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FORMING DIVERTION ROAD FOR THE MAIN WORK "CONSTRUCTION OF HIGH LEVEL BRIDGE ACROSS RIVER"

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ABSTRACT

This paper presents a study project on soil of survey main considerable Theodolite, check, and leveling. While doing hydraulic calculation attention should be the river cross section, bridge site, spill channels, should be properly located, marked and catered. To check the various levels of Inglis these are H.F.L (observed), H.F.L (Inglis), H.F.L (modified Inglis) and O.F.L. abstraction to discharge should be calculated for design H.F.L&O.F.L and flood level equal. Boring is the process of instructing hydraulic tubes into the ground by the laboratory consequences, type of soil, nature of soil, baring capacity of soil is decided. Laying of foundation plays a key role throughout life of the construction. Foundations are two types these are shallow foundation, deep foundation. Well foundation is used for drinking water purpose. The mild steel cutting edge made from structural steel sections. Cutting edge shape of "V". Soil is used to extrude of piers, bearing, slabs, and well foundation.

Keywords: Survey, Designing of H.F.L, O.F.L, Baring, boring, cutting edges, and well curb, stunning.

I INTRODUCTION

Preliminary exploration shall be carried out to determine the soil profile showing the boundaries between the soil types and between loose and dense parts in the same type of deposits. For guidance reference made to IRC: 75.for this purpose, as a first step, a suitable type of sub surface sounding (e.g. static or dynamic cone penetration test) shall be carried out. Exploratory drill holes should then be made at one or two locations where average condition prevails and near those few points where the penetration diagrams indicate maximum deviations from the average. This is the first step to precede the survey. It includes selection of site & topography. The minimum width of the river should be narrow. The constructed bridge should be straight. The site should be clear without any obstructions. The water in the selected site should be linear. Such type of way is known as linear water way.

II DETERMINATION OF LINEAR WATERWAY

The area through which the water flows between nulls bed and bridge superstructure is known as the waterway of bridge. The linear measurement of this area along the bridge is known as linear waterway. This linear waterway equal to sum of all the clear spans is called as effective linear waterway. Roughly linear waterway can be determined as below

Linear waterway at HFL/OFL = A/D

Where A = Wetted area of the discharging sections at HFL/OFL

Where A1, A2, A3 = Areas of compartments 1, 2 and 3

Q1, Q2, Q3 = Discharge of compartments 1, 2, 3

D = Maximum flood depth at HFL or OFL

= HFL/OFL - lowest bed level of central compartment

Planned At the Moment

- The selected site should be ranged.
- Rough estimation of the site value should be calculated.
- Rough alignment should be estimated.
- The total length of this HVL bridge is 449.67m
- The area and discharge is roughly estimate

III SURVEY

Mostly in this survey we perform two methods

3.1 Theodolite survey

3.2 Leveling

3.1 Theodolite: Adjustment of the instrument:

- The very first step of using the theodolite instrument is to setting the bubble.
- The bubble will be positioned with accuracy by making necessary adjustment.
- Note that the tripoid stand should be leveled to the ground surface.
- By the above instructions the following are to be checked

Checks: This survey is to check whether the alignment is in the proper way throughout the length of bridge or not.

i. It is to be conducted throughout the construction.
ii. The shifts are calculated every time.
iii. Total station may also be used instead of theodolite.
iv. The alignment of each and every curb and steinings should be calibrated once in a day.
v. By these measured values we can discern the orientation of particular object.

3.2 LEVELING:

This is to be done by using the dumpy level instrument.

By using this instrument we can find either the foundation curb is tilted or not.

The area is leveled with the instrument level. Staff, chain, and tape. The entire area is covered with four set ups of instrument, level. A temporary bench mark has taken and leveled. The booking is done in a level book. this field data is sufficient for finding the earth work involved in leveling it to the lowest level horizontal surface.

The volume of earth work is calculated by using different formulae namely

a) from cross sections,

b) by spot levels and

C) from contoured plan.

