

Control Period 6 - Year 3

UB 132/017 Forth Viaduct

Form 001

Doc. No.: 2444-MHB-REP-005

REMIT NO:	-	STRUCTURE NO:	UB 132/017
ELR:	SCM3	MILEAGE:	118miles 1430 yards
O.S. REF:	NS 798 944	MHB PROJECT REF:	2444



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Project title	Control Period 6 - Year 3 UB 132/017 Forth Viaduct		
Project Number			
Location	Between Stirling and Bridge of Allan		
ELR	SCM3	Mileage	118miles 1430 yards
Asset Number	UB 132/017	OS grid reference	NS 798 944
RRD Reference Nr.			
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Other AiP Documents Associated with this submission			

PART 1: DETAILS

1.1 Proposed Works

Brief General Description

UB 132/017 forms part of Network Rail's CP6 Year 3 to carry out the refurbishment of the existing bridge structure. In accordance with the project remit, the proposed works comprise the following:

- Detailed schedule of steelwork defects with prioritisation of repairs and proposed repair details designed to provide RA8@65mph.
- Detailed schedule of all substructure elements and masonry approach spans with prioritisation of repairs and proposed repair details using Network Rail Standard Details where possible.
- Replacing 4 No. rocker bearings at High Mileage abutment of the bridge and application of anti-corrosive treatment to the exposed parts of all remaining bearings.
- Provision of condition-led repair detail for addressing the cracking in compression elements.
- Provision of new corrosion protection system to all exposed metalwork, which is to provide a service life of 25 years in a C4 high environment painted to match the colour of adjacent structure (Holly Green 14C39).
- Replacement of all underslung walkway elements with new GRP walkway system designed to accommodate loading of 5kN/m² and include appropriate edge protection.
- Spot replacement of defective timbers in trackside walkway.
- Review drainage and water management system over structure and propose repairs and reinstatement of defective drainage.
- De-vegetation of 5m envelope (within Network Rail boundary) of the structure. Roots to be treated to prevent regrowth.

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1.1.1 Specifics

Superstructure

Metalwork Condition Led Repairs

Metalwork defects were identified during MHB Consultants condition surveys on 14 & 15 September 2020 undertaken from the walkways below the structure with assistance from rope access teams for safe access. The elements that were not able to be inspected directly by MHB Consultants were inspected via rope access by Geo-structural. MHB Consultants also undertook on-track inspections to inspect metallic elements trackside. Full details of the results of the various inspections can be seen in the MHB Consultants Defect Schedule (Doc. 2444-MHB-REP-003).

The defects identified were assigned a severity category of 1, 2 or 3:

Priority 1 Defects: Defects which are urgent safety items, presenting a risk to the public or vehicles being supported by the structure or high-risk defects requiring to be repaired in order to achieve the published rating of the structure or due to immediate health and safety concerns.

Priority 2 Defects: Defects which are medium risk, not currently impacting upon the overall assessment of the bridge but require to be addressed to maintain the current rating within the next 25 years prior to the next anticipated major intervention.

Priority 3 Defects: Defects which are low risk and/or aesthetic in nature that could be left to be monitored.

The following methodology was used to prioritise the defects as per the above definitions. Defects were defined as Priority 1 where losses found on site were greater than the Level 2 Assessment. These defects require intervention to restore the minimum section used in the Level 2 Assessment. Defects were defined as Priority 2 where the encountered losses were equal to or less than the Level 2 Assessment. These defects do not require intervention via a repair but as a minimum require repainting to arrest further corrosion that could be detrimental to the RA rating of the structure.

During the inspection of the structure, a number of defects were identified, requiring intervention to ensure the structure achieves the RA rating of RA8 @ 65mph. The defects requiring interventions along with their proposed repairs are listed below:

- Upward deflection of Main Girder bottom chord bottom flange plates between vertical posts throughout.
 - These deflections were noted in the Level 2 Assessment and, as such, it is recommended that they are monitored as part of Network Rail's ongoing maintenance regime.
- Evidence of buckling and outward deflection of Main Girder bottom chord webs between vertical posts throughout
 - These deflections were noted in the Level 2 Assessment and, as such, it is recommended that they are monitored as part of Network Rail's ongoing maintenance regime.
- No inspection walkway between Deck 3 and Deck 4 along main girder's supports. Redundant board has been placed as temporary solution.
 - Addressed by main scope of works via replacement of all underslung walkway elements with new GRP system.

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- Evidence of fire damage to Deck 2 inspection walkway.
 - Addressed by main scope of works via replacement of all underslung walkway elements with new GRP system.
- Cracked and loose bitumen waterproofing inside the bottom chord at several locations
 - Remedied via reinstatement of waterproofing and bitumen layer.
- 100% loss of section to various diaphragms at the base of verticals of the Main Girders
 - Remedied via a bolted repair where plate will be installed to address the section loss. See Repair Type 1.
- 1No. Missing pipe. Ingress of water and 1-2mm radial corrosion. 2mm loss of section to soffit of top flange of DK2-MGI1 over 300mm length.
 - Addressed by painting. A drip-check out of Sikadur CF 31 Rapid to be formed prior to painting.
- 100% loss of section to base of the web of bearing stiffeners of the Main Girders.
 - Remedied via installation of a bolted over plate to restore the lost material. See Repair Type 2.
- Knife edging and notching to the outstand of end plate of Low Mileage end of DK3-MGE2.
 - Remedied via Repair Type 3.
- Severe loss of section with 1No. hole to base of web of DK4-MGE1 (Bay 8).
 - Remedied via Repair Type 4.
- 7 out of 12 MPI tested vertical post were rejected. Evidence of cracking.
 - Repair Type 5 - 8 No. verticals per girder to receive repair (i.e. 4 No. at each end of girder) on all 3 Spans (96 No. in total)

It is proposed that a joint post-blast inspection shall be undertaken by the Designer, the Contractor and Network Rail when a safe system of work is installed, where all defects are confirmed, and the suitability of the proposed repairs are agreed.

Main Girder Compression Member Investigation

Non-Destructive Testing (NDT) to compression elements of the Main Girder trusses was carried-out to determine presence of microcracking. During the site visits on week beginning 14/09/2020, a total of 12 out of 120 compression elements (i.e. 10% of vertical posts) were tested. Surface discontinuities were found in the form of vertical cracks on 7 out of 12 (i.e. 68%) compression elements tested. A summary of the elements tested is shown below:

Deck ID	Element	MPI Testing Result
DK2	MGE1	Rejected
	MGI1	Rejected
	MGI2	Accepted
	MGE2	Accepted
DK3	MGE1	Accepted
	MGI1	Accepted
	MGI2	Rejected
	MGE2	Rejected

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DK4	MGE1	Accepted
	MGI1	Rejected
	MGI2	Rejected
	MGE2	Rejected

A typical example of the vertical cracks found during MPI testing can be seen in the picture below.

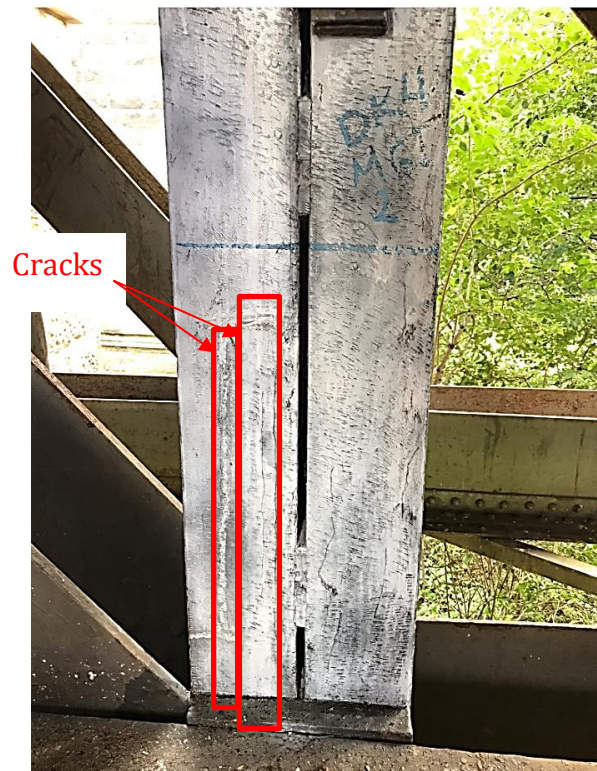
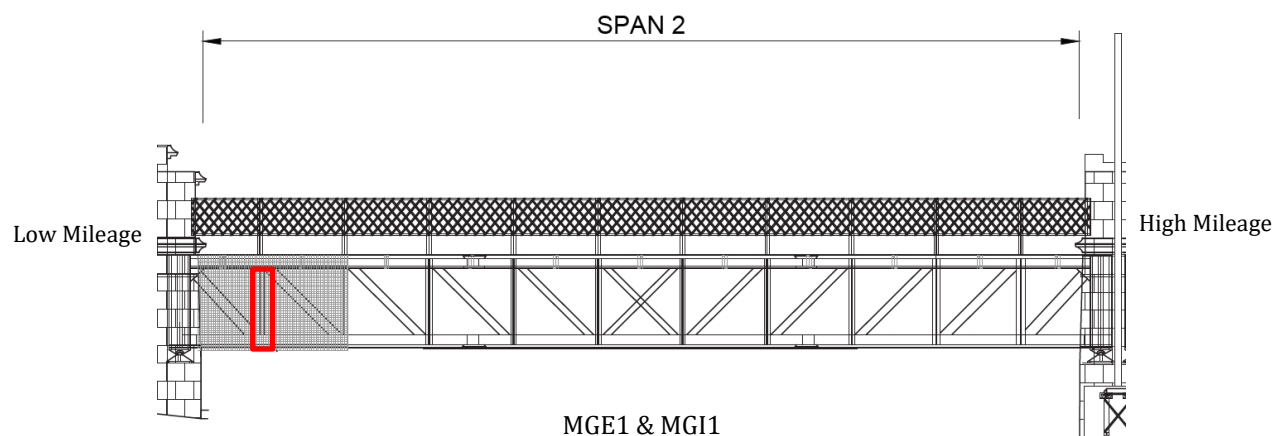


Figure 1-Typical examples of cracks found on compression elements during NDT testing

The results of the compression member investigation have been communicated to STORY and Network Rail in the form of Early Warning report (see 2444-MHB-EW-001). The locations of the vertical members which were rejected during the MPI testing are shown in Figure 2 below:



