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1. Abbreviations

CA Contract Administrator (for definition refer to preliminaries).

Engineer Employer's Engineer, Arup

AOD Above Ordnance Datum

CDM Construction (Design and Management) Regulations

CJ Construction Joint

CL Centre Line

DPM Damp proof membrane

EA Equal Angle

EQ Equals

FFL Finished floor level.

HSFG High Strength Friction Grip

MJ Movement Joint

NTS Not To Scale

PFC Parallel Flange Channel

Ph1 National Trust Castlefield Viaduct Phase 1

Ph2 National Trust Castlefield Viaduct Phase 2

RC Reinforced Concrete

SSL Structural Slab Level.

TCB Tension Control Bolt

TOC Top of concrete at support locations

TOS Top of steel at intersection with column centreline

UEA Unequal Angle

UNO Unless Noted Otherwise.

UOB Underside of Base

↔ Indicates span direction of slab, steel decking or steel flooring

▲ Indicates beam end connection to be designed for moment and/or torsional continuity

Steel

CFW Continuous Fillet Weld.

FFFW Full Profile Fillet Weld.

PPBW Full Penetration Butt Weld.

PPBW Partial Penetration Butt Weld

HD Bolt Holding Down Bolt

2. General Notes

2.1 This drawing is to be read in conjunction with all relevant documents, specification's, architectural and services drawings, including approved builders work drawings. The Contractor should notify the CA of any discrepancies between the structural drawings and specifications or other drawings.

2.2 Do not scale from the drawings or the computer digital data. Only figured dimensions are to be used.

2.3 All levels are in metres above ordnance datum unless noted otherwise.

2.4 All dimensions are in millimetres unless noted otherwise.

2.5 U.N.O on the drawings, all columns are located centrally about intersecting gridlines.

2.6 Refer to Architect's drawings for the following information:

- Setting out dimensions not shown on structural drawings.
- Locations and details of required surface finishes.
- Details of all damp proofing, waterproofing and sealants.
- Details and requirements for any insulation.

2.7 Refer to the Contractor's or Specialist Subcontractor's drawings for the following information:

- Details of connections, fixing brackets, inserts etc. for cladding, roofing, balustrades etc.
- Details of plinths, shoes or other supports to floor mounted equipment.

2.8 The Contractor shall be responsible for the design, fabrication, erection and removal of all temporary works and shall provide all temporary bracing and back propping necessary to maintain structural stability during construction.

2.9 Specific temporary works constraints arising from the permanent works design, if and where applicable, are noted on the Arup drawings to which they relate.

2.10 Arup have documented significant CDM risks in the hazard risk register.

2.11 Typical existing viaduct geometry based on Spatial Dimensions survey October 2021. TIGM viaduct arches, only, based on July 2024 survey by Spatial Dimensions.

2.12 Project GLs at viaduct level taken from upper transverse girder (Deansgate face). Refer to drawing CVI-ARUP-ZZ-ZZ-DR-S-1056 for relationship between GLs and existing soffit level structure.

2.13 Refer to the Local Authority for limits regarding acceptable levels of noise during construction.

2.14 Refer to the Heritage Consultant for constraints (materials/workmanship) affecting heritage-sensitive elements.

2.15 The Contractor is to coordinate with, and prepare method statements as required, for stakeholders responsible for adjacent assets including:

- Network Rail - concerning
- Local Authority - for adjacent footpaths/highways
- Canal and River Trust - for adjacent canals
- Environment Agency - for adjacent River Medlock
- TIGM - for adjacent Metrolink (and associated structures)
- Embassy Village - adjacent to TIGM viaduct arch 272

3. Design Loading

3.1 For design loading to Ph1 areas, refer to drawings CVI-ARUP-ZZ-ZZ-DR-S-1002 and CVI-ARUP-ZZ-ZZ-DR-S-1003

4. Fire Resistance

4.1 Refer to the fire strategy and the Architect's details for fire resistance periods.

5. Contractor-Designed Elements

5.1 Contractor designed elements include, but may not be limited to, the following. Refer to the Structural Performance Specification for detailed performance requirements (where applicable).