Total length of the HVL bridge =454.34m

The effective distance between two curbs =21.0m

The clear distance between curbs=12.6m

IV HYDRAULIC CALCULATIONS &HYDRAULIC DESIGN OF THE BRIDGE

While doing hydraulic calculations attention should be paid to the following-

1. The river cross section should be truly representative. The cross section should not be vitiated by artificial cuts etc.

2. If the bridge site is along the existing natural crossing, the cross-section for hydraulics should be across the nearby natural undisturbed channel. The cross section within 100 m U/S or D/S may be quite useful.

3. Spill channels should be properly located, marked, and catered for.

4. Details of various levels is explained as below.

HFL (observed) highest flood levels ever recorded. (50 years record)

HFL(Inglis) Flood level giving Manning's discharge equal to Inglis discharge.

HFL(Modified Inglis) Flood level giving Manning's discharge equal to Modified Inglis discharge.

O.F.L. Ordinary flood level. This is level of flood when cleared by bridge (without submergence of bridge) that will not give more than permissible interruption to traffic during floods.

5. Maximum permissible interruptions for various standards of roads are as follows-

National Highways – No interruptions.

Bridges on SH, MDR – 6 times a year and for a period not exceeding 12 hr at a time.

Bridges on ODR - 6 times a year and not exceeding 24 hours at a time.

Bridges on VR - 6 times a year and not exceeding 72 hours at a time.

(A) Ingles Formula (for Western Ghats and Tapi Valley)

$$Q = \frac{7000A}{\sqrt{A+4}}$$

Where Q = Discharge in cusecs (ft3/s)

A = Catchment area in sq. miles.

(B) Modified Ingis Formula : (Upper parts of Western Ghats)

$$Q = \frac{4000A}{\sqrt{A+4}}$$

Where Q = Discharge in cusecs (ft3/s)

A = Catchment area in sq.miles.

(C) Dicken's Formula (for Vidarbha & Marathwada Regions)

$$Q = C[A]^{3/4}$$

Where Q = Discharge in cusecs (ft^3/s)

A = Catchment area in sq. miles.

C = Constant whose value varies from 800 to 1600

= 800 to 1000 for rainfall 25" to 50"

= 1000 to 1400 generally this value taken in M.P can be adopted for Vidarbha adjacent to Madhya Pradesh

= 1400 to 1600 in Western Ghats.

- The discharge is then calculated at the assumed H.F.L. by using Manning's formula.
- The discharge calculated by Manning's formula is tallied with the discharge obtained from above empirica lformulae.
- By trial and error the H.F.L. is fixed.

V VERTICAL CLEARANCE

Where these considerations do not arise, vertical clearance in case of high-level bridges shall be as follows :

Discharge (m3/s)	**Minimum Vertical Clearance (in mm)**
0.3 up to 3	**150**
0.3 to 3.0	**450**
3.0 to 30	**600**
30 to 300	**900**
300 to 3000	**1200**
above 3000	**1500**

VI BORING

- Boring is the process of inserting hydraulic tubes in to the ground, until the rock stratum exist by excavation of different soil samples at different depths.
- The soil sample which is dig out from subversive part is dispatch to laboratory to test its nature.
- By the laboratory consequences,

➢ Type of soil
➢ Nature of soil
➢ Baring capacity of soil is decided.

Current mentioned project characteristics are as follows:

➢ Type of soil –silt sand& black cotton soil
➢ Nature of soil –
➢ Baring capacity of soil – 45 t/m^2

Laboratory test :

- The test is to be conducted, while the given soil sample is suitable for the foundation recommended.
- The Standard Penetration Test were conducted on the bore holes at regular depth interval every or change of strata in accordance with I.S. 2131(1981).
- A standard split spoon sampler of 50.8 mm diameter with cutting shoe and driving head attachments was driven at the bottom of clear bore hole by a 6.5kg monkey falling freely from a height of 75cms.
- The first 15cms of the drive was neglected and the stokes required to drive the next 30cms are recorded as standard penetration resistance (N value).
- The result of standard penetration tests (SPT) are given in the bore whole log data with corresponding depths.

➢ The standard penetration test values and the safe bearing capacity arrived from `N' values as per IS-6403-1971.
➢ The soil baring capacity of the soil is calculated by the Terzaghi's square footing equation.

