

Proposal of Repair for Corroded Steel Members by Carbon Fiber Sheets

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Summary

We propose the repair method for corroded steel members by carbon fiber sheets and its effectiveness is presented using at site measurement data. Based on our theoretical and experimental researches, the design and construction method are given. Working procedures or order of execution at the site is also explained. Finally, using at site measurement data of strain in steel members in a truss bridge in use, the effectiveness of our proposed repair method using carbon fiber sheets is emphasized.

Keywords: corrosion; repair; carbon fiber sheet; CFRP; truss member

1. Introduction

In Japan, steel bridges with corroded members, sometimes severely damaged members have been increasing. Since financial budget for public work has been drastically decreasing, the cyclic repainting in order to maintain steel bridges in sound condition is now becoming difficult. Steel members deteriorated due to corrosion have been repaired by the combination of surface cleaning and repainting. However, when the corrosion has reached advanced stage with reduced thickness, which causes overstress, this measure will be inadequate. In this case, stress reduction methods such as steel plate attachment by bolting or welding to corroded members, replacing the corroded members by new ones and so on will be employed. However, these methods need large-scaled scaffold at site. Hence, it is very useful to develop an effective repair method for the actual steel structures in use.

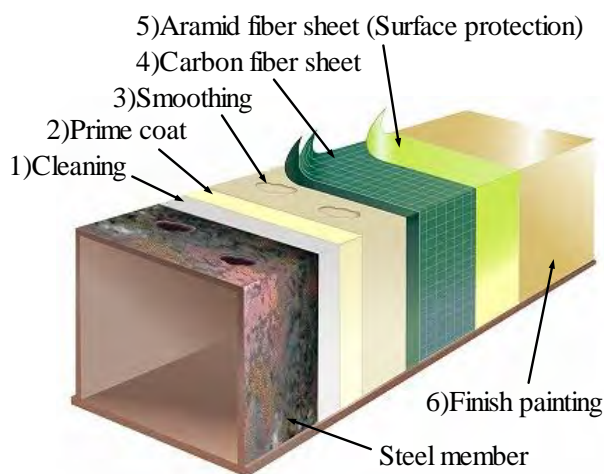


Fig. 1: Repair procedure for corroded steel members

We propose the repair method by bonding CFRP to corroded steel members in truss bridges and arch bridges. This paper describes the design and construction method of our proposed repair method. First, the design and working procedure are given. Second, using measurement data acquired from a steel truss bridge in use, we show the effectiveness of the proposed repair method.

2. Repair procedure by CFRP

Fig.1 shows the repair procedure consisting of six steps.

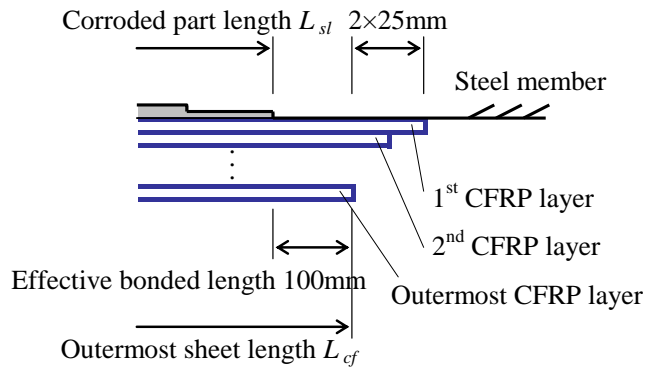


Fig. 2: Required CFRP length for the repair



Fig. 3: Asarigawa bridge

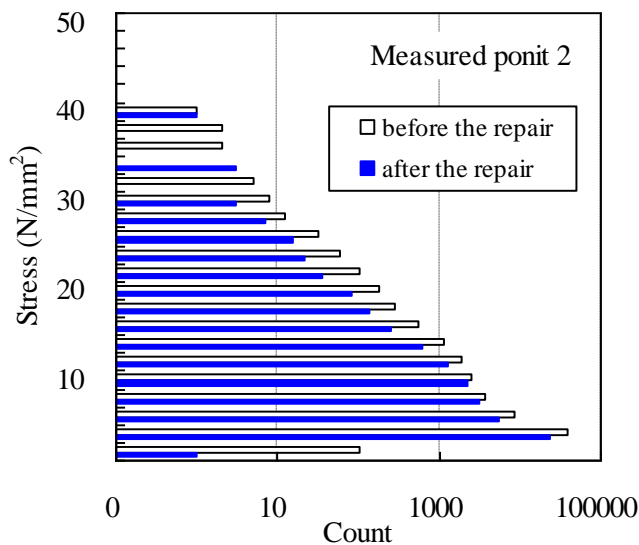


Fig. 4: Stress frequency

3. Design method

Carbon fiber sheet is the high efficiency inorganic material having a superior characteristic such as high strength, high modulus and high corrosion resistance. The specific modulus of carbon fiber (high-modulus type) is the highest in various fibers. Therefore, we selected high-modulus type in order to reduce number of sheets layer in consideration of the working efficiency at site.

Based on our theoretical and experimental studies, we proposed the design method, in which the aim, scope, number of required layer of CFRP, required bonding length (see Fig.2) of CFRP in member axis and detection of peeling are summarized.

4. At site measurement of a truss bridge in use

A continuous warren-type truss girder bridge, named ASARIGAWA Bridge, located on the route of expressway with heavy traffic volume was chosen (see Fig.3), and the effectiveness of the proposed design method was examined.

Fig.4 shows measured one-day stress frequency under actual service load. The measurement was carried out at weekday. It is clear that the stress after repair is lower than that before the repair.

5. Concluding remarks

We proposed the repair method for corroded steel members with reduced thickness. It is bonding of CFRP to corroded steel members in steel truss and arch bridge. The reduced CFRP volume exceeding lost area due to corrosion is bonded to steel plate. The detailed design and construction method, such as required CFRP volume, preventing peeling of CFRP and so on was also presented. The effectiveness of this method was confirmed from at site measurement data, which was acquired from steel truss bridge in use.