which can be got locally made or use Hydra Crane to expedite fixing and removal operations.
vi. Proper fenced area with fencing with arrangement to store needles in vertical position need to be made for proper protection.
vii. Rubber seal may need frequent replacement.
viii. Mitigate measures such as caution board, realigning the cart track, foot Bridge etc if required will have to be provided.
ix. For any clarification you may contact Shri P L Bongirwar, technical advisor or Dr R K Ingle, coordinator.

List of Drawings

SN	Drawing	Details
1	GN-01	Type Plan for Bridge cum Bandhara - general Notes
2	RC-01	Details of Bandhara on soft soil with cutoff walls (General Arrangement)
3	RC-02	Details of Bandhara on soft soil with cutoff walls (RCC details)
4	WU-01	Details of Bandhara on weir (U/S slope) for buried rock (General Arrangement)
5	WU-02	Details of Bandhara on weir (U/S slope) for buried rock (RCC Details)
6	WD-01	Details of Bandhara on weir (D/S slope) for buried rock (General Arrangement)
7	WD-02	Details of Bandhara on weir (D/S slope) for buried rock (RCC Details)
8	RB-01	Details of Bandhara on Exposed Rock (General Arrangement)
9	RB-02	Details of Bandhara on Exposed Rock (RCC Details)
10	TBB-01	RCC details of structures for tie beam Bandhara (General Arrangement)
11	TBB-02	RCC details of structures for tie beam Bandhara
12	G-1A	Gate for 3m depth of water with rectangular box section
13	G-1B	Gate for 3m depth of water with Angle / Channel section
14	G-1C	Single Gate for 3m depth of water with Angle / Channel section
15	G-1D	Single Gate for 3m depth of water with rectangular box section
16	G-1E	Gate for 3m depth of water with angle / channel section vertically spanning between ISMB 100
17	G-1F	Gate for 3m depth of water with rectangular box section vertically spanning between ISMB 100
18	G-2A	Gate for 2m depth of water with box section
19	G-2B	Gate for 2m depth of water with Angle / Channel section
20	G-2A	Single Gate for 2m depth of water with Angle / Channel section
21	G-2B	Single Gate for 2m depth of water with Box section
22	G-3A	Single Gate for 2m depth of water with Angle / Channel section
23	G-3B	Single Gate for 2m depth of water with rectangular box section
24	G-4A	Single Gate for 3m depth of water with Angle / Channel section (WIDTH 3.3M)
25	G-4B	Single Gate for 3m depth of water with BOX section (WIDTH 3.3M)
26	MP-1	Type plan for intermediate pier of BCB 2 lane deck – General Arrangement
27	MP-2	Type plan for intermediate pier of BCB 2 lane deck – RCC Details
28	DA-1	Typical details for debris arresters

GENERAL NOTES FOR DRAWINGS OF BRIDGE CUM BANDHARA

BRIDGE CUM BANDHARA(BCB)

- NEW STRUCTURES AS BRIDGE CUM BANDHARA HAVING ROCK EXPOSED CONDITION AND STORAGE UPTO 3.50M
- EXISTING BRIDGE TO BE CONVERTED INTO BRIDGE CUM BANDHARA
  - EXPOSED ROCK WITH STORAGE UPTO 3.50M
  - BURRIED ROCK WITH MAXIMUM DEPTH OF 5.0M WITH STORAGE UPTO 3.50M
  - NO ROCK WITH STORAGE UPTO 2.50M

NOTE: THE SETS OF DRAWINGS APPLICABLE FOR CONVERTING THE EXISTING BRIDGE INTO BCB CAN ALSO BE USED FOR NEW PROPOSED BRIDGE OR BRIDGE UNDER CONSTRUCTION TO BE USED AS BRIDGE CUM BANDHARA.

1. THE DRAWINGS OF BRIDGE CUM BANDHARA ARE PREPARED FOR FOLLOWING CASES FOR HIGH LEVEL AND SUBMERSIBLE BRIDGES.
   I. CONSTRUCTING NEW BRIDGE CUM BANDHARA WHEN ROCK IS EXPOSED (REFER DRAWING TBB1, TBB2).
   II. CONVERTING EXISTING BRIDGE INTO BRIDGE CUM BANDHARA FOR FOLLOWING CASES. IN THIS CASE THE MAIN BRIDGE IS AN INDEPENDENT STRUCTURE AND BANDHARA PIER IS AN ADDITIONAL SECONDARY STRUCTURE.
   A) WHEN ROCK IS EXPOSED – RAFT TYPE (REFER DRG. RB-01, RB-02).
   B) WHEN ROCK IS BURIED – WEIR TYPE (REFER DRG. WU-01, WU-02, WD-01, WD-02).
   C) WHEN NO ROCK AVAILABLE – RAFT TYPE (RC-01, RC-02).
2. STANDARD STEEL NEEDLES (GATE)–
   A) LENGTH 2.10M (REFER DRG. G-1A – G-3B) FOR HEIGHT OF STORAGE 1.00M TO 3.50M.
   B) LENGTH MAX. 3.10M (REFER DRG. G-4A, G-4B) FOR HEIGHT OF STORAGE 3.50M.
   C) A RUBBER GASKET OF 10MM THICK SHOULD BE GLUED TO THE BOTTOM AND SIDES OF THE GATE TO PREVENT LEAKAGE OF WATER.
3. LIMITATIONS FOR APPLICATION OF DRAWING ARE MENTIONED ON THE RELEVANT DRAWING
4. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE SPECIFIED
5. DIMENSIONS SHALL NOT BE SCALED FROM THE DRAWING. WRITTEN DIMENSIONS ONLY SHALL BE FOLLOWED
6. DRAWING IS PREPARED FOR NEEDLES OF 2.00M/3.00M CLEAR SPAN AND 2M GATE SHALL BE USED FOR CLEAR SPAN LESS THAN 2M AND ABOVE 2M (<3M) 3M CLEAR SPAN SHALL BE USED OR DESIGNED ACCORDINGLY.
7. SEPARATE DRAWING IS PREPARED FOR STEEL NEEDLE. THE NEEDLES COULD BE STRAIGHT OR CURVED. THE NEEDLES COULD ALSO BE OF FIBER REINFORCED CONCRETE OR FRP OR USING GODBOLE GATES.
8. MINIMUM VERTICAL CLEARANCE BETWEEN SOFFIT AND FTL SHALL BE 1.2 M FOR HIGH-LEVEL BRIDGE AND 0.6 M FOR SUBMERSIBLE BRIDGE
9. NEEDLES SHALL BE FIXED AT THE COMMENCEMENT OF FAIR SEASON AND REMOVED AT LEAST 15 DAYS BEFORE THE ONSET OF MONSOONS.
10. THE REMOVAL AND FIXING OF NEEDLES SHOULD BE SO ADJUSTED THAT THE WATER LEVEL DOES NOT EXCEED DESIGNED FULL TANK LEVEL. USE OF SIMPLE MECHANICAL EQUIPMENT SUCH AS HYDRA CRANE / SIMPLE CRANE TO BE MADE TO EXPEDITE THIS OPERATION.
11. ADEQUATE STORAGE SPACE MUST BE CREATED TO STORE THE NEEDLE GATES, AND ARRANGEMENT FOR WATCH & WARD MAY BE MADE.
12. COMBINED PERCENTAGE OBSTRUCTION SHALL BE CHECKED AND ENSURED THAT THE SAME DOES NOT CAUSE UNACCEPTABLE AFFLUX.
13. WHILE DESIGNING THE NEEDLES A FREE BOARD OF 0.5 M IS CONSIDERED.
14. WHILE DESIGNING THE BANDHARA PIERS THE EFFECT OF DIFFERENTIAL AFFLUX AND DIFFERENTIAL HEAD IN TRAFFIC DIRECTION ARE NOT CONSIDERED. HOWEVER THEY ARE NOT CRITICAL CASES.
15. WHILE DESIGNING THE BANDHARA PIERS THE EFFECT OF SEISMIC FORCES ARE CONSIDERED AS PER RELEVANT CODES
16. BRIDGE CUM BANDHARA STRUCTURE IS RECOMMENDED FOR WATERWAY UP TO 100 M BUT IT CAN BE USED FOR EVEN LARGER LENGTH
17. DESIGN ASSUMPTIONS
   I. LOADING TWO LANE OF CLASS A OR SINGLE LANE OF 70 R WHICH EVER PRODUCES WORST EFFECT
   II. THE GRADE OF CONCRETE SHALL BE M25 FOR STRUCTURAL CONCRETE AND STEEL FE 415 / FE500.
   III. BUOYANCY EFFECT 100%
   IV. SEISMIC COEFFICIENTS 1) ZONE 2: Z=0.1 2) ZONE 3: Z=0.16 3) ZONE 4: Z=0.24
   V. IMPORTANCE FACTOR – 1.0
   VI. MINIMUM FOS TO OVERTURNING FOR NON SEISMIC 2.0 AND SEISMIC 1.5
   VII. MINIMUM FOS TO SLIDING FOR NON-SEISMIC 1.5 AND SEISMIC 1.2
   VIII. TENSION AREA FOR SEISMIC CASE NOT TO EXCEED 33% ON ROCK AND FOR NON SEISMIC CASE NOT TO EXCEED 20%
   IX. MINIMUM S.B.C. OF FOUNDING STRATA 300 KN PER SQ M.
   X. AS PER CLAUSE 14.3.2 DURABILITY PROVISION OF IRC -112 , ALL BANDHARA STRUCTURES ARE CONSIDERED HAVING MODERATE EXPOSURE CONDITION AND THE FOLLOWING PROVISIONS ARE APPLIED AS PER TABLE 14.2EX.

EXPOSURE CONDITION	MAX W/C RATIO	MIN CEMENTITIOUS CONTENT kg/CUM	MINIMUM GRADE OF CONCRETE	MINIMUM COVER	
MODERATE	0.45	340	M:25	40MM	RCC
	0.50	340	M:20		PCC

   XII. DESIGN IS CHECKED FOR MAXIMUM MANNINGS VELOCITY OF 5 M/SEC FOR HIGH LEVEL AND SUBMERSIBLE BRIDGE
   XIII. COEFFICIENT OF FRICTION BETWEEN ROCK AND CONCRETE IS TAKEN AS 0.5
18. INCREMENTAL COST OF STRUCTURE SHOULD SATISFY THE NORMS OF IRRIGATION STRUCTURE RELATED TO STORAGE PRESCRIBED BY THE GOVERNMENT.
19. PROVISION OF CLAUSE 104.7.2 OF IRC SECTION 1 BE GENERALLY FOLLOWED
20. FOR SPACING OF BARS,OVERLAP,ANCHOR LENGTH ,PERMISSIBLE STRESSES ETC THE RELEVANT IRC CODES BE FOLLOWED
21. A STEEL ANGLE IS FIXED AT THE BASE TO ENSURE PROPER SEATING OF THE FIRST NEEDLE. ANGLES/CHANNELS/STEEL PLATE/COLD FORMED CHANNEL OR ANY OTHER SUITABLE MEAN SHALL BE PROVIDED IN THE GROVE FOR RESTING THE NEEDLES.

SILL BEAM TYPE BRIDGE CUM BANDHARA FOR NEW BRIDGE CUM BANDHARA

1. THE DRAWING IS APPLICABLE FOR PROPOSED NEW BRIDGE CUM BANDHARA WHEN ROCK IS EXPOSED
2. THE DRAWING SHOULD BE REFERRED ALONG WITH FOLLOWING DRAWINGS: REFER DRG. TBB1–TBB2.
3. HEIGHT OF MAIN PIER IS TAKEN FROM SOFFIT OF BASE WHILE PREPARING TABLES i.e. HEIGHT OF PIER-SOFFIT LEVEL OF BRIDGE–FOUNDING LEVEL OF PIER. REFER DRG MP1–MP3 FOR REFERENCE.
4. RESISTANT FOR MOVEMENT OFFERED BY ALL FACES OF SILL BEAM HAVING DEPTH OF 0.6M IS CONSIDERED FOR ANALYSIS PURPOSE. IT IS THEREFORE IMPORTANT THAT BOND BETWEEN ALL FACE OF SILL CONCRETE AND ROCK IS FULLY ENSURED BY DOING ANNULAR FILLING IN THE ENTIRE GAP BETWEEN EXCAVATED ROCK AND STRUCTURE. IN ANY CASE MINIMUM EMBEDMENT OF 0.6 M FOR SILL BEAM SHALL BE ENSURED.
5. PROPER EMBEDMENT OF 1.5 M IN SOFT ROCK AND 0.6 M IN HARD ROCK SHALL BE ENSURED FOR MAIN PIER AS PER IRC 78
6. FOR NEEDLE PIERS THE EMBEDMENT OF 0.15 M IN HARD ROCK AND 0.30 M IN SOFT ROCK SHALL BE ENSURED.

CONVERTING EXISTING BRIDGE INTO BANDHARA–ROCK EXPOSED – RAFT TYPE BRIDGE CUM BANDHARA

1. THE DRAWING IS VALID WHEN EXISTING BRIDGE ALREADY EXISTS AND ROCK IS EXPOSED (DRG. RB-01 & RB-02).
2. A SECONDARY RAFT INDEPENDENT OF MAIN BRIDGE RESTING ON ROCK TO SUPPORT INTERMEDIATE BANDHARA PIER IS PROPOSED. AS THIS IS INDEPENDENT STRUCTURE AND NOT CONNECTED TO MAIN BRIDGE THE STABILITY OF THE MAIN STRUCTURE IS NOT AFFECTED
3. THE INTERMEDIATE BANDHARA PIERS CAN HAVE SPACING OF 2.00 TO 3.50M TO MATCH WITH SPANS OF EXISTING BRIDGE.
4. IN CASE BED IS NOT UNIFORM THE RAFT SLAB CAN BE RESTED AT STEP LEVEL.
5. RAFT SLAB SHOULD BE EMBEDDED AT LEAST 60 CM IN ROCK AND CONCRETING TO BE DONE ON SUCH UNEVEN SURFACE TO IMPROVE THE BASE FRICTION.
6. SHEAR KEY IS ADDED TO PREVENT THE SLIDING OF STRUCTURE. THIS WILL ALSO STOP PERCOLATION.THE NATURAL PIT MADE FOR SHEAR KEY SHALL BE FULLY FILLED WITH CONCRETE. THE DEPTH AND WIDTH ETC. CAN BE DECIDED ON THE CRITERION OF STOPPING THE PERCOLATION.
7. THE BANDHARA PIER IN LINE WITH MAIN PIER OF BRIDGE HAS TO BE SEPARATED BY THERMO COLE PIECE AS SHOWN ON DRAWING.
8. THE RAFT STRUCTURE SHOULD BE LOCATED AS CLOSE TO EXISTING BRIDGE AS POSSIBLE SO AS TO FACILITATE LOWERING AND REMOVAL OF NEEDLES FROM EXISTING BRIDGE THE WIDTH OF RAFT NEAR MAIN PIER THEREFORE WILL GET REDUCED.
9. THE LOCATION OF SLOT FOR GATES IS TENTATIVE. IT CAN BE SHIFTED TO BRING THE SECONDARY STRUCTURE CLOSER FOR FACILITATING ERECTION AND REMOVAL OF GATES..

CONVERTING EXISTING BRIDGE INTO BANDHARA–WEIR TYPE(WHEN FOUNDING STRATA IS BURIED)

1. THE DRAWING IS VALID WHEN EXISTING BRIDGE IS HAVING OPEN FOUNDATION RESTING ON WEATHERED ROCK/SOFT ROCK/HARD ROCK IS PROPOSED FOR CONVERTING INTO BRIDGE CUM BANDHARA STRUCTURE. DEPTH OF FOUNDATION BELOW BED LEVEL SHOULD NOT EXCEED 5M. (DRG. WU-01, 02 & WD-01,02)).
2. A SECONDARY WEIR INDEPENDENT OF MAIN BRIDGE AT U/S IS PROPOSED TO SUPPORT THE INTERMEDIATE BANDHARA PIERS. AS THIS IS A SECONDARY STRUCTURE INDEPENDENT OF MAIN BRIDGE THE STABILITY OF MAIN BRIDGE IS NOT AFFECTED.
3. WEIR SHOULD BE EMBEDDED INTO WEATHERED ROCK/SOFT ROCK BY AT LEAST 0.6 M AND IN HARD ROCK BY 0.3M. IT SHOULD REST DIRECTLY ON SUCH PREPARED FOUNDATION SURFACE .UNEVEN BASE WOULD PREVENT PERCOLATION AND ALSO RESIST THE SLIDING FORCE EFFECTIVELY.
4. THE INTERMEDIATE BANDHARA PIERS CAN HAVE CLEAR SPACING OF 2.00 TO 3.00M TO MATCH WITH SPANS OF EXISTING BRIDGE.
5. IN CASE THE BED LEVEL IS NON UNIFORM THE STEPPING CAN BE GIVEN TO WEIR FOUNDING LEVEL.
6. THE WEIR SHOULD BE LOCATED AS CLOSE AS POSSIBLE TO MAIN STRUCTURE SO AS TO FACILITATE CONVENIENT PLACING AND REMOVAL OF NEEDLES FROM MAIN BRIDGE. THE SHAPE OF WEIR IN PLAN NEAR MAIN PIER THEREFORE WILL BE DIFFERENT.
7. THE MAIN PIER AND CORRESPONDING INTERMEDIATE PIER SHALL BE SEPARATED BY THERMACOLE.
8. A TENTATIVE BED PROTECTION ARRANGEMENT IS SHOWN FOR BED PROTECTION WHICH CAN BE MODIFIED SUITABLY AS PER SITE CONDITIONS.
9. IN NON-SEISMIC CONDITION 20% TENSION IS ALLOWED AT BASE AND FOR SEISMIC CONDITION TENSION AREA IS RESTRICTED TO 33%.
10. THE LOCATION OF SLOT ON INTERMEDIATE BANDHARA PIER CAN BE SHIFTED TO BRING THE WEIR CLOSER TO MAIN BRIDGE TO FACILITATE CONVENIENT ERECTION AND REMOVAL.

STANDARD NOTES FOR CASE WHERE NO ROCK IS AVAILABLE – RAFT TYPE BRIDGES

1. THE DRAWING IS PREPARED FOR PLANNING STORAGE RESTRICTED TO 2.5 M. BASED ON ACTUAL EXPERIENCE OF BEHAVIOR OF STRUCTURE FURTHER REVISION CAN BE TAKEN UP FOR INCREASING THE STORAGE HEIGHT.
2. THE SECONDARY STRUCTURE IS TO BE PLACED AT UP STREAM OF EXISTING BRIDGE.
3. THE DRAWING IS APPLICABLE FOR SUCH CASES WHERE GOOD FOUNDING STRATA IS DEEP.
4. THE CUTOFF DEPTH SHOULD BE MINIMUM 2.5 M FOR STORAGE UP TO 2.5 METER DEPTH AND CONCRETE U/S AND D/S APRON ALONG WITH CUTOFF DEPTH IS DECIDED TO MINIMIZE PERCOLATION. ADEQUATE CREEP LENGTH IS ADOPTED AND AS PER KHOSALA'S THEORY THE EXIT VELOCITY IS CALCULATE AND THE SAME IS LIMITED TO ACCEPTABLE LIMIT.IF IT IS OBSERVED THAT THE PERCOLATION IS EXCESSIVE THE LENGTH OF U/S AND D/S CONCRETE APRON BE INCREASED.
5. THE THICKNESS OF STONE APRON SHALL BE 60 CENTIMETER AND THE MINIMUM WEIGHT OF SHALL BE 40 KG. THE STONE APRON TO SERVE AS LAUNCHING APRON.
6. CROSS CUTOFF AT THE END OF RIVER BE GIVEN AS SHOWN IN DRAWING. (DRG. RC-01 & 02)
7. THE LONGITUDINAL U/S CUTOFF SHALL BE CONTINUED IN BANK FOR AT LEAST 5 M FOR 2.5 M DEPTH TO PREVENT PERCOLATION OF WATER
8. THE SOIL PROFILE OF THE CHANNEL WHERE RAFT IS TO BE LAID SHOULD BE MORE OR LESS UNIFORM SO AS TO PROVIDE UNIFORM SUB-GRADE REACTION FROM THE SOIL. ONE METER DEPTH OF SOIL BELOW THE BOTTOM OF RAFT SLAB SHOULD BE REMOVED AND REPLACED BY SELECTED EARTH FOR A DEPTH OF 900 MM, PREFERABLY GRANULAR MATERIAL, IT SHOULD BE BACKFILLED IN LAYERS AND COMPACTED TO 95% PROCTOR DENSITY, OVER WHICH THE 100 MM M20 GRADE OF CONCRETE LAYER BE PUT.
9. CUTOFF WALLS ARE NOT DESIGNED AS RETAINING WALL HENCE FILLING SHALL BE DONE EVENLY ON BOTH SIDES.
10. IN ORDER TO ENSURE SAFETY OF FOUNDATION THE RCC RAFT AND PROTECTION WORK i.e. CONCRETE APRON, CUTOFF AND STONE APRON SHALL BE DONE SIMULTANEOUSLY AND COMPLETED BEFORE MONSOON. THE CONSTRUCTION OF BANDHARA PIER SHALL NOT BE STARTED TILL THEN IF THE SAME CANNOT BE COMPLETED THEN A CROSS CUTOFF BE PROVIDED AT THE END.
11. THE D/S APRON SHALL BE EXTENDED BEYOND TWO METERS OF PIER FOUNDATION OF EXISTING BRIDGE.
12. THE HYDRAULIC AND STRUCTURAL SAFETY OF EXISTING BRIDGE TO BE RECHECKED ASSUMING APRON TOP AS BED LEVEL.
13. MAINTENANCE OF RAFT FOUNDATION– THE SATISFACTORY AND SAFE PERFORMANCE OF RAFT FOUNDATIONS DEPENDS ON THE FUNCTION OF RAFT SLAB, CUT OFF, ELASTIC BED MATERIAL BELOW THE SLAB, LAUNCHING APRON AND TOE WALLS. IT IS THEREFORE NECESSARY TO ENSURE THAT THESE ELEMENTS ARE INTACT. THESE ELEMENTS SHOULD BE INSPECTED AT LEAST ONCE IN A YEAR PREFERABLY AFTER MONSOON.
14. SAND DREDGING– DREDGING OF SAND AT LEAST FOR A LENGTH OF 6 TIMES THE RIVER WIDTH AT U/S AND D/S OR MINIMUM 300 M WHICHEVER IS MORE SHOULD NOT BE ALLOWED. THIS ZONE SHALL BE DECLARED A PROHIBITED ZONE AND NO DIGGING OR THE USE OF AREA WITHIN THE ZONE SHALL BE ALLOWED.
15. TOP OF THE RAFT SLAB IN PART STRETCH SHALL BE CLEARED AND CLOSELY INSPECTED. IF ANY DAMAGES ARE NOTICED THEN THE WHOLE RAFT SLAB SHALL BE CLEARED INSPECTED AND REPAIRED IF NECESSARY.
16. U/S AND D/S APRON SHALL BE INSPECTED AND DISLODGEED STONES SHALL BE REPLACED WITH APPROPRIATE QUANTITY OF STONES OF DESIRED WEIGHT.
17. TOE WALLS SHALL BE INSPECTED AND REPAIRED IF NEEDED.
18. SCOURING OF BED MATERIAL BELOW RAFT SLAB NEEDS TO BE MONITORED AND PROTECTED. HOLLOWS BELOW THE RAFT SLAB WITH OR WITHOUT APPEARANCE ARE NOT PERMITTED AS IT MAY LEAD TO SETTLEMENT AND CRACKING OF RAFT SLAB.

DRAWING DETAILS FOR BRIDGE CUM BANDHARA

DRAWING Nos.	DETAILS	REMARKS
TBB-01	GENERAL ARRNAGEMENT FOR SILL BEAM TYPE BCB SYSTEM	
TBB-02	RCC DETAILS FOR PIER AND TIE BEAM FOR NEEDLE SPACING AT 2.10M SPAN	
RB-01	DETAILS OF BANDHARA ON EXPOSED ROCK (GENERAL ARRANGEMENT)	
RB-02	DETAILS OF BANDHARA ON EXPOSED ROCK (RCC DETAILS)	
WU-01	DETAILS OF BANDHARA ON WEIR (U/S SLOPE) FOR BURIED ROCK (GENERAL ARRANGEMENT)	
WU-02	DETAILS OF BANDHARA ON WEIR (U/S SLOPE) FOR BURIED ROCK (RCC DETAILS)	
WD-01	DETAILS OF BANDHARA ON WEIR (D/S SLOPE) FOR BURIED ROCK (GENERAL ARRANGEMENT)	
WD-02	DETAILS OF BANDHARA ON WEIR (D/S SLOPE) FOR BURIED ROCK (RCC DETAILS)	
RC-01	DETAILS OF BANDHARA ON SOFT SOIL WITH CUTOFF WALL (GENERAL ARRANGEMENT)	
RC-02	DETAILS OF BANDHARA ON SOFT SOIL WITH CUTOFF WALL (RCC DETAILS)	
MP-01	RCC DETAILS OF MAIN PIER 8M C/C (GENERAL ARRANGEMENT)	
MP-02	RCC DETAILS OF MAIN PIER 8M C/C (RCC DETAILS)	

DRAWING DETAILS FOR GATES

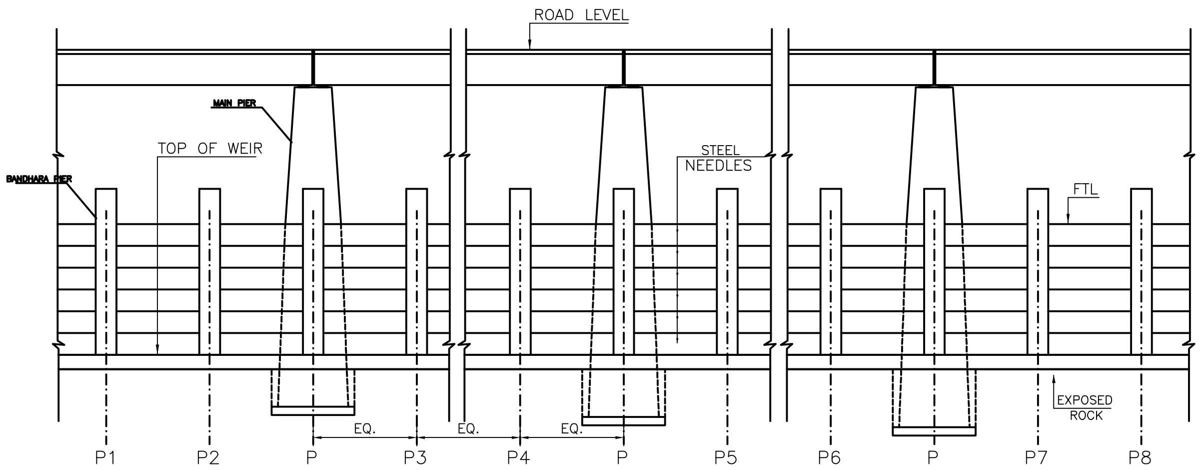
DRAWING Nos.	DETAILS	REMARKS
G-1A	(2.1 X 0.5 X 3M) GATE FOR 3M WATER DEPTH WITH RECTANGULAR BOX SECTION	
G-1B	(2.1 X 0.5 X 3M) GATE FOR 3M WATER DEPTH WITH ANGLE/CHANNEL SECTION	
G-1C	(2.1 X 0.5 X 3M) SINGLE GATE FOR 3M WATER DEPTH WITH ANGLE/CHANNEL SECTION	
G-1D	(2.1 X 0.5 X 3M) SINGLE GATE FOR 3M WATER DEPTH WITH RECTANGULAR BOX SECTION	
G-1E	(2.1 X 0.5 X 3M) GATE FOR 3M WATER DEPTH WITH ANGLE/CHANNEL SECTION VERTICALLY SPANNING	
G-1F	(2.1 X 0.5 X 3M) GATE FOR 3M WATER DEPTH WITH RECTANGULAR BOX SECTION VERTICALLY SPANNING	
G-2A	(2.1 X 0.5 X 2M) GATE FOR 2M WATER DEPTH WITH RECTANGULAR BOX SECTION	
G-2B	(2.1 X 0.5 X 2M) GATE FOR 2M WATER DEPTH WITH ANGLE/CHANNEL SECTION	
G-2C	(2.1 X 0.5 X 2M) SINGLE GATE FOR 2M WATER DEPTH WITH ANGLE/CHANNEL SECTION	
G-2D	(2.1 X 0.5 X 2M) SINGLE GATE FOR 2M WATER DEPTH WITH RECTANGULAR BOX SECTION	
G-3A	(2.1 X 0.5 X 1M) SINGLE GATE FOR 1M WATER DEPTH WITH ANGLE/CHANNEL SECTION	
G-3B	(2.1 X 0.5 X 1M) SINGLE GATE FOR 1M WATER DEPTH WITH RECTANGULAR BOX SECTION	
G-4A	(3.3 X 3M) SINGLE GATE FOR 3M WATER DEPTH WITH ANGLE/CHANNEL SECTION	
G-4B	(3.3 X 3M) SINGLE GATE FOR 3M WATER DEPTH WITH RHS SECTION	

DEPARTMENT OF APPLIED MECHANICS
VISVESVARAYA NATIONAL INSTITUTE OF TECHNOLOGY
NAGPUR.

TYPE PLAN FOR BRIDGE CUM BANDHARA.
GENERAL NOTES

NATIONAL RURAL ROAD DEVELOPMENT AUTHORITY
MINISTRY OF RURAL DEVELOPMENT, GOVT OF INDIA
R&D PROJECT F No P-17029/04/2007-P-II

TECHNICAL ADVISOR	CHECKED BY:	DESIGNED BY:
SHRI P L BONGIRWAR FORMER PRINCIPAL SECRETARY, PWD MAHARASHTRA	SHRI D K KANHERE CHIEF ENGINEER (RETD) PWD MAHARASHTRA	DR. R.K. INGLE
		DRG.No.-GN-01 DATE: DEC-2015



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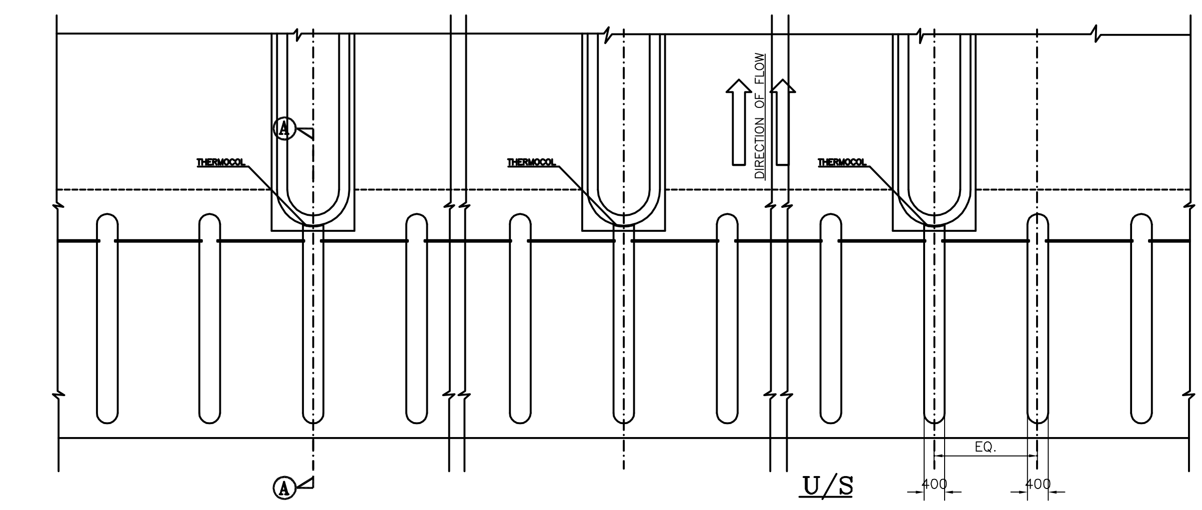

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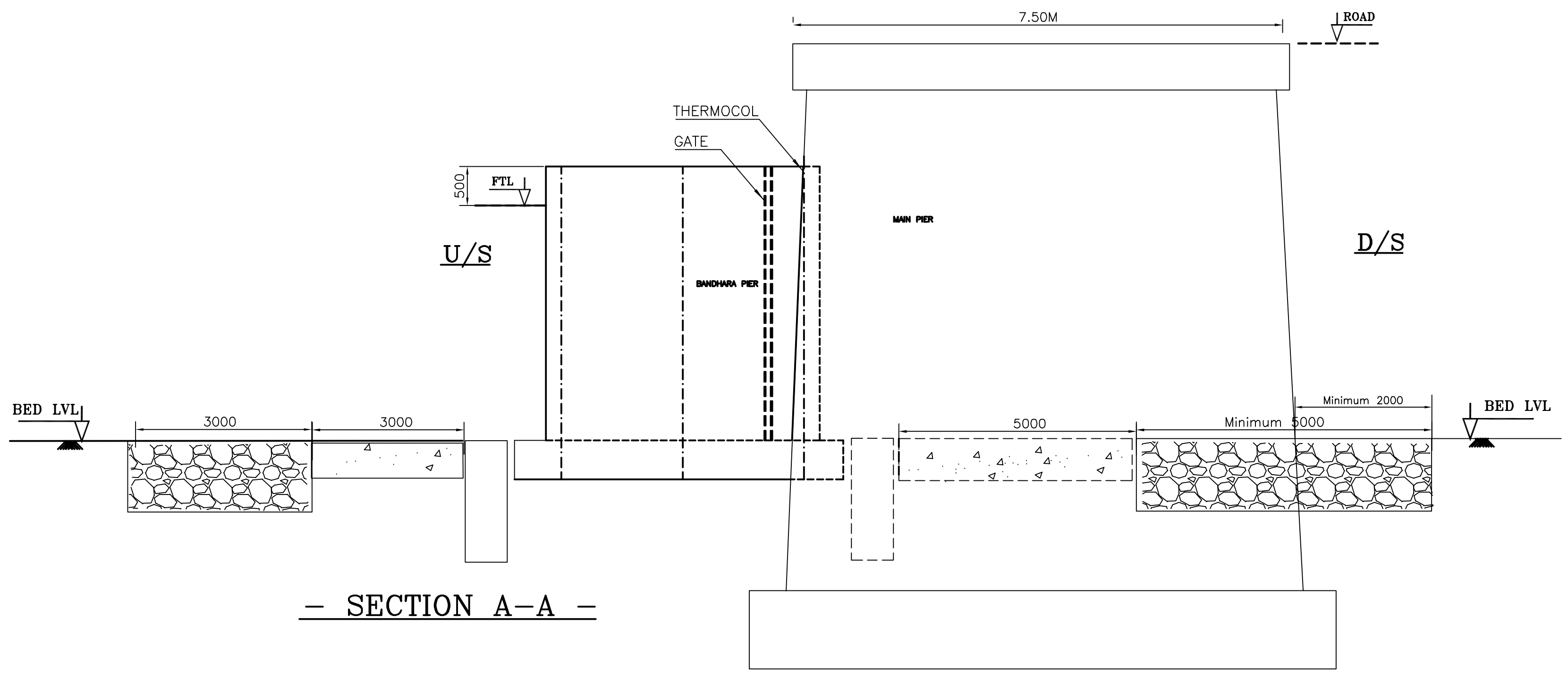

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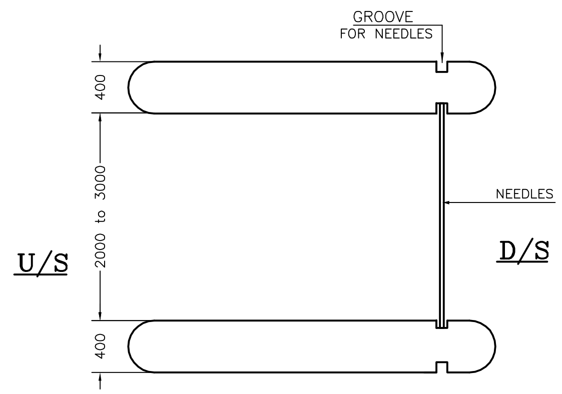
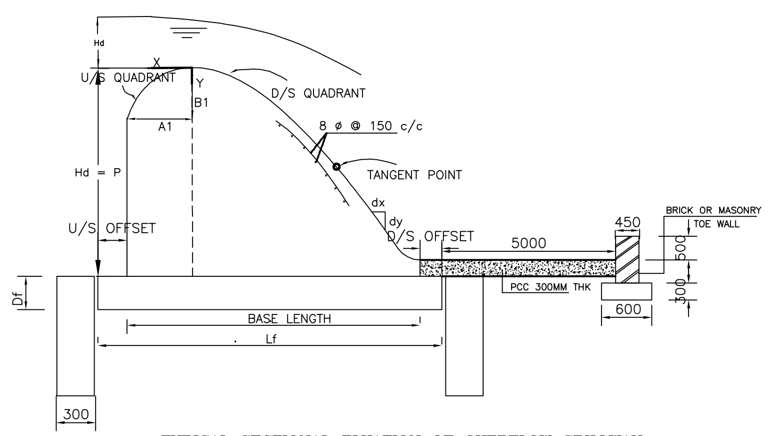




TYPICAL SECTIONAL ELVATION OF OVERFLOW SPILLWAY

U/S QUADRANT => (X^2/A^2)+(Y^2/B^2)=1

D/S QUADRANT => (X^1.85)=K2x(Hd^.85)xY

SCHEDULE FOR OVERFLOW SPILLWAY

A1 = 0.276 M

B1 = 0.164 M

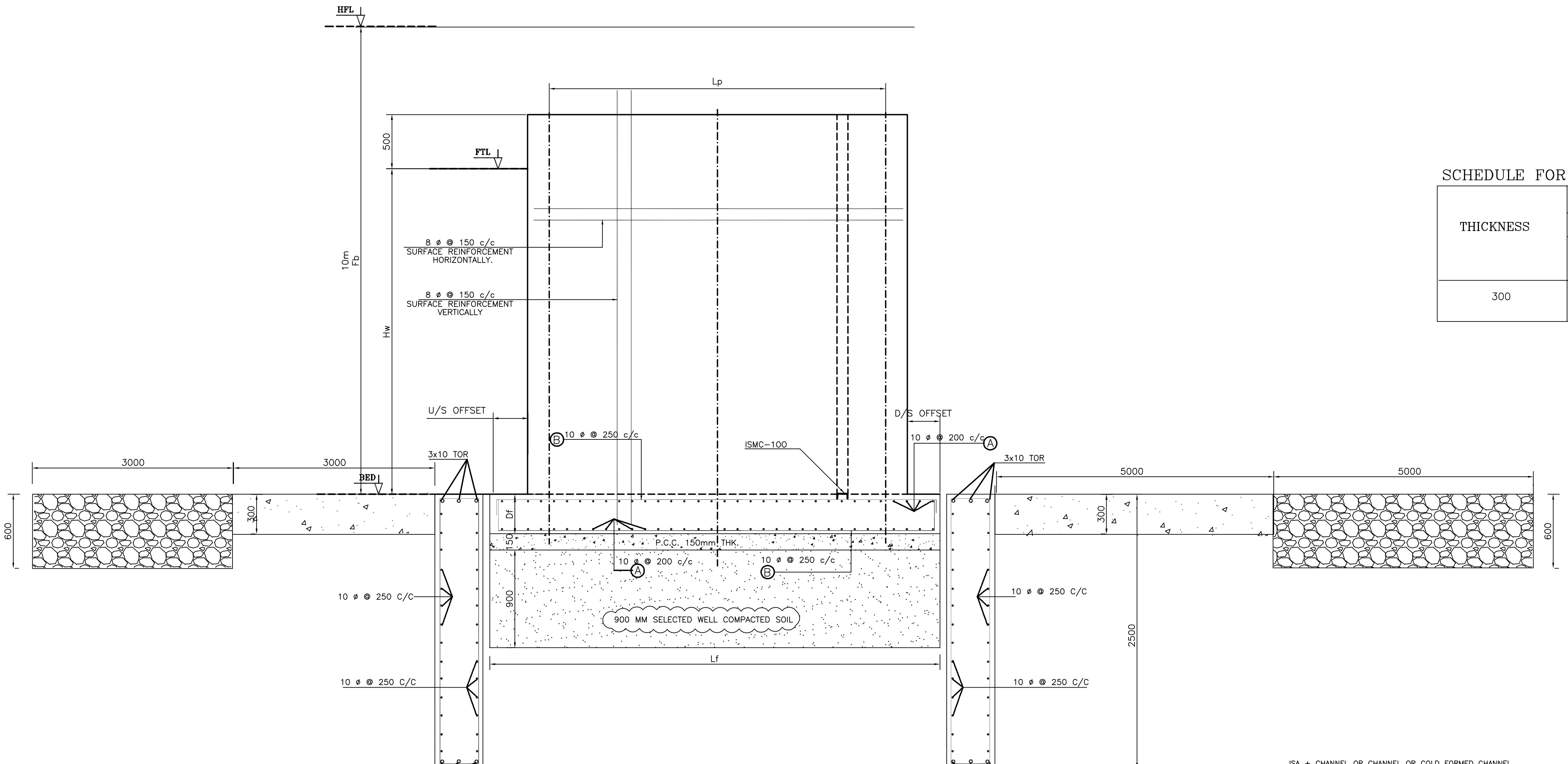
Hw	BASE LENGTH	Lf	U/S OFFSET	D/S OFFSET
2500	2860	3500	400	240
2000	2490	3500	400	610
1500	2100	3500	400	1000

DEPARTMENT OF APPLIED MECHANICS
VISVESVARAYA NATIONAL INSTITUTE OF TECHNOLOGY
NAGPUR.

