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Artikel: Rehabilitation of Yamuna Bridge at Kairana (India)
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10. Rehabilitation of Yamuna Bridge at Kairana (India)

General Details

The bridge is located at the borders of two States – Haryana and Uttar Pradesh. It was constructed in the year 1986. The portion of the bridge towards Uttar Pradesh side was affected in the year 1978 during the monsoon season.

Structural Details

The bridge is 478.8 metres long. Sub-structure comprises of twin hollow reinforced concrete cellular piers which are supported on 6.1 metre diameter, single circular masonry well foundations. Super structure is made of two cell reinforced concrete box girder of balanced cantilever type with main span of 48.8 metres, and 12.2 metre long cantilevers on either side.

The suspended spans of 24.4 metre length are supported on cantilever tips. Steel rocker bearings at one end and segmental roller bearings at the other end have been provided for the main spans as well as suspended spans.

Distress and its causes

One well foundation (well No. 3) settled as well as tilted during the unprecedented floods in the year 1978. Water level rose above the design high flood level. The river had confined its course towards one bank of the bridge, causing excessive scour around well No. 3. Waterway provided for the river was apparently excessive. Water flow was mainly confined in three spans out of total 10 spans. Moreover the water current was not at right angle to the bridge axis. This caused considerable scouring at one corner of the above well. It settled by 86 cms, and tilted by 1 in 42 in the longitudinal direction. Consequently, the top of Pier No. 3 supported on the affected well moved longitudinally by 86 cms. Single segmental roller bearings provided on Pier P3 toppled and box girder fell on collapsed bearings with an impact. Total settlement of box girder over pier was 1.34 metres, and at the lower most point of cantilever – 1.68 metres (see Fig. 1 and 2). The suspended spans supported on cantilever tips at either end of box girder also got tilted, one in downward and other one in upward direction. Rocker bearings provided at the other pier (No. 4) were not damaged or dislocated due to rotation of span. Some cracks developed in the webs of box girder as well as pier cap at the location of impact.

Remedial Measures

It was decided to restore the bridge, as similar floods were not anticipated for a long period. Boulders in steel wire crates were dumped in the form of flexible garland around the affected well No. 3 to increase its stability and reduce the chances of further scour of bed. The pier was strengthened by concrete jacketing, so that it could withstand the loading in tilted position of well and pier.

Fig. 1 Top view

Fig. 2 Position of segmental roller bearings

The well cap was also strengthened. Six numbers steel supports were erected from the well cap for lifting of the box girder. Each box girder was provided with two lifting points, one on either side of the pier. The large diameter Hydraulic Jacks of 200 tonnes capacity with safety nut arrangement were used for lifting the weight of 800 tonnes. In addition to the jacks stand-by support points were provided. Steel packing was provided over these support points continuously during lifting operation.

Before commencement of lifting operation, all the cracks were injected with epoxy resins. The sloping suspended spans were properly held with the cantilever tips to prevent any undesirable movement during lifting operation. To achieve uniform reaction at all the lifting points, all the jacks were connected to a common hydraulic circuit. The soffit of box girder was sloping. Therefore, wedge shaped steel boxes were fixed to the soffit for getting level surface at lifting points. Lifting arrangement is shown in Fig. 3. Packing boxes of different heights were planned so as to have a minimum number of them in position at any given time.

Tapered steel shims were used to cater for change in inclination of span over supports, during lifting operation. After bringing the span to the level position, the suspended spans were shifted longitudinally to their original position by use of Freyssinet flat jacks at the expansion joint positions.

The main operation of alignment of structure was completed in 12 days. While keeping the span supported, the new pier cap was concreted at the new higher level. Twin full roller bearings were provided for transfer of load of the span.

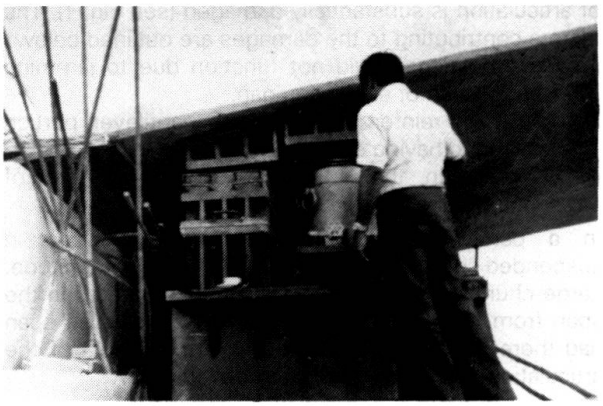

Fig. 3 Lifting arrangement

Experience gained

Excessive waterway should not be provided while planning the bridges. Proper guidebunds and other river training works shall be arranged to confine the flow of river in the desired direction.

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