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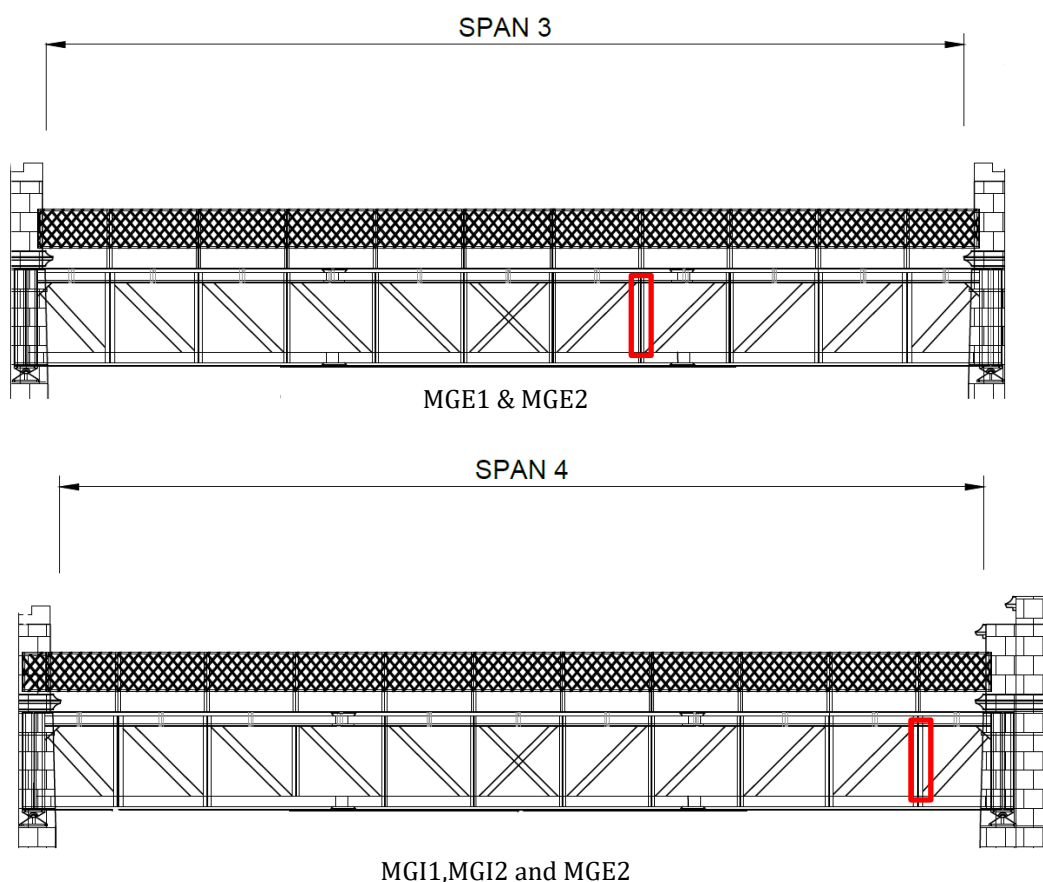


Figure 2-Locations of the vertical members which were rejected during MPI testing

Since during the MPI testing only 12% of the vertical posts were tested, considerations should be given for possible crack formation within rest of the compression elements that were not tested. A static elastic analysis was carried-out by MHB Consultants using the structural analysis package OASYS GSA to analyse the global behaviour of the bridge and particularly of the compression elements. The results suggested that the stress values developed in the last four vertical members (at either end of each span) are significantly higher than those developed in the middle members. Hence, it is proposed to conduct condition led-Repair Type 5 to 8 No. of vertical posts per girder (i.e. a total of 96 repairs). Should evidence of cracking be noted to the middle posts during the post-blast inspection, the number of envisaged Repair Type 5 shall be increased.

Bearing Investigation Works

During the inspection carried out by MHB Consultants Ltd on 14-15 September 2020, and from the Rope Access Survey carried out by Geo-Structural, the bearings were found to be in fair condition with moderate corrosion, delamination and up to 2mm loss of section to base plate and stiffeners.

The substructure supporting the bearings was found to be in fair condition with isolated areas of open joints and hairline fractures throughout the piers. The existing Inspection for Assessment reported 1No. transverse fracture through the pier head of IS3 between all girders.

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As part of the CRT for UB 132/017, Non-Destructive Testing (NDT) (reference LWC-Forth Viaduct 014) was undertaken during the initial site surveys to determine the condition of the bearings and whether any works would be required. The Magnetic Particle Inspection (MPI) testing was undertaken at all 24 bearings on 21 September 2020 by Gordon Wood Associates on behalf of Lanarkshire Welding Company (Reference: LWC-Forth Viaduct 014 to 017) with photos taken of all bearings inspected. Of the 24 bearings tested, 1 No. bearing was rejected, which was located at the High Mileage End of MGE1 on Deck 4 of the structure (see Figure 3 for location). The rejection of the bearing was due to a horizontal crack noted at the 'T' outstand at the end of the bearing as should in Figure 4.

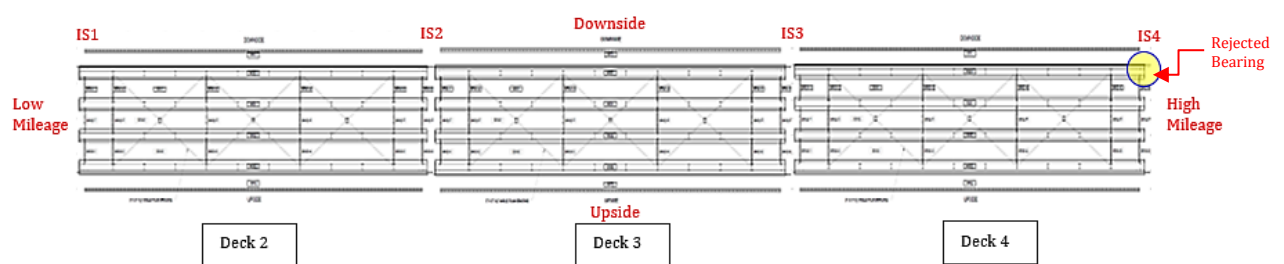


Figure 3-Bearings and Span Arrangements of UB 132/017



Figure 4-1 No. Crack to the outstand of the bearing extracted from LWC-Forth Viaduct 014

The crack found during the MPI testing (see Figure 4) appears to occur in the rocker assembly only. It is difficult to determine the reason for such crack to develop without further investigations but given the bearing type (i.e. Fixed) and the direction of the crack (i.e. transverse), it is possible the crack has occurred due to the presence of shear stresses occurring as the result of excessive horizontal forces being applied to the bearing.

From the above testing results, it is not possible to determine when the crack was formed and whether the defect is recent or historical. Conservatively, it should be assumed the crack occurred recently and the

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defect will grow progressively worse if untreated. The results of the bearing tests have been reviewed and discussed with STORY and Network Rail, see Doc. No. 2444-MHB-REP-006 for a full discussion on these results. Following these discussions, Network Rail instructed MHB Consultants to undertake the design work to replace 4 No. bearings at the High Mileage Abutment. The 4 No. bearings shall be replaced with new line rocker bearing capable of taking full LM71 loading in accordance with BS EN 1990 and be designed to the relevant Eurocodes.

The envisaged procedure for installing the new bearings is as follows:

- Following removal of the existing bearings, the existing cill will be prepared to allow the bearings to be installed.
- A new upper bearing plate will be fixed to the underside of the Main Girder bottom chord using counter sunk Tension Controlled Bolts.
- A new lower bearing plate will be connected to the prepared cill by threaded bars dowelled into the masonry below the cill.
- The bearing assembly will be connected to a second upper and lower bearing plate prior to installation.
- The bearing assembly will be manoeuvred into position and the fixed to the upper and lower bearing plates that are fixed to the cill and the bottom chord through tapped holes.
- Levelling shims will be installed below the lower bearing plate to ensure a tight fit prior to grouting with non-shrink cementitious bearing grout.

It should be noted that temporary works will be required to facilitate the removal in both dead and live load conditions.

In addition to the removal of the 4 No. bearings, it is proposed to apply anti-corrosive treatment to the exposed parts of all remaining bearings and, due to brittle nature of cast iron, install a monitoring system on the structure to allow all other bearings to be monitored for signs of cracking in the future.

Walkway Replacement DK2-4

The underslung walkway elements will be replaced with new GRP walkway system designed to accommodate 5kN/m² and will include compliant edge protection. To assist with future inspection works, it is proposed to install a lockable ladder access at High Mileage end of the structure should Network Rail approve that will allow access to the new underslung walkway.

Trespassing Protection System

The current trespass protection measures are as follows:

- Anti-climb mesh and spikes are on the external elevations of Bays 1 and 2 (Low Mileage End) of DK2 MGE1 and MGE2.
- Anti-climb mesh spanning between the bottom chords of the Main Girders at Low Mileage end of DK2.
- Anti-climb mesh from the cill of IS1 to the underside of the Main Girders over full width of the bridge.
- No anti-climb mesh is present at High Mileage end of the bridge (i.e. Private Land).

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The anti-climb mesh and spikes were generally in good condition. It is envisaged that the current system will need to be removed to undertake the refurbishment works before being reinstalled at the end of the works. It is not proposed to install any additional anti-trespass measures at the High Mileage end of the structure due to this area being surrounded by private land and the risk of unauthorised access is considered to be minimal.

Water Management System

The Level 2 Assessment and archive drawings (Reconstruction drawing No5) indicate a curved profile of bituminous concrete with an additional layer of Asphalt above the top of the buckle plate decks. The waterproofing system was buried and thus unable to be examined during the site investigation works. However, the soffit of the deck plates and the main girders were generally dry which suggest that the waterproofing system is still functioning, and no repair/reinstatement is required.

There are vertical drainage pipes installed to the elevations of DK2-4 MGE1 to MGE2 along the full span (i.e. 6 No. per elevation) see Figure 5. Weep pipes extending from the deck plates and top boom of main girders were noted, see Figure 7. Weep pipes in the centre of each bay in the bottom boom were also present throughout the structure (6No. per span), see Figure 6.

During the inspection and the Rope Access Survey, it was noted that the surface water drainage system consisting of metallic downpipes appears to no longer function with weep pipes through the centre of the top flange missing. This has led to surface water being discharged directly on to the structure which has contributed to the widespread corrosion of the elements. The drainage pipes running through the deck and inspection walkways also appear to be corroded. These drainage pipes are proposed to be replaced like-for-like. The approximate locations of the pipes and those requiring replacement are shown in Figure 8. It is envisaged to address the missing weep pipes in the top boom by painting and form a drip-check out of Sikadur prior to painting.