- The Events Building.
- Proprietary structural products such as 'Structural Insulated Panels' (SIPS)
- All connections including steel to steel, steel to timber, and timber to timber.
- Steel to column baseplate connections and holding-down assemblies.
- All elements of temporary works including the construction access path down the length of the viaduct.
- Secondary steelwork including but not limited to:
 - Handrails, railings and balustrades.
 - Support structure for services and ceilings.
 - Lift guide rails and associated steelwork.

6. Structural Concrete

6.1 For full requirements, refer to the Project Structural Concrete Specification (CVI-ARUP-ZZ-ZZ-SP-S1-000005)

6.2 All new concrete is to comply with the latest edition of the National Structural Concrete Specification for Buildings (NSCS), published by the Concrete Society, as modified by the Structural Concrete Specification

6.3 All concrete must be sourced from suppliers certified to BES 6001 to a level of at least 'Very Good'.

6.4 All steel reinforcement must be CARES SRS Certified.

6.5 Unless noted otherwise all reinforcement shall be B500B to BS4449 with a characteristic strength of 500N/mm2. Mesh fabric shall be to BS4483.

6.6 Concrete cover shall be as stated in the Structural Concrete Specification.

6.7 Concrete strengths shall be as defined in the Structural Concrete Specification

6.8 All holes in reinforced concrete are to be formed.

6.9 No cutting or removal of concrete to form holes, chases, rebates etc. is permitted without prior agreement of the CA.

6.10 Refer to the Structural Concrete Specification for finishes requirements, including for elements of visual concrete.

6.11 50mm minimum blinding layer to be placed under any reinforced concrete in contact with the ground.

6.12 All drilled fixings into concrete to be resin fixed in accordance with the manufacturer's recommendations.

6.13 Site welding of reinforcement is not permitted.

6.14 The Contractor shall design all formwork and temporary propping.

6.15 All exposed concrete corners shall have 20mm chamfers UNO.

7. New Structural Steelwork

7.1 All steelwork shall comply with 'The National Structural Steelwork Specification for Building Construction' 7th edition, published by BCSA/SCI, as modified by the project steel specification (CVI-ARUP-ZZ-ZZ-SP-S1-000002).

7.2 Unless noted otherwise structural steel grades shall be S355 designed to BS EN 1993 and delivered in accordance with BS EN 10025. Refer to Project Specification where applicable.

7.3 Connections are to be designed by the Contractor for the forces shown on the drawings & schedules. Where connections are detailed on the drawings the Contractor is to confirm acceptance of these details in writing prior to start of fabrication. Loads given relate only to the permanent works. All loading conditions resulting from temporary works or the construction sequence shall be determined and designed by the Contractor.

7.4 Connections of members will be located centrally about the respective axis of the members unless specifically noted otherwise.

7.5 The Contractor shall clearly identify on the fabrication drawings the location of connections added to the steelwork by the fabricator (such as those added to simplify fabrication or erection) together with details of and calculations for those connections.

7.6 All structural connections are to have a minimum of 2 No. M16 grade 8.8 bolts UNO.

7.7 All bolt and tie bar assemblies shall be property class 8.8 unless agreed otherwise with the Engineer.

7.8 Grade 8.8 bolts shape to BS EN 150 4014, BS EN 150 4017 or BS 3692. Grade 8.8 bolts to the strength grade of BS EN 150 4014 or BS EN 150 4017 but with the dimensions and tolerances of BS EN 150 4016 or BS EN 150 4018 may also be used, with matching nuts to the strength classes of BS EN 150 4032 but the dimensions and tolerances of BS EN 150 4034. Alternatively, grade 8.8 bolts and matching nuts to the strength grades of BS 3692 but the dimensions and tolerances of BS 4190 may be used.

