



Study Analysis on the High-Level Viaduct Over Bondivagu Drain

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Abstract

A viaduct is a structure used to hold obstacles such as water, road, valley. It also provides the way for these obstacles. Assorted designs of proposals serve various purposes and can be applied for different situations. Depending up on the usage of bridge its function will be varied and the factors that comes into action are nature, location of the proposal, materials used for its framework also amount that is authorized to construction.

In this paper we are presenting the study analysis on the high-level viaduct over Bondivagu drain. Construction of high-level viaduct over Bondivagu drain. As it approaches way of Hanamkonda to Warangal. The distance from Hanamkonda to Warangal is 4km approximately and this drain Bondivagu is located in a span of 2.5km from Hanamkonda and 1.5km from Warangal.

Through this bridge the bypass road of Hanamkonda to Khammam passes.

Keywords: Bridge, Construction, Foundation, Slab, Structure, Soil, Piers.

1. Introduction

Bridge help us for comfortable transportation through roadways moreover as railways. When any obstacle in the construction of any road or a rail there there's a need to construct a bridge.

There are various types of viaducts which serve different purposes. We even use bridge for crossing small rivers and streams also. Low level viaducts are capable of lower span lengths and their construction cost is also less when compared to high level bridges. High level bridges are used for high length bridges and the price of construction is better than a low-level bridge.

LOW LEVEL BRIDGE: The low-level viaduct would be approximately 900 meters in length, including 400 meters in approaches and 500 meters over water.

HIGH LEVEL: viaduct will be approximately 1500 meters in length, including 1000 meters in approaches and 500 meters over water.

The main differences between the high-level bridge and the low-level bridge are that; the high-level viaduct span will be 40% more than low-level bridge length, there could be a requirement for twin viaducts at the outset to realize the benefits of the high-level bridge. Substructure cost is larger than the low-level bridge for the reason of higher piers and longer length of spans that are required for the construction.

The cost can be made feasible for high-level bridge by lowering the height of pier in the river.

2. Study Objectives

Without closing the way beneath for providing passage over an

obstacle is called as viaduct. Road, railway, pedestrians, a canal or a pipeline are the required passages. Bridge serve the cause of providing way for river, road, railway and a valley. Bridge can be said as a structure which carries different loads like traffic load, hydraulic load, sometimes of the load given by road and railways. A bridge can connect a way without closing it because of some obstacles that come across it.

COMPONENTS OF BRIDGE: The viaduct of the following parts. Superstructure or Decking: This includes slab, girder, truss, etc. This bears the load passing over it and transmits the forces due to by the same to the substructures.

Bearings: The bearings transfer the load received from the decking on to the substructure and are provided for distribution of the load evenly over the substructure material which does not have sufficient bearing strength to resist the superstructure load directly.

Substructure: This consists piers and abutments, wing walls or returns and their foundation.

Piers and Abutments: These are vertical structures supporting deck/bearing provided for imparting the load down to the bed/earth through foundation.

Wing walls and Returns: These are provided as enlargement of the abutments to retain the earth of approach bank which otherwise has a natural angle of repose.

Foundation: This is provided to transmit the load from the piers or abutments and wings or returns to and evenly distribute the load on to the strata. This is to be provided sufficiently deep so that it is not affected by the scour caused by the flow in the river and does not get undermined. safety hand rails or parapets, guard rails or curbs are structurally operational parts which are provided over the decking in order.

2.1 Study Area

Construction of high-level viaduct over the Bondivagu drain. As it crosses the way of hanamkonda to Warangal. The distance from hanamkonda to Warangal is 4km approximately and this drain bondivagu is located at a distance of 2.5km from hanamkonda and 1.5km from Warangal. Through this bridge the bypass road of hanamkonda to khammam passes. Before the construction of this high-level bridge on drain bondivagu there was a road dam or a low-level cause way over that drain which was sufficient for those days traffic and drain water discharge.

But now-a-days as the discharge and traffic both are increased on that road so there was a necessity to construct a high-level bridge over that drain. When there was a road dam or a low-level cause way the flood water discharge was so problematic in rainy seasons and traffic was facing many problems due to that. Before the deck slab width of that road dam was also small which was inconvenient to the traffic flow at peak moments.