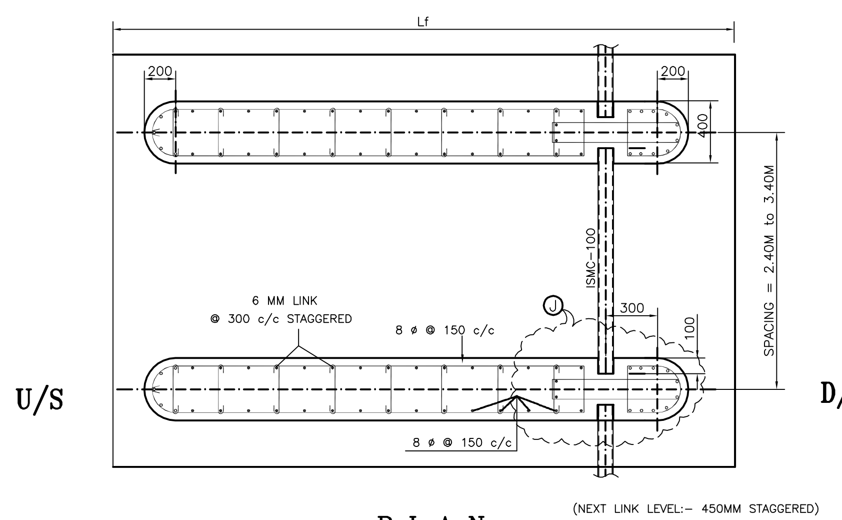
TYPE PLAN FOR BRIDGE CUM BANDHARA DETAILS OF BANDHARA ON SOFT SOIL WITH CUTOFF WALLS. (RCC DETAILS)

NATIONAL RURAL ROAD DEVELOPMENT AUTHORITY
MINISTRY OF RURAL DEVELOPMENT, GOVT OF INDIA
R&D PROJECT F No P-17029/04/2007-P-II

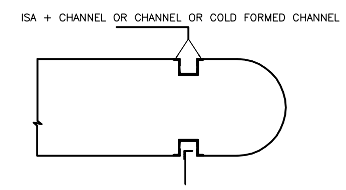
TECHNICAL ADVISIOR	CHECKED BY:	DESIGNED BY:	
SHRI P L BONGIRWAR FORMER PRINCIPAL SECRETARY, PWD MAHARASHTRA	SHRI D K KANHERE CHIEF ENGINEER (RETD) PWD MAHARASHTRA	DR. R.K. INGLE	
		DRG.No.–RC–01	DATE: DEC–2015



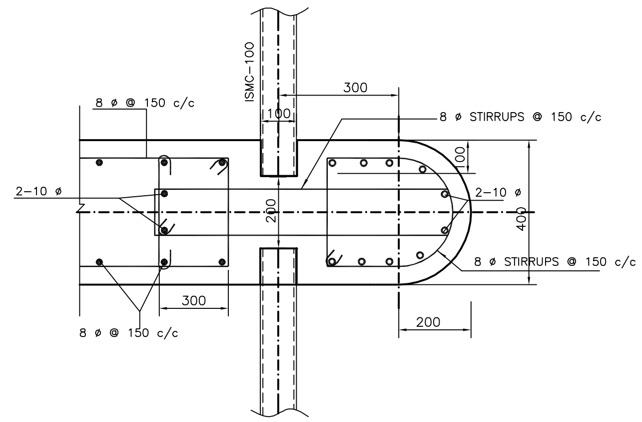
SECTIONAL ELVATION



P L A N



TYP. PLAN FOR GROOVE



DETAILS AT 'J'

SCHEDULE FOR INTERMEDIATE PIER DETAILS

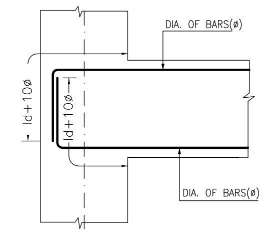
Hw	Df	Lp	Lf	U/S OFFSET	D/S OFFSET
2500	300	1800	3500	800	500
2000	300	1800	3500	800	500

SCHEDULE FOR RAFT REINFORCEMENT

THICKNESS	REINFORCEMENT			REMARKS
	AT BOTTOM	AT TOP		
	MAIN STEEL (A)	MAIN STEEL (A)	DISTRIBUTION (B)	
300	10 ø @ 200 c/c	10 ø @ 200 c/c	10 ø @ 250 c/c	

SCHEDULE FOR CUTOFF WALL REINFORCEMENT

THICKNESS	REINFORCEMENT		
	VERTICAL STRAIGHT	HORIZONTAL STRAIGHT	
300	10 ø @ 250 C/C	10 ø @ 250 C/C	



DEVELOPEMENT LENGTH Ld FOR BARS.

DIA. (MM)	M : 30	REMARKS
8	365	
10	455	
12	545	
16	725	
20	910	
25	1135	
32	1450	

NOTES FOR R.C.C. WORKS :-

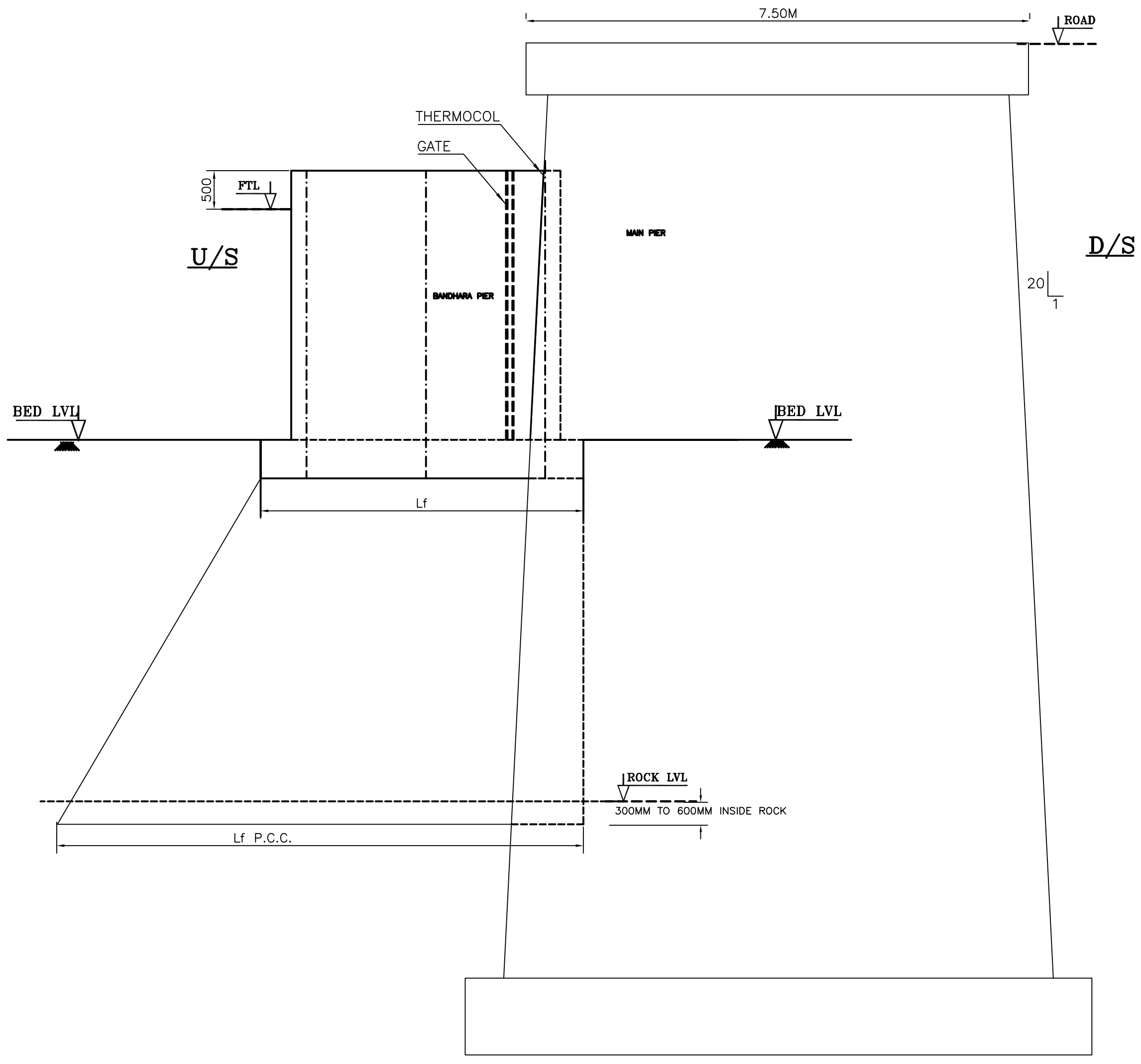
* ALL DIMENSIONS ARE IN MM UNLESS SPECIFIED OTHERWISE
* USE REINFORCEMENT OF GRADE Fe-415 FOR ALL STEEL EXCEPT 6 MM DIA.
* CLEAR COVER TO THE REINFORCEMENT FOR PIER - 40MM RAFT - 50MM.
* OVERLAPS SHALL BE PROVIDED AT STAGGERED LOCATIONS
* EXECUTION OF WORK SHALL BE CARRIED OUT IN ACCORDANCE WITH I.S.456- (2000).
* USE GRADE OF CONCRETE M-30 CONC.

DEPARTMENT OF APPLIED MECHANICS
VISVESVARAYA NATIONAL INSTITUTE OF TECHNOLOGY
NAGPUR.

TYPE PLAN FOR BRIDGE CUM BANDHARA
DETAILS OF BANDHARA ON SOFT SOIL WITH
CUTOFF WALLS. (RCC DETAILS)

NATIONAL RURAL ROAD DEVELOPMENT AUTHORITY
MINISTRY OF RURAL DEVELOPMENT, GOVT OF INDIA
R&D PROJECT F No P-17029/04/2007-P-II

TECHNICAL ADVISIOR	CHECKED BY:	DESIGNED BY:
SHRI P L BONGIRWAR FORMER PRINCIPAL SECRETARY, PWD MAHARASHTRA	SHRI D K KANHERE CHIEF ENGINEER (RETD) PWD MAHARASHTRA	DR. R.K. INGLE
		DRG.No.-RC-02 DATE: DEC-2015



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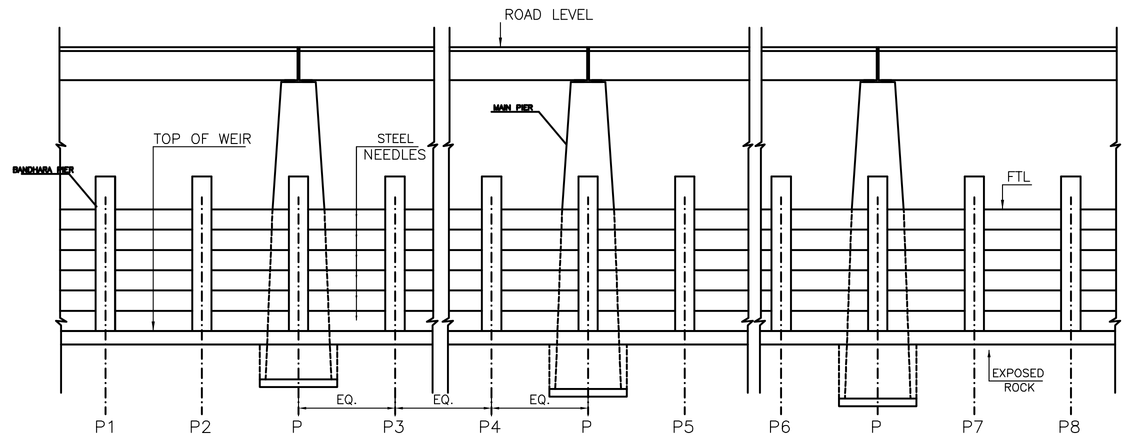

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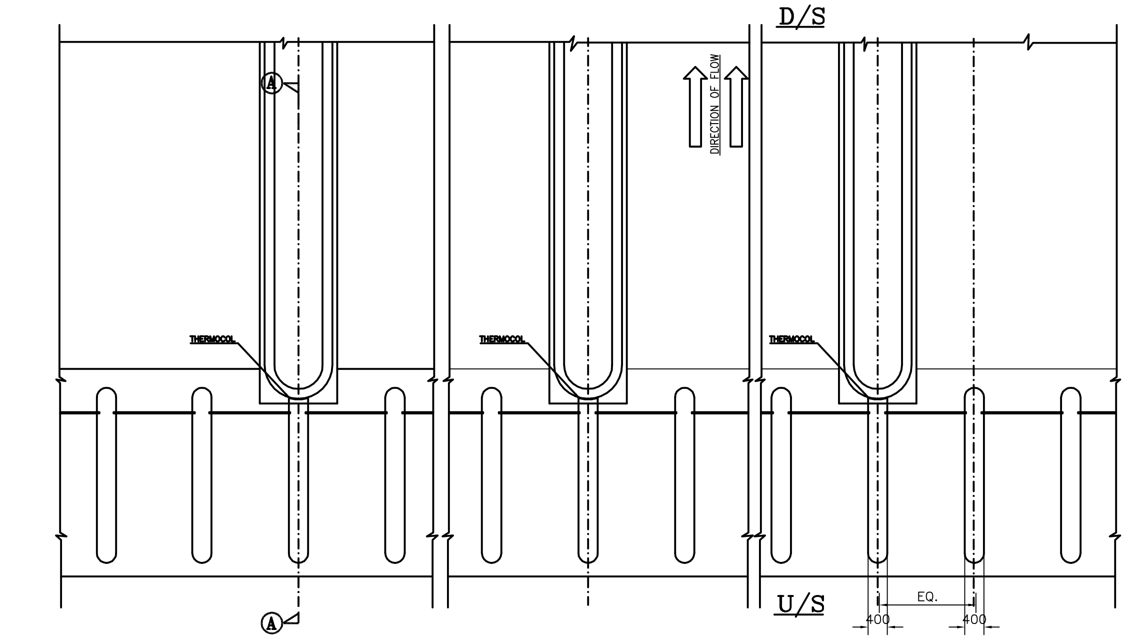

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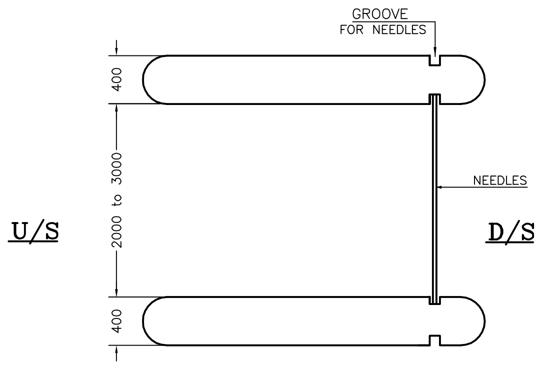
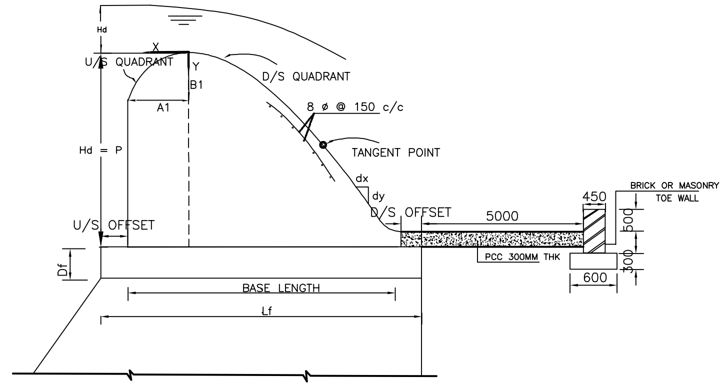




SECTIONAL ELVATION OF OVERFLOW SPILLWAY

U/S QUADRANT => (X^2/A^2)+(Y^2/B^2)=1

D/S QUADRANT => (X^1.85)=K2x(Hd^.85)xY

SCHEDULE FOR OVERFLOW SPILLWAY

A1 = 0.276 M
B1 = 0.164 M

Hw	BASE LENGTH	Lf	U/S OFFSET	D/S OFFSET
3500	3610	3900	200	90
3000	3240	3900	200	460
2500	2860	3100	200	41
2000	2490	3100	200	410

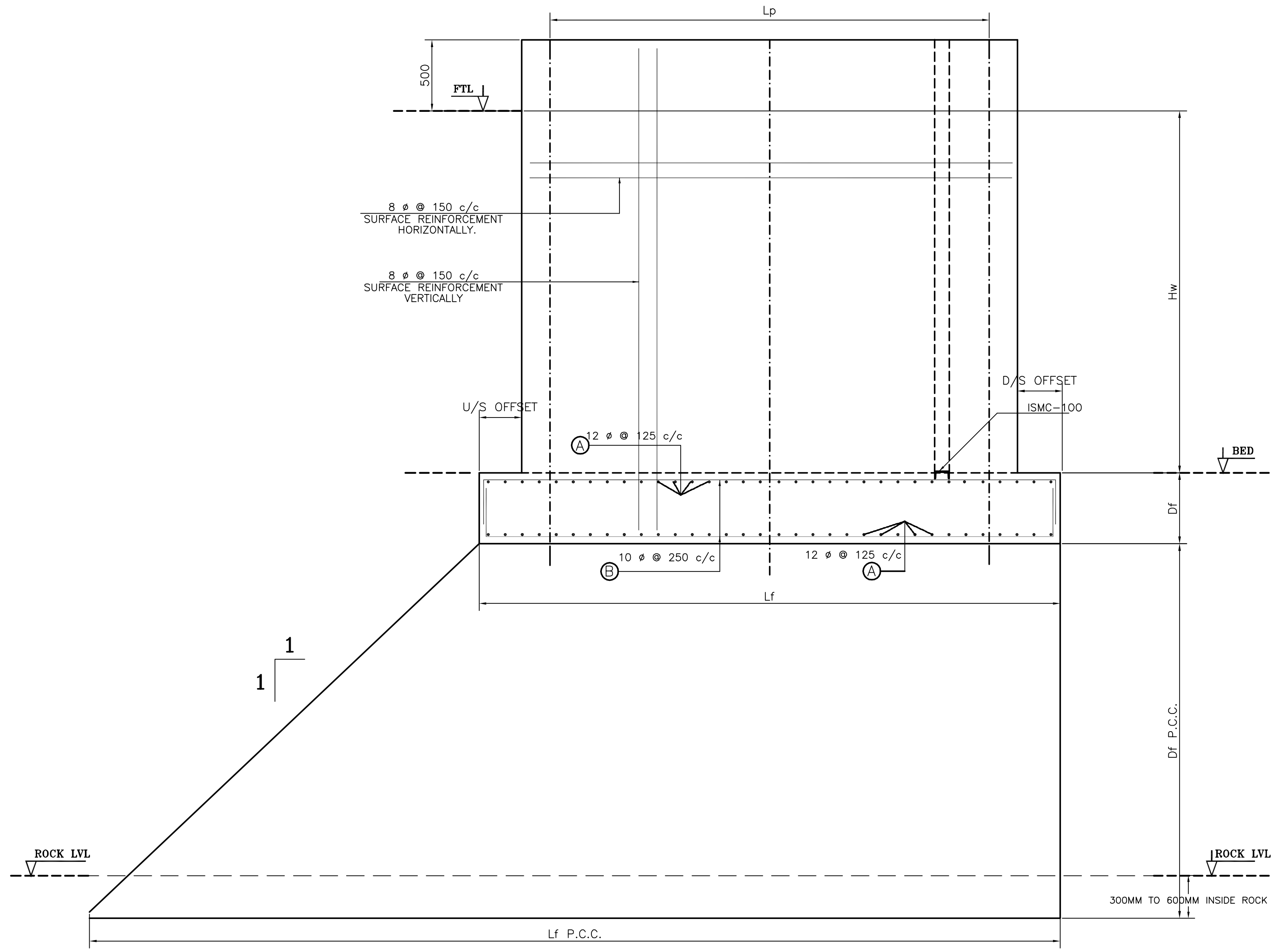
DEPARTMENT OF APPLIED MECHANICS
VISVESVARAYA NATIONAL INSTITUTE OF TECHNOLOGY
NAGPUR.

TYPE PLAN FOR BRIDGE CUM BANDHARA

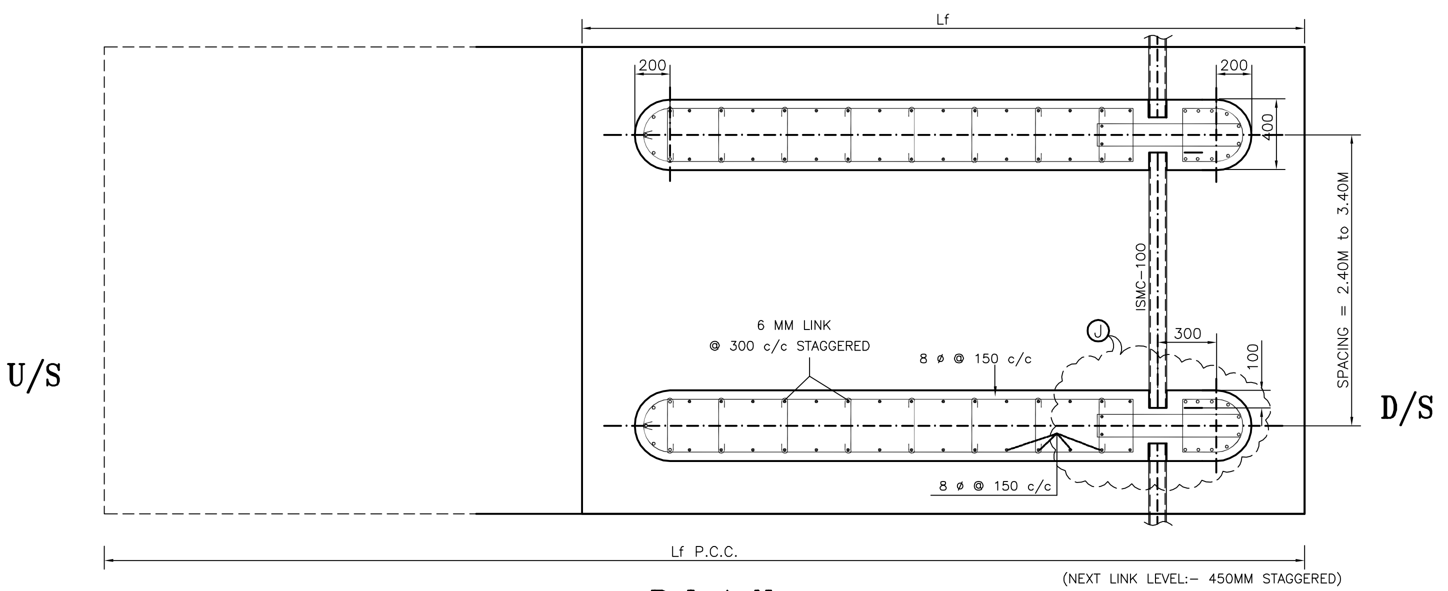
DETAILS OF BANDHARA ON WIER (U/S SLOPE) FOR BURIED ROCK. (GENERAL ARRANGEMENT)

NATIONAL RURAL ROAD DEVELOPMENT AUTHORITY
MINISTRY OF RURAL DEVELOPMENT, GOVT OF INDIA
R&D PROJECT F No P–17029/04/2007–P–II

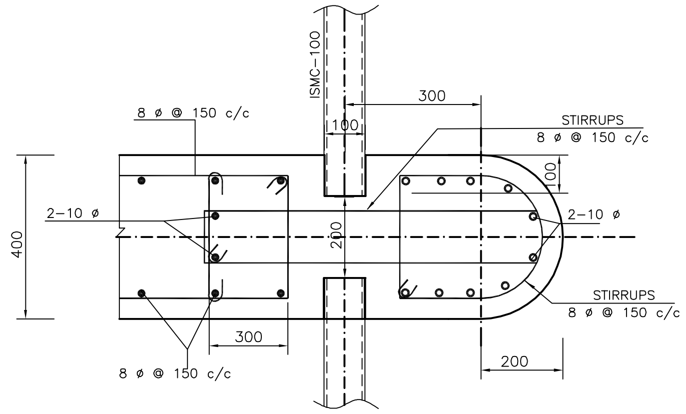
TECHNICAL ADVISIOR	CHECKED BY:	DESIGNED BY:
SHRI P L BONGIRWAR FORMER PRINCIPAL SECRETARY, PWD MAHARASHTRA	SHRI D K KANHERE CHIEF ENGINEER (RETD) PWD MAHARASHTRA	DR. R.K. INGLE
		DRG.No.–WU–01 DATE: DEC–2015



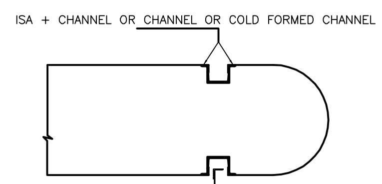
SECTIONAL ELVATION



P L A N



DETAILS AT 'J'



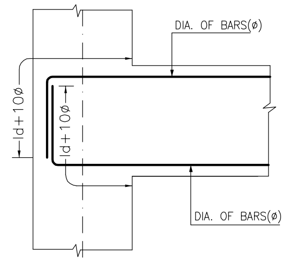
TYP. PLAN FOR GROOVE

SCHEDULE FOR FOUNDATION

Hw	Df	Lp	Lf P.C.C.	Lf PIER	U/S OFFSET	D/S OFFSET
3500	300	2200	8400	3700	500	600
3000	300	2200	8400	3700	500	600
2500	300	1800	7500	2800	300	300
2000	300	1800	7500	2800	300	300

SCHEDULE FOR RAFT REINFORCEMENT

REINFORCEMENT		
AT BOTTOM	AT TOP	
STRAIGHT (A)	STRAIGHT (A)	DISTRIBUTION (B)
12 ø @ 125 c/c	12 ø @ 125 c/c	10 ø @ 250 c/c



DEVELOPEMENT LENGTH Ld FOR BARS.

DIA. (MM)	M : 30	REMARKS
8	365	
10	455	
12	545	
16	725	
20	910	
25	1135	
32	1450	

NOTES FOR R.C.C. WORKS :-

* ALL DIMENSIONS ARE IN MM UNLESS SPECIFIED OTHERWISE
* USE REINFORCEMENT OF GRADE Fe-415 FOR ALL STEEL EXCEPT 6 MM DIA.
* CLEAR COVER TO THE REINFORCEMENT
  FOR PIER - 40MM
  RAFT - 50MM.
* OVERLAPS SHALL BE PROVIDED AT STAGGERED LOCATIONS
* EXECUTION OF WORK SHALL BE CARRIED OUT IN ACCORDANCE WITH I.S.456- (2000).
* *USE GRADE OF CONCRETE M-30 CONC.*
* THE WEIR IS DESIGNED FOR MAXIMUM FOUNDATION DEPTH OF 5M AND ABOVE TABLE GIVES BOTTOM WIDTH OF PCC WEIR.
* THE SLOPING FACE AT D/S OR U/S HAS SLOPE OF 1:1.DEPENDING ON DEPTH OF FOUNDATION THE BOTTOM WIDTH OF WEIR CAN BE WORKED OUT.
* WEIR IS IN PLAIN CONCRETE AND FROM DURABILITY CONSIDERATION THE GRADE OF CONCRETE SHALL BE M:20.

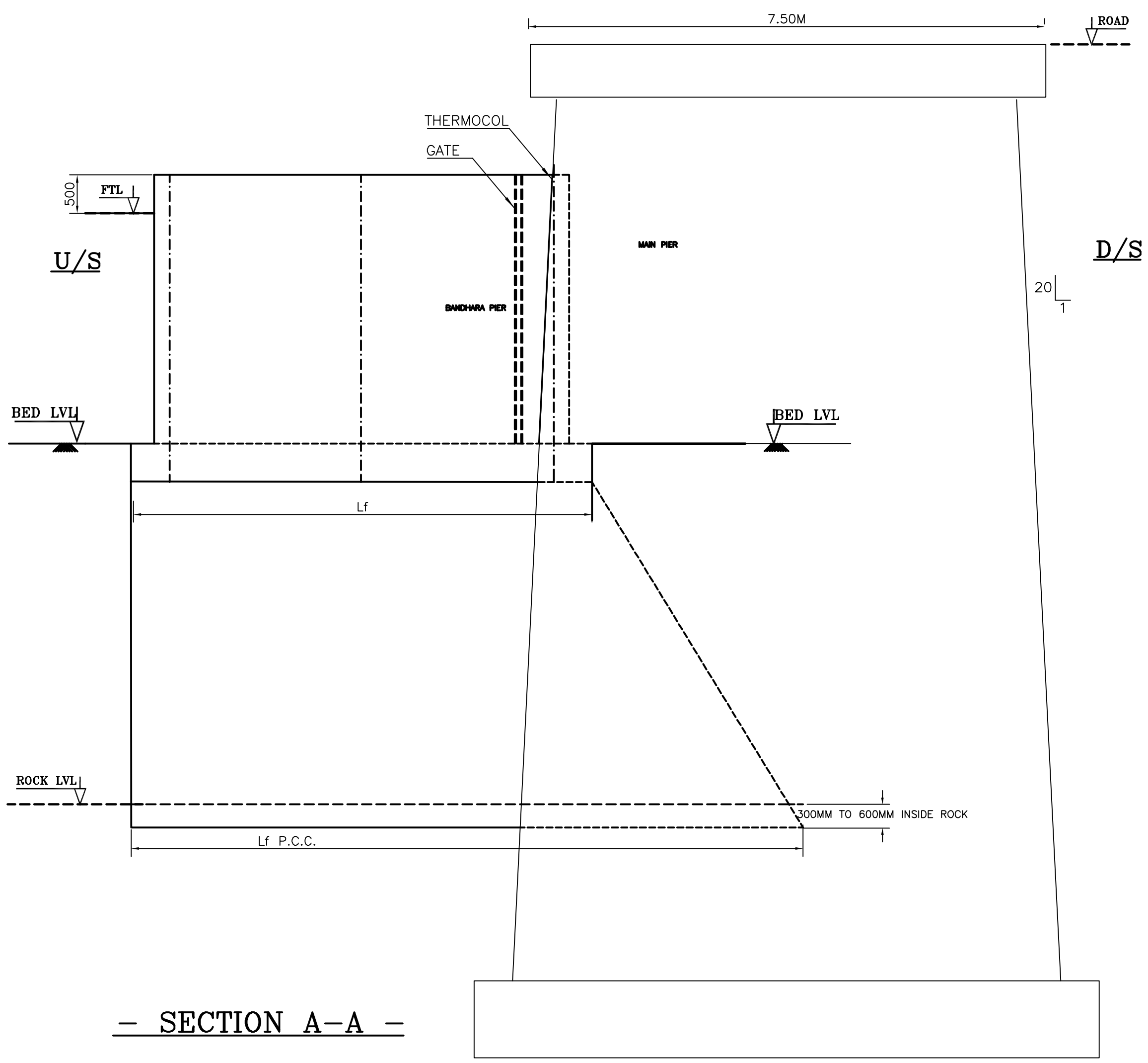
R1	11-5-16	SLOPE INDICATED & NOTES ADDED	
REV.	DATE	DESCRIPTION	REMRKS

DEPARTMENT OF APPLIED MECHANICS
VISVESVARAYA NATIONAL INSTITUTE OF TECHNOLOGY
NAGPUR.

