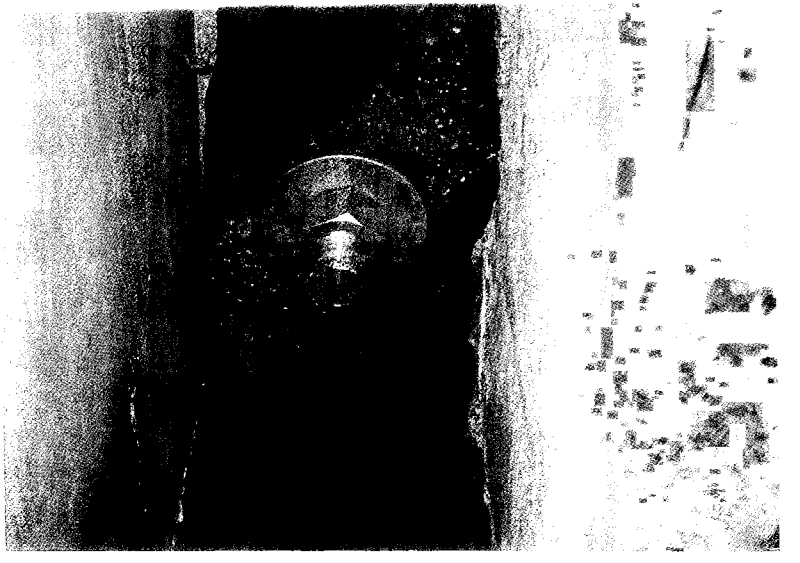
Fig. 3—Equi-Span (a)



Equi-Span (b)

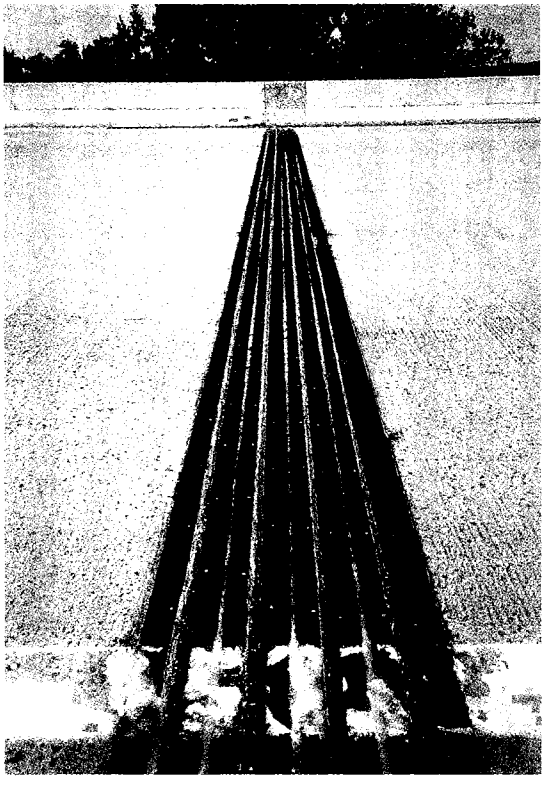
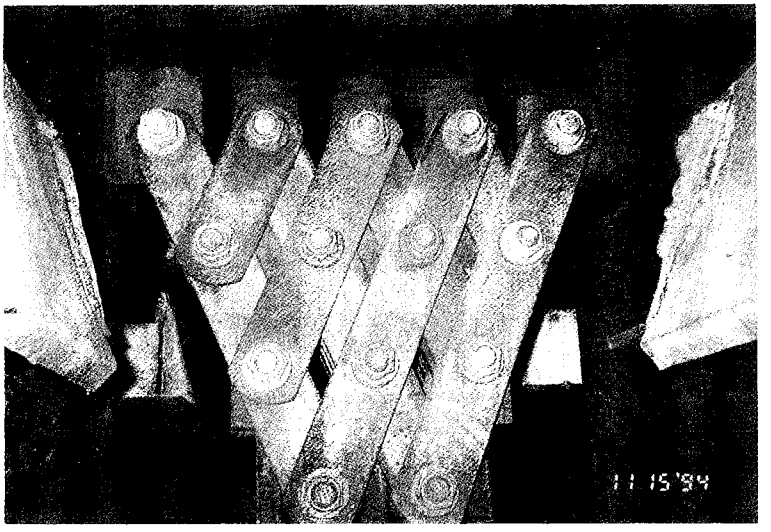