Analysis of SPT values:

The STP values of top layer sand formation vary between 30 and 70 blows. As per SPT values safe bearing capacity of the formation will be in the range of 20 to 40t/m^2.

The STP values of soft clay is only 2 and the SBC values can be taken as 2t/m^2.sandy clay formation value range between 4 and 8 and the **SBC** values can be taken as 6t/m^2.soft rock is weathered part of the rock where the original form of the completely changed. Rock pieces and sand materials is seen in samples collected.

Safe bearing capacity(SBC)

Analysis of U.D soil samples show that the SBC of soft silty clay range between 3.7t/^{m2and} 6.3t/m^2

The SBC of sandy clay vary between 7 and 10 t/m^2 at various depth.

In the soft rock and disintegrated rock no U.D samples are obtained and SPT values are recorded as more than 100 and SBC is assigned as >50t/m^2

VII EXCAVATION

i. This place a key role in construction to develop any structure, in considered area.
ii. The excavation is based on leveling which is done and obstruction existed.
iii. The excavation is necessary where we required according to our purpose.
iv. Where ever it is, level should be equal after excavation.
v. Mostly filling is not preferred because of investing more money and wasting lot of time.
vi. In this the ground is excavated until +3.575 are occurred.
vii. Usually excavation is done up to the sub-soil water level ,a curb is then laid and masonry **constructed** up to a height of about 3m above ground level and the sinking operation is done.
viii. For excavation pit up to sub-soil water level, different rates are allowed for every 1.5 m depth.
ix. This exaction in the wells are very difficult so we use the hydraulic machines i.e., p&h320 crane.

VIII LAYING OF FOUDATION

Lying of foundation plays a key role, throughout the life of the construction.

- Foundation is laid on the bases of results came in the tests conducted on soil.
- Foundation is also decided on the basis of flood level which is considered.
- There are types in foundation:

FOUNDATION TYPES

Generally two types of foundations are adopted for bridge structures.

(i) Shallow foundations - Open foundations
- Raft foundations

(ii) Deep foundations - Pile foundations
- Well foundations

Open foundation:

Open foundations are preferred over any other type. These are to be provided when good-founding strata is available at shallow depth and there is not much problem of dewatering. R.C.C. footings are preferred over P.C.C. footing in case of RCC piers.

Well foundation:

- The shape of well can be, Single Circular, Double D-Type,Dumbell Type, Twin Circular.
- The typical components of well and various methods of starting well foundations.

Some important points to be noted regarding well foundations are as follows –

a. If the external diameter of single circular wells exceeds 12 m relevant provisions of clause 708.1.2 of IRC: 78-2000 shall apply.

b. The steining thickness of well shall not be less than 500 mm and shall satisfy the following relationship

$$\sqrt{h} = kd\ L$$

where h = minimum thickness of steining in m

d = external diameter of circular well in m

L = depth of wells in m below top of well cap or LWL whichever is more

K = constant (for wells in cement concrete 0.03,brick masonry 0.05 and twin D wells 0.39(For details refer to clause 708.2.3 of IRC: 78-2000).

c. In case of PCC wells the concrete shall not be learner than M-15. In case of conditions of sever exposure, steining shall not be leaner than M-20. The horizontal annular section of well steining shall be checked for ovalisation moments taking account of side earth pressure.

d. M.S. cutting edge shall not be less than 40 kg/m to facilitate sinking through all types of strata. In case of well curb the internal angle should be kept at about 300 to 370.Well curb shall not be leaner than RCC M-25.

e. The bottom plug provided should be such that the top is kept not lower than 300 mm in the centre above the top of the curb sump to be provided below the level of cutting edge. Well filling above the bottom plug shall be done generally with sand. Top plug of 300 mm in M-15 shall be provided over filling.

The following points are to be noted while preparing bridge proposal.

(a) Span to height ratio for

Raft foundation be kept as 1.00 to 1.25

Open foundation be kept as 1.25 to 1.50

Pile foundation be kept as 1.25 to 1.75

Well foundations it should be 1.50 to 2.00

The height of pier is measured from foundation to top of pier i.e. up to pier cap top.