TYPE PLAN FOR BRIDGE CUM BANDHARA.
DETAILS OF BANDHARA ON WIER (U/S SLOPE)
FOR BURIED ROCK (RCC DETAILS)

NATIONAL RURAL ROAD DEVELOPMENT AUTHORITY
MINISTRY OF RURAL DEVELOPMENT, GOVT OF INDIA
R&D PROJECT F No P-17029/04/2007-P-II

TECHNICAL ADVISIOR	CHECKED BY:	DESIGNED BY:
SHRI P L BONGIRWAR FORMER PRINCIPAL SECRETARY, PWD MAHARASHTRA	SHRI D K KANHERE CHIEF ENGINEER (RETD) PWD MAHARASHTRA	DR. R.K. INGLE DRG.No.-WU-02 REV. - R1 DATE: DEC-2015



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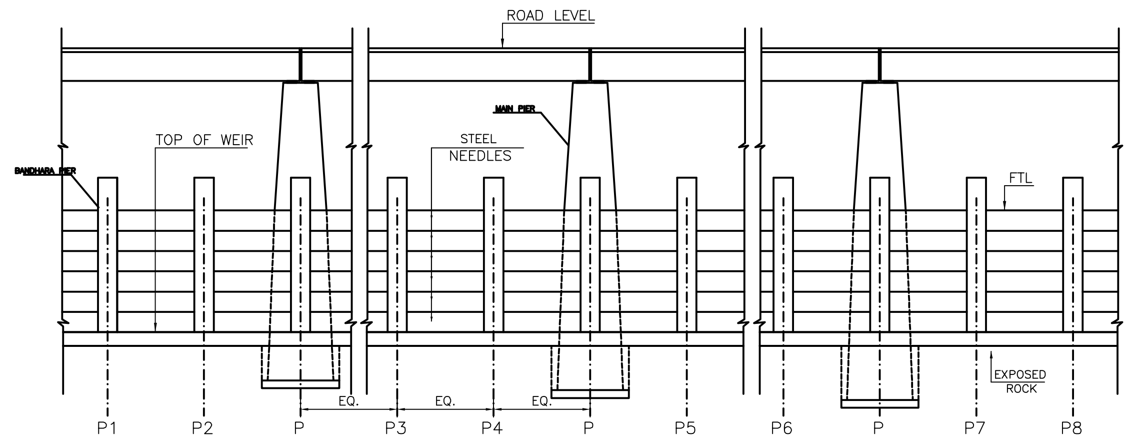

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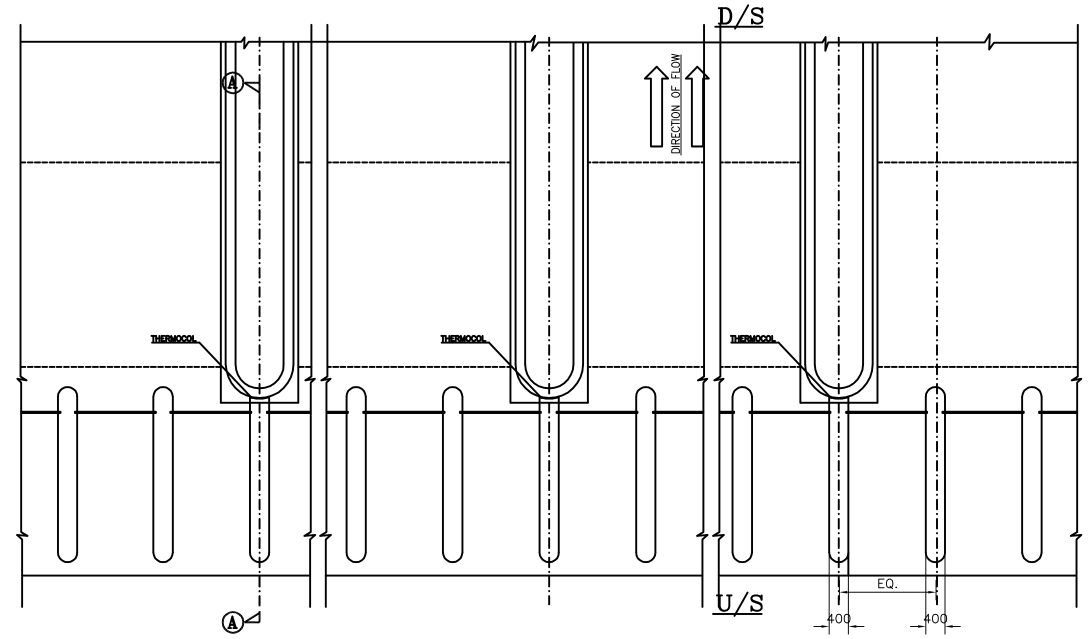

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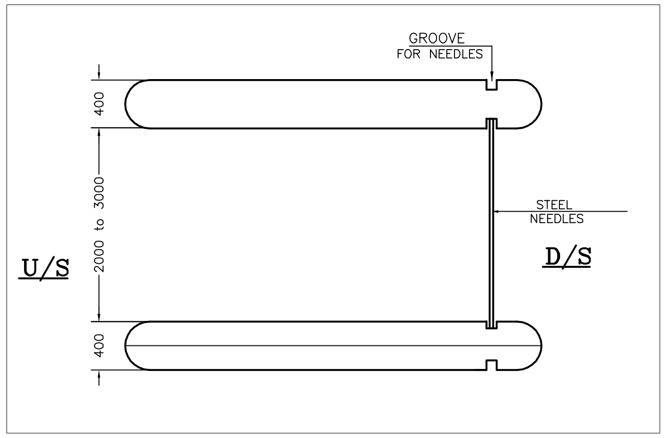
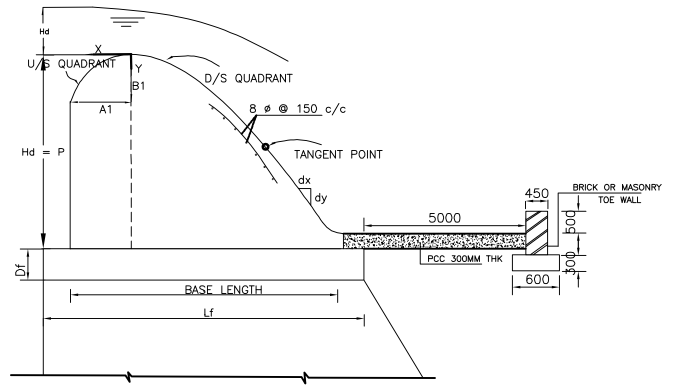




SECTIONAL ELEVATION OF OVERFLOW SPILLWAY

U/S QUADRANT => (X^2/A^2)+(Y^2/B^2)=1

D/S QUADRANT => (X^1.85)=K2x(Hd^.85)xY

SCHEDULE FOR OVERFLOW SPILLWAY

A1 = 0.276 M				
B1 = 0.164 M				
Hw	BASE LENGTH	Lf PIER	U/S OFFSET	D/S OFFSET
3500	3610	3900	200	90
3000	3240	3900	200	460
2500	2860	3100	200	40
2000	2490	3100	200	410

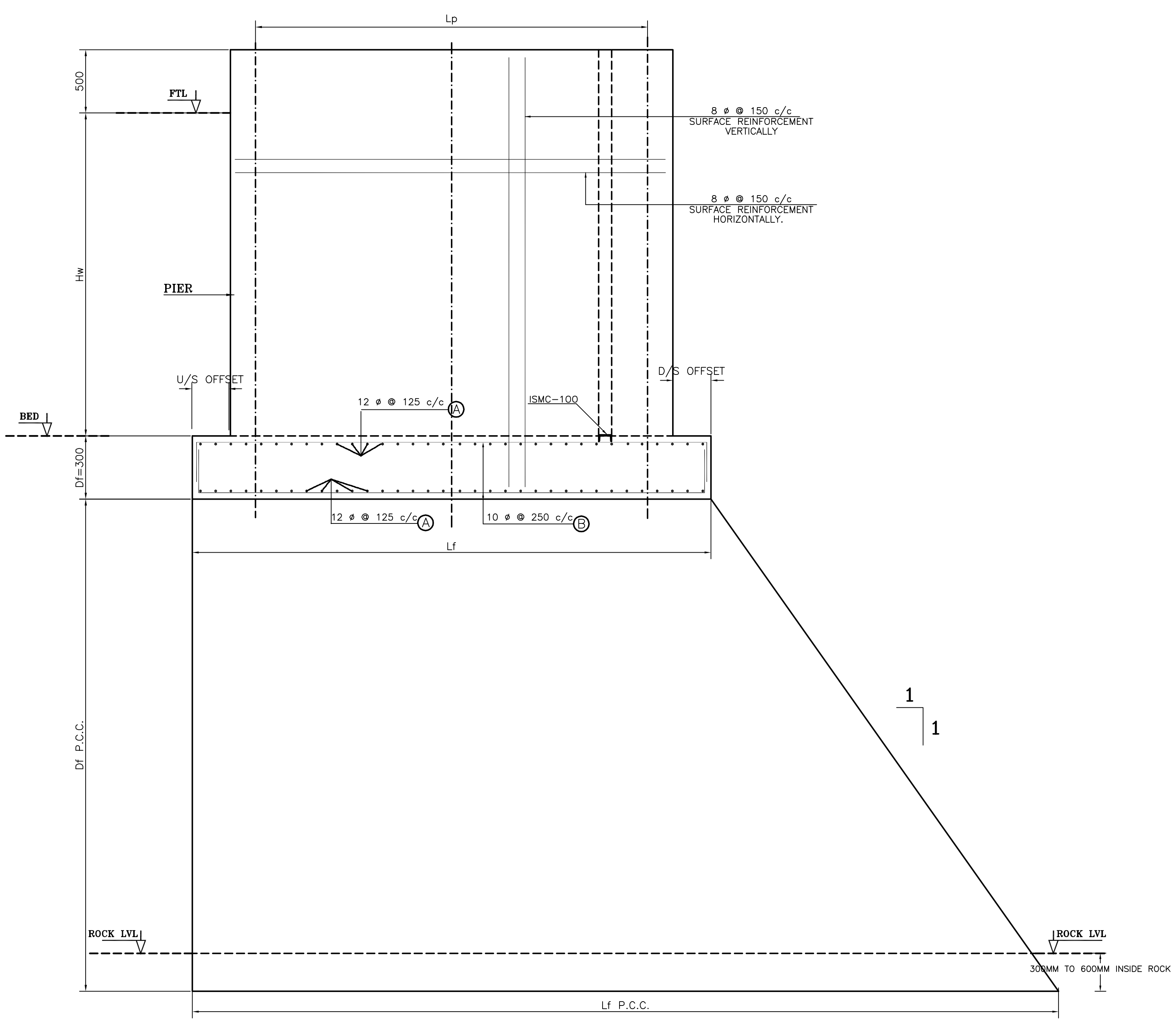
DEPARTMENT OF APPLIED MECHANICS
VISVESVARAYA NATIONAL INSTITUTE OF TECHNOLOGY
NAGPUR.

TYPE PLAN FOR BRIDGE CUM BANDHARA

DETAILS OF BANDHARA ON WIER (D/S SLOPE)
FOR BURIED ROCK. (GENERAL ARRANGEMENT)

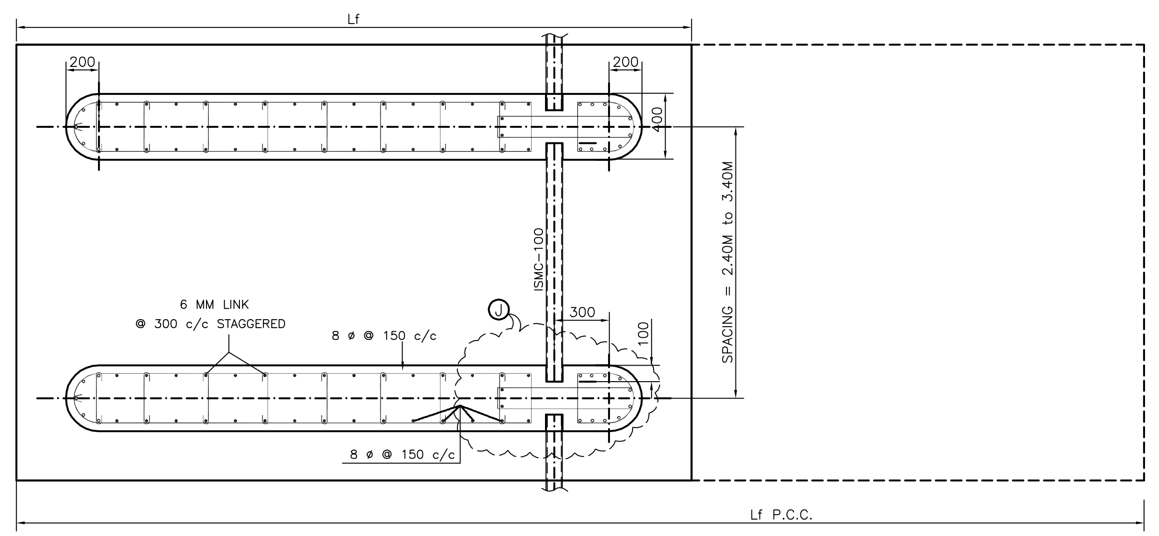
NATIONAL RURAL ROAD DEVELOPMENT AUTHORITY
MINISTRY OF RURAL DEVELOPMENT, GOVT OF INDIA
R&D PROJECT F No P-17029/04/2007-P-II

TECHNICAL ADVISIOR	CHECKED BY:	DESIGNED BY:
SHRI P L BONGIRWAR FORMER PRINCIPAL SECRETARY, PWD MAHARASHTRA	SHRI D K KANHERE CHIEF ENGINEER (RETD) PWD MAHARASHTRA	DR. R.K. INGLE
		DRG.No.-WD-01 DATE: DEC-2015



SECTIONAL ELVATION

UP STREAM



DOWN STREAM

P L A N

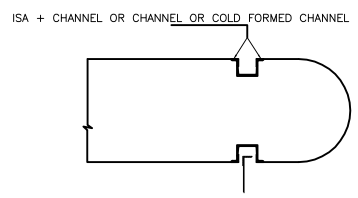
(NEXT LINK LEVEL:- 450MM STAGGERED)

SCHEDULE FOR FOUNDATION

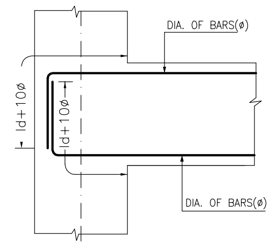
Hw	Df	Lp	Lf P.C.C.	Lf PIER	U/S OFFSET	D/S OFFSET
3500	300	2200	8400	3700	600	500
3000	300	2200	8400	3700	600	500
2500	300	1800	7500	2800	300	300
2000	300	1800	7500	2800	300	300

SCHEDULE FOR RAFT REINFORCEMENT

REINFORCEMENT			REMARKS
AT BOTTOM	AT TOP		
STRAIGHT (A)	STRAIGHT (A)	DISTRIBUTION (B)	
12 ø @ 125 c/c	12 ø @ 125 c/c	10 ø @ 250 c/c	



TYP. PLAN FOR GROOVE

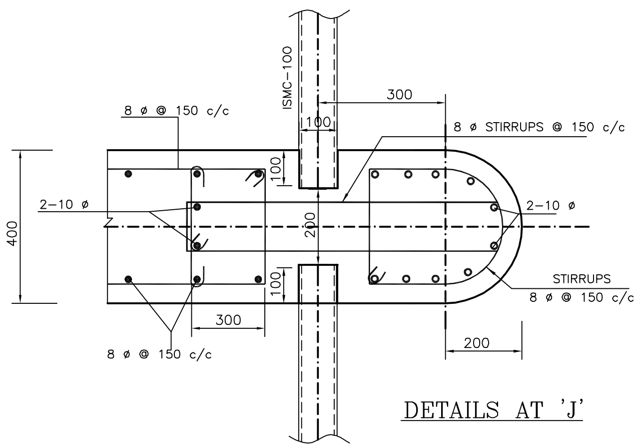


DEVELOPEMENT LENGTH Ld FOR BARS.

DIA. (MM)	M : 30	REMARKS
8	365	
10	455	
12	545	
16	725	
20	910	
25	1135	
32	1450	

NOTES FOR R.C.C. WORKS :-

* ALL DIMENSIONS ARE IN MM UNLESS SPECIFIED OTHERWISE
* USE REINFORCEMENT OF GRADE Fe-415 FOR ALL STEEL EXCEPT 6 MM DIA.
* CLEAR COVER TO THE REINFORCEMENT
  FOR PIER – 40MM
  RAFT – 50MM.
* OVERLAPS SHALL BE PROVIDED AT STAGGERED LOCATIONS
* EXECUTION OF WORK SHALL BE CARRIED OUT IN ACCORDANCE WITH I.S.456- (2000).
* USE GRADE OF CONCRETE M-30 CONC.
* THE WEIR IS DESIGNED FOR MAXIMUM FOUNDATION DEPTH OF 5M AND ABOVE TABLE GIVES BOTTOM WIDTH OF PCC WEIR.
* THE SLOPING FACE AT D/S OR U/S HAS SLOPE OF 1:1.DEPENDING ON DEPTH OF FOUNDATION THE BOTTOM WIDTH OF WEIR CAN BE WORKED OUT.
* WEIR IS IN PLAIN CONCRETE AND FROM DURABILITY CONSIDERATION THE GRADE OF CONCRETE SHALL BE M:20.



DETAILS AT 'J'

REV.	DATE	DESCRIPTION	REMRKS
R1	11-5-16	SLOPE INDICATED & NOTES ADDED	

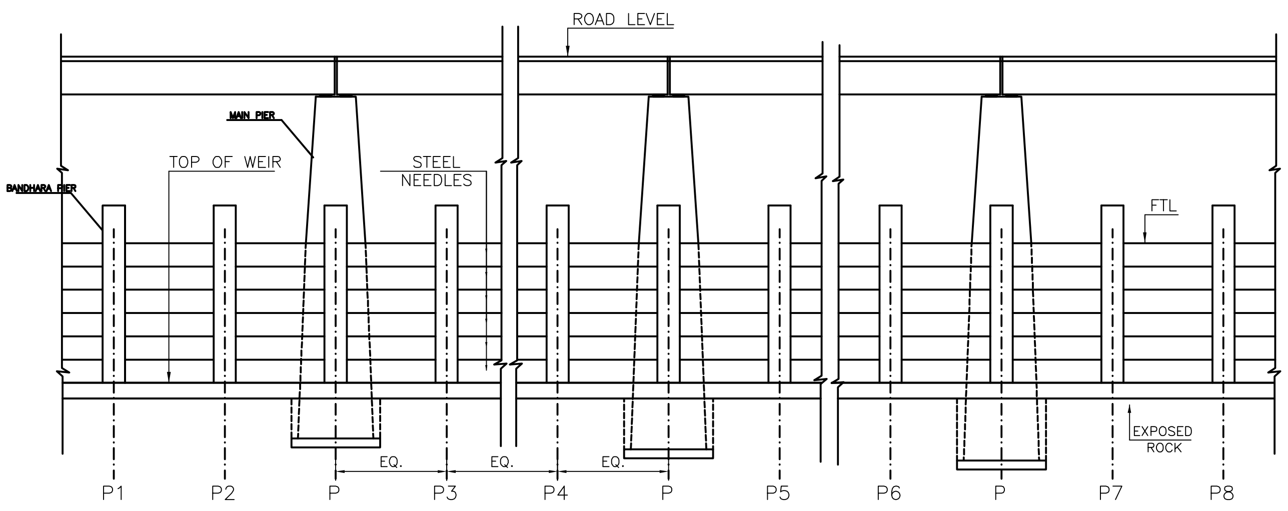
DEPARTMENT OF APPLIED MECHANICS
VISVESVARAYA NATIONAL INSTITUTE OF TECHNOLOGY
NAGPUR.

TYPE PLAN FOR BRIDGE CUM BANDHARA

DETAILS OF BANDHARA ON WIER (D/S SLOPE)
FOR BURIED ROCK (RCC DETAILS)

NATIONAL RURAL ROAD DEVELOPMENT AUTHORITY
MINISTRY OF RURAL DEVELOPMENT, GOVT OF INDIA
R&D PROJECT F No P-17029/04/2007-P-II

TECHNICAL ADVISIOR	CHECKED BY:	DESIGNED BY:	
SHRI P L BONGIRWAR, FORMER PRINCIPAL SECRETARY, PWD MAHARASHTRA	SHRI D K KANHERE, CHIEF ENGINEER (RETD) PWD MAHARASHTRA	DR. R.K. INGLE	
		DRG.No.-WD-02 REV. - R1	DATE: DEC-2015



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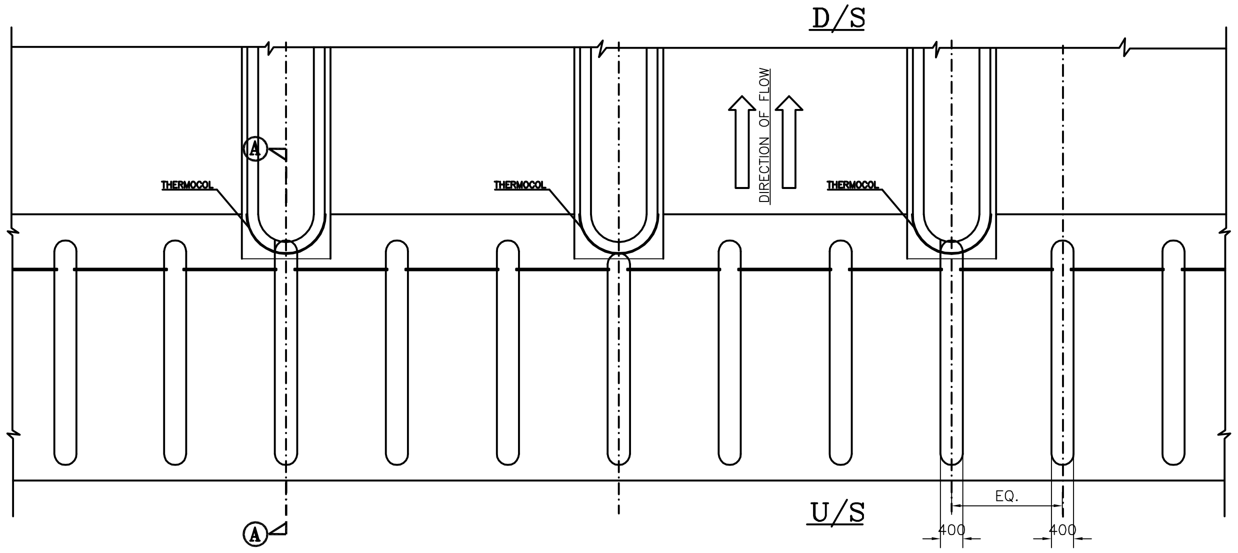

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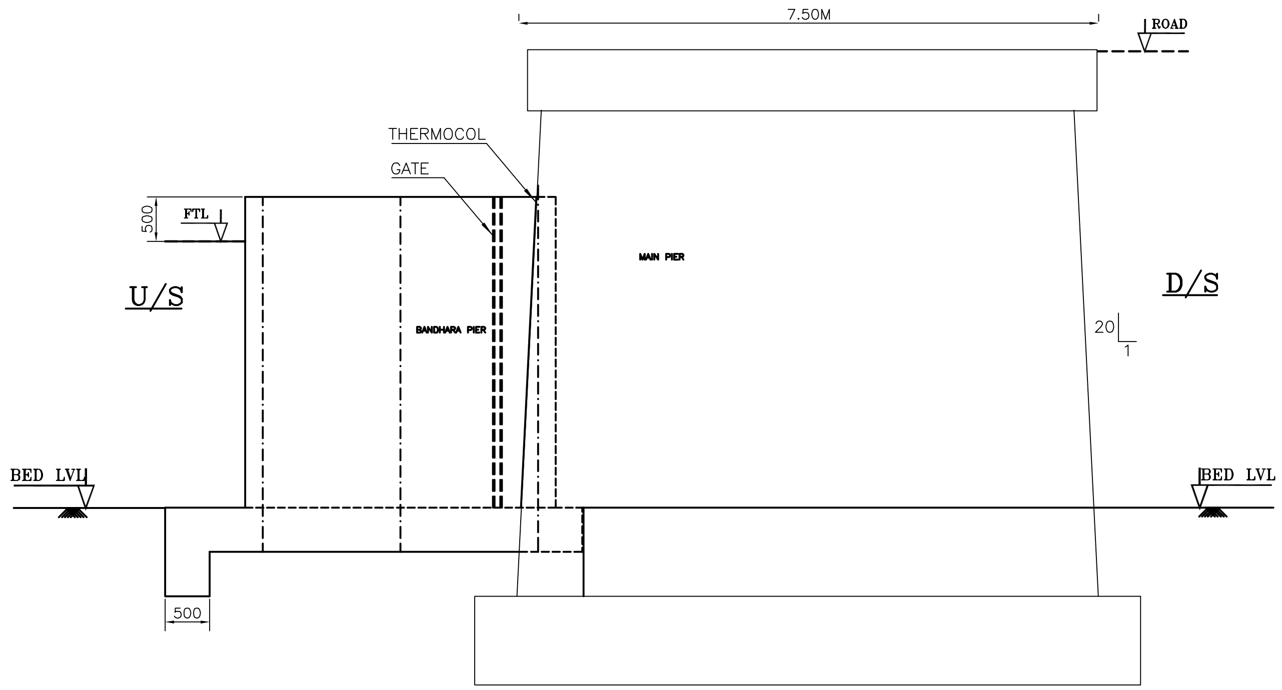
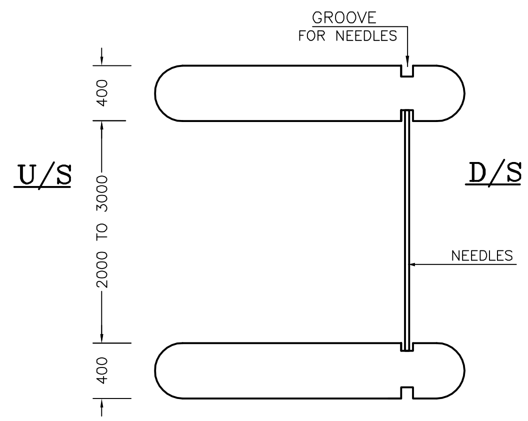
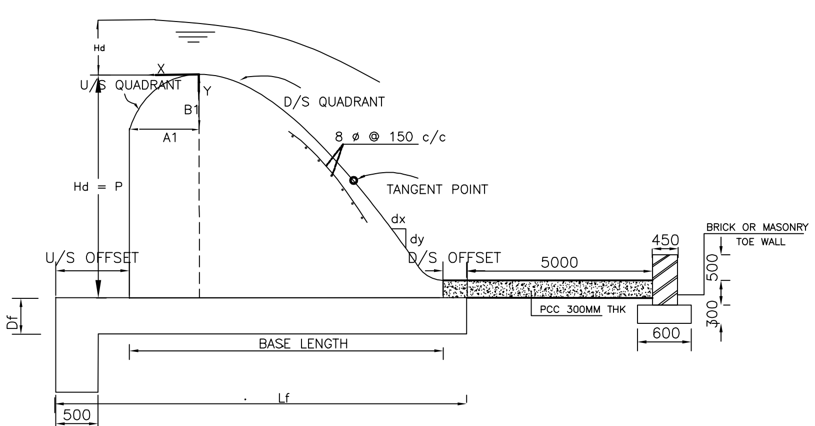


- SECTION A-A -





SECTIONAL ELVATION OF OVERFLOW SPILLWAY

U/S QUADRANT => (X^2/A^2)+(Y^2/B^2)=1

D/S QUADRANT => (X^1.85)=K2x(Hd^.85)xY

SCHEDULE FOR OVERFLOW SPILLWAY

A1 = 0.276 M
B1 = 0.164 M

Hw	BASE LENGTH	Lf	U/S OFFSET	D/S OFFSET
3500	3610	5400	300	1490
3000	3240	4600	300	1060
2500	2860	3700	300	540
2000	2490	3700	300	910

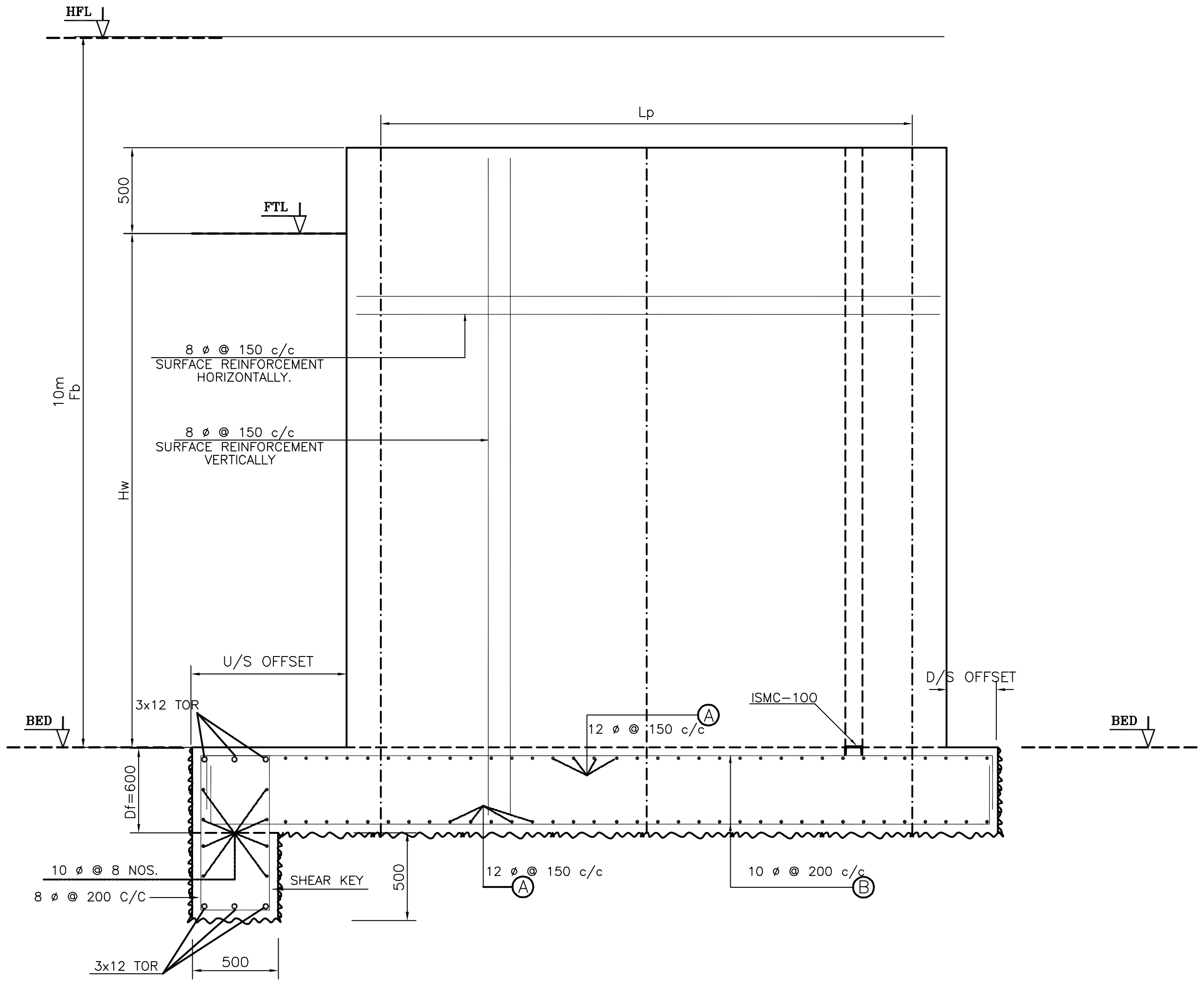
DEPARTMENT OF APPLIED MECHANICS
VISVESVARAYA NATIONAL INSTITUTE OF TECHNOLOGY
NAGPUR.

TYPE PLAN FOR BRIDGE CUM BANDHARA

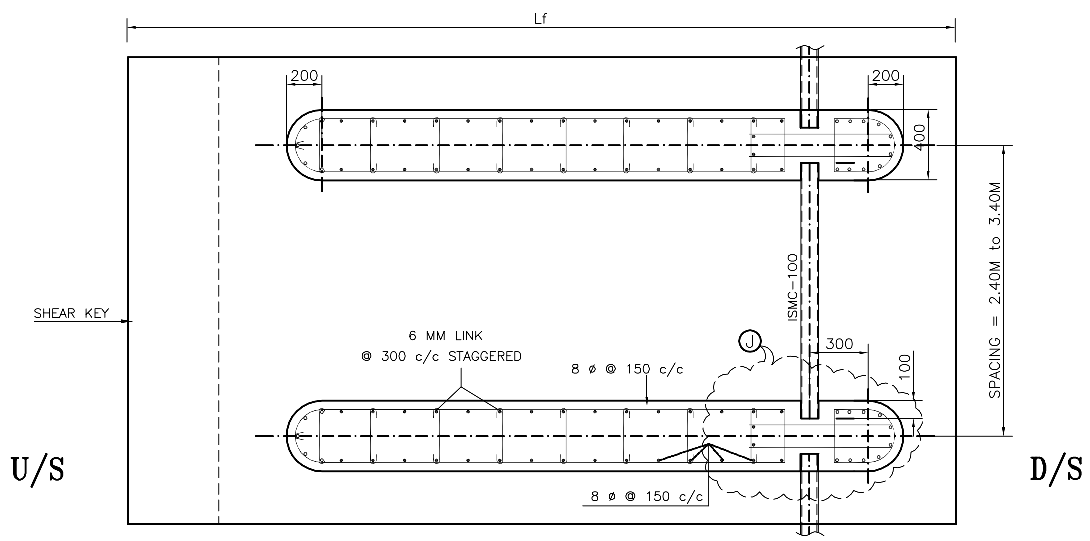
DETAILS OF BANDHARA ON EXPOSED ROCK
(GENERAL ARRANGEMENT).

NATIONAL RURAL ROAD DEVELOPMENT AUTHORITY
MINISTRY OF RURAL DEVELOPMENT, GOVT OF INDIA
R&D PROJECT F No P-17029/04/2007-P-II

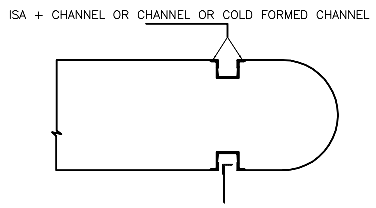
TECHNICAL ADVISIOR	CHECKED BY:	DESIGNED BY:
SHRI P L BONGIRWAR FORMER PRINCIPAL SECRETARY, PWD MAHARASHTRA	SHRI D K KANHERE CHIEF ENGINEER (RETD) PWD MAHARASHTRA	DR. R.K. INGLE DRG.No.-RB-01 DATE: DEC-2015



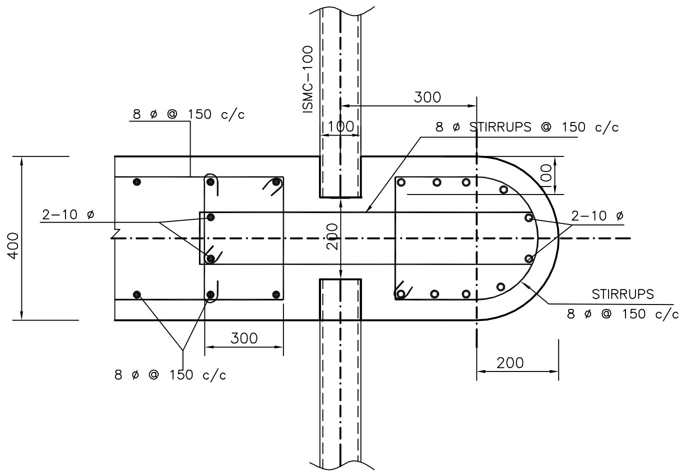
SECTIONAL ELVATION



P L A N



TYP. PLAN FOR GROOVE



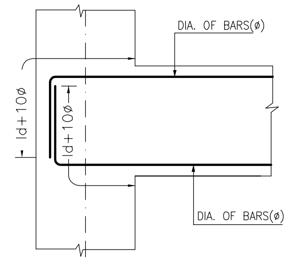
DETAILS AT 'J'

SCHEDULE FOR INTERMEDIATE PIER DETAILS

Hw	Df	Lp	Lf	U/S OFFSET	D/S OFFSET
3500	600	2200	5400	1800	1000
3000	600	2200	5400	1800	1000
2500	600	1800	3500	800	500
2000	600	1800	3500	800	500

SCHEDULE FOR RAFT REINFORCEMENT

REINFORCEMENT			REMARKS
AT BOTTOM	AT TOP		
STRAIGHT (A)	STRAIGHT (A)	DISTRIBUTION (B)	
12 ø @ 150 c/c	12 ø @ 150 c/c	10 ø @ 200 c/c	



DEVELOPEMENT LENGTH Ld FOR BARS.

