Durability Evaluation for Fatigue Retrofitting of Steel Bridges

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1. Introduction

Fig.1 Shows the steel bridge, fatigue cracks, and fatigue retrofitting. This research is directed to the orthotropic steel deck bridge with the lowest fatigue strength in steel bridges. The objective of research is to evaluate the local stress properties of fatigue retrofitting and to consider the effective fatigue retrofitting method for orthotropic steel deck bridges.

2. Experimental Methodology

(1) Real Size Specimen

Fig.2 Shows the real size specimen. The specimen was designed with the same local stress condition as actual bridges. Static load test with the real size specimen has been carried out. The loaded weight was 50kN in static loading test.

(2) Fatigue Retrofitting Method

Fig.3 Shows the fatigue retrofitting method, target line, and positioning strain gauges in this experiment. **Table1** shows the parameter of fatigue retrofitting. The following sentences are explanation of **Table.1**. Basically, this specimen is consisted of attached-plate and stop hole (SH). Thickness of attached-plates are 0, 6, 12 and 22 mm. Distance from the end of weld to attached-plate are 7, 30 and 65mm. The total parameter of this specimen has 12 cases.

(3) Loading

Load case of static load test is shown in **Fig.4**. Load case has 3 types of loading. The static loading test in this load case was carried out in order to reproduce the effect of front wheel and rear wheel of actual tracks.

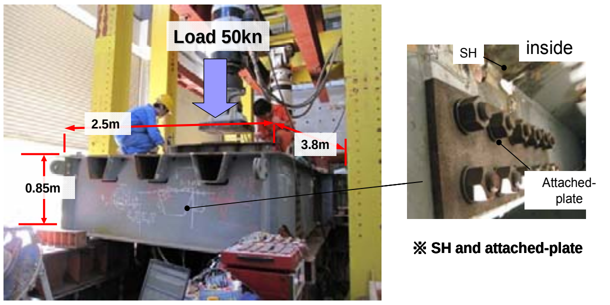


Fig.2 Real Size Specimen

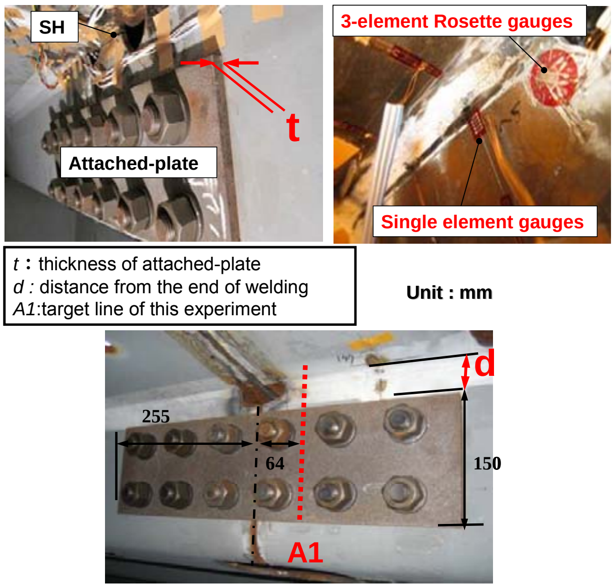


Fig.3 Fatigue Retrofitting

Table.1 Detail of Parameters

Unit: mm

	without plate	t=6	t=12	t=22
d=7	CaseA	CaseB	CaseC	CaseD
d=30	CaseE	CaseF	CaseG	CaseH
d=65	CaseI	CaseJ	CaseK	CaseL

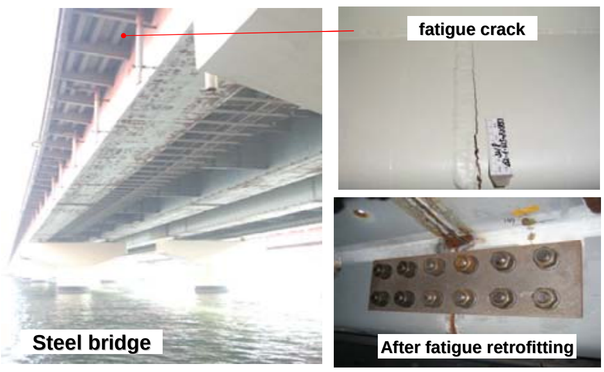
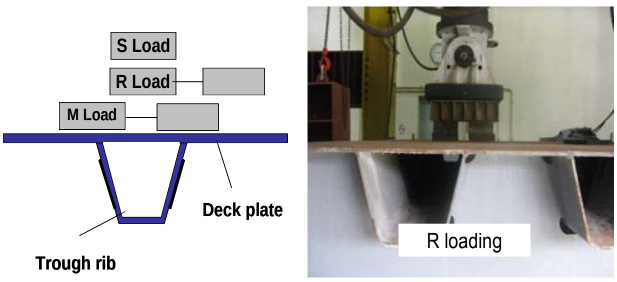


Fig.1 Steel Bridge and Fatigue Retrofitting



• Reproduced of the wheel vehicles

Fig.4 Load Cases

3. Experimental Results

(1)Local stress properties for fatigue retrofitting

a) Local stress property by plate thickness

Fig.5 shows the stress distribution about loading case of specimen. The following results were obtained from **Fig.5**.

