BUROHAPPOLD ENGINEERING

Bridgewater Place

Approval in Principle

22 January 2015

Revision T02

APPROVAL IN PRINCIPLE FORM

(Design of Bridges & other Highway Structures)

Name of Project: Bridgewater Place
Name of Structure: Baffles Structure
Structure Ref No:

Revision	Description	Issued by	Date
T01	First issue to LCC	SEF	12/12/2014
T02	Updated to address council comments	SEF	22/01/2015

Name of Project	**Bridgewater Place**
Name of Structure	**Baffles Structure**
Structure Ref No	

1. HIGHWAY DETAILS

1.1 Type of Highway

Unclassified road.

1.2 Permitted Traffic Speed [1]

30mph.

1.3 Existing Restrictions [2]

Not applicable.

2. SITE DETAILS

2.1 Obstacles Crossed

The three proposed baffle structures will span over Water Lane, Leeds.

3. PROPOSED STRUCTURE

3.1 Description of Structure

The baffles are portal structures with a framework that supports perforate metal cladding on one side. The function of the baffles is to alleviate the effects of wind in the vicinity of the Bridgewater Place building. The design working life of the baffles is 120 years.

3.2 Structural Type

The baffles comprise circular hollow section columns located within the verges/footways/carriageway of the existing highway. These columns support a steel truss comprising horizontally curved circular hollow section booms and tapering vertical fabricated fin members arranged as a ladder frame. Smaller circular hollow section diagonal members are provided to brace the truss.

3.3 Foundation Type

Piled foundations socketed into bedrock with pilecaps just below footway/verge/carriage-way level.

3.4 Span Arrangements

The baffles typically consist of a central span between columns of 9.5m to 17.0m with cantilevers on either side that extend 2.5m to 5.0m beyond the columns.

3.5 Articulation Arrangements

The baffle support columns are rigidly fixed to the pilecaps. The tops of the columns have pinned connections to the spanning truss members.

3.6 Types of road restraint systems

The baffle columns will be protected from superficial damage by full height trief kerbs at their base. However, the main function of the trief kerbs will be to give protection to the road users – refer to Appendix F (design hazard log) and Appendix G: Quantitative Risk Assessment. This will be considered as part of the Road Safety Audit.

3.7 Proposed arrangements for maintenance and inspection

3.7.1 Traffic management

Visual inspection – no traffic management required.

Cleaning, maintenance and principal inspection of the baffles will require partial closures of Water Lane.

3.7.2 Access

Visual inspection – no access equipment required.

General inspection - portions of the baffles above the footway may be accessed using a mobile scaffold tower or similar to allow a general inspection to be undertaken without a road closure.

Principal inspection - access to the full baffle structures is envisaged to require a mobile elevated work platform operating within a partial or full road closure.

3.7.3 Inspection

The following inspection regime is anticipated:

Visual inspection annually plus pre-high windspeed events.
General inspection every 2 years.
Principal inspection every 6 years.

3.7.4 Outline Maintenance Requirements

The following routine activities are expected to be necessary:

Architectural feature lighting – refer to Appendix E.

Cleaning of exterior cladding and removal of any debris that has accumulated inside the clad structure – recommended to take place twice a year.

Repainting of the structural steelwork – no maintenance anticipated for 10 years, minor maintenance after 10 years, major maintenance after 25 years.

3.8 Sustainability issues considered. Materials and finishes

Sustainable and low embodied energy materials will be used where possible.

All steel components of the superstructure shall be manufactured from recyclable materials. In particular, the main component, steel is 100% recyclable after use.

The specification for painting exposed steel surfaces will require the use of paint systems selected for optimum durability, appearance, cost and environmental suitability.

The baffle structure will comprise steel grade S355J2G3 to BS EN 10025 or S355J2H to BS EN 10210. Mild Steel may be used for certain secondary components. All outer steel surfaces to be painted in accordance with the MCHW. The structures will be classed as "difficult access" and hence protection system type II will be specified. No additional treatment will be provided within closed sections, which will be continuously sealed by welding.

Baffle cladding is anticipated to comprise stainless steel or marine grade aluminium with no additional protective treatment.

Connections in the primary structure will be generally made using high strength friction grip bolts or by welding. The structure will be proportioned to allow it to be delivered to site in large pieces with no requirement for site welding.

Continuous openings will be provided along the bottom of baffle to prevent debris accumulation and allow for drainage

Bird roosting will be discouraged by avoiding flat surfaces or recesses within the baffles. The possible benefits of additional anti-bird measures (mesh, “pigeon glide”, spikes, electric track, spring wire, netting, gel, sonic systems) will be evaluated.

3.9 Risks and hazards considered [3]

Refer to Appendix F for hazard log and Appendix G for quantitative risk assessment.

3.10 Estimated cost of proposed structure together with other structural forms considered, including where appropriate proprietary manufactured structure, and the reasons for their rejection including comparative whole life costs with dates of estimates.

Costs are not available at the time of writing.

The form of baffle structures has been developed following detailed computational fluid dynamic analysis and input from the project architect and local planning authority.

3.11 Proposed arrangements for construction

3.11.1 Traffic management

Partial and full lane closures will be required during construction of the baffle foundations and erection of the steelwork.

3.11.2 Service diversions

None anticipated.

3.11.3 Interface with existing structures

A large diameter Yorkshire Water combined sewer runs under Water Lane. The basement of Bridgewater Place extends beyond the footprint of the building. The Holbeck Canal Wharf culvert is present along the south boundary of the site.

4. DESIGN CRITERIA

4.1 Live Loading

4.1.1 Loading relating to normal traffic under AW regulations and C&U regulations [4]

Not applicable.

4.1.2 Loading relating to General Order traffic under STGO regulations

Not applicable.

4.1.3 Footway or footbridge live loading

Not applicable.

4.1.4 Loading relating to Special Order Traffic provision for exceptional abnormal loads indivisible loads including location of vehicle track on deck cross section [6]

Not applicable.

4.1.5 Any special loading not covered above

Vehicle impact

The baffle supports will be designed to withstand equivalent static design forces due to vehicular impact on members supporting foot and cycle track bridges over or adjacent to roads with speeds less than or equal to 45mph as IAN 124 Table A.4 and A.5 (i.e. 825kN main + 165kN residual loads in the direction of normal travel).

Refer to Appendix F (design hazard log).

Wind loading

Wind load will be derived according to BS EN 1991-1-4.

The mean wind speed is taken from the code (22.5m/s). Apart from the altitude factor, this wind speed is also adjusted to account for the tall building (Bridgewater Place) in the vicinity using results from computational fluid dynamics analysis and wind tunnel testing. The value of the wind pressure considered is that applicable at a height of 100m above ground level (i.e. the height of Bridgewater Place).

The force coefficient taken is 1.8, ignoring the porosity of the baffle cladding (nominally 50%). The design wind pressure to be applied in the design of the structure is therefore 3.2 kN/m^2.

Refer to Appendix D (wind studies) for more details of this derivation.

Ice

The ice load will be derived using BS EN 1993-3-1 Annex C and National Annex 2.33. The ice thickness is 72mm when there is no wind and 18mm when combined with wind.

Snow

The snow loading will be derived using IAN 124. The assessed ground snow load is 0.53 kN/m^2. The snow load on top is 0.43 kN/m^2 and no snow on the sloping face.

Temperature

The thermal load will be derived using BSEN 1991-1-5. Thermal load derived for expansion is +23 ^oC and contraction is -36^oC based on an initial temperature between 10 ^oC and 20 ^oC.

4.1.6 Heavy or High load route requirements and arrangements made to preserve the route, including any provision for future heavier loads or future widening

Not on a heavy or high load route.

4.1.7 Minimum headroom provided

6.000 m

(NB. Minimum required by TD 27/05 is 5.70m + s where s = sag curve component).

4.1.8 Authorities consulted and any special conditions required

Leeds City Council

- Highway layout and alignment
- Highway Cross-Sections
- Highway Cross-Sections at Structures
- Headrooms at Structures

Yorkshire Water

- A pile standoff distance of approximately 2m (or 3*pile diameter) to the external face of the combined sewer has been agreed in principle.
- Final requirements will be agreed by means of a formal Build Over Agreement (post planning).

4.2 List of relevant documents from the TAS

See Appendix A

4.2.1 Additional relevant standards

See Appendix B

4.3 Proposed departures from Standards given in 4.2 and 4.2.1

Not applicable.

4.4 Proposed methods for dealing with aspects not covered by Standards in 4.2 and 4.2.1

By reference to TAA.

5. STRUCTURAL ANALYSIS

5.1 Methods of analysis proposed for superstructure, substructure and foundations

5.1.1 Computational Fluid Dynamic Modelling

- Different CFD models are set up to optimise the baffle locations, bearing in mind the site constraints.
- Derivation of wind speed factor to account for the terrain around Bridgewater Place.

5.1.2 Wind tunnel testing.

- A 1 in 300 scale model is used in the wind tunnel test to evaluate the wind speed at various locations in the area. This test will confirm the wind speed at the baffle level with the CFD model results.

- A second test will be carried out to provide wind loads for static analysis.

5.1.2 Static Analysis

- To provide natural frequencies and mode shape to decide which type of the wind tunnel model to assess the baffle wind forces.

- To provide design forces for the design of the structure members, connections and foundations.

Proprietary computer software LUSAS, ROBOT and SAM will be used for the analysis of the baffle structure.

5.2 Description and idealised structure to be used for analysis

See Appendix C for idealised structure drawing

5.3 Assumptions intended for calculation of structural element stiffness

Full gross section properties will be used.

5.4 Proposed earth pressure coefficients (K_a, k_0, or K_p) to be used in the design of earth retaining elements

Not applicable.

6. GEOTECHNICAL CONDITIONS

6.1 Acceptance of recommendation of the Geotechnical Report to be used in the design and reasons for any proposed changes

Accepted.

6.2 Geotechnical Report Highway Structure Summary Information (Form C) [7]

<table>
<tr><td colspan="3">STRUCTURE NAME
BRIDGEWATER PLACE BAFFLE STRUCTURES</td><td>CHAINAGE and OS Grid Reference</td><td>Ref</td></tr>
<tr><td colspan="3">STRUCTURE TYPE
Wind baffles</td><td>AIP Ref No</td><td></td></tr>
<tr><td colspan="3"></td><td>DESIGN LIFE: 120 years</td><td></td></tr>
<tr><td colspan="3">SOILS/GEOLOGY</td><td>RELEVANT TRIAL HOLES

Colas have undertaken a series of trenches across the Water lane carriageway to identify/expose near surface utilities and obstructions.
No deep ground investigation is currently available. Historic Ground Investigations are been sought and additional Ground Investigation works are currently out to tender.
Current ground model based on:
• Geological data within the public domain (British Geological Survey (BGS) maps and BGS logs).
• Pile design schematics available for Bridgewater Place building (which are a summary of historical boreholes).</td><td></td></tr>
<tr><td>Stratum</td><td>Depth to top of strata (m BGL) - mean in brackets</td><td>Elevation of top of stratum (m OD) – mean in brackets</td><td>Typical description</td><td></td></tr>
<tr><td>Made Ground</td><td>0.00</td><td>~ +28.00</td><td>MADE GROUND no description available. .</td><td></td></tr>
<tr><td>Alluvium</td><td>3.00</td><td>~ +25.00</td><td>Alluvium – BGS describes as Clay, Silt , Sand and Gravel.</td><td></td></tr>
</table>

Lower Coal Measures.	10.00	~ +18.00	BGS describes as Mudstone, Siltstone and Sandstone. Pile design schematic describes primarily Mudstone with Sandstone bands ~0.00 m AOD. No significant Coal identified to depths in excess of >- 15.00 m AOD.	

PREVIOUS SITE HISTORY	
Maps	Construction
N/A	Refer to Contaminated Land Statement

CONTAMINATED GROUND RISK ASSESSMENT REQUIRED Not applicable – refer to Contaminated Land Statement.
GROUNDWATER Groundwater level is based on the data provided in the Pile Design Schematic and is indicated to be ~ 6.00 m BGL (22.00 m BGL).
EARTH PRESSURE VALUE - Not applicable
BEARING CAPACITY – Not applicable
PILE DESIGN – Not available - Detail Design to be undertaken by specialist piling contractor (once appointed).

6.3 Differential settlement to be allowed for in the design of the structure

10mm.

6.4 If the Geotechnical Report is not yet available, state when the results are expected and list the sources of information used to justify the preliminary choice of foundations [8]

Not applicable.

7. CHECKING

7.1 Proposed Category:

Category III

7.2 If Category 3, name of proposed Independent Checker

Flint & Neill

7.3 Erection proposals or temporary works for which an independent check will be required, listing parts of the structure affected with reasons for recommending an independent check

Not applicable.

8. DRAWINGS AND DOCUMENTS

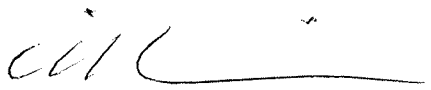
8.1 List of Drawings (including numbers) and documents accompanying the submission [9]

032543-C200	Proposed Highways General Arrangement
Appendix A	Technical Approval Schedule
Appendix B	List of Documents Covering Aspects Not Covered by Appendix A
Appendix C	Idealised Structure Diagrams
Appendix D	Wind Studies
Appendix E	External Electrical Services Maintenance Requirements
Appendix F	Design Hazard Log (Risk Assessment)
Appendix G	Quantitative Risk Assessment

9. THE ABOVE IS SUBMITTED FOR ACCEPTANCE

Signed	
Name	Simon Fryer
	Design Team Leader
Engineering Qualifications[10]	MEng CEng MICE MIStructE
Name of Organisation	Buro Happold
Date	22/01/2015

10. THE ABOVE IS REJECTED/AGREED SUBJECT TO THE AMENDMENTS AND CONDITIONS SHOWN BELOW

Signed	
Name	Claire Richardson
Position held	Bridges Manager
Engineering Qualifications[10]	CEng MICE
TAA	Leeds City Council
Date	3-2-15.

