Berlin Bridge Refurbishment

Lindapter Hollo-Bolts provided an innovative solution for strengthening the steel bridge decks that were suffering from fatigue cracks.

Project Background

Location: Duisburg, Germany
Product: Hollo-Bolt by Lindapter
Client: NRW State Road Construction Authority
Contractor: Schachtbau Nordhausen GmbH

The Berlin Bridge in Duisburg is one of the longest road bridges in Germany at 1.8km and is part of federal highway 59. It was built between 1960 and 1963 and is a haunched steel girder bridge design with orthotropic steel deck and concrete supporting piers. The deck consists of a structural steel deck plate stiffened with ribs to allow the deck to directly bear vehicular loads and to contribute to the bridge structure's overall load-bearing behaviour.

Client Requirement

Over the years, inspections of the bridge routinely identified fatigue cracks in the steel deck caused by the high dynamic loads from traffic. The solution had been to weld on stiffeners, unfortunately this was costly and only a short-term solution as cracks began to reappear. The client wanted a better technical solution and one that would be more economic and longer lasting so they worked with the German Committee for Steel Construction (DASt) who proposed a research project to investigate alternative solutions.

The steel bridge decks required strengthening

Hollo-Bolts provide an approved solution for dynamic load applications

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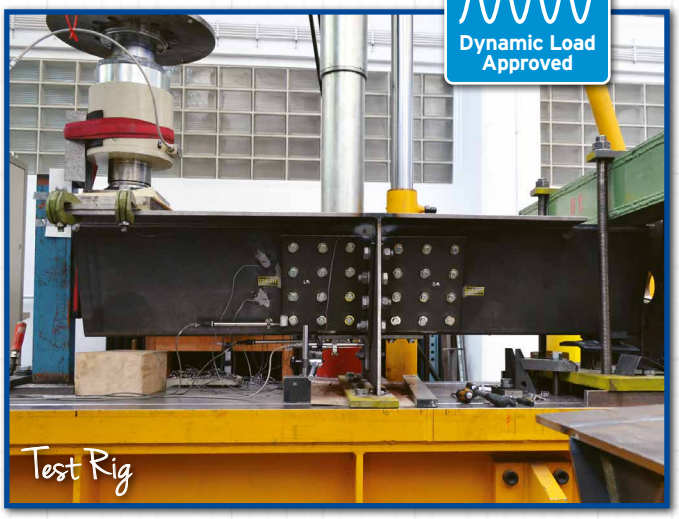
Design Solution

Lindapter were approached by DASt and Stuttgart University and invited to offer a solution capable of withstanding the dynamic loads applied to the bridge. Lindapter provided the solution to allow the connection of steel strengthening ribs to the bridge using carbon steel Hollo-Bolt expansion bolts.

Independent dynamic load tests on the Hollo-Bolts were performed by Stuttgart University in accordance with EN 1993-1-9 Eurocode 3: Design of steel structures - Part 1-9: Fatigue with the objective to determine the fatigue strength of the Hollo-Bolts in both tension and shear.

The testing required a test rig to be built to replicate a section of bridge and the strengthening ribs connected to it with Hollo-Bolts, a number of tests were performed at different load levels from 10,000 to 2.5 million cycles in order to determine a suitable detail category in both tension and shear.



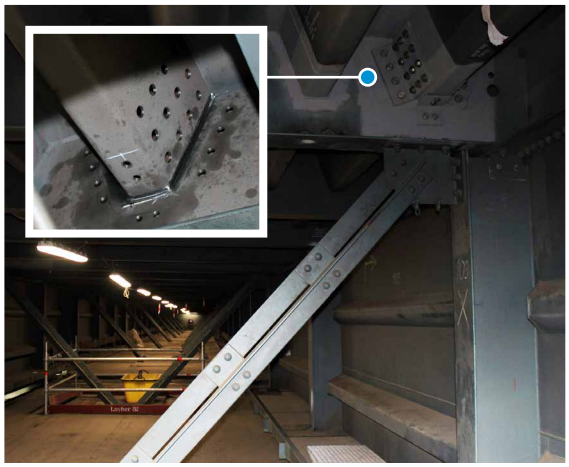
Installation

Following the successful independent tests, a 6 month trial began with size M10 and M16 hexagonal head Hollo-Bolts being used to install the steel strengthening ribs on the Berlin Bridge. Installation was quick and easy as each bolt was simply inserted into the predrilled holes of the ribs and then tightened with a wrench to the recommended tightening torque to provide the necessary clamping force.

Result

Inspections after 3 and 6 months on the Lindapter connections revealed that the cracks under the strengthening ribs had remained the same and had not enlarged, proving the design to be a successful solution to the problems caused by dynamic loads.

Having seen the benefits of this solution over traditional methods of bolting or welding Lindapter commissioned more independent dynamic load testing. The results from this have been used to calculate Safe Working Loads and characteristic resistances for Hollo-Bolts (hexagonal head, carbon steel) in all sizes M8, M10, M12, M16 and M20. Lindapter's Hollo-Bolt remains the only expansion bolt to have undergone independent dynamic load testing.



Insert into predrilled holes and tighten with a wrench

Key Benefits

ESR-3330

- ✔ Approved for dynamic load applications
- ✔ Cost effective and long lasting
- ✔ No welding or hot works required
- ✔ High tension and shear capacities

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