MOTT MACDONALD

Hammersmith Bridge–Listed Building Consent for Pedestal Stabilisation

Design, Access and Heritage Statement

3 December 2021

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Executive summary

This design, access and heritage statement has been commissioned by the London Borough of Hammersmith and Fulham in support of an application for Listed Building Consent for works to the Grade II* listed Hammersmith Bridge on the River Thames. The current superstructure of this three span suspension bridge dates from 1887 and was designed by Sir Joseph Bazalgette. It is located in the London Boroughs of Hammersmith & Fulham and Richmond upon Thames.

The proposed works to the bridge concern the stabilisation of the cast iron pedestals after significant cracking was discovered in 2019. The cause of this cracking was determined to be the seizure of the roller bearings between the pedestals and deviation saddles – the seizure of the rollers means that the pedestals have been taking large restraint forces which they were never designed to withstand.

Listed Building Consent was previously granted in 2019 by both boroughs for the dismantling of significant portions of the deviation chamber panels surrounding each pedestal. This was done in order to allow removal of paint from the pedestals to determine the full extent of cracking and any other defects. The dismantling of the deviation chambers was also required in order to allow for the works proposed in this new Listed Building Consent application.

The works to Hammersmith Bridge proposed in this new Listed Building Consent application consist of the removal of the existing seized roller bearings at the pedestals and their replacement with new elastomeric bearings. This will restore the bridge to its original behaviour and thus remove the overstress and root cause of cracking.

These works will involve permanent interventions including the addition of new strengthening elements and the removal of some original fabric. The permanent interventions comprise new steel saddle brackets and the filling of the pedestals with fibre-reinforced concrete & grout, as well as the aforementioned elastomeric bearings. The original existing rollers at the pedestals are to be permanently removed. Temporary removal of small areas of the original parapets and pedestal casings will also be required; these will be reinstated after the permanent intervention works are complete.

The other temporary (reversible) interventions comprise a series of flat jacks, steel cheek plate frames around the pedestals and hydraulic cylinders connecting the cheek plate frames to the saddle brackets. Temporary scaffold ramps will be provided to allow pedestrians to continue to use the bridge throughout the permanent intervention works, and temporary hoarding will be installed around the pedestals after the permanent intervention works are complete. The temporary ramps and hoarding will be the subject of separate planning and licence applications as required. Details of these temporary elements are shown for information and context only, and will be further developed upon engagement of the contractor.

The long term plan is for the deviation chamber panels to be re-erected around the pedestals. This means that the permanent works proposed in this application will ultimately be hidden from view, and the overall appearance of the bridge will remain unchanged. There is also precedent for similar works being carried out on the bridge in 1984 (at the Barnes tower) and 1998 (at the Hammersmith tower), when the towers' original roller bearings were also replaced with new elastomeric bearings by a similar method.

The pedestal stabilisation works proposed in this document are necessary to preserve this Grade II* listed bridge for future generations and improve access to the local area in the long term. Historic England and the conservation officers for both boroughs have been consulted, and efforts have been made to minimise the impact on the historic fabric as much as possible.

1. Introduction

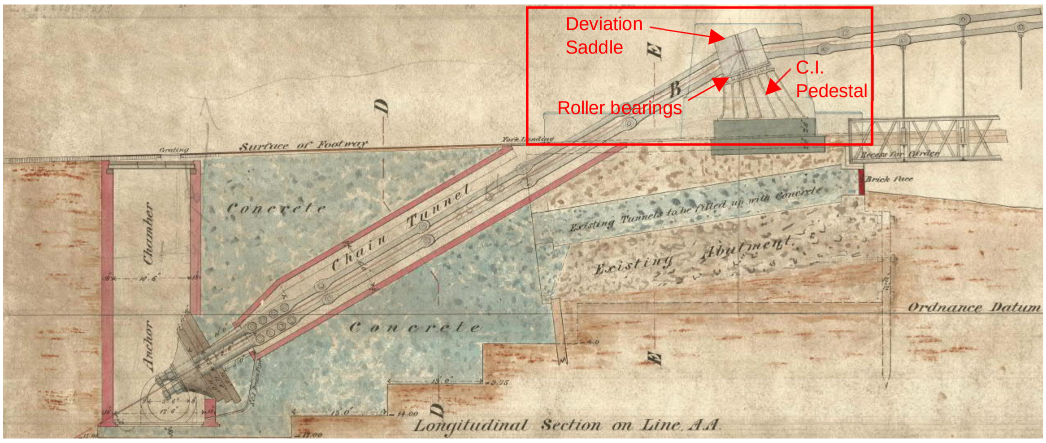
This design, access and heritage statement has been commissioned by the London Borough of Hammersmith and Fulham in support of an application for Listed Building Consent for works to the Grade II* listed Hammersmith Bridge on the River Thames.

Hammersmith Bridge is a three-span suspension bridge with ground anchored suspension chains. The original bridge was constructed in 1827 but the superstructure was replaced in 1887, supported on the enhanced original bridge foundations. The north side of the bridge is in the London Borough of Hammersmith & Fulham (LBHF), and the south side of the bridge is in the London Borough of Richmond upon Thames (LBRuT).

Figure 1.1: View of Hammersmith Bridge

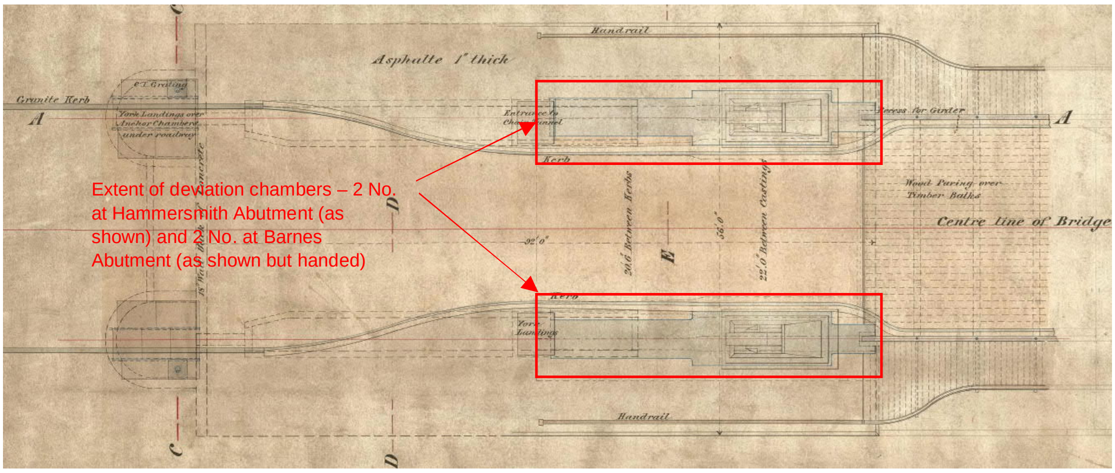
The proposed works involve the emergency stabilisation of the four cast iron pedestals, two at each end of the bridge. Each pedestal supports a deviation saddle, with roller bearings in between; the suspension chains pass over these deviation saddles and change angle. The chains dive down into the ground within a brick tunnel surrounded by concrete, and the chains are anchored at the bottom of the brick tunnel; this forms the gravity anchor.

Figure 1.2: Sectional elevation of chain tunnel and deviation saddle (4No. thus)



Source: Extract from original Contract Drawing No. 11

Figure 1.3: Plan of abutments, deviation saddle and deviation chambers



Source: Extract from original Contract Drawing No. 11

The roller bearings between the pedestals and deviation saddles have corroded and seized, resulting in the cast iron pedestals being overstressed. During the non-destructive testing (NDT) works in April 2019, a number of significant cracks were discovered in the cast iron pedestals, initiating from the areas where stress concentrations were expected. In response, London Borough of Hammersmith and Fulham instructed closure of the bridge to motorised traffic with immediate effect.

A scheme was then developed to dismantle a large proportion of the deviation chambers such that access could be gained to the cast iron pedestals within, to remove paint and fully inspect their condition. This work was the subject of the previous listed building consent application (2019/02727/LBC for LBHF and DC/SGR/19/2813/LBC/LBC for LBRuT) which was consented to in November 2019. The condition and location of all cracking was subsequently logged and captured digitally within 3D models. This enabled detailed assessment of each pedestal to be carried out providing a better understanding of their stressed state.

The bridge remained open to pedestrians and cyclists under a case for continued safe operation (CCSO), the basis of which relied heavily upon continuation of the observed steady state condition (i.e. no further deterioration to the pedestals). With regular visual inspection and monitoring including strain, temperature and acoustic emissions, this steady state condition was successfully demonstrated for more than a year.

In August 2020 however, following a sustained period of hot weather, propagation of cracking was detected and confirmed at the North East (NE) pedestal. This invalidated the CCSO, resulting in the immediate full closure of the bridge to pedestrians, cyclists and river traffic beneath.

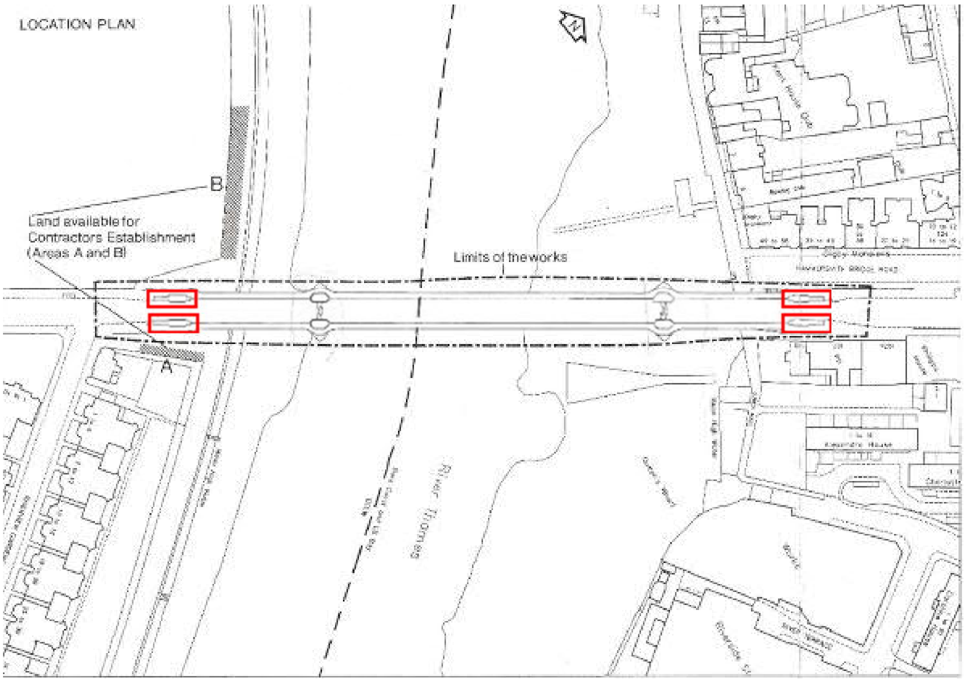
The bridge was only reopened to pedestrians, cyclists and river traffic in July 2021 after the introduction of a temperature control system and further detailed analysis. This was an effective interim measure, but the roller bearings remained seized and the pedestals remained cracked and damaged.