APPENDIX A:
TECHNICAL APPROVAL SCHEDULE "TAS" (FEBRUARY 2013)

Leeds City Council
Appendix A

Technical Approval Schedule TAS (*Insert Month/Year*)

Eurocodes	**(Including National Annexes)**				
Eurocode Part	**Title**	**Date**	**UK National Annex Publication Date**	**Ref**	**Tick if Relevant**
Eurocode 0	**Basis of Structural Design**				
BS EN 1990	Eurocode 0: Basis of structural design	2002	2004		✓
Eurocode 1	**Actions on Structures**				
BS EN 1991-1-1	Actions on structures – Part 1-1: General actions – Densities, self-weight and imposed loads for buildings	2002	2005		✓
BS EN 1991-1-3	Actions on structures – Part 1-3: General actions – Snow loads	2003	2005		✓
BS EN 1991-1-4	Actions on structures – Part 1-4: General actions – Wind actions	2005	2008		✓
BS EN 1991-1-5	Actions on structures – Part 1-5: General actions – Thermal actions	2004	2007		✓
BS EN 1991-1-6	Actions on structures – Part 1-6: General actions – Actions during execution	2005	2008		✓
BS EN 1991-1-7	Actions on structures – Part 1-7: General actions – Accidental actions	2006	2008		✓
BS EN 1991-2	Actions on structures – Part 2: Traffic loads on bridges	2003	2008		
Eurocode 2	**Design of Concrete Structures**				
BS EN 1992-1-1	Design of concrete structures – Part 1-1: General rules and rules for buildings	2004	2005		✓
BS EN 1992-2	Design of concrete structures – Part 2: Concrete bridges – Design and detailing rules	2005	2007		✓
BS EN 1992-3	Design of concrete structures – Part 3: Liquid retaining and containment structures	2006	2007		
Eurocode 3	**Design of Steel Structures**				
BS EN 1993-1-1	Design of steel structures – Part 1-1: General rules and rules for buildings	2005	2008		✓

Technical Approval Schedule TAS (*Insert Month/Year*)

Eurocodes	(Including National Annexes)				
Eurocode Part	**Title**	**Date**	**UK National Annex Publication Date**	Ref	Tick if Relevant
BS EN 1993-1-4	Design of steel structures – Part 1-4: General rules– Supplementary rules for stainless steels	2006	2009		
BS EN 1993-1-5	Design of steel structures – Part 1-5: Plated structural elements	2006	2008		✓
BS EN 1993-1-6	Design of steel structures – Part 1-6: Strength and stability of shell structures	2007	2007		
BS EN 1993-1-7	Design of steel structures – Part 1-7: Plated structures subject to out of plane loading	2007	2007		
BS EN 1993-1-8	Design of steel structures – Part 1-8: Design of joints	2005	2008		✓
BS EN 1993-1-9	Design of steel structures – Part 1-9: Fatigue	2005	2008		✓
BS EN 1993-110	Design of steel structures – Part 1-10: General – Material toughness and through thickness properties	2005	2009		✓
BS EN 1993-111	Design of steel structures – Part 1-11: Design of structures with tension components	2006	2008		
BS EN 1993-112	Design of steel structures – Part 1-12: Additional rules for the extension of EN 1993 up to steel grades S700	2007	2008		
BS EN 1993-2	Design of steel structures – Part 2-1: Steel bridges	2006	2008		✓
BS EN 1993-5	Design of steel structures – Part 5: Piling	2007	2009		
Eurocode 4	**Design of Composite and Concrete Structures**				
BS EN 1994-2	Design of composite steel and concrete structures – Part 2: Bridges	2005	2007		
Eurocode 5	**Design of Timber Structures**				
BS EN 1995-1-1	Design of timber structures – Part 1-1: General – Common rules and rules for buildings	2004	2006		
Eurocodes					

Leeds City Council
Appendix A

Technical Approval Schedule TAS (*Insert Month/Year*)

Eurocode Part	Title	Date	UK National Annex Publication Date	Ref	Tick if relevant
BS EN 1995-2	Design of timber structures – Part 2: Bridges	2004	2006		
Eurocode 6	**Design of Masonry Structures**				
BS EN 1996-1-1	Design of masonry structures – Part 1-1: General rules for reinforced and unreinforced masonry structures.	2005	2007		
BS EN 1996-2	Design of masonry structures – Part 2: Design considerations, selection of materials and execution of masonry.	2006	2007		
BS EN 1996-3	Design of masonry structures – Part 3: Simplified calculation methods for unreinforced masonry structures	2006	2007		
Eurocode 7	**Geotechnical design**				
BS EN 1997-1	Geotechnical design – Part 1: General rules	2004	2007		✓
BS EN 1997-2	Geotechnical design – Part 2: Ground investigation and testing	2007	2009		✓
Eurocode 8	**Design Of Structures For Earthquake Resistance**				
BS EN 1998-1	Design of structures for earthquake resistance – Part 1: General rules seismic actions and rules for buildings	2005	2008		
BS EN 1998-2	Design of structures for earthquake resistance – Part 2: Bridges	2005	2009		
BS EN 1998-5	Design of structures for earthquake resistance – Part 5: Foundations, retaining structures and geotechnical aspects	2005	2008		

Technical Approval Schedule TAS (*Insert Month/Year*)

Eurocodes					
Eurocode Part	**Title**	**Date**	**UK National Annex Publication Date**	Ref	Tick if relevant
Eurocode 9	**Design Of Aluminium Structures**				
BS EN 1999-1-1	Design of aluminium structures – Part 1-1: Design of Aluminium Structures – General Structural rules	2007	2008		
BS EN 1999-1-3	Design of aluminium structures – Part 1-3: Design of Aluminium Structures – Structures susceptible to fatigue	2007	2008		
BS EN 1999-1-4	Design of aluminium structures – Part 1-4: Design of Aluminium Structures – Cold-formed structural sheeting	2007	2009		

BSI Published Documents				
Document Reference	**Title**	**Date**	Ref	Tick if relevant
PD 6688-1-1	Background paper to the UK National Annex to BS EN 1991-1-1	(under preparation at the time of publication of this document)		✓
PD 6688-1-4	Background paper to the UK National Annex to BS EN 1991-1-4	2009		✓
PD 6688-1-7	Recommendations for the design of structures to BS EN 1991-1-7	2009		
PD 6688-2	Recommendations for the design of structures to BS EN 1991-2	(under preparation at the time of publication of this document)		✓
PD 6687-1	Background paper to the UK National Annexes to BS EN 1992	2006		✓
PD 6687-2	Recommendations for the design of structures to BS EN 1992	2008		✓
PD 6695-1-9	Recommendations for the design of structures to BS EN 1993-1-9	2008		✓

Technical Approval Schedule TAS (*Insert Month/Year*)

BSI Published Documents				
Document Reference	**Title**	**Date**	Ref	Tick if relevant
PD 6695-1-10	Recommendations for the design of structures to BS EN 1993-1-10	(under preparation at the time of publication of this document)		✓
PD 6695-2	Recommendations for the design of bridges to BS EN 1993	2008		✓
PD 6696-2	Background paper to BS EN 1994-2 and the UK National Annex to BS EN 1994-2	2007		
PD 6694-1	Recommendations for the design of structures subject to traffic loading to BS EN 1997-1:2004	(under preparation at the time of publication of this document)		
PD 6698	Recommendations for the design of structures for earthquake resistance to BS EN 1998	2009		
PD 6703	Structural bearings – Guidance on the use of structural bearings	(under preparation at the time of publication of this document)		
PD 6705-2	Recommendations on the execution of steel bridges to BS EN 1090-2	(under preparation at the time of publication of this document)		✓

Execution Standards				
Document Reference	**Title**	**Date of Issue**	Ref	Tick if relevant
BS EN 1090-1	Execution of steel structures and aluminium structures. Requirements for conformity assessment of structural components	2009		✓
BS EN 1090-2	Execution of steel structures and aluminium structures. Technical requirements for the execution of steel structures	2008		✓
BS EN 1090-3	Execution of steel structures and aluminium structures. Technical requirements for the execution of aluminium structures	2008		
BS EN 13670	Execution of concrete structures	2009		✓

Technical Approval Schedule TAS (*Insert Month/Year*)

British Standards (Non-conflicting with Eurocodes)				
Document Reference	**Title**	**Date of Issue**	Ref	Tick if relevant
BS 8500	Concrete. Complementary British Standard to BS EN 206-1. Method of specifying and guidance for the specifier	2006		✓
BS EN 1317-1	Road Restraints Systems – Terminology and general criteria for test methods	1998		
BS EN 1317-2	Road Restraint Systems – Performance classes, impact test acceptance criteria and test methods for safety barriers	1998		
BS EN 1317-3	Road Restraint Systems – Performance classes, impact test acceptance criteria and test methods for crash cushions	2000		
DD ENV 1317-4	Road Restraint Systems – Performance classes, impact test acceptance criteria and test methods for terminals and transitions of safety barriers	2002		
BS EN 1337-1:	Structural bearings. General design rules	2000		
BS EN 14388	Road traffic noise reducing devices. Specifications.	2005		
BS EN 15050	Precast concrete products. Bridge Elements	2007		

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British Standards				
Document Reference	Title	Date of Issue	Ref	Tick if relevant
BS 153 Part 3A	Specification for Steel Girder Bridges (see BE 1/77)			
BS 5268	Part 2 : 1996 Structural use of Timber	1996		
BS 5390 : 1976	Stone Masonry	1976		
BS 5400	Steel Concrete and Composite Bridges			
	Part 1 : 1988 General Statement (see also BD 15/92	1988		
	Part 2 : Specification for Loads (as implemented by BD37 – Appendix A)	2006		
	Part 3 : 2000 CP for Design of Steel Bridges (see BD13/90)	2000		
	Part 4 : 1990 CP for design of Concrete Bridges (see also BD24/92)	1990		
	Part 5 : 2005 CP for Design of Composite Bridges (see BD 16/82)	2005		
	Part 9 : 1983 Bridge Bearings (see BD 20/92)	1983		
	Part 10 : 1980 CP for Fatigue (see BD 9/81) Part 10C: 1999 Charts for Classification of details of Fatigue	1980 1999		
BS 5628	Part 1 : Code of practice for use of masonry. Structural use of unreinforced masonry (incorporating Corrigendum No. 1)	2005		
BS 5628	Part 2 : Code of practice for the use of masonry. Structural use of reinforced and prestressed masonry (incorporating Corrigendum No. 1)	2005		
BS 5628	Part 3 : Code of practice for use of masonry. Materials and components, design and workmanship (incorporating Corrigendum No. 1)	2005		
BS 5930 : 1999	Site Investigations	1999		
BS 6031 : 1981	Earthworks	1981		
BS 6651	Protection of Structures against Lightning (see BD 51/98)	2006		✓
BS 6779 -1 1998	BS 6779 Part 1 Parapets for Vehicular Containment on Highways Including Amd No. 14290, 21 March 2003 [Annex F is Withdrawn : see IAN 44/02 Rev1 & Rev 2]	1998		

Technical Approval Schedule TAS (*Insert Month/Year*)

British Standards, Codes of Practice

British Standards				
Document Reference	Title	Date of Issue	Ref	Tick if relevant
BS 6779 Part 4	Parapets for Vehicular Containment on Highways : Part 4 Masonry Parapets	1999		
BS 7818 : 1995	Pedestrian Restraint Systems in Metal	1995		
BS 8002 : 1994	Earth Retaining Structures	1994		
BS 8004 : 1986	Foundations (see BD 74/00)	1986		
BS 8118 - 1: 1991	The structural use of aluminium : Code of Practice for Design	1991		
BS 8666:2005	Specification for Scheduling, Dimensioning, Bending and Cutting of Steel Reinforcement for Concrete	2005		✓
BS EN 206-1 : 2000	Concrete - Part 1 : Specification, performance, production and conformity	2000		✓
BS EN 10025-5-2004	Technical delivery conditions for structural steels with improved atmospheric corrosion resistance	2004		
BS EN 10025-1:2004	Hot rolled products of structural steels. General technical delivery conditions	2004		✓

Technical Approval Schedule TAS (*Insert Month/Year*)

Document Reference	Title	Date of Issue	Ref	Tick if relevant
CP 116 Part 2	The structural use of precast concrete (see Tech Memo BE 1/73)			
BS 5395 Part 1 2000	Code of Practice for the Design Construction and Maintenance of Straight Stairs and Winders	2000		
BS 8006 : 1995	Code of Practice for Strengthened/Reinforced Soils and Other Fills	1995		
BS 8081: 1989	Code of Practice for Ground Anchorages			

Miscellaneous

Document Reference	Title	Date of Issue	Ref	Tick if relevant
	Circular Roads no 61/72 - Routes for heavy and high abnormal vehicles			✓
	TRL Report 204 : A Guide to Repair and Strengthening of Masonry Arch Highway Bridges (1996)			
	BRE Special Digest 1 2005 Concrete in Aggressive Ground (3rd Edition)			
	Traffic Management Act 2004			
	TRL Simplified tables of external loads on buried pipelines	1986		
Dept for Transport	Managing the accidental obstruction of the railway by road vehicles. Road Vehicle Incursion Risk Ranking.	Feb 2003		

The Manual of Contract Documents for Highway Works

Document Reference	Title	Date of Issue	Ref	Tick if relevant
Volume 1	Specification for Highway Works			✓
Volume 2	Notes for Guidance on the Specification for Highway Works			✓
Volume 3	Highway Construction Details			✓

Office Of Rail Regulation Publications

Document Reference	Title	Date of Issue	Ref	Tick if relevant
	Railway safety principles and guidance Part 1	1996		
HS(G)153/2	RSPG Part 2A - Guidance on infrastructure	1996		

Technical Approval Schedule TAS (*Insert Month/Year*)

