

Bridge Construction: Challenges Faced in Hilly Areas

Ghanishth Agrawal¹ and Tatsam Pandey²

¹Architecture Student Dept. of Arch. and Planning, MANIT Bhopal - 462051, India

²Civil Engineering Student Dept. of Civil Engineering Sushila Devi Bansal
College of Engineering Indore - 452001, India

E-mail: 1ghanisht.agrawal@gmail.com, 2pandeytatsam18@gmail.com

Abstract—India, a country with a total area of approx. 3.2 million sq. km. has around 23 % of its area covered with densely forested, thinly populated hills. Human habitation and Vegetation spreads to altitudes as high as 14000 to 16000 feet above Mean Sea Level. In order to exploit enormous potential of hilly areas like mineral deposit, scenic beauty, valuable medicinal herb, forest resources, bracing climate & hydel power for its renewable & non-polluting nature a new network of road is essential. Road network in hilly areas comprise bridges as an integral part of them, though hilly region pose unique problems for bridge construction. In a restricted hilly area itself geological features, climatic conditions and hydrological parameters vary considerably. Various challenges that come across while constructing bridges in hilly areas are dealing with deep gorges, extremely low temperature conditions, rivers with bouldary beds, high winds, landslides etc. and these require special attention to complete the exercise of bridge planning and construction. This paper aims on discussing every issue faced, starting from the idea of constructing a bridge until its completion.

1. INTRODUCTION

Hills, the most adorable scenic beauty with bracing climate, generally covered with the lush green forest which are full of medicinal herbs. But the mountains are only scenic beauty, constructing structures at hills is not an easy task. They are dangerous, as the hilly regions have mostly unfavorable climatic conditions at high altitudes as well as they do not provide stable ground as working site. To develop such a region which is thinly polluted and densely forested a good network of roads is essential. A mountainous area has a large number of obstacles for road construction like valleys, gorges, rivers, etc. to overcome these obstacles we design bridges to maintain the road alignment by keeping an eye on the environmental hazards by the construction. Society has now become aware of the environmental consequences resulting from road construction in hill areas so we prefer environment friendly construction.

In this paper, efforts have been made to focus on the construction challenges which are faced by the engineers while constructing heavy structures like bridges in hilly

regions. We have focused on both the technical as well as non-technical challenges of construction.

Construction in hilly region shows up with unique problems for bridge construction. In a hilly area, climatic conditions, geological features and hydrological parameters vary considerably which Makes the construction conditions unfavorable. Type of bridge and method of construction should be selected very carefully for safety as well as it should be economical and successful completion of bridge can be determined.

Various challenges and constraints that come across while constructing bridges in hilly region are as follows:

- Construction of bridge across deep gorges.
- Construction of bridge on rivers.
- Construction of bridges in extreme temperature zones.
- Construction of bridges on sharp turn on highway.
- Construction of bridges at great altitude.
- Landslide or Debris flow.

Deep gorges, rivers, extremely low temperature condition, high winds, high altitude, landslide etc. in hilly regions all these needs special attention to complete the activities of bridge planning and construction in a systematic way and are discussed here in.

2. BRIDGE CONSTRUCTION: SYNOPSIS

Planning and monitoring are fundamentally what is to be through in due course of time, and how it is to be executed in the planned period for the bridge. All the pros and cons of the likely problems in the awaited period need to be investigated. Also the records of decisive points are made neutral at site with executives as follows:

- Why this specific site was selected for the bridge?
- Why particular type of bridge is proposed?

- Site analysis and data.
- Draft of drawings.
- Soil strata and reports.
- Salient features of the bridge and quantities of each items involved.
- Upto date sanctioned geomorphologic drawings.

3. BRIDGE FOUNDATION AND SUBSTRUCTURE

Foundation building for any massive bridge takes time. Problems encountered while building of base count upon type of foundation, soil strata encountered, and equipment/plant deployed and logistical problems. Foundation can be of open foundation, pile foundation, well base or any other early types of foundation. In case of well foundation, the assorted type of soil are encountered and it becomes difficult to give any clear time schedule about the sinking of wells unless the soil details are clear and the awaited profile matched with the existent encountered. In case of rocky and argillaceous soil the rate of sinking schedule is likely to be slow as compared with the flaxen soil. Review of soil parameter if needed be given more attending and wheresoever needed the details whitethorn be referred to material examination laboratory merely inside the time schedule. This whitethorn be helpful to urge alteration in base level, wheresoever possible based on soil information report. Though strata in the base stage should be considered as technology friendly.

4. SUPERSTRUCTURE

For a particular bridge site there are number of super structural arrangements are possible. Final proposal should be based on the proper examination of the site conditions, that whether it is technically sound to work, aesthetics of structure and construction methodology to be adopted and the economy of project. Special care is needed in case of the deep gorges, where there is an appreciable difference between the deck level and bed level. This may raise difficulties for staging and shuttering. After the finalization of proposal for particular bridge, the construction can be planned as follows:

- According to the time limit.
- According to the climatic changes which occurs in the particular region.
- According to the working conditions in the extreme temperature conditions.
- According to the availability of resources.
- Estimation of quantities of each material, involved the prior calculations.
- Execution methods also be decided as per the requirement.

Basically planning for construction results into the smooth progress of project and decreases the possibilities of delay.

5. MANAGEMENT OF CONSTRUCTION ACTIVITIES

Management of the bridge construction expects that all the resources are used in such a way that the project is completed without any loss i.e. within the time limit and given budget. The Output of the work depends upon how the activities are managed at the site by manager and site engineers. It may vary from site to site as it depends on many factors. On the basis of experience, various aspects are identified for efficient construction management:

- Schedule of construction should be prepared along with major milestone and Bar Charts.
- Latest management techniques and software tools can be used for this.
- Design of Bridge is a post sanction in case of departmental construction. It has to be ensured that the project should be completed in time and in given budget also.
- Revised design of structure, if any should be updated, clarified and discussed with workers without delay. This is an important task in case of foundation, where the design may be affected by the soil parameters and which needs to be solved.
- It is mandatory that the work should progress according to the design only.