A design for emergency stabilisation of the pedestals was developed by Transport for London (TfL) and their consultants, in the form of an external jacking frame supported on new piled foundations through the existing anchor block. However, a number of issues were raised with this scheme including a clash with the gas mains, significant impact on the existing historic fabric, and the stability of the pedestals during construction of the new foundations. Therefore, Mott MacDonald (MM) were commissioned by LBHF to develop an alternative design for emergency stabilisation of the pedestals.

The scheme developed and presented herein is based on similar works already undertaken at the tower top saddles several decades ago. It involves the replacement of the corroded and seized roller bearings with laminated elastomeric bearings in order to reinstate the necessary movement and relieve the locked-in overstress within the cast iron pedestals. The scheme also includes the strengthening of the cracked cast iron pedestals allowing retention of the original fabric in full.

After the pedestal stabilisation works have been completed, major refurbishment works are planned, including the re-assembly of the removed original deviation chambers around the pedestals. These subsequent major refurbishment works will be the topic of future Listed Building Consent applications and are not discussed further herein.

Figure 1.4: Plan view of the bridge area in relation to the river



Source: Extract from Drawing No.:82440/29/1

2. Heritage Statement

Methodology

A desk-based study has been undertaken to identify and understand the heritage significance of the Grade II* listed Hammersmith bridge. Data sources used to carry out the assessment include:

- Heritage Environment Record (HER);
- National Heritage List for England;
- Local studies resources; and
- Historic mapping.

A full list of references can be found in Section 5.

Heritage Significance

Site Context

In 1824 the Hammersmith Company was established by an act of parliament, tasked with the construction of a bridge linking Hammersmith (Middlesex) with Barnes (Surrey). The company was also tasked with constructing roads and avenues to communicate with the bridge. The Surrey approach road was constructed on land which was previously a part of the Barn Elms Estate and owned by the Dean and Chapter of St Pauls. The land was acquired for the sum of £35,700 from the Dean who would only sell it on the condition that the entire 455-acre estate was purchased. (Phillips, 1981)

Hammersmith Bridge rests on pier foundations constructed for an earlier bridge on the site. The original Hammersmith Bridge, built in 1824-27 to designs by William Tierney Clark (1783-1852), was the first iron suspension bridge to span the Thames. The original bridge, as with the current version, was popular as a vantage point to watch the annual University Boat Race, so much so that the crowds of up to 12,000 people caused the original bridge to sway alarmingly when they rushed from one side to the other. Although the original bridge, depicted below, did not fail, the Metropolitan Board of Works chose to replace it with the current structure, retaining, and strengthening the original foundations. A temporary bridge was erected across the river and used until Bazalgette's structure was completed in 1887. (Dredge, 1897)

Figure 2.1: Original

Source: The London Picture Archive

The historic setting of the bridge has remained largely unchanged since its construction.

Figure 2.2: Hammersmith Bridge viewed from Barnes (c1940)

Source: The London Picture Archive

Historical Development

The architectural quality of Hammersmith Bridge is remarkable in both form, with its monumental towers, and ornamentation, as seen in the lavish colour scheme and heraldry; the bridge is one of the most distinctive on the Thames. Replacing one of the first modern suspension bridges in the world of which the foundations still survive, the bridge is of technological special interest for its materials and is also distinguished by its connection with the highly-significant Victorian engineer Joseph Bazalgette.

Hammersmith Bridge was begun for the Metropolitan Board of Works in 1884 and was opened by the Prince of Wales on 18 June 1887. It cost £71,500 and was designed by the Board's chief engineer, Sir Joseph Bazalgette (1819-91). In 1973-6 the bridge was strengthened and repaired in extensive works; in June 2000, Hammersmith Bridge was the target of a terrorist bomb attack and, after repairs, was reopened subject to a weight limit.

The bridge is recorded as currently being painted in the original colour envisaged by Bazalgette. Each of the saddle casings display the seal of the Metropolitan Board of Works which is made up from the following coats of arms: the Royal House, Kent, Guildford, Westminster, Colchester, Middlesex, the City of London, details of which are included within Drawing No: HC/209/C/40 in Section 6. (Hailstone, 1987)

Figure 2.3: Image of the coats of arms

Source: Mott MacDonald

Significant Past Events

- In 1939 a bomb was detonated by the IRA on the west side of the bridge at midspan. The stiffening girder was damaged, and part of the lower catenary chain was severed. A system of tensioned bars was used to bypass the damaged chain links with turnbuckles above and below the damaged section.
- In 1966 the mast of a yacht collided with the bridge, lifting part of the footway and fracturing the gas main beneath.
- In 1967 a hanger towards the centre of the bridge snapped and another hanger was found to have an incipient crack. This was attributed to exceptional use by trucks carrying excavated material associated with the infilling of a nearby reservoir. Temporary reinforcements were made.
- In 1977 a temporary footway was cantilevered from the bridge to allow the existing footways to be used as working areas. This applied a considerable additional moment on the downstream footway connection brackets necessitating the installation of a tie rod strengthening system (Note: Tie rods are still present today but are now redundant). Replacement of the stiffening girders allowed the short hangers to be replaced with new articulated hangers with turnbuckles designed to minimize the undesirable bending stresses. The chain saddle rollers were replaced by smaller diameter high tensile steel rollers using hydraulic jacks. Access hatches were installed in the side of the towers along with ladders in the towers to allow servicing of the roller bearings. Prefabricated Jarrah timber panels were used to enable 16ft lengths of existing deck to be removed and replaced overnight. The newly laid deck was then surfaced with gritted epoxy resin over 1in thick ply. Temporary gaps in the deck were bridged during the day with a temporary portable deck unit.
- The extensively corroded chains in the anchorage tunnels, were water blasted at 6000 psi, dried and painted with red lead paint.
- In July 1977 a pleasure cruiser collided with the bridge. The wheelhouse was crushed and eight people on the vessel were injured.
- On 25th February 1984 the roller bearings in the Barnes side towers came off their bearing plates and resulted in the saddles dropping 25mm. The chains dropped by three inches, allowing the carriageway to sag by approximately six inches on one side and two inches on the other. The bridge was closed for five weeks while repairs were carried out and the saddles jacked back up into place. The freedom of movement at the Barnes tower saddle level was reinstated by the end of 1984 by installing four 150mm thick laminated rubber bearings beneath the saddles.
- On 1st of June 2000 a bomb was detonated on the bridge which blew a large hole through the web of a cross-girder at the connection with the stiffening girder on the downstream Barnes side. Hyder were commissioned to design repair works in which a 1m length of locally buckled stiffening girder was replaced by a welded section, a severed palm plate hanger connection was replaced and a 4.5m length of cross-girder replaced.

The Designer

Sir Joseph Bazalgette, the designer of the new (current) Hammersmith Bridge, was one of the most eminent engineers of the Victorian era. He was born in 1819 in Enfield, London, setting up as a consulting engineer in 1842 and starting out engaging primarily on railway works. He is largely recognised for his contribution in the design of the London sewer system in which 83 miles of large intercepting sewers were built. However, he also designed many other notable structures and bridges including Putney Bridge, Maidstone Bridge (Crossing the River Medway in Maidstone), Battersea Bridge and Albert Bridge. In 1856, Bazalgette was appointed as chief engineer of the Metropolitan Board of Works. (Hailstone, 1987)

The Chain Link Design

Chain link suspension bridges were mainly used during the early 19th and 20th century. The idea is largely credited to James Finley who designed numerous suspension bridges, such as Jacob's Creek Bridge in America (1801). Finley incorporated vertical hangers to support the deck from the main cables which were made from square iron bars that were wrought into chain links. None of Finley's suspension bridges have survived and it is thought that this is due to the under specification of the links used.

Learning from Finley's mistakes, Samuel Brown refined the bridge form by replacing the chain link cables with eye-bar chain cables. These are typically comprised of flat or circular bars which have a bulbous end. At these ends is a hole to allow each bar to be hinged to the next bar using pins.

Eye-bars can be used to create pinned connections which allow for free end rotations. This is useful as free end rotations reduce stress levels in members, allowing for less material to be used in the connection detail. For early steel bridge designers this was very important as the cost of steel in the 19th and early 20th century was high.

The disadvantage of using eye-bars is that they are very hard to inspect as there can be hidden elements which cannot be seen. As a result, this can lead to corrosion not being noticed within certain elements. Furthermore, as pinned connections allow for more movement, the vibrations of eye bar members can increase. This is because any eye-bar/pin wear will cause a decrease in tension occurring in the eye-bar, subsequently leading to greater longitudinal side to side vibrations. Moving parts now become subject to wear due to these vibrations.

One of the earliest examples of these eye-bars is in the Union bridge (1820) which was country's first wrought iron suspension bridge, designed by Samuel Brown. Brown worked on similar projects such as Wellington suspension bridge. Wrought iron was a popular material of choice at the time as it was stronger than masonry and timber.

Other notable designers who utilised these eye-bars include Brunel for the design of Clifton bridge (1864), William Tierney Clark for his work on the original Hammersmith Bridge (1827), Marlow Bridge (1832), and the Chain Bridge in Budapest (1849). Thomas Telford also used eye-bars in his design for the Menai Bridge (1826).