3. Study Area Description

At the site of proposed construction are obtained for Site investigation or soil. Generally, soil exploration is used for finding the profile of natural soil deposit at the construction site and obtaining the soil samples and finding its engineering properties which are important in in-situ testing of soils. Soil is used: in the construction of dams, pavements, buildings etc., for carrying the super structure whenever the load is applied on it. The function of a foundation is to bear the load which causes excess stress with in the soil with a great depth beneath the foundation. These stresses are considered excessive whenever there is excessive settlement which occurs because of complete rupture (shear failure) or causes determinantal settlements which guides to the failure reason is of the excessive settlements.

Hence, we need to check the underground conditions of the soil in detail as they effect the design of the structure. The details of investigations from the field and laboratory are to be checked.to obtain necessary information regarding hydrological, geological, and the geotechnical properties of the soil.

The conditions of the soil are also considered whenever the structural loads, water and temperature effects are considered in the design. Also, the sub surface investigations are being carried out for finding the geotechnical properties of the soil. The soil type at the site bondivagu was found to be black soil so they laid a raft foundation and made the site suitable for the construction of bridge over that soil. The main function of that bridge was to drain of the drainage water in normal conditions and to drain of the rain water at the time of rains.as it contained black soil they have decided to lay a raft foundation and decided that the site is suitable for the construction of bridge.



Fig.1. Black soil

4. Methodology

As per the approved design the bridge consists of 5 number of vents each of length 8meters.the total length of the bridge deck slab is 42.70m from back to back of the backing wall. The length of the approaches is 100m to left and 100 m to right side of the bridge. Therefore, the length of the bridge in total including the

approaches is approximately 250m. The work at the site starts with the earth excavation for the foundation.

Then the surface is leveled using plain cement concrete in the ratio of 1:3:6. Then the raft is laid for a depth of .75m.they have used VRCC (vibrator reinforced cement concrete) and M20 grade mix in the raft. The raft reinforcement details in the foundation are: They reduced level of this foundation is +83.150 to +83.900 the depth of this foundation is .75m.they have used 16mm diameter bars at spacing of 170mm center to center in longitudinal direction and 12mm diameter bars at spacing of 200mm center to center in transverse direction. They have used VRCC M20 grade concrete. The Abutment reduced level is +83.900 to +88.330 the height of the abutment is 4.430m.the width of abutment at foundation is 2.8m and at sill level is 1.8 m and width at the deck slab level is .72m.

In abutments 8mm diameter rods have been used at spacing of 170mm center to center in both ways and at inclined surface of abutments 8mm diameter bars has used at 200mm center to center spacing in both the ways. VCC M20 grade concrete for construction of abutment has used. In footings the reduced level of the first footing is +83.900to +84.400 the depth of first footing is .5m and the width of it is 3m.the reduced level of second footing is +84.400 to +84.900 the depth of second footing is .5m and the width of the footing is 2m.

In footing 8mm diameter bars at 120mm center to center spacing in both ways, VCC M15 grade concrete has been used. The reduced level of pier is +84.900 to +88.330 the height of each pier is 3.430m. In piers 8mm diameter bars are used at spacing of 170mm center to center on both ways the bed block details are: 12mm diameter stirrups at 160mm center to center spacing 10mm diameter bars are used at 180mm center to enter spacing on both faces. 6 number of 12mm diameter bars at top and bottom equally spaced.in abutment bed blocks and VRCC M 20 grade concrete has been used. In pier bed block the dimensions of it are 1100mmx300mm and they used 10mm diameter bars at 120mm center to center spacing in lateral direction. In longitudinal direction 8 number of 12mm diameter bars at top and bottom equally spaced. VRCC M20 grade concrete for bed blocks over piers have been used. The reduced level of pier cap which transmit the load from the deck slab to the pier is +88.330 to +88.630 the height of it .3m. Therefore, the total height of the bridge from footing to the deck slab level is 4.73m. The reduced level of the deck slab is +88.630to +89.380 the height of this is .75m.the deck slab is again coated with a wearing coat to increase the life time of the bridge and does not allow to damage the deck slab directly. The wearing coat is generally given 3inches on the deck slab. VRCC M30 grade of concrete has been used for wearing coat. The total length of the deck slab is 42.70m back to back of backing wall. The width if it is 20.7m over the deck slab. This bridge is a two-lane road where width of each lane is 10.035m including the divider and the footpath. The width of the divider is .6m and the footpath is 2.25m therefore the width of the road is 7.5m.the thickness of the deck slab at the center is .75m and it decreases to .6m at the end to the single lane road this is called as camber which helps to flow of water from the road surface without stagnating on the road.

