Zeitschrift: IABSE congress report = Rapport du congrès AIPC = IVBH Kongressbericht

Band: 14 (1992)

Artikel: Interchange at New Yamuna bridge, New Delhi, India

Autor: Alimchandani, C.R. / Rangarajan, S.

DOI: https://doi.org/10.5169/seals-13884

Interchange at New Yamuna Bridge, New Delhi, India

Echangeur du pont sur le fleuve Jamuna à New Delhi

Kreuzung zur Neuen Jamuna Brücke bei New Delhi, Indien

C.R. ALIMCHANDANI
Chairman & Man. Dir.
STUP Consult. Ltd.
New Delhi, India

C.R. Alimchandani, born in 1935, graduated in Civil Engineering from Pune, India. After an initial stint in various construction projects, he joined STUP Consultants Limited and is presently its Chairman & Managing Director. He has been associated with the design of several outstanding structures.

S. RANGARAJAN
Princ. Consult.
STUP Consult. Ltd.
New Delhi, India

S. Rangarajan, born in 1943, obtained his Master's degree in Civil Engineering from Madras. After few years in a teaching career, he joined STUP Consultants Ltd and has been actively involved in the design of major concrete structures, prestressed concrete bridges, flyovers and highrise buildings.

SUMMARY
The recently commissioned new bridge across River Yamuna at Delhi is located at an important point, close to the Inter State Bus Terminal (ISBT), Red Fort, Rajghat and the busy old Delhi shopping area. The new bridge has eight lanes of divided carriageway to carry the large volume of commercial traffic originating and terminating at Delhi. The interchange system on the western approach to the new bridge is a complete traffic system catering to a large volume of traffic. The interchange has an overall carriageway length of 3 km, making it one of the largest flyovers in India.

RÉSUMÉ
Récemment mis en service, le pont enjambant le fleuve Jamuna à Delhi est situé à un point de circulation stratégique, entre la station d'autobus interrégionale, Red Fort, Rajghat et le centre commercial très actif de Delhi, la vieille ville. Le nouveau pont est pourvu d'une chaussée à huit voies séparées destinées à absorber une très forte densité de trafic à caractère commercial, partant et aboutissant à Delhi. L'échangeur réalisé sur l'accès ouest de ce pont est un système autoroutier complet, prévu pour drainer un énorme volume de circulation urbaine. Il comporte une longueur de chaussée développée de 3 km, devenant ainsi l'un des plus imposants passages supérieurs en Inde.

ZUSAMMENFASSUNG
Die kürzlich dem Verkehr übergebene Brücke über den Jamuna bei Delhi liegt an einem wichtigen Knotenpunkt zwischen einer Überlandbuslinie und dem betriebsamen alten Einkaufszentrum von Delhi. Die neue Brücke hat acht Spuren auf zwei Fahrbahnen zur Aufnahme des grossen Verkehrsvolumens von und nach Delhi. Die Wesen Brückenzufahrt ist ein komplettes verkehrssystem mit insgesamt 3 km Farbahnen und damit einer der grössten kreuzungsfreien Verkehrsknoten Indiens.

1. GENERAL

1.1 Layout

The interchange consists of a main flyover ABCD (Fig.1). It has an eight lane divided carriageway and passes over the Ring Road, carrying traffic to and from the Yamuna bridge. EH and MJ are two slips, on Metcalf side and ISBT side respectively, which facilitate traffic flow both ways between Ring Road and the bridge. The two slips get connected to the loops GH and LM on Metcalf House side and ISBT side respectively.

Each carriageway on Flyover ABCD has a clear width of 14.5 m with footpath of 900 mm width and common central verge of 1800 mm width. A length of 155 m at the approach on the Boulevard Road side, with a gradient of 1.30 is on earthfill retained by RCC walls. The stilted portion of the flyover has continuous prestressed concrete box girder spans of about 32 m. The main crossing over the Ring Road has a span of 48.5 m with simply supported prestressed box girder with sections of uniform depth of 2200 mm for the entire structure.

The stilted portion of slip EH has ten continuous spans of about 25 m on a circular curve of radius of about 150 m. The carriageway has a clear width of 8.1 m with footpath width 1500 m on the inner side of the curve and a kerb of 600 mm width on the outer. The superstructure is of continuous box section,

