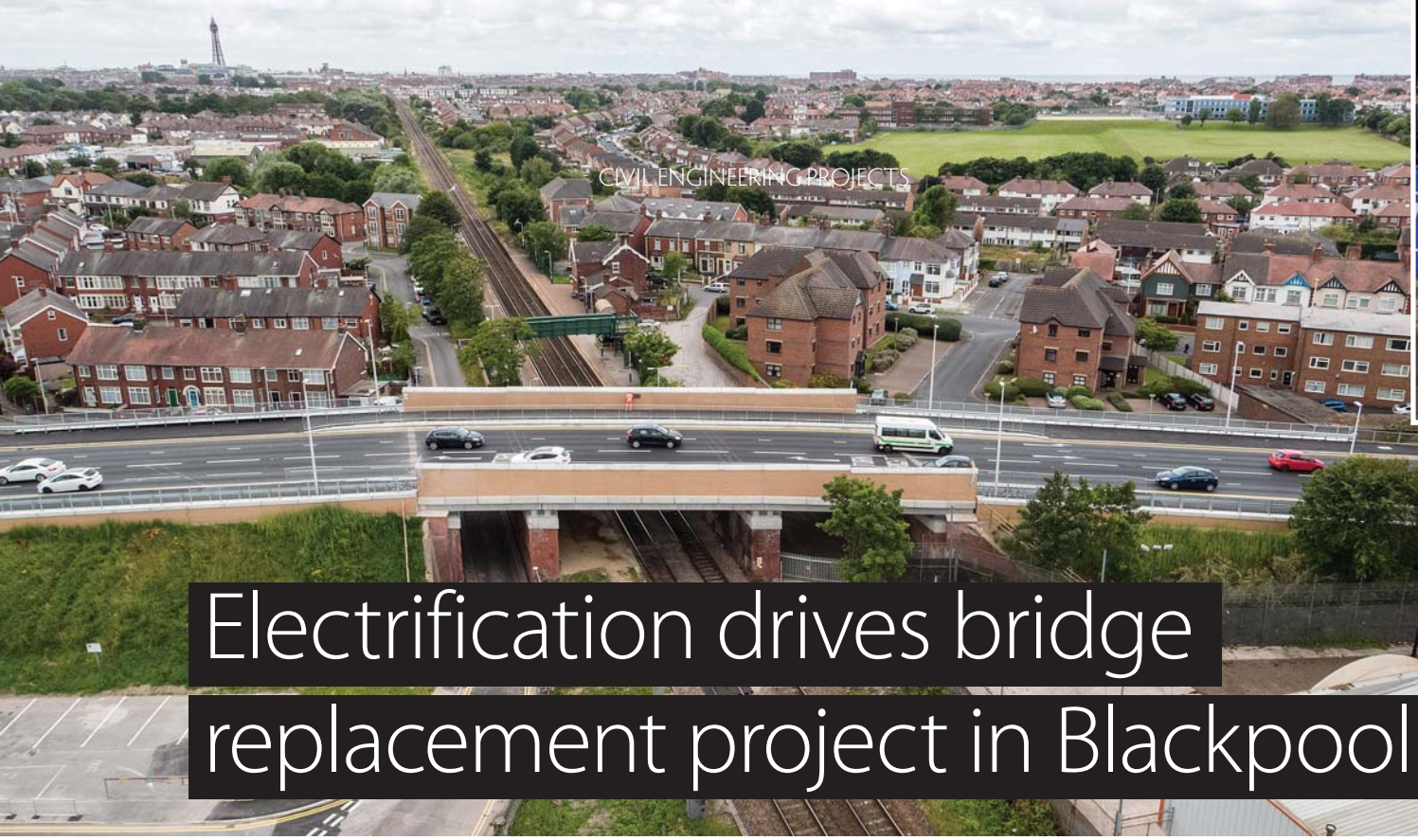


Electrification drives bridge replacement project in Blackpool

Ilyass Meslek of CCL discusses the design considerations for a concrete bridge replacement project in Blackpool.

Above: The three-span road-over-rail bridge at Plymouth Road in Blackpool.

Plymouth Road Bridge – a road-over-rail bridge providing a key route into Blackpool town centre – has been replaced in a year-long programme designed to ensure the safety of both road users and rail traffic.

The steel within the legacy concrete structure was severely corroded and the life-expired bridge needed to be replaced to extend the service life of the surrounding infrastructure. The soffit was also raised as part of renewal of the asset to enable electrification of the rail line.

