Zeitschrift: IABSE structures = Constructions AIPC = IVBH Bauwerke
Band: 12 (1988)
Heft: C-47: Repair and rehabilitation of bridges: case studies II

Artikel: TIG arc remelting as a repair method for steel railway bridges (Japan)
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DOI: https://doi.org/10.5169/seals-20935

5. TIG Arc Remelting as a Repair Method for Steel Railway Bridges (Japan)

Owner: *Central Japan Railway Co.*
Engineer: *Central Japan Railway Co. Railway Technical Research Institute*
Date of Construction: *1964*
Date of Repair: *1987*

Introduction

The fatigue cracks are occasionally found at the stress-concentrated parts of main member of steel railway bridges. The fatigue crack in web plate that developed at the toe of filled welded joint of stiffener end is one of these kinds of cracks and Tungsten Inert Gas(TIG) arc remelting was adopted as one of the effective repair methods.

Description of bridges and cracking

The Tokaido Shinkansen Line, 515 km long, which started operation in 1964, has approximately 1500 steel bridges.

Fatigue cracks have been detected at the toe of fillet welded joints of stiffener ends in the web plates of stringer beams of truss bridges and box section plate girders (see Fig. 1). The first fatigue crack was found in 1975. The rates of the number of bridges having cracks detected to that of the same type of bridges are seven percent for truss bridges and five percent for box girders.

All these cracks were initiated at the stiffener end and the schematic of crack propagation was shown in Fig. 2.

Repair method

In the conventional repair work, the fatigue crack formed at the stiffener end used to be removed by arc air gouging and re-welded, then additional steel plates were attached in that part using high-strength bolts. However, as this method was expensive, a more economical and effective method was requested.

Even if the fatigue crack is not formed at these parts, it is desirable to decrease the possibility of initiation of crack by increasing the fatigue strength of filled welded joint. The TIG arc remelting method shown in Fig. 3 is adopted for the above-mentioned reasons.

The TIG arc remelting is a method of melting the toe of filled welded joint with nonconsumable tungsten electrodes. In order to repair the fatigue crack by TIG arc remelting, it is necessary to obtain the deep fusion and to smooth the toe shape. The conditions for TIG arc remelting, as shown in Table 1, were set up based on the results of preliminary tests.

Fatigue strength improved by TIG Arc remelting

Fatigue tests were performed to confirm the effect of this treatment on improvement of fatigue strength. The fatigue strength of a joint subject to TIG arc remelting was much higher than that of an as-welded joint as shown in Fig. 4.

