※Josei Measurement Technology;②-3

Repair Measures for Existing Bridges

Restoration of Deteriorated Concrete Gelber Bridge

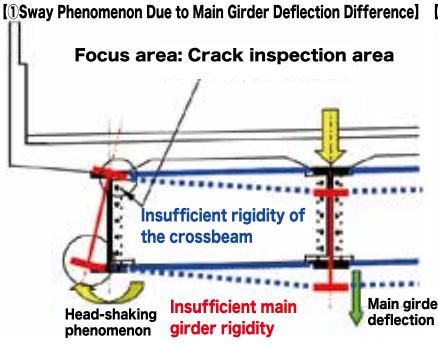
- Adoption of Chipping Technology Using the WJ Method
- Concept of Cross-Section Repair Work

In recent years, fatigue damage cases have been reported in bridges and other structures located on heavily trafficked routes. Fatigue damage in steel road bridges varies widely in damage patterns, causes, and countermeasures depending on traffic and structural conditions, welding quality, and other factors. Josei has earned high praise for offering comprehensive proposals covering investigation, diagnosis, and countermeasure planning for these cases.

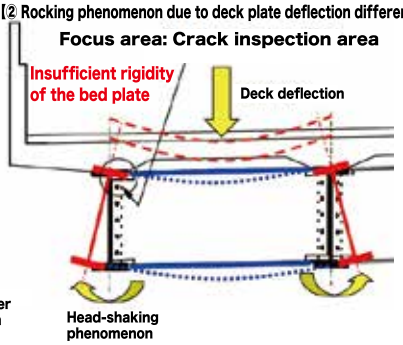
Introduction to Fatigue Crack Cases: Fatigue Crack in Vertical Braces

The primary causes of cracks at the upper flange and vertical stiffener joint, as shown in the right figure, are believed to be either ① the sway phenomenon due to main girder deflection differences or ② the sway phenomenon due to deck slab deflection differences. The main cause of ① is considered to be insufficient stiffness in the cross girders connecting the main girders and in the main girders themselves. The main cause of ② is considered to be insufficient stiffness in the deck slab itself. The countermeasures required differ significantly depending on which type is responsible.
At Josei, we conduct stress measurements based on load tests to elucidate fatigue crack mechanisms and propose optimal countermeasures

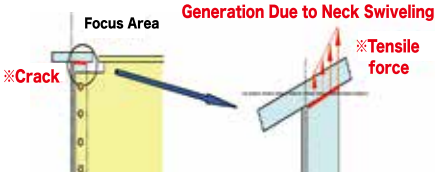
【①Sway Phenomenon Due to Main Girder Deflection Difference】



【② Rocking phenomenon due to deck plate deflection difference】



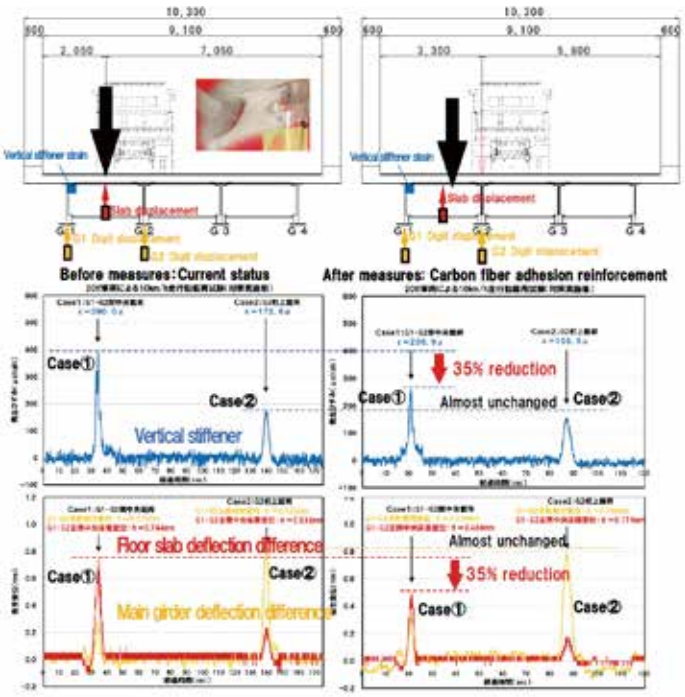
Mechanism of Tensile Stress Generation Due to Neck Swiveling



Identifying Fatigue Crack Causes and Verifying Reinforcement Effectiveness Through Stress Measurement Based on Load Tests (Case Study)

The figure above illustrates a case where the cause of cracks occurring at the connection between the upper flange and vertical stiffeners in a four-main-girder simply composite girder bridge was elucidated through stress measurements based on loading tests.
CASE① shows measurement results when the load was applied centrally between G1 and G2. CASE② shows results when the load was applied on girder G2. Judging from these results, the vertical stiffener's induced strain was measured to be larger in CASE②'s loading pattern than in CASE①. This indicates that cracks occurred due to rocking caused by deck deflection differences, resulting from the deck's low stiffness.
As shown in the lower left photo, numerous bidirectional cracks had already developed in the deck slab. Although deck replacement was proposed, the route carries heavy traffic, and implementing all traffic restrictions, including alternating one-way traffic, was difficult at this stage. Therefore, an emergency countermeasure using carbon fiber bonding was implemented. The lower right diagram shows the stress measurement results before and after this emergency countermeasure, confirming that it achieved a sufficient stress reduction effect

【CASE①: Central Load Between G1 and G2】 【CASE②: G2 Truss Top Load】



⇒When the slab deflection difference is large, the vertical stiffener strain is large!

⇒ Case①: 35% reduction
⇒ Case②: Virtually unchanged

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