Designed by Wilde Consulting Engineers and delivered by Story Contracting for Network Rail, in association with Blackpool Council, the project required removal of the existing three-span deck, which equated to around 1000 tonnes of concrete and steel. The demolition was carried out in a phased programme, with a temporary service bridge constructed to maintain pedestrian access throughout the scheme.

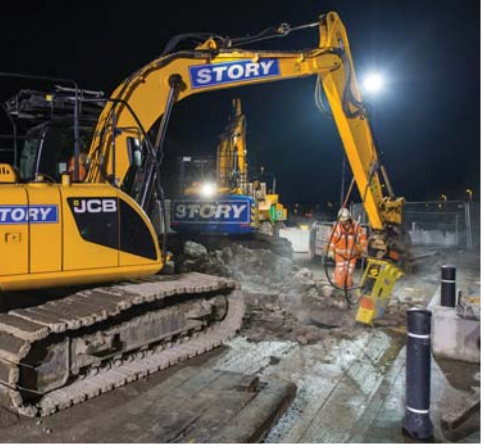
A temporary service bridge maintained pedestrian access.

Using the existing abutments and piers, a new bridge deck was constructed with 18 prestressed precast concrete beams per span with 54 prestressed precast concrete beams in total for the three spans. These were lowered into position following installation of 108 custom-designed and manufactured elastomeric bridge bearings, using a 1000-tonne lattice crane. With a combined weight of 600 tonnes, the precast beams were installed in day- and night-time operations over just two 54-hour weekend railway possessions.

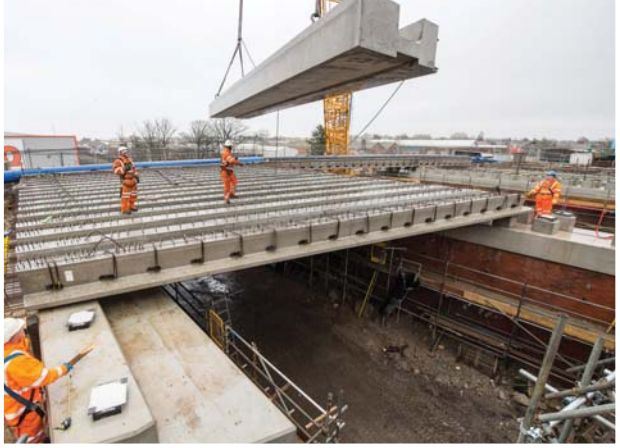
Design considerations

CCL was brought in to advise on the bridge bearing requirements of the project by Wilde Consulting during the early design stages of the project to ensure that the maximum vertical loading, transverse force and rotational movement could be achieved within the constraints of the bearing design. As a refurbishment project using the existing abutments and piers, the space available for the bearing shelf and, consequently, the bearings, was limited to the existing structural parameters.

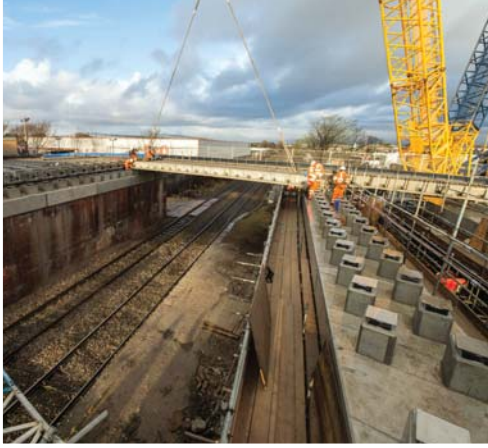
The existing structure also influenced the bridge design itself. Plymouth Road Bridge is a three-span bridge with the largest span in



Removal of the existing three-span deck.



Prestressed precast beams being lowered onto CCL Elastomeric bridge bearings.



CCL elastomeric bridge bearings located on bearing shelves.

the centre, supported by a pair of central piers. If all three spans had been the same length, the replacement bridge could have been designed as a continuous structure. However, because the spans were different lengths, they were designed as semi-discrete structures to allow rotational movement at the piers. An infilled slab ties the three spans together, while each span can act independently.

Among the other key design criteria was the requirement for a high-containment parapet running the whole span of the bridge to safeguard pedestrians and mitigate the risk of any vehicles falling onto the railway line in the event of a road-traffic accident. This parapet had to be factored into the design considerations for the bridge bearings because it increased the forces for the edge beams of the central span.