STANDARDS – BRIDGES AND STRUCTURES (BD SERIES)				
Document Reference	Title	Date of Issue	Ref	Tick if relevant
BD 2/12	Technical Approval of Highway Structures	May 2012	1.1.1	✓
BD 7/01	Weathering Steel for Highway Structures	Nov 2001	2.8.3	
BD 9/81	Implementation of BS 5400: Part 10: 1980. Code of Practice for Fatigue	Dec 1981	1.3	
BD 10/97	Design of Highway Structures in Areas of Mining Subsidence	May 1997	1.3	✓
BD 12/01	Design of Corrugated Steel Buried Structures with Spans Greater than 0.9 Metres and up to 8.0 Metres	Nov 2001	2.2.6	
BD 13/06	Design of Steel Bridges. Use of BS 5400-3: 2000	May 2006	1.3.14	
BD 15/92	General Principles for the Design and Construction of Bridges. Use of BS 5400: Part 1: 1988	Dec 1992	1.3.2	
BD 16/82	Design of Composite Bridges. Use of BS 5400: Part 5:1979 Amendment No.1	Nov 1982 Dec 1987	1.3 1.3	
BD 20/92	Bridge Bearings. Use of BD 5400: Part 9: 1983	Oct 1992	2.3.1	
BD 21/01	The Assessment of Highway Bridges and Structures	May 2001	3.4.3	
BD 24/92	Design of Concrete Bridges. Use of BS 5400: Part 4:1990	Nov 1992	1.3.1	
BD 27/86	Materials for the Repair of Concrete Highway Structures	Nov 1986	3.3	
BD 28/87	Early Thermal Cracking of Concrete Amendment No. 1	Jul 1987 Aug 1989	1.3	
BD 29/04	Design Criteria for Footbridges	Aug 2004	2.2.8	
BD 30/87	Backfilled Retaining Walls and Bridge Abutments	Aug 1987	2.1.5	
BD 31/01	The Design of Buried Concrete Box and Portal Frame Structures	Nov 2001	2.2.12	

Technical Approval Schedule TAS (*Insert Month/Year*)

STANDARDS – BRIDGES AND STRUCTURES (BD SERIES)				
Document Reference	Title	Date of Issue	Ref	Tick if relevant
BD 33/94	Expansion Joints for Use in Highway Bridge Decks	Nov 1994	2.3.6	
BD 34/90	Technical Requirements for the Assessment and Strengthening Programme for Highway Structures	Sep 1990	3.4	
BD 35/06	Quality Assurance Scheme for Paints and Similar Protective Coatings	May 2006	2.4.1	✓
BD 36/92	Evaluation of Maintenance Costs in Comparing Alternative Designs for Highway Structures	Aug 1992	1.2.1	
BD 37/01	Loads for Highway Bridges	Aug 2001	1.3.14	
BD 41/97	Reinforced Clay Brickwork Retaining Walls of Pocket Type and Grouted Cavity type Construction Use of BS 5628: Part 2: 1995	May 1997	2.1.1	
BD 42/00	Design of Embedded Retaining Walls and Bridge Abutments	May 2000	2.1.2	
BD 43/03	The Impregnation of Reinforced and Prestressed Concrete Highway Structures using Hydrophobic Pore-Lining Impregnants	Feb 2003	2.4.2	
BD 44/95	The Assessment of Concrete Highway Bridges and Structures	Jan 1995	3.4.14	
BD 45/93	Identification Marking of Highway Structures	Aug 1993	3.1.1	✓
BD 46/92	Technical Requirements for the Assessment and Strengthening Programme for Highway Structures [Stage 2 – Modern Short Span Bridges]	Aug 1992	3.4.1	
BD 47/99	Waterproofing and Surfacing of Concrete Bridge Decks	Aug 1999	2.3.4	
BD 48/93	The Assessment and Strengthening of Highway Bridge Supports	Jun 1993	3.4.7	
BD 49/01	Design Rules for Aerodynamic Effects on Bridges	May 2001	1.3.3	
BD 50/92	Technical Requirements for the Assessment and Strengthening Programme for Highway Structures Stage 3 – Long Span Bridges	Dec 1992	3.4.2	
BD 51/98	Portal and Cantilever Signs/Signal Gantries	May 1998	2.2.4	✓

Technical Approval Schedule TAS (*Insert Month/Year*)

STANDARDS – BRIDGES AND STRUCTURES (BD SERIES)				
Document Reference	Title	Date of Issue	Ref	Tick if relevant
BD 53/95	Inspection and Records for Road Tunnels	Jul 1995	3.1.6	
BD 54/93	Post-tensioned Concrete Bridges Prioritisation of Special Inspections	Apr 1993	3.1.2	
BD 56/10	The Assessment of Steel Highway Bridges and Structures	Jun 2010	3.4.11	
BD 57/01	Design for Durability	Aug 2001	1.3.7	
BD 58/94	The Design of Concrete Highway Bridges and Structures with External and Unbonded Prestressing	Nov 1994	1.3.9	
BD 60/04	Design of Highway Bridges for Vehicle Collision Loads	May 2004	1.3.5	
BD 61/10	The Assessment of Composite Highway Bridges	Jun 2010	3.4.16	
BD 62/07	As Built, Operational and Maintenance Records for Highway Structures	Feb 2007	3.2.1	
BD 63/07	Inspection of Highway Structures	Feb 2007	3.1.4	
BD 65/97	Design Criteria for Collision Protector Beams	Feb 1997	2.2.5	
BD 67/96	Enclosure of Bridges	Aug 1996	2.2.7	
BD 68/97	Crib Retaining Walls	Feb 1997	2.1.3	
BD 70/03	Strengthened/Reinforced Soils and Other Fills for Retaining Walls and Bridge Abutments Use of BS8006: 1995, incorporating Amendment No.1 (Issue 2 March 1999)	May 2003	2.1.5	
BD 74/00	Foundations	May 2000	2.1.8	✓
BD 78/99	Design of Road Tunnels	Aug 1999	2.2.9	
BD 79/13	The Management of Sub-standard Highway Structures	Feb 2013	3.4.18	

Technical Approval Schedule TAS (*Insert Month/Year*)

STANDARDS – BRIDGES AND STRUCTURES (BD SERIES)				
Document Reference	Title	Date of Issue	Ref	Tick if relevant
BD 81/02	Use of Compressive Membrane Action in Bridge Decks	May 2002	3.4.20	
BD 82/00	Design of Buried Rigid Pipes	Aug 2000	2.2.10	
BD 84/02	Strengthening of Concrete Bridge Supports Vehicle Impact Using Fibre Reinforced Polymers	Aug 2002	1.3.16	
BD 85/08	Strengthening Highway Structures Using Externally Bonded Fibre Reinforced Polymer	Nov 2008	1.3.18	
BD 86/07	The Assessment of Highway Bridges and Structures For The Effects of Special Types General Order (STGO) and Special Order (SO) Vehicles	Nov 2007	3.4.19	
BD 87/05	Maintenance Painting of Steelwork	May 2005	3.2.2	
BD 89/03	The Conservation of Highway Structures	Nov 2003	3.2.4	
BD 90/05	Design of FRP Bridges and Highway Structures	May 2005	1.3.17	
BD 91/04	Unreinforced Masonry Arch Bridges	Nov 2004	2.2.14	
BD 93/09	Structural Assessment of Bridges with Deck Hinges	Feb 2009		
BD 94/07	Design of Minor Structures	Feb 2007	2.2.1	
BD 95/07	Treatment of Existing Structures on Highway Widening Schemes	Aug 2007		
BD 97/12	The Assessment of Scour and Other Hydraulic Actions at Highway Structures	May 2012		
BD 101/11	Structural Review and Assessment of Highway Structures	Nov 2011	3.4.22	

Technical Approval Schedule TAS (*Insert Month/Year*)

ADVICE NOTES – BRIDGES AND STRUCTURES (BA SERIES)				
Document Reference	Title	Date of Issue	Ref	Tick if relevant
BA 9/81	The Use of BS 5400: Part 10: 1980. Code of Practice for Fatigue Amendment No. 1	Dec 1981 Nov 1983	1.3	
BA 16/97	The Assessment of Highway Bridges and Structures. Amendment No. 1 Amendment No. 2	May 1997 Nov 1997 Nov 2001	3.4.4	
BA 19/85	The Use of BS 5400: Part 3: 1982	Jan 1985	1.3	
BA 24/87	Early Thermal Cracking of Concrete Amendment No. 1	Jul 1987 Aug 1989	1.3	
BA 26/94	Expansion Joints for Use in Highway Bridge Decks	Nov 1994	2.3.7	
BA 28/92	Evaluation of Maintenance Costs in Comparing Alternative Designs for Highway Structures	Aug 1992	1.2.2	
BA 30/94	Strengthening of Concrete Highway Structures Using Externally Bonded Plates	Feb 1994	3.3.1	
BA 34/90	Technical Requirements for the Assessment and Strengthening Programme for Highway Structures	Sep 1990	3.4	
BA 35/90	Inspection and Repair of Concrete Highway Structures	Jun 1990	3.3	
BA 36/90	The Use of Permanent Formwork	Feb 1991	2.3	
BA 37/92	Priority Ranking of Existing Parapets	Oct 1992	2.3.2	
BA 38/93	Assessment of the Fatigue Life of Corroded or Damaged Reinforcing Bars	Oct 1990	3.4.5	
BA 39/93	Assessment of Reinforced Concrete Half-joints	Apr 1993	3.4.6	
BA 40/93	Tack Welding of Reinforcing Bars	Apr 1993	1.3.4	
BA 41/98	The Design and Appearance of Bridges	Feb 1998	1.3.11	
BA 42/96	The Design of Integral Bridges [Incorporating Amendment No.1 dated May 2003]	Nov 1996	1.3.12	
BA 43/94	Strengthening, Repair and Monitoring of Post- tensioned Concrete Bridge Decks	Dec 1994	3.3.2	

Technical Approval Schedule TAS (*Insert Month/Year*)

ADVICE NOTES – BRIDGES AND STRUCTURES (BA SERIES)				
Document Reference	Title	Date of Issue	Ref	Tick if relevant
BA 44/96	Assessment of Concrete Highway Bridge and Structures	Nov 1996	3.4.15	
BA 47/99	Waterproofing and Surfacing Concrete Bridge Decks	Aug 1999	2.3.5	
BA 50/93	Post-tensioned Concrete Bridges: Planning, Organisation and Methods for Carrying Out Special Inspections	Jul 1993	3.1.3	
BA 51/95	The Assessment of Concrete Structures Affected by Steel Corrosion	Feb 1995	3.4.13	
BA 52/94	The Assessment of Concrete Highway Structures Affected by Alkali Silica Reaction	Nov 1994	3.4.10	
BA 53/94	Bracing Systems and the Use of U-Frames in Steel Highway Bridges	Dec 1994	1.2.13	
BA 54/94	Load Testing for Bridge Assessment	Apr 1994	3.4.8	
BA 55/06	The Assessment of Bridge Substructures and Foundations, Retaining Walls and Buried Structures	May 2006	3.4.9	
BA 57/01	Design for Durability	Aug 2001	1.3.8	
BA 58/94	Design of Bridges and Concrete Structures with External Unbonded Prestressing	Nov 1994	1.3.10	
BA 59/94	Design of Highway Bridges for Hydraulic Action	May 1994	1.3.6	
BA 67/96	Enclosure of Bridges	Aug 1996	2.2.8	
BA 68/97	Crib Retaining Walls	Feb 1997	2.1.4	
BA 72/03	Maintenance of Road Tunnels	May 2003	3.2.3	
~~BA 74/06~~	~~Assessment of Scour at Highway Bridges~~ Replaced by BD 97/12	~~Aug 2006~~	~~3.4.21~~	

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ADVICE NOTES – BRIDGES AND STRUCTURES (BA SERIES)				
Document Reference	Title	Date of Issue	Ref	Tick if relevant
BA 80/99	Use of Rock Bolts	Feb 1999	2.1.7	
BA 82/00	Formation of Continuity Joints in Bridge Decks	Nov 2000	2..3.7	
BA 83/02	Cathodic Protection for Use in Reinforced Concrete Highway Structures	Feb 2002	3.3.3	
BA 84/02	Use of Stainless Steel Reinforced in Highway Structures	Feb 2002	1.3.15	
BA 85/04	Coatings for Concrete Highway Structures & Ancillary Structures	May 2004	2.4.3	
BA 86/06	Advice Notes on the Non-destructive Testing of Highway Structures	Aug t 2006	3.1.7	
BA 87/04	Management of Corrugated Steel Buried Structures Correction No.1	Aug 2004 Feb 2006	3.3.4 3.3.5	
BA 88/04	Management of Buried Concrete Box Structures	Aug 2004	3.3.3	
BA 92/07	The Use of Recycled Concrete Aggregates in Structural Concrete	May 2007	2.3.9	
BA 93/09	Structural Assessment of Bridges with Deck Hinges	Feb 2009	3.1.5	

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TECHNICAL MEMORANDA – BRIDGES (BE SERIES)				
Document Reference	Title	Date of Issue	Ref	Tick if relevant
BE 13	Fatigue Risk in Bailey Bridges	Apr 1968	3.4	
BE 23	Shear Key Decks Amendment No. 1 to Annex	Nov 1970 Jun 1971	1.3	
BE 5/75	Rules for the Design and Use of Freyssinet Concrete Hinges in Highway Structures	Mar 1975		
BE 7/04	Departmental Standard (Interim) Motorway Sign/Signal Gantries	Aug 2004	2.2.8	

STANDARDS – TRAFFIC ENGINEERING AND CONTROL (TD SERIES)				
Document Reference	Title	Date of Issue	Ref	Tick if relevant
TD 9/93	Highway Link Design As amended by TD 19/06	June 1993	6.1.1	
	Amendment No.1	Feb 2002		
TD 19/06	Requirement for Road Restraint Systems Correction No.1	Aug 2006 Feb 2008	2.2.8	✓
TD 27/05	Cross-Sections and Headrooms	Feb 2005	6.1.2	✓
TD 36/93	Subways for Pedestrians and Pedal Cyclists Layout and Dimensions	July 1993	6.3.1	
TD 89/08	Use of passively Safe Signposts, Lighting Columns and Traffic Signal Posts to BS EN 12767	May 2008	8.2.2	

ADVICE NOTES – TRAFFIC ENGINEERING AND CONTROL (TA SERIES)				
Document Reference	Title	Date of Issue	Ref	Tick if relevant
TA 92/03	Crossover and Changeover Design	Nov 2003	8.4.6	

Technical Approval Schedule TAS (*Insert Month/Year*)

ADVICE NOTES – HIGHWAYS (HA SERIES)				
Document Reference	Title	Date of Issue	Ref	Tick if relevant
HA 65/94	Environmental barriers. Design for environmental barriers.	July 1994	10.5.1	
HA 66/95	Environmental Barriers – Technical Requirements As amended by TD 19/06	Sept 1995	10.5.2	
HA 84/01	Nature Conservation and Biodiversity	Feb 2001	10.4.1	
HA 59/92	Mitigating against effects on Badgers	Feb 1997	10.4.2	
HA 80/99	Nature Conservation Advice in Relation to Bats	May 1999	10.4.3	
HA 81/99	Nature Conservation Advice in Relation to Otters	May 1999	10.4.4	
HA 97/01	Nature Conservation Advice in Relation to Dormice	Feb 2001	10.4.5	
HA98/01	Nature Conservation Advice in Relation to Amphibians	Feb 2001	10.4.6	
HA 116/05	Nature Conservation Advice in Relation to Reptiles and Roads	May 2005	10.4.7	
HA213/08	Noise and Vibration	Aug 2008	11.3.7	
	Environmental Assessment: Ecology and Nature Conservation		11.3.4	

