第Ⅰ部門

Compression Behavior of Thickness-reduced Steel Structural Member Repaired by Patch Welding

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1. Introduction

When applying patch plate to thickness-reduced steel bridge members due to corrosion, high-strength bolts are generally selected as the joining method, and welding is rarely used [1]. In this study, considering the adaptability of repair by patch welding on thickness-reduced steel structural members, a basic experiment was conducted to examine the effect of patch welding in each different dimension. By loading the specimens, the changes in compression behavior of thickness-reduced steel structural member repaired by different dimensions of patch plates were examined.

2. Size Design of Patch Plate Specimen

In this study, in order to clarify the influence of dimension of patch plate on the ultimate strength of patch-repaired specimen, steel plate specimens with uniform thickness reduction were selected.

The length of the corroded base material specimens is always 600mm. The length of thickness reduction is 60 mm. The thickness reduction of base plate is 50% [2] of the original thickness as 18 mm. As shown in Table 1, the length of patch plate, L is 90 mm in A, B and C specimens. That is 150 mm in D, E and F specimens. The thickness of patch plate and the weld bead size are different in each group. The number of specimens in each group is 3.

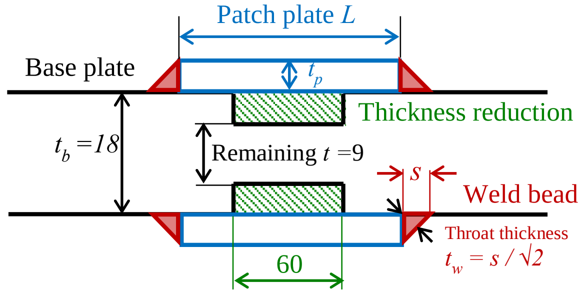

Fig. 1 Shape and dimension of specimen (mm)

Table 1 Detailed size information of specimens (mm)

Type	*tb*	*t*	*L*	*tp*	*s*
A	18	9	90	4.5	4.5
B	18	9	90	7.5	7.5
C	18	9	90	7.5	4.5
D	18	9	150	4.5	4.5
E	18	9	150	7.5	7.5
F	18	9	150	7.5	4.5

3. Compressive Loading Experiment

After measuring and recording the detailed dimensions of each specimen, a universal testing machine was used for the compressive loading experiment on the 6 sets of specimens. The specimens were fixed on both ends by steel blocks. Two displacement transducers were set between the upper and lower blocks for measuring the vertical displacement as shown in Fig. 2.

By the loading machine, the monotonic compressive load in a vertical direction was slowly applied to the specimen. The maximum load was confirmed and the vertical displacement reached 2 mm, then the load was released. Fig. 3 shows the relationship between load and vertical displacement. In the figure, the result of one specimen per each group is shown.

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The experimental results of the three sets of A, B, C specimens, of which the length of patch plate is 90 mm, are compared. When the thickness of patch plate was greater, the ultimate strength was also greater. When the thickness of patch plate was the same (B and C), the weld bead size was larger, its ultimate strength was also greater.

Also, the experimental results of the three sets of D, E, F specimens, of which the length of patch plate is 150 mm, are compared. When the thickness of patch plate was greater, its ultimate strength was also greater. But unlike the specimens with a length of 90 mm, the ultimate strength of type E was lower than that of type F even though the weld bead size of type E (7.5 mm) was larger than that of type F (4.5 mm). Then, the cross-section of type E was observed as shown in Fig. 4. The weld root of type E had the insufficient penetration. It meant that the weld throat thickness of type E was actually thinner than that of type F. Therefore, the load transfer from the base plate to the patch plate was not enough in type E. Eventually, it might be that the ultimate strength of type E was lower than that of type F.

4. Conclusions

(1) The ultimate compressive strength of thickness-reduced steel plates with patch welding was influenced by the weld bead size and the thickness of patch plate. When the thickness of patch plate was the same, the weld bead size was larger, its ultimate strength was also greater. The weld throat thickness of should be ensured as the designed dimension.

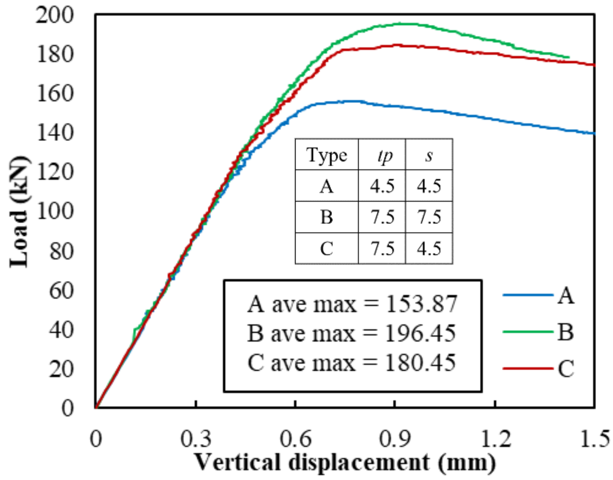
(2) Under the limited conditions performed in this study, the shorter patch plate provided the higher ultimate strength.

References

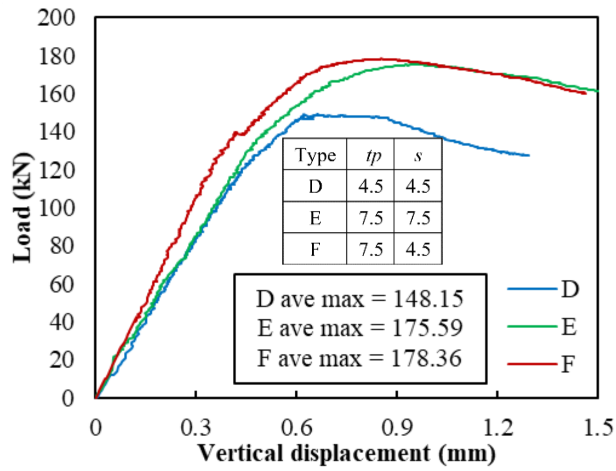
[1] Gheitasi, A., & Harris, D. K. (2015). Failure characteristics and ultimate load-carrying capacity of redundant composite steel girder bridges: Case study. *Journal of Bridge Engineering*, *20*(3), 05014012.

[2] Tamakoshi, T., Yoshida, Y., Sakai, Y., & Fukunaga, S. (2006). Analysis of damage occurring in steel plate girder bridges on national roads in Japan. *Public Work Research Institute of Japan*.

Fig. 2 Compressive loading experiment



(a) Load and vertical displacement of A, B, C



(b) Load and vertical displacement of D, E, F

Fig. 3 Results of compressive loading experiments

Fig. 4 E specimen before and after experiment