DIA. (MM)	M : 30	REMARKS
8	365	
10	455	
12	545	
16	725	
20	910	
25	1135	
32	1450	

NOTES FOR R.C.C. WORKS :-

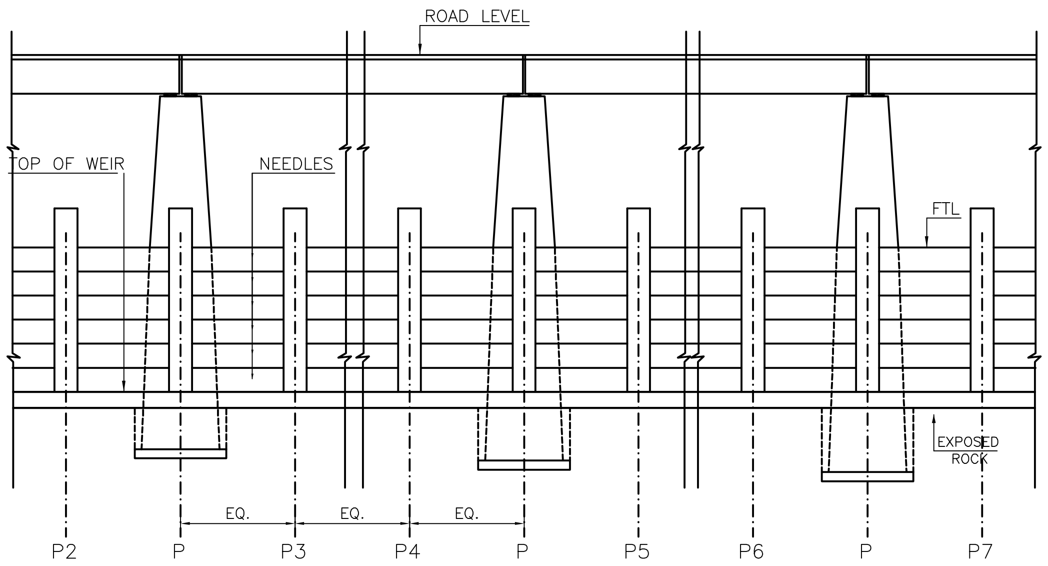
* ALL DIMENSIONS ARE IN MM UNLESS SPECIFIED OTHERWISE
* USE REINFORCEMENT OF GRADE Fe-415 FOR ALL STEEL EXCEPT 6 MM DIA.
* CLEAR COVER TO THE REINFORCEMENT
  FOR PIER – 40MM
  RAFT – 50MM.
* OVERLAPS SHALL BE PROVIDED AT STAGGERED LOCATIONS
* EXECUTION OF WORK SHALL BE CARRIED OUT IN ACCORDANCE WITH I.S.456- (2000).
* USE GRADE OF CONCRETE M-30 CONC.

DEPARTMENT OF APPLIED MECHANICS
VISVESVARAYA NATIONAL INSTITUTE OF TECHNOLOGY
NAGPUR.

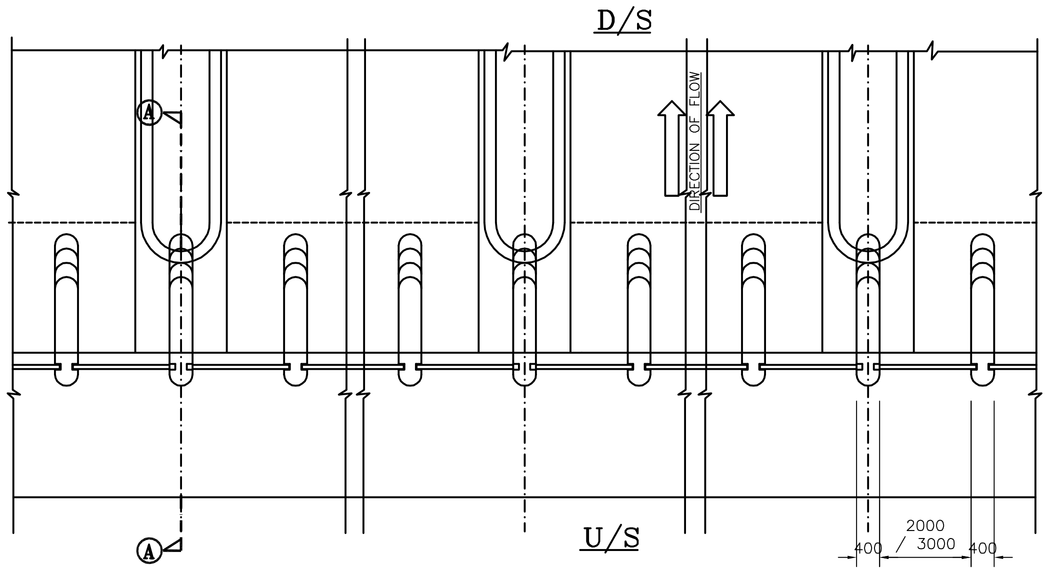
TYPE PLAN FOR BRIDGE CUM BANDHARA
DETAILS OF BANDHARA ON EXPOSED ROCK (RCC DETAILS)

NATIONAL RURAL ROAD DEVELOPMENT AUTHORITY
MINISTRY OF RURAL DEVELOPMENT, GOVT OF INDIA
R&D PROJECT F No P-17029/04/2007-P-II

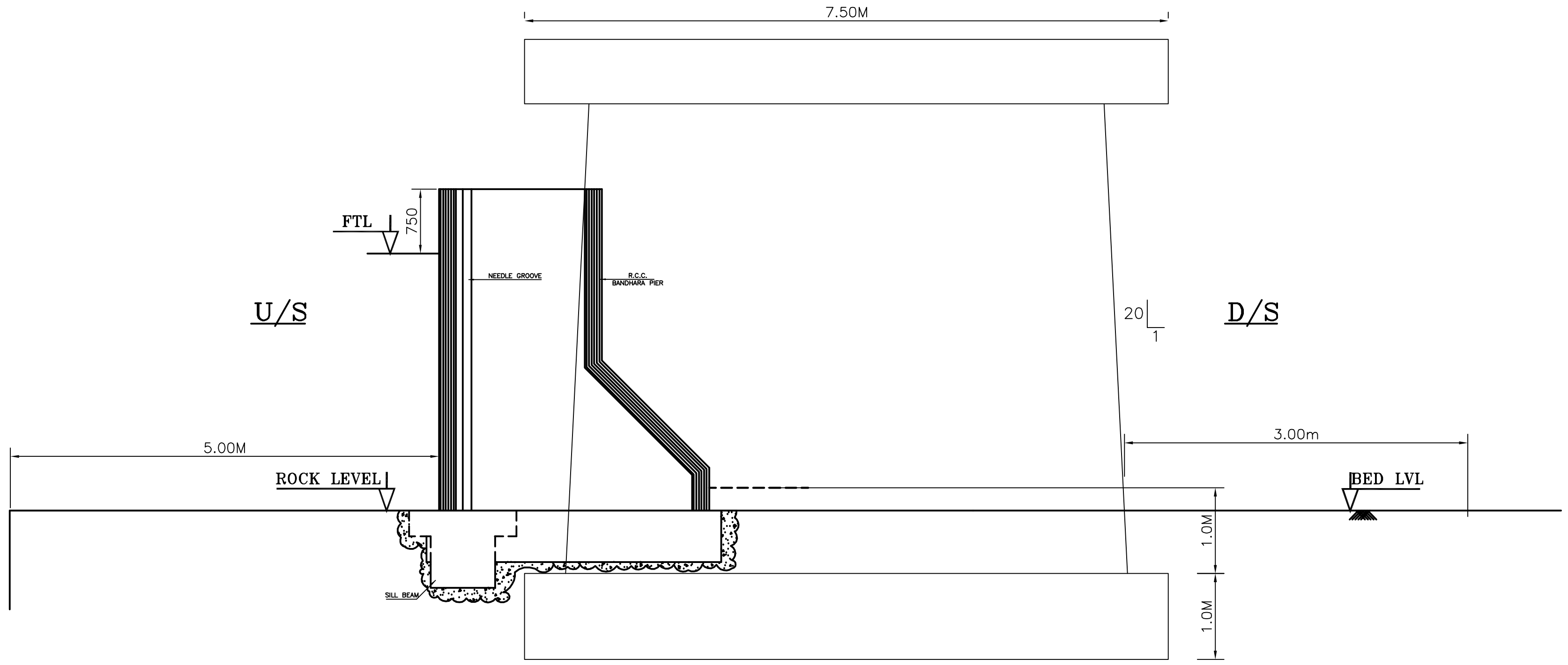
TECHNICAL ADVISIOR	CHECKED BY:	DESIGNED BY:	
SHRI P L BONGIRWAR FORMER PRINCIPAL SECRETARY, PWD MAHARASHTRA	SHRI D K KANHERE CHIEF ENGINEER (RETD) PWD MAHARASHTRA	DR. R.K. INGLE	
		DRG.No.-RB-02	DATE: DEC-2015

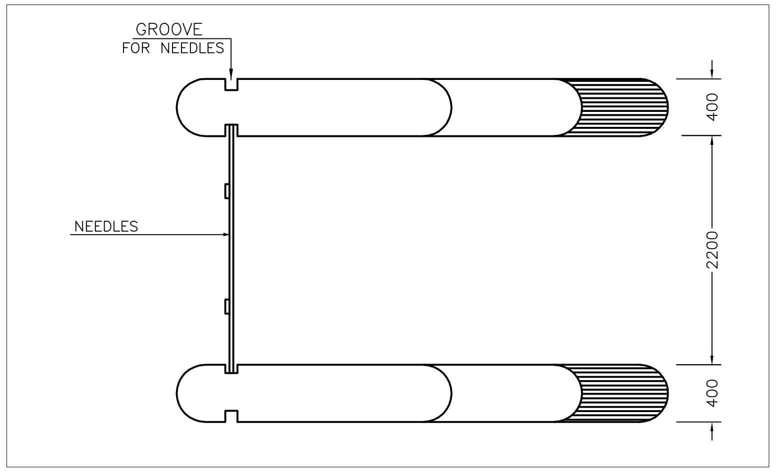


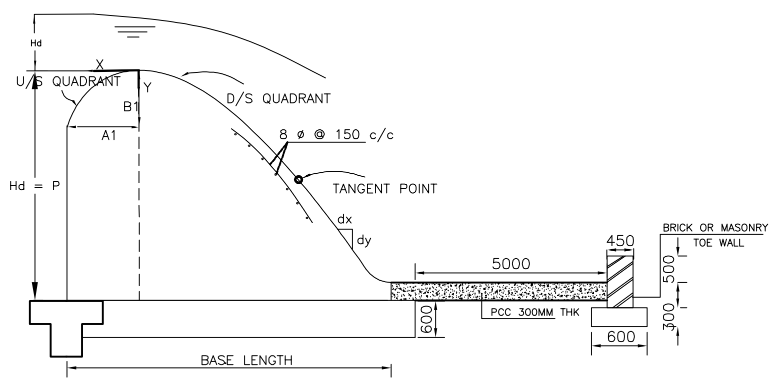
—ELEVATION—



— PLAN WITH INTERMEDIATE PIERS TO DIVIDE MAIN PIER SPAN (8M) EQUALLY—







SECTIONAL ELVATION OF OVERFLOW SPILLWAY

U/S QUADRANT => (X^2/A^2)+(Y^2/B^2)=1

D/S QUADRANT => (X^1.85)=K2x(Hd^.85)xY

SCHEDULE FOR OVERFLOW SPILLWAY

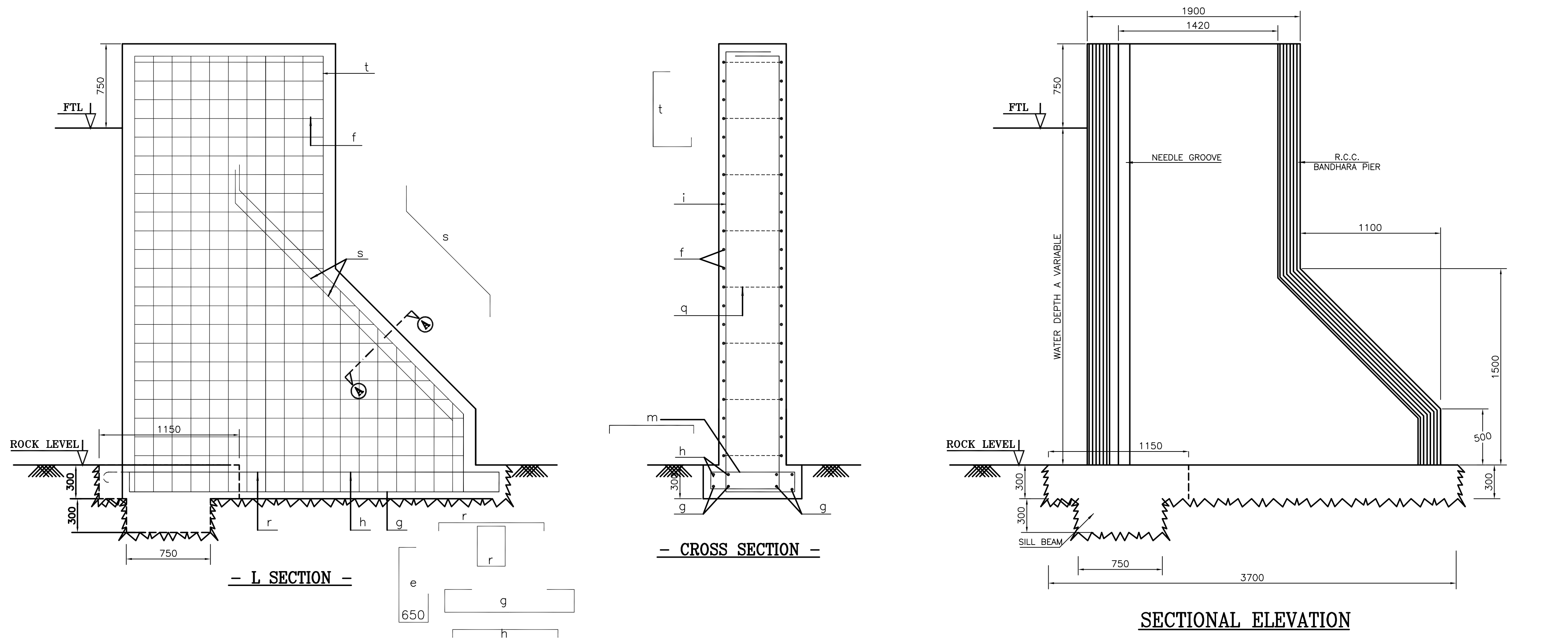
A1 = 0.276 M	
B1 = 0.164 M	
Hw	BASE LENGTH
3500	3610
3000	3240
2500	2860
2000	2490

DEPARTMENT OF APPLIED MECHANICS
VISVESVARAYA NATIONAL INSTITUTE OF TECHNOLOGY
NAGPUR.

TYPE PLAN FOR BRIDGE CUM BANDHARA.
DETAILS OF BANDHARA WITH SILL BEAM
ON ROCK (GENERAL ARRANGEMENT)

NATIONAL RURAL ROAD DEVELOPMENT AUTHORITY
MINISTRY OF RURAL DEVELOPMENT, GOVT OF INDIA
R&D PROJECT F No P-17029/04/2007-P-II

TECHNICAL ADVISIOR	CHECKED BY:	DESIGNED BY:	
SHRI P L BONGIRWAR FORMER PRINCIPAL SECRETARY, PWD MAHARASHTRA	SHRI D K KANHERE CHIEF ENGINEER (RETD) PWD MAHARASHTRA	DR. R.K. INGLE	
		DRG.No.-TBB-01	DATE: DEC-2015



- L SECTION -

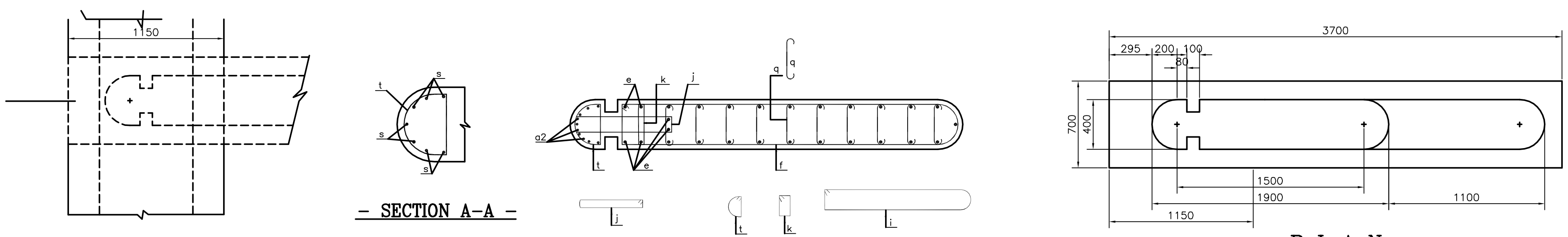
- CROSS SECTION -

SECTIONAL ELEVATION

-REINFORCEMENT SCHEDULE FOR BANDHARA PIER-

BAR NOTATION	WATER STORAGE DEPTH								
	2500			3000			3500		
	DIA.	NO.	C/C	DIA.	NO.	C/C	DIA.	NO.	C/C
a1	20	4	–	20	4	–	20	4	–
a2	16	2	–	16	3	–	16	4	–
b	20	4	–	20	4	–	20	4	–
c	8	4	–	8	4	–	8	4	–
d	12	–	200	12	–	200	12	–	200
e	12	6	–	12	6	–	12	6	–
f	12	–	190	12	–	160	12	–	160
g	20	4	–	20	4	–	20	4	–
h	12	3	–	12	3	–	12	3	–
i	8	–	150	8	–	150	8	–	150
j	8	–	150	8	–	150	8	–	150
k	8	–	140	8	–	140	8	–	140
l	8	–	140	8	–	140	8	–	140
m	10	–	300	10	–	300	10	–	300
n	12	–	200	12	–	200	12	–	200
p	12	12	–	12	12	–	12	12	–
q	8	–	140	8	–	140	8	–	140
r	16	3	–	16	3	–	16	3	–
s	12	–	190	12	–	160	12	–	160
t	12	–	190	12	–	160	12	–	160

* q AT EVERY THIRD LAYER.



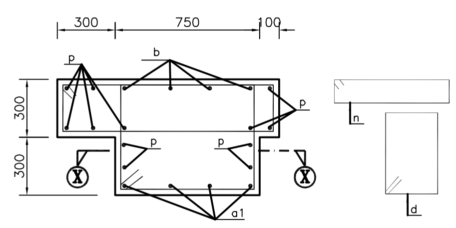
- SECTION X-X -

- SECTION A-A -

- GENERAL REINFORCEMENT ARRANGEMENT -

P L A N

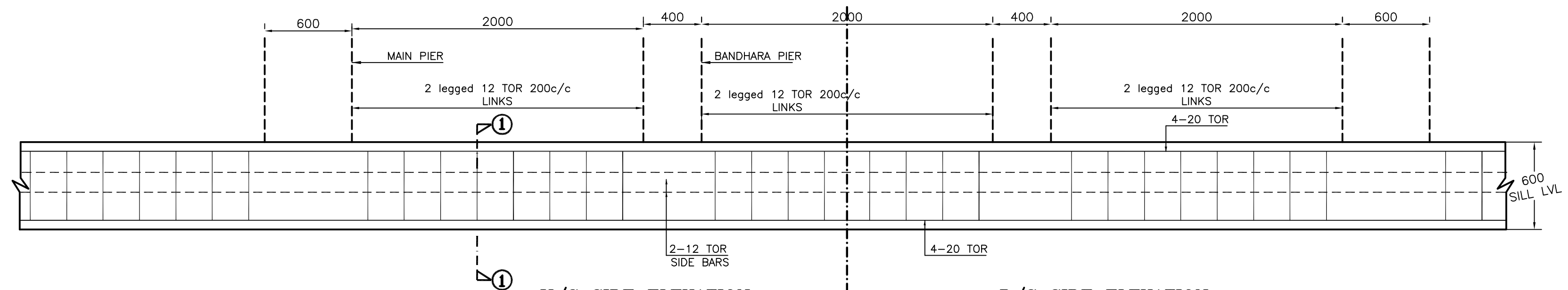
- TYPICAL DETAILS OF BANDHARA PIER -



- DETAILS OF SILL BEAM -

– NOTES –

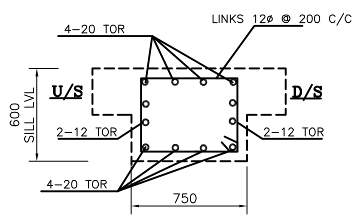
1. GRADE OF CONCRETE
   a) NEEDLE PIER M:30,
   b) RAFT SLAB, FOOTING & KEY M:30
   C) STEEL FE-415
2. COEFFICIENT OF FRICTION BETWEEN ROCK AND RAFT SLAB-0.65
3. MINIMUM 50mm COVER TO STEEL BAR REINFORCEMENT SHOULD PROVIDE AS PER PROVISIONS OF I.R.C. 21
4. LAPS AND JOINTS SHOULD BE AVOIDED AS PER AS POSSIBLE. WHERE EVER REQUIRED THEY SHALL BE PROVIDED AS PER I.R.C. 21



U/S SIDE ELEVATION

D/S SIDE ELEVATION

- SECTION THROUGH SILL BEAM - FOR 3.50M WATER DEPTH



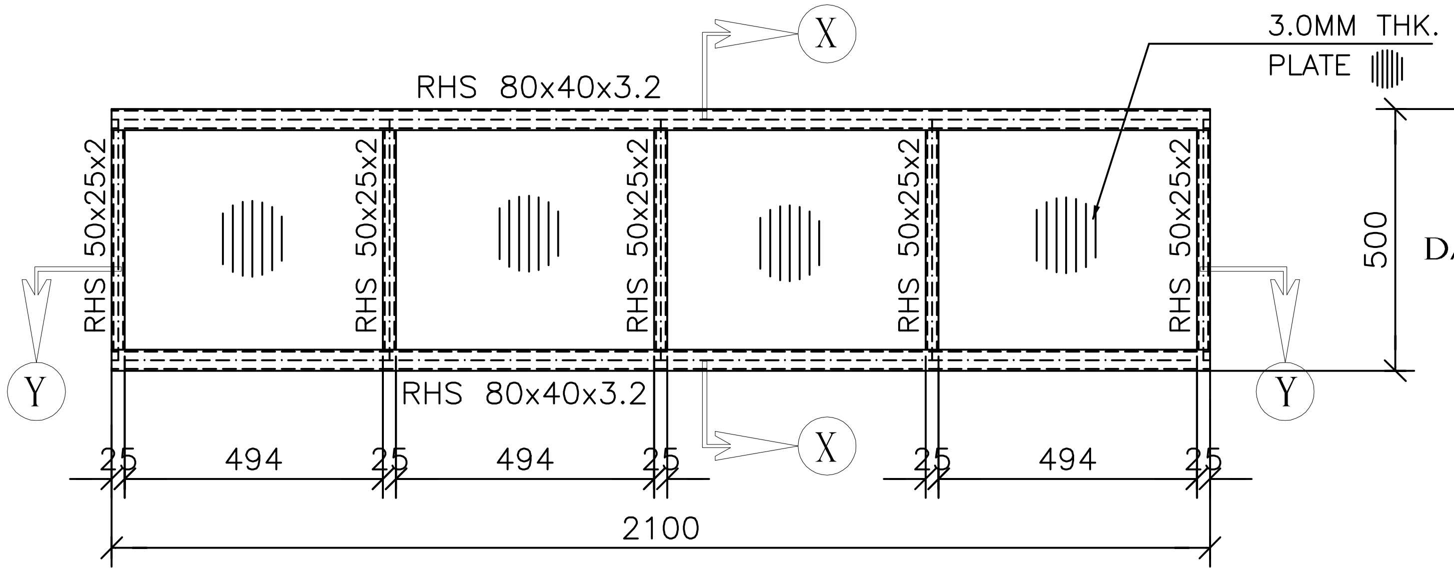
- SECTION 1-1

DEPARTMENT OF APPLIED MECHANICS
VISVESVARAYA NATIONAL INSTITUTE OF TECHNOLOGY NAGPUR.

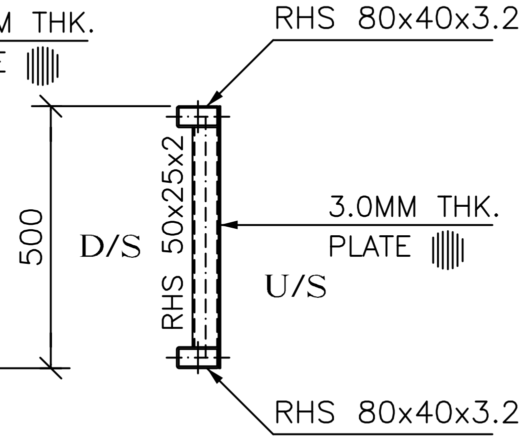
TYPE PLAN FOR BRIDGE CUM BANDHARA.
DETAILS OF BANDHARA WITH SILL BEAM ON ROCK (RCC DETAILS)

NATIONAL RURAL ROAD DEVELOPMENT AUTHORITY
MINISTRY OF RURAL DEVELOPMENT, GOVT OF INDIA
R&D PROJECT F No P-17029/04/2007-P-II

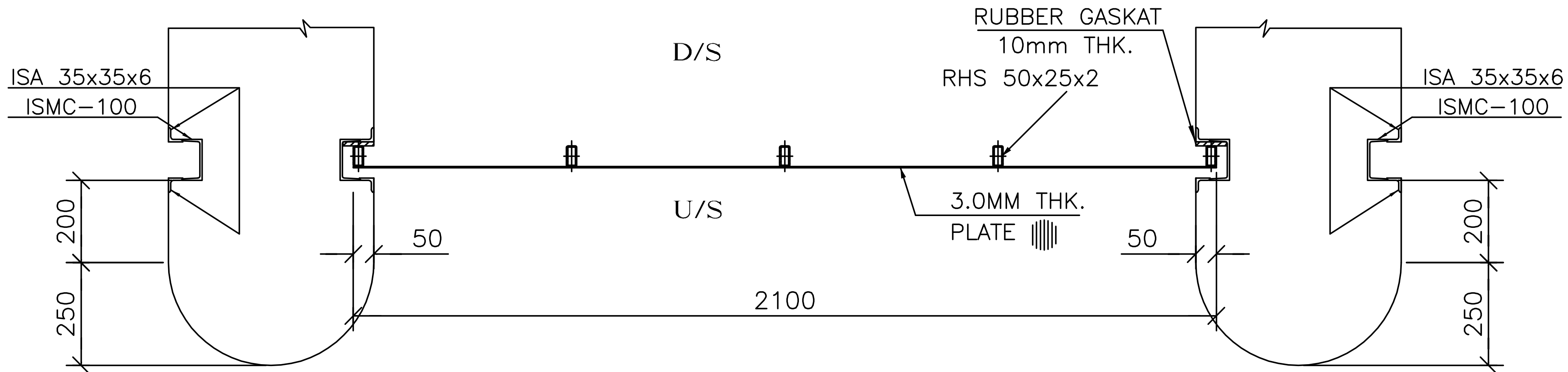
TECHNICAL ADVISOR	CHECKED BY:	DESIGNED BY:
SHRI P L BONGIRWAR FORMER PRINCIPAL SECRETARY, PWD MAHARASHTRA	SHRI D K KANHERE CHIEF ENGINEER (RETD) PWD MAHARASHTRA	DR. R.K. INGLE
		DRG.No.-TBB-02 DATE: DEC-2015



ELEVATION FOR GATE PANEL



SECTION AT X-X



SECTION AT Y-Y

WEIGHT OF SINGLE NEEDLE

SR. NO.	DISCRIPTION	NOS.	SIZE/LENGTH	UNIT WEIGHT	WEIGHT
1	SKIN PLATE 3mm THK.	1	2.10 x 0.5	23.55 Kg/sq.m.	24.73 Kg
2	LONGITUDINAL RHS80x40x3.2	2	2.1	5.50 Kg/m	23.10 Kg
3	VERTICAL RHS 50x25x2	5	0.5	2.15 Kg/m	5.38 Kg
4	LIFTING HOOKS	2			0.10 Kg
				TOTAL WEIGHT	53.31 Kg

NOTES

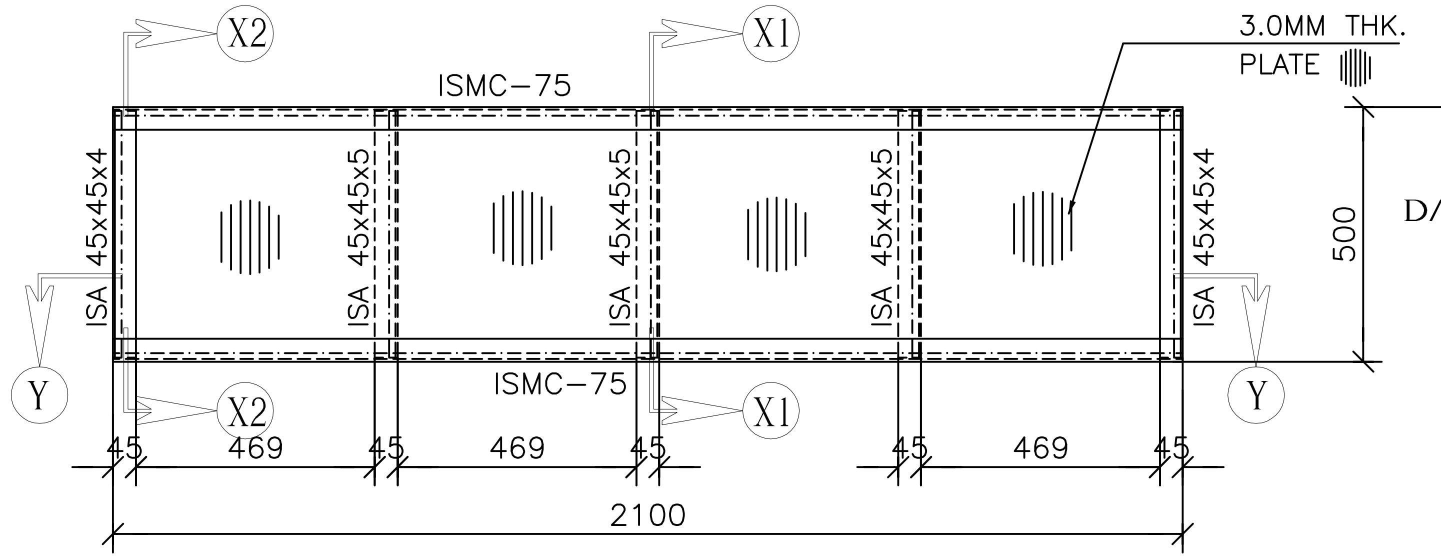
1. ALL DIMENSIONS ARE IN MM AND LEVELS ARE IN METERS UNLESS SPECIFIED OTHERWISE.
2. MATERIALS SPECIFICATION a) ALL STRUCTURAL STEEL ROLLED SECTIONS AND PLATES SHALL CONFORM TO IS-226-1975 AND IS:2062-1980.
3. WELDING SHALL CONFORM TO IS: 816-1969.
4. ALL ELECTRODES SHALL CONFORM TO IS:814 (PART 1) 1974.
5. ALL M.S. BLACK BOLTS AND NUTS SHALL CONFORM TO IS: 1363 (PART 1 TO 3) 1984.
6. WASHERS SHALL CONFORM TO IS: 5369-1975, IS: 5370-1969, IS:5372-1975 OR IS: 5374-1975.
7. ALL DIMENSIONS ARE TO BE CHECKED AND VERIFIED BY SHOP LAYOUT.
8. PAINTING: ALL EXPOSED SURFACES STRUCTURES AFTER FABRI--CATION SHALL BE PAINTED AS PER RESPECTIVE SPECIFICATION.
9. ALL THE STRUCTURES AFTER FABRICATION SHALL BE CONTROL ASSEMBLED IN SHOP TO MATCH THE MATCHING DIMENSIONS AND CONNECTIONS OF DIFFERENT ERECTION MARKS BEFORE DESPATCH TO SITE.
10. PROPER RUBBER GASKET OF 10MM THICK PROPERLY GLUED SHALL BE PROVIDED AT RELEVANT FACES TO ARREST LEAKAGE OF WATER.
11. NEEDLES SHALL BE PAINTED EVERY YEAR BEFORE USE.

DEPARTMENT OF APPLIED MECHANICS
VISVESVARAYA NATIONAL INSTITUTE OF TECHNOLOGY
NAGPUR.