STANDARDS – HIGHWAYS (HD SERIES)				
Document Reference	Title	Date of Issue	Ref	Tick if relevant
HD 19/03	Road Safety Audits	Nov 2003	5.2.2	✓
HD 22/08	Managing Geotechnical Risk	Aug 2008	4.1.2	✓

STANDARDS – GENERAL REQUIREMENTS (GD SERIES)				
Document Reference	Title	Date of Issue	Ref	Tick if relevant
GD 02/08	Quality Management Systems for Highway Design	May 2008	0.2.1	✓
GD 03/08	Implementation and Use of the Standards Improvement System	May 2008	0.2.2	

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APPENDIX B:
LIST OF DOCUMENTS COVERING ASPECTS NOT COVERED IN APPENDIX A (AUGUST 2013)

Leeds City Council
Appendix B

List of Documents covering aspects not covered by Standards in 4.2

INTERIM ADVICE NOTES				
Document Reference	Title	Date of Issue	Ref	Tick if relevant
IAN 173/13	Implementation of BD 97/12 – The Assessment of Scour and Other Hydraulic Actions at Highway Structures	Feb 13		
IAN 169/12 Rev1	Temporary Cover Plates over Bridge Expansion Joints	Jul 13		
IAN 168/12	Strategy for the Repair/Replacement of Bridge Expansion Joints	Oct 12		
IAN 149/11	Existing Motorway Minimum Requirements. Supersedes IAN 87/07	July 11		
IAN 124/11	Use of Eurocodes for the design of highway structures.	July 11		✓
IAN 117/08 r2	Certification of combined kerb and drainage products	Jun 09		
IAN 116/08	Nature conservation advice in relation to bats	Oct 08		
IAN 115/08	Hard shoulder working	Nov 08		
IAN 114/08	Highways Agency Carbon Calculation and Reporting Requirements	Sept 08		
IAN 113/08	Temporary Automatic Speed Camera System for the Enforcement of Mandatory Speed Limits at Roadworks (TASCAR)	July 08		
IAN 112/08	Managed Motorway Implementation Guidance – Through Junction Hard Shoulder Running [PR 100/08]	Jun 08		
IAN 111/09	Managed Motorway Implementation Guidance – Dynamic Use of Hard Shoulder	Nov 09		
IAN 109/08	Advice Regarding the Motorway Signal Mark 4 (MS4)	Apr 08		
IAN 108/xx	Cross-sections and layout as physical restraints	Pending		
IAN 107/08	Variable Demand Modelling As Part Of A Transport Assessment For The Highways Agency	Feb 08		
IAN 106/08	Guidance Note for Traffic Consultants Employed on Highways Agency Schemes	Jan 08	DMRB	
IAN 105/08	Implementation of Construction (Design and Management) 2007 and the withdrawal of SD 10 and SD 11	Jan 08	SD10 SD11	✓
IAN 104/07	The Anchorage of Reinforcement & Fixings in Hardened Concrete	Dec 07		
IAN 103/08	Ramp metering	Mar 08		
IAN 100/07	Cultural Heritage Asset Management Plans	Oct 07	DMRB 10	
IAN 99/07	Implementation of Local Grid Referencing System for England	Nov 07	SD 12/96	
IAN 98/07	HD 28 -Guidance for HA Service Providers on Implementing the Skid Resistance Policy	Sept 07	HD 28	
IAN 97/07	Assessment and upgrading of existing parapets	Aug 07		

Leeds City Council
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List of Documents covering aspects not covered by Standards in 4.2

INTERIM ADVICE NOTES				
Document Reference	Title	Date of Issue	Ref	Tick if relevant
IAN 96/07r1	Guidance On Implementing Results Of Research On Bridge Deck Waterproofing	Aug 07		
IAN 95/07	Revised guidance regarding the use of BS8500(2006) for the design and construction of structures using concrete	May 07		✓
IAN 93/07	Driver location signs – Interim Performance Specification	Apr 07	Vol 11	
IAN 91/07	Interim Advice on the identification of 'Particularly at Risk' Supports	Mar 07		✓
IAN 90/07 Amnt No 1	Guidance For The Use Of Rapid Setting Emergency Repair Materials	Apr 07	MCHW Series 900	
IAN 86/07	Amendments To Design Requirements For Portal And Cantilever Sign/Signal Gantries	Jun 07	BD 51	✓
IAN 85/07	Design Of Passively Safe Portal Signal Gantries	Jun 07		✓
IAN 84/07	Environmental Information System (EnvIS)	July 07	Vol 10	
IAN 83/06	Principal and General Inspection of Sign/Signal Gantries, and Gantries with low handrails or open mesh flooring	Jun 06		✓
IAN 75/06	Code of Practice for Emergency Access to and Egress from the Trunk Road Network in England	May 06		
IAN 73/06 Rev 1	Design of Pavement Foundations	Feb 09	HD 25/xx	
IAN 71/06	Marker Posts On Lay By Segregation Islands	Feb 06	TA 69/96	
IAN 70/06	Implementation Of New Reinforcement Standards (BS 4449:2005, BS 4482:2005, BS 4483:2005 and BS 8666:2005)	Jan 06	BS 5400 Pt 4 SHW 1700 NG 1700	
IAN 69/05	Designing for Maintenance	Dec 05		✓
IAN 68/05	Infrastructure changes to improve emergency access to and egress from the trunk road network in England	May 06		
IAN 64/05	Driver Information At Road Works	Apr 05		
IAN 63/05r2	Asbestos Management Applicable To The Strategic Road Network (Supersedes IAN 63/05r1)	Oct 09		

Leeds City Council
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List of Documents covering aspects not covered by Standards in 4.2

INTERIM ADVICE NOTES				
Document Reference	Title	Date of Issue	Ref	Tick if relevant
IAN 56/04	Maintenance Of Traffic Signs With Dew Resistant Coatings	Aug 04	TD 25 / 01 DMRB 8.2.2	
IAN 53/04	Concrete Half-Joint Deck Structures	Feb 04		
~~IAN 51/03~~	~~Hinge Deck Structures~~ Replace by BA 93/09	~~Jul 03~~	~~DMRB 3.1~~	
IAN 49/03	Use of Warning Signs For New Asphalt Road Surfaces	Mar 03	DMRB 7.5	
IAN 48/03	Measures To Minimise The Risk of Sulphate Attack (Including Thaumasite) – New Construction and Structures Under Construction	Jan 03	DMRB 2.1	
IAN 47/02	Post Tensioned Grouted Duct Concrete Bridges	Dec 02	DMRB 2.2	
IAN 41/02	European Cement Standards	Jan 02	DMRB 1.3	
IAN 39/01	Post Opening Project Appraisal (POPE)	Jun 01	DMRB 12.1.1	
IAN 36/01	The Use and Application of Micro-Simulation Traffic Models	Jun 01	DMRB 12	
IAN 05/96	BD 24/92 The Design of Concrete Highway Bridges and Structures. Use of BS 5400: Part 4:1990	July 96	DMRB 1.3.1	
IAN 04/96	BD 44/95 The Assessment of Concrete Highway Bridges and Structures	July 96	DMRB 3.4.14	
IAN 03/96	BA 50/93 Post Tensioned Concrete Bridges	July 96	DMRB 3.1.3	
IAN 01/05	TD 37/93 Scheme Assessment Reporting	Oct 95	DMRB 5.1.2	

RAILWAY GROUP STANDARDS				
Document Reference	Title	Date of Issue	Ref	Tick if relevant
GC/RC5510	Railway Approved Code of Practice Recommendations for the Design of Bridges (withdrawn by NR and replaced by GC/RT5112 Iss 2)	Aug 2000		
GC/RT5112 iss 2	Railway Group Standard - Loading Requirements for the Design of Bridges	Dec 2008		
GC/RT5212	Railway Group Standard - Requirements for Defining and Maintaining Clearances	Feb 2003		

List of Documents covering aspects not covered by Standards in 4.2

NETWORK RAIL BRIDGEGUARD 3 CURRENT INFORMATION SHEETS				
Document Reference	Title	Date of Issue	Ref	Tick if relevant
CIS 7	Earth Pressure Coefficient			
CIS 13	Bridges Constructed after 1975			
CIS 14	BD21/97 Traffic Flow and Road Surface Categories			
CIS 15	AWL and Footway Loadings			
CIS 16	Assessment of Piers			
CIS 17	British Rail Specifications			
CIS 18	Mechanism Analysis of Multi-Span Arches			
CIS 19	Condition Factors in Rigorous Arch Assessment			
CIS 20	Assessment of Skew Arches			
CIS 21	Technical Advice on Single Span arches with h greater than D			
CIS 22	Assessment of Jack Arches, Metal Arch Plates & Ties in Metal Beam Bridge Decks			
CIS 23	Use of BD and BA61 for Cased and Filler Beam Bridges			
CIS 25	Pedestrian Live Loading (issued as letter)			
CIS 26	Section 117 (BE4) Assessments			
CIS 27	HB Capacity with MEXE			
CIS 29	Clarification Interpretation of BD44 / BA44 for Shear in Simply Supported Pre-tensioned Beam Decks			
CIS 30	Use of BD61 for Composite Bridges with Shear Connection			
CIS 31	Use of Archie-M for the Analysis of Single and Multi-Span Arches			
CIS 32	Strength of Rivets			
CIS 33	Con - Arches			
CIS 34				
CIS 35	Assessment of Hogging Metal Plates in Metal Beam bridge decks			

List of Documents covering aspects not covered by Standards in 4.2

Miscellaneous				
Document Reference	Title	Date of Issue	Ref	Tick if relevant
	Historical Structural Steelwork Handbook : W. Bates Properties of U.K. and European Cast Iron, Wrought Iron and Steel Sections including Design, Load and Stress Data since the Mid 19th Century			
NPSBS	Non-Proprietary Safety Barrier Systems (NPSBS) - Revision 1: Highways Agency July 2005			
	Institution of Lighting Engineers Technical Report No.7 High Masts for Lighting and CCTV (2000 Edition) Specification for design, manufacture, assembly, erection, painting, testing and maintenance	See BD83/01		
Parsons Brinckerhoff for HA	A Review of Bridge Assessment Failures on the Motorway and Trunk Road Network Final Project Report Dec 2003	SE/598 e31/04		
Network Rail	Guidelines for the Design of Supports for Structures built over or close to Railway Lines – Protection against the effects of Derailments			
UK Roads Liaison Group	Provision of Road Restraint systems on Local Highway Authority Roads	Oct 11		
UK Roads Liaison Group	Departures from Standards Procedures for Local Highway Authorities	Sep 11		

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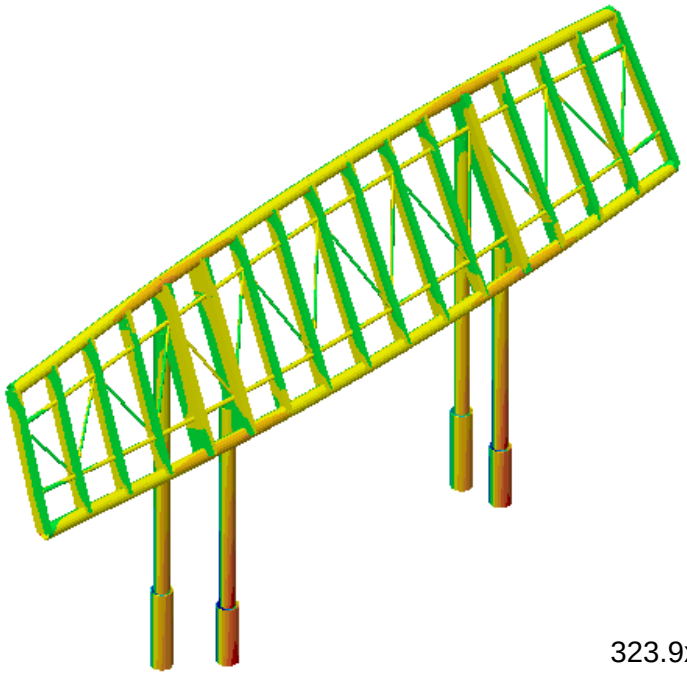
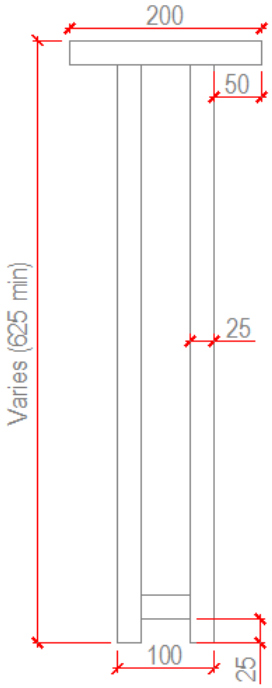
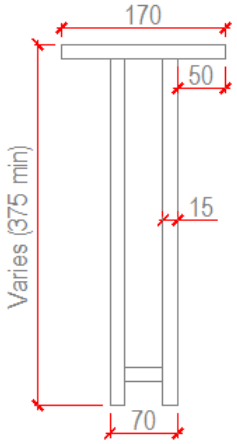
APPENDIX C: IDEALISED STRUCTURE DRAWING