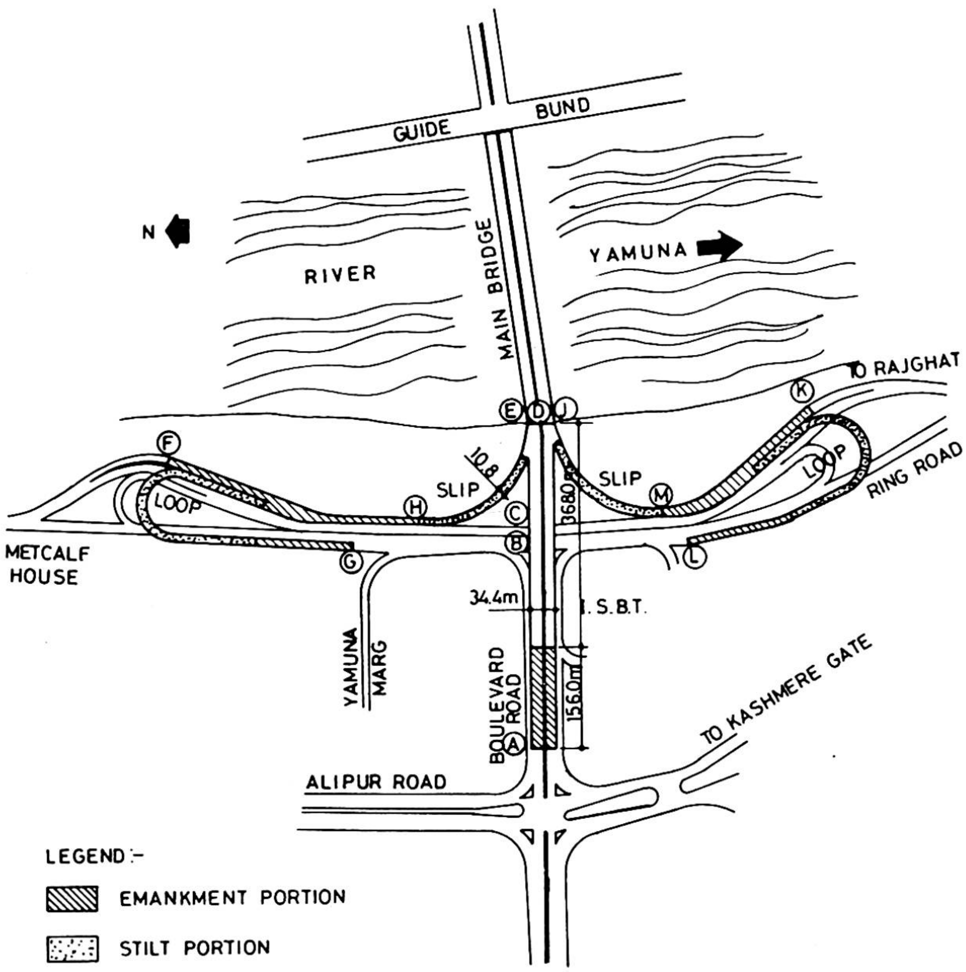

Fig. 1 General Layout

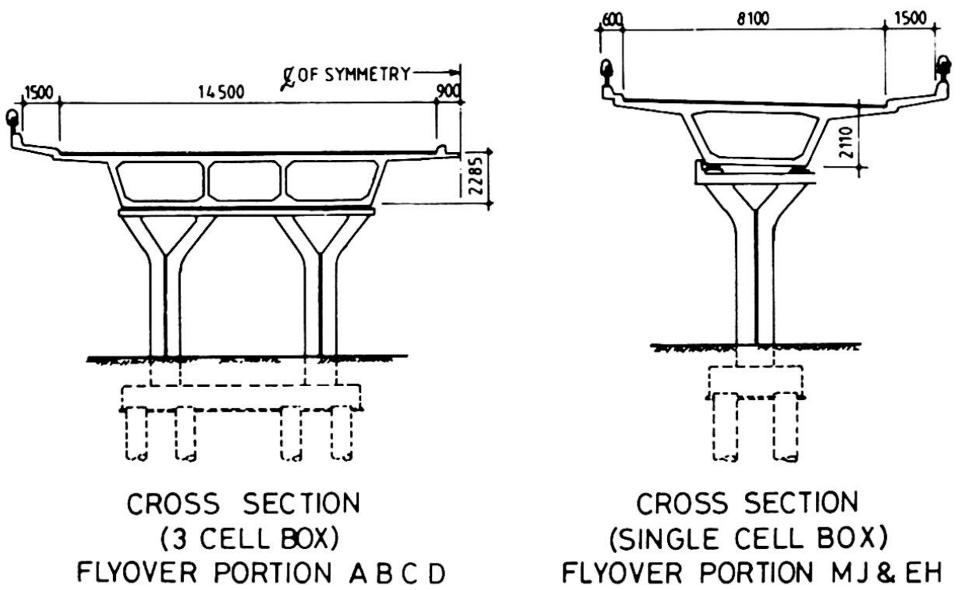

Fig.2 Cross Section of Flyover portion

longitudinally prestressed, resting on single pier at each support location within expansion joints at the ends of the circular portion. Slip MJ, similarly has ten spans of about 25 m on a circular curve of radius 165 m., with expansion joints at the ends.