The use of eye-bars slowly ceased towards the beginning of the 20th century as engineers in France began using cables comprising of parallel bundles of iron wires. The benefit of this technique, with some wires being 3mm in diameter, is that the cable can be up to twice as strong when compared to eye-bars.

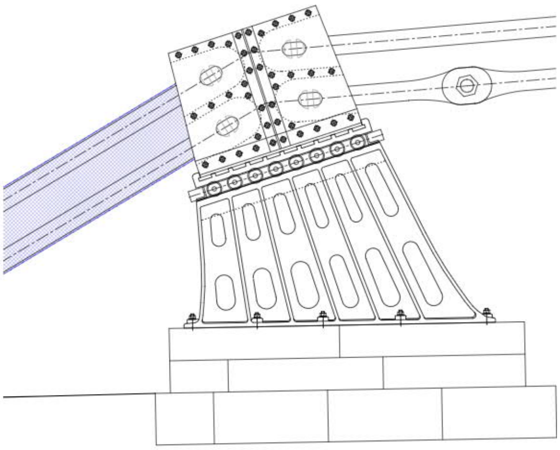
3. Proposed Interventions

The proposed scheme, applied at each of the four pedestals of the bridge (NE, NW, SE & SW), includes both permanent and short term temporary interventions (temporary works) which are necessary to facilitate freeing up, and replacement, of the original corroded and seized steel roller bearings. The permanent additions are generally depicted in red whilst the temporary/reversible interventions (temporary works) are depicted in blue.

The proposed permanent interventions comprise:

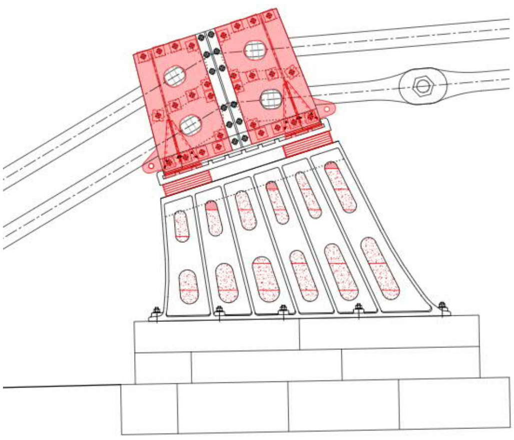
- The addition of fabricated steel brackets which are to be stressed onto the sides of the existing deviation saddles.
- These brackets spread load into 4 no. corner elastomeric bearings which replace the original (8 No.) corroded steel rollers.
- The internal voids of the pedestals are filled with fibre reinforced concrete (with a top lift of injected grout), supplemented with a light cage of conventional reinforcing steel. The external surfaces of the original cast iron pedestals will remain exposed and visible.

Figure 3.1: Existing Arrangement



Source: Mott MacDonald

Figure 3.2: Proposed Arrangement



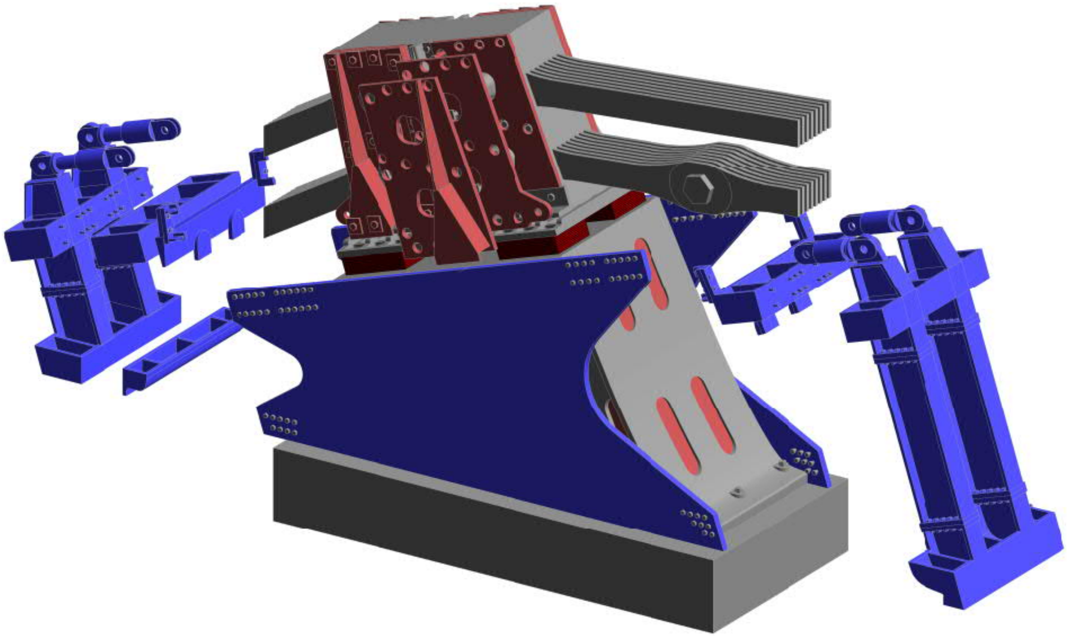
Source: Mott MacDonald

For scale drawings of the existing and proposed elevations of the pedestals, refer to drawing 105098-MMD-XX-00-DR-C-0061.

The proposed temporary (reversable) interventions comprise:

- Local dismantling of pedestrian parapet panels.
- Dismantling and offsite storage of additional cast iron deviation chamber casing panels

Figure 3.3: Exploded isometric view of pedestals (permanent interventions in red, temporary (reversible) interventions in blue)



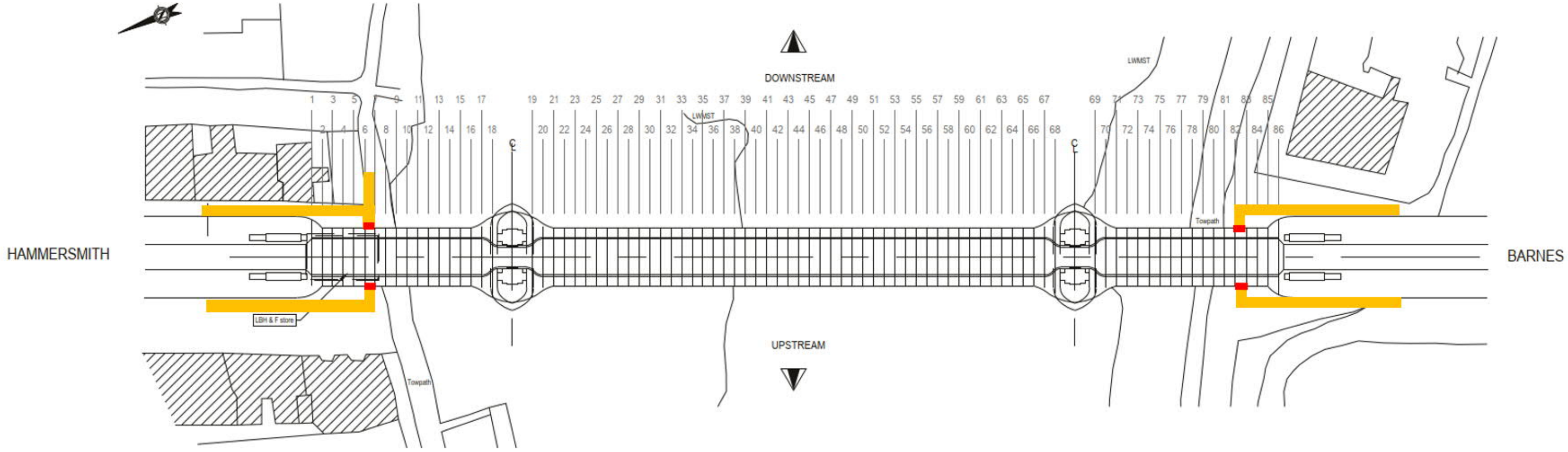
Local dismantling of parapet panels

The bridge has now been re-opened to pedestrians and cyclists, and this access will need to be maintained throughout the intervention works. It will not be possible to divert pedestrians and cyclists onto the carriageway during the intervention works for safety reasons, as this space would have to be occupied by cranes and other construction equipment.

Two-way pedestrian traffic must be maintained at all times. To achieve this, four temporary scaffold ramps will be constructed to divert pedestrians and cyclists around the pedestals. This will also require the temporary removal of short lengths of the original parapets. It is proposed that a total of four “panels” (i.e. between adjacent vertical members) would be removed in order to allow the four temporary access ramps to connect to the existing bridge footways. Each “panel” is 2.44m wide (8’), compared to a maximum temporary access ramp width of 2m.

The proposed temporary ramps and the lengths of parapet to be temporarily removed are shown indicatively on Figure 3.4. These ramps will be the subject of separate planning and licence applications (as required) to be pursued by LBHF and the proposed contractor with the respective Network Management/Traffic Management/Highway Licencing Teams of both LBRuT and LBHF – details of these ramps are provided here for information and context only, and will be developed further upon engagement of the contractor.

Figure 3.4: Indicative plan view of temporary ramps (shown in orange) and lengths of parapet to be temporarily removed (shown in red)



Source: Adapted from drawing no. 82440/185/1

There is already an opening in the parapet at the north-west end to allow pedestrians to access the bridge from the road below via a staircase. Although this would allow a diversion route past the north-west pedestal works without having to remove any of the parapet members, it would not be accessible to cyclists or people with mobility impairments, and is thus not a viable option.

Photo 3.1: Existing opening in parapet for access staircase at the north-west end

All ramps would have a maximum gradient of 1:12 to ensure adequate access for cyclists and people with mobility impairments.

Crash decks consisting of a boarded platform would be located above each ramp in the vicinity of each of the pedestals. These would protect pedestrians and cyclists from falling objects during the interventions.

There is currently an opening in the wall and an access door to the Lower Mall residential building from the existing footpath adjacent to the north-east end of the bridge. The temporary ramps will be designed to allow residents to access this opening and door at all times during the interventions.

