

Brighton Road

Bridge Collision Protection Beams

Issue

Brighton Road Bridge, which carries the Brighton Main Railway Line over the A237, has been struck multiple times by large vehicles whose drivers have misjudged the available headroom.

Bridge strikes are a major cause of infrastructure damage, train delays, and traffic diversions, but despite efforts to improve signage and educate drivers, Brighton Road Bridge continued to be struck. As a result, a permanent solution was needed to protect the structure and improve service reliability for the thousands of daily rail passengers and highway users.

The installation of collision protection beams is a proven solution to safeguard structures. Steel beams filled with concrete grout are supported on either side of the deck to absorb any vehicle strikes and prevent impact damage to the bridge.

At Brighton Road Bridge, Four Tees Engineers (FTE) were appointed by SRE Volker Fitzpatrick to fabricate and install steel collision protection beams that had been designed by Tony Gee & Partners (TGP) along with the detailing and fabrication of the associated steelwork support structures. The acute skew of the bridge resulted in the protection beams believed to be among the longest ever used in the UK.

Solution

The two carefully detailed, fabricated and installed structural steelwork protection beams were 26.3m and 24.6m in length, both 744mm in diameter and totalling 27 tonnes of steel. The associated support structures, each weighing 2 tonnes, were also detailed and fabricated by FTE, giving a total of 35 tonnes of fabricated steelwork to protect Brighton Road Bridge from impacts.





Sustainable Proactive Steelwork Fabrication

In support of FTE's commitment to more sustainable production, recycled steel pipeline sections were sourced for fabrication of the new collision protection beams from Norway's Ormen Lange Gas Field. The recycled tubes were tested in situ to ensure full compliance with the project specification before being welded together at the steel supplier's facility. The oversized lengths of steel tube were then shipped to FTE's fabrication shop.

Upon receipt, the beams were carefully manoeuvred and positioned for fabrication within the FTE yard and workshop using motorised rollers. FTE then cut and angled the beams to length, adding the end detail and bearing plates to the very specific and exacting tolerances specified.

Due to the substantial clear span of the collision protection beams, they had to be pre-cambered before installation. This specialist operation was undertaken by Angle Ring: 36mm for the shorter beam and 74mm for the longer beam. This pre-camber



accounted for the weight of the beams and the weight of the concrete grout that would be used to fill the steelwork tubes once they were installed.

The fabricated beams were transported to FTE's specialist coating partner Hi-Tech Surface Treatment Ltd for application of the protective coating, a P3 finish with an N4 Paint system.

Comprehensive testing by the paint inspector involved 302 individual readings to confirm that the final paint thickness complied with the specification, prior to the beams being delivered to site for installation.

FTE also detailed and fabricated the four substantial steel structures that would support the ends of the new protection beams. These were to be fixed to the existing bridge abutments by others, using a resin anchor system, prior to FTE's installation of the main beams.

Design Reviews and Pre-Installation Inspections

A critical element of the FTE Intelligent Integration approach involves designers, engineers and project managers undertaking a detailed review of the designs that are provided for fabrication. This ensures that all elements will fit together before the site installation phase begins and that any potential issues are identified promptly. This also allows customers and their teams to make any necessary design amendments before fabrication, helping to avoid impacts on the project programme and any key deadlines such as railway blockades.

During the review of this project, the FTE Design Team identified a height difference between the two collision protection beams on each side of the bridge.

If left uncorrected, there was potential for a high vehicle to pass beneath the first beam but fail to clear the exit beam. Following FTE's intervention, TGP were able to adjust the design levels before any site work commenced.

FTE also raised concerns that the specified 50mm diameter access holes to fill the steel beams with concrete grout were not large enough to efficiently place the material. This was later confirmed by the concrete grouting contractor and resulted in FTE responding promptly, increasing the access holes to 150mm diameter and providing the additional local strengthening measures required.

As the support structures were unusually being installed by others, FTE took the prudent decision to tack weld only the beams during fabrication, and to delay final welding until an accurate "as-installed" survey of the support structures had been completed. This decision proved invaluable, enabling FTE to efficiently re-detail and modify the beam ends to accurately match the as-built position of the supports. It also prevented significant rework that would have been necessary had the welding and fabrication been completed to the specified design requirements. Most importantly, this methodology guaranteed a first time fit installation during the rail blockade.

The survey of the completed support structures also identified the need for significant modifications to the fixing anchorages due to inconsistencies with the design. This required the fixing anchorages to be strengthened, averting a situation that could have compromised the level of protection provided by the beams.

Resilient Design Solutions

Whilst the original methodology proposed lifting the beams into place with a crane situated in the road adjacent to the bridge, issues with buried services within the highway subsequently required the crane position to be relocated. The alternative location in the adjacent Coulsdon South Station car park posed additional challenges due to the sloping ground, for which the in-house FTE Design Team developed temporary works designs to provide the necessary foundations.

The relocation of the crane also required careful route planning for delivery of the final collision protection beams through the approach roads, for which rear-wheel-steer transporters were used to safely overcome obstacles and obstructions.

The temporary lifting lugs for the collision protection beams were also designed by FTE's in-house Design Team. With a focus on sustainable solutions, these were over-designed as permanent fixings, meaning they can be used in the future should the beams need to be removed or potentially repurposed.

Outcome

FTE's intelligent integration ensured that the challenging project to protect Brighton Road Bridge from vehicular impact was completed sustainably and accurately, reducing full lifecycle costs, providing structural resilience and preventing inconvenient delays to passengers and the travelling public.





Complexities arising from onerous tolerances, variations in as-built elements, and evolving methodologies required FTE to make proactive and responsive decisions that ultimately ensured the successful delivery of resilient bridge protection measures.

With a focus on providing sustainable solutions, FTE sourced recycled steel tube from of Norway's Ormen Lange Gas Field for fabrication of the new collision protection beams, delivering savings in both carbon and overall cost. The lifting lugs were designed as a permanent solution to future-proof any requirements for the beams to be removed or repurposed. Proactive decisions to delay final welding also allowed efficient modifications to be made to the beams, enabling them to match as-built conditions without rework, support precise fabrication and avoid potential on-site clashes.

Through FTE's process of design reviews to ensure buildability, an anomaly in the design levels was identified, allowing this to be rectified at the outset, before any fabrication or installation work had commenced.

Similarly, FTE's pre-installation survey and inspection process highlighted design inconsistencies with the support fixing anchorages, allowing these to be rectified before the collision protection beams were lifted into position.

The project's success was further enhanced by FTE's ability to proactively plan and respond to a changing project environment. When modifications to the beams were required to allow them to be filled with concrete grout, FTE responded promptly, providing suitable access measures along with the required additional local strengthening.

And when the crane had to be relocated, FTE provided temporary works foundation calculations and route planning for delivery of the final beams.

Bridge strikes are a major cause of infrastructure damage, train delays, and traffic diversions. The provision of the permanent collision protection solution at Brighton Road Bridge will improve service reliability for the thousands of daily rail passengers and reduce traffic disruption for highway users for many years to come.



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