The width of hand rail is .5m which helps the pedestrians to walk without falling. The height of the wing wall is 5.75m and the width of it is also 5m.the reduced level is +83.600 to +89.350.at the ground level a lean mix is given up to 100mm for the surface to be level. The width of the wing wall is 4m at ground level and then it decreases to 3m and then to 2m at a reduced level of +85.300.in wing wall the reinforcement is they have used 8mm diameter bars at spacing of 200 mm center to center in both ways at base of the wing wall.at the side reinforcement 8mm diameter bars are used at spacing of 170mm center to center and VCCM15 grade concrete for construction of wing wall.

Approach slab is that where the vehicle enters to the bridge. The length of this is 3.5m. VRCC M30 grade concrete in the construction of the approach slab. The total width of the bridge at the piers

is 21.7m but as piers have cutoff walls at its ends which are semi-circular in shape then the leftover length of 1m is lost including both the sides.in cut off walls VCC M15 concrete mix for construction of cut off walls.

constructed weep holes in the abutment, wing wall, and on the surface of the road to let out water from the bridge. The maximum flood level of this bridge is at reduced level of +87.580 i.e. at a height of 3.68m from the foundation. The weep holes in the abutment are kept inclined at some angle generally up to 45degrees so that the water from outside do not enter into the bridge. The bridge is of 42.70m and it has four piers and two abutments. The bridge has 5 spans each span of length 8m.as it has four piers the number of vents through which water flow are 5 in umber each vent of length 8m with footpaths. The retaining wall is made zero at 100m from the abutment of the bridge.so to attain that height the retaining walls are earth filled on both sides.

The temporary bench mark on an electrical pole which is near to it has taken. They have used jcb for excavation of the earth.

5 Observations

It was observed that the piers and abutments were constructed over a raft foundation due to weak soil zone. Both abutments including the wing walls and return walls were completed and 4piers were completed up to deck slab level.

While visiting this project the 3deck slabs were completed at the beginning i.e. D1, D2, D3 were already laid. Remaining deck slabs i.e. D3, D4, D5 were seen by us. This bridge is laid across a 4-lane road dually provided with a joint in between the two decks slabs. It was observed that the vibrators were used in construction of this project. A part of construction of wing wall and return wall was seen by us. The construction of retaining wall to left approach of 100 m is completed. Staggered weep holes of 100mm diameter spaced at 1-1.5 were provided to abutments wing walls and retaining walls. ready mix concrete has been used for deck slabs, wing walls, abutments, return walls, approaches and etc. Almost total project is done using the ready-mix concrete. visited the ready-mix plant and done the test for compression test and found that the strength of the cube for 28 days was found to be 689kN for 300mmX300mm cube. Approaches and other miscellaneous works are under progress. The total cost of the project was approved for Rs450 lakhs by Roads and Buildings Department.



Fig.2. Wingwall



Fig.3. Abutment

6. Results

The reduced level of the foundation is +83.150 to +83.900 the depth of this foundation is 0.75m , 16mm diameter bars at spacing of 170mm center to center in longitudinal direction and 12mm diameter bars at spacing of 200mm center to center in transverse direction. VRCC M20 grade concrete. The Abutment reduced level is +83.900 to +88.330 the height of the abutment is 4.430m.the width of abutment at foundation is 2.8m and at sill level is 1.8 m and width at the deck slab level is .72m. In abutments they have used 8mm diameter rods at spacing of 170mm center to center in both ways and at inclined surface of abutments they have used 8mm diameter bars at 200mm center to center

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Weep Holes:



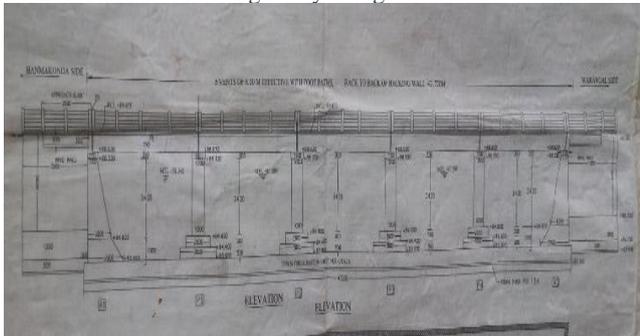
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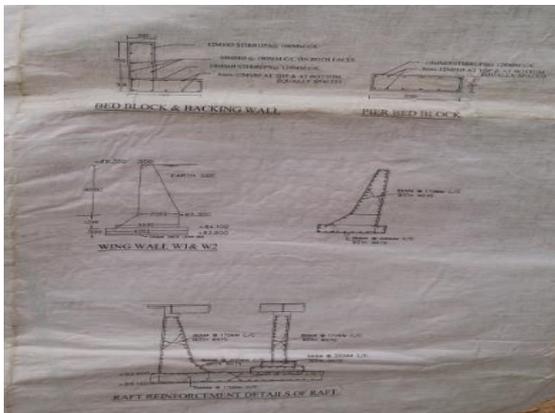
earth. The concrete mix plant which is situated near to ursigutta was visited. in that plant there were different materials that are to be summed to prepare concrete. They are spitted off into sections and the mixer takes in the required proportions of material quantity and then mixes it and loads it in the trucks. From each load of concrete mix, a cube is prepared, and it is cured for 28 days and its strength is known by placing cube in load testing machine. The results that obtained from these backgrounds was useful to create an efficient and accurate procedure for the design of each individual system which was later compared. The comparison for each independent system was done and the comparative analysis was carried out. The results that we obtained gives a valuable information regarding project but it's not entirely conclusive. In this work, the independent results of the systems and invited them for the final recommendation. As given before our results regarding three designs were estimated based on the initial and life cycle cost. The retaining wall and to make the retaining wall zero was also done.

Data Design at Project:

Sectional Elevation of High Way Bridge



Bed Block, Backing Wall, Pier Bed Wall & Wingwall



7. Conclusions

The overall purpose of this report was to compare three different bridge designs on the posit of constructability moreover initial and life-cycle cost. An extensive background was developed for each bridge component moreover the life-cycle planning can provide would be materially less than the second economically beneficial system. Last, constructability was maintenance, replacement and ultimately overall life-cycle costs.

As a result, the initial investment to benefit from the savings examined. However, this analysis did not conclude the precast girder design to be the most efficient in response with the construction despite the growing consensus within the infrastructure world. Though Hunter's Weighted Evaluation Approach was applied, we feel there was still not enough weight put on the "onsite assembly" variable, which favored precast girder construction. Despite this

anomaly, the precast girder system is undoubtedly our recommendation with respect to the preceding comparative measures.

In addition to the results of our study now-a -days precast girder bridges are used commonly in the infrastructure industry. Usability of precast concrete materials is being fabricated on site which can allow the construction more rapidly. This rapid construction process allows for less labor and ultimately reduces the overall initial cost. With this it's simple to understand the growing partiality towards precast bridges. Above the top with immediate fiscal related advantages the precast system offers comes minimal user costs. Minimum maintenance and high-speed construction practices reduce user related costs associated with traffic flow inefficiencies. The evaluation techniques to fully understand the implications projects such as this can have on infrastructure management practices. By applying the techniques with this report to numerous sets of differing initial conditions (i.e. span length, loading, number of lanes, etc.) will allow governing agencies to properly identify the most advantageous design with constructability, initial and life-cycle cost while continuing to consider user related costs. Last, in applying the results of this report it also has the crucial impact of the location with regards to funding policies, maintenance practices and construction

8. References:

- [1] Daniels, David. The Golden Age of Contract Bridge. New York: Stein and Day.
- [2] Clay, John. Culbertson: The Man Who Made Contract Bridge. London: Weidenfeld and Nicolson.
- [3] 3.Mahmood, Zia. Bridge My Way. London: Faber.
- [4] 4.Hamman, Bob; Manley, Brent. At the Table: My Life and Times. Memphis.
- [5] 5. Clay, John. Tales. London: Hodder & Stoughton.
- [6] 6.Advanced Bridge: Granovetters. Forgive Me, Partner.
- [7] 7. Lederman, Julian. A Bridge to Inspired Declarer Play. Master Point Press (Toronto).