Figure 5-External Drainage pipe installed vertically along the main girders

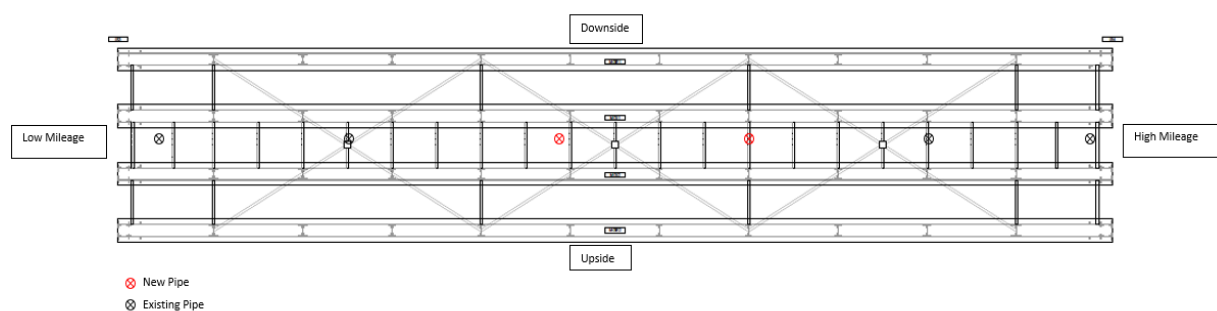
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Figure 6-Corrosion and loss of section to drainage pipes passing through the inspection walkway

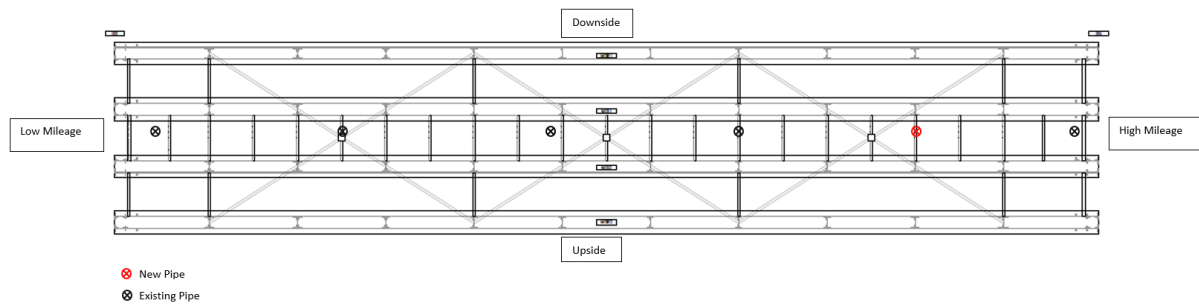


Figure 7- Radial corrosion to buckled deck plate around the drainage pipe

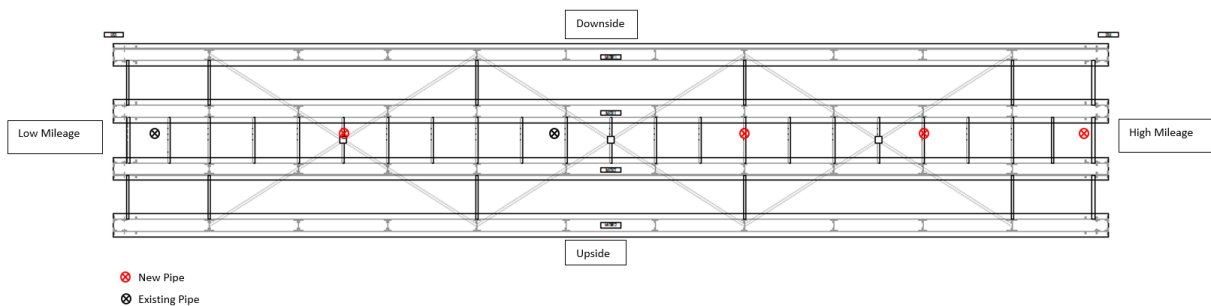


Span 2-Plan on soffit

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Span 3-Plan on soffit



Span 4-Plan on soffit

Figure 8- Approximate locations of weep pipes passing through the inspection walkway

Parapet Walkway Timbers

The trackside walkway comprises longitudinal timber and grid mech panel spanning along parapet girders. During the On-track inspection the trackside timber was found to be in good condition and no works are proposed.

*Figure 9-Trackside walkway, comprising longitudinal timber and grid mesh panel spanning along parapet girders (DK2-4)*

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Foundations and Substructure

A survey of the masonry substructure including below the water line was undertaken by HTA (REF S-2188-20). MHB Consultants have carried-out a masonry inspection on the banking of Spans 1 and 5 (2444-MHB-REP-003). The survey was carried out to the underside of the structure up to a height of 1m above the water line.

The masonry report revealed the following defects with their proposed repairs outlined:

- Spalled Masonry.
 - To be repaired in accordance with Network Rail Standard details NR/CIV/SD/101.
- Evidence of Fracture.
 - Stitching in accordance with Network Rail Standards NR/CIV/SD/109 and grout cracks.
- Evidence of scour hole at 2No. locations typically 500mm deeper than surrounding bed level for 1m².
 - Outside the scope of work. However, Network Rail to advise if a repair shall be developed for Form 003 submission.
- Stepped crack through primary arch ring on Upside Elevation.
 - Stitching in accordance with Network Rail Standards NR/CIV/SD/109 and grout cracks.

Hidden Parts

The hidden parts identified on Deck 2, 3 and 4 during the site visits are listed below:

- On all spans, the top surface of the bottom flange and lower portion of the internal faces of the web plates inside the bottom boom are hidden behind a bitumen and concrete waterproofing layer.
 - It was agreed with Network Rail that 10% of the bottom chords should be broken out with the bitumen and concrete removed to underlying metal (see 2444-MHB-REP-004). The breakout of the material report(ref: GS2056) indicated that there were areas in the bottom chord where some corrosion had localised at the intersection of the bitumen and the metalwork but the loss noted was not significant enough to require a repair. However, this intersection shall be viewed during the post blast inspection. Areas that have been previously broken out to receive new corrosion protection system and intersection with remaining bitumen to be effectively sealed to prevent water ingress.
- The upper surface of the deck plates is buried by the ballast and waterproofing layer. The soffit of the plates is also partially hidden above the main girders.
 - It is not possible to remove this hidden area and it shall be managed by Network Rail as part of their ongoing maintenance regime. The underside of the deck plate was generally found to be in good condition.
- The internal face of the ballast plates is hidden behind the ballast.
 - The external face of the ballast plates is in good condition. Hence, it is not proposed to remove this hidden element.
- The top surface of the top flange of all the main girders are hidden behind the deck plate and buried in ballast.
 - It is not proposed to remove this hidden element.

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Bearing & Span Arrangements

UB 132/017 is a 5-span viaduct. DK1 and DK5 comprise semi-circular sandstone masonry arches with tangential backing which have been under-ringed with concrete whilst DK2, DK3 and DK4 each comprise 4No simply supported metallic Pratt truss girders supporting buckled plate decks. The truss girders rest on sliding plates over IS1 & IS3 and are fixed over IS2 & IS4. There are a total of 24 bearings (i.e. 4 No at the end of each span), see Figure 2 and 'bearing investigation works' section of this report.

Archive information suggest that an original cast iron arch structure was constructed circa 1848 for the opening of the Scottish Central Railway. The current superstructure was constructed circa 1905 by the Caledonian Railway. No information regarding the manufacture of the bearings is available but the rocker bearings are believed to consist of cast iron.

Headroom & Clearances

There will be no reduction in the current headroom or lateral clearances. The width between parapets will be unchanged because of the proposed works.

Effect on Sighting Distances

None.

Unusual Features of Design

None.

Materials to be Used

All new steel to be hot rolled structural steel accordance with BS EN 10025:2004 and shall comply with BS EN 1090-2 and NR/GN/CIV/140/1800 for Execution Class EXC3 and Production Category 2.

All bolts for new steelwork shall be Grade 10.9 HRC Tension Control Bolts (TCB) in accordance with BS EN 14399-10:2009.

GRP Mesh panels Relinea Re-Grid or similar approved.

Special Finishes/Architectural Involvement (if any)

On all areas of accessible metalwork, paint shall be removed and replaced with a Network Rail approved corrosion protection system to NR/L3/CIV/039 and NR/L3/CIV/040.

The project remit states that the selected paint system must satisfy a 25-year service life in a C4 High environment. An M20 or M21 system blast cleaned to surface standard Sa2½ is one such corrosion protection system that will meet this specification.

All new steelwork shall be blast cleaned to surface standard Sa2½.

The final colour of the bridge is to match the adjacent structure (Holly Green 14C39).

Special Access/Inspection/Maintenance Arrangements (if any)

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Scaffolding will be required to complete the works. Where reasonably practicable, repairs will be undertaken during standard Rules of Route possessions. It is anticipated that a Form 002/003 submission will be required to demonstrate that the structure will be capable of carrying the additional scaffolding loads that will be applied.

A construction sequence will be provided on the drawings for all repair types to state which elements of the works can be completed during dayshift and which elements require to be completed during Rules of the Route possessions.

It is envisaged that blasting and painting of the structure will be performed whilst live load is crossing the structure.

Significant Interface with Network Rail non-civil engineering disciplines or equipment

None.

Significant interface with external organisations

The south approach span (DK1) spans over Lover's Walk, Stirling and the north approach span (DK5) crosses allotment land. Contractor to liaise with local authority/ third parties to develop any required access strategy for temporary closure of the road/land below the structure.

Method of construction/erection envisaged and any associated Temporary Works known to be required

It is envisaged that much of the works to the metalwork and substructure will be undertaken out with a disruptive possession during Standard Rules of the Route possessions.

Blasting and painting of the structure to be performed whilst live load is crossing the structure and any restrictions on when metalwork repairs can be undertaken will be outlined on the appropriate drawings.

Temporary works are required to facilitate the replacement of the existing rocker bearings. This will entail jacking of the bridge via hydraulic jacks and support system the details of which will be provided as part of F002/F003 submission.

Disruption to rail/road/pedestrian traffic caused by construction

There will be disruption to the rail track above and the road below the structure because of the works. Consultation with Network Rail and the local authority/landowner will be required at the earliest convenience.