7.9 Pre-loaded assemblies shall be in accordance with BS EN 14399 parts 3, 7 or 10.

7.10 All contractor designed work is to be submitted for acceptance by Arup.

7.11 All submissions and method statements are to be submitted at least two weeks prior to commencement of fabrication for acceptance by Arup.

7.12 All structural welds are to be a minimum of 6mm fillet weld. Where shown on the drawings design sizes have been given for PPBW i.e. they relate to the depth of penetration. Unless otherwise agreed the depth of penetration of a V or bevel weld shall be taken as the depth of preparation minus 3mm. For J and U welds no reduction need be made. The design calculations shall distinguish between design thickness and penetration depth.

7.13 Foundation bolts shall be in accordance with BS 74110. Where grouted sleeves are used no reliance should be placed on the grout to resist horizontal shear. The Contractors design should ensure such horizontal forces can be transmitted by either base friction or directly by setting the baseplate into a shallow pocket, or in the case of high shear forces by the provision of a shear key fixed to the underside of the baseplate.

7.14 Grout around foundation bolts and under base plates is to be non-shrink and have a minimum characteristic strength at 28 days of 40N/mm².

7.15 Site welding shall only be carried out with the prior written consent of Arup and after submission and acceptance of the fabricator's welding procedure.

7.16 No cutting or removal of placed steelwork is permitted without prior acceptance by the CA.

7.17 Refer to specification for the extent and nature of corrosion protection. The contractor shall ensure that the systems selected for corrosion protection and fire protection are compatible and shall obtain acceptance by Arup prior to use.

7.18 The Contractor is to allow for coordination with other Contractors whose work interfaces with the steel frame. This coordination may include the design, fabrication, and erection of steel elements, brackets, and fixings specified by other Contractors, that do not appear on the Arup drawings.

7.19 Refer to the steelwork specification for notes relating to temporary works during erection. The contractor is responsible for all temporary works which include but are not limited to the items noted in the drawings, specification and scope of works & CDM sheets.

7.20 Fire protection to steelwork to be in accordance with the architect's specification.

7.21 For orientation of columns refer to Arup drawings.

7.22 The contractor shall clearly identify the location of site connections on the fabrication drawings together with details of and calculations for those connections.

7.23 A minimum bolt projection of 2 full threads beyond the nut should be ensured on all bolts.

8. Existing Structural Steelwork

8.1 Existing viaduct is in steel. Refer to drawing CVI-ARUP-ZZ-ZZ-DR-S-1055 for description of existing structural arrangement.

8.2 Refer to drawing CVI-ARUP-ZZ-ZZ-DR-S-1056 for naming system for viaduct spans, piers, and transverse beams.

8.3 Unless otherwise stated, site welding to existing structure not to be undertaken. All new connections to be bolted.

8.4 When removing existing rivets, mechanical shearing of rivet heads and the punching out of rivet shafts shall be the preferred method. The surrounding metalwork shall not be damaged or adversely affected. Removal of rivets by flame cutting shall not be permitted.

8.5 Existing holes from which rivets are removed shall be reamed to remove any cracks or other fatigue details which may be present. In all cases, reaming shall enlarge the diameter of the hole by a minimum of 2mm. Flame cutting or punching shall not be used for enlarging of holes. Reaming shall not have any adverse effects on the structural capacity or edge distances.

8.6 New holes shall be formed by drilling. Punching or flame cutting shall not be used to form holes.

8.7 All holes from which rivets are removed shall, as far as is reasonably practicable, have replacement bolts inserted.

8.8 The diameter of new bolts which replace existing rivets shall be at least equivalent to the replaced rivets.

8.9 All new bolts to be dome-headed TCB-type HSFG UNO, with dome head orientated to visible face. Standard 2mm clearance assumed: where rivet reaming increases bolt holes above standard, Engineer to be informed for review.

8.10 All new steel plates to be site measured prior to fabrication (e.g. to match existing rivet spacings)

8.11 All gaps between new steel plates and existing plates to be closed off with steel packers to ensure physical connection between the two. 'Cheese' packer plates to be used where spacing off over existing rivet heads. Packers to be tack-welded to new strengthening plates where possible to avoid slippage.