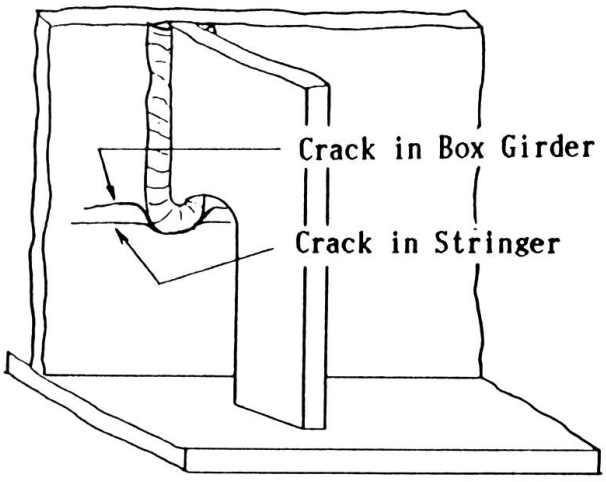

Fig. 2 Schematic of Crack Propagation

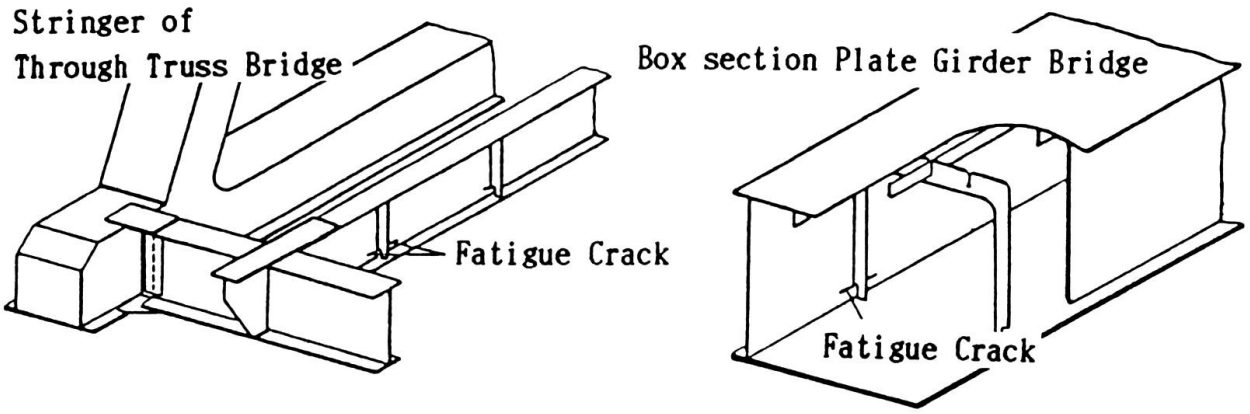

Fig. 1 Fatigue Crack at Stiffener End

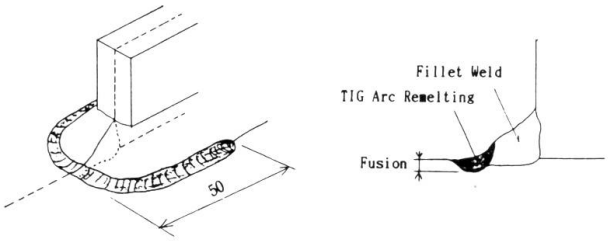

Fig. 3 TIG Arc Remelting

Electrode diameter	3．2㎜
Current	240A
Voltage	13～14V(arc length 0～1㎜)
Speed	45～60s/100㎜
Aiming position	0 to 1㎜ from the toe of weld
Torch angle	90°

Table 1 Condition of TIG Arc Remelting

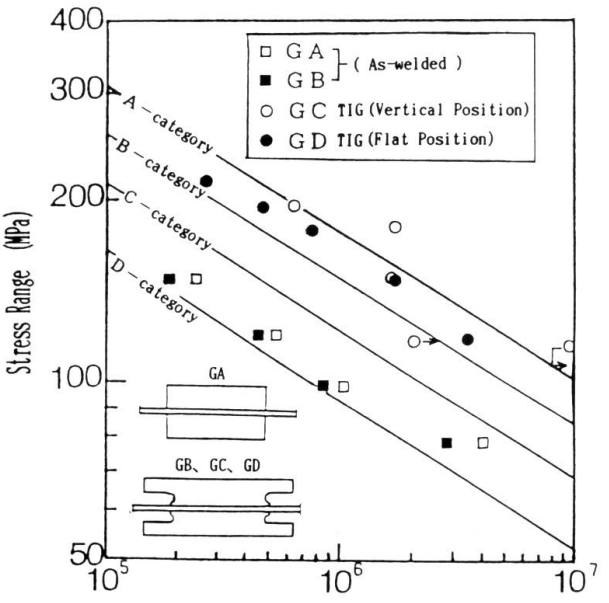

Fig. 4 Results of Fatigue Test

Repair work

Repair works for fatigue cracks at the stiffener end were performed to approximately 300 box girders along the Tokaido Shinkansen Line.

In the repair work, toes of fillet welded joints were inspected first with the magnetic particle testing. If no crack was indicated or the crack size was indicated as less than 10 mm, TIG arc remelting was simply performed. When the crack size was more than 10 mm, the cracks were firstly removed by arc air gouging and re-welded, then the toes of the re-welded joints were remelted by TIG arc. If the crack size was very large, additional steel plates were attached after re-welding.

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