Environmental Constraints

An Ecological Survey was undertaken by Story Contracting Ltd in August 2020 and outlined the following recommendations:

- All works in or near the burn will follow best practice measures to ensure their protection against pollution, silting and erosion.
- [REDACTED]
- Any temporarily exposed excavations, trenches or holes must be provided with mammal exit ramps e.g. wooden planks or earth ramps when Contractors are off site to allow animals to

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escape.

- All works must be timed to avoid the periods around dusk and dawn [REDACTED]

- [REDACTED]
[REDACTED]
[REDACTED]
[REDACTED]

Any Other Relevant Information

None.

Alternative Options Considered & Justification for Rejection

None.

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1.2 Assets Affected (see Appendix A)

The areas affected can be seen in Figure and Figure below:



Figure 10 – Downstream Elevation



Figure 11 – Upstream Elevation

Brief General Description

UB 132/017 is a 5-span viaduct carrying 2 No. electrified tracks of the SC119 Greenhill Upper Jn to Dundee line over the River Forth, disused land and a one-way street (Lover's Walk) in Stirling. It is unknown when the anti-climb mesh and spikes over Lover's Walk were installed. DK1 and DK5 comprise semi-circular sandstone masonry arches with tangential backing which have been under-ringed with concrete. DK1 spans over Lover's Walk in Stirling, a street that has recently been reduced to one-way traffic and DK5 spans over unused land between Bridgehaugh Allotments and a residential property. A temporary fence has been erected along the Downside face of DK5. DK2, DK3 and DK4 each comprise 4No simply supported metallic Pratt truss girders supporting buckled plate decks. The truss girders are of built-up construction each comprising 11No bays with a cross truss in the central bay. The top and bottom boom of the girders are built up of consistent sized plates throughout the span of the girder; however, the diagonal plates and vertical posts (comprising back-to-back angles and lacer bars) vary in width and thickness between the supports and mid-span. The girders bear on to rocker bearings which rest on sliding plates over IS1 & IS3 and are fixed over IS2 & IS4. The central walkway comprises 6No longitudinal timbers nailed to transverse timbers that rest on angles bolted to the bottom boom of the main internal girders at regular centres.

The structure also supports 2No cess walkways at track level either side of the MGEs. The parapets comprise lattice girders consisting of a 'T' section for the top chord and back-to-back angles on the bottom chord. The parapet girders are stiffened by the outriggers on the external face and 'T' sections on the internal face at consistent centres.

Archive information suggests that an original cast iron arch structure was constructed circa 1848 for the opening of the Scottish Central Railway. The current superstructure was constructed circa 1905 by the Caledonian Railway.

Structures or Permanent Way Affected

UB 132/017 Forth Viaduct

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Existing Headroom/Lateral Clearances

The minimum headroom below the structure is 5.86m. The bridge is signed for 10'-3".

Masonry Parapet Height (DK1 & 5)

- DK1: Cess to Downside parapet: 1.520m
- DK1: Cess to Upside parapet: 1.320m
- DK5: Cess to Downside parapet: 1.360m
- DK5: Cess to Upside parapet: 1.360m

Parapet Girder Height (DK2-4)

- DK2: Cess to Downside parapet: 1.180m
- DK2: Cess to Upside parapet: 1.170m
- DK3: Cess to Downside parapet: 1.190m
- DK3: Cess to Upside parapet: 1.180m
- DK5: Cess to Downside parapet: 1.180m
- DK5: Cess to Upside parapet: 1.190m

All parapet heights are not compliant with the requirement to be 1250mm above the adjacent walkway as per NR/L3/CIV/020 Clause 10.14. However, due to the marginal noncompliance, and considering cost effectiveness, no work is proposed to be carried-out to make the parapet heights compliant.

From the topographical survey carried out by MHB Survey Services, the minimum distance from the tracks to the structure is as follows:

Deck	Upline LM	Upline HM	Downline LM	Downline HM
	(m)	(m)	(m)	(m)
DK1	1.92	1.89	1.78	1.80
DK2	1.68	1.69	1.62	1.63
DK3	1.68	1.68	1.64	1.64
DK4	1.67	1.66	1.64	1.63
DK5	1.90	1.95	1.75	1.74

Span / Bearing / Articulation Arrangements for Bridge

The dimensions of the underbridge are as follows:

DK2, DK3 and DK4

- Overall girder length– 32.868m
- Spans between centres of bearings– 32.868m
- Skew Angle– None

Local Road Name/Road No./River Name

River Forth

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Public or Private Rights of Way Affected by Works

Passage below the structure will be affected by the works

DK1 spans over Lover's Walk in Stirling, a street that has recently been reduced to one-way traffic and DK5 spans over unused land between Bridgehaugh Allotments and a residential property

Number and Layout of Tracks

2 no. non-electrified tracks of the SC119 Greenhill Upper Jn to Dundee line

Adjacent Earthworks and Terrain

The surroundings are urban and conservational. The River Teith Special Area of Conservation is directly upstream of the structure. The Bridgehaugh and Bruce Street Conservation Areas are also adjacent to the structure. The structure lies within the boundaries of The Battle of Stirling Bridge (11th September 1297). Stirling Old Bridge, which lies 200m upstream of the structure, and the remains of a former bridge to the north are scheduled monuments.

Known Hazards at the Site

The key hazards identified on the site are:

- Working at height
- Exposure to dust through blast cleaning
- High lead content in the existing paint (370g/kg or 37%)
- Non-compliant cess widths for safe access during live traffic
- Danger of falling objects during the removal bituminous protection to bottom flange of Main Girders.
- Exposed electrical cables run along the inside of the Downside parapet.

Refer to Designers Risk Assessment for full list of hazards associated with the project (Doc 2244-MHB-DRA-008).

Details of Design Criteria for Existing Structure (if known)

Unknown.

Construction & Existing Materials

3 No. metalwork samples were taken from the structure to determine the steelwork type. These metalwork samples were analysed by Socotec UK (REF: M122783R5) and found to be consistent with a grade 43 mild-steel (S275). The metalwork material was on the other hand identified as wrought iron in the Level 2 Assessment. Due to the disagreement in the material type, additional metalwork samples were taken the results (REF:COA/05646) of which identified the structural material as weldable low carbon steel.

2 No. paint samples were taken from each span (i.e. a total of 6) the Main Girders. The lowest lead content found was 11% (DK2 Sample 1) and the highest lead content reported was 37% (DK3 Sample 1). For full details of the paint sample results see Socotec Doc. COA05646.

The abutments were taken to be as ashlar sandstone as per the available archived information.

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Historic Assessment Results

A Level 2 assessment was carried out by AECOM in September 2019. The assessment was undertaken in accordance with Network Rail Code of Practice NR/GN/CIV/025 'The Structural Assessment of Underbridges'.

The results of the Assessment indicate that the structure has a capacity of RA10+ @ 65mph at ULS, however the capacity was theoretically limited by the transverse bracing to truss girder chord connections which were found to be inadequate for RA8 at 65mph (RA of the line) at ULS.

1.3 Assumptions and Risks

The following assumptions and risks should be noted:

- It is assumed that the work will be able to be carried out under permitted development rights.
- The works shall not create any new areas of hidden parts and elements.
- There is a risk of an increase in the scope of condition led repairs following blast cleaning of the structure.
- Repairs and strengthening will be carried out under dead load conditions only.
- It is taken that the most recent Assessment Report is accurate, and the design of condition led repairs has been undertaken to ensure the structure meets the section property requirements of the assessment.

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PART 2: DESIGNER'S SUBMISSION

I confirm that the criteria specified in NR/L2/CIV/003 have been considered and that the Design is submitted for Approval in Principle on behalf of:


MHB Consultants Ltd.

52 St Enoch Square

3rd Floor

Glasgow

G1 4AA

Signed:		Title: Director
Name (print) F Aitchison		Date 28/05/21
To be signed by the Contractor's Responsible Engineer.		

NR/L2/CIV/003/F001: APPROVAL IN PRINCIPLE				
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PART 3: CONSTRUCTION ORGANISATION'S ACKNOWLEDGEMENT OF SUBMISSION BY A SUB-CONTRACT DESIGNER

The Design organisation named in **PART 1** is engaged as a sub-contractor to the organisation stated below. I formally acknowledge the submission of this Certificate to Network Rail in support of our sub-contract obligation for provision of the Design on behalf of:


Story Contracting Ltd.

Whistleberry Rd

Blantyre

Glasgow

G72 0TA

Signed		Title	Design Manager
Name (print)	Graeme Hutton	Date	18/06/2021
To be signed by the Contractor's Responsible Engineer appointed for the Construction Phase.			

NR/L2/CIV/003/F001: APPROVAL IN PRINCIPLE				
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PART 3: SUPPLEMENTARY NETWORK RAIL REVIEWS AND ENDORSEMENT

Security, Emergency and Contingency Review

My comments on the submission are given below. Provided that these comments are addressed, I hereby endorse the Approval in Principle of the above proposals regarding the physical security, emergency and contingency arrangements of railway infrastructure.

Signed	Title
Name (print)	Date
To be signed by the Security and contingency planning specialist.	

Station Pedestrian Capacity and Evacuation Review

My comments on the submission are given below. Provided that these comments are addressed, I hereby endorse Approval in Principle of the above proposals regarding Station capacity and evacuation.

Signed	Title
Name (print)	Date
To be signed by the Network Rail Capacity Engineer.	

Fire Safety Review

My comments on the submission are given below. Provided that these comments are addressed, I hereby endorse Approval in Principle of the above proposals regarding Fire Safety.

Signed	Title
Name (print)	Date
To be signed by the Network Rail Fire Engineer.	

NR/L2/CIV/003/F001: APPROVAL IN PRINCIPLE				
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PART 5: PROJECT ENGINEER'S COMMENTS

I have considered this submission for Approval in Principle and I am satisfied that this has adequately addressed the criteria specified in **NR/L2/CIV/003** and confirm that the Design of the Permanent Works is to be checked in accordance with the Design Check Categories listed in 12.2 of **NR/L2/CIV/003**.

My comments on the submission are given below. Provided that these comments are addressed, I hereby give Approval in Principle to the proposals.

Signed	Title
Name (print)	Date
To be signed by the Project Engineer (Building and Civil Engineering).	

Signed	Title
Name (print)	Date
To be signed by other responsible person (if applicable - Project Engineer (Building Services) for example)	

NR/L2/CIV/003/F001: APPROVAL IN PRINCIPLE				
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PART 6: ASSET MANAGER'S APPROVAL

I have considered the submission and confirm that this is approved subject to the comments given below being addressed within the Detailed Design.

