

CASE STUDY

REPLACEMENT OF THE MONMORE GREEN BRIDGE, WOLVERHAMPTON, BY PFA AND EARTH EMBANKMENT

In August 1989, Wolverhampton Metropolitan Borough Council commissioned Mott MacDonald to carry out load assessments on three bridges. One of these bridges was Monmore Green Bridge between Bilston and Wolverhampton, which carried the A41, a busy urban highway, over the old Great Western Railway's 'Low Level Line' from Birmingham, Snow Hill to Wolverhampton. Rail traffic had ceased and the two span, highly skewed bridge crossed a linear walkway and cycleway, which had been created along the line of the old permanent way.



The bridge consisted of two steel parapet girders spanning between brick abutments, with a central brick pier as an intermediate support. Steel cross girders spanned square to the abutments and supported precast concrete slabs spanning between the cross girders. In turn, these slabs were overlain with mass concrete and tarmacadam surfacing, carrying two wide lanes of heavy traffic.

Inspection and assessment

The inspection revealed heavy corrosion of the steelwork, largely due to leakage through the joints in the deck slabs.

In addition, a corner of one of the brick abutments was cracked and there were signs of ongoing movement.

An initial assessment showed that the load carrying capacity of the bridge was inadequate for 40T Assessment Live Loading. Lane restrictions were applied to restrict traffic loading and material

testing and a site investigation was carried out. This was followed by a more detailed assessment which confirmed the inadequacy of the bridge superstructure to carry 40T ALL and 45 units of HB Loading. The site investigation indicated partial extraction of coal beneath the bridge, particularly in the area of the cracked abutments.

Possible solution

Mott MacDonald were retained by Wolverhampton MBC to investigate the feasibility of strengthening or, alternatively, replacement of the bridge. Various methods of increasing the load carrying capacity of the bridge superstructure were considered, involving renewal of the deck slabs and refurbishment of the steelwork. Each of these presented problems with highway alignment, traffic control and accommodation of services and did not address the long term stability of the structure, particularly at the abutments.

The proposed Midland Metro line 1 will follow the disused railway formation for the majority of the route between Birmingham and Wolverhampton. However, it is at Monmore Green that the Metro rises from railway level to street running along the A41 for the remainder of the route to Wolverhampton.

Consequently, a bridge structure was not required and the solution was to replace the bridge with an earth embankment. A pedestrian subway through the embankment was considered but rejected. The long, shallow graded embankment slopes required for environmental reasons and to bring the tracks of the proposed Midland Metro up to street level would mean an expensive and unacceptably long subway.

Constraints

The decision to replace the bridge meant solving a number of practical problems.

The maintenance of two way traffic on the A41 was a priority, as was the maintenance of services in both footways. In particular, British Telecom's main trunk feeders were old and delicate and could not be disturbed.

The form of construction of the bridge and the angle of skew would make demolition in longitudinal strips impossible.

The anticipated programme for Midland Metro required substantial completion of the work by the end of March 1992.

Various layouts of temporary embankments, possibly incorporating Bailey bridges, were examined and whilst acceptable highway layouts might have been achieved, the costs were very high. However, the overriding factor of the BT cables was virtually unsurmountable. BT had no alternative capacity on to which to divert the cables or resources to complete temporary diversions in a realistic timescale.

The chosen solution

The solution adopted involved extensive use of PFA, both as bulk fill as the principal constituent of the grout mixes, and provided answers to the above problems. Most importantly, it avoided the need for major temporary traffic or services diversions and enabled almost complete removal of the structure with minimum disruption to the community.

How it was achieved

Detailed design and contract documentation was prepared by Mott MacDonald and following competitive tendering the works were completed within eight months.

The first step was the grouting with PFA: cement grout of the abandoned mineworkings, both beneath the existing structure and throughout the area of the proposed structural embankments. Unsuitable material was then removed from the base of the cutting and drainage installed.

A Pulverised Fuel Ash (PFA) embankment was constructed with 1 in 2 side slopes until headroom for the compaction plant was lost, following which a retaining structure consisting of stone filled gabions with a geotextile membrane lining was built between the top of the PFA and the bridge soffit. The remaining void was grouted with a PFA: cement grout, up to the soffit of the cross beams of the bridge. Tests were carried out to ensure that the hardened grout was in intimate contact with the underside of the cross beams and strong enough to carry the weight of the deck and traffic loads.

The deck slabs and cross beams of the bridge were then removed and the carriageway reconstructed in a sequence of three phased traffic diversions. The voids beneath the footways were subsequently grouted to support the deck slabs and services, including those of British Telecom.



Finally, after the completion of landscape filling either side of the bridge, including fill compacted to Department of Transport specification beneath the planned Metro formation, the parapet girders were removed and the footways made good.

To complete the project, the embankments were landscaped to the local authority's specification and the linear walkway was reinstated, allowing pedestrians to cross the road at surface level.

Acknowledgments

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Wolverhampton Metropolitan Borough Council

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