MACRO ANALYSIS OF FATIGUE CRACKS AROUND RIB-TO-DECK JOINT IN ORTHOTROPIC STEEL BRIDGE DECK WITH U RIB

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1. INTRODUCTION

Orthotropic steel bridge decks (OSD) are widely used in Hanshin Expressway due to their low dead weight and short construction time. However many fatigue cracks were observed in some long-time served OSDs. The fatigue crack, which initiates from the rib-to-deck (RD) joint, may produce asphalt surfacing damage and hence cause impact on traffic safety. In this paper, the macro analysis was carried out for these fatigue cracks in Wangan(bay) route of Hanshin Expressway.

2. ORTHOTROPIC STEEL BRIDGE DECK IN WANAN(BAY) ROUTE

The orthotropic steel bridge consists of a deck plate supported by longitudinal and transverse stiffeners and covered by the asphalt surfacing. Two basic types of longitude stiffener, open rib and U rib, are normally applied in the OSD. Since U ribs constraint the transverse deformations of the deck plate and the partial joint penetration (PJP) ratio of U rib to deck joint is low, RD joints in the OSDs with U ribs are more prone to fatigue failures than that in the OSDs with open ribs. As shown in the Fig.1, four kinds of potential fatigue cracks may occur around the RD joint. However, only type 2 and 4 fatigue cracks were observed in Wangan(Bay) Route. There are up to 92 spans of OSD with U rib in the Wangan route, and the RD fatigue cracks were observed in 10 spans. The damage ratio of spans is about 10 percent in 2012.4.

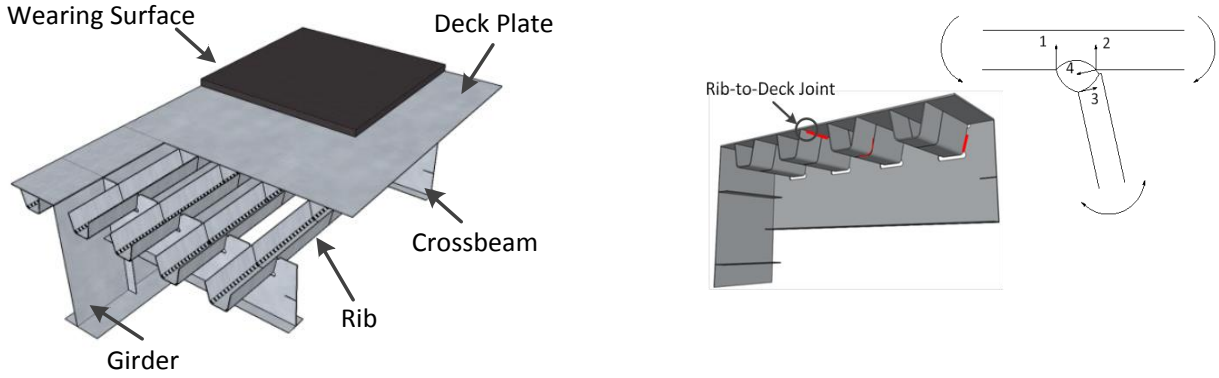

Fig. 1 Components of the Orthotropic Steel Deck Bridge and Potential RD Fatigue Crack Types

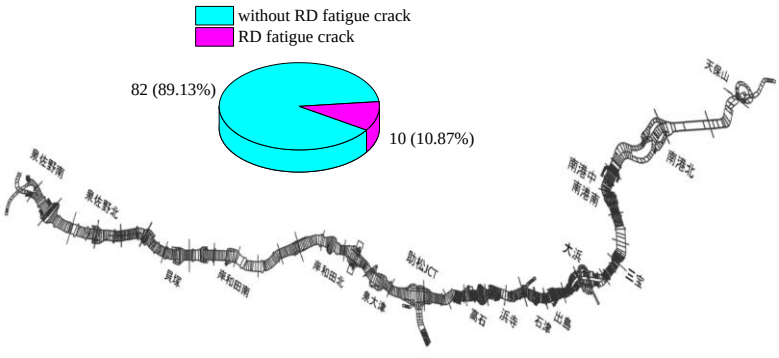

Fig. 2 Route Map of Wanan(bay) Route

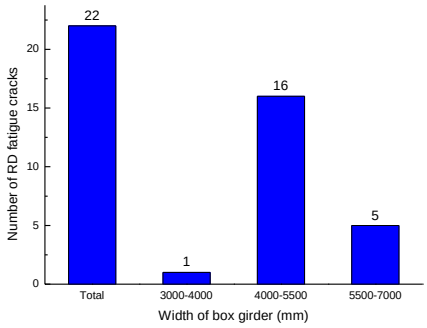

Fig. 3 RD Fatigue Cracks and Box Girder Width

3. MACRO ANALYSIS OF FATIGUE CRACKS AROUND RD JOINT

The spans with RD fatigue cracks are chosen as the objective spans for macro analysis, which contain 8 spans of box girder bridges, 1 span of cable stayed bridges and 1span of Lohse bridges.