Signed	Title
Name (print)	Date
To be signed by the Asset Manager (Structures).	

Signed	Title
Name (print)	Date
To be signed by the Asset Manager (Geotechnical).	

Signed	Title
Name (print)	Date
To be signed by the Asset Manager (Drainage).	

Signed	Title
Name (print)	Date
To be signed by the Asset Manager (Buildings).	

NR/L2/CIV/003/F001: APPROVAL IN PRINCIPLE				
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APPENDIX A

A1 List of Buildings and Civil Engineering assets affected by the proposal

Asset No 1

Description	UB 132/017 Forth Viaduct			
Location	Between Stirling and Bridge of Allan			
ELR	SCM3	Mileage	118miles 1430 yards	
Asset Number	UB 132/017	OS Grid Reference	NS 798 944	

A1.1 Drawings and Models of Proposals

2444-MHB-DRG-1000	A02	Index of Drawings
2444-MHB-DRG-1001	A01	Existing General Arrangement
2444-MHB-DRG-1002	A01	Existing Section
2444-MHB-DRG-1003	A01	Topographical Survey and Utilities Search
2444-MHB-DRG-1005	A01	Existing Metalwork Details Sheet 1 of 2
2444-MHB-DRG-1006	A01	Existing Metalwork Details Sheet 2 of 2
2444-MHB-DRG-1100	A02	Proposed General Arrangement
2444-MHB-DRG-1101	A01	Proposed Section
2444-MHB-DRG-1200	A01	Proposed Bearing Replacement General Arrangement
2444-MHB-DRG-1201	A01	Proposed Bearing Replacement Details
2444-MHB-DRG-1700	A01	Proposed Painting Extents
2444-MHB-DRG-1801	A01	Condition Survey Main Girder Span 2 MGE1
2444-MHB-DRG-1802	A02	Condition Survey Main Girder Span 2 MGI1
2444-MHB-DRG-1803	A01	Condition Survey Main Girder Span 2 MGI2
2444-MHB-DRG-1804	A01	Condition Survey Main Girder Span 2 MGE2
2444-MHB-DRG-1805	A01	Condition Survey Main Span 2 PPT1 External
2444-MHB-DRG-1806	A01	Condition Survey Main Span 2 PPT1 Internal
2444-MHB-DRG-1807	A01	Condition Survey Main Span 2 PPT2 External
2444-MHB-DRG-1808	A01	Condition Survey Main Span 2 PPT2 Internal
2444-MHB-DRG-1809	A01	Condition Survey Deck 2
2444-MHB-DRG-1810	A01	Condition Survey Main Girder Span 3 MGE1
2444-MHB-DRG-1811	A01	Condition Survey Main Girder Span 3 MGI1
2444-MHB-DRG-1812	A01	Condition Survey Main Girder Span 3 MGI2
2444-MHB-DRG-1813	A01	Condition Survey Main Girder Span 3 MGE2
2444-MHB-DRG-1814	A01	Condition Survey Main Span 3 PPT1 External
2444-MHB-DRG-1815	A01	Condition Survey Main Span 3 PPT1 Internal
2444-MHB-DRG-1816	A01	Condition Survey Main Span 3 PPT2 External
2444-MHB-DRG-1817	A01	Condition Survey Main Span 3 PPT2 Internal
2444-MHB-DRG-1818	A01	Condition Survey Deck 3
2444-MHB-DRG-1819	A01	Condition Survey Main Girder Span 4 MGE1

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2444-MHB-DRG-1820	A01	Condition Survey Main Girder Span 4 MGI1
2444-MHB-DRG-1821	A01	Condition Survey Main Girder Span 4 MGI2
2444-MHB-DRG-1822	A01	Condition Survey Main Girder Span 4 MGE2
2444-MHB-DRG-1823	A01	Condition Survey Main Span 4 PPT1 External
2444-MHB-DRG-1824	A01	Condition Survey Main Span 4 PPT1 Internal
2444-MHB-DRG-1825	A01	Condition Survey Main Span 4 PPT2 External
2444-MHB-DRG-1826	A01	Condition Survey Main Span 4 PPT2 Internal
2444-MHB-DRG-1827	A01	Condition Survey Deck 4
2444-MHB-DRG-1829	A01	Condition Survey Main Span 1 Upside & Downside
2444-MHB-DRG-1830	A01	Condition Survey Main Span 1 Low Mileage Elevation and Soffit
2444-MHB-DRG-1831	A01	Condition Survey Main Span 5 Upside & Downside
2444-MHB-DRG-1832	A01	Condition Survey Main Span 5 Low Mileage Elevation and Soffit
2444-MHB-DRG-1833	A01	Condition Survey Pier 1 Sheet 1 of 2
2444-MHB-DRG-1834	A01	Condition Survey Pier 1 Sheet 2 of 2
2444-MHB-DRG-1835	A01	Condition Survey Pier 2 Sheet 1 of 2
2444-MHB-DRG-1836	A01	Condition Survey Pier 2 Sheet 2 of 2
2444-MHB-DRG-1837	A01	Condition Survey Pier 3 Sheet 1 of 2
2444-MHB-DRG-1838	A01	Condition Survey Pier 3 Sheet 2 of 2
2444-MHB-DRG-1839	A01	Condition Survey Pier 4 Sheet 1 of 2
2444-MHB-DRG-1840	A01	Condition Survey Pier 4 Sheet 2 of 2
2444-MHB-DRG-1850	A01	Condition Led Repairs - Repair Type 1
2444-MHB-DRG-1851	A01	Condition Led Repairs - Repair Type 2
2444-MHB-DRG-1852	A01	Condition Led Repairs - Repair Type 3
2444-MHB-DRG-1853	A01	Condition Led Repairs - Repair Type 4
2444-MHB-DRG-1854	A01	Condition Led Repairs - Repair Type 5

MHB Reports

2444-MHB-EW-001	Rev A	UB 132-017 Forth Viaduct - Compression Member MPI Testing
2444-MHB-EW-002	Rev A	UB 132-017 Forth Viaduct - Bottom Chord Issues
2444-MHB-REP-003	Rev B	UB 132-017 Forth Viaduct - Defect Schedule
2444-MHB-REP-004	Rev A	UB 132-017 Forth Viaduct - Break Out Locations
2444-MHB-REP-006	Rev A	UB 132-017 Forth Viaduct - Review of Bearing Results
2444-MHB-REP-007	Rev A	UB 132-017 Forth Viaduct - SI Report
2444-MHB-DRA-008	Rev A	Forth Viaduct Designers Risk Assessment

A1.2 DESIGN CRITERIA

Design Loading

Condition Repairs to achieve route availability of RA 8 at 65mph.

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Design Life

Additional Structural Elements: 60 years

Altered or Repaired Structural Elements: 30 years

Paint: 25 years (for areas blast cleaned to surface standard Sa2½)
15 years (for areas mechanical prepared to surface standard St3)

A1.3 ANTICIPATED DEVIATIONS FROM STANDARDS (with justification)

The parapet heights on the bridge are marginally noncompliant (i.e. 70mm approx. short). However, due to cost efficiency no extension details have been proposed to address this small height increase needed.

A1.4 GEOTECHNICAL CONSIDERATIONS

No considerable change to self-weight resulting from the proposed works, therefore no further considerations required.

A1.5 ACCOMPANYING DRAWINGS AND OTHER DOCUMENTS

Reference Drawings

None.

Reference Reports

132_017_SCM3_LEVEL 2_FINAL_V1	Level 2 Assessment AECOM
Socotec COA/05646	Paint Assessment – UB 132-017 Forth Viaduct
Socotec M122783R5	Metallurgical Assessment – UB 132-017 Forth Viaduct
IKM- Forth Viaduct	Ecology Report.
2444-MHB-REP-003A	UB 132-017 Forth Viaduct -Defect Schedule
2444-MHB-DRA-008-A	Designers Risk Assessment
Socotec COA/05646	Additional Analysis of Metal Samples

A1.6 OTHER RELEVANT INFORMATION

Condition Survey

A condition survey was carried out by MHB Consultants and Geo-Structural (Rope Access Survey) on the 14th and 15th of September 2020 to identify the extent of condition led repairs and produce a schedule of defects for agreement with the Sponsor. Refer to document 2444-MHB-REP-003 for details.

Buried Services

A buried services search was provided by STORY that indicated there were a number of buried services within the vicinity of the structure. For full details of the buried services see the Topographical Survey and Utilities drawing.

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A1.7 SPECIAL ACCESS ARRANGEMENTS/REQUIREMENTS FOR EXAMINATION, INSPECTION, REPAIR, RENEWAL OR REMOVAL

Scaffolding will be required to undertake the works.

A1.8 CHECKING CATEGORY

The Design of the Permanent Works is proposed to be checked in accordance with the following Categories in NR/L2/CIV/003.

Description of asset	Permanent or Temporary Works	Design Check Category
UB 132/017 Forth Viaduct	Permanent	Ib

DO NOT SCALE. Contractor to check all dimensions and report any omissions or errors

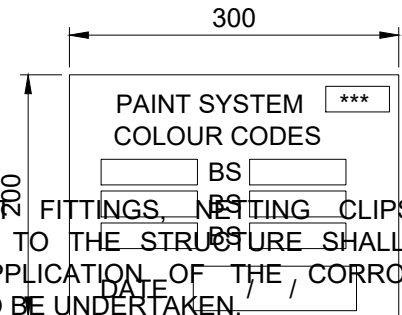


GENERAL NOTES

1. ALL DIMENSIONS IN MILLIMETRES UNLESS STATED OTHERWISE
2. THIS DRAWING SHALL BE READ IN CONJUNCTION WITH:
- 2444-MHB-DRG-1000 INDEX OF DRAWINGS