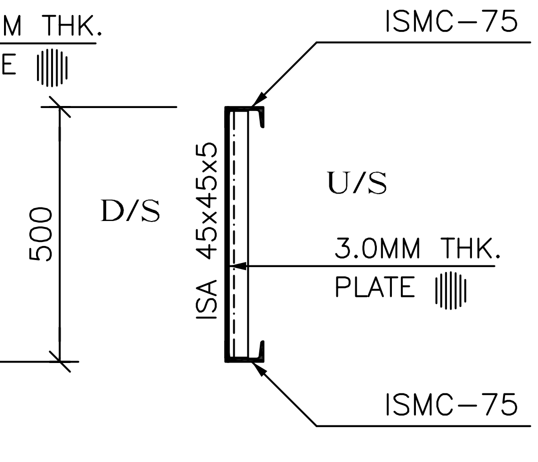
TYPE DETAILS FOR STEEL GATES ON BRIDGE CUM BANDHARA.
GATE FOR 3M DEPTH OF WATER WITH RECTANGULAR BOX SECTION

NATIONAL RURAL ROAD DEVELOPMENT AUTHORITY
MINISTRY OF RURAL DEVELOPMENT, GOVT OF INDIA
R&D PROJECT F No P-17029/04/2007-P-II

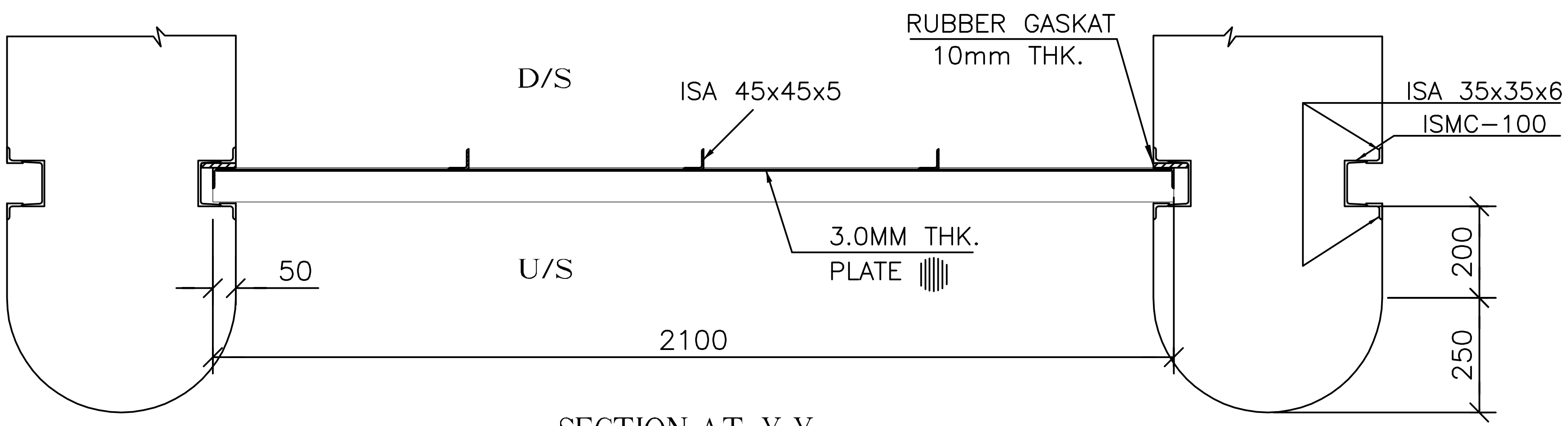
TECHNICAL ADVISIOR	CHECKED BY:	DESIGNED BY:	
SHRI P L BONGIRWAR FORMER PRINCIPAL SECRETARY, PWD MAHARASHTRA	SHRI D K KANHERE CHIEF ENGINEER (RETD) PWD MAHARASHTRA	DR. R.K. INGLE	
		DRG.No.-G-1A	DATE: DEC-2015



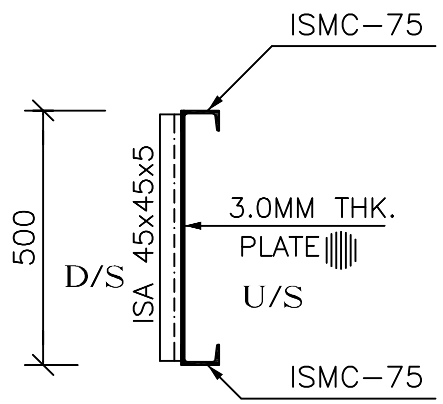
ELEVATION FOR GATE PANEL



SECTION AT X2-X2



SECTION AT Y-Y



SECTION AT X1-X1

WEIGHT OF SINGLE NEEDLE

SR. NO.	DISCRIPTION	NOS.	SIZE/LENGTH	UNIT WEIGHT	WEIGHT
1	SKIN PLATE 3mm THK.	1	2.10 x 0.5	23.55 Kg/sq.m.	24.73 Kg
2	LONGITUDINAL ISMC 75	2	2.1	6.80 Kg/m	28.56 Kg
3	END VERTICAL ISA 45x45x4	2	0.5	2.70 Kg/m	2.70 Kg
4	MIDDLE VERT. ISA 45x45x5	3	0.5	3.40 Kg/m	5.10 Kg
5	LIFTING HOOKS	2			0.10 Kg
				TOTAL WEIGHT	61.19 Kg

NOTES

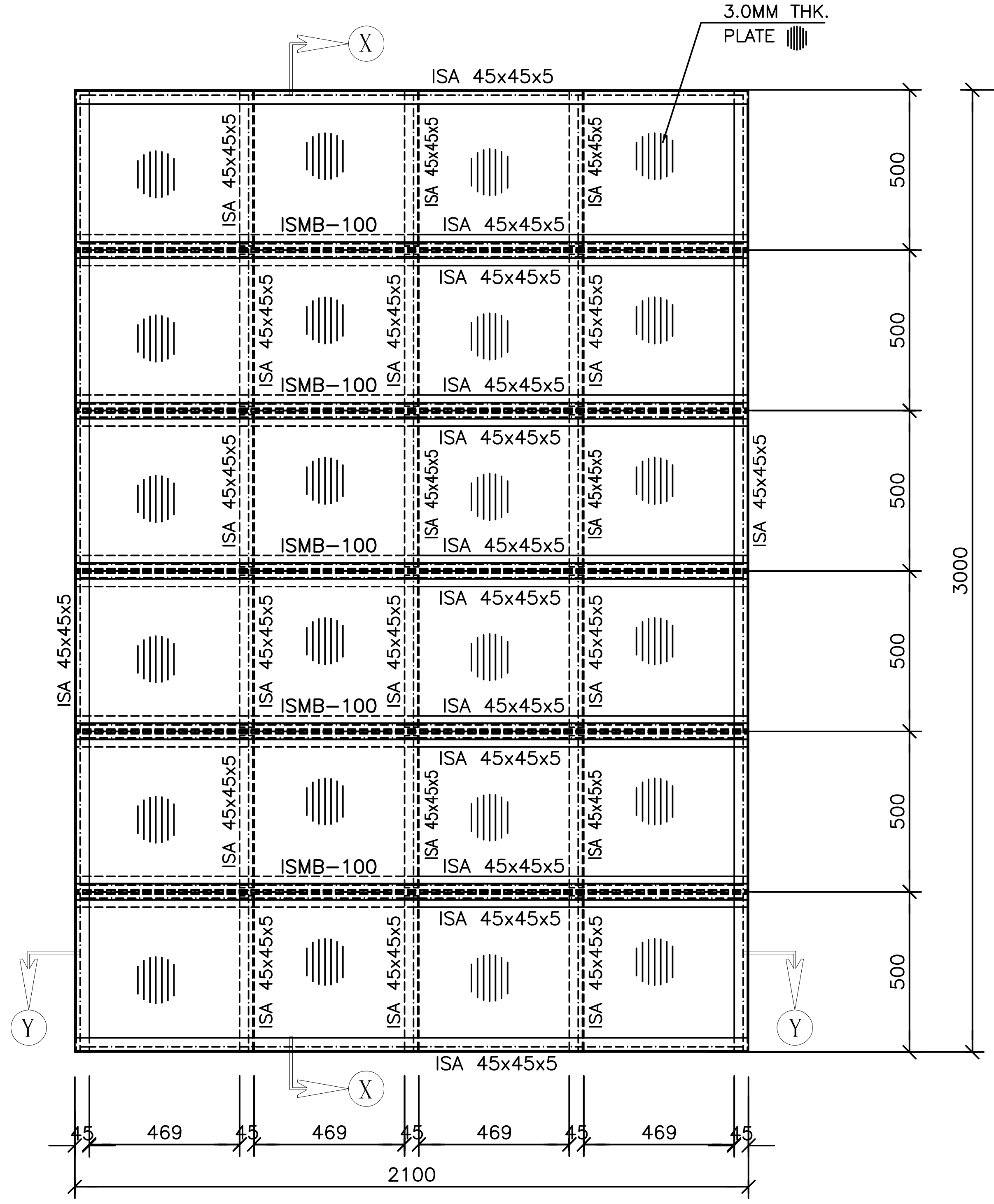
1. ALL DIMENSIONS ARE IN MM AND LEVELS ARE IN METERS UNLESS SPECIFIED OTHERWISE.
2. MATERIALS SPECIFICATION a) ALL STRUCTURAL STEEL ROLLED SECTIONS AND PLATES SHALL CONFORM TO IS-226-1975 AND IS:2062-1980.
3. WELDING SHALL CONFORM TO IS: 816-1969.
4. ALL ELECTRODES SHALL CONFORM TO IS:814 (PART 1) 1974.
5. ALL M.S. BLACK BOLTS AND NUTS SHALL CONFORM TO IS: 1363 (PART 1 TO 3) 1984.
6. WASHERS SHALL CONFORM TO IS: 5369-1975, IS: 5370-1969, IS:5372-1975 OR IS: 5374-1975.
7. ALL DIMENSIONS ARE TO BE CHECKED AND VERIFIED BY SHOP LAYOUT.
8. PAINTING: ALL EXPOSED SURFACES STRUCTURES AFTER FABRI-CATION SHALL BE PAINTED AS PER RESPECTIVE SPECIFICATION.
9. ALL THE STRUCTURES AFTER FABRICATION SHALL BE CONTROL ASSEMBLED IN SHOP TO MATCH THE MATCHING DIMENSIONS AND CONNECTIONS OF DIFFERENT ERECTION MARKS BEFORE DESPATCH TO SITE.
10. PROPER RUBBER GASKET OF 10MM THICK PROPERLY GLUED SHALL BE PROVIDED AT RELEVANT FACES TO ARREST LEAKAGE OF WATER.
11. NEEDLES SHALL BE PAINTED EVERY YEAR BEFORE USE.

DEPARTMENT OF APPLIED MECHANICS
VISVESVARAYA NATIONAL INSTITUTE OF TECHNOLOGY
NAGPUR.

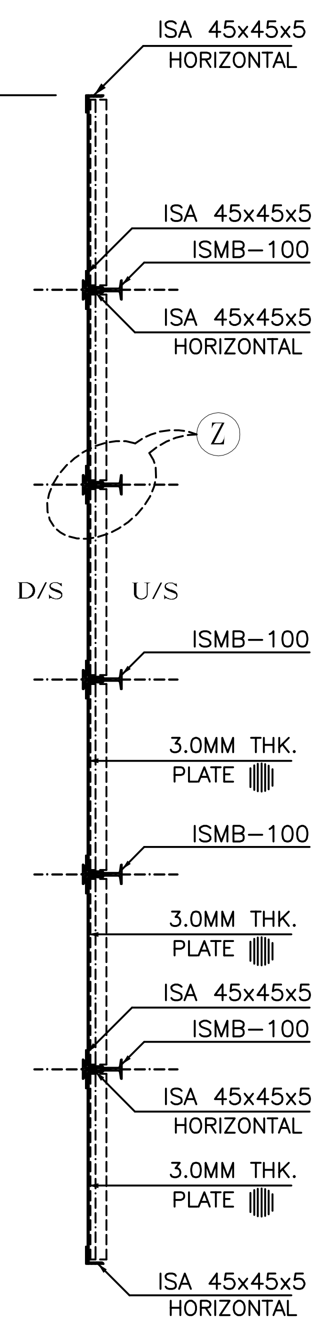
TYPE DETAILS FOR STEEL GATES ON BRIDGE CUM BANDHARA.
GATE FOR 3M DEPTH OF WATER WITH ANGLE / CHANNEL SECTION

NATIONAL RURAL ROAD DEVELOPMENT AUTHORITY
MINISTRY OF RURAL DEVELOPMENT, GOVT OF INDIA
R&D PROJECT F No P-17029/04/2007-P-II

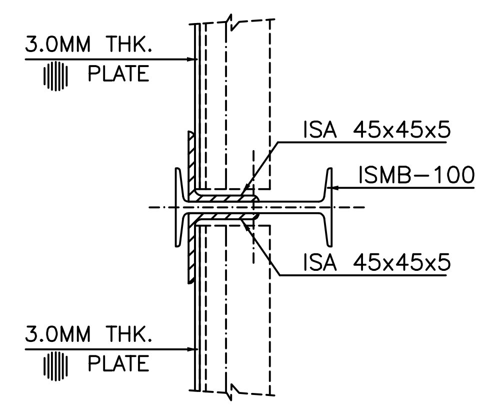
TECHNICAL ADVISOR	CHECKED BY:	DESIGNED BY:	
SHRI P L BONGIRWAR FORMER PRINCIPAL SECRETARY, PWD MAHARASHTRA	SHRI D K KANHERE CHIEF ENGINEER (RETD) PWD MAHARASHTRA	DR. R.K. INGLE	
		DRG.No.-G-1B	DATE: DEC-2015



ELEVATION FOR GATE PANEL



SECTION AT X-X



DETAILS AT 'Z'

NOTES

1. ALL DIMENSIONS ARE IN MM AND LEVELS ARE IN METERS UNLESS SPECIFIED OTHERWISE.
2. MATERIALS SPECIFICATION a) ALL STRUCTURAL STEEL ROLLED SECTIONS AND PLATES SHALL CONFORM TO IS–226–1975 AND IS:2062–1980.
3. WELDING SHALL CONFORM TO IS: 816–1969.
4. ALL ELECTRODES SHALL CONFORM TO IS:814 (PART 1) 1974.
5. ALL M.S. BLACK BOLTS AND NUTS SHALL CONFORM TO IS: 1363 (PART 1 TO 3) 1984.
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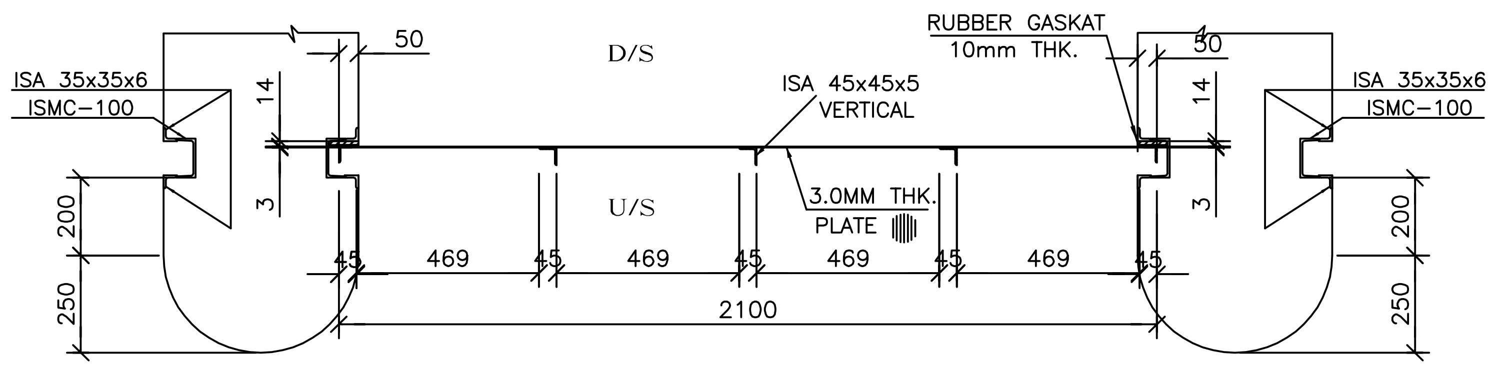
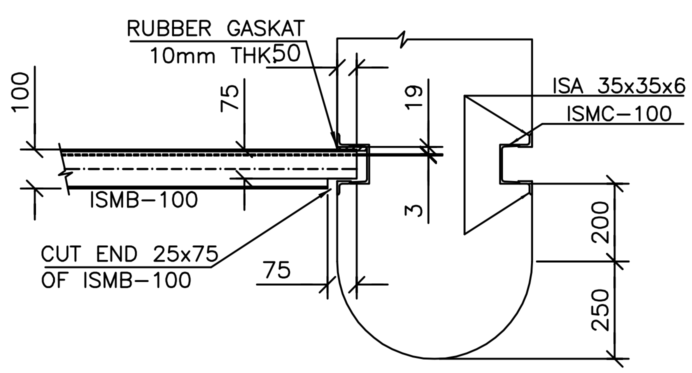
7. ALL DIMENSIONS ARE TO BE CHECKED AND VERIFIED BY SHOP LAYOUT.
8. PAINTING: ALL EXPOSED SURFACES STRUCTURES AFTER FABRI–CATION SHALL BE PAINTED AS PER RESPECTIVE SPECIFICATION.
9. ALL THE STRUCTURES AFTER FABRICATION SHALL BE CONTROL ASSEMBLED IN SHOP TO MATCH THE MATCHING DIMENSIONS AND CONNECTIONS OF DIFFERENT ERECTION MARKS BEFORE DESPATCH TO SITE.
10. PROPER RUBBER GASKET OF 10MM THICK PROPERLY GLUED SHALL BE PROVIDED AT RELEVANT FACES TO ARREST LEAKAGE OF WATER.
11. NEEDLES SHALL BE PAINTED EVERY YEAR BEFORE USE.

QUANTITY FOR SINGLE GATE

SR. NO.	DISCRIPTION	NOS.	SIZE	UNIT WEIGHT	WEIGHT
1	SKIN PLATE 3mm THK.	1	2.10 x 0.5	23.55 Kg/sq.m.	24.73 Kg
2	LONGITUDANL ISA 45x45x4	2	2.1	2.70 Kg/m.	11.34 Kg
3	END VERTICAL ISA 45x45x4	2	0.5	2.70 Kg/m.	2.70 Kg
4	MIDDLE VERT. ISA 45x45x5	3	0.5	3.80 Kg/m.	5.70 Kg
5	LIFTING HOOKS	2			0.1 Kg
				TOTAL WEIGHT	44.57 Kg
	TOTAL WEIGHT OF GATE				
1	NEEDLES	6	–	44.57 /NEEDLE	267.42 Kg
2	STIFFNERS ISMB–100	5	2.1	11.50 Kg/m.	120.75 Kg
				TOTAL WEIGHT	388.17 Kg



SECTION AT Y-Y



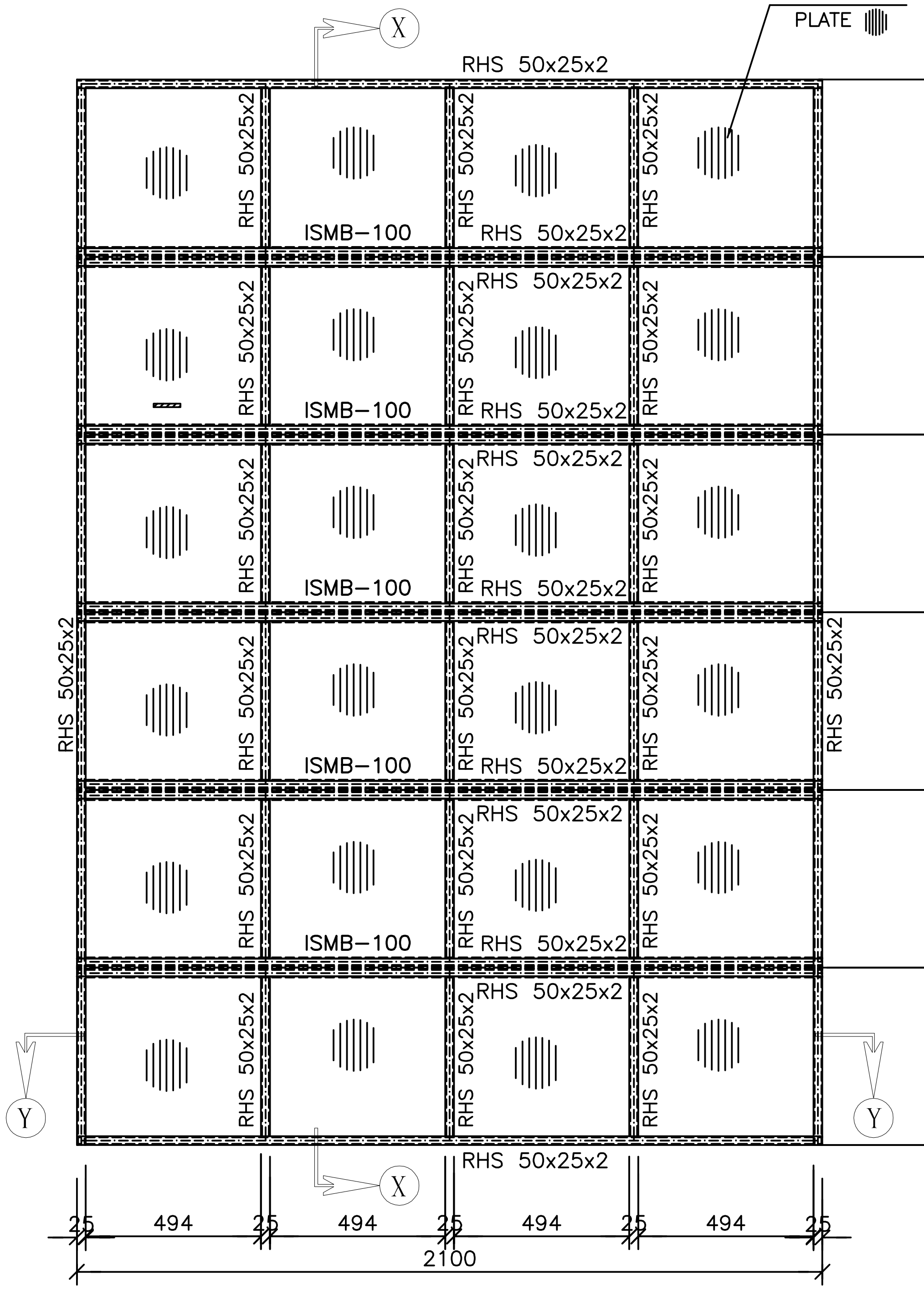
PLAN SHOWING END DETAILS OF ISMB-100

DEPARTMENT OF APPLIED MECHANICS
VISVESVARAYA NATIONAL INSTITUTE OF TECHNOLOGY
NAGPUR.

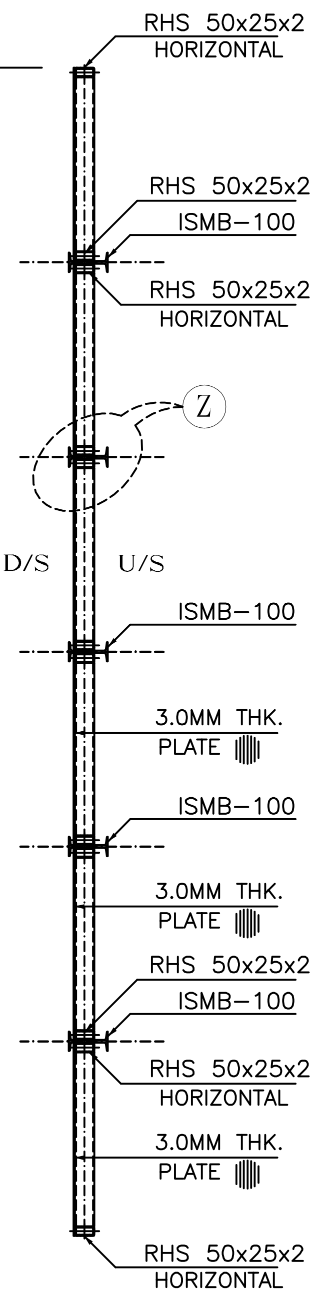
TYPE DETAILS FOR STEEL GATES ON BRIDGE CUM BANDHARA.
GATE FOR 3M DEPTH OF WATER WITH ANGLE/CHANNEL SECTION VERTICALLY SPANNING BETWEEN ISMB 100

NATIONAL RURAL ROAD DEVELOPMENT AUTHORITY
MINISTRY OF RURAL DEVELOPMENT, GOVT OF INDIA
R&D PROJECT F No P-17029/04/2007-P-II

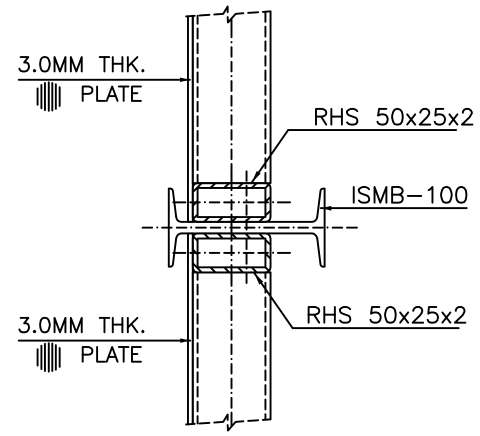
TECHNICAL ADVISIOR	CHECKED BY:	DESIGNED BY:	
SHRI P L BONGIRWAR FORMER PRINCIPAL SECRETARY, PWD MAHARASHTRA	SHRI D K KANHERE CHIEF ENGINEER (RETD) PWD MAHARASHTRA	DR. R.K. INGLE	
		DRG.No.–G–1C	DATE: DEC–2015



ELEVATION FOR GATE PANEL



SECTION AT X-X



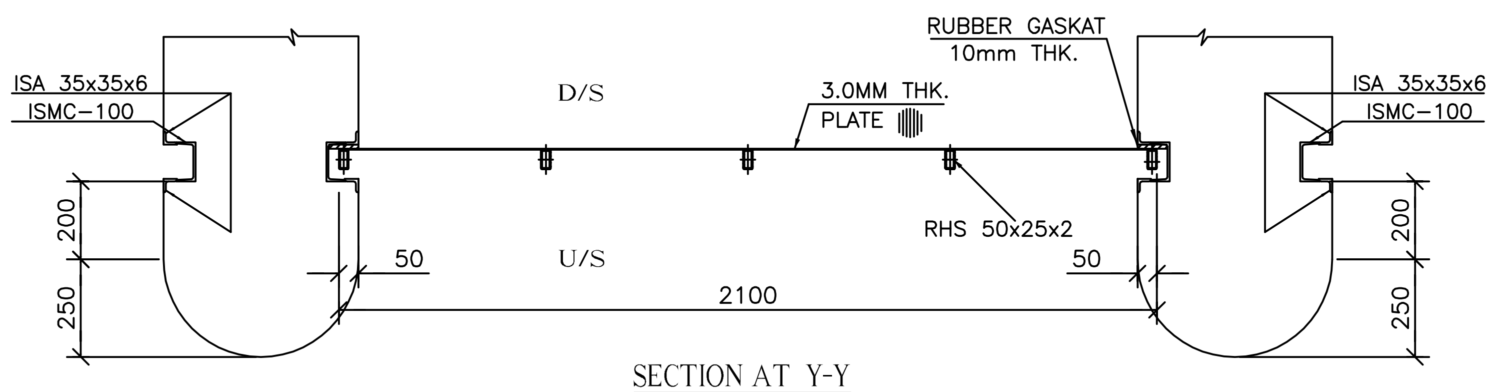
DETAILS AT 'Z'

NOTES

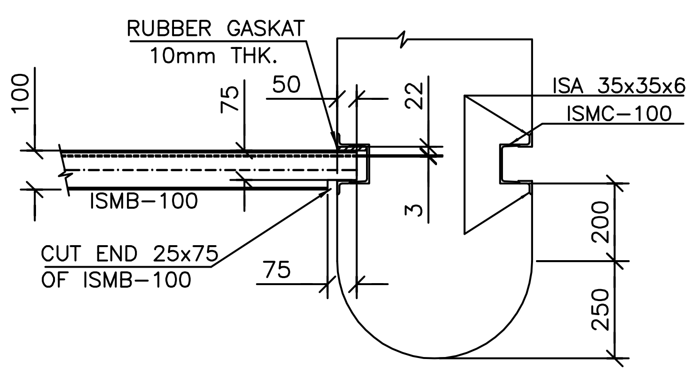
1. ALL DIMENSIONS ARE IN MM AND LEVELS ARE IN METERS UNLESS SPECIFIED OTHERWISE.
2. MATERIALS SPECIFICATION a) ALL STRUCTURAL STEEL ROLLED SECTIONS AND PLATES SHALL CONFORM TO IS-226-1975 AND IS:2062-1980.
3. WELDING SHALL CONFORM TO IS: 816-1969.
4. ALL ELECTRODES SHALL CONFORM TO IS:814 (PART 1) 1974.
5. ALL M.S. BLACK BOLTS AND NUTS SHALL CONFORM TO IS: 1363 (PART 1 TO 3) 1984.
6. WASHERS SHALL CONFORM TO IS: 5369-1975, IS: 5370-1969, IS:5372-1975 OR IS: 5374-1975.
7. ALL DIMENSIONS ARE TO BE CHECKED AND VERIFIED BY SHOP LAYOUT.
8. PAINTING: ALL EXPOSED SURFACES STRUCTURES AFTER FABRI--CATION SHALL BE PAINTED AS PER RESPECTIVE SPECIFICATION.
9. ALL THE STRUCTURES AFTER FABRICATION SHALL BE CONTROL ASSEMBLED IN SHOP TO MATCH THE MATCHING DIMENSIONS AND CONNECTIONS OF DIFFERENT ERECTION MARKS BEFORE DESPATCH TO SITE.
10. PROPER RUBBER GASKET OF 10MM THICK PROPERLY GLUED SHALL BE PROVIDED AT RELEVANT FACES TO ARREST LEAKAGE OF WATER.
11. NEEDLES SHALL BE PAINTED EVERY YEAR BEFORE USE.

QUANTITY FOR SINGLE GATE

SR. NO.	DISCRIPTION	NOS.	SIZE	UNIT WEIGHT	WEIGHT
1	SKIN PLATE 3mm THK.	1	2.10 x 0.5	23.55 Kg/sq.m	24.73 Kg
2	LONGITUDANL RHS50252	2	2.1	2.15 Kg/m.	9.03 Kg
3	END VERTICAL RHS50252	2	0.5	2.15 Kg/m	2.15 Kg
4	MIDDLE VERT. RHS50252	3	0.5	2.15 Kg/m	3.23 Kg
5	LIFTING HOOKS	2			0.1 Kg
				TOTAL WEIGHT	39.24 Kg
	TOTAL WEIGHT OF GATE				
1	NEEDLES	6	–	39.24 /NEEDLE	235.44 Kg
2	STIFFNERS ISMB-100	5	2.1	11.50 Kg/m.	120.75 Kg
				TOTAL WEIGHT	356.19 Kg



SECTION AT Y-Y



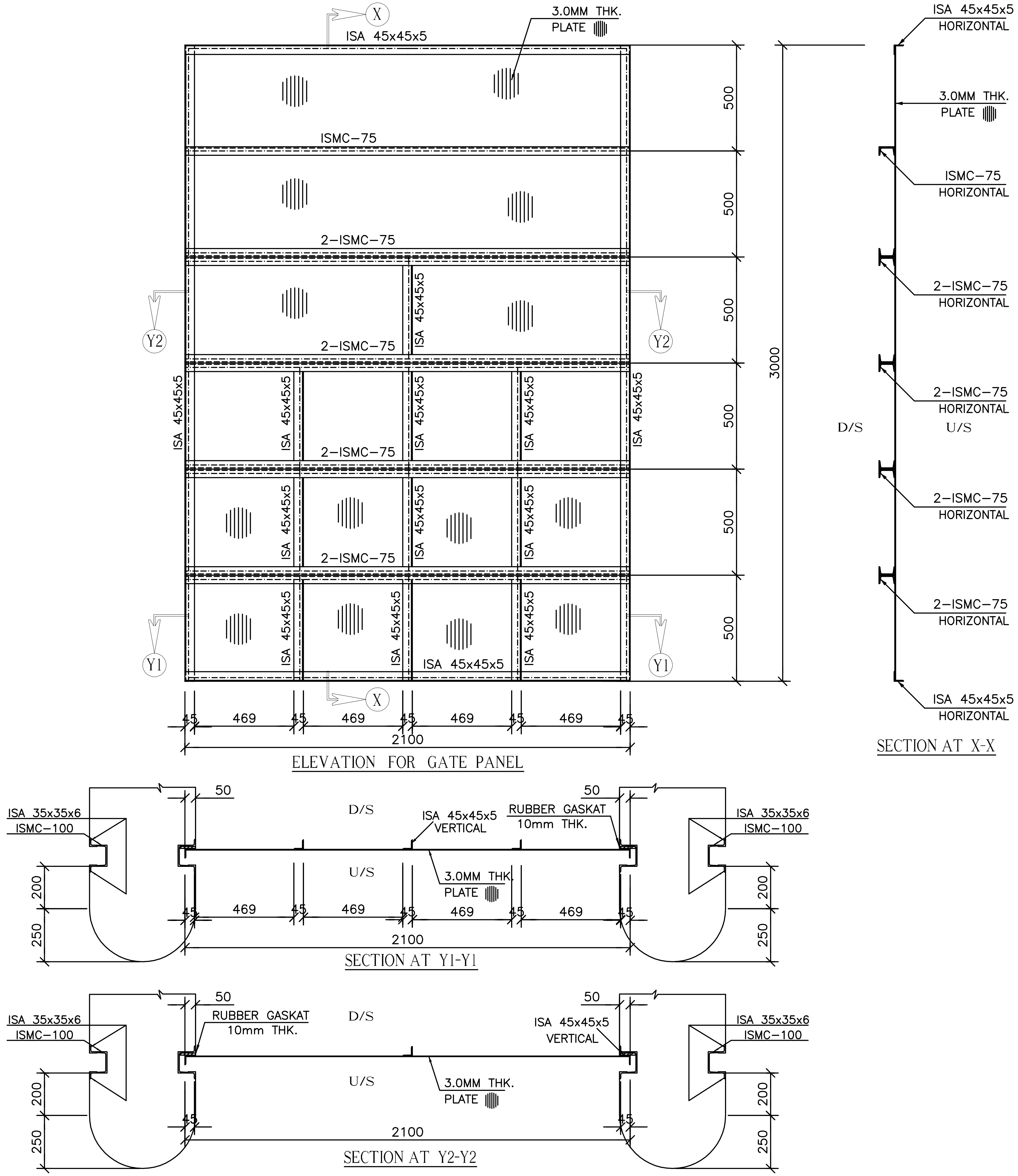
PLAN SHOWING END DETAILS OF ISMB-100

DEPARTMENT OF APPLIED MECHANICS
VISVESVARAYA NATIONAL INSTITUTE OF TECHNOLOGY
NAGPUR.

TYPE DETAILS FOR STEEL GATES ON BRIDGE CUM BANDHARA.
GATE FOR 3M DEPTH OF WATER WITH RECT. BOX SECTION VERTICALLY SPANNING BETWEEN ISMB 100

NATIONAL RURAL ROAD DEVELOPMENT AUTHORITY
MINISTRY OF RURAL DEVELOPMENT, GOVT OF INDIA
R&D PROJECT F No P-17029/04/2007-P-II

TECHNICAL ADVISIOR	CHECKED BY:	DESIGNED BY:	
SHRI P L BONGIRWAR FORMER PRINCIPAL SECRETARY, PWD MAHARASHTRA	SHRI D K KANHERE CHIEF ENGINEER (RETD) PWD MAHARASHTRA	DR. R.K. INGLE	
		DRG.No.-G-1D	DATE: DEC-2015



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10. PROPER RUBBER GASKET OF 10MM THICK PROPERLY GLUED SHALL BE PROVIDED AT RELEVANT FACES TO ARREST LEAKAGE OF WATER.
11. NEEDLES SHALL BE PAINTED EVERY YEAR BEFORE USE.

WEIGHT OF SINGLE NEEDLE

SR. NO.	DISCRIPTION	NOS.	SIZE/LENGTH	UNIT WEIGHT	WEIGHT
1	SKIN PLATE 3mm THK.	1	2.10 x 3.0	23.55 Kg/sq.m.	148.37 Kg
2	LONGITUDINAL ISMC 75	9	2.1	6.80 Kg/m	128.52 Kg
3	END VERTICAL ISA 45x45x4	2	3.0	2.70 Kg/m	16.20 Kg
4	CENTRAL ISA 45x45x5	1	10X0.5	3.40 Kg/m	17.00 Kg
5	LIFTING HOOKS	2			0.10 Kg
				TOTAL WEIGHT	310.19 Kg

DEPARTMENT OF APPLIED MECHANICS
VISVESVARAYA NATIONAL INSTITUTE OF TECHNOLOGY
NAGPUR.

TYPE DETAILS FOR STEEL GATES ON BRIDGE CUM BANDHARA.
SINGLE GATE FOR 3M WATER DEPTH WITH ANGLE/CHANNEL SECTION

NATIONAL RURAL ROAD DEVELOPMENT AUTHORITY
MINISTRY OF RURAL DEVELOPMENT, GOVT OF INDIA
R&D PROJECT F No P-17029/04/2007-P-II

TECHNICAL ADVISIOR	CHECKED BY:	DESIGNED BY:	
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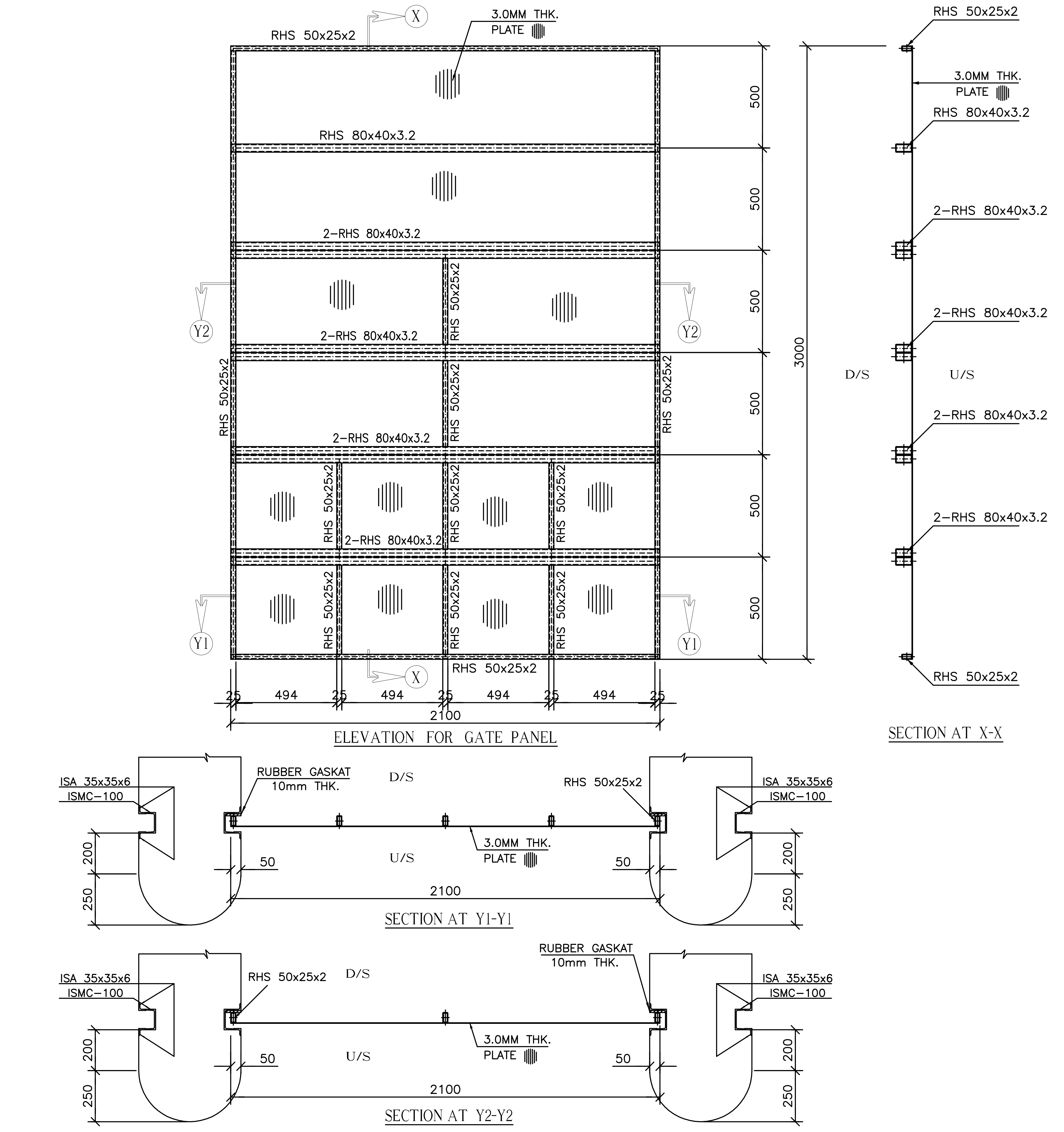
		DRG.No.-G-1E	DATE: DEC-2015



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WEIGHT OF SINGLE NEEDLE

SR. NO.	DISCRIPTION	NOS.	SIZE/LENGTH	UNIT WEIGHT	WEIGHT
1	SKIN PLATE 3mm THK.	1	2.10 x 3.0	23.55 Kg/sq.m.	148.37 Kg
2	LONGITUDINAL RHS 80403.2	9	2.1	5.50 Kg/m.	103.95 Kg
3	END VERTICAL RHS50252	2	3.0	2.15 Kg/m.	12.90 Kg
4	CENTRAL RHS 50252	1	10X0.5	2.15 Kg/m.	10.75 Kg
5	LIFTING HOOKS	2			0.10 Kg
				TOTAL WEIGHT	275.97 Kg

DEPARTMENT OF APPLIED MECHANICS
VISVESVARAYA NATIONAL INSTITUTE OF TECHNOLOGY
NAGPUR.