Fig. 4—Rheinstal (a)



Rheinstal (b)

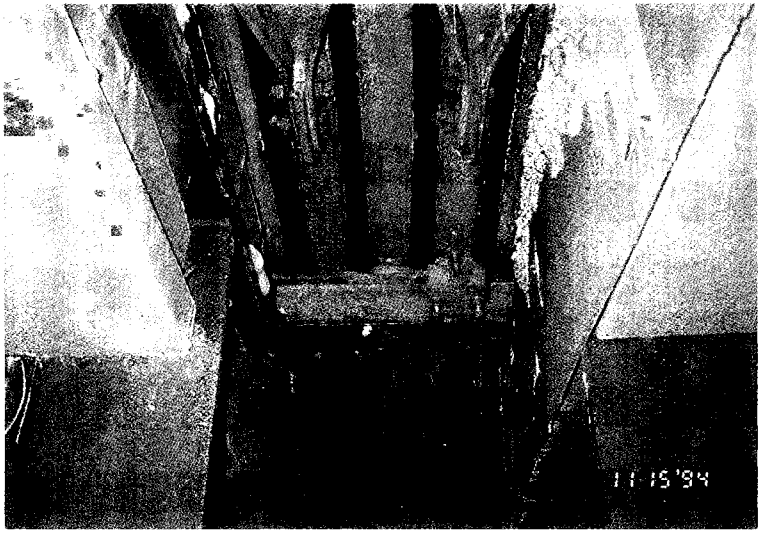


Fig. 5—Acme Beta

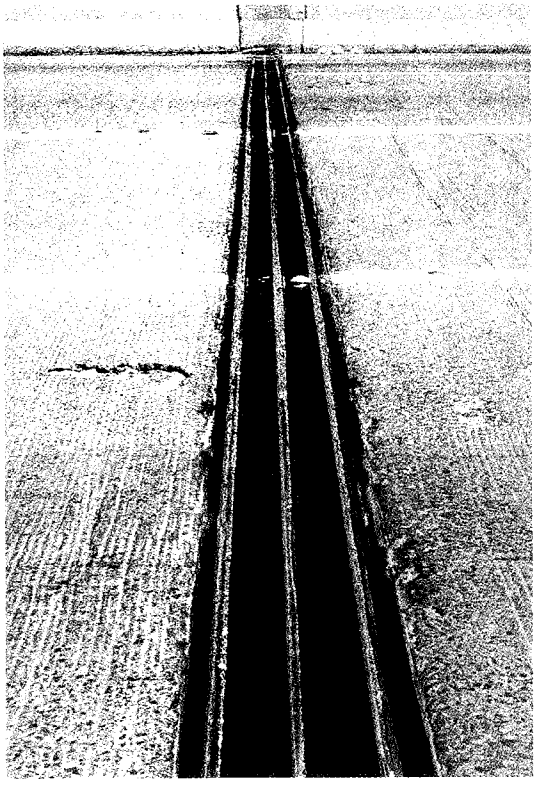
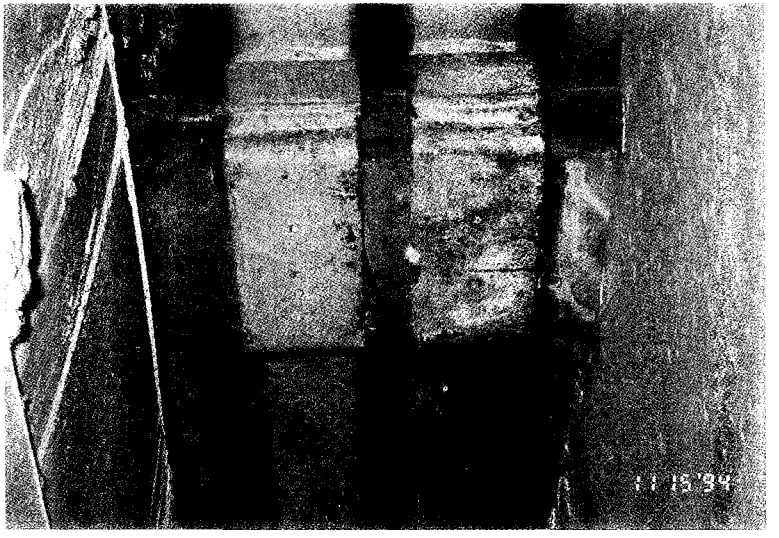


