Construction of a High Level Bridge

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Abstract— The Detail Project Report is an essential building block for any construction project. The DPR is to be prepared carefully and with sufficient details to ensure appraisal, approval, and subsequent implementation in a timely and efficient manner. The detailed project report gives us the clear idea about the existing site conditions and improvements needed to be accomplished. The DPR survey has been done for construction of a high level bridge on road pertaining @ km 6/2 (R&B) road to Kadapa district. The bridge crosses the river in normal crossing. It has total span of 50.80mts.This work has been executed under MNREGS scheme. The bridge has 3 vents of 6.37m effective span. The bridge is constructed across the stream to provide transportation facilities to people of Proddatur to various places of Kadapa District. This stream has an adequate discharge of 97.00 cusecs and it increases more during in rainy season. Traffic studies have been conducted on this road and the outcome was 120cvpd. The maximum flood level of this stream is 99.830.The linear water way is 18.00m. The design drawings and plans were given by MORT&H for execution of work. To calculate the discharge levels has been surveyed around 300mts both upstream and down streams. Funding for this project has been given by the government of A.P. The work has to be completed in a period of one year. The total estimate amount of the project is said to be 69.50 Lakhs.

Key words: High Level Bridge, Flood Level, Upstream, Downstream, Environment, Highway

I. INTRODUCTION

A bridge is a structure built to span physical obstacles such as a body of water, valley or road for the purpose of providing passage over the obstacle .Bridges is used elsewhere in many different Ways they may be used in the construction of roadways and railways. The first bridges were made by nature itself as simple as a log fallen across a stream or stones in a river. The first bridges made by humans were probably spans of cut wooden legs or planks and eventually stones, using a simple support and cross beam arrangement.

In this project we are going to explain you in detail the construction of a high level bridge across the stream in the Mydukur (Mandal) which is connecting two villages - Chapadu and Alladupalle under the scheme of MNERGS.

The first step in design is for analysis of cross-drainage facilities, the establishment of the flood frequency curve and the stage-discharge; and the second step is to make a decision concerning the type of cross-drainage structure. All types of facilities should be appraised based on performance and economy. The choice is usually between a bridge and culvert. If the stream crossing is wide with multiple concentrations of flow, a multiple opening facility may be in order.

At many locations, either a bridge or a culvert has to full-fill both the structural and hydraulic requirements for the stream crossing. The roadway designer should choose the appropriate structure based on the following criteria:

- Construction and maintenance costs
- Risk of failure
- Risk of property damage
- Traffic safety
- Environmental and aesthetic considerations
- Construction cost.

Although the cost of an individual bridge is usually relatively small, the total cost of bridge construction constitutes a substantial share of the total cost of highway construction. Similarly, bridge maintenance may account for a large share of the total cost of maintaining highway hydraulic features. The roadway designer can achieve improved traffic service and reduced cost by judicious choice of design criteria and careful attention to the hydraulic design of each bridge.

II. LITERATURE SURVEY

The hydraulic analysis of a highway-stream crossing for a particular flood frequency involves the following:

- Determination of the backwater associated with each alternative profile and waterway opening(s)
- Determination of the effects on flow distribution and velocities
- Estimation of scour potential.

The hydraulic design of a bridge over a waterway involves the following risks associated with backwater and increased velocities are:

- Establishing a location
- Bridge length
- Orientation
- Road way and bridge profiles.

A Hydrologic and Hydraulic analysis is required for designing all new Bridges over waterways, Bridge widening, Bridge replacement, and Road-way profile modifications that may adversely affect the floodplain even if no structural modifications are necessary. Typically, this should include the following:

- An estimate of peak discharge (sometimes complete runoff hydrographs) existing and proposed condition water surface profiles for design and check flood conduit
- Consideration of the potential for stream stability problems and scour portions

A. *Flow Through Bridges*

When flood flows encounter a restriction in the natural stream, adjustments take place in the vicinity of the restriction. The portion of flow not directly approaching the bridge opening is redirected towards the opening by the embankment. The flow contracts as it enters the bridge and then expands as it exits the bridge. Maintaining the contraction and expansion of flow and overcoming friction and disturbances associated with piers and abutments requires an exchange of energy. An increase in the depth of flow upstream of the encroachment, termed backwater, reflects this energy exchange