PROTECTIVE TREATMENT

- NEW PLATES BLAST WITH SHOT OR GRIT AND ENSURE ALL LOOSE RUST REMOVED TO SURFACE STANDARD SA2½ PRIOR TO DELIVERY TO SITE AND NO PRIMER SHALL BE APPLIED TO FAYING SURFACES
4. A PROTECTIVE COATING SYSTEM WITH A MINIMUM DESIGN LIFE OF 25 YEARS IN A C4 HIGH ENVIRONMENT. ON SUCH SYSTEM BEING AN M20 OR M21 SYSTEM
5. AREAS OF DIFFICULT TO ACCESS METALWORK AS AGREED WITH NETWORK RAIL, SHALL BE MECHANICALLY PREPARED TO SURFACE STANDARD ST3. AREAS MECHANICALLY PREPARED SHALL HAVE A DESIGN LIFE OF 15 YEARS.
6. PAINT COLOUR FOR SUPERSTRUCTURE TO MATCH ADJACENT STRUCTURE (HOLLY GREEN 14C39)
7. ALL PROTECTIVE TREATMENT SHALL BE IN ACCORDANCE WITH NR/L3/CIV/039 AND NR/L3/CIV/040 APPLIED IN ACCORDANCE WITH NR/GN/CIV/002
8. ALL FEATHERED EDGES SHALL BE GROUND BACK TO NOMINAL 2mm RADIUS PRIOR TO APPLICATION OF CORROSION PROTECTION SYSTEM
9. UPON COMPLETION OF SITE PAINTING A RECORD OF THE PROTECTIVE TREATMENT IS TO BE MADE, AND A TABLE PAINTED ON THE STRUCTURE WITH WHITE LETTERING 20MM HIGH X 12MM WIDE IN RT.98 ITEM 5.13.5.PANELS TO GIVE NAME & ADDRESSES OF;
 - a. STEELWORK FABRICATOR
 - b. PAINTING CONTRACTOR
 - c. PAINT SUPPLIER
 - d. PROTECTIVE TREATMENT APPLIED
 - e. COLOUR OF TOP COAT
 - f. DATE COMPLETED



10. ANY LIGHT FITTINGS, NESTING CLIPS OR EQUIPMENT ATTACHED TO THE STRUCTURE SHALL BE REMOVED TO ALLOW APPLICATION OF THE CORROSION PROTECTION SYSTEM TO BE UNDERTAKEN.

A01	15/02/21	FORM 001 FIRST ISSUE	DWC	NM	FA	
Rev	Date	Description of Revisions	Drawn	Chkd	Appr	
Status						

F001



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Project

UB 132 / 017

FORTH VIADUCT

OS REF: NS 7979 9437

Drawing Title

PROPOSED
PAINTING EXTENTS

Drawn	Date	Checked	Date	Approved	Date
DWC	08/02/2021	NM	15/02/2021	FA	15/02/2021
Scale(s)	Sheet	ELR & Mileage			
AS SHOWN	1 of 1	SCM3 118m 1430yds			
Drawing Number					Revision
2444-MHB-DRG-1700					A01



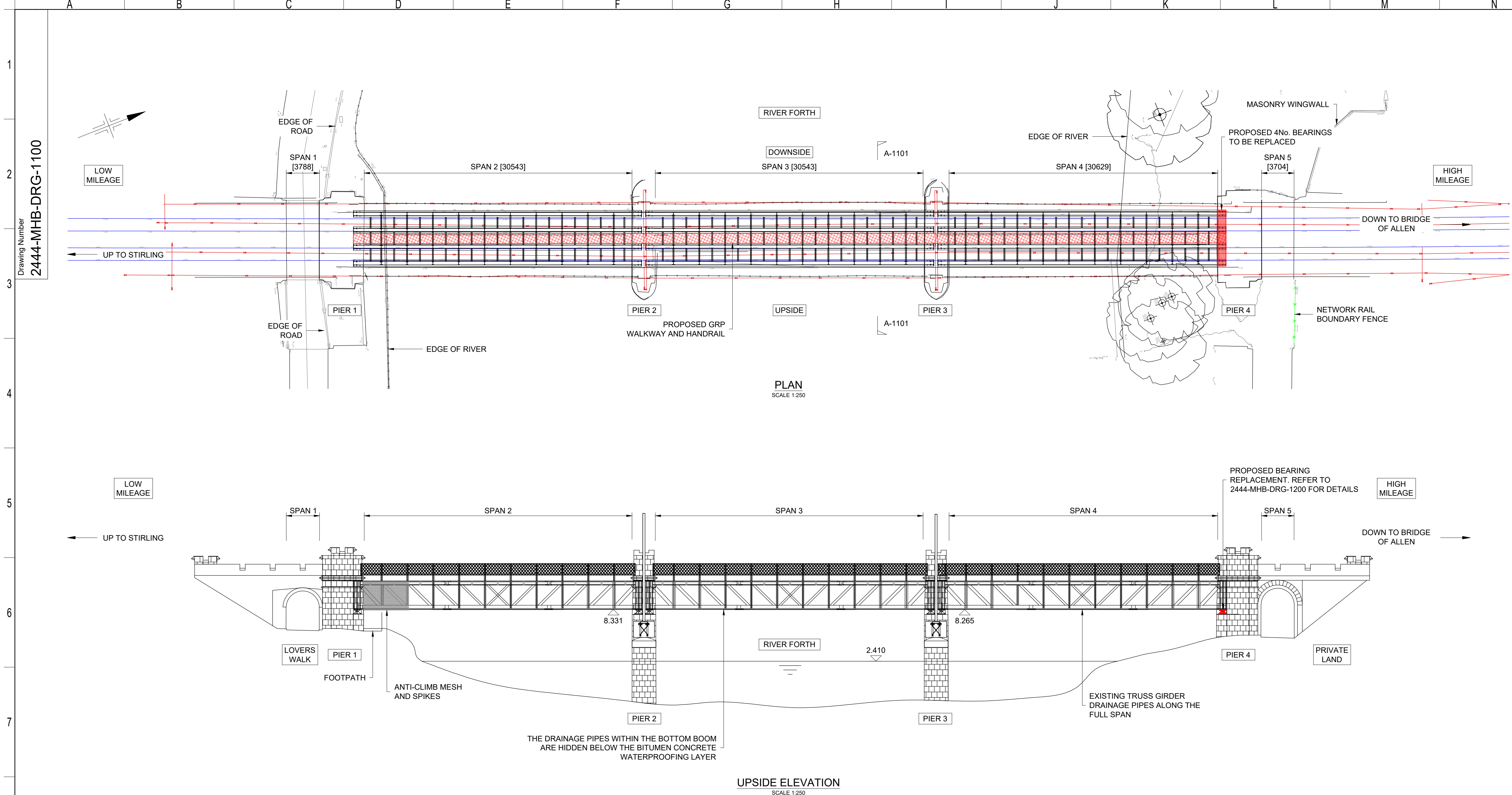
SAFETY, HEALTH & ENVIRONMENTAL INFORMATION

THE FOLLOWING NOTES HIGHLIGHT SIGNIFICANT RESIDUAL HAZARDS IDENTIFIED BY THE DESIGNER, TYPICAL HAZARDS THAT SHOULD BE IDENTIFIED BY A COMPETENT CONTRACTOR ARE NOT INCLUDED. THE CONTRACTOR SHALL CARRY OUT THE WORKS USING AN APPROVED SAFE SYSTEM OF WORK.

FURTHER INFORMATION ON HAZARDS CAN BE FOUND IN THE DRA AND / OR CSM HAZARD LOG


#	RISK	STAGE	MITIGATING MEASURES
2	Existing paint found to contain lead (3700g/kg or 37% as per Socotec report COA05646 Dated 20th Oct 2020)	C	Fit for purpose ventilation to be installed in the use of any enclosure. Any personnel who enter the enclosure/ vicinity of the works are to wear the appropriate respiratory PPE as specified by the contractor. Any individual carrying out these tasks are to also refer to the COSHH register.
3	Falling from height due to non compliant handrails	C	Contractor to ensure a suitable safe system of work is in place
4	Parapet height not compliant with NR/L3/CIV/020	C	Contractor to ensure a suitable safe system of work is in place
9	Vehicular collision with access scaffolding	C	Traffic management system to be in place for the duration of the works. Scaffolding towers to be protected against collision to ensure minimised risk.
10	Noise disturbance to local residents during the works.	C	Contractor to ensure that construction noise is minimised during the works.
11	Exposed cables along Downside parapets	C	"Not possible to reduce risk through design. Contractor to take account of the presence of services in the Upside cess during the implementation works and mitigate against the risk to operatives in method statement."

STAGE CODE: O = OPERATION C = CONSTRUCTION D = DEMOLITION



- SCOPE OF WORKS**
- CONDITION LED METALWORK REPAIRS
 - CONDITION LED SUBSTRUCTURE REPAIRS
 - APPLICATION OF CORROSION PROTECTION SYSTEM TO SATISFY 25 YEAR DESIGN LIFE IN C4 HIGH ENVIRONMENT PAINTED TO MATCH THE COLOUR OF ADJACENT STRUCTURE (HOLLY GREEN 14C39)
 - REPLACEMENT OF ALL UNDERSLUNG WALKWAY ELEMENTS WITH NEW GRP WALKWAY SYSTEM DESIGNED TO ACCOMMODATE LOADING OF 5Kk/m² AND INCLUDE APPROPRIATE EDGE PROTECTION
 - REPLACEMENT OF 4No. BEARINGS AT HIGH MILEAGE ABUTMENT
 - STRENGTHENING OF TRUSS COMPRESSION ELEMENTS
 - SPOT REPLACEMENT OF DEFECTIVE TIMBERS IN TRACKSIDE WALKWAY
 - REPAIRS AND REINSTATEMENT OF DEFECTIVE DRAINAGE
 - DE-VEGETATION OF STRUCTURE WITHIN A 5m ENVELOPE WITH ROOTS TREATED TO PREVENT REGROWTH

SAFETY, HEALTH & ENVIRONMENTAL INFORMATION			
THE FOLLOWING NOTES HIGHLIGHT SIGNIFICANT RESIDUAL HAZARDS IDENTIFIED BY THE DESIGNER. TYPICAL HAZARDS THAT SHOULD BE IDENTIFIED BY A COMPETENT CONTRACTOR ARE NOT INCLUDED. THE CONTRACTOR SHALL CARRY OUT THE WORKS USING AN APPROVED SAFE SYSTEM OF WORK. FURTHER INFORMATION ON HAZARDS CAN BE FOUND IN THE DRA AND / OR CSM HAZARD LOG			
#	RISK	STAGE	MITIGATING MEASURES
1	Buried Services/ S+T Cables	C	Buried service search to be completed prior to commencement of the works. Any services identified are to be marked out on site and protected as required.
2	Existing paint found to contain lead (3700g/kg or 37% as per Socotec report COA05646 Dated 20th Oct 2020)	C	Fit for purpose ventilation to be installed in the use of any enclosure. Any personnel who enter the enclosure/vicinity of the works are to wear the appropriate respiratory PPE as specified by the contractor. Any individual carrying out these tasks are to also refer to the COSHH register.
3	Falling from height due to non compliant handrails	C	Contractor to ensure a suitable safe system of work is in place
4	Parapet height not compliant with NR/L3/CIV/020	C	Contractor to ensure a suitable safe system of work is in place
5	Unknown condition of hidden areas that could increase scope of works and affect project programme	C	Contractor & Network Rail shall provide access to hidden areas that require inspection at earliest opportunity.
6	Unable to achieve edge distances in accordance with design code requirements	M	Fabricator to template areas of girders and troughing for repair and ensure compliant edge distances are achieved.
7	Lack of fit between new and existing metalwork.	C	Contractor to report any discrepancies in the metalwork dimensions found on site to the designer at the earliest opportunity.Fabricator to template existing metalwork prior to fabrication of proposed repairs.
8	Risk from operational railway	C	Works to be completed during Rules of the Route possessions where necessary
11	Exposed cables along Downside parapets	C	"Not possible to reduce risk through design. Contractor to take account of the presence of services in the Upside cess during the implementation works and mitigate against the risk to operatives in method statement."
STAGE CODE: O = OPERATION C = CONSTRUCTION D = DEMOLITION			