Creating the central span

The maximum force requirements for each element of the bridge were generated in structural analysis software and, for the majority of the 108 bridge bearings, the design requirements were for vertical forces of up to 750kN, transverse loading of up to 35kN and rotation of up to 0.006 radians. The precast bearing shelf was fabricated in three sections for ease of transport and CCL had to design the bearings to fit the dimensions of the shelf, which were restricted by the abutments and pillars.

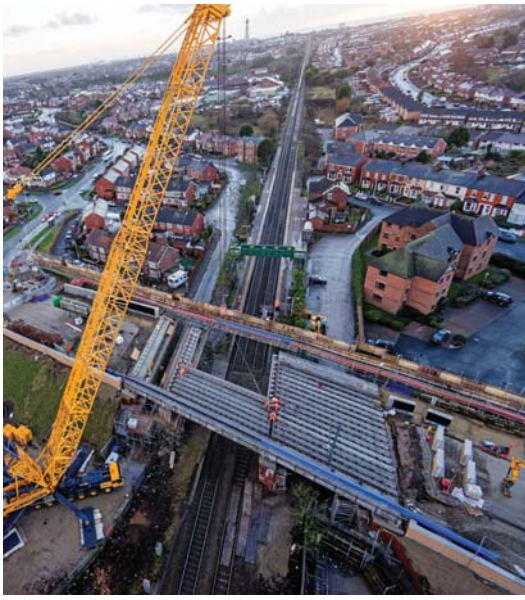
Speed of manufacture was also critical, as the bearings had to be installed within the prescribed window in the schedule, in line with agreed railway possessions. The CCL team developed a series of design iterations for the bearings so that the design and delivery team could agree the best-fit solution for the project. The bearings were then manufactured and delivered to site with guidance on the most appropriate fixing methodology.

Once the bearing shelves were in position, surveyors marked out the locations for each bearing across the length of the shelf and each bearing was secured in place using an epoxy mortar.

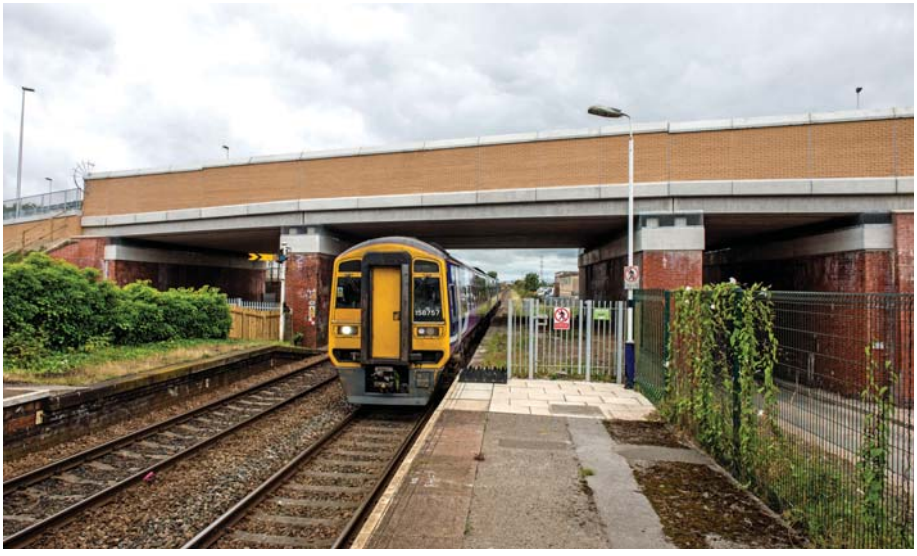
With all the bearings in place, the precast beams were lowered into position onto the bearings with a narrow void between each beam. All the beams were cast with transverse details to enable steel ties to be threaded through the new structure, tying the beams together. An in-situ pour, totalling some 800 tonnes of concrete, filled the void between the beams to create a single, monolithic structure and a level deck 150mm above the surface of the beams. A bridge-deck waterproofing surface was then sprayed onto the concrete deck prior to installation of the road surface.

Early completion

Throughout the project, keeping the programme on track was business-critical for both the contractor, Network Rail and Blackpool Council, and the project was successfully completed three weeks ahead of schedule. ■



A 1000-tonne lattice crane was used to lower the prestressed precast concrete beams into position.



The completed three-span bridge at Plymouth Road, Blackpool.