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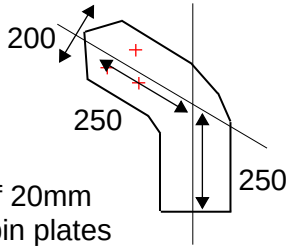
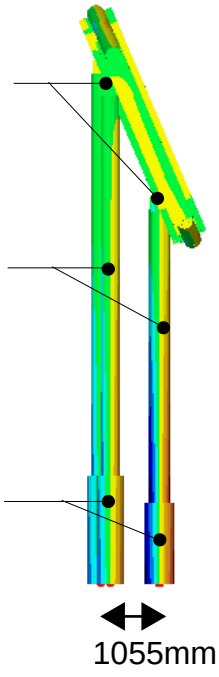
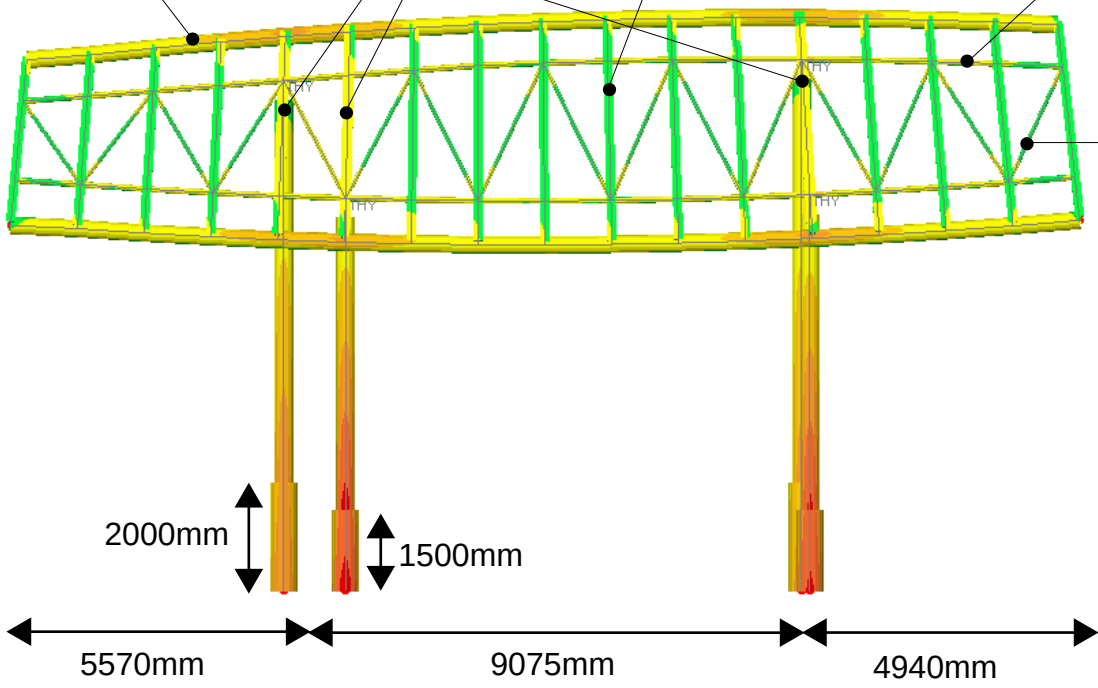
Job No. 032543
Baffle
Made by: KL
Date: 11/03/2014
Sketch No. BHB-007

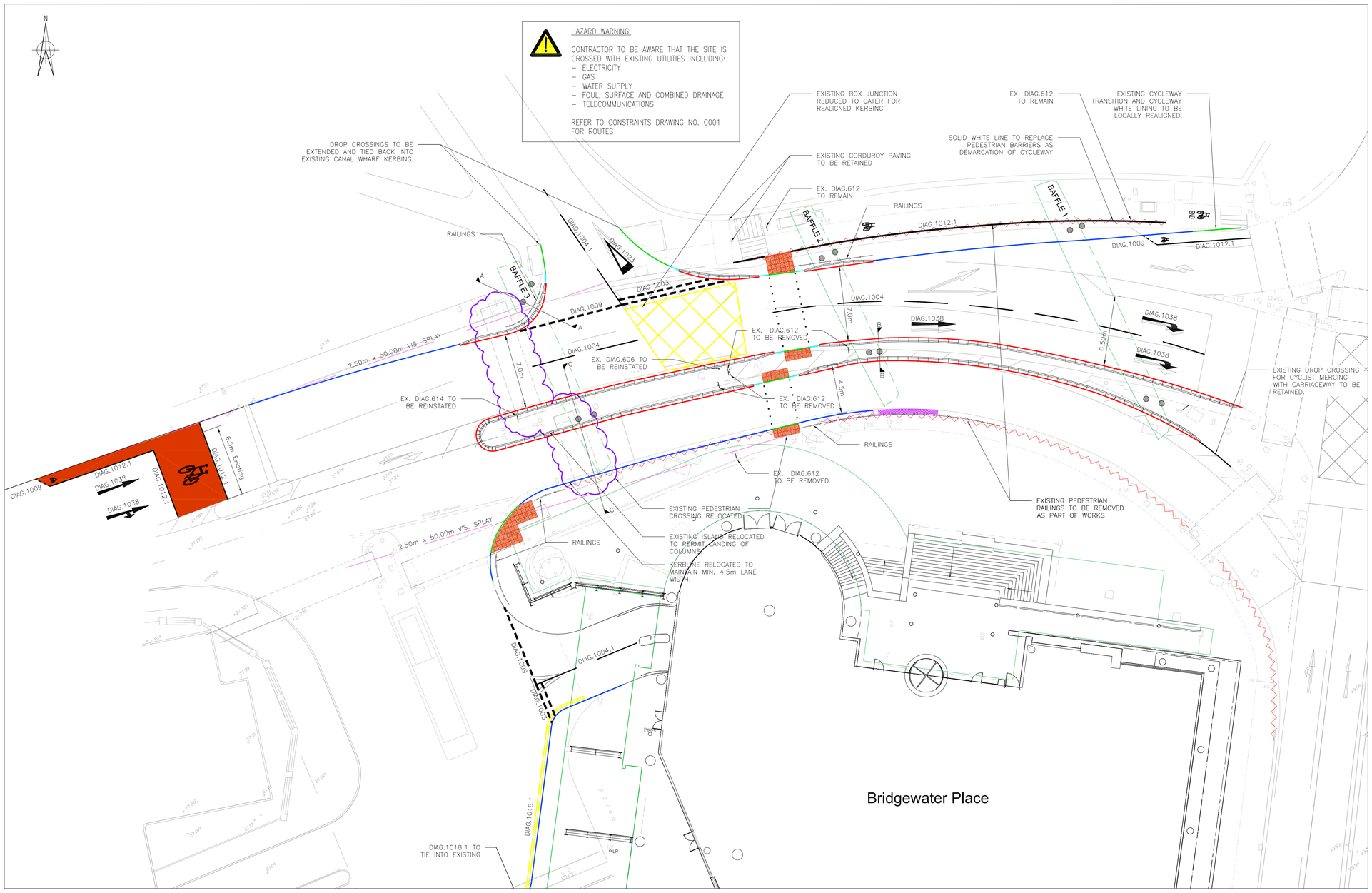
Not to scale

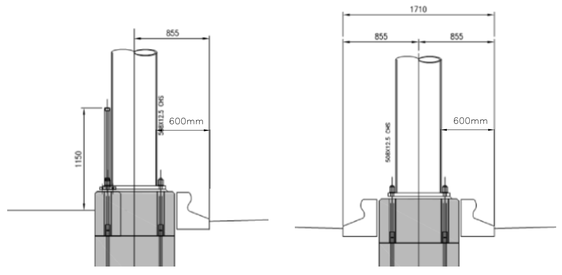


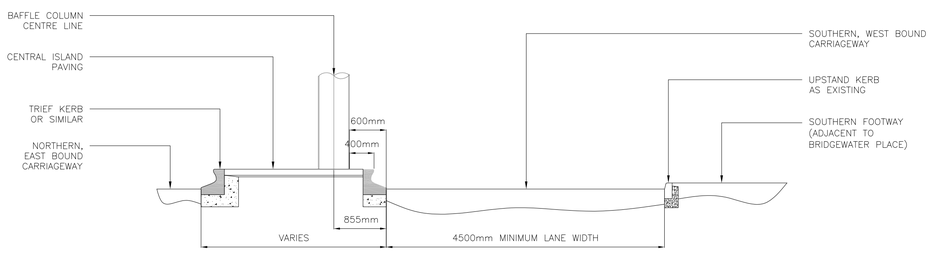
Pair of 20mm
thick pin plates











LEGEND:

- PROPOSED TRIEF KERB OR SIMILAR (LINE OF TOE)
- PROPOSED TRIEF KERB OR SIMILAR
- PROPOSED KERB ALIGNMENT (TYPE AS EXISTING)
- PROPOSED DROP KERB ALIGNMENT (TYPE AS EXISTING)
- DIAG. 1058 PROPOSED WHITE LINING AND REFERENCE
- EXTENT OF PROPOSED BAFFLE / CANOPY
- PROPOSED BEANY BLOCK ALIGNMENT
- PROPOSED 400sq. TACTILE PAVING IN RED
- PROPOSED PEDESTRIAN ROAD STUD
- PROPOSED BAFFLE COLUMN LOCATION
- EXISTING BARRIER TO BE REMOVED
- EXISTING SURVEY / LANDSCAPE

STANDARD HIGHWAYS DETAILS NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.
2. THIS DRAWING TO BE READ IN CONJUNCTION WITH ALL RELEVANT BH DRAWINGS.
3. FOR GUIDANCE, ALL CLAUSE NUMBERS RELATE TO THE SPECIFICATION FOR HIGHWAY WORKS.
4. PREPARATION AND TREATMENT OF FORMATION TO CLAUSE 616. MADE GROUND TO BE REMOVED DOWN TO VIRGIN GROUND, OR AS DIRECTED BY THE ENGINEER. SUBJECT TO HIGHWAY INSPECTORS APPROVAL, EXCAVATED MATERIAL MAY BE RE-USED AS FILL BACK UP TO FORMATION LEVEL PROVIDED IT MEETS THE SPECIFICATION FOR 6F2. RE-USED EXCAVATED MATERIAL TO BE COMPACTED IN LAYERS WITH A VIBRATORY ROLLER COMPLYING WITH METHOD 2 OF TABLE 6/4 OF SPECIFICATION FOR HIGHWAY WORKS. COMPACTION WORKS TO BE CARRIED OUT IN DRY WEATHER CONDITIONS. SIMILAR TREATMENT REQUIRED IN DRAINAGE TRENCHES. CONTAMINATED MATERIAL TO BE REMOVED TO A LICENSED TIP.
5. GENERAL REQUIREMENTS FOR ROAD PAVEMENTS SHALL BE IN ACCORDANCE WITH CLAUSES 701 TO 707 INCLUSIVE.
6. ALL BITUMEN MACADAM SHALL BE IN ACCORDANCE WITH B.S.594987.
7. ALL BITUMINOUS BOUND MATERIALS SHALL BE TRANSPORTED, LAID AND COMPACTED IN ACCORDANCE WITH CL. 901.
8. GRANULAR TYPE 1 SUB BASE SHALL BE IN ACCORDANCE WITH CL. 803.
9. LAYING AND COMPACTION OF SUB BASE SHALL BE IN ACCORDANCE WITH CL. 802.
10. BASE SHALL BE DENSE MACADAM IN ACCORDANCE WITH CL. 903.
11. BINDER COURSE SHALL BE DENSE BITUMEN MACADAM IN ACCORDANCE WITH CL.906.
12. SURFACE COURSE SHALL BE STONE MASTIC ASPHALT.
13. LIMESTONE AGGREGATE IS NOT PERMITTED IN THE SURFACE COURSE.
14. ALL CONCRETE IN BACKING TO KERBS, CHANNELS AND EDGINGS SHALL BE GRADE ST4.
15. INSITU AND PRECAST CONCRETE UNITS SHALL HAVE SULPHATE RESISTING PORTLAND CEMENT TO BS 4027, UNLESS AGREED OTHERWISE WITH THE ADOPTING AUTHORITY.
16. PRECAST CONCRETE PRODUCTS SHALL COMPLY WITH THE RELEVANT PROVISIONS OF BS 5911:2010, BS EN 1916:2009, AND BS EN 1917:2008 AND BE KITEMARKED.
17. POSITION SIZE AND DEPTH OF ALL EXISTING SEWERS AND SERVICES SHALL BE ESTABLISHED PRIOR TO COMMENCEMENT ON SITE AND ANY DISCREPANCIES REPORTED TO BH.
18. THE CONTRACTOR SHALL ALLOW FOR THE PROTECTION, TEMPORARY AND PERMANENT SUPPORT, AND TEMPORARY AND PERMANENT DIVERSION WORKS, AS NECESSARY TO ALL EXISTING SERVICES.
19. THE CONTRACTOR SHALL ALLOW FOR ALL TRAFFIC MANAGEMENT IN CONNECTION WITH ROAD AND SEWER WORKS.
20. THE CONTRACTOR SHALL ALLOW FOR KEEPING SEWER TRENCHES AND EXCAVATIONS AS DRY AS PRACTICABLE BY PUMPING FROM TEMPORARY SUMPS AND DEWATERING AS APPROPRIATE. THE POINT AND METHOD OF DISCHARGE TO BE AGREED WITH THE DRAINAGE AUTHORITY AND ENVIRONMENT AGENCY.
21. GULLY GRATES AND FRAMES SHALL COMPLY WITH THE RELEVANT PROVISIONS OF BS EN124 AND BE OF A NON-ROCKING DESIGN WITH LEFT HANDED CAPTIVE HINGE ACCESS AND BE KITEMARKED. LOAD CLASS D400.
22. CLASS Z BEDDING DETAIL SHALL BE PROVIDED WHERE COVER TO THE PIPE BARREL IS LESS THAN 1.2M IN VEHICULAR TRAFFICKED AREAS AND 0.9M ELSEWHERE, TO ALL ROAD GULLY CONNECTIONS AND WITHIN AREAS OF DEEP ROOTING VEGETATION.
23. SHOULD THERE BE ANY CONFLICT BETWEEN INFORMATION ON THIS DRAWING AND THE HIGHWAY AUTHORITY'S RECOMMENDATION AND SPECIFICATION, THE AUTHORITY'S REQUIREMENTS TAKE PRECEDENCE. THE CONTRACTOR MUST LIAISE CLOSELY WITH THE AUTHORITY WITH RESPECT TO ANY TESTING, APPROVALS, INSPECTIONS, PERMISSIONS OR LICENCES REQUIRED AS WORK PROGRESSES.
24. UNSEALED AND LOOSE MATERIAL, SUCH AS CRUSHED STONE, GRAVEL AND PEBBLES, SHALL NOT BE USED ADJACENT TO THE HIGHWAY.
25. PRE-CAST CONCRETE KERBS, CHANNELS AND EDGINGS SHALL BE TO BS EN 1340:2003 AND SHALL BE LAID TRUE TO LINE AND LEVEL.
26. CBR VALUES ARE TO BE VERIFIED BY IN SITU TESTING AT A MAXIMUM INTERVAL OF 50M AND AT ANY VISIBLE CHANGE OF SUBGRADE.