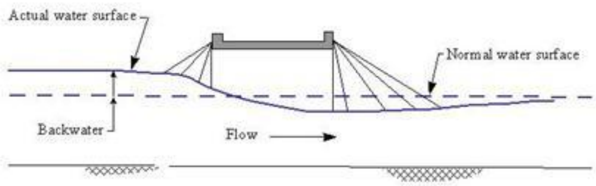

Fig. 1: Backwater at A Stream Crossing

Any stream crossing that uses a combination of fill and bridge within the floodplain disturbs flow distribution during some floods. However, the normal flow distribution should be preserved to the extent practicable in order to:

- Avoid disruption of the stream-side environment
- Preserve local drainage patterns
- Minimize damage to property by either excessive backwater or high local velocities
- Avoid concentrating flow areas that were not subjected to concentrated flow prior to construction of the highway facility
- Avoid diversions for long distances along the roadway embankment.

Generally, the disturbance of flow distribution can be minimized by locating bridge openings at the areas of high conveyance. For many situations, one-dimensional analysis techniques suffice for determining optimum bridge locations. When analyzing complex sites, such as those at a bend and at skewed crossings a great deal of intuition, experience, and engineering judgment are needed to supplement the one-dimensional analysis. Unfortunately, complex sites are frequently encountered in stream crossing design. The development of two-dimensional techniques of analysis greatly enhances the capabilities of hydraulics designers to deal with these complex sites. However, two-dimensional models required a great deal more data, intuition, experience and time than a one-dimensional model.

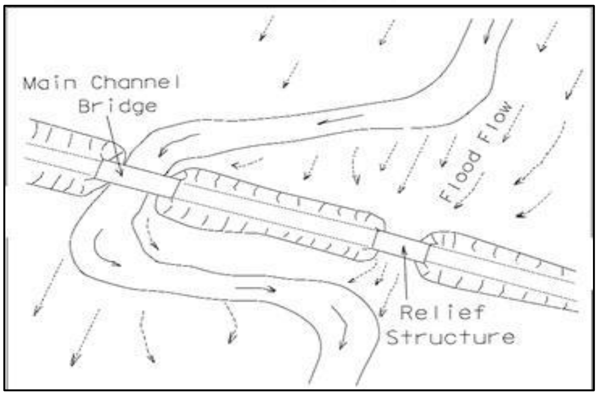

Fig. 2: Highway Stream Crossing at A Bend

B. Factors Affecting Bridge Length

Bridges over waterways are not always limited to the length of the hydraulic opening required.

- The roadway alignment is at a skew to the streambed, and normalizing the alignment would require unsafe or undesirable curves on the approaches to the bridge.
- Embankments may be limited to a certain location due to local soil instability or permitting requirements.
- Bridge costs might be cheaper than embankment costs.
- Matching the highway profile grade line.
- High potential for a meander to migrate, or other channel instabilities.

These and other aspects are valid considerations that affect bridge waterway openings. However, hydraulic computations are necessary to predict the performance and operation of the waterway opening at flood stages. Do not neglect hydraulic design. The design decisions, including the reasons for any excess opening, must be documented.

III. Bridge Layout

A. Marking Quadrilateral Method

In this method, instead of one triangle, two triangles forming a quadrilateral are used. The procedure is

1) AB is the centre line of the bridge whose length AB has to be determined.
2) Set out a base line AC approximately at right angles to the line AB. Measure the length of the base line AC accurately.
3) Set out another line BD approximately at right angles to AB. Measure the length BD accurately.
4) Measure the angles in the quadrilateral ABCD accurately. There are two angles at each station, making a total of eight angles. Thus measure angles BAC and DAC at A, angles ACB and ACD at C, angles ABC and CBD at B and angles BDA and CDA at D.
5) Assuming one of the base line lengths as correct, calculate the length of the other base line. As an example using the measured value of AC calculate the length of BD. The sine rule can be applied to calculate the length.
6) If the calculated length matches the measured length of BD within the specified limits of precision, then calculate the length of AB using these values. The limit of precision in the case of large bridges is not less than 1 in 5000.
7) It not repeats the procedure until the values match.