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GENERAL NOTES

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- THIS DRAWING SHALL BE READ IN CONJUNCTION WITH:
2444-MHB-DRG-1000 INDEX OF DRAWINGS
- ALL RIVETS TAKEN AS FOLLOWS UNLESS STATED OTHERWISE:
3/4"Ø ON LATTICE PARAPET
5/8"Ø AT 4" PITCH ON ALL OTHER METALWORK
- TYPICAL HAZARDS THAT SHOULD BE IDENTIFIED BY A COMPETENT CONTRACTOR ARE NOT INCLUDED. THE CONTRACTOR SHALL CARRY OUT THE WORKS USING AN APPROPRIATE SYSTEM OF WORK. FURTHER INFORMATION ON HAZARDS CAN BE FOUND IN THE DESIGNERS RISK ASSESSMENT 2444-MHB-DRA-008
- TRACKS COMPRISING CONTINUOUSLY WELDED FLAT BOTTOM RAILS ON CONCRETE SLEEPERS
- ALL PROPOSED WORKS TO BE CARRIED OUT IN ACCORDANCE WITH NETWORK RAIL MODEL CLAUSES FOR CIVIL ENGINEERING WORKS NR/L3/CIV/140 AND AS AMENDED BY THESE CONTRACT DRAWINGS
- A PROTECTIVE COATING SYSTEM WITH A MINIMUM DESIGN LIFE OF 25 YEARS IN A C4 HIGH ENVIRONMENT.
- PAINT COLOUR TO MATCH THE ADJACENT STRUCTURE (HOLLY GREEN 14C39)

KEY



— OHE — UTILITIES - OVERHEAD LINES


— x — NETWORK RAIL BOUNDARY FENCE

EXISTING HEADROOM SIGN
LOVERS WALK
10'-3"

A02	28/05/21	FORM 001		DWC	NM	FA
P01	15/02/21	DRAFT F001		DWC	NM	FA
Rev	Date	Description of Revisions	Drawn	Chkd	Appr	
Status						

F001





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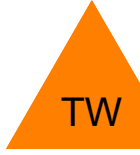
Project

UB 132 / 017
FORTH VIADUCT
OS REF: NS 7979 9437

Drawing Title

PROPOSED
GENERAL ARRANGEMENT

Drawn	Date	Checked	Date	Approved	Date
DWC	08/02/2021	NM	15/02/2021	FA	15/02/2021
Scale(s)	Sheet	ELR & Mileage			
AS SHOWN	1 of 1	SCM3 118m 1430yds			
Drawing Number					Revision
2444-MHB-DRG-1100					A01



TEMPORARY REMOVAL OF MASONRY REQUIRED
— TO ACCESS HOLDING DOWN BOLT LOCATION FOR
DRILLING



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2444-MHB-DRG-1000 INDEX OF DRAWINGS
4. ALL PLATE ARRISES AND EDGES TO RECEIVE PROTECTIVE TREATMENT TO BE PROFILED TO A 3mm RADIUS
5. ALL NEW STEELWORK SHALL BE IN ACCORDANCE WITH BS EN 10025:2004. STEELWORK SHALL COMPLY WITH BS EN 10022 FOR EXECUTION CLASS EXC3 AND TOLERANCE CLASS 2. THE FOLLOWING STEEL GRADE SHALL BE USED:

STEEL PLATE S355J2+N TO BS EN 10025-2
6. PAINT SYSTEM SHALL BE N1 AS PER NR/L3/CIV/039 AND NR/L3/CIV/040 SPECIFICATIONS AND ALL STEEL WORK WHICH WILL BE PAINTED SHALL BE AS PER REQUIREMENTS FOR BS-EN-ISO-8501-3 WITH PREPARATION GRADE P3
7. ALL BEARING BOLTS SHALL BE 8.8 GRADE AND ALL OTHER BOLTS ARE TCB OF 10.9 GRADE
8. THE GROUT SHALL BE OF STRENGTH NOT LESS THAN 50N/mm²
9. UPON REMOVAL OF THE EXISTING BEARING THERE IS A RISK THAT EXISTING RIVET HEADS ARE CHEESE HOLED INTO THE TOP PLATE OF THE BEARING AS SUCH THIS COULD REQUIRE MODIFICATION TO PLATE WHICH COULD DELAY SITE WORKS
10. BEARING SHOWN IS BASED ON PRELIMINARY DESIGN OF AN EN1336-6 ROCKER BE BY EKSPAN

