Evaluation of Various Technology Solutions to Address Riverside Construction Problems

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Abstract - Modern technology introduces a variety of bridges to help with the challenge of crossing rivers. A bridge is a building designed to cross a physical barrier (such a body of water, valley, road, or rail) without obstructing the path below. It is designed to allow passage over the obstruction, which is typically something that would be difficult or impossible to cross otherwise. Construction of Bridges main challenge is how to construction the foundation in to the river. The objective of current research is to use a variety of technology to research and analyze the river flow at the tidal influence. Various management strategies are proposed to overcome difficulties in building bridges across rivers

Keywords - Bridge, river side construction

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1. INTRODUCTION

Construction of bridges is made more difficult by river location. Climate, geological potential, and hydrological characteristics vary greatly within a constrained River region. For a safe, economical, and successful finishing touch to the bridge building, the bridge form and manufacturing technique must be carefully chosen while bearing in mind the bridge site and numerous constraints. There are a number of difficult circumstances that arise while building bridges near rivers, including

1. Building a bridge over a river.
2. Building a bridge over a lengthy river.
3. Building bridges in regions with severe temperatures.
4. Building bridges over steep highway and railway turns.
5. Building bridges over areas with significant tidal effects.

Obstructions & challenges created by the river:

- ✓ A flood of unwanted water; an increase in the high tide level. [H.T.L]
- ✓ lowering the Low Water Level (L.W.L.)
- ✓ Different levels of scouring.
- ✓ High fluctuation tide range is influenced by the full and half-moons.
- ✓ A few Barrages or Dams Discharge Water.
- ✓ Challenges in creating a suitable workspace.
- ✓ Accessibility issues for machinery and equipment.
- ✓ Preferable working conditions and plans for inclement weather.

2. LITERATURE REVIEW

Bunn et. al. [1] By taking into account nonlinearity in the pier and well. Three alternative embedding lengths are subjected to two longitudinal seismic motions while accounting for interface and structure nonlinearity. The separation between the soil and the well is represented using the compression alone gap element method. The investigation was conducted in two parts, with the first step obtaining the motion at the base of the finite element for the provided time history analysis and.

Pascual et. al. [2] studied -supported bridge piers that were encircled by uniform soil. The superstructure is modelled using two degrees of freedom, while the pier is represented as a beam because the concentrated load was placed on the pier head. The suggested model includes dashpots that are shook by the free field displacement profile as well as translational and rotational springs. According to the analysis, the slenderness ratio determines how long a system will operate for. The suggested approach is trustworthy.

Muller et. al. [3] Create a model to illustrate the concept of soil-well interaction using the. The analysis's findings indicate that the interaction between the soil and the well increases the reaction of a fixed base, and that this reaction of a rigid foundation increases as soil stiffness decreases.

Newborne et. al. [4] Performed an experiment to test the impact of foundation rocking on the seismic response of a thin bridge pier. This experiment used monotonic and slow cyclic loading. To address this, three potential foundation sizes—large, medium, and small—with respective FOS values of 1.07, 0.55, and 0.43 were taken into account. Conclusion: The structure is protected by the rocking base, which resists seismic shaking.

Hall et. al. [5] There is a strong demand on project management to use cutting-edge approaches for a more thorough assessment of performance data under uncertain conditions due to the inherent complexity and iterative nature of bridge construction projects. The implementation of simulation-based modelling is subpar in the construction industry, particularly in the construction of bridges, despite the fact that new technologically based approaches like simulation have shown to be effective techniques to deal with cyclic and uncertain project behaviors. The significance of modern modelling approaches in the realm of building is discussed in this essay. The research, which is a part of a larger investigation into the possibilities of simulation-based scheduling and management strategies for New Zealand construction projects, takes into account the repetitive, uncertain, and complicated nature of these projects.

