



Naini River Bridge Strenghtening

Jean-Roch Lucas

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NAINI BRIDGE STRENGTHENING

Jean-Roch LUCAS
Freyssinet, Foreva Director

INTRODUCTION

The Naini stay cable bridge (a) over Yamuna river is located in the city of Allahabad in Uttar Pradesh, India. The bridge was built in early 2000 and it is one of the two only way to cross the river across the town.



a) Naini Bridge

The approach spans and the side spans of the stayed cable part are connected by an half-joint equipped with bearings (b).

Almost immediately after completion of bridge construction, some cracks appeared in the vicinity of the half-joint (c). A thorough investigation ordered by National Highway Authority of India lead to the conclusion that the design loads of the bearings and the half-joint between Piers P20 and P21 has been under-estimated by 20%.

Eventually, after several years of study to assess the extend of the structural issue and define possible corrective action, a solution to strengthen the half-joint and to replace the bearing was defined by the designer COWI and Freyssinet was awarded to the procurement and execution of the work with two phases:

- The reinforcement of the structure by installation of two 40-tons beams clamped with PT bars on each bridge girder
- The replacement of the bearings at the joint and at the top of the nearby pile.
- The replacement of expansion joint



b) Half-Joint P20A



c) Cracks on Half-Joint

METHOD

The main challenge of this project was to be able to deliver the 40T strengthening steel beams from underneath the bridge deck to minimize the load on the half-joint during temporary phase of the work.

During this project, Freyssinet developed an innovative floating platform carrying the steel beams to launch them directly from the bank of the river. The floating platform was then tugged on the river right below the bridge deck to allow the lifting the beams in their final position.

The platform assembly (d) has been done on the bank of the river taking advantage of the dry season between November and early June during when the low water level expose a relatively flat and wide ground area.



d) Assembly Area on Naini river Bank

WORK EXECUTION

Beam Strengthening

The challenge was to develop a launching system able to accommodate a poor ground condition (sediment) and enter into the low tide water safely where there is a break in the bank slope.

Rolling airbags has been used. They are inflated following a detailed sequence allowing to adjust the height and level of the platform during motion. The platform was retained by means of winch and tug by boat.

Once the platform was tugged under the half-joint, it was connected to 4 strand jacks fixed on the deck (e). Lifting point were positioned to ensure the strengthening beam is in its final position once reaching the deck soffit.

The platform was left in position to be used as temporary access during strengthening beam connection.



e) Lifting down of platform

The strengthening beam is connected with PT bars. In order to accommodate the tolerance of the components and bridge as-built geometry, the coring for PT bars was performed once the beam was in position.

To ensure a full contact between the strengthening beam and the deck soffit, a layer of grout was applied before the stressing of PT bars (f).



f) Upper deck beam connection

Bearings replacement

The second step of the works was the replacement of existing bearings with new Freyssinet bearings designed to take the recalculated actual loads.

A negative scaffolding platform (g) has been built to access to the bearing location and handle the old and new bearings into position.



g) negative scaffolding erection

The replacement of bearings has been performed following traditional technic of by-passing the load thanks to hydraulically linked jacks (h). This technic ensure an accurate and safe way to control the loads and displacement of the deck



h) Bearing replacement

Expansion joint replacement

The last step of the works was the replacement of existing expansion joint at P15 upstream and downstream. The installation has been staged as per Traffic restriction Plan to mitigate impact on the bridge traffic and ensure the safety of workers



h) Traffic Management

After breaking out of concrete and removal of existing Expansion joint, the new joint has been positioned and maintained in position as per designed level and slope.



i) Setup of new expansion joint

The New reinforcement arrangement was then installed as per Designer requirement. It was followed by concreting with concrete compatible with existing concrete grade and quality. After proper concrete curing the final bituminous concrete was applied.



j) Concreting

CONCLUSION

Repair and strengthening projects on existing structure are oftenly complex as many parameters are involved such as environment of the structure, consideration of the design constraints and the limitation of structure capacity during temporary stage.

To conduct successfully such project, a close partnership between the Designer (COWI) and the Contractor (Freyssinet) was necessary to tackle the numerous adaptation required during work preparation and execution to adapt to the actual site and structure condition.

Repair and strengthening projects require experienced Designer and Contractors able to develop and implement a wide combinaison of construction technics and method.

Along the years, Freyssinet has developed worldwide a high level of expertise in the rehabilitation of structures allowing to execute iconic projects as demonstrated on Naini Bridge.

ACKNOWLEDGMENTS

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