HEALTH AND SAFETY INFORMATION

IN ADDITION TO THE HAZARDS/RISKS NORMALLY ASSOCIATED WITH THE TYPES OF WORK DETAILED ON THIS DRAWING, NOTE THE FOLLOWING

CONSTRUCTION.
- WORKS ADJACENT TO LIVE TRAFFIC
- WORKS IN VICINITY OF LIVE SERVICES

MAINTENANCE/CLEANING/OPERATION.
- WORKS ADJACENT TO LIVE TRAFFIC
- WORKS IN VICINITY OF LIVE SERVICES

DECOMMISSIONING/DEMOLITION.
- WORKS ADJACENT TO LIVE TRAFFIC
- WORKS IN VICINITY OF LIVE SERVICES

Notes

GENERAL NOTES:

1. THIS DRAWING HAS BEEN BASED ON THE FOLLOWING DRAWINGS AND INFORMATION:
   - TOPOGRAPHICAL SURVEY: DRAWING No. 2374CT/1 DATED JULY 2012, BY CT SURVEY
   - ARCHITECT DRAWINGS: "PROPOSED SITE PLAN" DRAWING No. SK100 REV A, BY CHETWOODS ARCHITECTS
   - UTILITIES SURVEY INFORMATION: BY COLAS LIMITED (LEEDS CIVILS)
   - ORDNANCE SURVEY TILES
2. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT DRAWINGS, DETAILS AND SPECIFICATIONS.
3. ALL DIMENSIONS ARE IN METRES UNLESS STATED OTHERWISE.
4. THE CONTRACTOR SHALL TAKE ALL NECESSARY SAFETY PRECAUTIONS IN LINE WITH CURRENT LEGISLATION WHEN WORKING IN/NEAR CONFINED SPACES, DEEP EXCAVATIONS AND UTILITIES.

SUBJECT TO THE APPROVAL OF THE HIGHWAYS AUTHORITY

Rev	Description	Date	Drn	Ch'd
C	Planning Issue Updated	11.07.14	MB	PJL
B	Planning Planning Issue	11.06.14	PJL	PJL
A	Planning Issue	15.05.14	PJL	PJL

PLANNING

Status of drawing

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Buro Happold
Consulting Engineers

Architect	*CHETWOODS ARCHITECTS*
Project	**BRIDGEWATER PLACE**
Drg Title	Civils Infrastructure Proposed Highways General Arrangement

Scales@A1	1 in 200	Job No.	032543
Drawn by	PJL	Drawing No.	C200
Checked by	PJL	Rev	C
Date	May 2014		

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APPENDIX D: WIND STUDIES

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WIND STUDIES

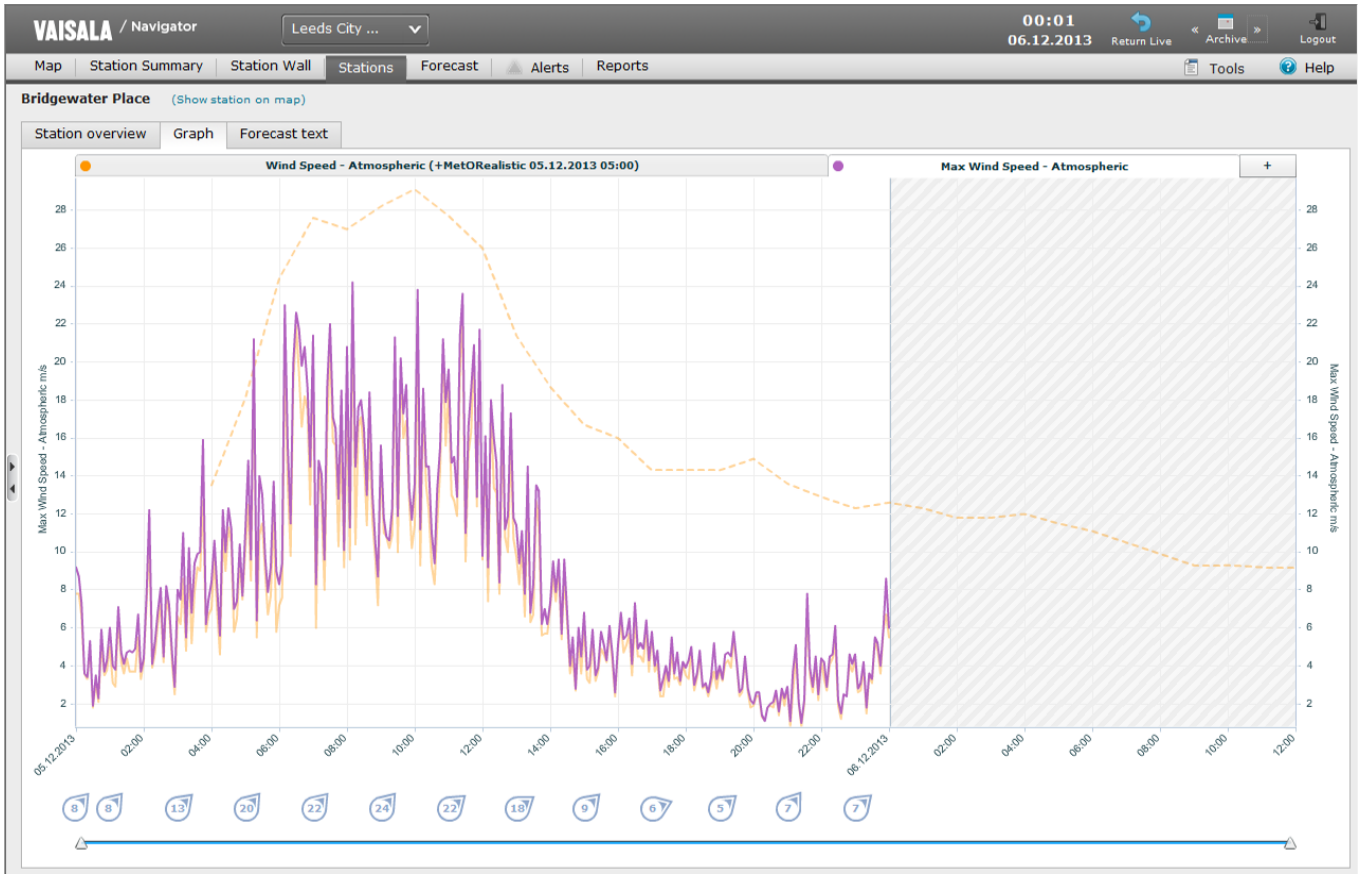
Background

The baffle structures form part of a package of measures, that also includes canopies and screens, in order to reduce high wind speeds experienced in the vicinity of the Bridgewater Place building in Leeds.

Refer to the Project Wind Study Report for further details.

Site measurements/observations

An anemometer has been installed near the site at the junction of Water Lane and Neville Street. A high wind scenario occurred on 5th December 2013 when recorded 3 second gust velocities (calculated over a 10 minute interval) were as plotted in the graph below, peaking at 24 m/s.



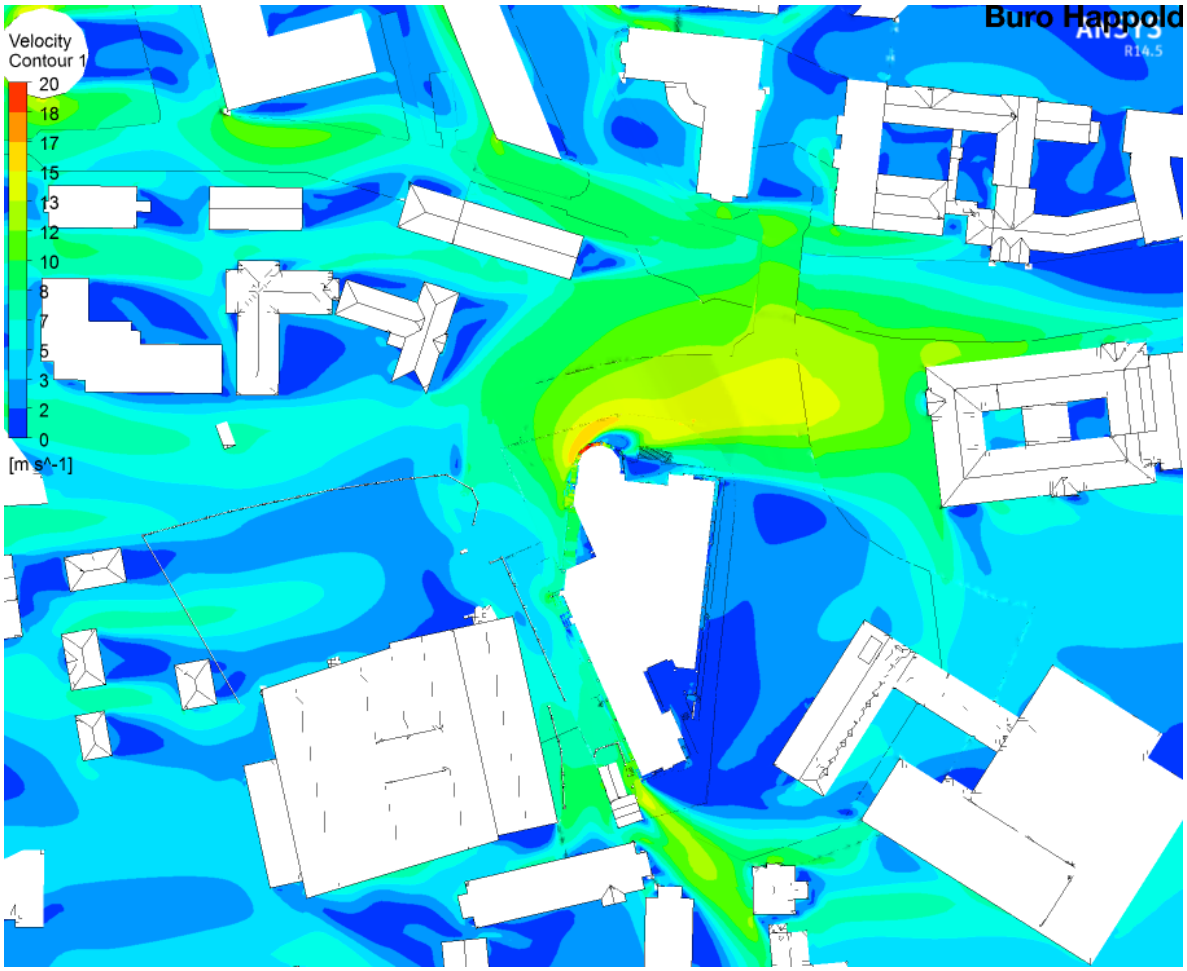
Computational Fluid Dynamic (CFD) Analysis

Extensive computational fluid dynamic analysis has been used to test the effectiveness of various mitigation measures and this has led to the recommendation that three baffles are provided over the road.

In the design of the baffles, it is recognised that the unusual terrain around the building requires special consideration in relation to any funnelling effects that occur on the site. Initially, this funnelling factor was derived from the detailed computational fluid dynamic models.

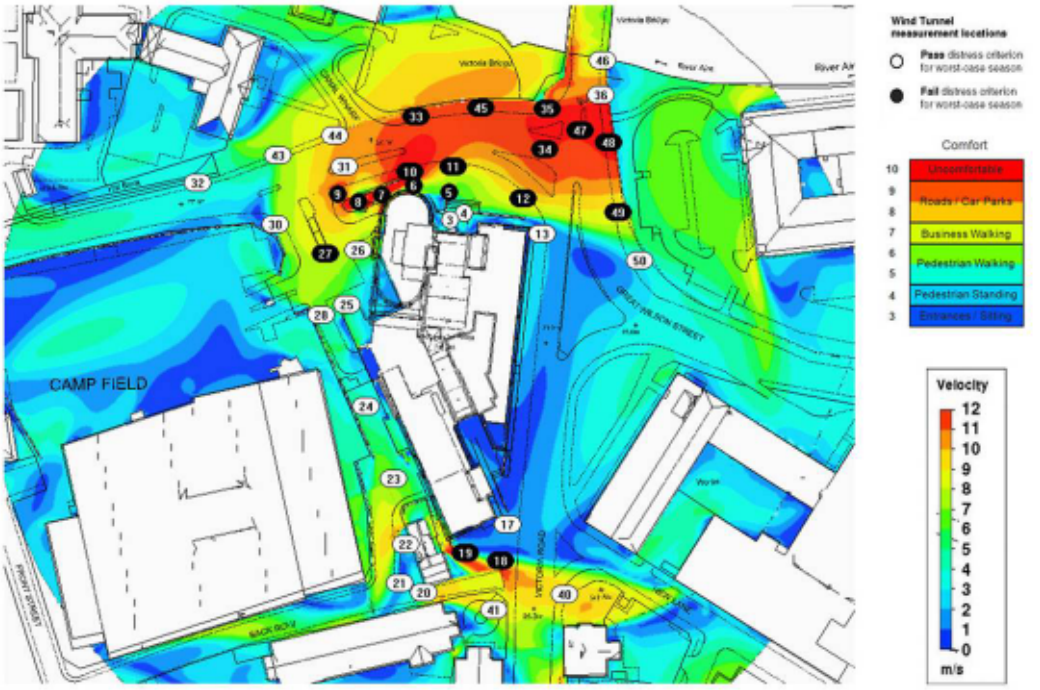
The inlet wind speed at the top of the tower was calculated at a level of 100m, which is the height of the tower. This was based on a boundary layer profile, where wind speed increases with height to account for the surrounding terrain roughness. This value was then factored by the wind speed as calculated within the CFD analysis at the baffle locations. The values used were those for the simulations without the wind mitigation measures in place, as shown in the Figure below. This was done in order to discount the braking effect that the baffles will have on the wind speed. This factor was then used to increase the mean wind speed as given by BS EN 1991-1-4.

The wind speed calculated using this method was 51m/s.