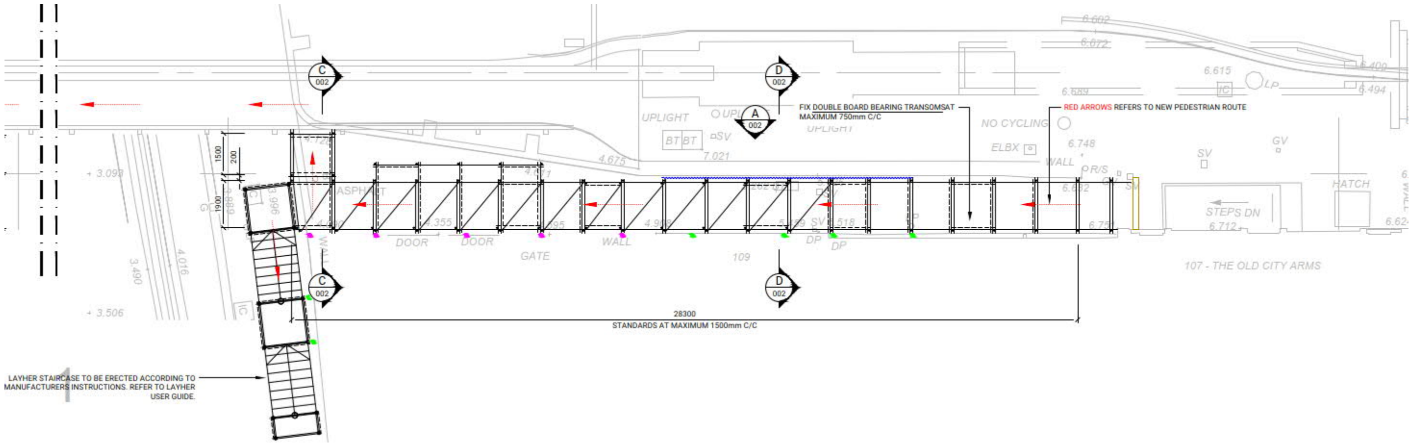
The new temporary ramps will not involve alterations or intrusive fixings into the heritage structure. The ramps will also be designed such that they have sufficient stability to avoid slipping and damaging the bridge.

During the permanent intervention works, there will be a minor change to the pedestrian experience of the heritage structure. In the short-term, pedestrians will not be able to use the original footways in the vicinity of the pedestals as a result of being diverted onto the temporary ramps. This means that pedestrians' views of the bridge will be affected during this period. However, the diversion routes around the pedestals will follow a route parallel to the existing bridge, and at a similar level, so the impact will be minor. The diversion routes around the pedestals will also be made as short as possible to minimise the impact, whilst still maintaining public safety.

The scaffold ramps will be removed after completion of the permanent interventions, and the removed lengths of the original parapets would also be reinstated at this time. There will therefore be no adverse impacts on the appearance of the bridge and its curtilage in the long term.

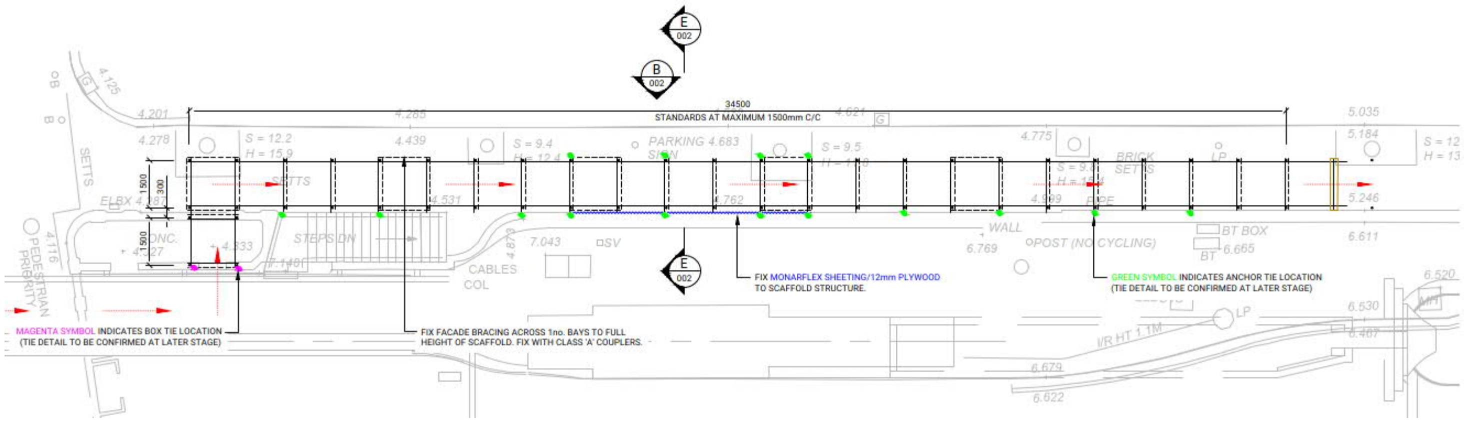
More detailed views of each ramp are shown on Figure 3.5 and Figure 3.6 for the Hammersmith end, and Figure 3.7 and Figure 3.8 for the Barnes end.

Figure 3.5: Indicative scaffold ramp to divert pedestrians around the north-east pedestal (Hammersmith end)



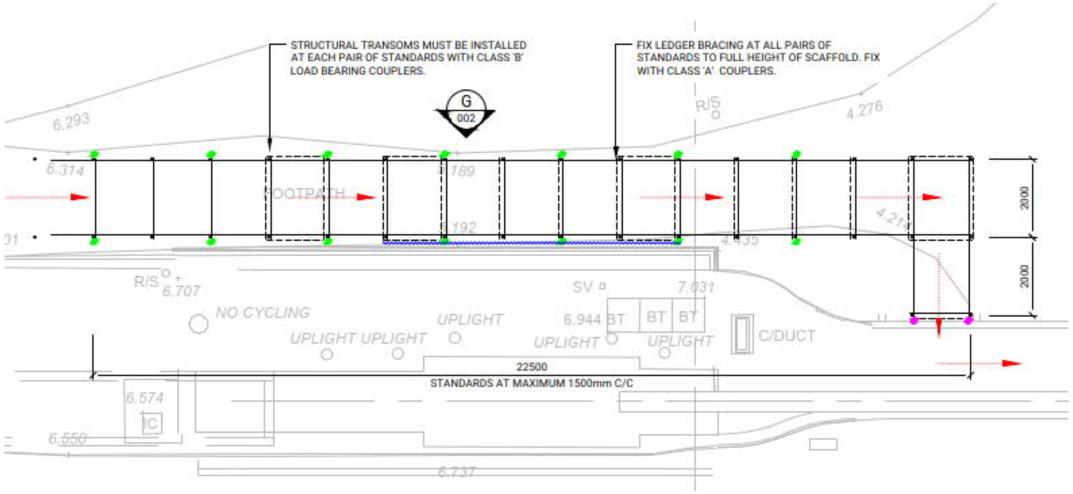
Source: Taziker

Figure 3.6: Indicative scaffold ramp to divert pedestrians around the north-west pedestal (Hammersmith end)



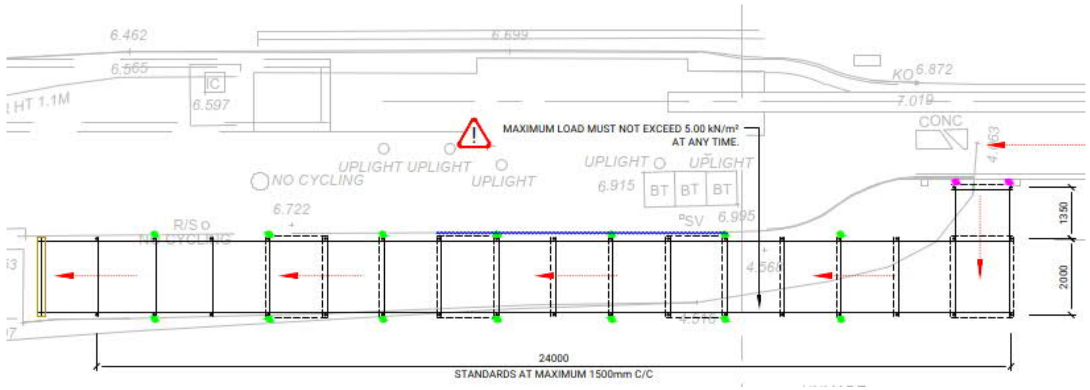
Source: Taziker

Figure 3.7: Indicative scaffold ramp to divert pedestrians around the south-west pedestal (Barnes end)



Source: Taziker

Figure 3.8: Indicative scaffold ramp to divert pedestrians around the south-east pedestal (Barnes end)