Fig. 6—Wabo-Beta (a)



Wabo-Beta (b)

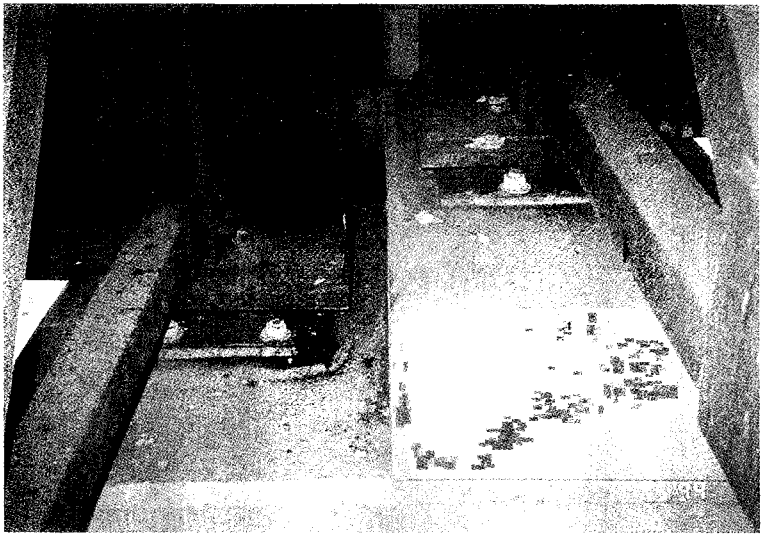


Fig. 7—Typical pier cap under expansion joints

Replacement of Expansion Joint of "Rabindra Setu" (Howrah Bridge), Calcutta, India

by Subrata Datta, Mukul Ray and Tarak Nath Mitra

Synopsis:

This paper deals with the very interesting subject of replacement of Expansion Joints of a 50 year old balanced cantilever steel bridge by judiciously using a set of reinforced elastomeric slab seal type expansion joint.

The expansion joints installed 50 years ago have been corroded and eroded with time, damaging even the replacement systems which might have been provided originally. As the replacement is being done on a bridge which is on regular use the entire work is being carried out in the night only. Care has been taken to ensure possibility of replacement of the elastomer slab seal at later dates, if necessary, by providing stainless steel fixing bolts & nuts and stainless steel bed plates. The specification and methods used for fixing reinforced elastomer slab seal units have been elaborately dealt with in this paper.

The paper also contains four drawings and three photographs showing various relevant details of the bridge and the expansion joints.

Keywords: Bridges (structures); control joints; history; repairs; steels.

The Authors :

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[All the authors are fellows of Institution of Engineers (India) and members of many professional learned bodies including Indian Road Congress, IJBRC. They have participated in the 2nd & 3rd World Congress on Joints & Bearings in San Antonio & Toronto.]

