New Low-Rigidity Design for Widening of Elevated Bridges

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Summary

A two-lane junction bridge connecting the Loop to a radial route on the Hanshin Expressway in Osaka was widened to a three-lane configuration by constructing an additional steel box girder bridge as a relief of chronic traffic congestion suffered at the site. This project was successfully completed, and remarkable mitigation of traffic congestion was achieved. The additional bridge support piers were built at the midspans of the original bridge, and the two bridges were not rigidly connected. Although a large longitudinal joint was installed to accommodate a differential deflection of 50 mm between the two bridges, it was found to be damaged by the heavy traffic of vehicles. An investigation was made to study a possibility of removing the joint and connecting the two bridges, and cross beams were adopted as the connecting members to achieve the desired connection.

Keywords: low-rigidity connection, vertical deflection, existing structure.

1. Introduction

A two-lane junction bridge connecting the Loop (#1) to the Higashi Osaka Route (#13) on the Hanshin Expressway was widened to a three-lane configuration in 1997 as a relief of chronic traffic congestion suffered at the site. An additional bridge was built parallel to the existing original bridge, but they were not structurally connected to each other. To accommodate bumps generated by the differential vertical deflection between the original and additional bridges, a long rubber expansion joint (= longitudinal joint) of about 600 mm wide was installed to cover a length of about 570 m, making the traveling surfaces continuous. However, impact of the vertical deflection (about 50 mm at maximum)[1)2)] was so significant that the longitudinal joint was damaged at many locations, not only impairing driving comfort but generating abnormal noises. To address these problems, the authors examined changing the separate girders into a connected structure in which the longitudinal joint would be unnecessary.

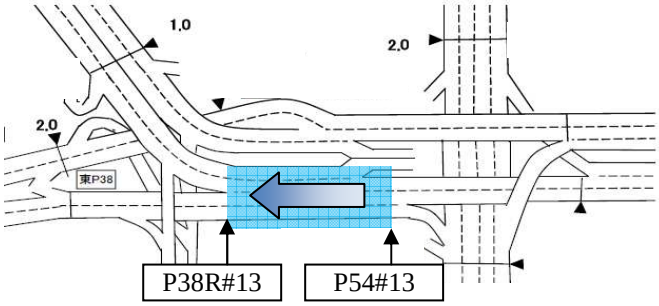

Fig. 1: Location of the bridges under investigation

A structure in which the longitudinal joint would be unnecessary will be made possible by eliminating differential vertical deflection. The original and additional bridges need to be connected with each other using some structural members into a unified structure to eliminate behavior differences between them. As an approach to achieve this, use of high-rigidity members was initially examined for the connection of the bridges.

Although connection using high-rigidity members will ensure reduction in differential vertical deflection, their load distribution effect will be high and may result in disruption of the design balance achieved in the existing structure, creating locations with poor load carrying capacity. On the other hand, connection using low-rigidity members will have less impact on the existing structure, but only a small effect may be expected in reducing differential deflection.

Consequently, the goal was set at reducing the differential vertical deflection at the longitudinal

https://doi.org/10.2749/222137810796063670