Source: Taziker

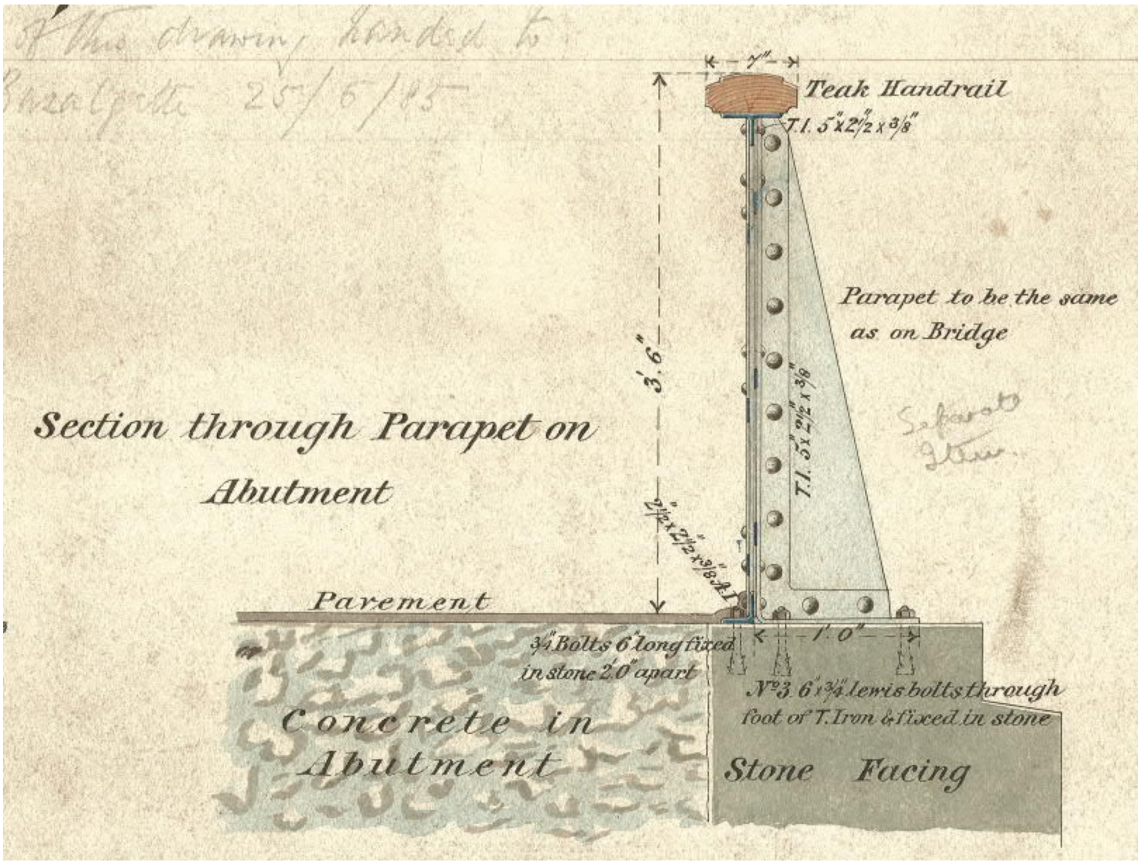
Some photographs and record drawings of the existing parapets are shown below. As can be seen on these images, the original parapet consists of metal flat bars joined together by riveting. The handrail consists of teak; the joints in this handrail generally do not coincide with the vertical cast iron members on the parapet.

Photo 3.2: Typical parapet near north-east pedestal, viewed from adjacent ramp

Photo 3.3: Typical parapet adjacent to ramp at north-east end

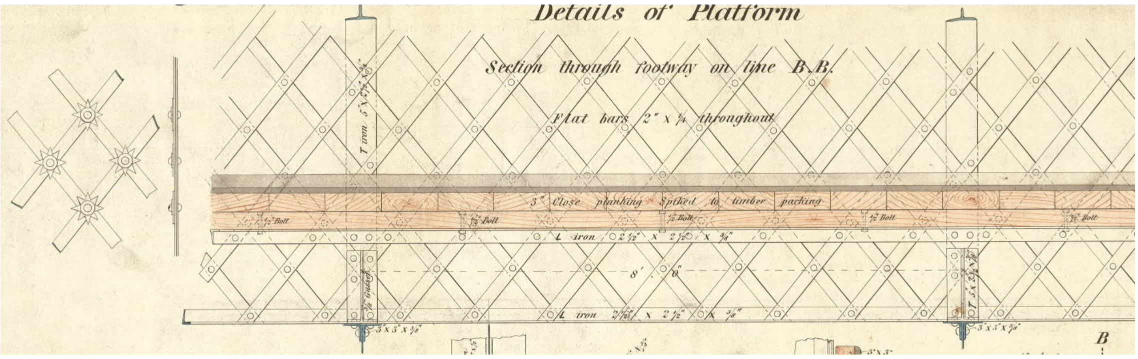
Photo 3.4: Typical parapet near north-west pedestal, viewed from bridge footway

Figure 3.9: Cross-section of existing parapet



Source: Hammersmith Bridge Alterations, Contract Drawing No. 11a

Figure 3.10: Elevation of existing parapet



Source: Hammersmith Bridge Alterations, Contract Drawing No. 4

However, closer to the towers, there are signs that sections of the original parapet have been removed in the past, possibly as part of the temporary footway interventions carried out in 1977. Photo 3.5 shows the original riveted vertical members on the left, and a newer, bolted T-section vertical member on the right; the newer member makes use of dome-headed bolts instead of rivets, and some of the diagonal members have been butt-welded to this vertical member as well.

Photo 3.5: Replacement parapet vertical member from previous interventions (west side of the bridge, near the Hammersmith end tower)

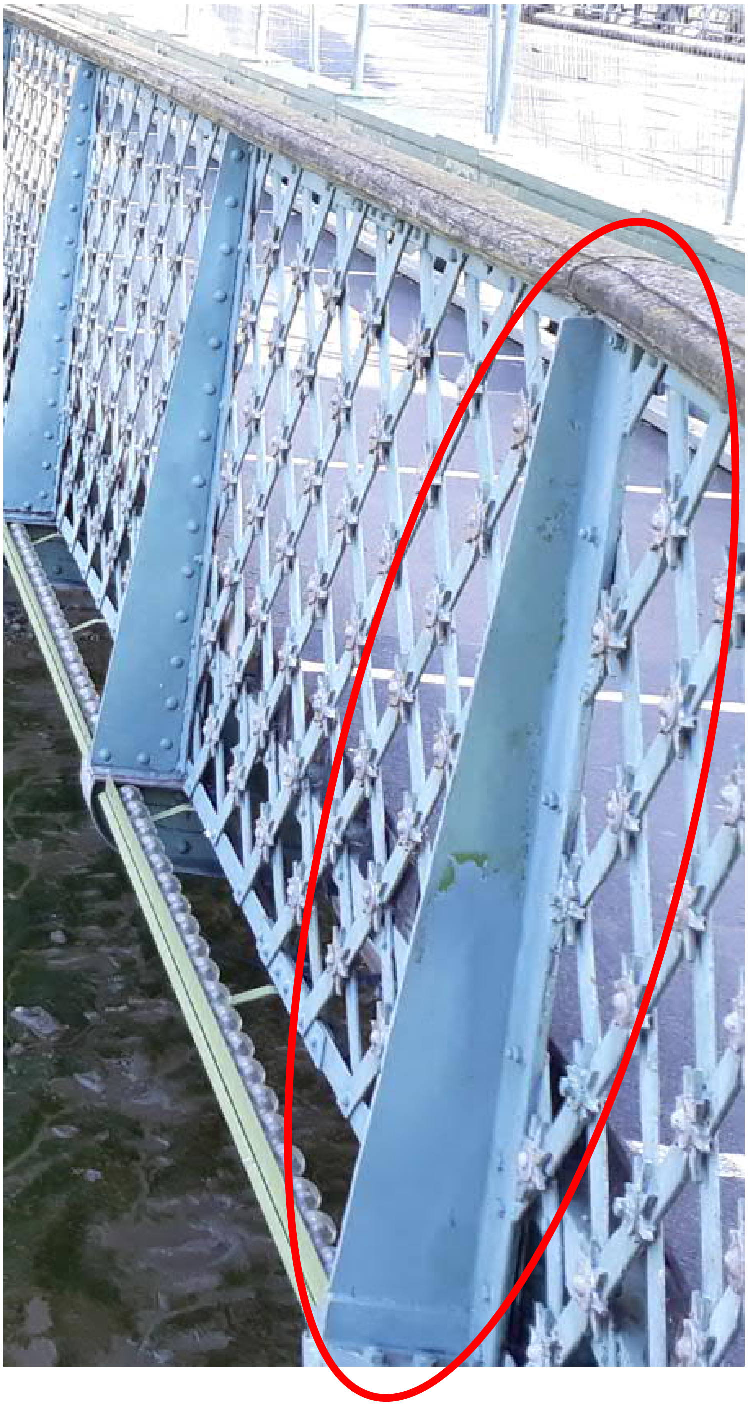


Photo 3.6 shows the footway side of the length of parapet shown in Photo 3.5 – the diagonal members were cut at the location of the original vertical member and then reinstated by bolting them onto the replacement vertical member.

Photo 3.6: Evidence of previous cutting of parapet diagonal members

There are also signs of the bottom horizontal member on the east side of the bridge near the Barnes end abutment having previously been cut and welded back together, as shown on Photo 3.7.

Photo 3.7: Signs of previous cutting and welding of parapet bottom horizontal member (east side of the bridge, near Barnes end abutment)

In other words, there is precedent for removing and replacing sections of the parapets on Hammersmith Bridge, without adversely affecting its overall appearance.

The proposed indicative sequence of the parapet removal works for each panel is as follows (to be read in conjunction with Photo 3.8):

i. At the locations of the vertical members, cut the timber handrail, top horizontal angle member, middle horizontal angle member and diagonal members vertically.
ii. Remove the rivets connecting the diagonal members to the bottom horizontal angle member. Lift out the resulting parapet panel in one piece.
iii. Install a temporary timber beam or steel joist to provide support to the existing timber planks that make up the footway (the middle horizontal angle member provides support to the planks at present, as shown on Figure 3.11).

Photo 3.8: Proposed parapet member cutting locations on inside face of vertical members (in red), proposed rivets to be removed (in orange), proposed parapet length to be removed (in yellow)