INTRODUCTION

The City of Calcutta (population 10 million approx) used to be the Capital of British India till 1911. Calcutta is situated on the eastern bank of river Hooghly ,and another city- Howrah (population 6 million approx) is situated right across the river on the western bank. The terminal point of all the Railways connecting Calcutta with rest of India, is situated in Howrah and therefore, the link between the twin cities of Calcutta & Howrah across the river Hooghly has always been of vital importance. (Fig.1 shows Map of Calcutta/Howrah).

Till early 40's, the only direct link between the twin cities of Howrah and Calcutta had been a floating pontoon bridge (constructed in 1874) (Fig.2). This **Old Floating Howrah Bridge** had a total length of 464 metres between centres of abutments and provided a roadway of 14.6 metres alongwith two footways of 2.1 metres. It had a central removable section of 60 metres which had to be floated away for passage of larger vessels. To cater for smaller river crafts, there was 18 m opening on either side of the central span. A traffic census was carried out in 1931, The maximum hourly totals obtained for

each class of traffic are given in Table-I which also gives comperative figures obtained in 1931, 1946 & 1995 of the New Howrah Bridge referred to hereafter as **Rabindra Setu**, which was constructed in 1943.

Consideration of the New Bridge was mooted during early 30's, as it was realised that the old floating bridge would have to be replaced on account of inadequate provision for continuously increasing volume of traffic and increasing cost of maintenance.

BRIEF HISTORY OF THE BRIDGE

Commensurate with the need for a new permanent bridge to cater for the fast increasing traffic load, a proposal for construction of a permanent bridge was finalised in 1933 after several feasibility studies had been carried out by several British firms including Rendal Palmer & Tritton (RPT). RPT's proposal for a steel balanced cantilever bridge had been accepted by the Govt. of Bengal and tenders had been invited in April 1935, simultaneously from Calcutta and London. Amongst British, German and Indian offers a German firm had been found to be the lowest tenderer, but in view of gathering war clouds in the European sky, their offer was by-passed and the construction contract was awarded by the Howrah Bridge Commissioners to M/s Cleveland Bridge & Engg Co/UK with M/s Rendal Palmer & Tritton/UK being the designer and overall consultant for the project. M/s. Cleveland Bridge & Engg Co in turn sublet the entire fabrication work to the Calcutta based firm M/s. BBJ Construction Co. The estimated cost at 1935 price-level has been £ 2,418,622/-. Construction work was started in October 1936 and completed in December 1942. After final inspection and testing, the bridge was opened to traffic in Feb 1943. The actual construction cost had been £ 2,463,887/- i.e. with practically no cost overrun.

BRIDGE PARAMETERS

The Rabindra Setu is a steel truss cantilever bridge supported on four main steel towers (2 on either side) of hollow section and tied down at the ends by four steel anchorages or ties (2 on either side) built-up from several steel plates. The deck of the main bridge consists of cross girders and stringer beams with concrete fill over trough plates. The whole deck is suspended from the overhead main truss by a number of suspenders (fabricated out of steel angles and flats) from the nodal points of the overhead truss and connecting the ends of the cross girders. However, the side spans are not suspended from the overhead truss but they are built over reinforced concrete multicell boxes supported over ground. The bridge has a central span of 457.2 metres and two side spans of 99.0 metres (Fig.3).

Main Parametres

Type-- Balanced cantilever type steel bridge with a main central suspended span.

Main central span -- 1500 ft (457.14 m) between tower centre.

Anchor Span -- 325 ft (99.05 m), each on either side.

Height of Tower -- 270 ft (82.32 m)

Main span consists of :

a] Two cantilever arms - 468 ft (142.63 m) each
b] Suspended span - 564 ft (171.89 m)

Trusses for Super Structure :

a] K-type of variable height -- Main Trusses of cantilever & anchor arms.
b] N-type -- On suspended span.

Main trusses are 76 ft (23.17m) centre to centre.

Width of carriageway -- 71 ft (21.64m)

Clear width of Footpath-- 15 ft (4.57m) on each side.