Keywords: Orthotropic Steel Bridge Deck, Rib-To-Deck Joint, Fatigue Crack
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3.1 RD fatigue crack in the box girder bridges

All the RD fatigue cracks are observed inside box girder. Fig.3 shows the relationship between width of box girder and number of RD fatigue cracks. It can be considered that box girder may less prone to RD fatigue crack which width is less than 4000mm.

3.2 RD Fatigue Crack and volume of equivalent load axle of 10 ton

Fig. 4 shows the relationship between RD fatigue crack and volume of equivalent load axle of 10 ton. It can be concluded that there are significant more fatigue cracks in the traffic lanes with large volume of equivalent load axle than those traffic lanes with small traffic volume.

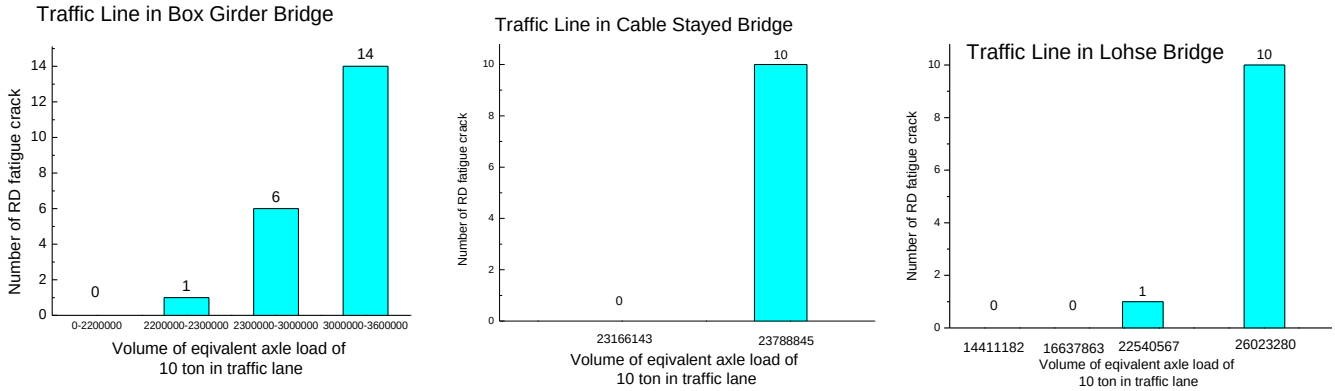

Fig. 4 RD fatigue crack and traffic volume

3.3 RD Fatigue Crack and Transverse Position of Tire

Fig. 5 shows the distribution of the RD fatigue cracks refer to the center of right and left tire. I t can be seen from the figure that all the RD fatigue cracks are in the range of 800mm from tire center.

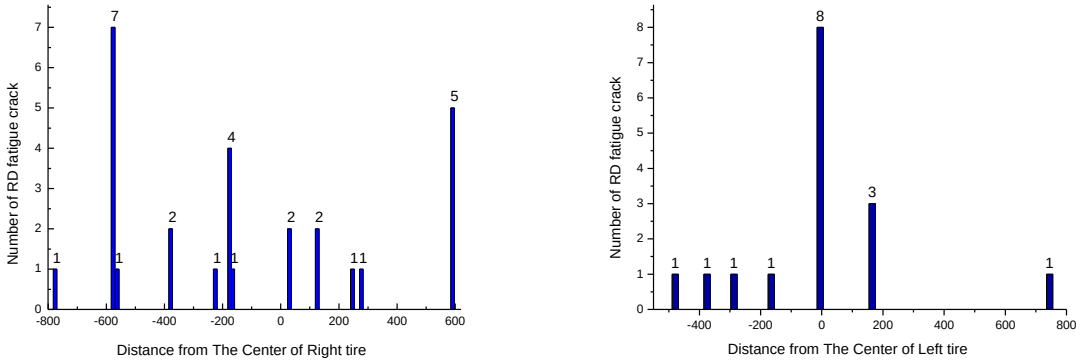

Fig. 5 RD fatigue crack and transverse position of center of tire

4. CONCLUSIONS

It can be concluded from the macro analysis that the number of fatigue cracks around the RD joint is significantly influenced by traffic volume of heavy load axles, box girder may be less prone to RD fatigue crack which width shorter than 4000mm and all the RD fatigue cracks are located in the transverse range of 800mm from tire center.

REFERENCES

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