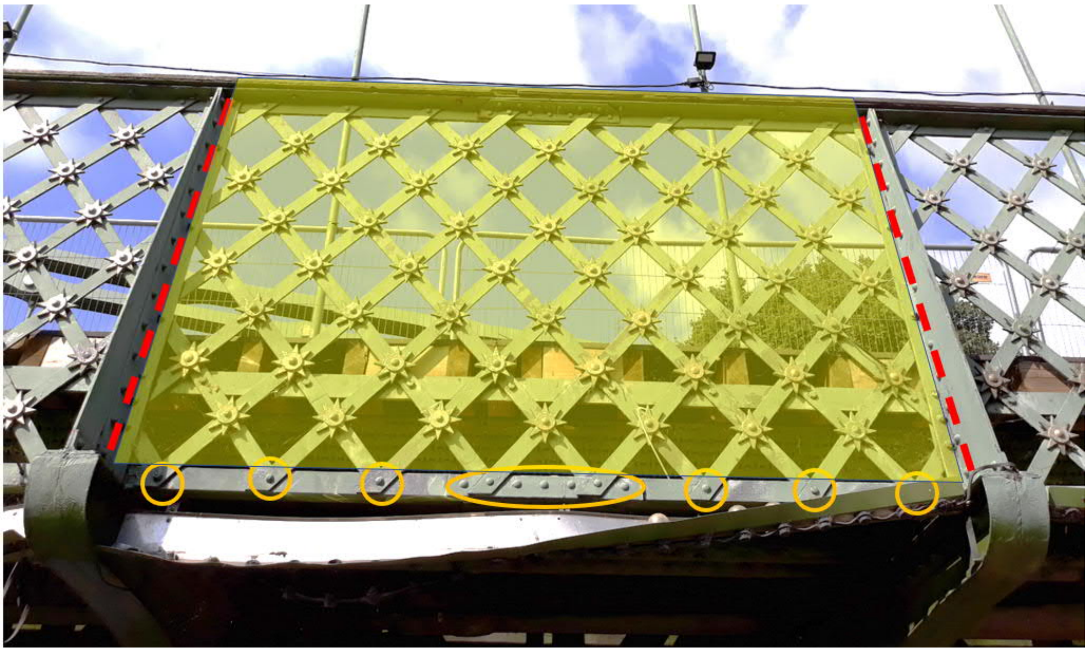
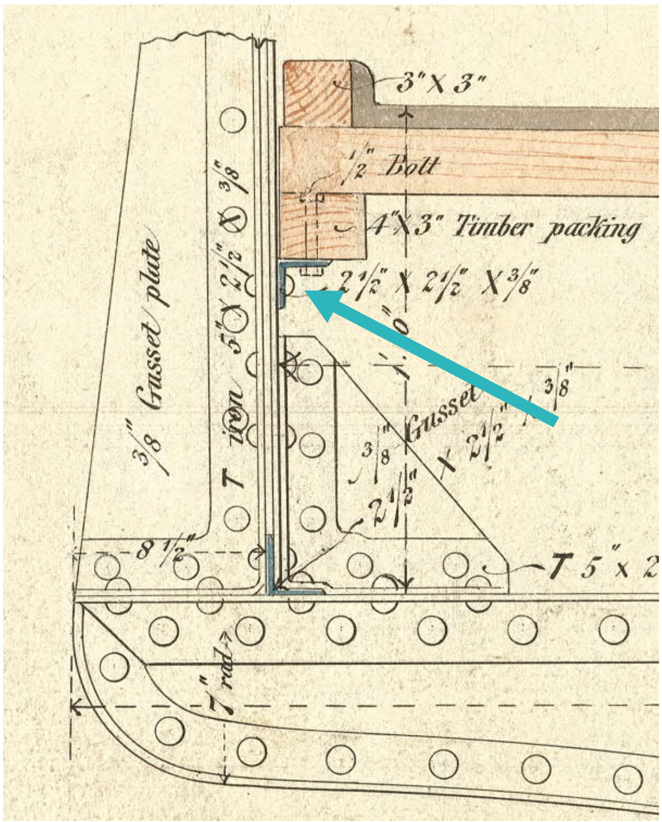


Figure 3.11: Cross-section through existing parapet, showing how the timber footway planks are supported by the middle horizontal angle member



Source: Hammersmith Bridge Alterations, Contract Drawing No. 4

The removed parapet members would be kept in a suitable storage facility and reinstated once the works are complete. Parapet members would be reinstated using butt welding and dome-headed bolts instead of rivets, as was done for the previous parapet removal works. Dome-headed bolts produce a very similar visual effect to rivets overall, and can be removed more easily than rivets if further works to the parapets are needed in future.

It should be noted that some parts of the teak handrail are currently showing signs of rot, and some of the stars at the intersections between diagonal members are also damaged. The contractor would have to undertake a condition survey of any sections of parapet to be removed, so that these can be targeted for repairs as part of the planned major refurbishment works for the bridge.

Dismantling and storage of deviation chamber casing panels

The additional cast iron casing panels to be removed for each pedestal are shown in orange as follows:

Figure 3.12: Further cast iron cladding panels to be temporarily removed for each pedestal (in orange) to allow access to implement the works

Source: Taziker/Mott MacDonald

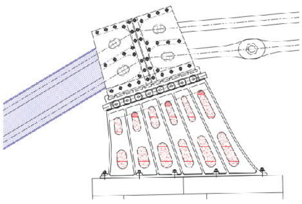
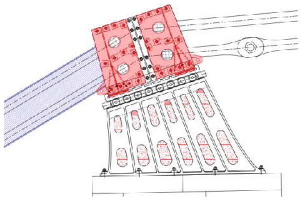
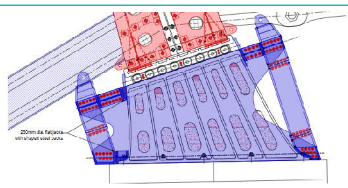
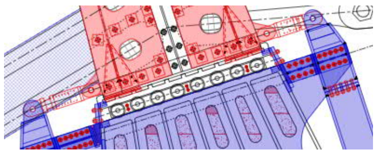
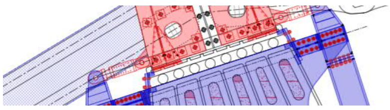
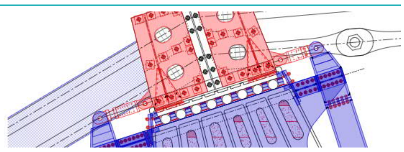
These panels would be removed using scaffolding and a lifting gantry, and they would be stored in the same facility as the other panels which were previously removed in 2020. For reference, the removal of the panels described in the 2019 Listed Building Consent application can be seen in the following image (other pedestals similar):

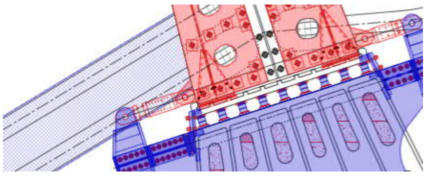
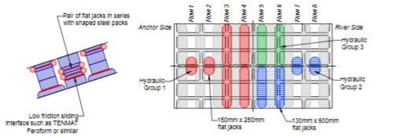
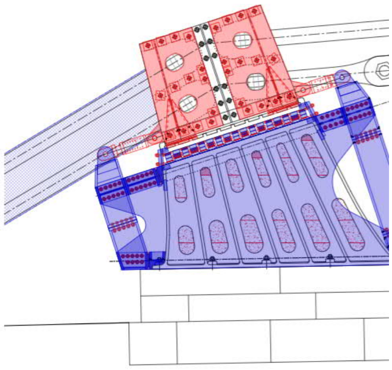
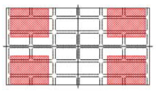
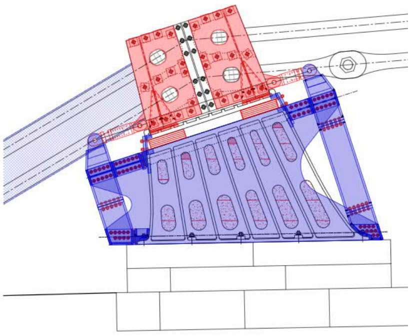
Figure 3.13: Panels removed as described in the 2019 Listed Building Consent application

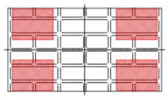
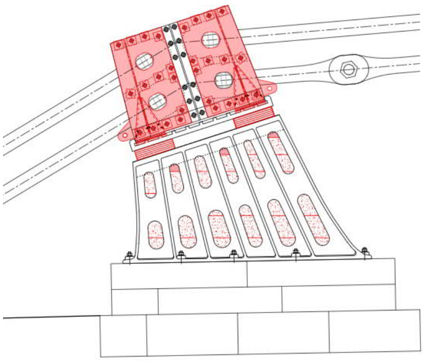
The intention is for the deviation chamber panels to be reassembled as part of the planned future major refurbishment works (including any local repairs and/or modifications), thus restoring the original appearance of the bridge. The scheme allows for future replacement of the bearings without the need to dismantle the deviation chamber casings.

Proposed Methodology

Illustrated below is the high-level sequence of works proposed for the stabilisation of the pedestals (permanent interventions shown in red, temporary (reversible) interventions shown in blue). Before work commences, the contractor will undertake a full dilapidation survey noting all visible defects, taking photographic records and producing defect sketches to record the condition of the structure.

Description of works in each stage	Image
Erect pedestrian and cyclist temporary scaffold access ramps, locally remove pedestrian parapet panel at each access point and divert public away from the pedestal worksite areas.	
Dismantle additional casing panels and remove for safe storage. The casing removal will be undertaken by the same contractor that did this previously, and they will follow the same methodology and principles set out in the previous Listed Building Consent.	
Install sleeves on upper part of anchorage chains, remove existing timber hoarding and then dismantle additional cast iron cladding panels and put them into storage (refer to Figure 3.12).	
Install a light reinforcement cage through the pedestal openings. Then fill internal voids of pedestal with fibre reinforced concrete and grout.	
Shave down the cast iron bed plate ribs, cut rivet heads at saddle angles and grind flush, grit blast the deviation saddle side plates. Fit saddle brackets and pack plates over existing wrought iron long bolts, then replace the long bolts with high strength tensioning bars.	
Erect steel cheek plate frame around pedestal with layer of metal loaded epoxy putty at the contact interfaces between frame and pedestal.	
Fit hydraulic cylinders between cheek plate frame and saddle brackets. Install lateral restraint brackets through slotted holes in cheek plate frame stubs.	
Remove roller keep plates and cut off roller heads. Repair any significant pitting on pedestal top plate and cast iron bed plate with metal loaded epoxy putty.	
Pressurise jacks to uniformly lift the saddle, then gradually depressurise to slowly release the restrained force from the system.	

Description of works in each stage	Image
Remove existing rollers by sliding to the side.	
Insert second set of flat jacks and stacked steel plates in between the first set of jacks. Use the lower flat jacks to lift the saddle, and remove first set of jacks and their accompanying steel plates.	 
Use the upper flat jacks to lift the saddle, and position the new replacement elastomeric bearings in place.	 
Land the saddle on the new elastomeric bearings, then remove the flat jacks and stacked steel plates.	

Description of works in each stage	Image
Remove the hydraulic cylinders and temporary steel cheek plate frame, leaving only the permanent interventions. Decommission and remove the temperature control system, and erect temporary timber hoarding around the saddles in the interim period before the start of the planned major refurbishment works.	 
Reinstate the parapet panels that were locally removed in Stage 1 and remove the temporary scaffold ramps.	