TYPE DETAILS FOR STEEL GATES ON BRIDGE CUM BANDHARA.
SINGLE GATE FOR 3M WATER DEPTH WITH ANGLE/CHANNEL SECTION

NATIONAL RURAL ROAD DEVELOPMENT AUTHORITY
MINISTRY OF RURAL DEVELOPMENT, GOVT OF INDIA
R&D PROJECT F No P-17029/04/2007-P-II

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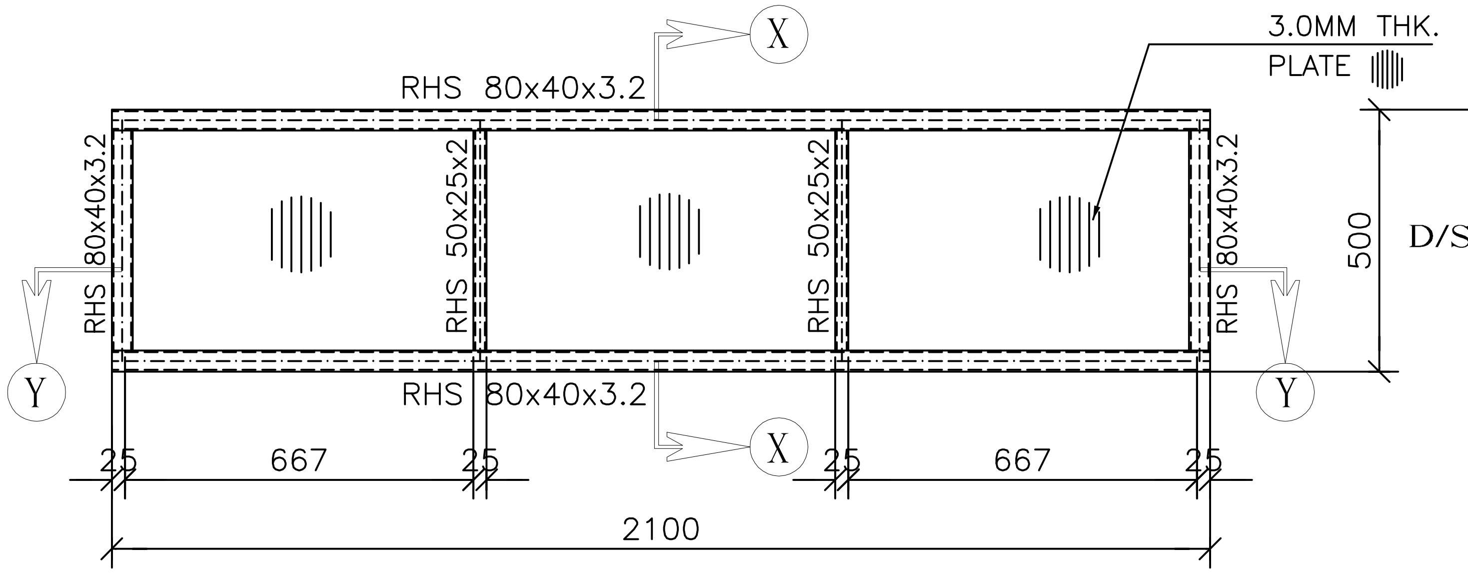
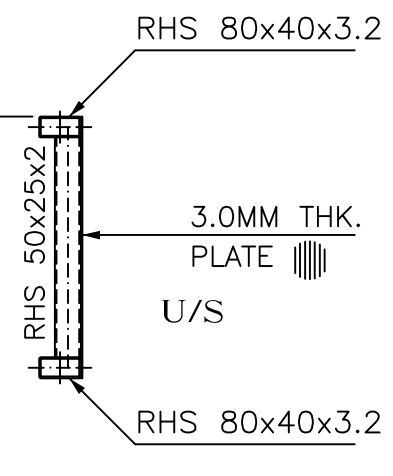
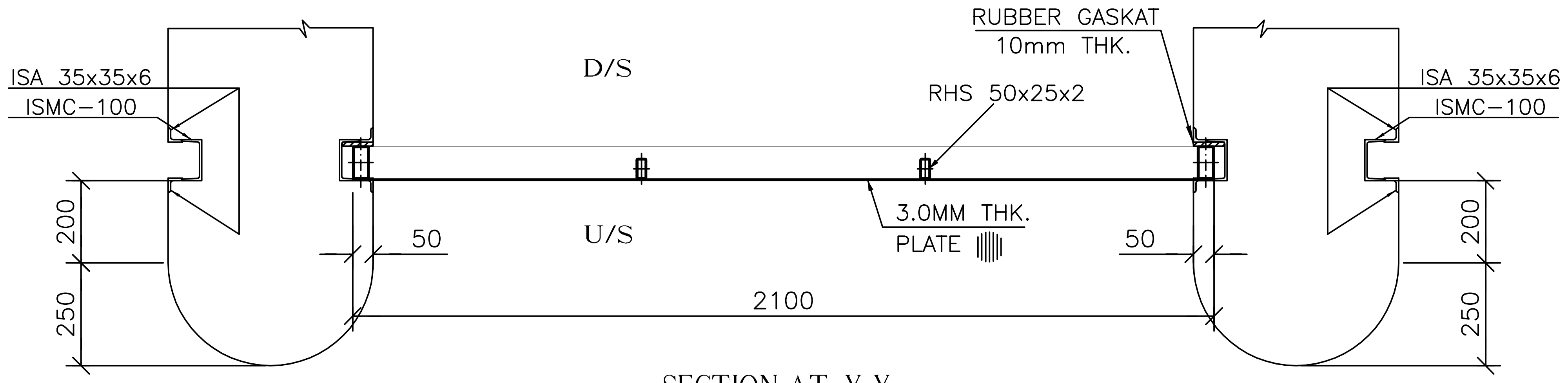
		DRG.No.-G-1F	DATE: DEC-2015



ELEVATION FOR GATE PANEL



SECTION AT X-X



SECTION AT Y-Y

WEIGHT OF SINGLE NEEDLE

SR. NO.	DISCRIPTION	NOS.	SIZE/LENGTH	UNIT WEIGHT	WEIGHT
1	SKIN PLATE 3mm THK.	1	2.10 x 0.5	23.55 Kg/sq.m.	24.73 Kg
2	LONGITUDINAL RHS80x40x3.2 VERTICAL RHS80x40x3.2	2 2	2.1 0.5	5.50 Kg/m 5.50 Kg/m	23.10 Kg 5.50 Kg
3	VERTICAL RHS 50x25x2	2	0.5	2.15 Kg/m	2.15 Kg
4	LIFTING HOOKS	2			0.10 Kg
				TOTAL WEIGHT	55.58 Kg

NOTES

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DEPARTMENT OF APPLIED MECHANICS
VISVESVARAYA NATIONAL INSTITUTE OF TECHNOLOGY
NAGPUR.

TYPE DETAILS FOR STEEL GATES ON BRIDGE CUM BANDHARA.
GATE FOR 2M DEPTH OF WATER WITH RECTANGULAR BOX SECTION

NATIONAL RURAL ROAD DEVELOPMENT AUTHORITY
MINISTRY OF RURAL DEVELOPMENT, GOVT OF INDIA
R&D PROJECT F No P-17029/04/2007-P-II

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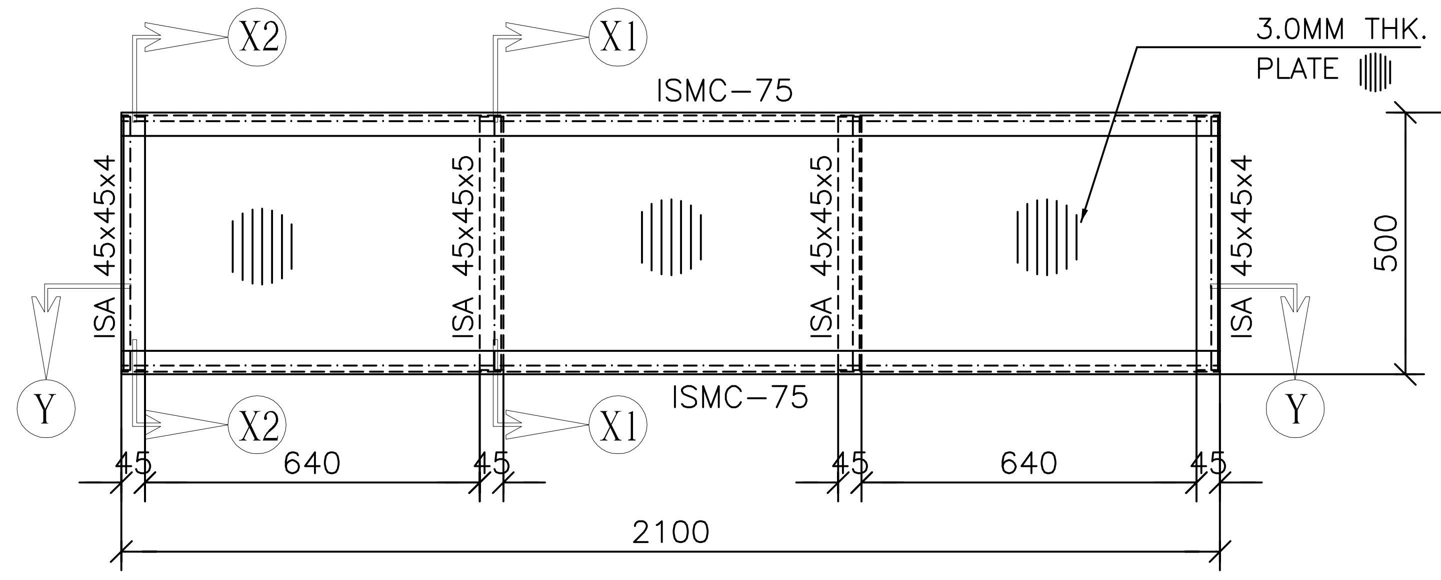
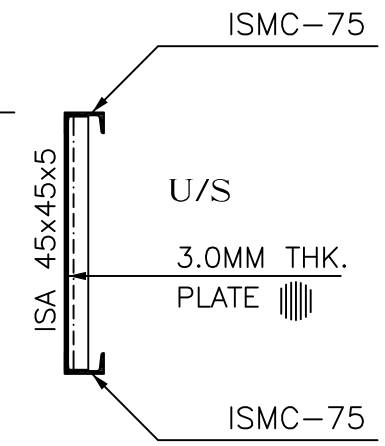
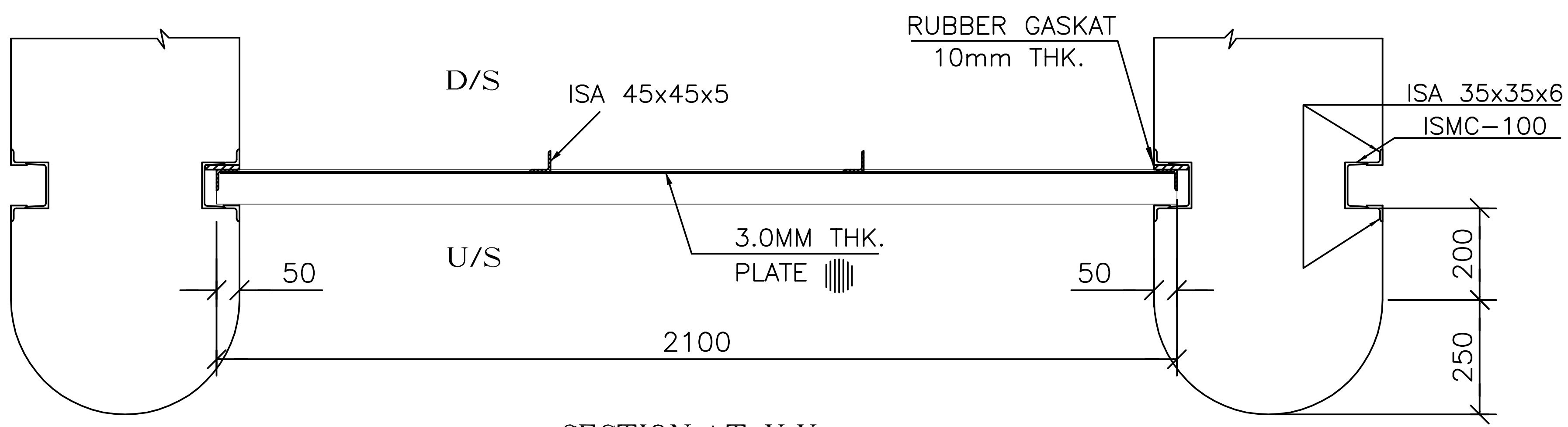
		DRG.No.-G-2A	DATE: DEC-2015



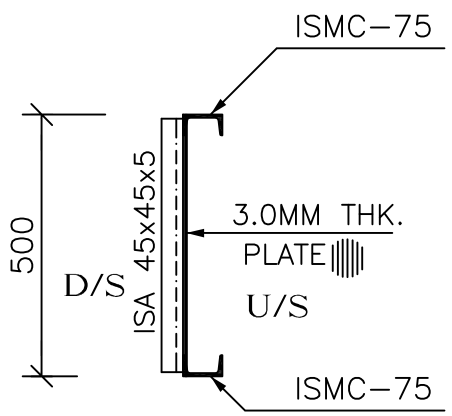
ELEVATION FOR GATE PANEL



SECTION AT X2-X2



SECTION AT Y-Y



SECTION AT X1-X1

WEIGHT OF SINGLE NEEDLE

SR. NO.	DISCRIPTION	NOS.	SIZE/LENGTH	UNIT WEIGHT	WEIGHT
1	SKIN PLATE 3mm THK.	1	2.10 x 0.5	23.55 Kg/sq.m.	24.73 Kg
2	LONGITUDINAL ISMC 75	2	2.1	6.80 Kg/m	28.56 Kg
3	END VERTICAL ISA 45x45x4	2	0.5	2.70 Kg/m	2.70 Kg
4	MIDDLE VERT. ISA 45x45x5	2	0.5	3.40 Kg/m	3.40 Kg
5	LIFTING HOOKS	2			0.10 Kg
				TOTAL WEIGHT	59.49 Kg

NOTES

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11. NEEDLES SHALL BE PAINTED EVERY YEAR BEFORE USE.

DEPARTMENT OF APPLIED MECHANICS
VISVESVARAYA NATIONAL INSTITUTE OF TECHNOLOGY
NAGPUR.

TYPE DETAILS FOR STEEL GATES ON BRIDGE CUM BANDHARA.
GATE FOR 2M DEPTH OF WATER WITH ANGLE / CHANNEL SECTION

NATIONAL RURAL ROAD DEVELOPMENT AUTHORITY
MINISTRY OF RURAL DEVELOPMENT, GOVT OF INDIA
R&D PROJECT F No P-17029/04/2007-P-II

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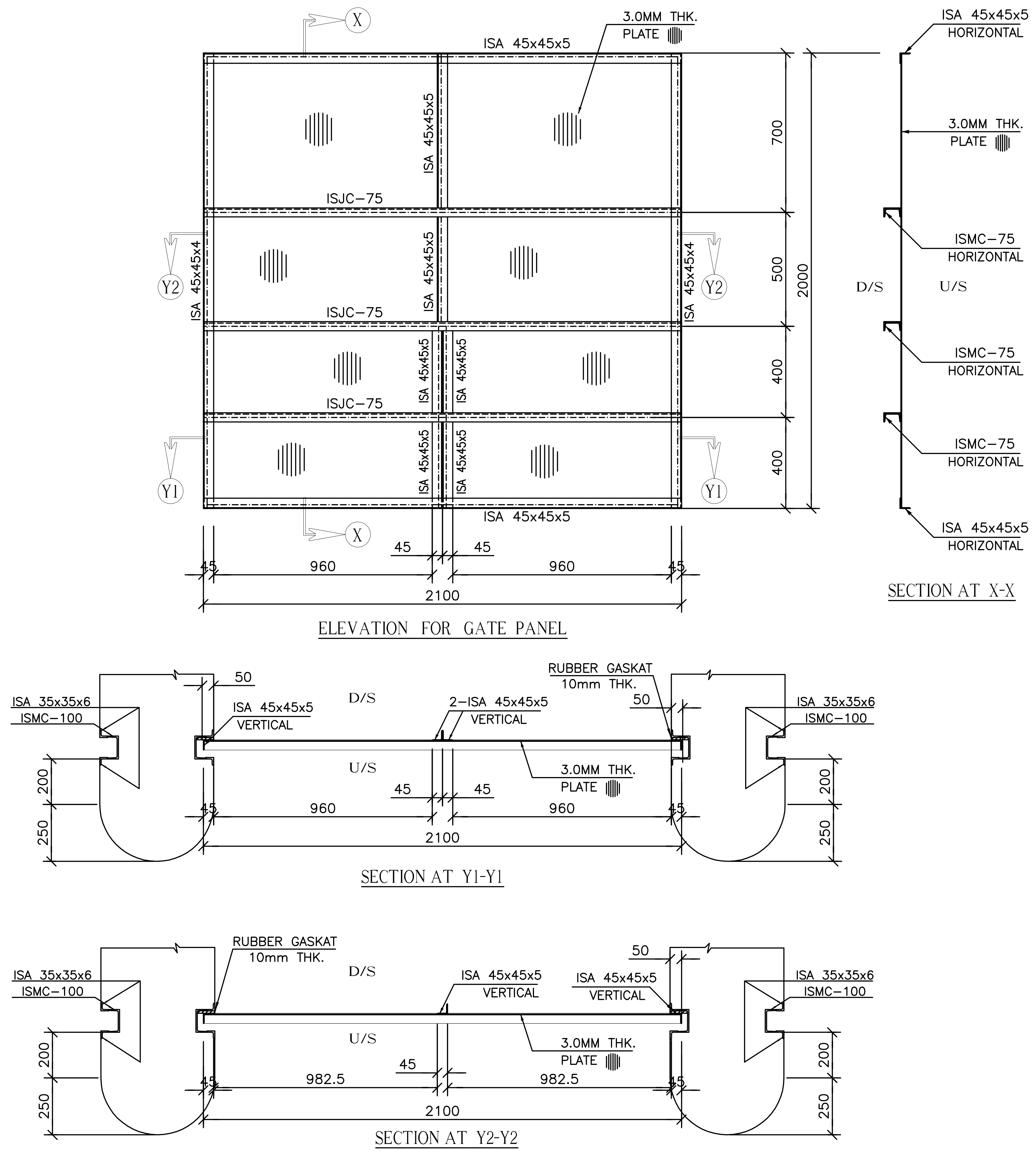
		DRG.No.-G-2B	DATE: DEC-2015



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WEIGHT OF SINGLE NEEDLE

SR. NO.	DISCRIPTION	NOS.	SIZE/LENGTH	UNIT WEIGHT	WEIGHT
1	SKIN PLATE 3mm THK.	1	2.10 x 2.0	23.55 Kg/sq.m.	98.91 Kg
2	LONGITUDINAL ISMC 75	3	2.1	6.80 Kg/m	42.84 Kg
3	END VERTICAL ISA 45x45x4	2	2.0	2.70 Kg/m	10.80 Kg
4	CENTRAL ISA 45x45x5	1	2X0.8+1.8	3.40 Kg/m	11.56 Kg
5	LIFTING HOOKS	2			0.10 Kg
				TOTAL WEIGHT	164.21 Kg

DEPARTMENT OF APPLIED MECHANICS
VISVESVARAYA NATIONAL INSTITUTE OF TECHNOLOGY
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TYPE DETAILS FOR STEEL GATES ON BRIDGE CUM BANDHARA.
SINGLE GATE FOR 2M WATER DEPTH WITH ANGLE/CHANNEL SECTION

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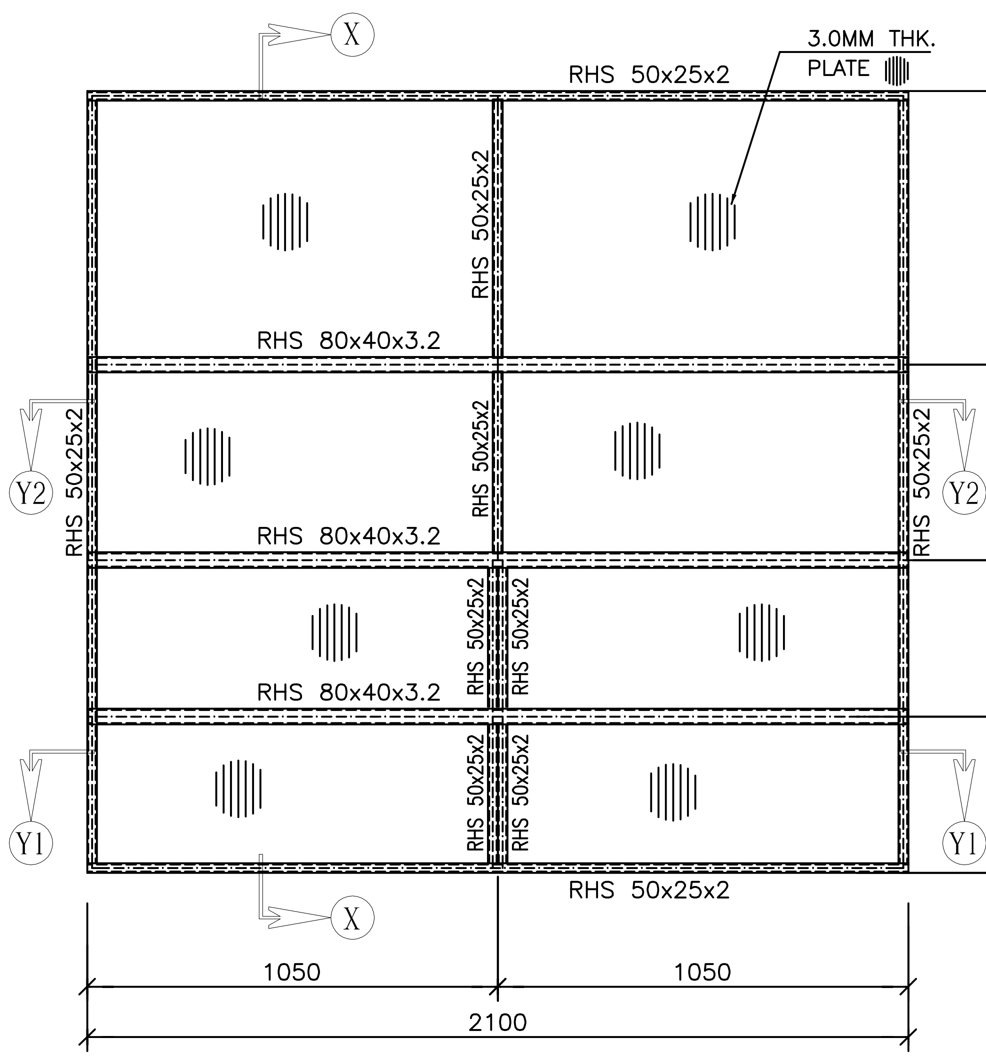
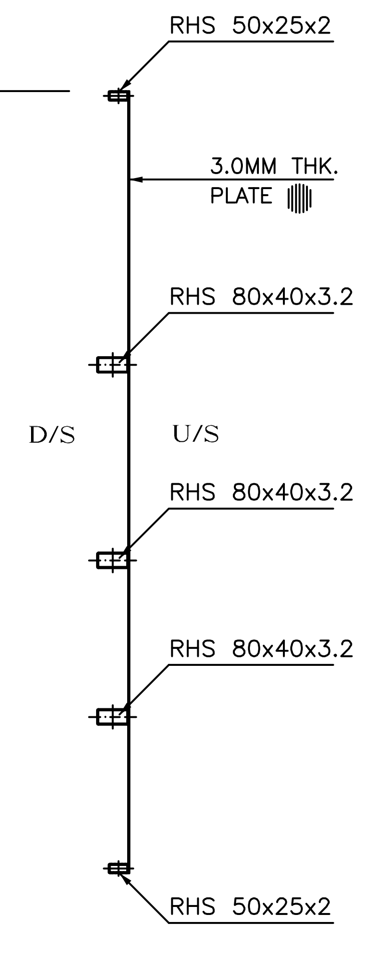
		DRG.No.-G-2C	DATE: DEC-2015

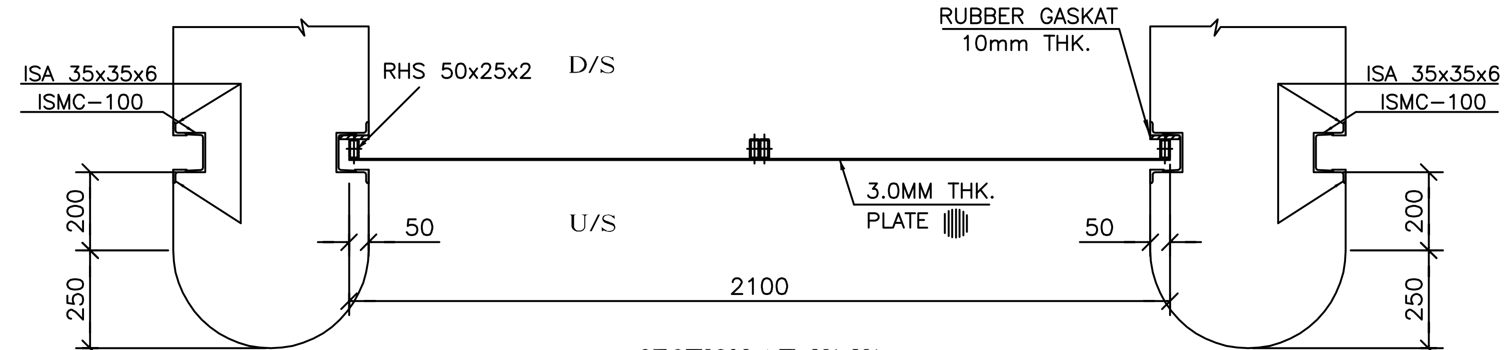


ELEVATION FOR GATE PANEL

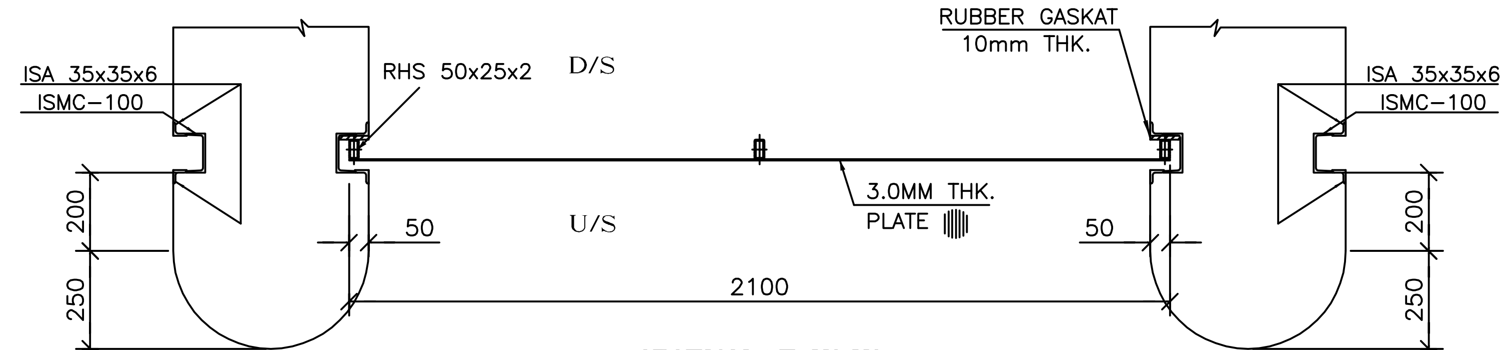


SECTION AT X-X

SECTION AT X-X



SECTION AT Y1-Y1



SECTION AT Y2-Y2

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WEIGHT OF SINGLE NEEDLE

SR. NO.	DISCRIPTION	NOS.	SIZE/LENGTH	UNIT WEIGHT	WEIGHT
1	SKIN PLATE 3mm THK.	1	2.10 x 2.0	23.55 Kg/sq.m.	98.91 Kg
2	LONGITUDINAL 2RHS80403.2	3	2.1	5.50 Kg/m	34.65 Kg
3	END VERTICAL RHS 50252	2	2.0	2.15 Kg/m	8.60 Kg
4	CENTRAL RHS 50252	1	2X0.8+1.8	2.15 Kg/m	7.31 Kg
5	LIFTING HOOKS	2			0.10 Kg
				TOTAL WEIGHT	149.57 Kg

DEPARTMENT OF APPLIED MECHANICS
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TYPE DETAILS FOR STEEL GATES ON BRIDGE CUM BANDHARA.
SINGLE GATE FOR 2M WATER DEPTH WITH RECT. BOX SECTIONS

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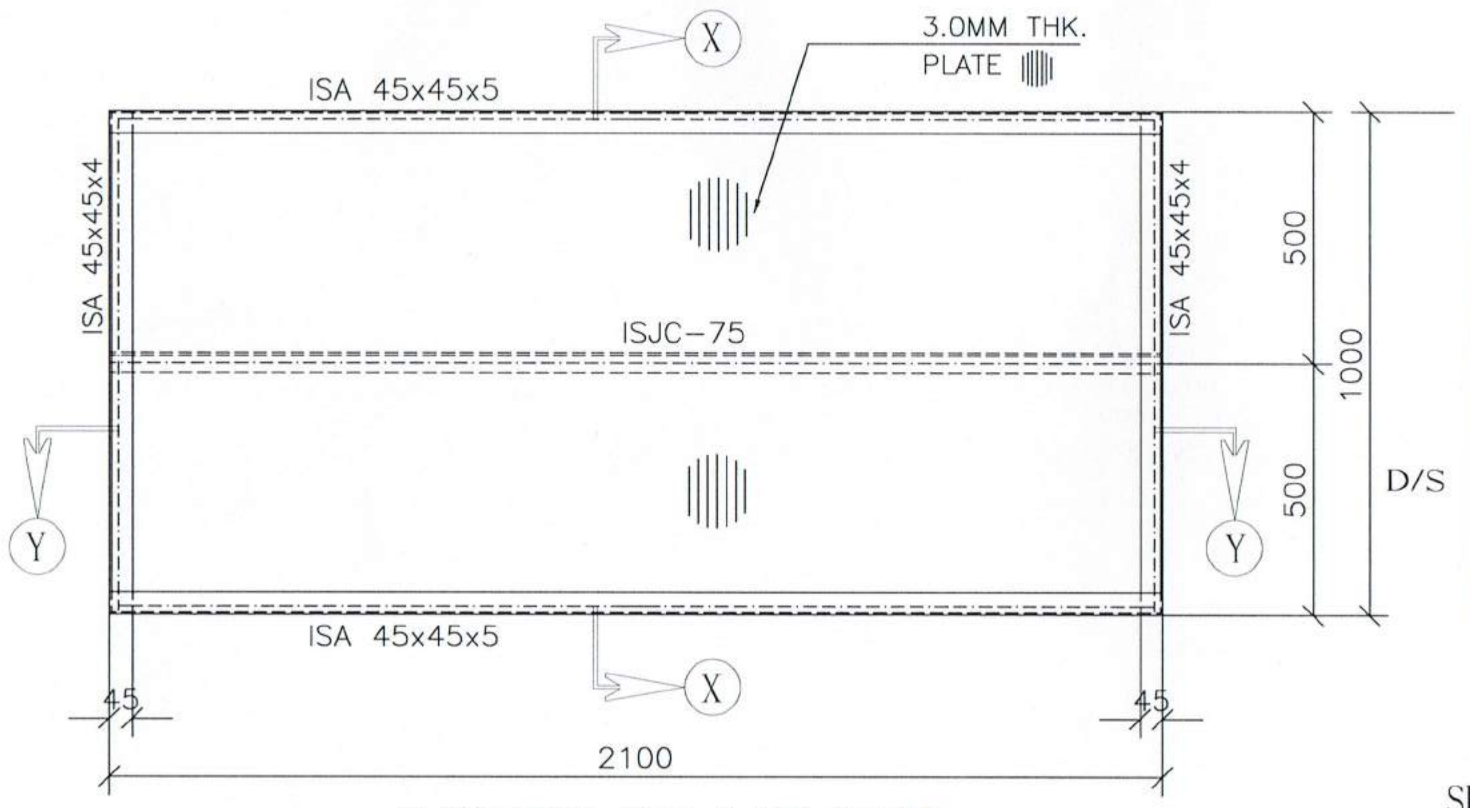
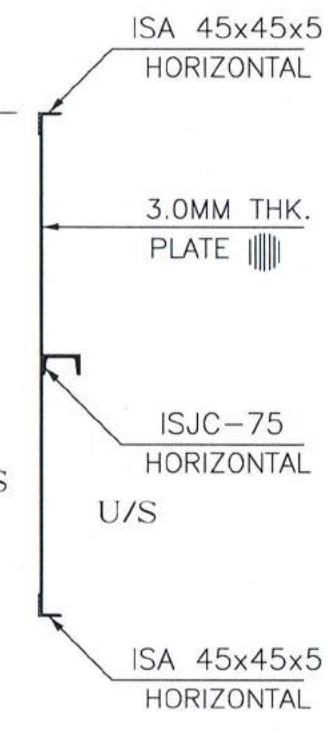
R&D PROJECT F No P-17029/04/2007-P-II

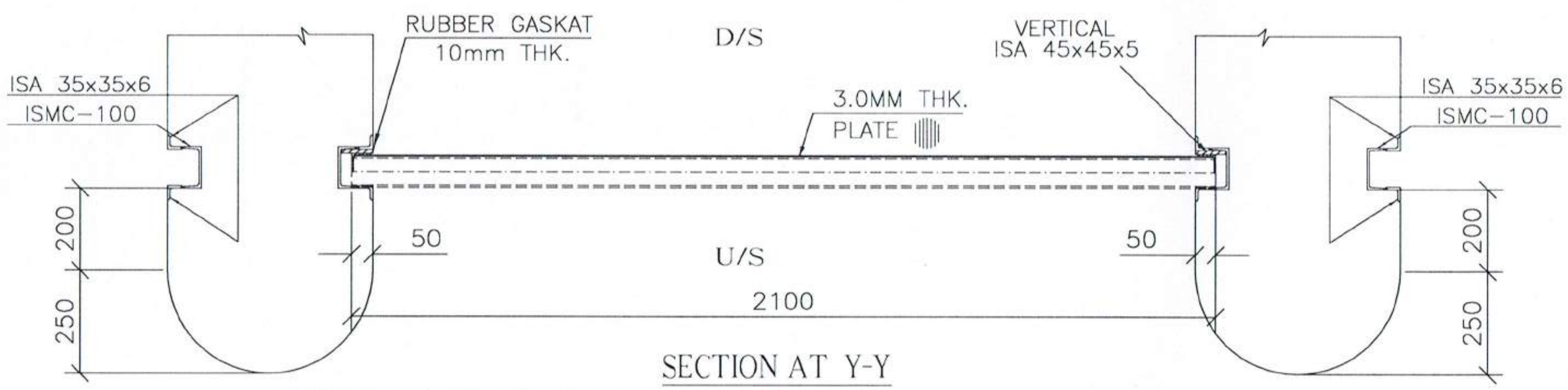
TECHNICAL ADVISIOR	CHECKED BY:	DESIGNED BY:	
SHRI P L BONGIRWAR FORMER PRINCIPAL SECRETARY, PWD MAHARASHTRA	SHRI D K KANHERE CHIEF ENGINEER (RETD) PWD MAHARASHTRA	DR. R.K. INGLE	
		DRG.No.-G-2D	DATE: DEC-2015



ELEVATION FOR GATE PANEL



SECTION AT X-X



SECTION AT Y-Y

WEIGHT OF SINGLE NEEDLE

SR. NO.	DISCRIPTION	NOS.	SIZE/LENGTH	UNIT WEIGHT	WEIGHT
1	SKIN PLATE 3mm THK.	1	2.10 x 1.0	23.55 Kg/sq.m.	49.46 Kg
2	LONGITUDINAL ISMC 75	1	2.1	6.80 Kg/m	14.28 Kg
3	END VERTICAL ISA 45x45x4	2	0.5	2.70 Kg/m	2.70 Kg
4	LONGITUDINAL ISA 45x45x5	2	2.1	3.40 Kg/m	14.28 Kg
5	LIFTING HOOKS	2			0.10 Kg
				TOTAL WEIGHT	80.82 Kg

NOTES

1. ALL DIMENSIONS ARE IN MM AND LEVELS ARE IN METERS UNLESS SPECIFIED OTHERWISE.
2. MATERIALS SPECIFICATION a) ALL STRUCTURAL STEEL ROLLED SECTIONS AND PLATES SHALL CONFORM TO IS-226-1975 AND IS:2062-1980.
3. WELDING SHALL CONFORM TO IS: 816-1969.
4. ALL ELECTRODES SHALL CONFORM TO IS:814 (PART 1) 1974.
5. ALL M.S. BLACK BOLTS AND NUTS SHALL CONFORM TO IS: 1363 (PART 1 TO 3) 1984.
6. WASHERS SHALL CONFORM TO IS: 5369-1975, IS: 5370-1969, IS:5372-1975 OR IS: 5374-1975.
7. ALL DIMENSIONS ARE TO BE CHECKED AND VERIFIED BY SHOP LAYOUT.
8. PAINTING: ALL EXPOSED SURFACES STRUCTURES AFTER FABRI--CATION SHALL BE PAINTED AS PER RESPECTIVE SPECIFICATION.
9. ALL THE STRUCTURES AFTER FABRICATION SHALL BE CONTROL ASSEMBLED IN SHOP TO MATCH THE MATCHING DIMENSIONS AND CONNECTIONS OF DIFFERENT ERECTION MARKS BEFORE DESPATCH TO SITE.
10. PROPER RUBBER GASKET OF 10MM THICK PROPERLY GLUED SHALL BE PROVIDED AT RELEVANT FACES TO ARREST LEAKAGE OF WATER.
11. NEEDLES SHALL BE PAINTED EVERY YEAR BEFORE USE.