Speed et. al. [6] Since ancient times, a bridge has been required to traverse rivers, valleys, hills, and other barriers. Perhaps a tree that had fallen across these barriers served as the first bridge. Numerous new bridge types, such as "Steel and RCC bridges," were developed as civil engineering advanced. A bridge today represents national progress for any country. This review covers the need for bridges, their various types, their history both globally and in India, and a classification of them based on the materials they are composed of. A bridge is a structure that permits transportation to pass over an impediment without obstructing the road below. The required route may be for a pipeline, a canal, a road, a railway, or even for people.

3. PROBLEM IDENTIFICATION AND OBJECTIVES

Modern technology introduces a variety of bridges to help with the challenge of crossing rivers. A bridge is a building designed to cross a physical barrier (such a body of water, valley, road, or rail) without obstructing the path below. It is designed to allow passage over the obstruction, which is typically something that would be difficult or impossible to cross otherwise. Construction of Bridges main challenge is how to construction the foundation in to the river. The objective of current research is to use a variety of technology to research and analyses the river flow at the tidal influence.

1. Time, cost, and machinery management, as well as proper planning and monitoring of all activities.
2. Management of Safety [Zero Harm Policy].
3. Maximum resource productivity.

4. STUDY AREA

The Narmada River is the fifth-longest river in India and the longest west-flowing river overall. It is sometimes referred to as the Reva and was originally known as the Narbada or Nerbudda in English. It is also the largest flowing river in the state of Madhya Pradesh. Gujarat and Madhya Pradesh, two Indian states, are cut through by this river. It is sometimes referred to as the "Life Line of Madhya Pradesh and Gujarat" because of its huge contribution to the two states in different ways. The Narmada River rises in the Amarkantak Plateau in the Madhya Pradesh district of Anuppur. It divides North India from South India historically across a distance of 1,312 km (815.2 mi), before flowing through the Gulf of Khambhat into the Arabian Sea. It is one of only two large rivers in peninsular India that flows from west to east (longest west flowing river), the other being the Tapti River. One of India's rivers runs through a valley that is separated from one another by the Satpura and Vindhya Mountain ranges. The Narmada is a rift valley river, but estuaries rather than deltas are what rift valley rivers produce. Two more rivers that flow through the rift valley are the Tapti and the Damodar River in the Chota Nagpur Plateau. Although they are between different mountain ranges, the Mahi River and the Tapti River both cross rift valleys. It travels through the states of Gujrat (very close to the Madhya Pradesh–Gujarat border), Maharashtra (74 km [46.0 mi]), and Madhya Pradesh (1,077 km [669.2 mi]).

- ✓ The Narmada River bridge site is located in Dahej, about 22 KM from the sea.
- ✓ During high and low tides, there is significant turbulence in the water.
- ✓ Water moves at an average speed of 6 m/sec.
- ✓ The summertime minimum water level is RL+ 1.535m.
- ✓ Except during the monsoon, the maximum level of water is RL+ 5.5m to +5.8m.
- ✓ The water's depth ranges from 6.6 to 10 meters.
- ✓ The full moon and no moon had a strong tidal influence that lasted for five days.

5. WELL COMPONENTS

5.1 Components of Well

In Well Foundation there are mainly three parts of the structure which is mention below:

1. Cutting edge.
2. Well Curb.
3. Well, Steining/Side Wall.
4. Bottom Plug.
5. Sand Filling
6. Intermediate/Middle Plug.
7. Top Plug.
8. Well Cap.

Cutting edge

In practise, a slope of I horizontal to 2 verticals or a 30° angle to the vertical have both been found to be suitable. Steel plates measuring 12 mm are wrapped around the lowest part of the cutting edge in concrete caissons, and they are fastened to the concrete by steel straps.Usually, the exterior face of the caisson has a sharp vertical edge. When pneumatic caissons are used, this edge speeds up sinking and prevents air leaks.