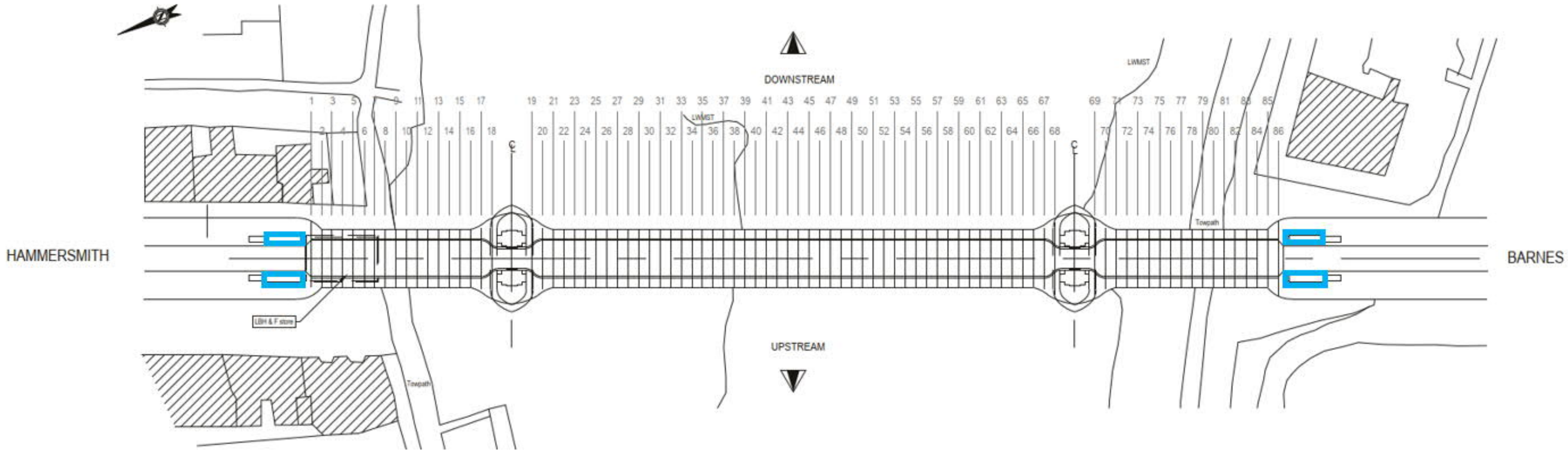
Source: Taziker/Mott MacDonald

The temporary timber hoarding to be erected around the saddles on completion of the permanent intervention works is shown indicatively on Figure 3.14. The hoarding will be designed such that there are no significant impacts on the width of the adjacent footway. Refer to Photo 3.9 for the current hoarding around the pedestals (during and after erection) – similar hoarding would be erected and extended (see Figure 3.15 for plan) after the permanent interventions described in this Listed Building Consent application are complete.

Photo 3.9: Current hoarding around pedestals

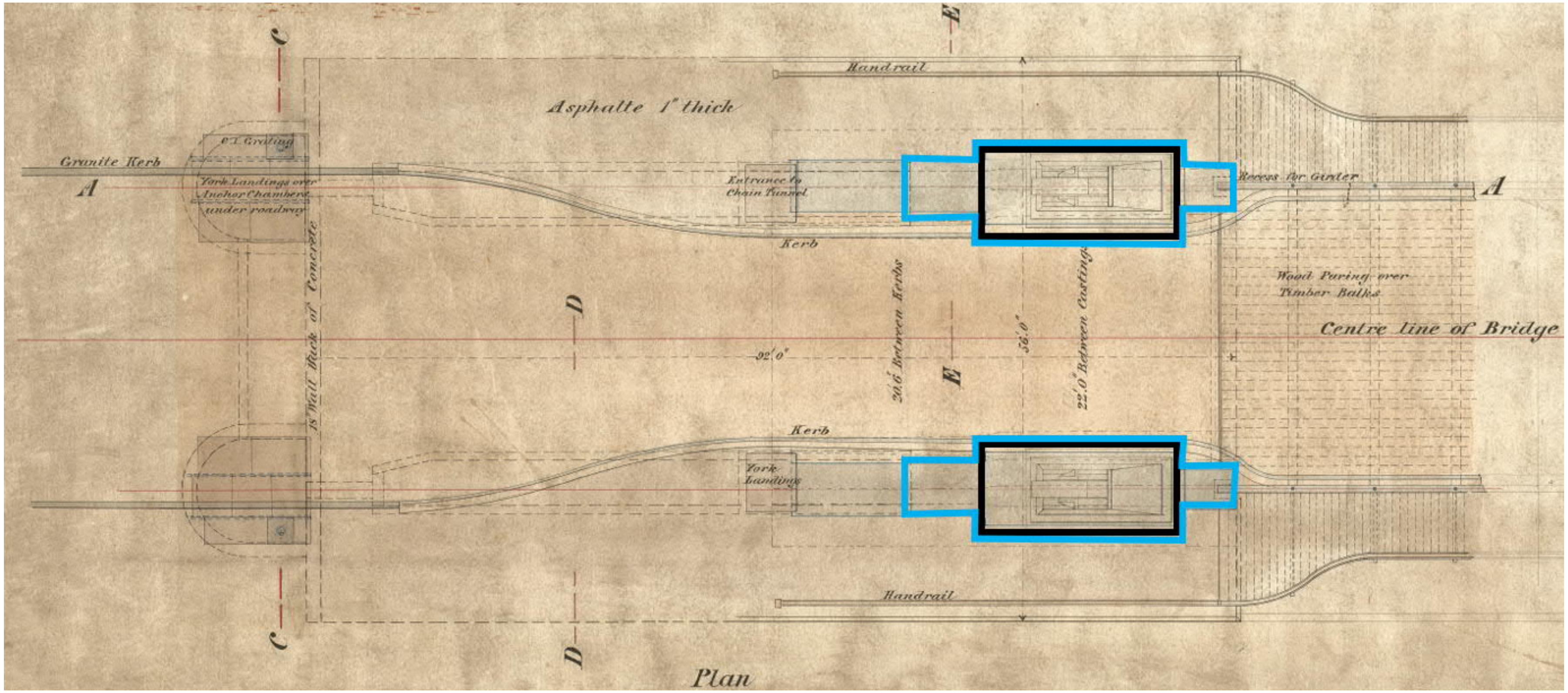
Full details of this hoarding will be provided by the contractor once engaged, as was the case for the previous Listed Building Consent application for the deviation chamber casing panel removal.

Figure 3.14: Indicative plan location of temporary hoarding (shown in blue) after permanent intervention works are complete



Source: Adapted from drawing no. 82440/185/1

Figure 3.15: Indicative plan view of current temporary hoarding (shown in black) and proposed temporary hoarding after permanent intervention works are complete (shown in blue)



Source: Adapted from Hammersmith Bridge Alterations, Record Drawing No. 11

Assessment of Potential Impacts

Item	Heritage impact
Deviation chamber casing panels	The casing is original fabric. Similar to the interventions described in the previous Listed Building Consent application, all additional removed panels will be stored securely off-site. They will all be reinstated simultaneously as part of the planned major refurbishment interventions. There will be no long-term impacts.
Saddles	The saddles are original fabric, and will be surrounded by new saddle brackets as part of the permanent interventions. The saddles have always been hidden from view by the deviation chamber casing, and will continue to be hidden from view once the casing is reinstated. The long-term impact is therefore minimal.
Pedestals	The pedestals are original fabric, and will be filled with fibre-reinforced concrete and grout as part of the permanent interventions. The pedestals have always been hidden from view by the deviation chamber casing, and will continue to be hidden from view once the casing is reinstated. The long-term impact is therefore minimal.
Rollers	The corroded rollers between the pedestals and saddles are original fabric, and will permanently be removed as part of these interventions. They will be replaced by new elastomeric bearings. The original steel rollers are heavily corroded and retaining them is not a feasible option if the bridge is to remain open. The rollers have always been hidden from view by the deviation chamber casing, and the new elastomeric bearings will also be hidden from view once the casing is reinstated. The long-term impact is therefore minimal.
Parapets	The teak handrail is not original fabric, but the metal members are original. There is precedent on the bridge for cutting out sections of the original metal members and replacing them, with only a minimal impact on the appearance of the bridge. A similar approach will be taken for these proposed interventions. Some original rivets will be lost and replaced with dome-headed bolts; however this will be kept to a minimum. The proposed lengths of parapet to be removed are short compared to the length of the bridge, and they will all be reinstated at the same time, as soon as the permanent interventions are complete. There will be no significant long-term impact as a result.
Temporary ramps	The temporary ramps themselves will have no fixings into the original fabric on the bridge. The pedestrian experience of the heritage structure will be slightly altered in the short-term as people are diverted around the pedestals. In order to minimise the impact, the diversion routes will be made as short as possible whilst still maintaining public safety, and the original footways will be reopened for public use as soon as the permanent intervention works are complete. There will be no long-term impacts.

Item	Heritage impact
Temporary hoarding	The temporary hoarding will have no fixings into the original fabric on the bridge, in a similar manner to what was done previously. It will have only a minor impact on the existing appearance of the bridge, and will be removed as part of the planned major refurbishment works. There will be no long-term impacts.

Consultation with Historic England and Borough Conservation Officers

Listed Building Consent was previously granted by the London Borough of Hammersmith & Fulham and the London Borough of Richmond upon Thames in November 2019 for the temporary removal of defined sections of the deviation chamber panels which surround and encase the pedestals. Dismantling, removal and safe storage of these panels was required to enable full removal of paint from the cast iron pedestals to determine their true and full condition and thereafter integrity. This in turn has informed the refined strengthening (stabilisation) works defined within this current submission.

For the next phase of the works, a meeting was held on 12th May 2021 with Historic England, the London Borough of Hammersmith & Fulham, and the London Borough of Richmond upon Thames, where Mott MacDonald presented the alternative proposals for the pedestal stabilisation works compared to the original Pell Frischmann proposals. Historic England was also consulted for pre-application advice subsequent to this meeting.