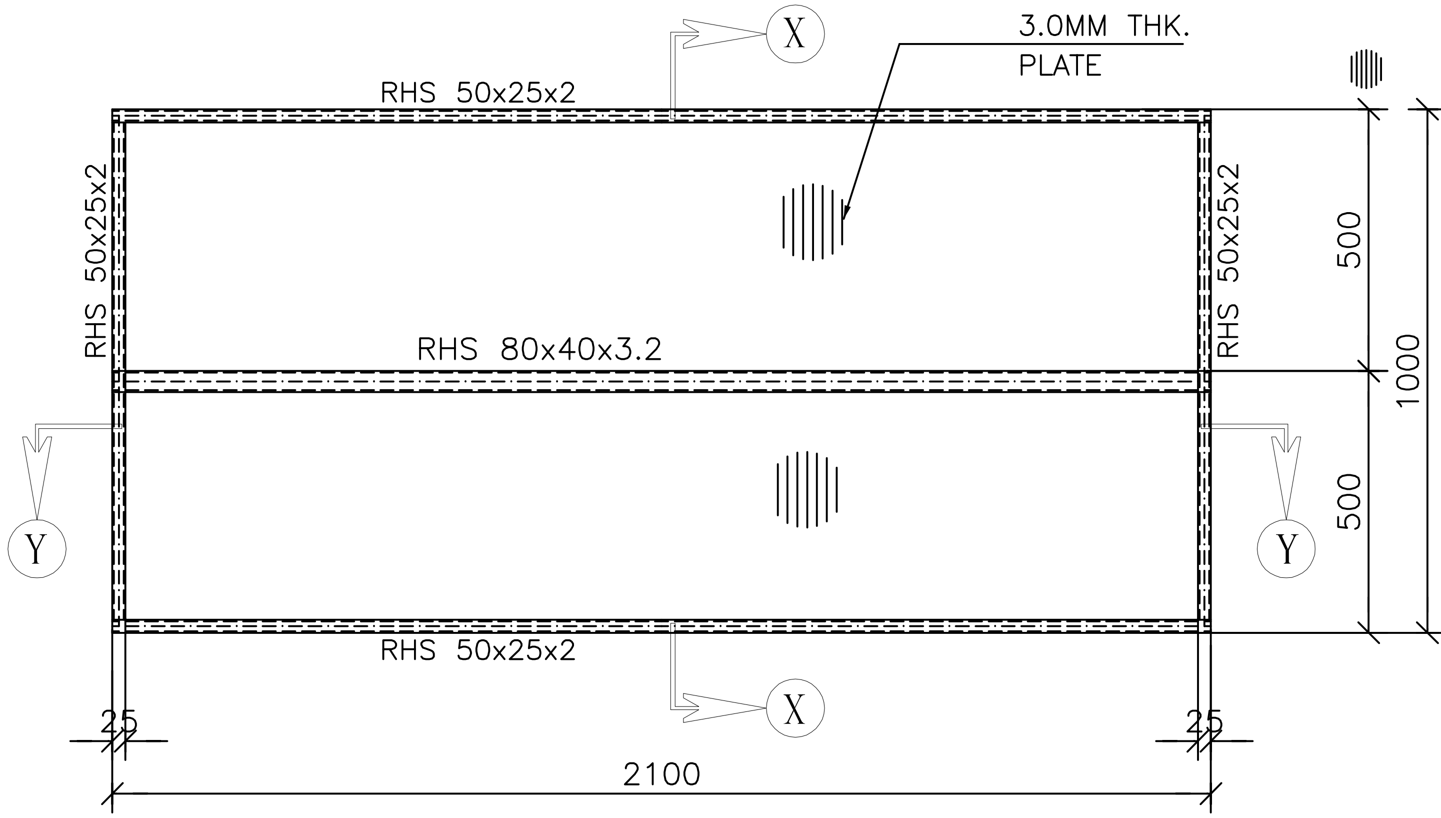
dumanhere

DEPARTMENT OF APPLIED MECHANICS
VISVESVARAYA NATIONAL INSTITUTE OF TECHNOLOGY
NAGPUR.

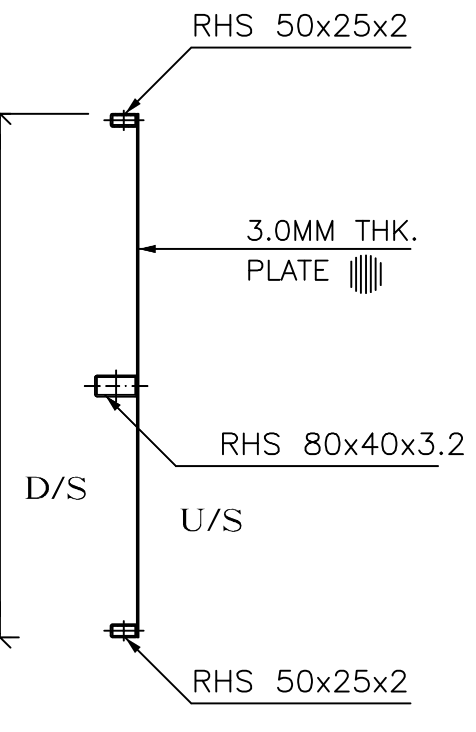
TYPE DETAILS FOR STEEL GATES ON BRIDGE CUM BANDHARA.
SINGLE GATE FOR 1M WATER DEPTH WITH ANGLE/CHANNEL SECTION

NATIONAL RURAL ROAD DEVELOPMENT AUTHORITY
MINISTRY OF RURAL DEVELOPMENT, GOVT OF INDIA
R&D PROJECT F No P-17029/04/2007-P-II

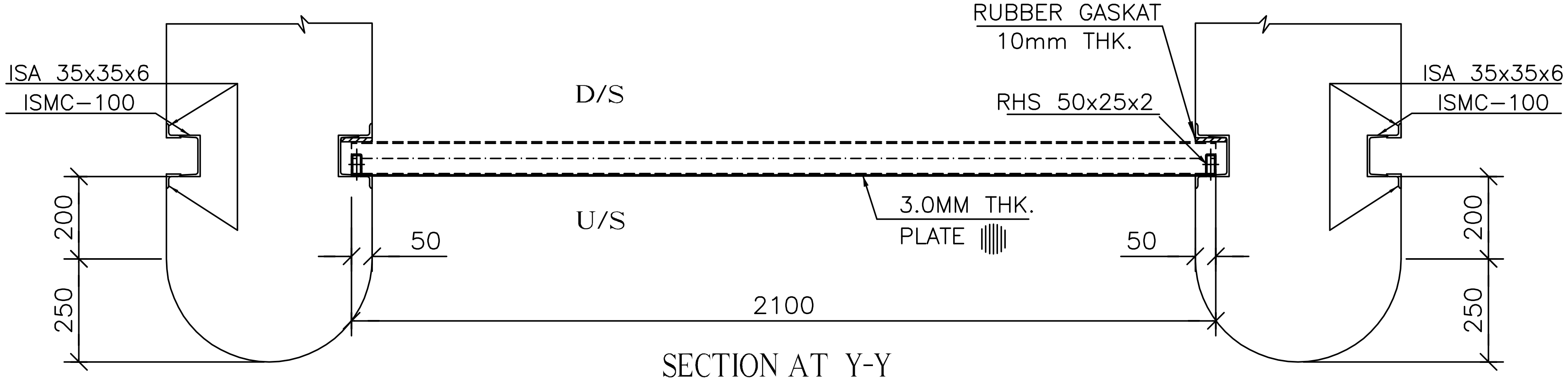
TECHNICAL ADVISIOR	CHECKED BY:	DESIGNED BY:	
P.L. Bongirwar SHRI P L BONGIRWAR FORMER PRINCIPAL SECRETARY, PWD MAHARASHTRA	SHRI D K KANHERE CHIEF ENGINEER (RETD) PWD MAHARASHTRA	DR. R.K. INGLE DRG.No.-G-3A	DATE: DEC-2015



ELEVATION FOR GATE PANEL



SECTION AT X-X



SECTION AT Y-Y

WEIGHT OF SINGLE NEEDLE

SR. NO.	DISCRIPTION	NOS.	SIZE/LENGTH	UNIT WEIGHT	WEIGHT
1	SKIN PLATE 3mm THK.	1	2.10 x 1.0	23.55 Kg/sq.m.	49.46 Kg
2	LONGITUDINAL RHS80x40x3.2	1	2.1	5.50 Kg/m	11.55 Kg
3	LONGITUDINAL RHS 50x25x2	2	2.1	2.15 Kg/m	9.03 Kg
4	VERTICAL RHS 50x25x2	2	0.5	2.15 Kg/m	2.15 Kg
5	LIFTING HOOKS	2			0.10 Kg
				TOTAL WEIGHT	72.29 Kg

NOTES

1. ALL DIMENSIONS ARE IN MM AND LEVELS ARE IN METERS UNLESS SPECIFIED OTHERWISE.
2. MATERIALS SPECIFICATION a) ALL STRUCTURAL STEEL ROLLED SECTIONS AND PLATES SHALL CONFORM TO IS-226-1975 AND IS:2062-1980.
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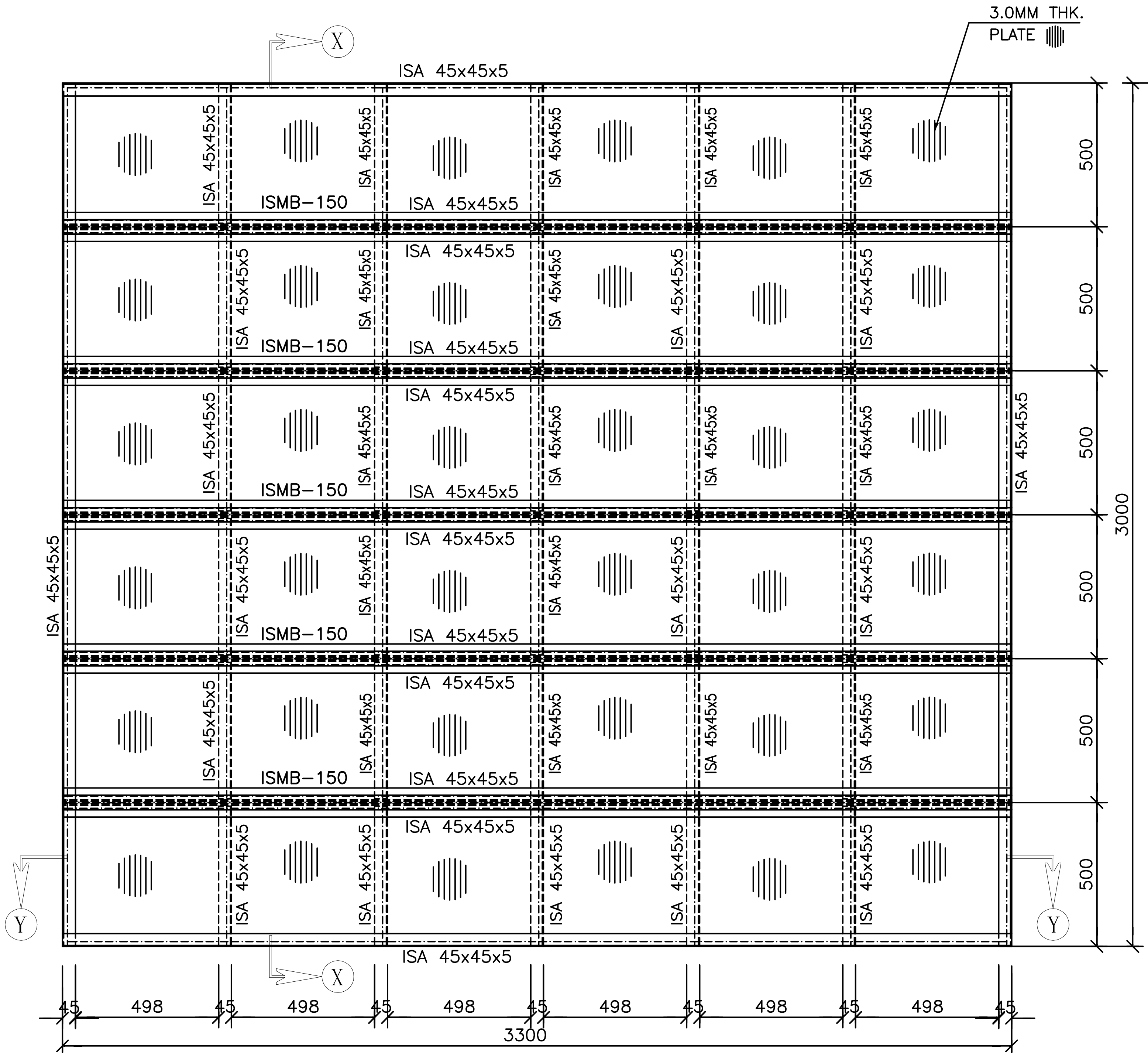
5. ALL M.S. BLACK BOLTS AND NUTS SHALL CONFORM TO IS: 1363 (PART 1 TO 3) 1984.
6. WASHERS SHALL CONFORM TO IS: 5369-1975, IS: 5370-1969, IS:5372-1975 OR IS: 5374-1975.
7. ALL DIMENSIONS ARE TO BE CHECKED AND VERIFIED BY SHOP LAYOUT.
8. PAINTING: ALL EXPOSED SURFACES STRUCTURES AFTER FABRI--CATION SHALL BE PAINTED AS PER RESPECTIVE SPECIFICATION.
9. ALL THE STRUCTURES AFTER FABRICATION SHALL BE CONTROL ASSEMBLED IN SHOP TO MATCH THE MATCHING DIMENSIONS AND CONNECTIONS OF DIFFERENT ERECTION MARKS BEFORE DESPATCH TO SITE.
10. PROPER RUBBER GASKET OF 10MM THICK PROPERLY GLUED SHALL BE PROVIDED AT RELEVANT FACES TO ARREST LEAKAGE OF WATER.
11. NEEDLES SHALL BE PAINTED EVERY YEAR BEFORE USE.

DEPARTMENT OF APPLIED MECHANICS
VISVESVARAYA NATIONAL INSTITUTE OF TECHNOLOGY
NAGPUR.

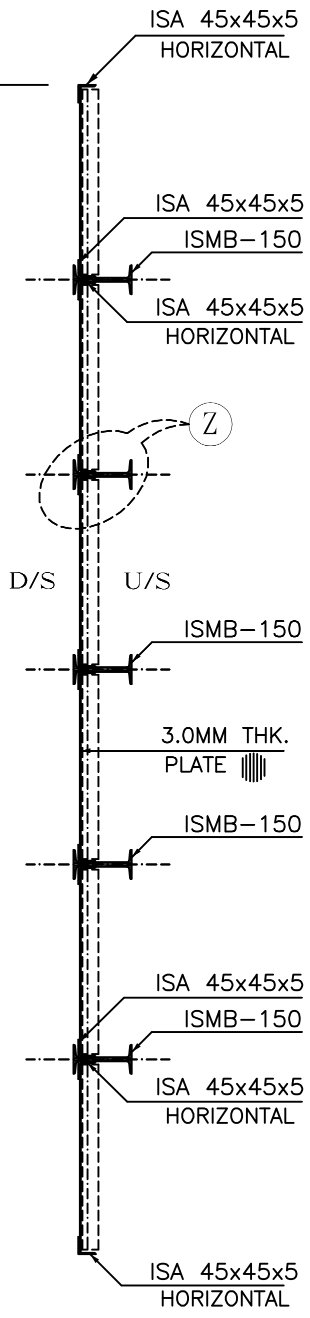
TYPE DETAILS FOR STEEL GATES ON BRIDGE CUM BANDHARA.
SINGLE GATE FOR 1M WATER DEPTH WITH RECT. BOX SECTION

NATIONAL RURAL ROAD DEVELOPMENT AUTHORITY
MINISTRY OF RURAL DEVELOPMENT, GOVT OF INDIA
R&D PROJECT F No P-17029/04/2007-P-II

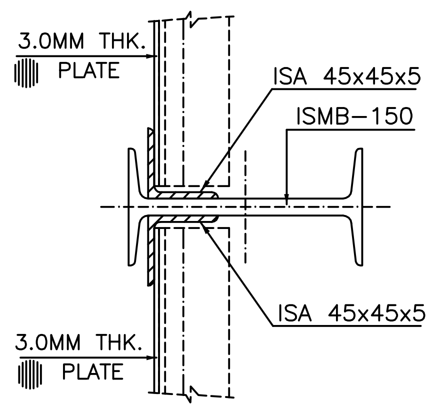
TECHNICAL ADVISOR	CHECKED BY:	DESIGNED BY:	
SHRI P L BONGIRWAR FORMER PRINCIPAL SECRETARY, PWD MAHARASHTRA	SHRI D K KANHERE CHIEF ENGINEER (RETD) PWD MAHARASHTRA	DR. R.K. INGLE	
		DRG.No.-G-3B	DATE: DEC-2015



ELEVATION FOR GATE PANEL



SECTION AT X-X



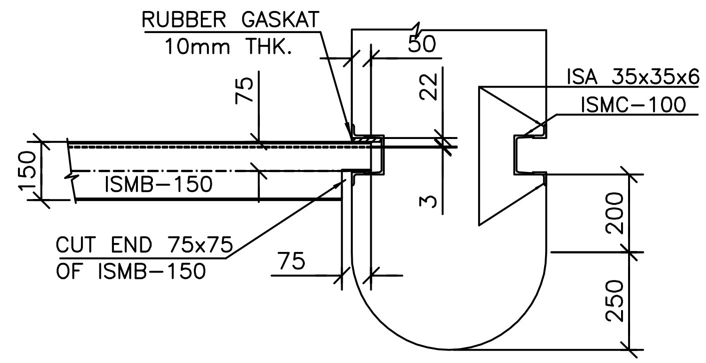
DETAILS AT 'Z'

NOTES

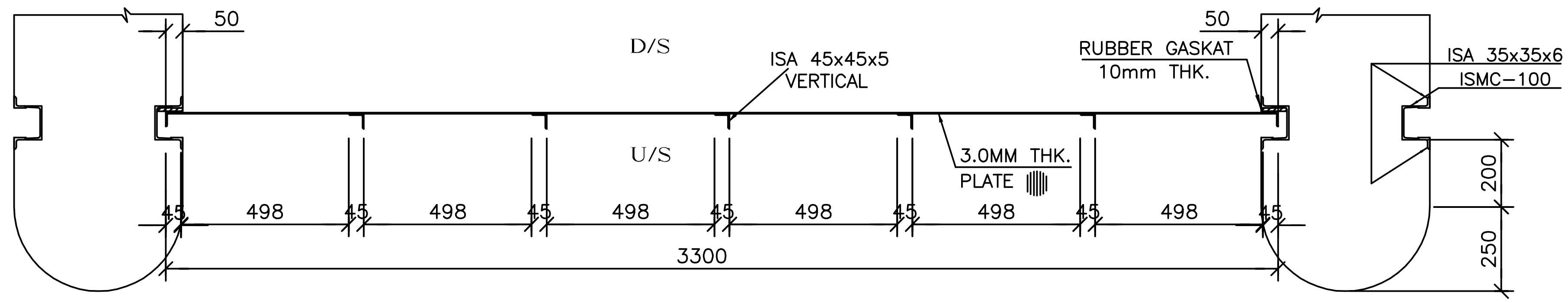
1. ALL DIMENSIONS ARE IN MM AND LEVELS ARE IN METERS UNLESS SPECIFIED OTHERWISE.
2. MATERIALS SPECIFICATION a) ALL STRUCTURAL STEEL ROLLED SECTIONS AND PLATES SHALL CONFORM TO IS-226-1975 AND IS:2062-1980.
3. WELDING SHALL CONFORM TO IS: 816-1969.
4. ALL ELECTRODES SHALL CONFORM TO IS:814 (PART 1) 1974.
5. ALL M.S. BLACK BOLTS AND NUTS SHALL CONFORM TO IS: 1363 (PART 1 TO 3) 1984.
6. WASHERS SHALL CONFORM TO IS: 5369-1975, IS: 5370-1969, IS:5372-1975 OR IS: 5374-1975.
7. ALL DIMENSIONS ARE TO BE CHECKED AND VERIFIED BY SHOP LAYOUT.
8. PAINTING: ALL EXPOSED SURFACES STRUCTURES AFTER FABRI--CATION SHALL BE PAINTED AS PER RESPECTIVE SPECIFICATION.
9. ALL THE STRUCTURES AFTER FABRICATION SHALL BE CONTROL ASSEMBLED IN SHOP TO MATCH THE MATCHING DIMENSIONS AND CONNECTIONS OF DIFFERENT ERECTION MARKS BEFORE DESPATCH TO SITE.
10. PROPER RUBBER GASKET OF 10MM THICK PROPERLY GLUED SHALL BE PROVIDED AT RELEVANT FACES TO ARREST LEAKAGE OF WATER.
11. NEEDLES SHALL BE PAINTED EVERY YEAR BEFORE USE.

QUANTITY FOR SINGLE GATE

SR. NO.	DISCRIPTION	NOS.	SIZE	UNIT WEIGHT	WEIGHT
1	SKIN PLATE 3mm THK.	1	3.30 x 0.5	23.55 Kg/sq.m.	38.86 Kg
2	LONGITUDANL ISA 45x45x4	2	3.3	2.70 Kg/m.	17.82 Kg
3	END VERTICAL ISA 45x45x4	2	0.5	2.70 Kg/m.	2.70 Kg
4	MIDDLE VERT. ISA 45x45x5	5	0.5	3.80 Kg/m.	9.50 Kg
5	LIFTING HOOKS	2			0.1 Kg
				TOTAL WEIGHT	68.98 Kg
	TOTAL WEIGHT OF GATE				
1	NEEDLES	6	–	68.98 /NEEDLE	413.88 Kg
2	STIFFNERS ISMB-150	5	3.3	14.9 Kg/m.	245.85 Kg
				TOTAL WEIGHT	659.73 Kg



PLAN SHOWING END DETAILS OF ISMB-150



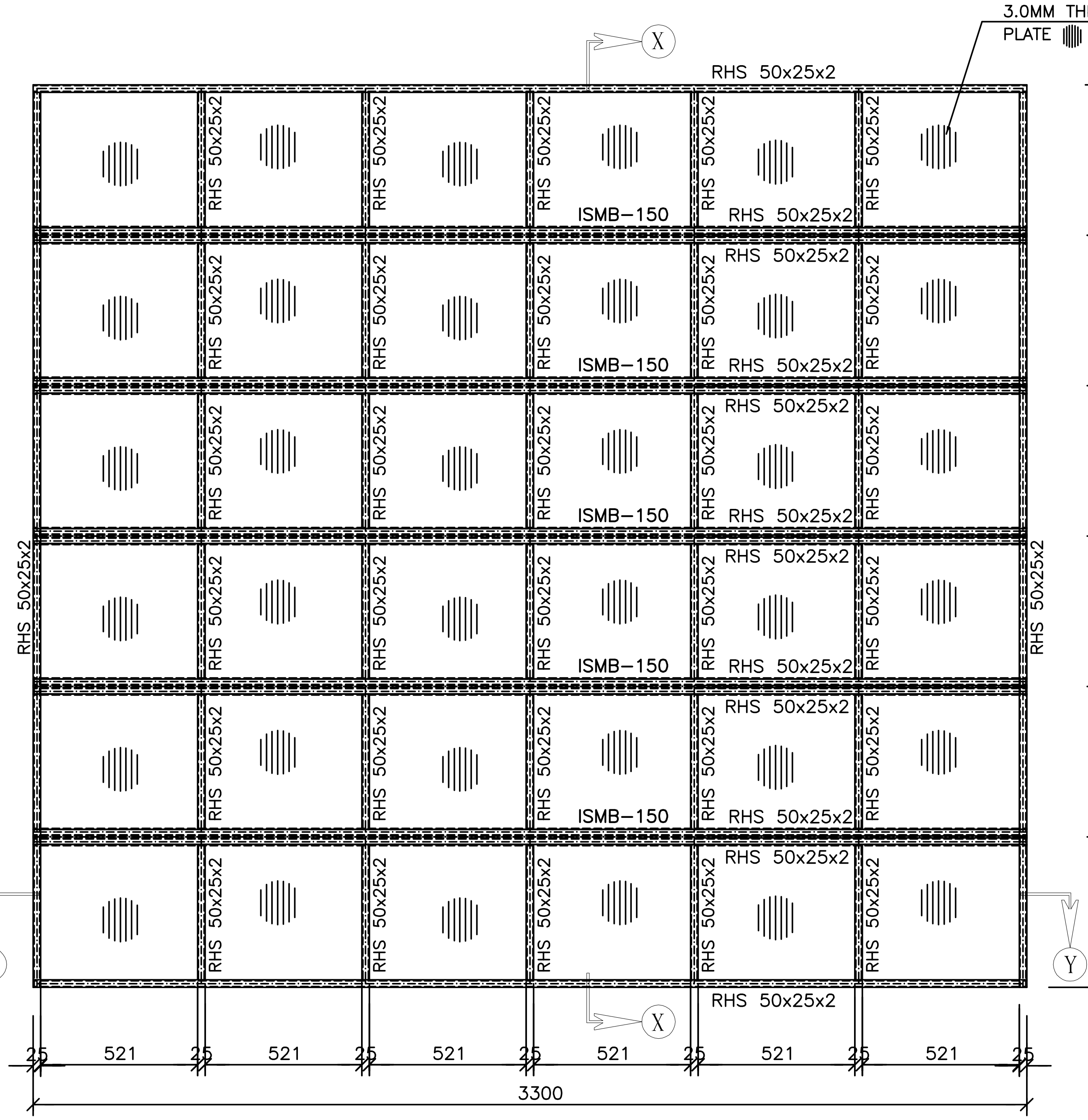
SECTION AT Y-Y

DEPARTMENT OF APPLIED MECHANICS
VISVESVARAYA NATIONAL INSTITUTE OF TECHNOLOGY
NAGPUR.

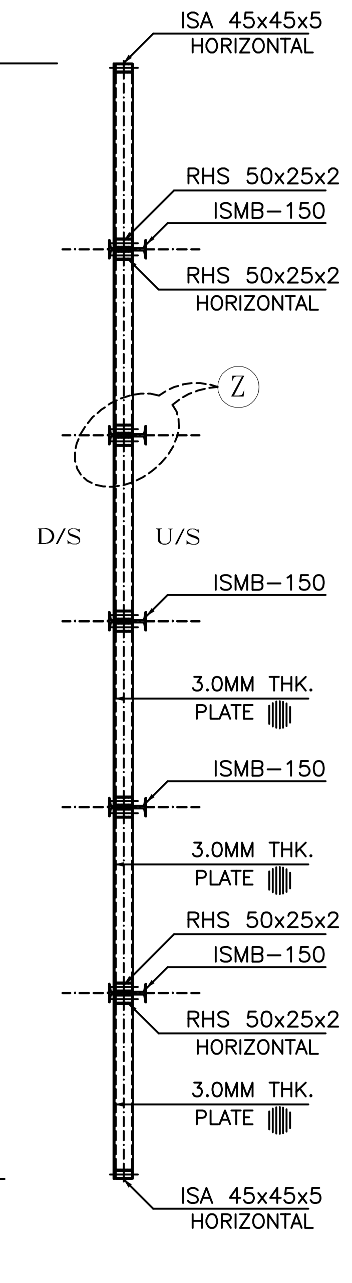
TYPE DETAILS FOR STEEL GATES ON BRIDGE CUM BANDHARA SPAN 3200MM
GATE FOR 3M DEPTH OF WATER WITH ANGLE SECTION

NATIONAL RURAL ROAD DEVELOPMENT AUTHORITY
MINISTRY OF RURAL DEVELOPMENT, GOVT OF INDIA
R&D PROJECT F No P-17029/04/2007-P-II

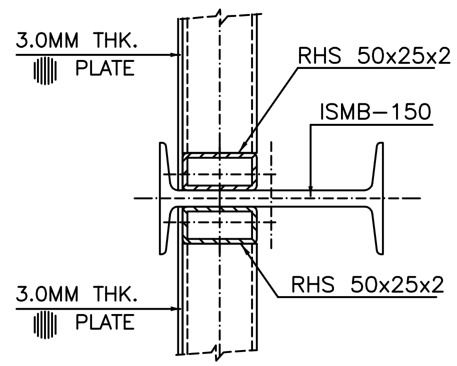
TECHNICAL ADVISOR	CHECKED BY:	DESIGNED BY:	
SHRI P L BONGIRWAR FORMER PRINCIPAL SECRETARY, PWD MAHARASHTRA	SHRI D K KANHERE CHIEF ENGINEER (RETD) PWD MAHARASHTRA	DR. R.K. INGLE	
		DRG.No.-G-4A	DATE: DEC-2015



ELEVATION FOR GATE PANEL



SECTION AT X-X



DETAILS AT 'Z'

NOTES

1. ALL DIMENSIONS ARE IN MM AND LEVELS ARE IN METERS UNLESS SPECIFIED OTHERWISE.
2. MATERIALS SPECIFICATION a) ALL STRUCTURAL STEEL ROLLED SECTIONS AND PLATES SHALL CONFORM TO IS-226-1975 AND IS:2062-1980.
3. WELDING SHALL CONFORM TO IS: 816-1969.
4. ALL ELECTRODES SHALL CONFORM TO IS:814 (PART 1) 1974.
5. ALL M.S. BLACK BOLTS AND NUTS SHALL CONFORM TO IS: 1363 (PART 1 TO 3) 1984.
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9. ALL THE STRUCTURES AFTER FABRICATION SHALL BE CONTROL ASSEMBLED IN SHOP TO MATCH THE MATCHING DIMENSIONS AND CONNECTIONS OF DIFFERENT ERECTION MARKS BEFORE DESPATCH TO SITE.
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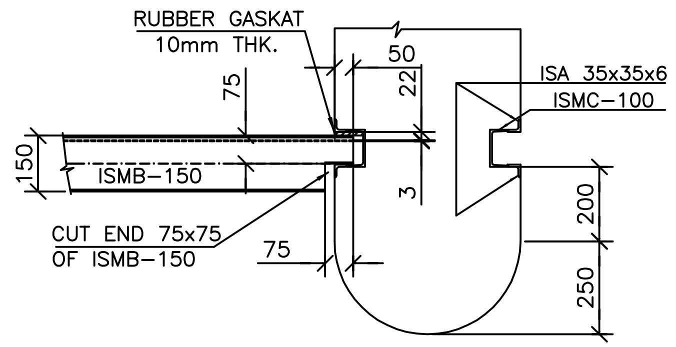
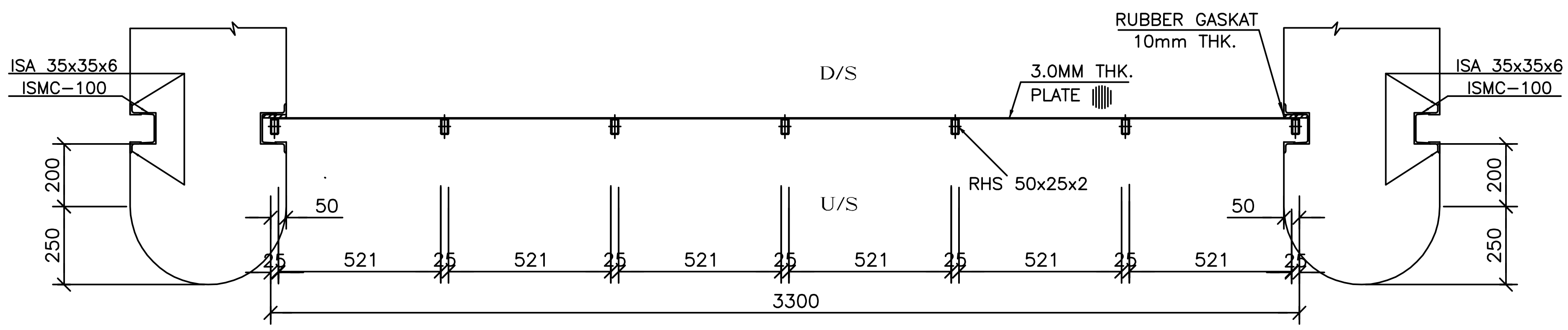
11. NEEDLES SHALL BE PAINTED EVERY YEAR BEFORE USE.

