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Retrofit of Corroded Splice Plates Using Epoxy Glued Escort Plates

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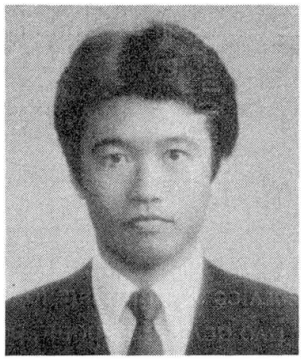

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Summary

Corrosion can be the most serious problem, in particular, for very complicated steel structures such as truss bridges. The Port Bridge in Osaka suffered water leakage and then serious corrosion at the joints of the cross beams, which are also floor beams for the deck plates, between the main truss members. As a result, the head of bolts seriously corroded and the splice plates became 3 to 5 mm thinner than the original. For the retrofit, additional reinforcing plates (escort plates) glued with epoxy resin was chosen. The effectiveness of this method was researched in laboratory tests.

1. Outline of corrosion

The Port Bridge is the third longest Gerber truss bridge in the world. It was constructed in 1975 and connected the reclaimed lands of Osaka Bay area with a 450 metre centre span as shown in fig.1.

As shown in fig.2, rain water entered from the scallops of the web plate of cross beam welded to the main truss members. There are no drainage holes around them, and the box beams have collected water inside them. As a result, corrosion has been advanced at the lower flange joints of the cross beams. This created two structural problems. One is the reduction of axle force of the high tension bolts. The maximum rate of measured reduction was 30 %, which is bigger than that due to relaxation (approximately 10 to 15%). Another is the reduction of thickness of the splice plates. The most corroded one was 5 mm thinner than the original. Finally, the stress limitation can not be guaranteed at the joints.

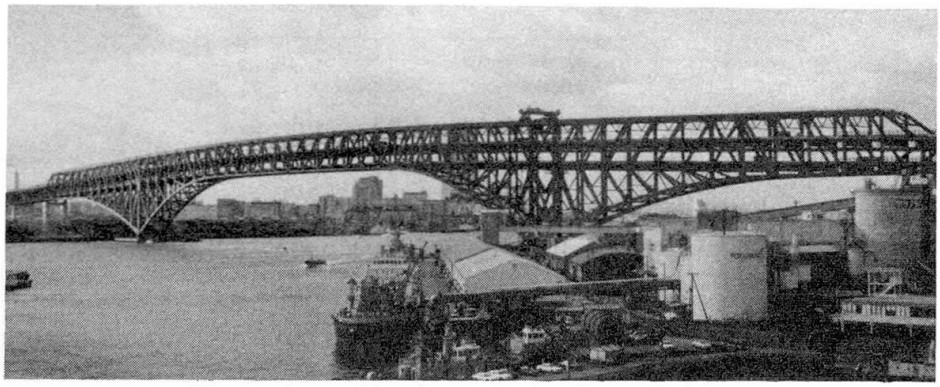

Fig. 1 Overall-view of the Port Bridge

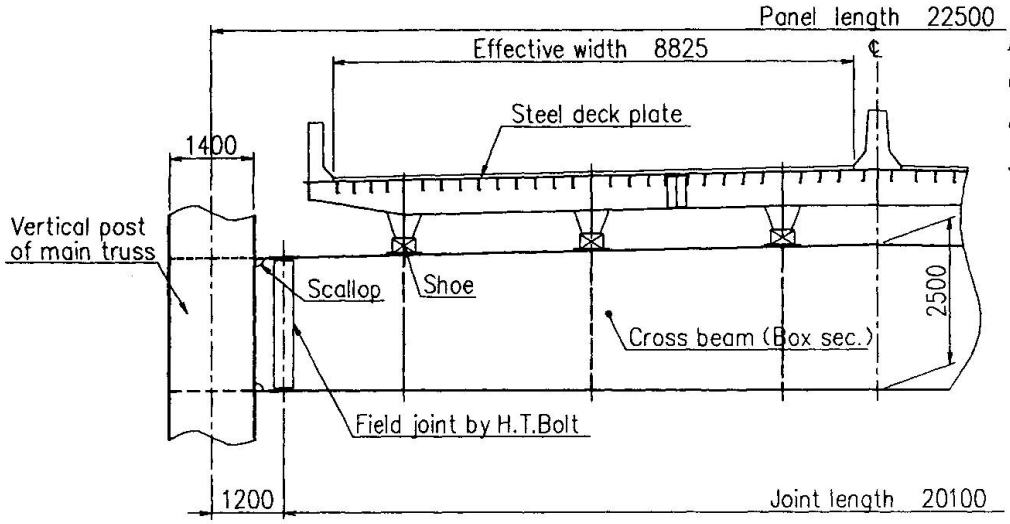

Fig. 2 General view around corroded joint

2. Retrofit concept

Fig.3 shows the retrofit using epoxy glued escort plates. In this method, the original splice plate can remain and only a row of bolts can be removed. These are replaced with new ones at the same time for fitting a long rectangular escort plate. The bolts should be replaced from the centre to the corners of the flange, so that re-distribution of the stress flow can be improved. Filler plates should be also fitted to make up for the lack of thickness of the corroded flange plates.

Other methods for retrofit have been considered such as replacement of the whole splice plates or reinforcing them with additional plates fixed by welding. They, however, were rejected for the following reasons.

(1) The working stresses due to dead loads are too large to remove the whole splice plate and all bolts from the lower flange at the same time.

(2) The influence of welding would be great, because high tension steel (HT70, HT80) was used.

Finally, using epoxy glued escort plates resulted in the most effective and practical method.

Laboratory tests have been done to examine the effectiveness of this method. The two bolts model test indicated that there were no remarkable difference between the sound specimen and the corroded ones reinforced by the escort plate.

It should be noted that using epoxy resin together with H.T.bolts may be able to reduce the number of bolts at the design stage.

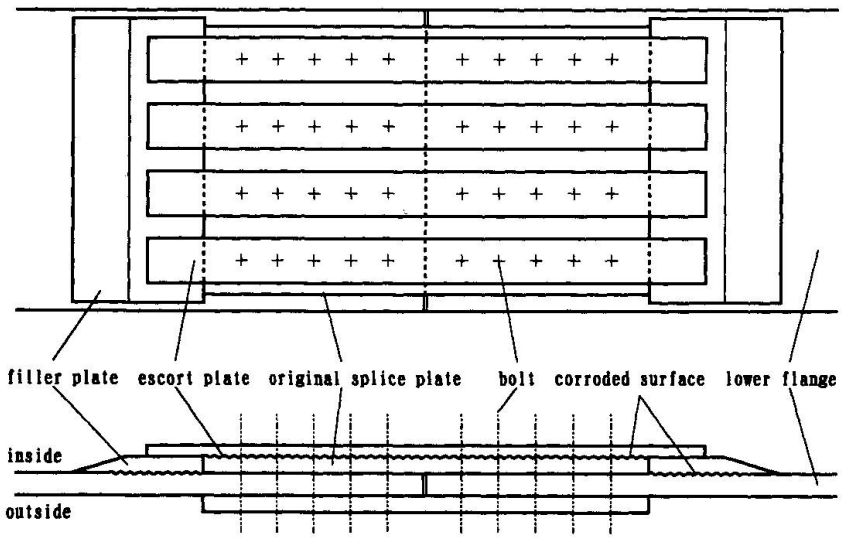

Fig. 3 Retrofit of corroded splice plates using epoxy glued escort plate