8.12 All exposed edges between new steel plates and existing to be plugged with polyurethane sealant or similar

9. Structural Timber

9.1 For full requirements, refer to the Project timber specification (CVI-ARUP-ZZ-ZZ-SP-S1-000003).

9.2 All timber shall be obtained from well managed forests, and should have PEFC or FSC chain of custody certification to demonstrate they have been sourced from sustainable sources.

9.3 All timber shall be graded to approval and marked accordingly.

9.4 Unless noted otherwise, the softwood timber grade shall be C24.

9.5 All timber elements are to be raised off the ground in the permanent case to minimise rot and insect attack.

9.6 All connections are to BS EN 14592, and bolt spacing, edge and end distances to BS EN 1995-1-1. Wane, splits, knots and other defects should be limited in the region of the connections.

9.7 A moisture control plan is required. Moisture content shall be less than 18% before erection and shall be less than 12% at handover.

10. Proposed Remedials Context

10.1 A number of proposed structural remedials for the viaduct are shown from drawing CVI-ARUP-ZZ-ZZ-DR-S-4001 onwards

10.2 These are based on typical defects identified in the previous viaduct surveys (refer to Arup Ph2 RIBA WS2 report for more background):

- Jacobs 2010
- Carillion 2012
- Jacobs 2014
- Balfour Beatty 2020
- Balfour Beatty 2024

10.3 The Arup Ph2 report outlines the limitations of these surveys: in terms of clarity, ambiguity and spatial communication of defects. The proposed structural remedials are consequently sketch concepts only, to illustrate the key principles

10.4 A further programme of touching-distance (tactile) surveys are proposed after the planned brush-down and gutter clearance in late 2024 / early 2025.

10.5 The proposed surveys will allow for a process of:

- validating current assumptions;
- providing the confidence needed for existing structure assessment (including by analysis where necessary);
- developing remedial details to final construction status;
- determining how many remedials are required and where.

10.6 Some remedials are more likely to be required than others: for example the transverse beam bearing stiffener remedials on (drawing CVI-ARUP-ZZ-ZZ-DR-S-4001) will be required where high future loads occur in places with known deterioration to existing stiffeners. However the process outlined above may also demonstrate that some of the proposed remedials are not required (e.g. through analysis or other assessment).

10.7 Due to the time-sensitive nature of the project these drawings give an upper bound estimate of proposed structural remedials for the purposes of the Listed Building Consent approval process. This is a conservative approach to establish principles that can be applied through the future survey, assessment and remediation process.

Notes:

1. These drawings shall be read in conjunction with all relevant Engineer's and Architect's drawings and with all relevant specifications.

2. All dimensions are to be checked by the Contractor prior to fabrication or construction.

3. The information shown on this drawing reflects RIBA Work Stage 4 level.

4. All dimensions are in millimetres, unless noted otherwise.

5. All levels are in metres above ordnance datum, unless otherwise stated.

6. Drawing to be read in colour.

7. Do not scale from this drawing.

8. Typical existing viaduct geometry based on Spatial Dimensions survey October 2021. TIGM viaduct arches, only, based on July 2024 survey by Spatial Dimensions.

9. Project GLs at viaduct level taken from upper transverse girder (Deansgate face). Refer to drawing CVI-ARUP-ZZ-ZZ-DR-S-1056 for relationship between GLs and existing soffit level structure.

T1

14/08/24

RR

GH

Preliminary Issue

Rev

Date

Chkd

Appd

Issue Notes

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Client

The National Trust

Project Title

Castlefield Viaduct
Phase 2

Drawing Title

General Notes

Scale at A1

Drawn By
NC

Role

Structural

Status

S2 - For Information

Arup Job No
282210

Rev
T1

ID

CVI-ARUP-ZZ-ZX-DR-S-0001

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