B. Discharge Calculations Of Bridge

C/S OF STREAM @ SITE OF CROSSING							
CHAINAGE	MFL	BED LEVEL	LEVEL DIFFERENCE	MEAN DIFFERENCE	DISTANCE	AREA	WETTED PERIMETER
-18	99.83	99.83	0	0	0	0	0
-14		99.965	0.135	0.0675	4	0.27	4.002
-12		99.83	0	0.0675	2	0.135	2
-9		98.445	1.385	0.06925	3	2.0775	3.304
-6		98.06	1.77	1.5775	3	4.7325	3.483
-3		97.805	2.025	1.8975	3	5.6925	3.619
0		97.685	2.145	2.085	3	6.255	3.687
3		97.95	1.88	2.012	3	6.0375	3.54
6		98.215	1.615	1.747	3	5.2425	3.407
9		98.52	1.31	1.4625	3	4.3875	3.273
12		99.83	0	0.655	3	1.965	3
15		99.92	0.09	0.045	3	0.135	3.001

SITE OF CROSSING

A=36.93

P=36.31

R=A/P=1.01

N=0.045

S=0.003

$$V=1/N*R^{2/3}*S^{1/2}$$

$$=0.045*(1.01)^{0.66}*(0.003)^{0.5}$$

$$=1.118\text{cumec}$$

$$Q=AV$$

$$=36.93*1.118$$

$$=41.28 \text{ cumec}$$

C/S OF STREAM @ AT 300M D/S							
CHAINAGE	MFL	BED LEVEL	LEVEL DIFFERENCE	MEAN DIFFERENCE	DISTANCE	AREA	WETTED PERIMETER
-18	99.14	99.14	0	0	0	0	0
-15		99.32	0.18	0.09	3	0.27	3.005
-9		99.14	0	0.09	3	0.27	3
-6		98.54	0.6	0.3	3	0.9	3.059
-3		97.653	1.487	1.043	3	3.129	3.348
0		97.115	2.025	1.756	3	5.268	3.619
3		96.745	2.395	2.21	3	6.63	3.838
6		96.93	2.21	2.3025	3	6.9075	3.726
9		97.265	1.875	2.042	3	6.126	3.537
12		97.52	1.62	1.747	3	5.241	3.409
15		98.416	0.724	1.172	3	3.516	3.086
18		99.14	0	0.362	3	1.086	3
		99.38	0.24	0.12	3	0.36	3
					36	3.97	39.627

300m D/S

A=39.70

P=39.627

R=A/P=1.001

N=0.045

S=0.003

IV. CONSTUCTION DETAILS

A. *Excavation*

Excavation is the moving or processing of parts of the earth surface involving quantities of soil or unformed rock. Now a day's mostly excavation is done by mechanical stabilization. Excavation is primary process for any type of construction. It includes rail, road, dams, canals, buildings and bridges. In this excavation process we use mechanical machines such as Bulldozers, Grader, Back-hoe, and Deadline Excavator. If an excavation or dredging is made a site of the structure, the contractor shall without extra charge after the foundation base in place, backfill all such excavation to be orginal ground surface or riverbed with material satisfactory to the consultant. Material deposited with in the stream area for foundation or the excavation, or from any other operations, shall be removed and the stream area freed from obstruction. Generally excavation for the bridges may be done in two categories structural excavation is done for foundations and for sub-structure & channel excavation is done for natural flow part of the channel.

B. Dewatering

The process of removing water from a construction area is dewatering. The purpose of dewatering is to keep the excavation dry so that concreting can be done ,it is done at the time of construction .It is followed by restoration to its original water table after the structure has been completed. Permanent dewatering is required for removing sub surface gravitational water throughout the life of a structure .It is also necessary to keep the water away from the structure to check dampness or other ill effects.

C. Raft Foundations

A raft or mat is a combined footing that covers the entire area beneath a structure and supports all the walls and columns. When the allowable soil pressure is low , or the building loads are heavy , the use of spread footings would cover more than one-half of the area and it may prove more economical to use mat or raft foundation . They are also used where the soil mass contains compressible lenses or the soil is sufficiently erratic so that differential settlement would be difficult to control. The mat or raft tends to bridge over the erratic deposits and eliminates the differential settlement. Raft foundation is also used to reduce settlement above highly compressible soils, by making the weight of structure and raft approximately equal to the weight of the soil excavated

Fig. 3: Raft Foundations

D. Conventional Design of Raft Foundation

In the conventional method of design, the raft is assumed to be infinitely rigid and the pressure distribution is taken as planar. The assumption is valid when the raft rests on soft clay which is highly compressible, and the eccentricity of the load is small. In the case when the soil is stiff or when the eccentricity is large, the method does not give accurate results. The elastic method, which takes into account the stiffness of the soil and raft, is more economical and accurate in the latter case. The simplified elastic method is discussed.