QUANTITY FOR SINGLE GATE

SR. NO.	DISCRIPTION	NOS.	SIZE	UNIT WEIGHT	WEIGHT
1	SKIN PLATE 3mm THK.	1	3.30 x 0.5	23.55 Kg/sq.m.	38.86 Kg
2	LONGITUDANL RHS50252	2	3.3	2.15 Kg/m.	14.19 Kg
3	END VERTICAL RHS50252	2	0.5	2.15 Kg/m	2.15 Kg
4	MIDDLE VERT. RHS50252	5	0.5	2.15 Kg/m	5.38 Kg
5	LIFTING HOOKS	2			0.1 Kg
				TOTAL WEIGHT	60.58 Kg
	TOTAL WEIGHT OF GATE				
1	NEEDLES	6	–	60.58 /NEEDLE	363.48 Kg
2	STIFFNERS ISMB-150	5	3.3	14.90 Kg/m.	245.85 Kg
				TOTAL WEIGHT	609.33 Kg

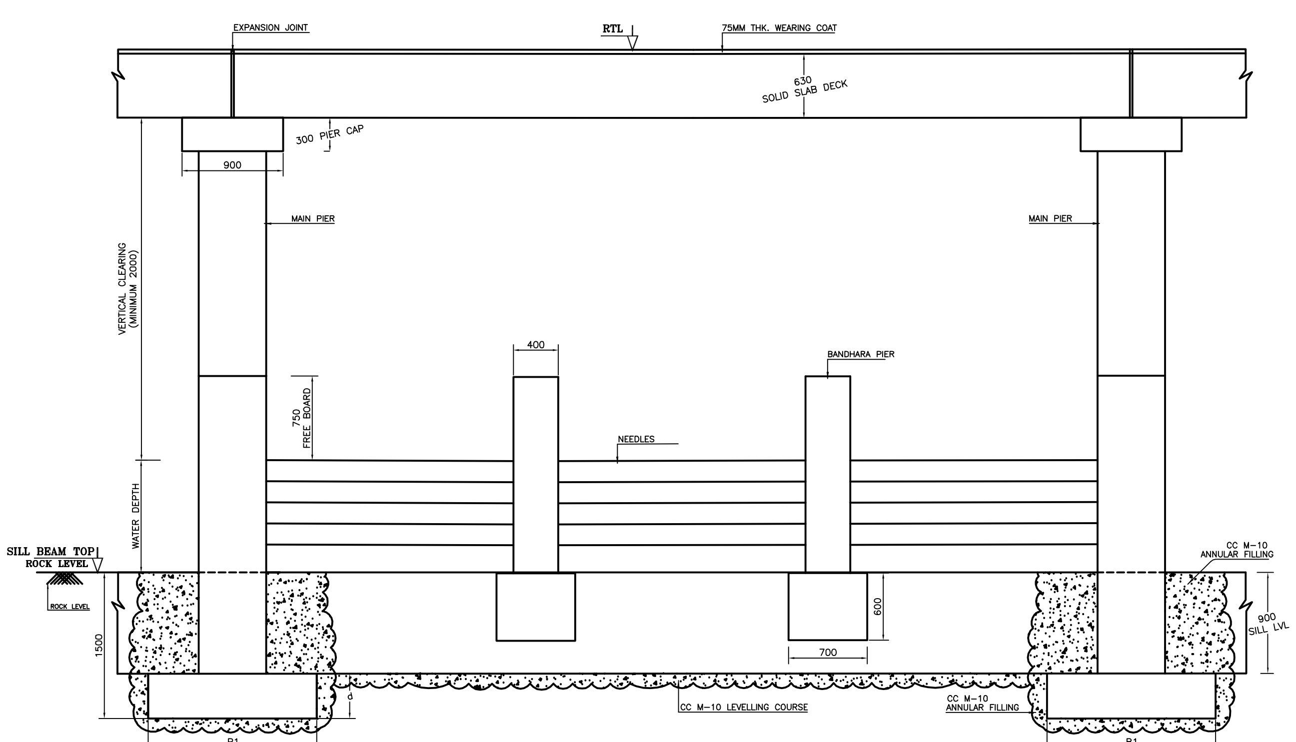


PLAN SHOWING END DETAILS OF ISMB-150

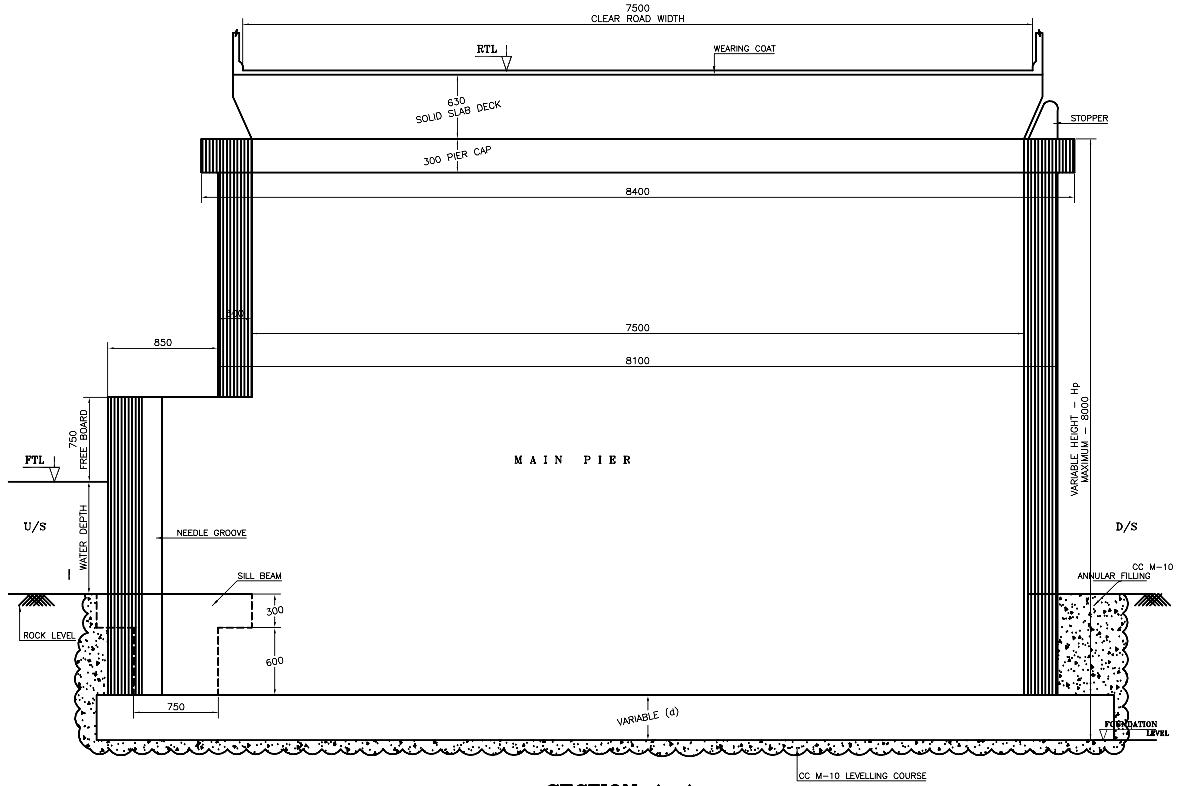


SECTION AT Y-Y

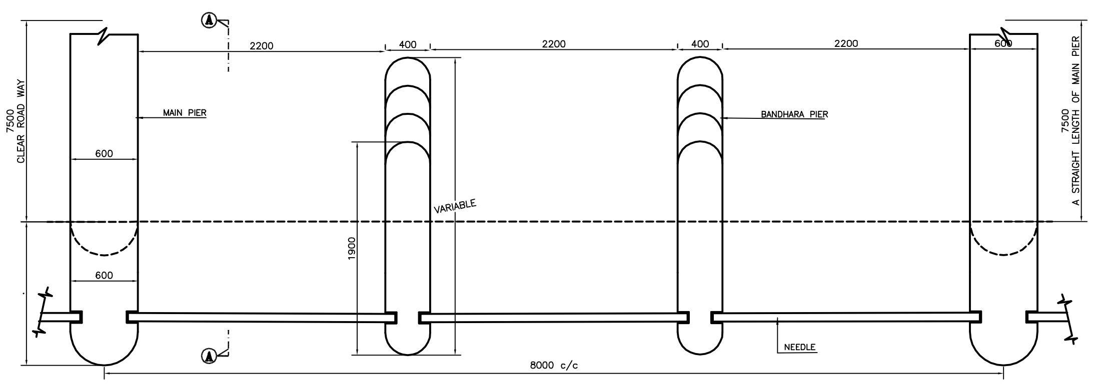
DEPARTMENT OF APPLIED MECHANICS VISVESVARAYA NATIONAL INSTITUTE OF TECHNOLOGY NAGPUR.		
TYPE DETAILS FOR STEEL GATES ON BRIDGE CUM BANDHARA SPAN 3200MM GATE FOR 3M DEPTH OF WATER WITH RECTANGULAR BOX SECTION		
NATIONAL RURAL ROAD DEVELOPMENT AUTHORITY MINISTRY OF RURAL DEVELOPMENT, GOVT OF INDIA R&D PROJECT F No P-17029/04/2007-P-II		
TECHNICAL ADVISOR	CHECKED BY:	DESIGNED BY:
SHRI P L BONGIRWAR FORMER PRINCIPAL SECRETARY, PWD MAHARASHTRA	SHRI D K KANHERE CHIEF ENGINEER (RETD) PWD MAHARASHTRA	DR. R.K. INGLE DRG.No.-G-4B DATE: DEC-2015



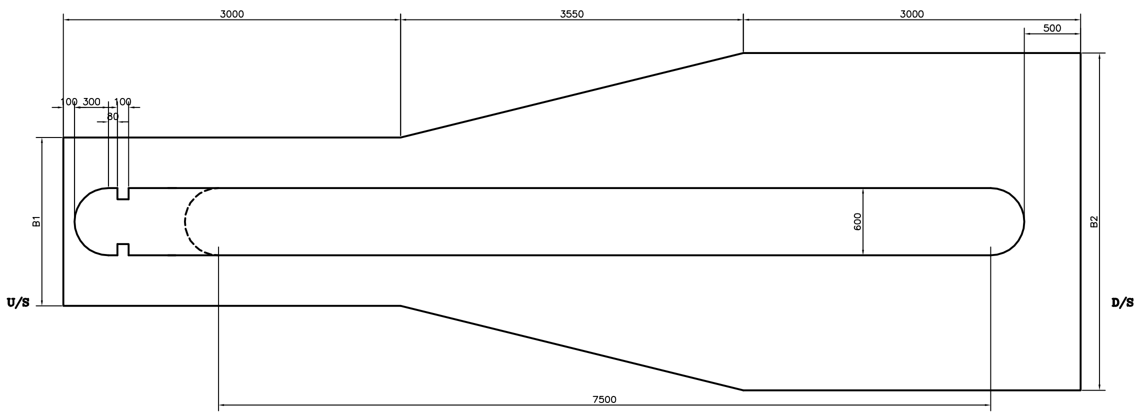
SECTIONAL ELEVATION



SECTION A–A



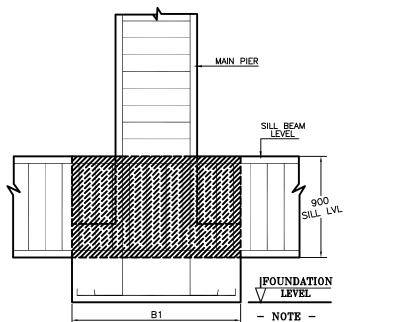
P L A N
GENERAL ARRANGEMENT – BRIDGE CUM BANDHARA.



PLAN MAIN PIER

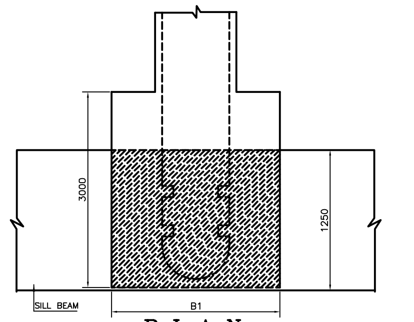
– NOTES –

1. GRADE OF CONCRETE : M30 RCC
   STEEL FE 415
2. MINIMUM 50mm COVER TO STEEL BAR REINFORCEMENT
3. LAPS AND JOINTS SHOULD BE AVOIDED AS PER AS POSSIBLE. WHERE EVER REQUIRED THEY SHALL BE PROVIDED AS PER I.R.C. 21



SECTION

– NOTE –
HATCHED PORTION (i.e. JUNCTION OF MAIN PIER AND SILL BEAM) SHOULD BE CAST MONOLITHICALLY WITH C.C. M-20.



P L A N
-DETAILS AT JUNCTION OF MAIN PIER AND SILL BEAM-

SEISMIC ZONE–II/III/IV

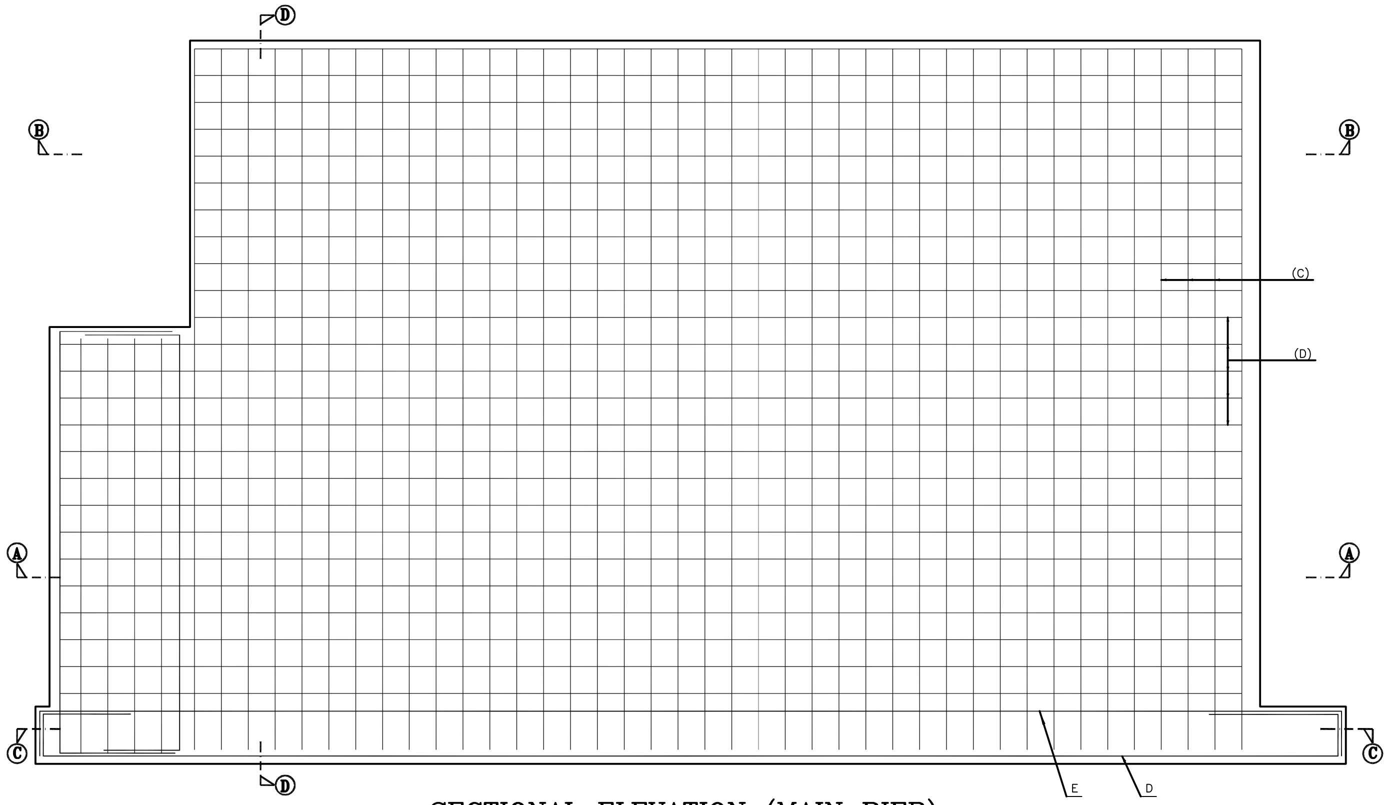
SR.	MAIN PIER					PIER FOOTING			FOUNDATION STEEL		
NO.	WIDTH	HEIGHT (Hp)	% AREA REINFORCEMENT	VERTICAL REINFORCEMENT EACH FACE (C)	HORIZONTAL REINFORCEMENT (D)	B1	B2	DEPTH (d)	PARALLEL TO TRAFFIC (A)	PARALLEL TO CURRENT (B)	TOP STEEL ON BOTHWAY (E)
1	600	6000	0.30	12 TOR @125	10 TOR @200	1700	2700	600	16 TOR @200	16 TOR @150	8 TOR @150
2				12 TOR @125	10 TOR @200	2200	2200	600	16 TOR @200	16 TOR @200	8 TOR @150
3	600	6500	0.30	12 TOR @125	10 TOR @200	1750	2900	650	16 TOR @200	16 TOR @120	8 TOR @150
4				12 TOR @125	10 TOR @200	2350	2350	650	16 TOR @200	16 TOR @200	8 TOR @150
5	600	7000	0.30	12 TOR @125	10 TOR @200	1850	3100	700	16 TOR @170	16 TOR @120	8 TOR @150
2				12 TOR @125	10 TOR @200	2500	2500	700	16 TOR @170	16 TOR @170	8 TOR @150
3	600	7500	0.30	12 TOR @125	10 TOR @200	2200	3100	700	16 TOR @170	16 TOR @120	8 TOR @150
4				12 TOR @125	10 TOR @200	2650	2650	700	16 TOR @170	16 TOR @150	8 TOR @150
5	600	8000	0.30	12 TOR @125	10 TOR @200	2400	3200	750	16 TOR @150	16 TOR @120	8 TOR @150
4				12 TOR @125	10 TOR @200	2800	2800	750	16 TOR @150	16 TOR @150	8 TOR @150

DEPARTMENT OF APPLIED MECHANICS
VISVESVARAYA NATIONAL INSTITUTE OF TECHNOLOGY
NAGPUR.

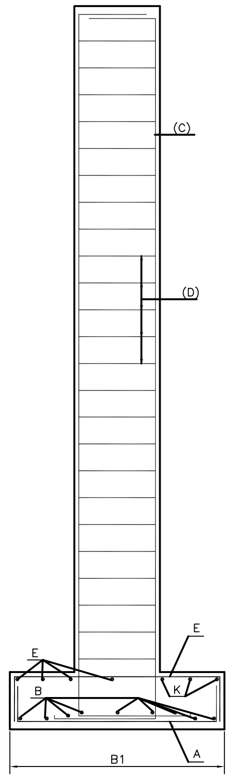
TYPE PLAN FOR INTERMEDIATE PIER OF BRIDGE CUM BANDHARA TWO LANE DECK.
GA AND RCC DETAILS OF MAIN PIER – 8M C/C (GA)

NATIONAL RURAL ROAD DEVELOPMENT AUTHORITY
MINISTRY OF RURAL DEVELOPMENT, GOVT OF INDIA
R&D PROJECT F No P-17029/04/2007-P-II

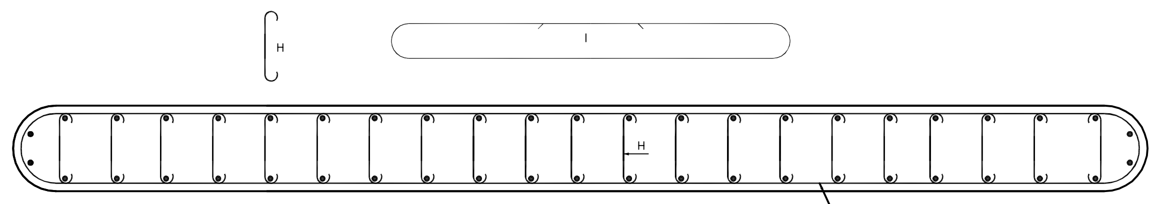
TECHNICAL ADVISOR	CHECKED BY:	DESIGNED BY:	
SHRI P L BONGIRWAR FORMER PRINCIPAL SECRETARY, PWD MAHARASHTRA	SHRI D K KANHERE CHIEF ENGINEER (RETD) PWD MAHARASHTRA	DR. R.K. INGLE DRG.No.–MP–01	DATE: DEC–2015



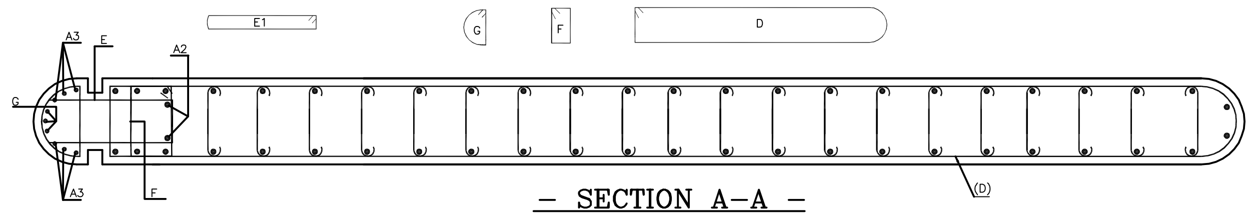
- SECTIONAL ELEVATION (MAIN PIER) -



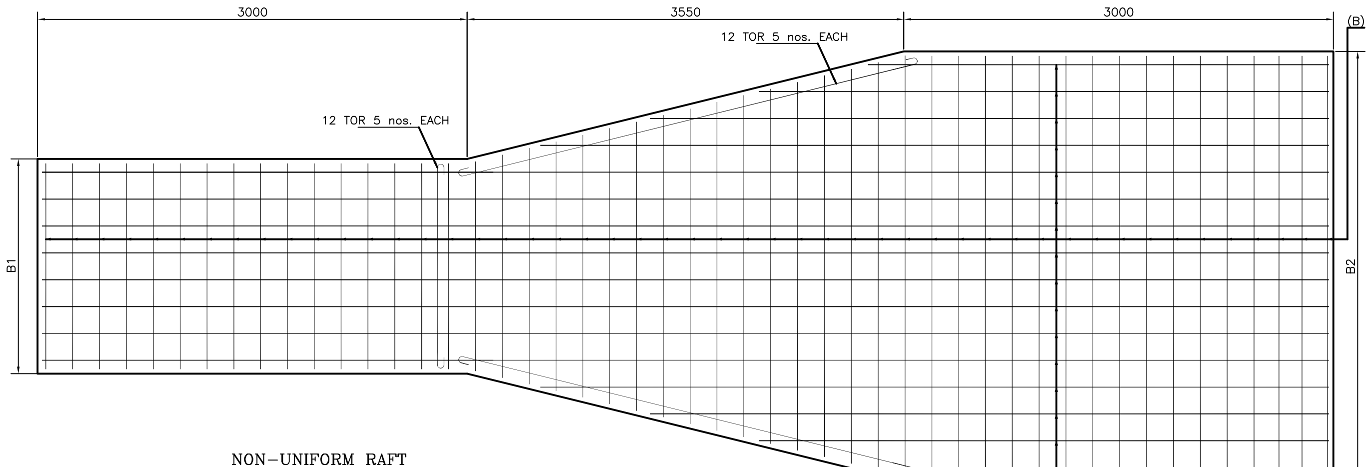
SECTION D–D



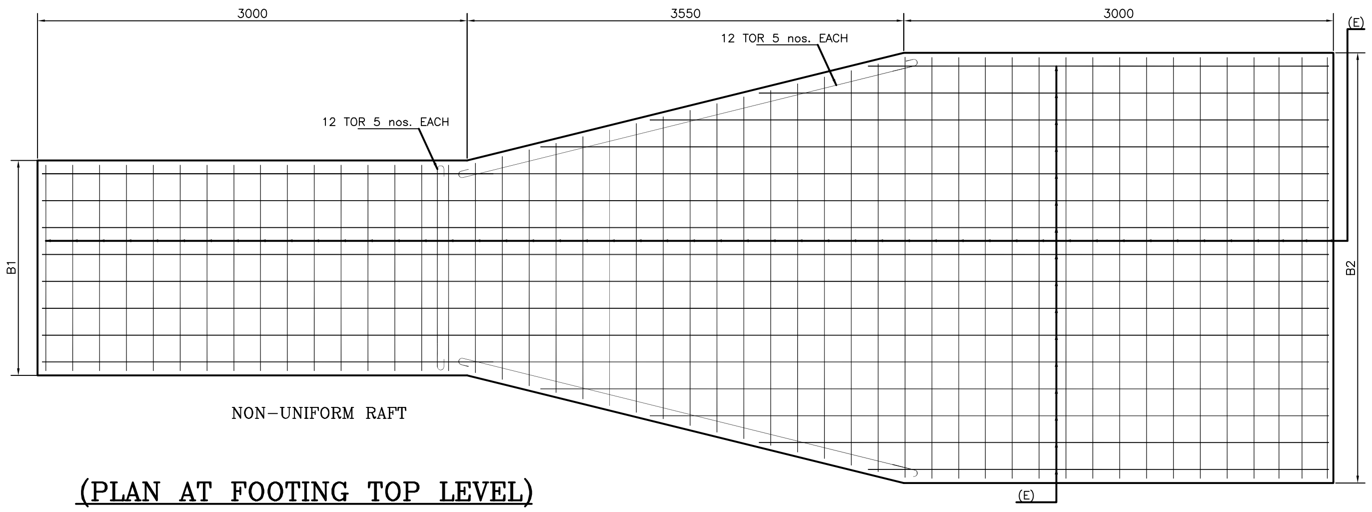
- SECTION B–B -



- SECTION A–A -



(PLAN AT FOOTING BOTTOM LEVEL)



(PLAN AT FOOTING TOP LEVEL)

- TYPICAL DETAILS OF MAIN PIER REINFORCEMENT -

- NOTES -

1. GRADE OF CONCRETE : M30 RCC M:15 PCC
   STEEL FE145
2. MINIMUM 50mm COVER TO STEEL BAR REINFORCEMENT
3. LAPS AND JOINTS SHOULD BE AVOIDED AS PER AS POSSIBLE WHERE EVER THEY ARE PROVIDED AS PER I.R.C. 21

-REINFORCEMENT SCHEDULE FOR MAIN PIER-

BAR NOTATION	HEIGHT OF PIER (HP)														
	6000			6500			7000			7500			8000		
	DIA.	NO.	C/C	DIA.	NO.	C/C	DIA.	NO.	C/C	DIA.	NO.	C/C	DIA.	NO.	C/C
E1	8	--	190	8	--	190	8	--	190	8	--	190	8	--	190
F	8	--	190	8	--	190	8	--	190	8	--	190	8	--	190
G	8	--	190	8	--	190	8	--	190	8	--	190	8	--	190
H	8	--	190	8	--	190	8	--	190	8	--	190	8	--	190
A2,A3	16	--	150	16	--	150	16	--	150	16	--	150	16	--	125

* H _ AT EVERY THIRD LAYER.

- NOTES -

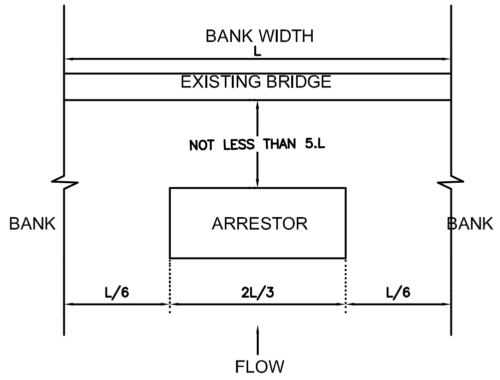
1. GRADE OF CONCRETE : M30 RCC
   STEEL FE 415
2. MINIMUM 50mm COVER TO STEEL BAR REINFORCEMENT
3. LAPS AND JOINTS SHOULD BE AVOIDED AS PER AS POSSIBLE. WHERE EVER REQUIRED THEY SHALL BE PROVIDED AS PER I.R.C. 21

DEPARTMENT OF APPLIED MECHANICS
VISVESVARAYA NATIONAL INSTITUTE OF TECHNOLOGY
NAGPUR.

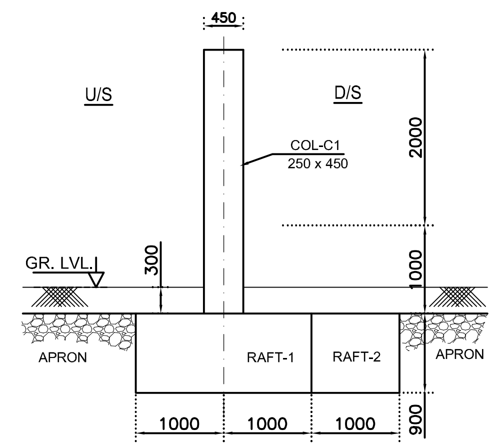
TYPE PLAN FOR INTERMEDIATE PIER OF BRIDGE CUM BANDHARA TWO LANE DECK.
RCC DETAILS OF MAIN PIER - 8M C/C (RCC DETAILS)

NATIONAL RURAL ROAD DEVELOPMENT AUTHORITY
MINISTRY OF RURAL DEVELOPMENT, GOVT OF INDIA
R&D PROJECT F No P-17029/04/2007-P-II

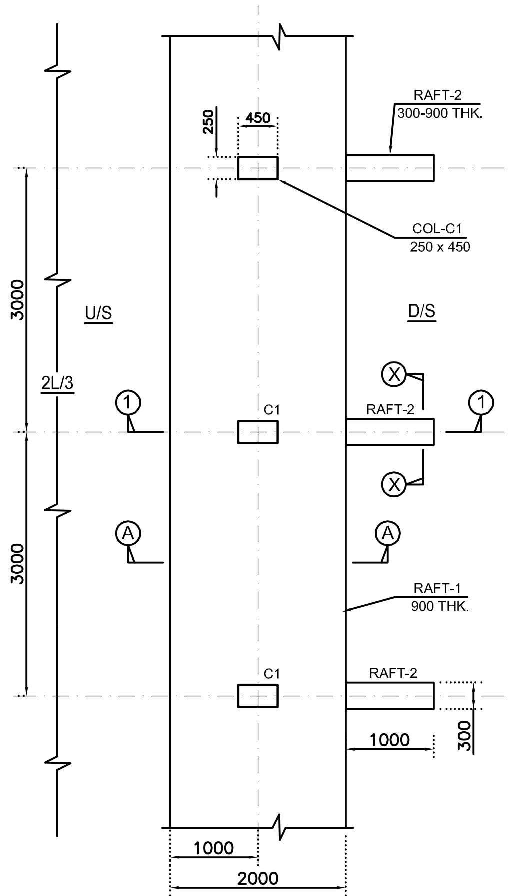
TECHNICAL ADVISOR	CHECKED BY:	DESIGNED BY:
SHRI P L BONGIRWAR FORMER PRINCIPAL SECRETARY, PWD MAHARASHTRA	SHRI D K KANHERE CHIEF ENGINEER (RETD) PWD MAHARASHTRA	DR. R.K. INGLE
		DRG.No.-MP-02 DATE: DEC-2015



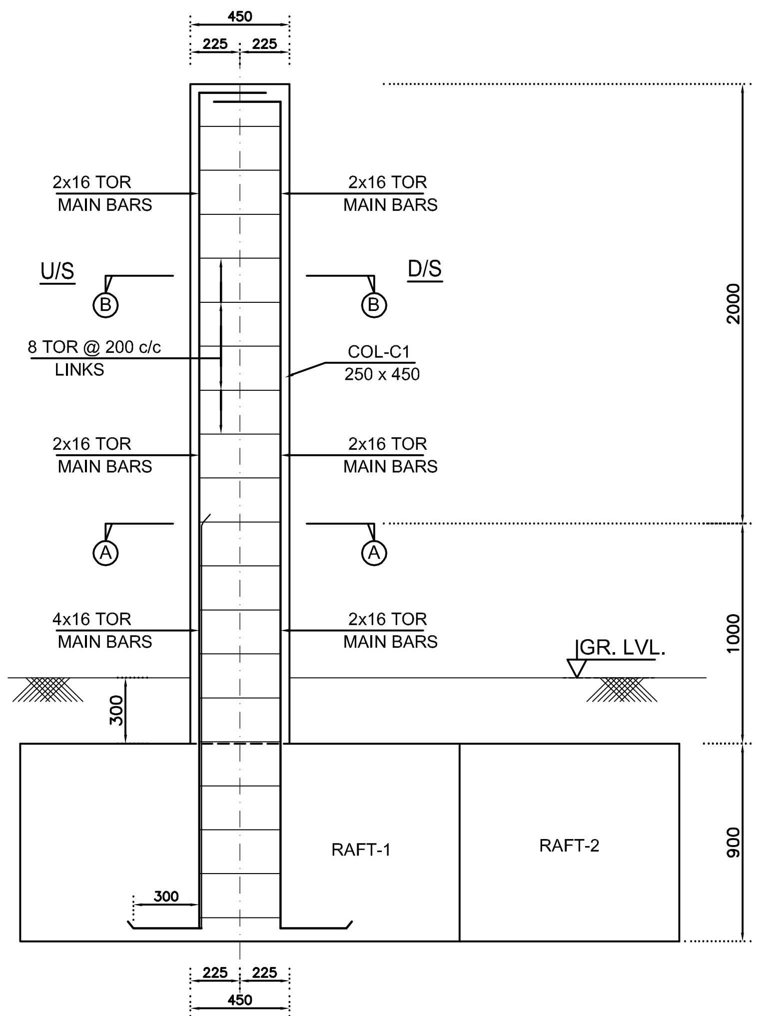
GENERAL ARRANGEMENT FOR LOCATION OF ARRESTOR



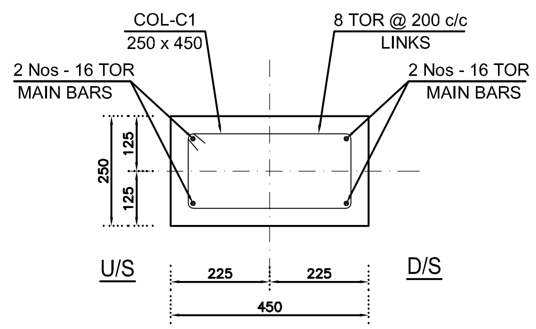
END VIEW OF A UNIT



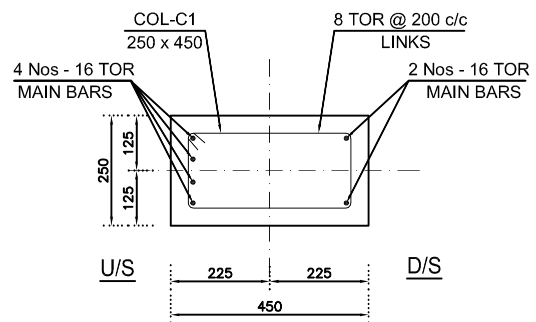
TYP. PLAN OF A UNIT



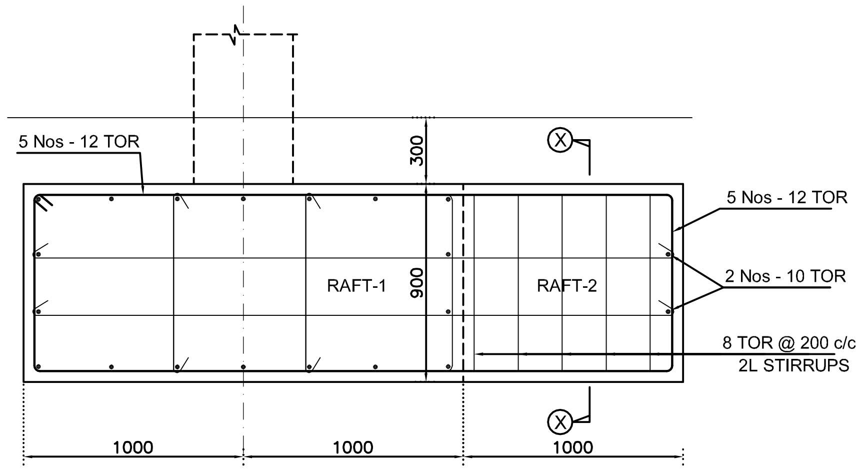
SECTION AT 1-1



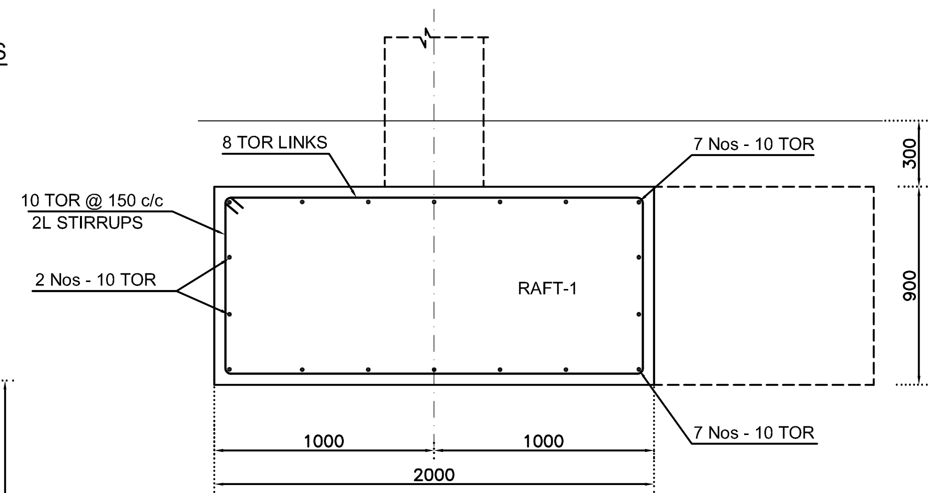
SECTION AT B-B



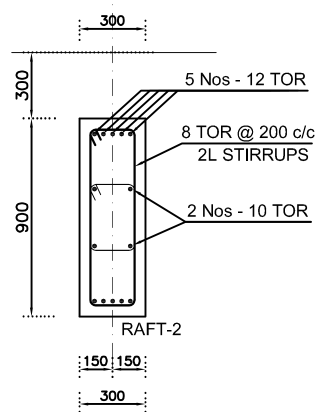
SECTION AT A-A



TYPICAL SECTION OF RAFT-2 SECTION AT 1-1



TYPICAL SECTION OF RAFT-1 SECTION AT 1-1



SECTION AT X-X

NOTES :-

1. ALL DIMENSIONS ARE IN MILIMETER OTHERWISE MENTIONED.
2. GRADE OF CONCRETE FOR COLUMN WILL BE M-30 & FOR BASE BLOCK GRADE OF CONCRETE WILL BE M-25.
3. CLEAR COVER TO THE REINFORCEMENT SHALL BE 50mm.
4. ARRESTOR ARE DESIGNED FOR VELOCITY OF FLOW OF 2.5m/sec. AND 10% IMPACT ON THE COLUMNS DUE TO THE FLOATING DEBRIS.
5. TOP OF THE BASE BLOCK SHALL BE 0.30m BELOW GROUND.
6. ARRESTED BAMBOOS AND TREES SHALL BE REMOVED AS EARLY AS POSSIBLE AFTER FLOOD RECEDES.
7. STONE ARRON 2.0m WIDE AND 0.3m THICK WITH SUITABLE WEIGHT ON D/S AND U/S SHALL BE PROVIDED.
8. UNIT OF ARRESTOR SHALL BE PREPARED FOR A LENGTH OF 2/3 BANK WIDTH.

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TYPE PLAN FOR BRIDGE CUM BANDHARA

DETAILS OF DEBRIES ARRESTER

NATIONAL RURAL ROAD DEVELOPMENT AUTHORITY
MINISTRY OF RURAL DEVELOPMENT, GOVT OF INDIA
R&D PROJECT F No P-17029/04/2007-P-II

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