6. EQUIPMENTS

Requirement of equipments be assessed methodically and accordingly actions may be taken to arrange them for a particular construction jobs.

- Quality and quantity of work covering all the items precisely
- Time available for work to be executed
- Details of equipment and also minimum requirement as per the job.
- Capacity of equipments to be used.
- Estimated capacity of equipment.
- Itinerary of maintenance
- Stockpile of spare parts required.
- Repair cover to equipments.

The outline should assure minimum movement of materials, equipment and particular of the area is an essential condition, for some equipments like caterpillars, cranes etc. It is not possible to perform at heavy winds speed. Stone crusher plant if required for site should be suitably located to minimize transportation of material. Supporting facilities such as generator, office, stores should not be situated in the path of flow i.e. construction. The service roads should be properly

maintained. When number of equipments are in used proper records of dispatch, maintenance of equipment should kept precisely in format to keep the details of its utilization at site. If required necessary action should be taken to utilize all the equipments efficiently to achieve the goal. The required facilities for repair of machinery must be established near the site to meet requirements.

7. MATERIAL

Management of materials is an essential activity along with start of the Project. It runs correspondent to project work as unavailability of material will affects the progress of work.

This cover procurement of camp material, office equipment, major purchased items, such as aggregates, sand, cement, steel, structural steel, shuttering consumables, electrical fittings etc.

Estimation of quantities of materials and cost of various items should be done on monthly basis to avoid the runoff of material at site.

8. FINANCE

No project can be completed without considering the financial boundations. The manager should get his budget fixed on monthly basis or on the basis of work done at site, as guided by higher authorities. Key to measure financial planning is to take appropriate decisions at the right moment of time so that total cost of construction should not be affected and progress of work will be maintained.

9. QUALITY

Quality of work is most important activity at a site, structure failure is not only be the loss of capital it may leads to the loss of lives also. A manager should always work to improve the same. Proper training and guidance to staff should be provided to update the quality control measure and proper supervision will also be there. It should become the part of the work practice. At site material testing laboratory should be established to check the quality of components of concrete.

Work should be done on the design basis i.e. the proportions in concrete mix should be precise, if the construction scale is large one should provide a concrete mix plant to attain require quality.

Mix design should be prepared on the basis of latest code to produce the concrete of desirable strength and it should consider the mixing of admixtures. Compaction of concrete should be given more attention before final setting to improve the quality. Latest guidelines issued by the local authorities should also be followed for systematic quality control. Quality assurance in work improve the aesthetic of structures.

10. SAFETY

Safety of employees and labors at site should be taken very seriously. All the workers at site should be given detailed briefing about the safety requirements based on the site hazards. Especially when the formwork structure is attempted on deep gorges, suitable safety arrangement should be provided to avoid accidents at site during in-situ casting of superstructure. Also in case of foundation or underground structures where the deep excavation is involved, the quality of soil beneath the ground level should be kept in view. There are many incidents where workers got buried in deep excavation due to sudden collapse of side soil walls, this should be taken care in proper supervision.

The precautions should be seriously followed to avoid any hazard at site. Safety management is also necessary in case on staging shuttering for superstructure. This needs check in before casting the superstructure. In case steel truss is being used as a staging arrangement, design and launching arrangement be precisely checked.

11. DOCUMENTATION

Management of document during the contract is not just an formality its an important thing which is to be properly handled. Systematic management of documents is an utmost requirement for the client and the construction firm. All the details should be properly examined by both the parties. Precise and systematic documentation will avoid any disputes during the currency and after completion of contract .This needs special attention of the manager on both sides. Most of the disputes occurs due to lack of understanding and communication between two parties which are further affected by improper documentation. In fact the better documentation reflect the system of management in any project. Control estimate should be prepared annually to assess the job position. This should include progress of work till date and balance work in terms of money.

12. CONCLUSION

As the time is changing, faster, durable and cost effective construction is required. In current scenario the safety is also an important aspect of construction. In the bridge construction we have to focus on both the technical restrictions which are discussed above occurs in hilly areas should be resolved as well as the non-technical issues which may cause the delay in project or may affect the cost of project should also be solved smartly as discussed in the paper. In this way civil engineers can provide efficient work with safety of workers and of their self.

REFERENCES

- [1] Dhiman RK - "Caisson Launching A- Case Study" Civil Engineering and Major Ecological Problems.
- [2] Abdullah C.H., Mohamad A., Yusof M.A.M., Gue S.S. & Mahmud M. (2007), "Development of Slope Management in Malaysia".
- [3] Tan Y. C. &Gue, S.S. (2006), "Landslide: Case Histories, Lessons Learned and Mitigation Measures", IEM/JKR Geotechnical Engineering Conference 2006, Ipoh, Perak, 6 - 7 March 2006.
- [4] Wong, H.N. & Ho, K.K.S. (2006), "Landslide risk management and slope engineering in Hong Kong." Proceedings of the State-Of-The-Practice of Geotechnical Engineering in Taiwan and Hong Kong, Hong Kong.
- [5] <http://health.massttopics.com/topic/co/construction-challenges-for-bridges-in-hilly-area.html>
- [6] <http://seminarprojects.org/t-construction-challenges-for-bridges-in-hilly-area>
- [7] <http://www.edufive.com/seminartopics/civil/CE27.html>
- [8] <http://seminarprojects.org/t-construction-challenges-for-bridges-in-hilly-area-pdf--79199>