The loops are in the configuration of a horse shoe with radii of about 50 m and 60 m. The loops have continuous prestressed concrete spans approximately ranging between 26 m to 40 m. The horse shoe portions with expansion joints at the ends have widened carriageway of 8.4 m clear width with footpath of 1500 mm width on the outer side and kerb of 600mm width on the inner side.

1.2 Foundations

The subsoil upto a depth of 40 m is generally alluvial in nature consisting of fine sand/silty clay with sand. At locations, rock was found at a depth of 20 m on the ISBT side of the ABCD flyover. Vertical bored cast-in-situ piles of 700mm diameter were adopted for foundations of the flyover. Slips and loops were subjected to large horizontal forces due to centrifugal action. Hence 500 mm diameter driven cast in situ piles, both vertical and raker were used for slips and loops. The lateral load on vertical pile under normal loading condition was restricted to 1% of the safe vertical load and to 5% under seismic loads.

1.3 Substructure

The pier column is of rectangular RCC Section with a fork at the top. A single pier column supports the two lane carriageway of slip and loop portions whereas the four lane carriageway of ABCD is supported on two pier columns.

The shape of the pier with a central groove and configuration of the top fork has been designed on aesthetic considerations. Fig.2 shows typical sections of the four lane and two lane flyovers.

1.4 Expansion Joints

A smooth riding surface is essential for high speed vehicles negotiating curved flyovers. Hence, even at the tender stage, it was a requirement that curved portions shall be continuous. This was ensured by providing expansion joints at the ends of curved portions of the slip and loop flyovers. Specially manufactured neoprene slab expansion joints were used to permit large movements. The straight portions of the flyover are either two span continuous or single span simply supported structures.

1.5 Bearings

The superstructure of the ABCD flyover rests on reinforced neoprene bearing pads and the curved spans of slip and loop portions rest on POT-cum-PTFE bearings, with provisions for lateral restraints at the ends and a pin at the anchor pier locations. Fig.3 shows the type of bearings used for the typical loop portion, to illustrate the type of restraints imposed and movements permitted.

2. ANALYSIS AND DESIGN

2.1 Loading

The bridge portion is designed for combinations of live loads specified by the Indian Roads Congress. In the case of continuous spans, influence lines were plotted for moment, shear and torsion. Critical values were then obtained at various sections for moving trains and wheels. For ease of construction, spans of ABCD flyover and the slip portions, EH and MJ were cast as simply supported spans on sand jacks with construction gaps over pier and subsequently made continuous by casting these gaps, stressing continuity cables and finally lowering the span over the bearings on centre line of pier.

Due to this procedure, dead load analysis for simply supported spans was carried out in these cases. For the loop portions similar procedure was adopted except that two spans were cast at a time to ensure stability of the structure with a construction gap between adjacent pairs of spans.

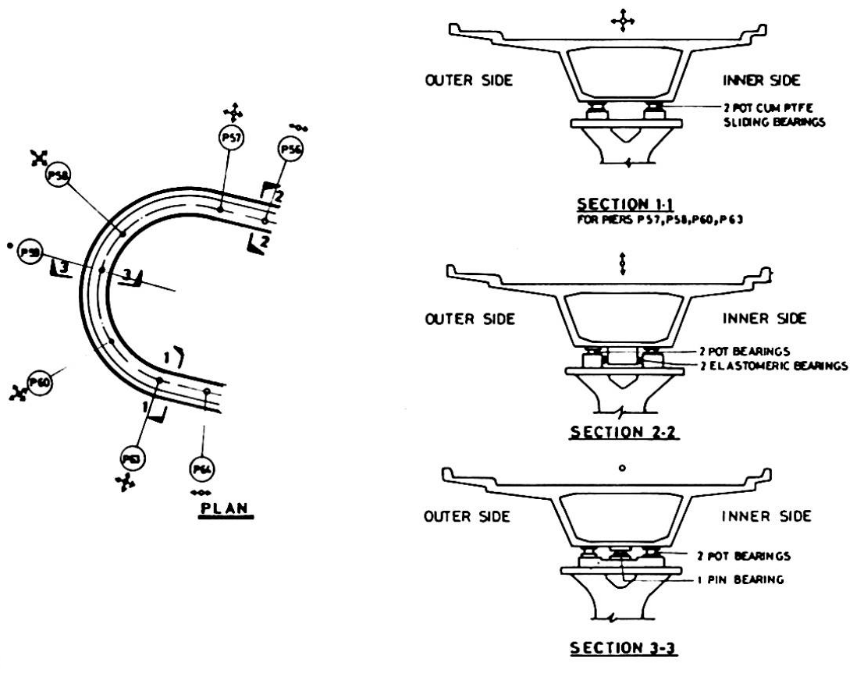

Fig. 3 Bearings for Loop Portion

2.2 Secondary Effects

In the design, a temperature gradient of 25 Deg.C. is considered in the top 200 mm thickness of deck slab. Differential settlement effect to the extent of 12mm between adjacent piers has been considered in the analysis. For the provision of prestressing, 50% of the differential settlement effect is provided for by prestressing and the balance taken by untensioned reinforcement. Secondary effects due to prestressing of continuity cables are calculated as per construction sequence.