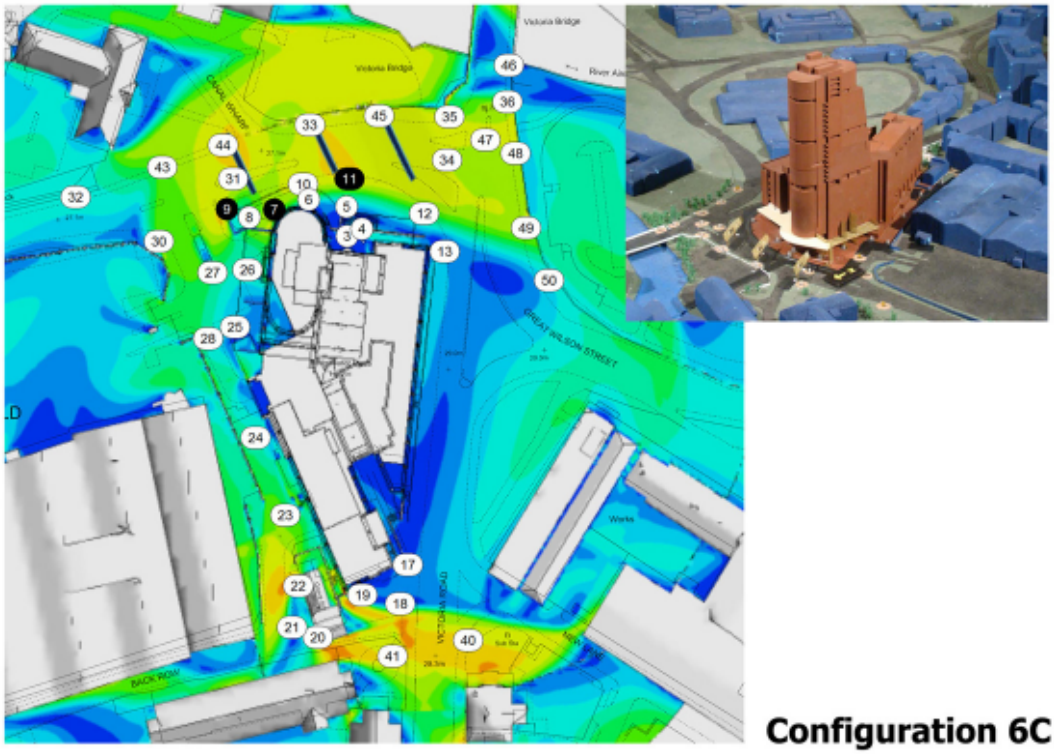


Wind Tunnel Testing

Following the CFD work, wind tunnel testing was commissioned to verify the effectiveness of the mitigation. Typical plots showing the results before and after the installation of these measures are shown below and these demonstrate that "hot spots" of uncomfortably high wind speeds have been generally eliminated.



AC (existing baseline)



Configuration 6C

The wind tunnel testing can also be used to verify the funnelling effects.

The structural wind speeds are derived simply from the ratio of the gust wind speed at each of the locations to the reference wind speed at the top of the building in the wind tunnel. The codified mean wind speed is then calculated to provide the structural loading wind speeds.

From the first phase of the wind tunnel test, the estimated gust speeds for a design working life category 4 structure (BS EN 1990 UK NAD table NA.2.1) are as tabulated below:

Wind Dir.	0	22.5	45	67.5	90	112.5	135	157.5	180	202.5	225	247.5	270	292.5	315	337.5
	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
Location								Gust speed (m/s)								
81	24.2	32.7	34.3	34.8	33.2	31.9	31.9	26.6	30.4	33.4	39.4	44.2	42.0	35.8	28.6	20.3
82	27.6	27.6	33.0	29.4	30.0	30.9	28.1	22.8	18.1	30.6	37.4	46.8	42.2	40.6	33.5	23.1
83	26.5	25.1	28.1	28.9	32.3	30.0	32.7	21.6	21.2	34.6	42.1	53.1	51.1	47.5	30.1	22.2
84	20.1	26.1	31.4	34.3	36.0	30.2	28.8	18.6	18.6	27.3	39.2	48.0	50.2	45.6	33.8	24.4
85	29.2	21.4	25.1	29.6	31.2	34.9	35.0	29.1	25.9	40.7	45.1	51.0	49.4	37.6	28.5	23.5
86	26.6	17.6	26.4	27.2	33.7	34.1	36.2	26.3	20.3	30.8	33.1	47.2	47.2	44.2	32.5	21.7

Figure 1 Location Points

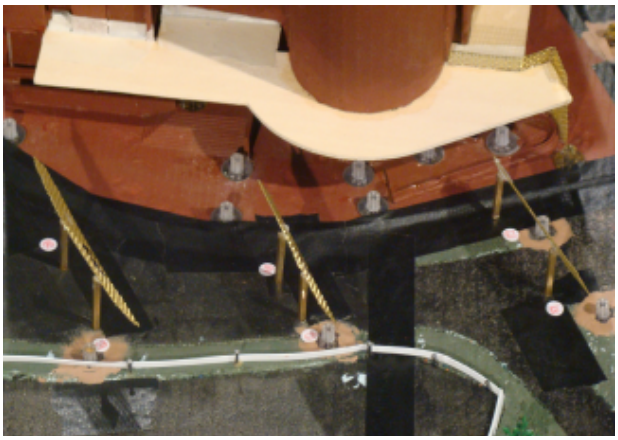
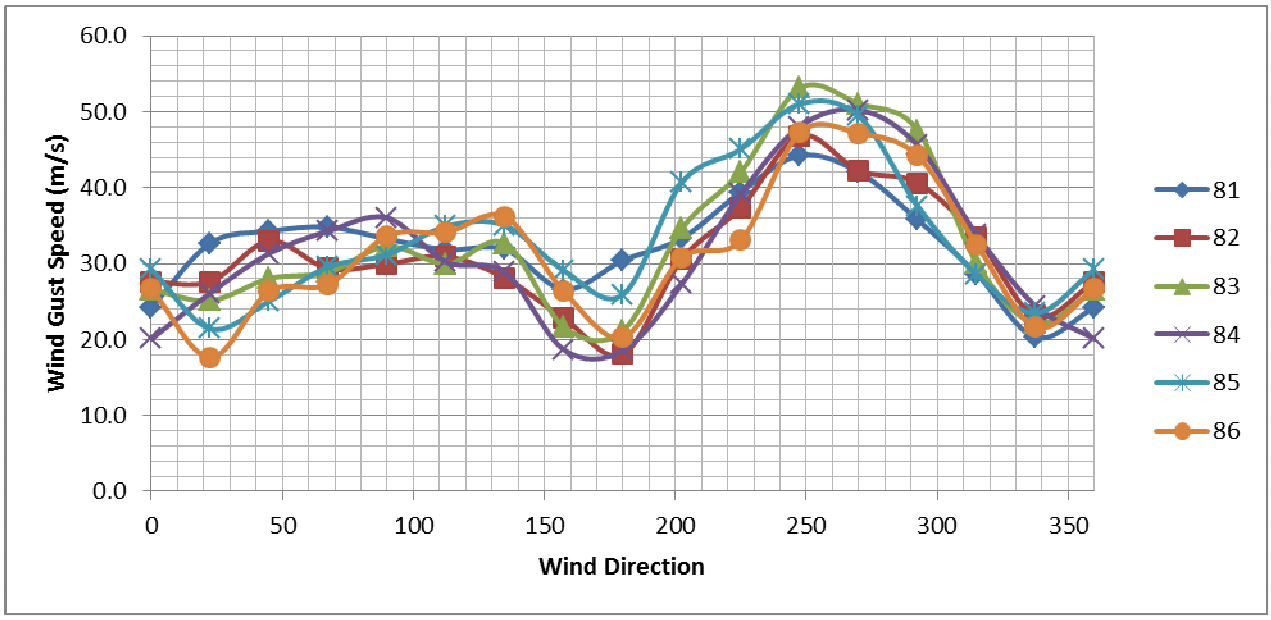


Figure 2 Wind Tunnel Model

By plotting the gust speed data, the maximum gust speed is estimated as **54 m/s**, which is slightly higher than that previously derived from the CFD results and is therefore the value carried forward into the design.



Derivation of Design Wind Load

The gust velocity determined taking account of terrain factors is 54 m/s.

This corresponds to a basic wind pressure of 1.79 kPa.

The force coefficient according to BSEN 1991-1-4 is 1.8.

The baffles have a nominal 50% porosity which is conservatively ignored in the calculation of wind loads.

Hence the design wind pressure used in the baffle design is **3.2 kPa**,

Further Work

Further structural wind testing and tests to examine wind generated noise are planned to take place as part of the detailed design.

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APPENDIX E: EXTERNAL ELECTRICAL SERVICES MAINTENANCE REQUIREMENTS

1 Executive Summary

The surrounding area to Bridgewater place is currently been re developed to mitigate the effects caused by high winds. As part of this process it is intended to install wind baffles to deflect the flow of the wind from the surrounding area, As part of this scheme it is intended to provide illumination to the baffle structures with the possibility of supplementary street lighting. Below is a brief outline of the expected maintenance regimes and life cycles of the selected components for the associated infrastructure and equipment.

System	Component	Life Expectancy	Maintenance Cycle
Baffle Lighting	LED Lamp Source	19 Years	In accordance with TD23
	Driver	5 Years	In accordance with TD23
	Controls	25+ Years	In accordance with TD23
Street Lighting	Lamp	3 Years	In accordance with TD23
	Column	25+ Years	In accordance with TD23
	Controls	16 Years	In accordance with TD23

Maintenance shall be carried out to the regimes set out within the document TD23 Annex B

ANNEX B - ROUTINE MAINTENANCE AND INSPECTION INTERVALS

Type of Inspection	Inspection Area	Elements of Inspection	Frequency of Inspection
Safety	Performance of lighting system	Lamp Failure	Trunk Road (Winter) 14 days Trunk Road (Summer) 28 days Motorway 28 days
		Lamp not fully operational or cycling	
		Obscuration	
		Other notable defects	
Detailed	Luminaires	Lamp Replacement	Defined in Table 4
		Cleaning internal and external surfaces	At bulk lamp change
		Cleaning, adjustment and visual inspection of electrical components and wiring	
		Cleaning, lubrication, adjustment and visual inspection of mechanical components	
	Columns	Clean and visual inspection of base compartment, column reference number and any overhead line warning notices	At bulk lamp change
		Lubricate, adjust and visual inspection of structural condition of column, door and fixings	
		Visual inspection and repair of protective coating	
		Cleaning, adjustment and visual inspection of electrical components and wiring within base compartment	
	Network Cabling	Cleaning, adjustment and visual inspection of electrical terminations	At bulk lamp change
		Complete electrical test and inspection (See Table 8, Annex C)	Every 6 years (maximum)

The testing of electrical systems will be in accordance with the current edition of BS7671 including all ammendments.

2 Systems

The purpose of this document is to highlight the possible maintenance requirements of the electrical apparatus listed below .

- Mood lighting to the baffles
- Street Lighting

2.1 Baffle Mood Lighting

The proposed mood lighting will compromise of a low wattage LED driven solution which will be installed within the baffle to provide a soft illumination. This system will compromise of the following components,

- LED Lamp Source
- LED Driver
- Controls & Cabling

Detailed bellow is a short summary of the perceived maintenance requirements and life expectancies.

- LED Source – The LED emitting diodes have a long life cycle of around 70,000 hours based on manufacturers information which broken down would equate to 19 years of usage based on an average 10 hour per day operation.
- LED Driver – The driver component has an average life of 20,000 hours, based on the same usage criteria as the LED emitter this would have a life cycle of 5 years. LED driver would be located external to the baffle to allow for ease of access for any maintenance requirements.
- Associated controls – Daylight sensing and time clocks have an extremely long operating life cycle and above to adverse failures due to manufacturing tolerances would only require replacement on failure. Typically external daylight sensors and time clocks have an operation life of 200,000 on/off operations. This equates to 273 years based on one on and one off function per day.
- The baffle lighting would be fed from the LV unmetered public supply as the current public street lighting provisions
- It would be proposed that maintenance regimes are based on the Design Manual For Roads and Bridges, document TD23 Annex B. Extended manufacturers warranties can be investigated from the initial 12 months.
- Baffle lighting will require formed concrete access chambers to house the associated controls, The ground chamber cover and chamber will be constructed to highway load requirements.

2.2 Street Lighting Requirement

Street Lighting would follow the same approach to maintenance regimes as currently implemented by the local authority. Luminaires and associated controls would be selected from the local authorities approved suppliers and would be supplied via the local public LV supply arrangement..

Throughout the installation process the local authorities clerk of works would be invited to witness all stages of construction as to confirm that the installation meets the required standards.

It would be proposed that maintenance regimes are based on the Design Manual For Roads and Bridges, document TD23 Annex B.