Historic England's views were as follows:

- A timely solution for the pedestal stabilisation works is required in order to allow the subsequent major refurbishment works to proceed.
- The Mott MacDonald proposals would have significantly less impact on the historic fabric than the Pell Frischmann proposals, would be more cost-effective and could be delivered in a shorter timeframe.
- The Mott MacDonald proposals would only affect functional components of the bridge which contribute to its technological special interest as opposed to its aesthetic value. Historic England have previously accepted the removal of some original fabric and introduction of non-traditional elements as long as they are concealed and the overall principles of the suspension system are maintained.
- The use of temporary check plates around the pedestals is similar to the technique previously used to replace the roller bearings within the bridge towers with elastomeric bearings in 1984 (at the Barnes tower) and 1998 (at the Hammersmith tower), and so the Mott MacDonald approach is acceptable in principle.

In a letter dated 8th June 2021, Historic England provided further comments and questions, and these have been addressed under separate cover.

Other considerations

All interventions would be above-ground only; the existing bridge foundations and ground profile would remain unchanged (i.e. no excavation would be required). Therefore, there should be no archaeological impacts or risks due to working with contaminated land.

No excavation also means that the interventions would have no impact on any nearby tree roots. There are a number of trees in the vicinity; however, the interventions are relatively small-scale and would take place in close proximity to the bridge pedestals only. Any nearby tree trunks and canopies will thus be unaffected.

Although the pedestals are within flood zone 3 due to their proximity to the River Thames, the proposed interventions will have negligible effect on the flood risk to the bridge and/or surrounding area.

The pedestal stabilisation works will also have a positive long-term impact in terms of reducing noise, as they will allow the current temperature control system to be decommissioned.

The proposed interventions are necessary to safeguard long-term use of the bridge by pedestrians, cyclists, river users and road vehicles. Thus, the interventions will improve access for all users overall.

4. Relevant Planning Policy

Legislation

Planning (Listed Building and Conservation Areas) Act 1990

This Act sets out the protection given to buildings of special architectural or historic interest through listing. It also sets out the framework for authorising works for demolition or the alteration or extension of listed buildings through the grant of Listed Building Consent.

National Planning Policy

The National Planning Policy Framework (NPPF) (updated 2018) considers the importance of the historic environment in planning and development and sets out the Government's policies with regard to development that affects the historic environment. It requires that proposals are fully evidenced and assessed to help informed decision making. Chapter 16 outlines these policies. The following paragraphs are relevant to this Listed Building Consent application:

- Paragraph 189: In determining applications, local planning authorities should require an applicant to describe the significance of any heritage assets affected, including any contribution made by their setting;
- Paragraph 192 asks local planning authorities to take into account the following factors when determining applications:
  - The desirability of sustaining and enhancing the significance of heritage assets and putting them to viable uses consistent with their conservation;
  - The positive contribution that conservation of heritage assets can make to sustainable communities including their economic viability; and
  - The desirability of new development making a positive contribution to local character and
  - Distinctiveness
- Paragraph 193: When considering the impact of a proposed development on the significance of a designated heritage asset, great weight should be given to the conservation of the asset. The more important the asset, the greater the weight should be;
- Paragraph 196: Where a development proposal will lead to less than substantial harm to the significance of a designated heritage asset, this harm should be weighed against the public benefits of the proposal, including securing its optimum viable use.

London Plan

The London Plan contains a policy on heritage assets (Policy 7.8).

Local Planning Policy (London Borough of Hammersmith and Fulham)

Local Plan

On 28 February 2018, the council for the London Borough of Hammersmith and Fulham adopted its new Local Plan. This plan replaces the Core Strategy 2011 and the Development Management Local Plan 2013 and together with the London Plan forms the Development Plan for the borough. With respect to the conservation of the borough's historic environment, Policy DC8 states that the council will apply the following (extracted relevant) principles:

- b. the presumption will be in favour of the conservation, restoration and enhancement of heritage assets, and proposals should secure the long term future of heritage assets. The more significant the designated heritage asset, the greater the presumption should be in favour of its conservation;
- f. where changes of use are proposed for heritage assets, the proposed use, and any alterations that are required resulting from the proposed use should be consistent with the aims of conservation of the asset's significance, including securing its optimum viable use;
- g. applications should include a description of the significance of the asset concerned and an assessment of the impact of the proposal upon it or its setting which should be carried out with the assistance of a suitably qualified person. The extent of the requirement should be proportionate to the nature and level of the asset's significance. Where archaeological remains of national significance may be affected applications should also be supported by an archaeological field evaluation;
- h. proposals which involve substantial harm, or less than substantial harm to the significance of a heritage asset will be refused unless it can be demonstrated that they meet the criteria specified in paragraph 133 and 134 of the National Planning Policy Framework;
- i. where a heritage asset cannot be retained in its entirety or when a change of use is proposed, the developer should ensure that a suitably qualified person carries out an analysis (including photographic surveys) of its design and significance, in order to record and advance the understanding of heritage in the borough. The extent of the requirement should be proportionate to the nature and level of the asset's significance;

Planning Guidance – Supplementary Planning Document

Adopted in February 2018, the SPD provides supplementary detail to policies concerned with a variety of topics within London Borough of Hammersmith and Fulham's Local Plan. Section 5 addresses Archaeology and Heritage Assets.

Local Planning Policy (London Borough of Richmond Upon Thames)

Local Plan

In July 2018, the council for the London Borough of Richmond upon Thames adopted its new Local Plan which replaced previous policies within the Core Strategy and Development Management Plan.

Castelnau Conservation Area 25

Hammersmith Bridge falls within the Castlenau conservation area (No. 25) designated in 1977 and extended into the river in 1982. The conservation area statement highlights the following problems and opportunities:

Problems and Pressures:

- Development pressure which may harm the balance of the landscape and river-dominated setting, and the obstruction or spoiling of views, skylines and landmarks
- Loss of traditional architectural features and materials due to unsympathetic alterations
- Loss of front boundary treatments and front gardens for car parking
- Lack of coordination and poor quality of street furniture and flooring
- Domination of traffic and poor pedestrian safety leading to clutter of signage and street furniture
- Loss of original or quality shopfronts and unsympathetic alterations and advertisement

Opportunity for Enhancement

- Improvement and protection of landscape and river setting
- Preservation, enhancement and reinstatement of architectural quality and unity
- Retain and enhance front boundary treatments and discourage increase in the amount of hard surfacing in front gardens
- Coordination of colour and design and improvement in quality of street furniture and flooring
- Improvement of highways conditions and pedestrian convenience, and rationalisation of existing signage and street furniture
- Retain and improve the quality of shopfronts and advertisement

Structure Specific Conservation Plan

Hammersmith Bridge does not currently have a structure specific conservation plan.

Guidance

The following guidance has been used to inform the assessment:

- Conservation Principles, Policies and Guidance (English Heritage, 2008);
- Historic Environment Good Practice Advice in Planning Note 2: Managing Significance in Decision Taking (Historic England, 2015); and
- Historic Environment Good Practice Advice in Planning Note 3: The Setting of Heritage Assets (Historic England, 2017).

5. References

Primary and Cartographic Sources

[1] Historic England's List Entry for Hammersmith Bridge

[2] D Smith, 'The works of William Tierney Clark', Trans. Newcomen Soc, 63 (1991-92), 181-207.

[3] D Smith, 'Hammersmith Bridge', in Civil Engineering Heritage: London and the Thames Valley (Institution of Civil Engineers/MPG Books, 2001), 39-40.

[4] 'The new Hammersmith Bridge', The Engineer, 63 (1887), 309, 330-31, 391-94.

[5] C Hailstone, Hammersmith Bridge (Barnes & Mortlake History Society, London, 1987)

[6] J Dredg, 'Thames Bridges, From the Tower to the Source' (1897)

[7] J.E. Harding, G.A.R. Parke, M.J.Ryall, 'Hammersmith Bridge: 160 Year of Road Traffic' (1990)

[8] B.G.R. Holloway, H.J.Wadsworth, The strengthening of Hammersmith Bridge (1977)

[9] Hammersmith & Fulham Local Plan, February 2018

[10] Phillips, G. (1981). Thames crossings. Newton Abbot [Devon]: David & Charles.

Legislation and Guidance

Historic England, 2006 Understanding Historic Buildings, London: Historic England

Historic England, 2015 The Setting of Heritage Assets, Historic Environment Good Practice Advice in Planning: 3, London: Historic England

Historic England, 2015 Managing significance in Decision Taking in the Historic Environment, Historic Environment Good Practice Advice in Planning Note 2, London, Historic England

Historic England, 2017 The Setting of Heritage Assets, Historic Environment Good Practice Advice in Planning Note 3, London, Historic England

Secondary Literature

[10] R.F.D Porter Goff, 'Brunel and the Design of the Clifton Suspension Bridge', Institution of Civil Engineers, Vol 58, Issue 3 (1975)

Websites

National Heritage List for England - http://historicengland.org.uk/listing

NMR Historic Environment database - http://www.pastscape.org.uk

Barnes and Mortlake History Society - http://www.barnes-history.org.uk/picindex.pdf

Historical Drawings

Contract Drawing No. 4 – Details of Platform

Contract Drawing No.10 – Details of Middlesex Abutment – Details of Base for Saddle Cover

Contract Drawing No.11 – Details of Abutments

Contract Drawing No.11a – Details of Special Cantilevers and Cast-Iron Girders over Anchor Chambers

Contract Drawing No.11E – Details of Anchor Beds and entrance to Chain Tunnel

Contract Drawing No.12 – Details of Saddles for Abutments

Drawing No. HC/209/C39/T10-137 – Colour Scheme for Repainting (Not current colour scheme but included for information)

Drawing No: HC/209/C/40 - Coats of Arms on abutment saddle casings

Plans and elevations

417457-MMD-XX-XX-DR-S-00001 – Hammersmith Bridge Pedestal Stabilisation, General Arrangements Sheet 1 of 2

417457-MMD-XX-XX-DR-S-00002 – Hammersmith Bridge Pedestal Stabilisation, General Arrangements Sheet 2 of 2

417457-MMD-XX-XX-DR-S-00052 – Hammersmith Bridge Pedestal Stabilisation, Pedestal Infill Details

105098-MMD-XX-00-DR-C-0061 – Hammersmith Bridge Pedestal Stabilisation, Existing and Proposed Elevations mottmac.com