The analysis of the curved flyovers has been carried out by the SAP IV PROGRAM taking the flexibility of piers into account. Box girder is idealised as a single line element with actual sectional properties. Boundary conditions at the pier top have been considered by introducing suitable end release codes.

2.3 Load Combinations

Normal load combinations involving dead load, superimposed dead load, live load, prestress, differential settlement, temperature gradient, seismic loading and wind loading are considered as per provisions of the Codes of the Indian Roads Congress. Permissible increase in allowable stresses are taken into account as per codal provisions. The seismic analysis is carried out using a static coefficient of 0.072 for horizontal effects.

2.4 Prestressing

Prestressing is carried out with HTS strands in standard 12T13 or 7T13 cables in suitable stages.

3. CONSTRUCTION ASPECTS

3.1 Service Lines

Existing service lines interfere with the construction of any urban interchange system. Water line, sewer lines, electricity and other cables had to be accommodated or relocated. The water line had to be accommodated by changing the pile layout and providing bridging pile caps over the pipe line in the stilted portion. In some portions of the embankment, pipe lines were taken inside hollow box RCC sections resting on ground. The use of box section instead of earthfilling, especially where the height of filling is above 6 m, restricted the bearing pressure under the base of box section to the required level. Fig. 4 shows the interchange under construction.

3.2 Traffic Diversion

Traffic diversion during construction was planned carefully since the entire superstructure was done on staging. During the construction of spans over the Ring Road, traffic was diverted on the adjacent spans and the casting sequence of spans provided for this arrangement. As already discussed, the continuous spans were cast as single spans with construction gaps filled later and rendered continuous through prestressing.

3.3 Piling

Bored cast-in-situ piles of 700mm diameter and driven cast-in-situ piles of 500mm diameter were adopted. The piles were driven to a depth of 18 to 20 m below ground level. The bored piles were designed for a safe load capacity of

1850 kN and the driven piles for 850 kN.

4. CREDITS AND ACKNOWLEDGEMENT

The authors are thankful to the authorities of Delhi Administration for the information contained in this paper. The interchange was constructed by M/s.Uttam Singh Dugal & Co. and Simplex Concrete Piles and consultancy was rendered by STUP Consultants Limited.

Fig. 4 Flyover Portion 'E.H'

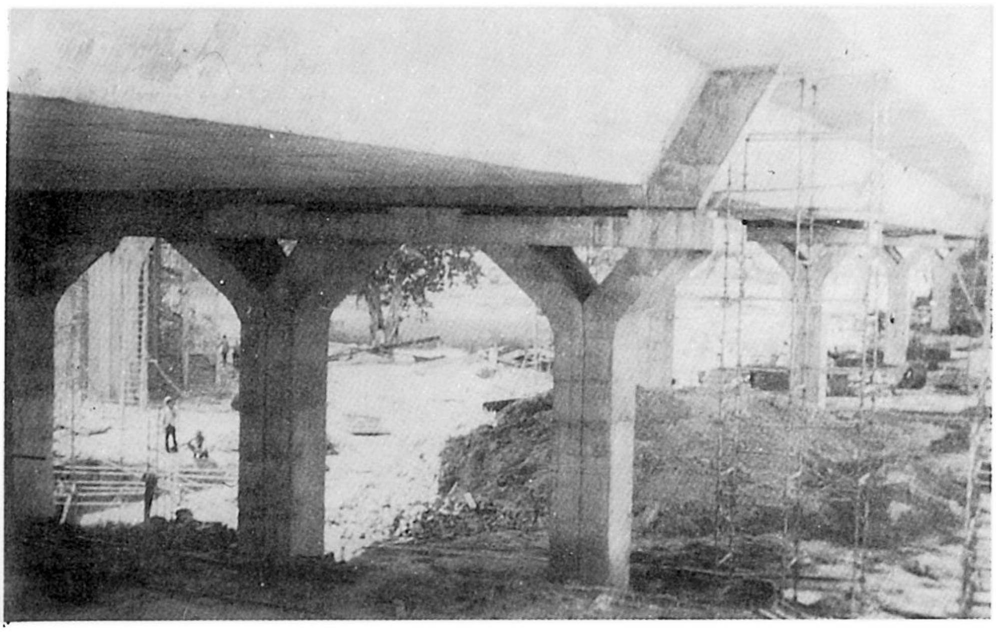

Fig. 5 Flyover Portion 'ABCD'