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date	16 January 2014
approved	Martin Mckay
signature	
date	16 January 2014

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APPENDIX F: DESIGN HAZARD LOG

HSF04.01a - Design Hazard Checklist
Baffles

Project: *Bridgewater Place* **Design Stage:** *Planning submission / AIP* **Date:** 2/5/2014

Ref No.	Hazard	What action have you taken to eliminate/reduce this hazard?	What information are you providing about this hazard?	To be actioned by whom & when?	Action Confirmed (Date & Project Leader's Initials)
Site Wide Issues					
1.01	Is there sufficient space at the perimeter of the site boundary for structural erection, i.e. crane access, scaffold etc? If not how does this impact on design & construction sequence?	It is assumed that full or partial road closure will be required to facilitate erection.	Described in AIP outline construction sequence.	BH – AIP submission	SEF - May 2014
1.02	Are access restrictions i.e. site access, turning circles in the vicinity of the site, or congested sites, likely to cause restrictions in the ability to crane or hoist materials resulting in an impact on design, i.e. minimising component sizes or in-situ work?	Components will be sized to facilitate delivery to site.	Described in AIP outline construction sequence.	BH – AIP submission	SEF - May 2014
1.03	Has sufficient structural survey of any existing structures been undertaken, including the presence of post tensioned concrete, high alumina cement, deterioration by vibration, vandalism and in timber fungal attack?	The existing deep level sewer has been surveyed in detail. Trial trenches have been undertaken to locate the presence of any services and also to locate the walls of Holbeck culvert. There is a known defect in the Yorkshire Water sewer that will need to be considered further at the next stage.	Survey findings reflected on drawings.	BH – Site plans	SEF - May 2014
1.04	Have existing structures below or above ground been surveyed for the presence of asbestos or other suspect harmful materials?	A contamination statement has been prepared.	Contamination statement	BH – Geotech	SEF - May 2014
1.05	Is the site likely to be contaminated both above and below ground?	A contamination statement has been prepared.	Contamination statement	BH – Geotech	SEF - May 2014
1.06	Are there any live services within the existing structures and or on the site? Have these been adequately identified especially next to live services?	Utilities searches, a review of record information and trial trenches have been undertaken.	Survey findings reflected on drawings.	BH – Site plans	SEF - May 2014
1.07	Could the location of new structures result in undermining or cause vibration to existing structures resulting in structural collapse or damage?	Set backs for piling from the existing sewer have been agreed with Yorkshire Water.	Identify piling exclusion zone on the drawings.	BH – Site plans	SEF - May 2014
1.08	Will construction work result in excessive noise, dust, vibration which could affect adjacent properties such as schools and hospitals?	Requirements in relation to noise, dust and vibration will be included in the contract documents.	To be provided in general contract requirements.		
1.09	Are the works likely to prevent natural dispersal of storm water or allow ingress of storm water where previously not possible?	The introduction of new traffic islands around the baffle supports will require drainage in these areas to be considered.	To be considered in detailed design.		
1.10	Are there any site issues with regard to water e.g. flooding, tidal and ground water?	A site-specific flood risk assessment has been undertaken. It was concluded that the scheme will have no significant impact on surface water run-off, attenuation or flood storage in respect of the existing situation.			
1.11	Is structural erection likely to impede the means of escape from occupied or nearby premises or restrict access for emergency vehicles during construction?	Not applicable.			
1.12	Has adequate consideration been given to eliminating hazards due to working over operational roads/railways/waterways?	Work above the highway will typically be undertaken during a road closure.	Described in AIP outline construction sequence.	BH – AIP submission	SEF - May 2014

Ref No.	Hazard	What action have you taken to eliminate/reduce this hazard?	What information are you providing about this hazard?	To be actioned by whom & when?	Action Confirmed (Date & Project Leader's Initials)
1.13	Has the presence of any overhead line equipment been identified on the drawings?	Not applicable.			
Earthworks and Foundations					
1.14	Is the construction work likely to create any surcharge loads as a result of earth moving or removing existing structures from the ground?	Not applicable.			
1.15	Have depths of drainage runs been minimised to minimise depths of excavations?	Not applicable.			
1.16	Are temporary construction loads likely to endanger the stability of any new retaining structures?	Not applicable.			
1.17	Is there a danger that existing below or above ground structures/boundary walls could become unstable as a result of construction loads or construction work?	Not applicable.			
1.18	Are there any particular difficulties associated with getting a piling rig to site or manoeuvring it to the points where piles will be placed?	It is envisaged that new foundations can be constructed using a mini-piling rig.	Described in AIP outline construction sequence.	BH – AIP submission	SEF - May 2014
1.19	Is the existing ground able to maintain the stability of a piling rig?	It is envisaged that new foundations can be constructed using a mini-piling rig.	Described in AIP outline construction sequence.	BH – AIP submission	SEF - May 2014
1.20	Is the vibration from driven piles to endanger the stability of nearby structures?	Driven piles will not be used.			
1.21	Is the 'spin-off of debris from augured piling likely to be within range of other construction activities or the general public?	Piling will need to be carried out in carefully hoarded out areas.	To be provided in general contract requirements.		
1.22	Do concrete pile heads have to be broken down, thereby necessitating working methods that eliminate the use of hand held vibrating tools?	Alternatives to hand breaking to be considered by Contractor in order to reduce risk.			
1.23	Will the use of driven piles cause noise and vibration hazards for adjacent property?	Driven piles will not be used.			
1.24	Will the designed levels of pad foundations mean excessively deep excavations?	Foundations will be piled to minimise the depth of excavations.			
Structures					
1.25	Is the structure going to be subject to any temporary instability issues? If so what information are you providing?	No special requirements are anticipated.			
1.26	Are retaining walls and bridge structures designed to accommodate construction traffic/imposed loading? If so what are the maximum design loads and have these been stated on the drawings?	The road is suitable for normal highway loading.			

Ref No.	Hazard	What action have you taken to eliminate/reduce this hazard?	What information are you providing about this hazard?	To be actioned by whom & when?	Action Confirmed (Date & Project Leader's Initials)
1.27	Are there any unusual methods of construction that create unusual hazards that require their methodology to be explained on the drawings?	No special requirements are anticipated.	Described in AIP outline construction sequence.	BH – AIP submission	SEF - May 2014
1.28	Can you confirm that you have communicated your Design assumptions to the Principal Contractor (Temporary Works Designer) and that you are satisfied that there is at least one safe method of constructing the permanent works?	The method of baffle construction has been described in principle and will be developed further in the detailed design.	Described in AIP outline construction sequence.	BH – AIP submission	SEF - May 2014
1.29	When prefabricated steelwork or pre-cast concrete units are specified has consideration been given for providing suitable lifting points, to hold them securely during lifting and installation?	These will be incorporated in the detailed design.			
1.30	If site connections have been specified are there any difficulties in accessing them, particularly at high level? Has consideration been given to eliminating site welding by detailing bolted connections?	Site welding will generally be avoided. High level site connections will typically be located at the column tops only.	Described in AIP outline construction sequence.	BH – AIP submission	SEF - May 2014
1.31	Does the design create unusual or difficult access issues to erect and strike formwork, particularly at high level?	Not applicable.			
1.32	Has high level painting and fire protection of steelwork been eliminated/reduced by off sire application?	It is envisaged that all protective treatment will be applied off-site.			
1.33	Has the use of prefabrication been critically assessed to eliminate/reduce the amount of time/exposure to working at height/need for site welding and site cutting?	Prefabrication will be used as far as possible with all elements trial erected off site prior to installation.			
1.34	Is there any secondary steelwork, masonry, pre-cast units, shelf angles etc that weigh more than 20kg and will require a degree of manual handling?	The weight of cladding panels needs to be considered in the detailed design.			
1.35	Are there any reinforcement requirements resulting in rebar being too heavy for manual handling?	The weight of reinforcement in foundations needs to be considered in the detailed design.			
1.36	Will the shape of any steel members make them difficult to sling when lifting?	The baffle geometry is unusual and will therefore require a careful calculation of the centre of gravity when the lifting plan is developed and lifting points are specified. This matter will be considered further as part of the detailed design.			
1.37	Has the requirement for scabbling of concrete been eliminated?	Refer to item1.22.			
1.38	Has the possibility of accidental or malicious damage, e.g. severing of a stay cable, been considered in the design?	All elements and fixings will be robustly detailed. This aspect will be considered further as part of the detailed design.			
1.39	Has the structural design been checked and subjected to a Design Review?	Design reviews will be carried out at each project stage. The detailed design will be subject to an independent (cat 3) check.			
1.40	Is there a danger of unseen deterioration of the interior of hollow section structural elements, e.g. baffle masts and boom members?	All structural hollow sections will be hermetically sealed for durability. This is a commonly accepted approach for highway structures.	Described in AIP.	BH – AIP submission	SEF - May 2014

HSF04.01a - Design Hazard Checklist
Baffles

Ref No.	Hazard	What action have you taken to eliminate/reduce this hazard?	What information are you providing about this hazard?	To be actioned by whom & when?	Action Confirmed (Date & Project Leader's Initials)
Finishes/Furniture					
1.41	Have fixing points, holes for services, been pre-cast or fixed into structures in order to minimise the need for post drilling?	Ducts for lighting cables will be integrated into the detailed design.			
1.42	Has adequate consideration been given to the provision of pedestrian edge protection/road restraint systems in accordance with relevant standards?	Not applicable.			
1.43	Does the bridge surfacing have adequate slip resistance when wet and have tripping hazards/non-heel safe gratings etc been avoided?	Not applicable.			
1.44	Has adequate lighting been provided?	Task lighting is provided separately to the baffle structures. Architectural feature lighting may be incorporated in the detailed design.			
Operation and maintenance					
1.45	Are access openings for inspection and maintenance located safely, i.e. away from live carriageways?	It is envisaged that high level general inspection of the baffles may be undertaken from above the footways.	Described in AIP outline inspection and maintenance strategy.	BH – AIP submission	SEF - May 2014
1.46	Has a safe method of access for inspection been considered, including periodic principal inspections where all bridge elements should be examined at close quarters?	Principal inspection will require mobile elevated work platforms and partial road closure.	Described in AIP outline inspection and maintenance strategy.	BH – AIP submission	SEF - May 2014
1.47	Has future maintenance/cleaning/replacement of the following been considered: surfacing, drainage gullies, gutters, light fittings, parapets, movement joints, bearings?	Light fittings may be replaced using mobile elevated work platforms and partial road closure.	Described in AIP outline inspection and maintenance strategy.	BH – AIP submission	SEF - May 2014
1.48	Have high durability protective treatments been specified in order to minimise the need for future maintenance?	Protective treatment will be specified as "inland, difficult access" in accordance with the Specification for Highways Works.	Described in AIP.	BH – AIP submission	SEF - May 2014
1.49	Have bridge details been made robust to prevent vandalism?	All elements and fixings will be robustly detailed. This aspect will be considered further as part of the detailed design.			
1.50	Have concealed areas that might encourage antisocial behaviour/mugging been avoided?	Baffle columns are circular and present limited opportunity for concealment.			
1.51	Have any load restrictions that apply during general use or specialist maintenance activities (such as jacking for bearing replacement) been specified on the drawings?	Not applicable.			
1.52	Have special hazards associated with movable structures been considered?	Not applicable.			
Vehicle Collision Protection					
1.53	Has the risk of vehicle/train/vessel/floating debris impact on bridge piers and or superstructure been assessed?	A number of alternative means of providing vehicle protection have been considered – refer to supplementary note below. Columns will be designed for vehicle collision loading and additional protection in the form of trief kerbs will be provided.	Described in AIP.	BH – AIP submission	SEF - May 2014

HSF04.01a - Design Hazard Checklist
Baffles

Collision Protection of Baffle Structures – Supplementary Note

Alternative Means of Protection

Wherever possible, baffle support columns are set back as far as possible from the kerb. However, where they are close to edge of the carriageway, there is a risk of the baffle supports being hit by an errant vehicle. Several alternative means of protecting the supports were considered as part of the concept design, as follows:

- Independent deformable safety fences located between the columns and the carriageway
- Mounting of the baffle supports on concrete wall or plinth structures that are designed as non-deformable vehicle barriers
- Design of circular hollow section steel columns for applicable vehicle collision loading

Factors that were examined in assessing these options included: the available space for foundations and supports based on site constraints; sight lines and visibility; pedestrian accessibility and aesthetics. It was concluded that the preferred option was to design the circular hollow section steel columns for applicable vehicle collision loading.

Applicable Vehicle Collision Loading

Interim Advice Note 124/11 covers the use of Eurocodes for the design of highway structures. This document contains the following statement: “Chapters 3 and 4 of BD51 on loadings for and design of portal and cantilever sign/signal gantries respectively contain design rules based on standards such as BS5400 that conflict with Eurocodes. Prior to the publication of a revised version of BD51, guidance should be sought from the TAA on a project specific basis on whether Eurocodes should be used for the design of portal and cantilever sign/signal gantries.”

Further to the meeting with LCC’s Highway and Transportation Department on 22nd April 2014, it is proposed that the baffle supports be designed to withstand equivalent static design forces due to vehicular impact on members supporting foot and cycle track bridges over or adjacent to roads with speeds less than or equal to 45mph as IAN 124 Table A.4 and A.5 (i.e. 825kN main + 165kN residual loads in the direction of normal travel). This provision is over and above the minimum forces specified for general robustness and greater than the residual loads previously specified in BD 51 for sign and signal gantries.

It is considered unduly onerous to consider the higher equivalent static design forces due to vehicular impact on members supporting a road bridge on a gantry structure that is not carrying pedestrian or vehicular traffic.

Provision of Trief Kerbs

It is proposed to incorporate trief kerbs around the traffic islands on which the baffle supports are located close to the carriageway as additional protection for the columns against mechanical damage and also to provide additional protection for errant vehicles that may otherwise collide with the solid column supports and sustain damage. Trief kerbs are particularly effective for impacts that occur at angles of incidence at up to an approximately 20 degrees, however there is evidence that impacts at greater angles can result in overturning of the vehicle. Studying the road layout around the baffles, the possibility of near to head on impacts does exist with some potential vehicle movements, however it is argued that on balance the presence of trief kerbs provides a greater level of protection than omitting them. The potential for vehicles to flip over on impact will be mitigated during the detailed design by careful consideration of the shaping of traffic islands.

Refer also to Quantitative Risk Assessment based on “Design & Maintenance Guidance for Local Authority Roads - Provision of Road Restraint Systems on Local Authority Roads”, October 2011.

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APPENDIX G: QUANTITATIVE RISK ASSESSMENT

Quantitative Risk Assessment

Based on "Design & Maintenance Guidance for Local Authority Roads - Provision of Road Restraint Systems on Local Authority Roads", October 2011.

Risk Scoring (Section 6) is summarised as follows:

Table reference	Factor	Category	Notes	Risk Score
6.1	Location Factor	Urban B Road		3
6.2 & 6.3	Layout Factor	Some potential for lane changing, overtaking, positioning manoeuvres or avoiding action		2
6.4 & 6.5	Collision factor	• Series of individual hazards less than 50m apart or a longitudinal hazard that might be reached • Percentage of KSI for primary hazard 20 -30%	Reference also made to Table 3.2 for KSI ranking relative to other similar hazards	2 (= 1 + 1)
6.6, 6.7 & 6.8	Consequential Factor	• When damaged or collapsed the feature could give rise to the risk of secondary vehicular accidents • If hazardous feature was damaged or collapsed this could give rise to network disruption for more than one day • Significant cost of repair or replacement following collision		3
TOTAL RISK SCORE				**10**

According to Table 6.9, the total risk score places the site in the Medium Priority category.

Table 5.2 states:-

1. Intervention may be required to introduce control measures to drive residual risk towards the Lower Priority Site category.

2. The residual risk can be tolerated only if further risk reduction is impracticable or requires action that is grossly disproportionate to the reduction in risk achieved.

Table 5.2 also indicates:-

1. That where the risk evaluation identifies a site that is medium priority, a Road Restraint System may be justified.

Therefore, in this location, it is proposed to use an N1 containment Trief kerb.

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