(b) The dimensions of pier, abutment, and well foundation to be taken from type designs or from the latest I.R.C. Codes.

(c) Proper uniform sitting of well foundation could be ensured by taking the foundation into rock by about 15 cm.

(d) The raft foundation details be taken from the type designs as applicable.

(e) Other similar designs prepared and approved by the Designs Circle should also be studied and referred to.

IX STEININGS

The dimensions, shape, concrete strength, and reinforcements of the well shall strictly conform to those shown on the drawings. The form work shall be preferable be of M.S sheets shaped and stiffened suitably. In case timber forms are used, they shell be lined with play wood or M.S. sheets. Steining built in the first lift above the curb shell not be more than 2m and in subsequent lifts it shell not exceed the diameter of the well or the depth of the well sunk bellow the adjoining bed level at any time. For stability, the first lift of steenings shell be cast only after shrinking the curb at least partially for stability. Concreting of steining may be carried out in subsequent lifts of about 2 to 2.5m. Attempts should be made to minimize the no. of construction joints. the concreting layers shell be limited to about 450mm restricting the free fall of concrete not more than 1.5m. The steining of the well shall be built in one straight line from bottom to top such that if the well is tilted, the next lift of steining will be aligned in direction of the tilt. After the reaching the founding level, the well steining shall be inspected to check for any damages cracks.

Concrete used in steining – M_{25} N/mm^2

Mixed ratio - 1:3:6

Grade of steel used - Fe_{415}n/mm^2

Main priority of Fe415:

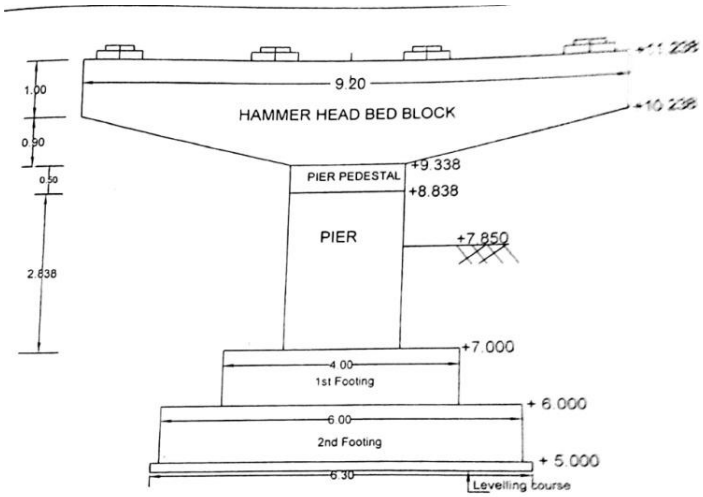
This is the standard grade of steel which is used for economical point of view.

Its strength is comparatively higher than Fe250.

X EXTRUDE OF PIERS

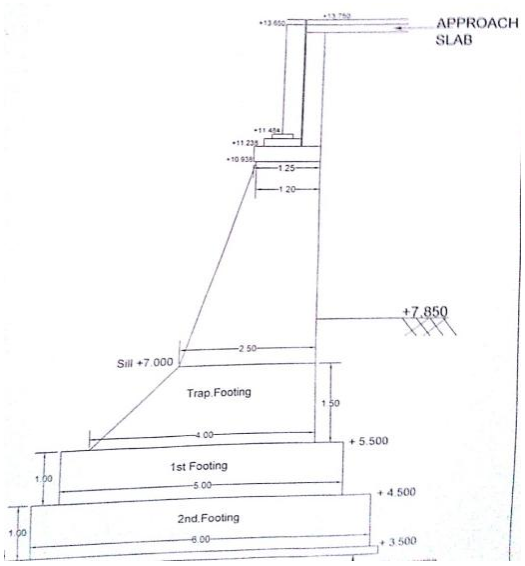
✓ The foundation soil of pier-1 represented by bore hole-P1 consisted of Brown silty clay, brown clay, weathered rock followed by highly fractured rock.

