

**“Technical Research and Development for Road Policy Quality Improvement”
Study Summary**

No.	Title	Principal Researcher
No.28 - 8	Development of a Retrofitting Method for Steel Bridge by Transforming under Service	Japan Bridge Association Mr. Toyoshige Ohno

This research proposes a new construction method to enhance environmental adaptability and maintainability of the bridge while minimizing traffic restriction. The feature of the retrofitting method is to transfer the load from the existing girders to the new reinforcement girders. The applicability, safety and practicality of the method were verified by experiment and analysis.

1. Backgrounds and Objects

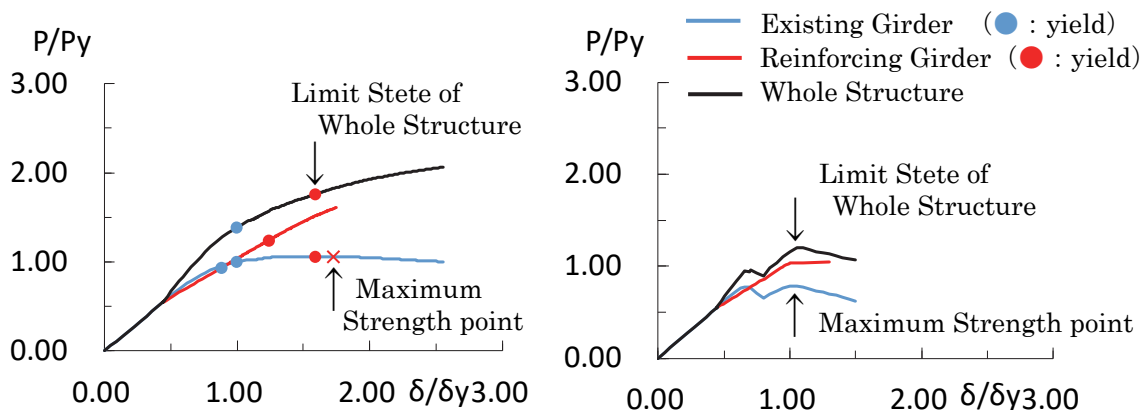
Repairing the cross section of a damaged steel bridge often leads to re-deterioration often without removing the cause of the damage such as corrosion and fatigue. In the case of large-scale remodeling of the structure or replacement of the steel bridge, traffic restrictions such as closed roads are required, and the disadvantage for the user increases. Repair work is difficult in mountainous areas and overpasses where it is difficult to secure detours. The purpose of this research is to propose a retrofitting method for steel bridge by transforming under service.

2. Activities in Research Period

First, the feasibility of the proposed method for railway overpass bridges was clarified¹⁾. Next, the load resistance mechanism of the whole structure where the existing girder and the new reinforcing girder integrated was clarified by experiment and analysis. Three experiments were conducted. The first is the case of the existing composite girder and the new steel girder²⁾. The second is the case of the existing steel girder and the new steel girder³⁾. It was confirmed that the new reinforcing girder bears the load increment and the load resistance function is maintained as a whole structure, even if the existing one is the maximum strength point. The third experiments clarified the reinforcement effect of the existing web plate necessary for the application of this method⁴⁾.

3. Study Results

Figure 1 shows an example of the performance curve considered by this method. (a) is an experimental example²⁾, and (b) is an image when the existing post-buckling strength can be expected.

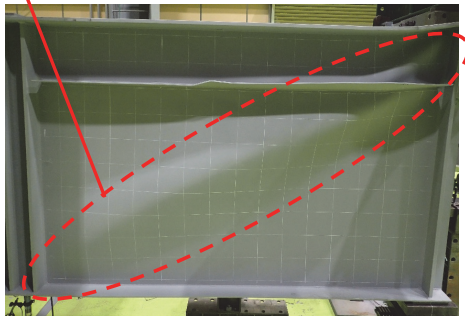


(a) Existing Composite Girder reaching yield Strength (b) Local Buckling of Existing Girder

Fig. 1 Performance Curve Example

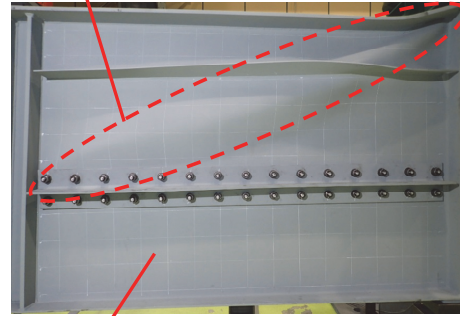
The following two conditions are for the load resistance of the whole structure to be the sum of the existing and the reinforcing when the existing load increment after yield shifts to the reinforcing girder. One is the proper arrangement of load-distribution cross-girders, and the other is the ability to reinforce the existing web plate so that the buckling does not become the ultimate limit of the entire structure. The feasibility of the method is high because it was confirmed by experiments and analysis that the required conditions are satisfied. It is effective that the addition of horizontal stiffeners to the lower panel of the Web plate as shown in Fig. 2.

Diagonal Tension Field
Over Horizontal Stiffener



(a) Before reinforcement

Diagonal Tension Field
Over Horizontal Stiffener



Lower Panel without Buckling

(b) After Reinforcement

Fig. 2 Experiment Example of the out-of-plane deformation of Web Plate

4. Papers for Presentation

1) Toshihiro KASUGAI, et al. : Characteristic of Load Capacity for Improved Overbridge , 73th Japan Society of Civil Engineers 2018 Annual Meeting. 2) Satoshi Maeda, et al. : Loading Test on a Composite Girder reinforced with Steel Girders , 73th Japan Society of Civil Engineers 2018 Annual Meeting. 3) Tatsunori KAWAHIGASHI, et al. : Loading Test on a Steel Girder reinforced with Steel Girders, 74th Japan Society of Civil Engineers 2019 Annual Meeting. 4) Satoshi Maeda, et al. : Shear Buckling Test on Steel Girder with Additional Horizontal Stiffener, 74th Japan Society of Civil Engineers 2019 Annual Meeting.

5. Study Development and Future Issues

If various reinforcement methods are examined using the experimental and analytical examination methods presented in this research, it is thought that great results will be obtained that will contribute to the realization of a reinforcement method that can make the most of existing members.

6. Contribution to Road Policy Quality Improvement

We proposed a new design method of securing the necessary safety as the whole structure by integrating the existing members and the new members. The proposed method is a practical one that can be handled by existing technology. The results are considered to have a great impact that can be a catalyst for the development of steel structure technology.

7. References, Websites, etc.

There is no corresponding website.