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CARRINGTON BRIDGE

PROJECT
Carrington Bridge, Worcester

CLIENT
Worcestershire County Council

MAIN CONTRACTOR
Griffiths

ENGINEER
COWI

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Cleveland Bridge installs UK's first bridge using new high-strength steel – reducing time, cost and environmental impacts

Requirement

Worcestershire County Council is converting the A4440 Worcester Southern Link Road to dual carriageway along its entire length. It is one of Worcestershire's busiest roads and provides one of only two road crossings of the River Severn in Worcester City. The final phase of the scheme required a new bridge and viaduct to be constructed over the River Severn, adjacent to the existing Carrington Bridge. The old bridge will be refurbished to carry two lanes of eastbound traffic, while the new bridge will carry the two westbound lanes.

Solution

Main contractor, Griffiths, appointed Cleveland Bridge to fabricate and install the structural steel for the new Carrington Bridge. At the tender stage, the steel construction specialist proposed using S460 steel for the plate girders, rather than the S355 grade originally specified. S460 is a newly approved grade of steel supplied by Dillinger, which offers greater tensile strength than S355. Using this high-strength steel allowed the bridge design to be modified from its original six-span structure to a three-span arrangement. This cut the number of piers required from five to two and dispensed with the need for doubler plates.

The 30% higher yield strength of S460 enabled the plate thickness to be reduced, decreasing the overall weight of steel by 15%. Its mechanical strength and similar weldability to S355 resulted in significant savings on materials, time and costs. Thanks to its chemical composition, weathering steel also provides enhanced resistance to atmospheric corrosion, making it maintenance-free for life, with no need for painting or coating.

Project scope

Cleveland Bridge was responsible for supplying, fabricating and installing all 873 tonnes of steel for the bridge, along with all temporary works required during the installation.

The final design for the 205m-long bridge featured three spans, two of which cross the floodplain and one which crosses the River Severn. The bridge is formed from four main steel girders, connected and reinforced with bracing elements. The longest girder is 42m long, while the heaviest weighs 42 tonnes. Cleveland Bridge used a total of 825 tonnes of S460 for the main beams, diaphragm beams and bracing elements, while S355 was used for the transverse bracing beams, diagonal braces and connecting plates.

The girders were delivered to site as 12 part-length pairs and spliced together to create six longer pairs which were lifted into their final position and all remaining connections completed.

Challenges

The biggest challenges for this project related to the site location, with its close proximity to the existing bridge and to overhead power lines. The original plan was to use two 500-tonne crawler cranes working in tandem. However, Cleveland Bridge chose instead to use a single 1200-tonne strut jib crane, in a fixed position. This had a number of benefits. It avoided the need for road closures and night-time working to install the third span over the river, and avoided the risks associated with lifting large loads by mobile crane close to the new structure. Using a fixed crane also eliminated the need for extensive earthworks to accommodate crawler cranes.

The size of the crane enabled the final pairs of girders to be lifted over the river at a radius of 82m from the crane. To eliminate the risk of the crane boom collapsing onto power lines, it was also moved to a new position part way through the installation.

The bridge section spanning the river required a bolted splice connection to be made approximately 25m out over the water. This connection could not be reached from land, so Cleveland Bridge adopted a new method using a workboat with two Mobile Elevated Work Platforms on board. The boat was positioned below the bridge and the platform baskets were raised to provide access to the splice connections.

The choice of the new S460 steel grade required new weld procedures to be tested and qualified. Cleveland Bridge procured test material early so it could carry out weld testing over a six-week period. This meant it was able to qualify the new weld procedures before the main steel was delivered, ensuring there were no delays to the fabrication process.

Outcomes

Carrington Bridge is the first in the UK to be constructed using S460 weather-resistant, high-strength steel. By choosing this steel, Cleveland Bridge demonstrated its potential for saving time, cost and resources on major bridge projects.

The use of S460 steel ultimately reduced the bridge weight, simplified the construction programme, accelerated the installation, and resulted in fewer transport movements. It reduced overall construction time by seven weeks.

The bridge was successfully constructed in full compliance with Covid-19 restrictions.

"Griffiths were impressed with the collaborative and innovative design solution proposed by Cleveland Bridge UK, which reduced the construction duration and associated risks of working within the flood plain and the professionalism of their delivery team."

Aled Davies,
Project Manager, Griffiths

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