According to the American concrete institute committee 436, the design of mats should be done using the conventional method if the spacing of the columns in a strip of the raft is less than 1.75/

Where k=coefficient of sub grade reaction (KN/),=width of the strip(m)

E=modulus of the elasticity of the raft material (KN/), I=moment of inertia

The coefficient of sub grade reaction of a soil is the pressure required to produce a unit settlement of a plate it is given by

K=q/z

Where q= Pressure (KN/), z= settlement (m), k=coefficient of sub grade reaction (KN/)

The coefficient of sub grade reaction is not a constant for a given soil. It depends upon a number of factors, such as length, width, depth and shape of foundation.

1) Procedure:

The procedure for the conventional design consists of the following steps.

- Determine the line of action of all the loads acting on the raft. The self weight of the raft is not considered, as it is taken directly by the soil.
- Determine the contact pressure distribution as under.
- If the resultant passes through the centre of the raft, the contact pressure is given by
- q = Q/A
- If the resultant has an eccentricity of and in x-and y-directions. The maximum contact pressure should be less than the allowable soil pressure.
- Divide the slab into strips in x-and y-directions. Each strip is assumed to act as independent beam subjected to the contact pressure and the column loads.
- Draw the shear force and bending moment diagrams for each strip.
- Determine the modified column loads as explained below.

It is generally found that the strip does not satisfy statics, the resultant of column loads and the resultant of contact pressure are not equal and they do not act in the same line. The reason is that the strips do not act independently as assumed and there is some shear transfer between adjoining strips. Let us consider the strip carrying column loads Q1,Q2 and Q3. Let B1 be the width of the strip. Let the average soil pressure on the strip be q avg. Let B the length of the strip. Average load on the strip .The modified average soil pressure is given by the column load modification factor is given by. All the column loads are multiplied by f for that strip. For this strip, the column loads are FQ1, FQ2 and FQ3.

- The bending moment and shear force diagrams are drawn for the modified column loads and the modified average soil pressure ().
- Design the individual strips for the bending moment and shear force. The raft designed as an inverted floor supported at columns.
- As the analysis is approximate, the actual reinforcement provided is twice the computed value.

E. General Design Considerations

Abutment design loads usually include vertical and horizontal loads from the bridge superstructure, vertical and lateral soil pressures, abutment gravity load, and the live-load surcharge on the abutment backfill materials. An abutment should be designed so as to withstand damage from the Earth pressure, the gravity loads of the bridge superstructure and abutment, live load on the superstructure or the approach fill, wind loads, and the transitional loads transferred through the connections between the superstructure and the abutment. Any possible combinations of those forces, which produce the most severe condition of loading, should be investigated in abutment design. Meanwhile, for the integral abutment or monolithic type of abutment the effects of bridge superstructure deformations, including bridge thermal movements.

Fig. 4: General Design Considerations

F. Approach Slab

The portion of the road constructed to reach the bridge from their general route or height is known as approach of the bridge .The alignment and the level of the approaches mainly depend upon the design and layout of the bridge .Indian road congress recommended that a minimum of 15m length on either side of the bridge should be kept straight .This length may be increased depending on the minimum sight distance in case of fast moving traffic .The width of the approach should not be less than the road way width of the bridge.

Fig. 5: Approach Slab

V. CONCLUSION

Bridge construction is a huge task as it involves specialization in many topics. One who is taking the responsibility of bridge work should have minimum knowledge of discharge calculations, level locating and minimum design concepts. From any bridge or construction activity foundation should be stable. As bridge takes many impact loads moving with heavy speeds the slabs and the intermediate supports should be provided with enough strength to score the purpose. M15 VCC is the most mix design used in the construction. The location of the site at which the bridge is constructed will give adequate transportation facilities to the people of proddatur to mydukur. It gives better connectivity to the nearer town's chapadu and alladupally. These people do not have a primary health centre .Now when the bridge is constructed completely people can treat their illness with their will and can have emergency services on their foot. They can move fast products to the towns and can have their livelihood. The standard of living of the people also changes.

We have been following this particular bridge construction for the past one year. Since its foundation and have learnt many topics and aspects in construction. The levels making has been important task for the laying of P.C.C beds, foundation and to calculate M.F.L values.

While working this project we have gone through many books to collect the required information and data by that we learned some valuable concepts. We are here with thanking for that Authors of Books from bottom of our hearts.

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