5.2 Steps of cutting-edge fabrication & Fetchers

- ✓ Welded 2 angle (150X150X10) to be rolled in desired radius.
- ✓ The main plate (16mm) is to weld with the rolled angle with plug welding.
- ✓ The stiffeners are to weld with the rolled angles to strengthen the cutting edge.
- ✓ The weld thickness of stiffeners to plate is 6mm. and 8mm between plate and angles.
- ✓ To confirm the adequacy of weldment, weld gage to be used to confirm the weld thickness and DPT test.
- ✓ DPT means Dye Penetration Test which shows the crack in welding's.
- ✓ If crack found, remove the weld and re-weld it. Check the DPT again.
- ✓ Provided at the bottom of well curb & Cut soil during sinking.

5.3 Well Curb

In other words, when only a portion of the cutting edge is in touch with the soil and the remaining portion is held only by skin friction, the well curb is made to sustain the weight of the well with only a little support at the bottom of the cutting edge. For the sake of design, it is plausible to assume a three-point support for the cutting edge that is perched on a log. The load transferred to the cutting edge is unclear since a significant portion of the weight is carried via skin friction. Because the entire well functions as a deep girder to endure twisting and bending, the precise depth of the well curb is somewhat ambiguous. Working stress levels up to 99% of yield stress may be allowed because the load is intermittent. The well curb must be able to bear pressure from sand blows and any necessary mild blasting when a rock prevents the well from sinking.

5.4 Steps of Well Curb & Fetchers

- ✓ Start the welding of bond reinforcement.
- ✓ It's a metal arc welding and dia of electrodes should not be more than 3.15mm to avoid the melting of rods. Reinforcement shall be weld on either side.
- ✓ Internal shutter erection to be start parallel.
- ✓ Check the position of internal shutter after fixing because it affects the diameter of well and other parameters.
- ✓ Check the reinforcement as per drawing and BBS.
- ✓ Shape offering minimum resistance during sinking
- ✓ Transit super-imposed loads from steining to the bottom plug
- ✓ The bottom ends of vertical bond rods to be fixed securely to the cutting edge with check nuts or weld.

5.5 Well Steining/Side Wall

The thickness of the steining is designed such that the well can be dug under its own weight at all stages because the requirement for kentledge weighing takes time and considerably slows down progress. For a circular well with an outside diameter of D and a thickness of I of the steining, the results are self-weight per unit height = (D - t) t and skin friction forces per unit weight = D r. Where is equal to the unit weight of the concrete or brickwork utilised in the steining Unit. r = Skin Friction

The result of equating the two is (D - t) t = D r.

From this equation, it can be shown that the steining thickness decreases with increasing well diameter for a fixed magnitude of skin friction.

Table 1: Dia vs Steining Thickness of Well

D (Outside Dia of the Wall)	T (Steining thickness)
3.00 m	0.750m
5.00 m	1.200m
7.0m	2.000m

5.6 Steps Well Steining & Fetchers

- ✓ Transfers full load to the well curb
- ✓ In several lifts; each lift not more than 2.0 mtr in 1st lift
- ✓ Laps not to be kept at the construction joints.
- ✓ Laitance formed at the top surface of concrete shall be removed and coarse aggregate shall be exposed before concrete gets set

In that case, skin friction is one of the elements that needs to be decreased for the side wall. The skin friction at a given depth is determined by multiplying the friction coefficient by the lateral earth pressure. With depth, the unit skin friction rises. Furthermore, it is impossible to calculate its value precisely. The value may be utilised for design purposes:

Table 2: Soil vs Skin Friction of Well

Skin Friction (t/m2)	Type of the Soil
0.73 – 2.930	Silt and Soft Clay
4.9 – 19.50	Very Stiff Clay
1.220 – 3.420	Loose Sand
3.420 – 6.840	Dense Sand
04.9 – 9.40	Dense Gravel

More skin friction necessitates more sinking efforts, which slows the well's descent. Therefore, techniques should be employed to lessen skin friction as the well is being sunk. Since the frictional resistance depends on the roughness of the surface of contact, skin friction will be significantly reduced by a smoothly plastered, well-steining surface that is on the right plane and free of kinks or warps.The flared wellness also lessens skin friction. The San Francisco Oakland Bay Bridge's skin friction was minimised by utilising a coating that provided a slippery, oily surface and was durable enough to remain on the caissons' walls during sinking. This, according to calculations, reduced friction between the concrete and the rather solid clay by 40%.