✓ Considering the sub soil conditions prevailing at the proposed site of pier-1, spread footing may be adopted restricting allowable bearing capacity of rock to 125 t/m2 at a minimum foundation depth of 6.3m.



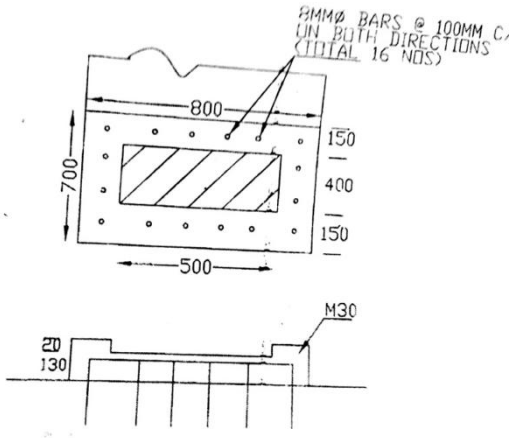
XI ABUTMENTS

- Various types of abutments used are gravity type, spill through type, counter-fort type. Various types of abutments used in the department are shown.
- Selection of a particular type of abutment depends upon the span, type of superstructure, height of substructure, magnitude of loads and forces to be transmitted, availability of type of construction material and construction equipment at site, time for construction and minimal cost.
- Solid abutments are proposed when height required is less than 10 m.
- Counter effort abutments are proposed when the height of abutment required is very high.
- Spill through abutment may be provided when the spilled earth is not subject to velocity more than 2 m/s and when solid and counter fort abutments are not feasible.
- Spill through material shall be suitably protected from wash out.



XII BEARINGS

- Bearing plats, rockers, assemblies and other expansion or fixed device shall be constructed in accordance with the details shown on the drawings.



BEARING PEDASTAL DETAILS

- The bearings may either be supplied directly to the engineer by the manufacturer to be installed by the contractor or the contractor is to supply and install the bearings as the part of the contract.
- In the formal case the manufacturer shall be associated with the installation of bearings to the full satisfaction of the engineers, where as in the latter case, the contractor shall be slowly responsible for the satisfactory supply and installation of the bearing.
- Bearing shall be handling with care and store under cover.
- When bearings assemblies or plats are shown to be placed directly on concrete bearing area shall be constructed slightly above grade (not exceeding 12mm) and shall be finished by grinding.

- It shall be ensured that the bottoms of girders to be resived on the bearings are plane at the locations of these bearings and care shall be taken that the bearings are not displacing while placing the girders. M.S. sliding on M.S. plats shall not be permitted for sliding plate bearings stainless ,steel surface sliding on stainless steel plate with mild steel matrix shall be used .the other option shall be to provide PTFE surface sliding on surface steel.

Permissible Shear Stress in Concrete

Permissible Shear Stress in Concrete, tc 14/mm bd Grade of Concrete

M20 (1)	M25 (2)	M30 (3)	M35 (4)	M40 (5)	ABOVE
O.15	0.18	0.19	0.20	0.20	0.20
0.25	0.22	0.23	0.23	0.23	0.23
0.50	0.30	0.31	0.31	0.31	0.32
0.75	0.35	0.36	0.37	0.37	0.38
1.00	0.39	0.40	0.41	0.42	0.42
1.25	0.42	0.44	0.45	0.45	0.46
1.50	0.45	0.46	0.48	0.49	0.49
1.75	0.47	0.49	0.50	0.52	0.52
2.00	0.49	0.51	0.53	0.54	0.55
2.25	0.51	0.53	0.55	0.56	0.57
2.5	0.51	0.55	0.57	0.58	0.60
2.75	0.51	0.56	0.56	0.60	0.62
3.00 and above	0.51	0.57	0.60	0.62	0.63

Note : 'As' is the area of longitudinal tension reinforcement (within the web in case of box sections), which Continues at least one effective depth beyond the section being considered except at supports where the full area of tension reinforcement may be used provided the detailing conforms to Clause 304.6.2.2 of IRC:21-2000.