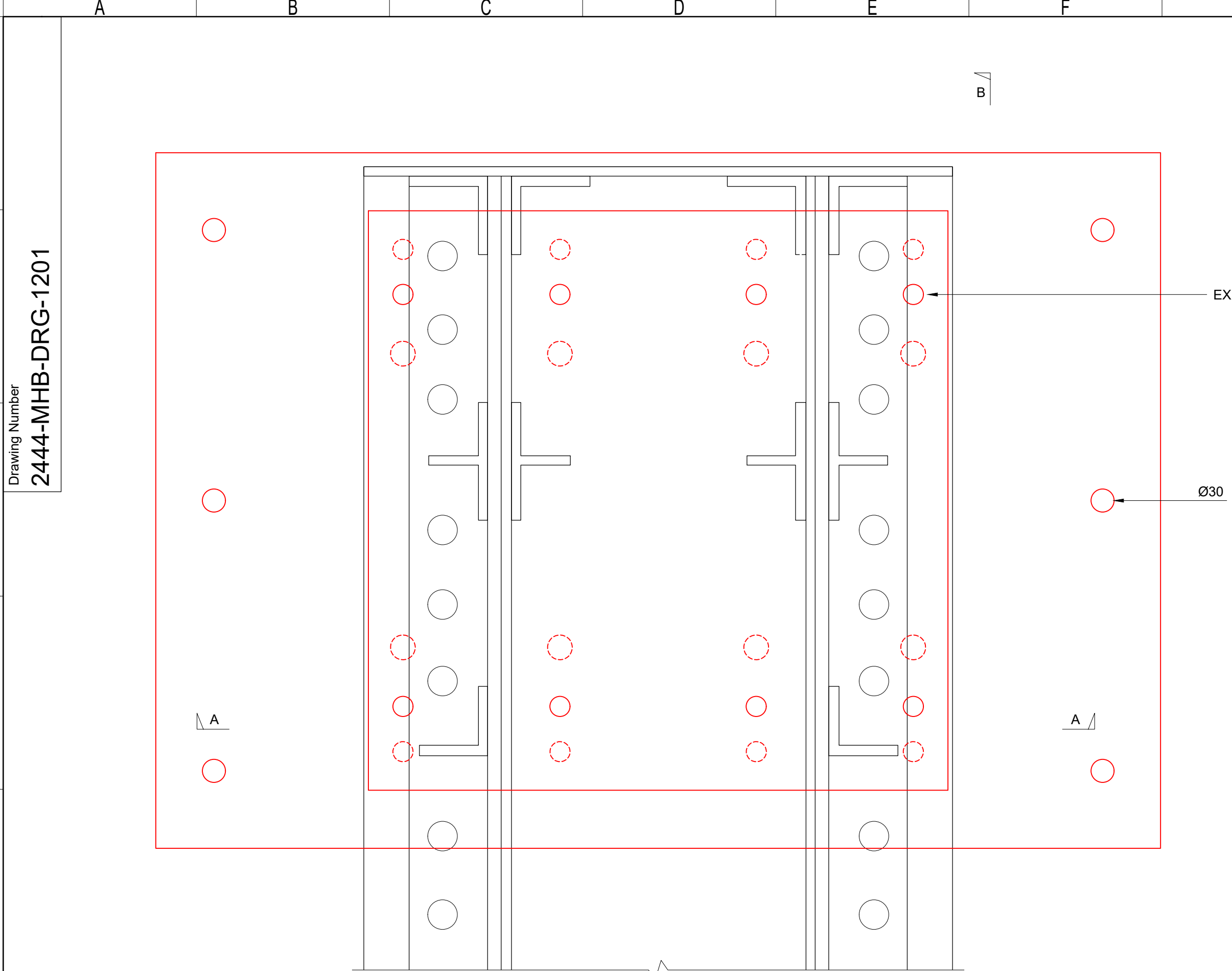
F001



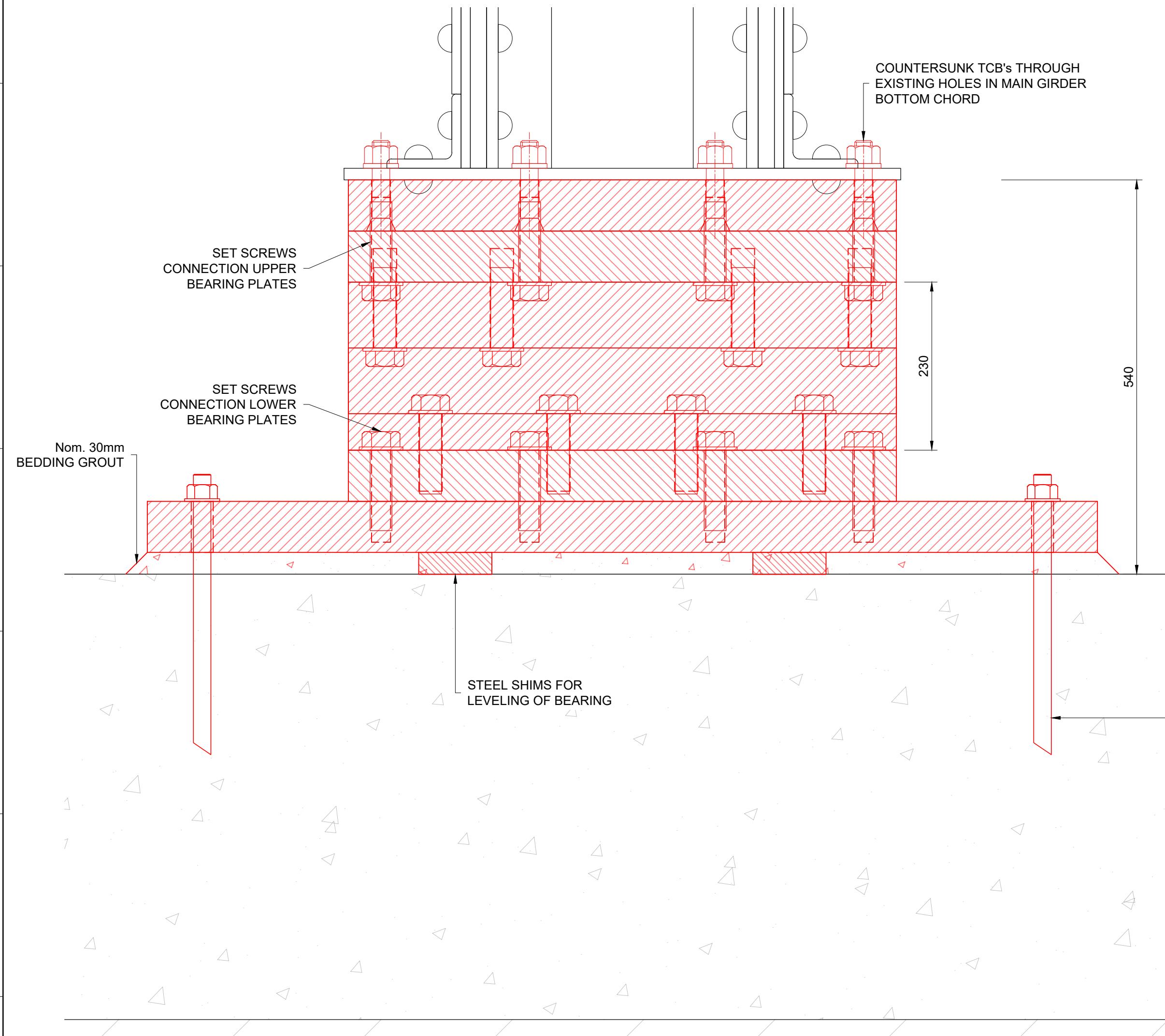
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PROPOSED
BEARING REPLACEMENT
GENERAL ARRANGEMENT

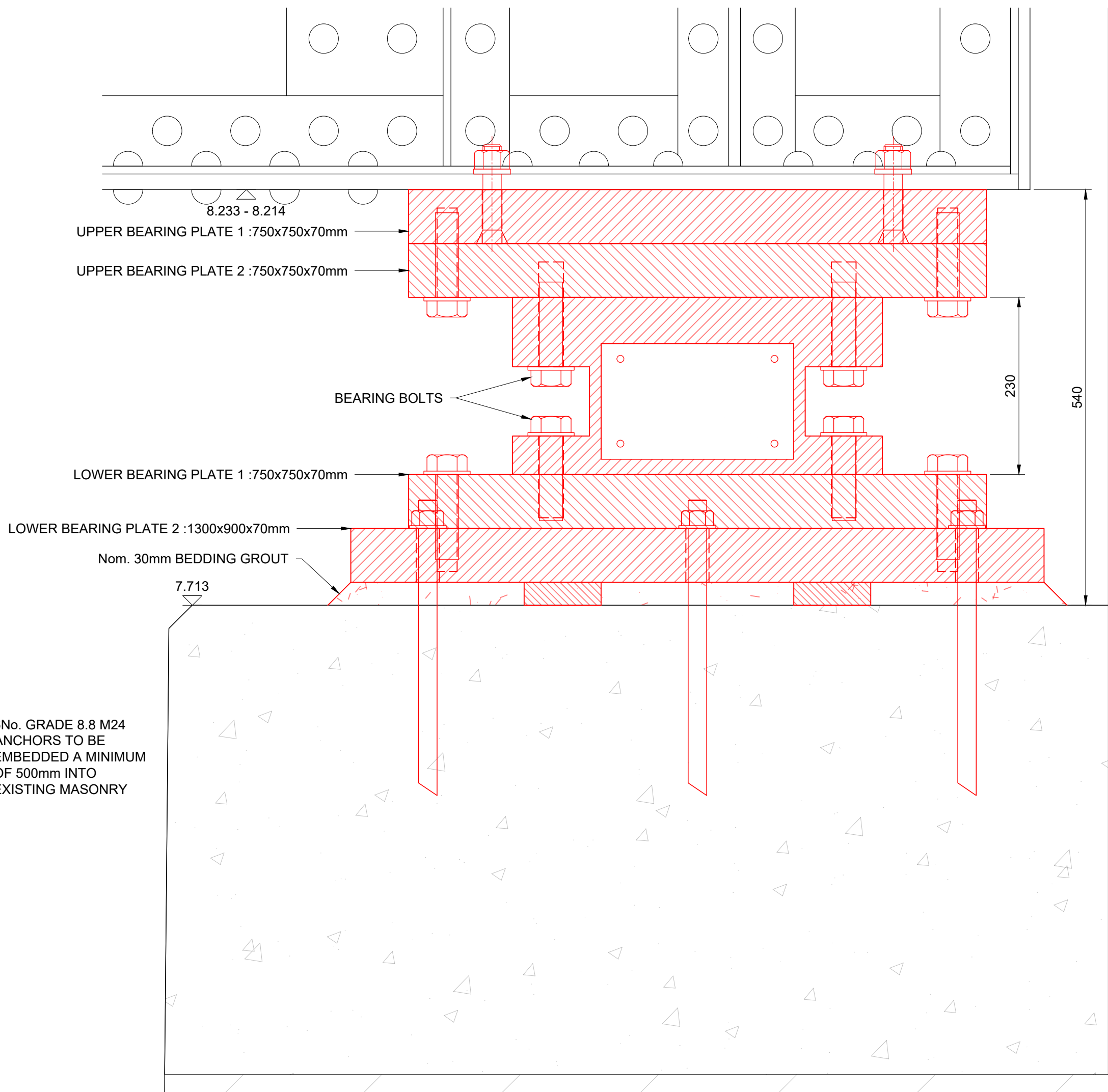
Drawn	Date	Checked	Date	Approved	Date
DWC	18/05/2021	MJL	28/05/2021	FA	28/05/2021
Scale(s)		Sheet	ELR & Mileage		
AS SHOWN		1 of 1	SCM3 118m 1430yds		
Drawing Number					Revision
2444-MHB-DRG-1200					A01



PLAN ON BEARING
SCALE 1:5



SECTION A-A
SCALE 1:5

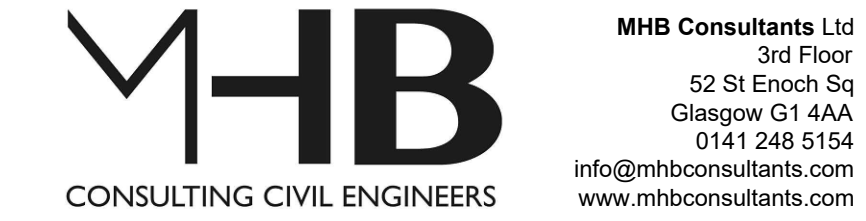


SECTION B-B
SCALE 1:5

STRUCTURE NAME OR REFERENCE			FORTH VIADUCT
BEARING IDENTIFICATION MARK			A
TYPE OF BEARING			FIXED
NUMBER OFF			4
SEATING	MATERIAL	UPPER SURFACE	STEEL
		LOWER SURFACE	CONCRETE
	AVERAGE DESIGN CONTACT PRESSURE (N/mm²)	UPPER SURFACE	307.36
SUPPORT AREA	UPPER SURFACE	LONGITUDINAL (mm)	762
		TRANSVERSE (mm)	762
	LOWER SURFACE	LONGITUDINAL (mm)	990.6
		TRANSVERSE (mm)	914.4
DESIGN LOAD (kN)	OVERALL HEIGHT		MAX 300
	ULTIMATE LIMIT STATE	VERTICAL	MAX
			2632
			PERMANENT
			707
			MIN
			563
			TRANSVERSE
			480
			LONGITUDINAL
			1139
DISPLACEMENT	SERVICEABILITY LIMIT STATE	VERTICAL	MAX
			1931
			TRANSVERSE
			480
			LONGITUDINAL
			800
	REVERSIBLE	TRANSVERSE (m)	-
			LONGITUDINAL (m)
			-
	ULTIMATE LIMIT STATE	IRREVERSIBLE	TRANSVERSE (m)
			-
			LONGITUDINAL (m)
ROTATION (RADIAN)	SERVICEABILITY LIMIT STATE	IRREVERSIBLE	TRANSVERSE (m)
			-
			LONGITUDINAL (m)
			-
			TRANSVERSE (m)
			-
			LONGITUDINAL (m)
			-
	REVERSIBLE	TRANSVERSE (m)	-
			LONGITUDINAL (m)
			-
TOLERABLE MOVEMENT OF BEARING UNDER TRANSIENT LOADS (mm)	MAXIMUM ACCEPTABLE REACTION TO DISPLACEMENT UNDER SERVICEABILITY LIMIT STATE (kN)	VERTICAL	2632
			LONGITUDINAL
			1139
	MAXIMUM ACCEPTABLE REACTION TO ROTATION UNDER SERVICEABILITY LIMIT STATE	VERTICAL	-
			LONGITUDINAL
			-
	TYPE OF FIXING REQUIRED	UPPER FACE	BOLT
			LOWER FACE
			BOLT
			BOLT

- DO NOT SCALE. Contractor to check all dimensions and report any omissions or errors
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A01	28/05/21	FORM 001		DWC	MJL
Rev	Date	Description of Revisions		Drawn	Chkd
Status				Appr	



Project

UB 132 / 017
FORTH VIADUCT
OS REF: NS 7979 9437

Drawing Title

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BEARING REPLACEMENT
DETAILS

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Drawing Number	Revision				
2444-MHB-DRG-1201	A01				