5.7 Bottom Plug

The concrete bottom plug must be built to support an upward force equal to the soil pressure (including pore pressure) less the weight of the bottom plug and filling. The bottom plug is fashioned like a bowl to provide an inverted arch effect. No reinforcing is possible because the bottom plug must typically be concretized underwater.

The bottom plug is typically made of a thick plate that is placed under pressure to support

$$t^2 = \frac{3W}{8\pi f_c}(3+\mu) = 1.18\,R\frac{q}{f_c} \quad \text{(For circular wells)}$$

$$t^2 = \frac{3qb^2}{4f_c(1+1.61\,\alpha)} \qquad \text{(For rectangular wells)}$$

Were,

t = The steel or concrete plug's thickness

W is the total bearing pressure on the well's base.

C is the concrete seal's flexural strength.

Concrete has a Poisson's ratio of 0.15.

R is the well base's radius.

Q equals the unit bearing pressure on the well's base

b = Width or the short side of the well = Width / length, or, the short side / long side of the well.

5.8 Sand Filling

When the well is filled with sand, the bottom will be stable and won't experience tensile pressures.

5.9 Intermediate/Middle Plug

It is not advisable to entirely fill the well with sand if it is resting on clayey strata. In such circumstances, a sand filling is either not performed or only completed to the scour level.

5.10 Top Plug

The top plug is offered after the filling is finished. The top plug aids in transferring to the steining the weight of the pier and superstructure. Unreinforced concrete serves as the top plug, which normally has a thickness of around 600 mm beneath the well cap to transfer weights from the pier to the steining. For the top plug, concrete with a minimum grade of M15 must be utilised.

5.11 Well Cap

It is intended to shift a pier's weight to the well. It is made up of a slab that resists the well. Due to the differences in their shapes, the well cap acts as an intermediary layer between the well pier and cap. The well cap at the pier's base provides a minimal all-around offset. To transfer the loads and moments from the pier to the well or wells below, an RCC slab is constructed at the top of the well steining. The well cap is the same shape as the well and has a potential 150 mm overhang all around to accommodate long piers. It's designed to be a two-way slab with some of the supports set in place. In rivers with seasonal flow, the well cap is often kept at bed level or, in rivers with perennial flow, at roughly low water. The typical range for well cap thickness is 1500 to 2000 mm.

6. CONCLUSION

The quick release of water from the extra basin to the shortage basin is essential to the project's successful operation. The Indian government assembled a task team of experts in science, engineering, economics, and social sciences to investigate the proposal. A delegate from a state with a water shortage and a representation from a state with an abundance of water were both placed on the task force as formal stakeholders. It will deal with the following major issues: leading standards for evaluating the economic viability, socioeconomic effects, environmental effects, and preparation of resettlement plans for individual projects; developing a mechanism for quick consensus among states; prioritizing different projects; proposing executive structures for the project's implementation; and thinking about financial support modalities for the project. The manager should be familiar with the order of all the activities. Both the contractor and the customer must make decisions quickly and under strict time constraints in order to avoid project delays and cost overruns. Reviewing and monitoring as a type of control has the catalyzing impact to accelerate progress. Although building bridges in rivers presents a number of difficulties and obstacles, we also employ a number of cutting-edge management strategies to effectively manage our time and sustain productivity levels that meet our objectives. To ensure that all of the operations go off without a hitch, we can implement and build some temporary structures. As a result, the problem and the precise answer for the problem may alter as a result of nature, but we must still take steps to reduce the problem as much as we can.

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