Study on a member replacement for an existing steel bridge by attaching the additional steel patch plates

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Research on Bypass Construction Methods

BACKGROUND

In high-strength bolt frictional joints, it is challenging to ensure sufficient coating thickness. Additionally, corrosion damage caused by rainwater intrusion and water stagnation at the joint areas has been reported. When the thinning of the connection plate becomes significant, the connection plate is replaced. In such cases, it is desirable to replace the connection plate without using erection scaffolding. Therefore, this study focuses on the replacement of steel bridge components using bypass members (auxiliary members) and examines this approach.

Fig.1 Corrosion of joint

Fig.2 conventional bypass device

KEYWORDS

- Bypass Method
- FEM
- Replacement of splice plate

METHOD

①Verification through experiments of the web bypass construction method.

A loading experiment on a steel I-girder simulating the replacement construction of a lower flange connection plate using a web bypass member was conducted to verify the mechanical behavior and stress characteristics of the steel I-girder during replacement, as well as the reinforcing effect of the web bypass member.

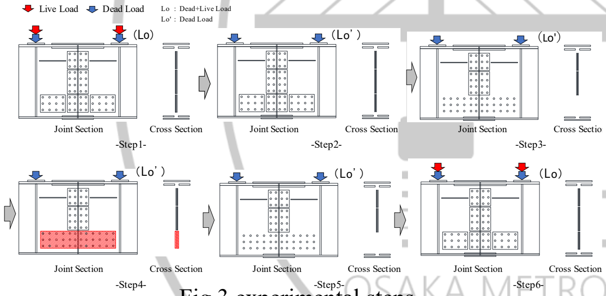

Fig.3 experimental steps

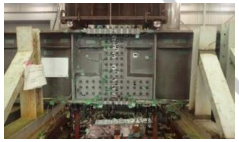

Fig.4 Web bypass member verification experiment

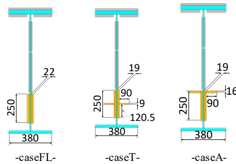

Fig.5 Analytical case

②Proposal for a Bypass Component to be Installed on the Web

FEM analysis was conducted using the cross-sectional shape of the web bypass member as a parameter, and shapes with high reinforcement effects were examined.

RESULTS

① Fig. 6, regarding the vertical displacement at the center of the span, linear behavior was observed throughout all steps; however, residual displacement occurred before and after the replacement. The cause of the residual displacement is considered to be the deformation that increases due to the reduction in cross-sectional rigidity caused by the removal of the connecting plates from Step 3 onward, which remains even after the connecting plates are reinstalled in subsequent steps.

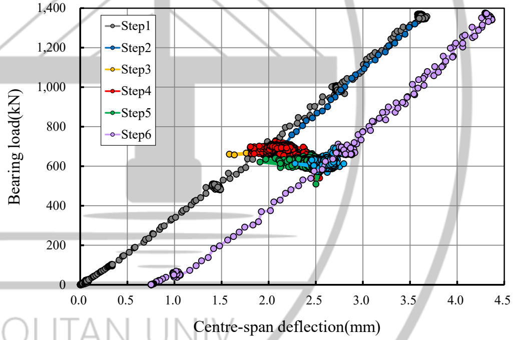

Fig.6 Center span deflection

②From Fig. 7, it can be observed that the stress distribution of the web when the lower flange splice plate is removed shows almost no difference depending on the cross-sectional shape of the web bypass member. Therefore, it can be considered that the stress behavior of the web during the removal of the lower flange connection plate does not depend on the cross-sectional shape of the web bypass member.

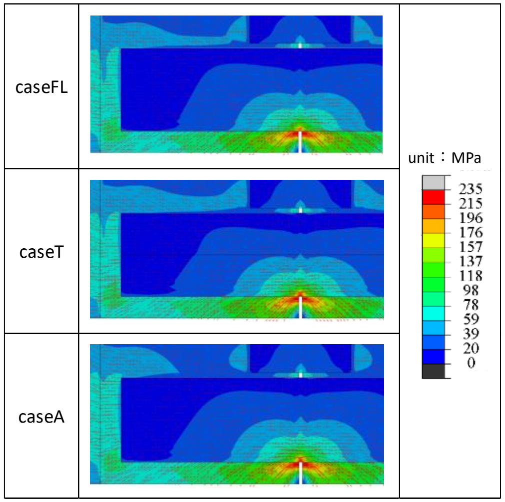

Fig.7 Maximum principal stress diagram in Step4 (unit: MPa)

SUMMARY

①When the web bypass construction method is applied, residual displacement occurs due to the reduction in cross-sectional rigidity during the construction steps, even though elastic behavior is exhibited throughout.
② The cross-sectional shape of the web bypass member applied to the replacement of the lower flange connection plate of the steel I-girder can be determined by the web thickness without the need for a flange section, considering the reinforcement effect, marketability, and workability comprehensively.