① Stress of S load is the most severe

② Local stress was increased by retrofitting

③ Thickness of attached-plate has no effect on the local stress property

Thereafter, deals with results of S load.

b) Local stress property for plate position

Fig.6 Shows the stress distribution about attached-plate position. This figure had the following result.

① When the attached-plate positions approached the welding edge, local stress increased

(2) Principle Stress Property Around the SH

a) Principal stress properties of plate thickness

The principle Stress by 3-element Rosette gauges are shown in **Fig.7**. This figure had the following results.

① Direction of σ_{max} changed to half-clockwise rotation 118 degrees by retrofitting.

② When principal stress became large, there was thinning of the plate thickness

b) Principal stress property by plate position

Fig.8 Shows the principal stress of plate position. The following result was obtained from **Fig.8**.

① When principal stress became lower, attached-plate position was d=65mm

4. Conclusion

This research was to evaluate the local stress property of fatigue retrofitting and to consider the effective fatigue retrofitting method. The following results were obtained. 1) When the attached-plate position approached the welding edge, local stress and principle stress was increased. 2) The thickness of plate doesn't effect the local stress but, effects the principle stress. Therefore, more effective fatigue retrofitting helped decide that to keep attached-plate away from welding edge, and not to consider the thickness of plate.

It will be necessary to analyze FEM (Finite Element Method), and to evaluate the stress property from the comparison between experimental results and analytical results more in detail.

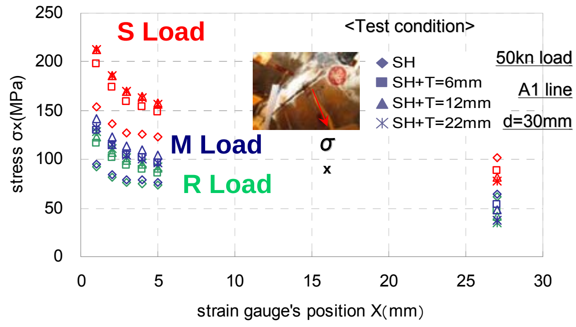


Fig.5 Local Stress Property by Fatigue Retrofitting

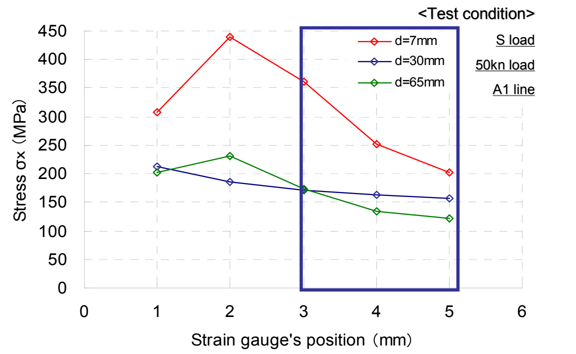


Fig.6 Local Stress Property by Retrofitting Position

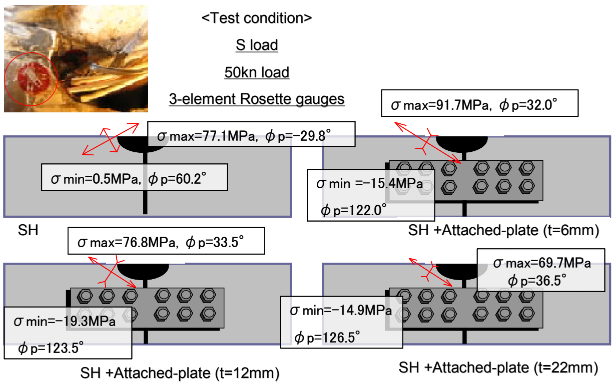


Fig.7 Principal Stress Property by Plate Thickness

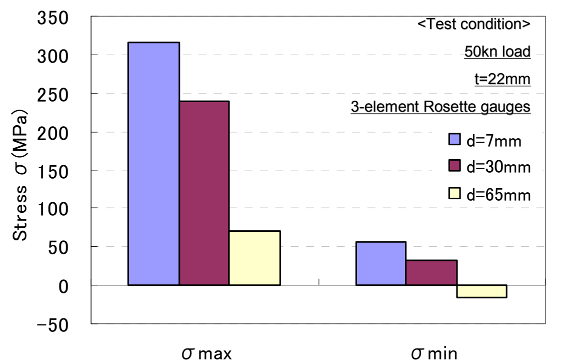


Fig.8 Principle Stress Property by Retrofitting Position

References

[1] T.SHIMOZATO, Y.HIRABAYASI, N.INABA, S.ONO: Fatigue damage of orthotropic steel bridge decks and its retrofit

[2] JAPAN ROAD ASSOCIATION: Fatigue of steel bridge