XIII SLABS

SUPERSTRUCTURE:

- Various types of superstructures are Arches, Masonry, C.C., R.C.C. Girder and deck slab, Solid Slab, R.C.C. T-Beam Slab, R.C.C. Box Beam, Voided Slab, P.S.C. Two Girder, Three Girder, Multi-Girder,

Box Girder, Simply supported continuous Cantilever, Balance Cantilever, Hammer Head, Bow string girder, composite construction, cable stayed, suspension.

❖ Selection of Proper Superstructure: Generally the following criteria should be followed for selection of superstructure depending on span length.

1. Spans up to 10m. R.C.C. solid slab.
2. Spans- 10 to 15m R.C.C. solid slab /Ribbed slab,
3. Spans - 15m.to 20m R.C.C. Multi-girder slab system.
4. Spans - 20m.to 30m P.S.C. Girder/Box type superstructure.
5. Span - 30m to 60m P.S.C. Box girder.

- For spans more than 60 m the discussions should be held with Superintending Engineer, Designs Circle regarding selection of the type of superstructure.
- 2-girder system for two-lane superstructure should not be proposed unless other alternatives are considered unfeasible.
- For spans up to 10m solid slab superstructures are found most suitable. As the span increases beyond 10m the thickness of solid slab poses difficulties during concreting.
- Lot of construction joints are created in the structure if proper program of concreting is not prepared and insisted upon. Its, thus, desirable to go for ribbed slab or multi-girder system of deck slab. Spans between 10 m to 15 m could be conveniently covered in this manner.
- Spans between 15m to 20m, multi-girder system would be desirable. Two-girder system should be avoided as far as possible. In case of single lane bridges two-girder system is natural choice. But this system should not be preferred in severe exposure conditions.
- There is a school of thought that damage to one girder makes the entire structure unstable and unsafe and hence multi girder system is to be preferred.

XIV CLASSIFICATION OF TRAFFIC:

Type of Traffic	No. of commercial vehicles Per day, over 3 t	Equivalent single wheel load	Approx. Total equivalent load	C.B.R. Design curve for flexible pavement
Exceptionally light	15 nos. and under	-	-	A
Very light	15-45 nos.	5000 lbs.	100-400 t	B
Light	45-150 nos.	7000 lbs.	400-1500 t	C
Medium	150-450 nos.	9000 lbs.	1500-4000 t	D
Medium Heavy	450-1500 nos.	12000 lbs.	4000-12000 t	E
Heavy	1500 nos. and over	-	-	F

XV WEARING COAT

(1) Earlier up to 1980 R.C.C. wearing coat was generally adopted. Now as per Govt. in P.W.D. Circular No.CEC/1179/50677/CR-225/D-29-A dated 12.08.80, following type of wearing coat is generally provided for bridges.

Conventional Practice

- High Level Bridges : Bituminous 50 mm DBM + 25 mm AC/SDBC
- Submersible Bridges: C.C. M-20 with temperature steel.
- Long Span Bridges: Bituminous.

The performance of C.C. wearing coat on long span bridges (where deflections under live load are Considerable) is not found to be satisfactory. It develops cracks and spoils the riding quality. The Cracked surface also allows water to seep through and leads to correction in the main deck elements particularly in saline climates.

Bituminous wearing coat with 50 mm DBM + 25 mm. SDBC generally does not perform well during Monsoon, particularly in high rain fall area (> 1000 mm per annum).

Better treatment considered today is –12 mm Mastic Asphalt as leak proof layer.

+ 50 mm DBM

+ 25 mm bituminous concrete / Mastic Asphalt

We may part with the 12 mm. thick Mastic Asphalt layer in areas where climate is not severe and that The rainfall is less than 1000 mm per annum.

XVI CONCLUSION

A list of difficult situations, which engineers normally encounter during sinking of well foundations, is presented the problems like the formation of hump inside the dredge hole are wells cracking due to sand blow, or in a strip clay layer wells becoming stationery and not sinking down are quit common situations. In several cases, how these problems were overcome and whatever the solutions adopted and explained. Thus, it was observed that, at most care should be taken while analyzing and designing well foundation with the help of appropriate data and adoption of correct detailing.

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