4.4 Authorities consulted and any special conditions required

Additionally, continuous collaboration within BADGER as well as with Highways England representatives allows for seamless incorporation of any change into the design, once agreed between all parties.

This project is the subject of a Development Consent Order (DCO). In preparation of the DCO application, consultation with interested third parties has been undertaken. The approved DCO will specify conditions for the design, construction and operation of the tunnel. It will also specify requirements for ongoing consultation with relevant third parties and set out various planning conditions to be discharged and approvals gained.

4.5 Standards and documents listed in the technical approval schedule (TAS)

Technical Approval Schedule (TAS) is in **Appendix A** to this OAIP.

4.6 Proposed departures from standards given in 4.5

None

4.7 Proposed departures relating to methods for dealing with aspects not covered by standards in 4.5

Agreement to use stabilised chalk as Class 6I/J has been agreed with Highways England during the Tender Report by DQ.

4.8 Proposed safety critical fixings

None

5 STRUCTURAL ANALYSIS

5.1 Methods of analysis proposed for superstructure, substructure and foundations

Closed form solutions used for the initial assessment to size the elements for this stage of design. Upon award of the detailed design, a structural analysis model will be created using software such as Midas Civil Structural Analysis.

For embankments, the design includes checks for both external stability (overturning, sliding, and bearing) and internal stability (adhesion & reinforcement rupture).

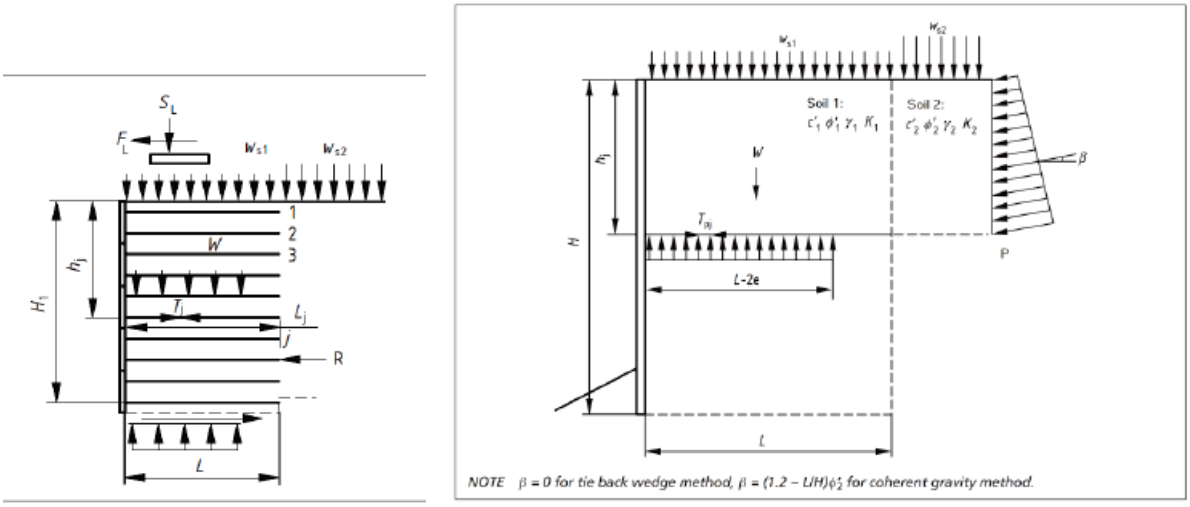
Internal stability was designed on a metre strip basis based on BS-8006-1:2010 with the use of tie back wedge method.

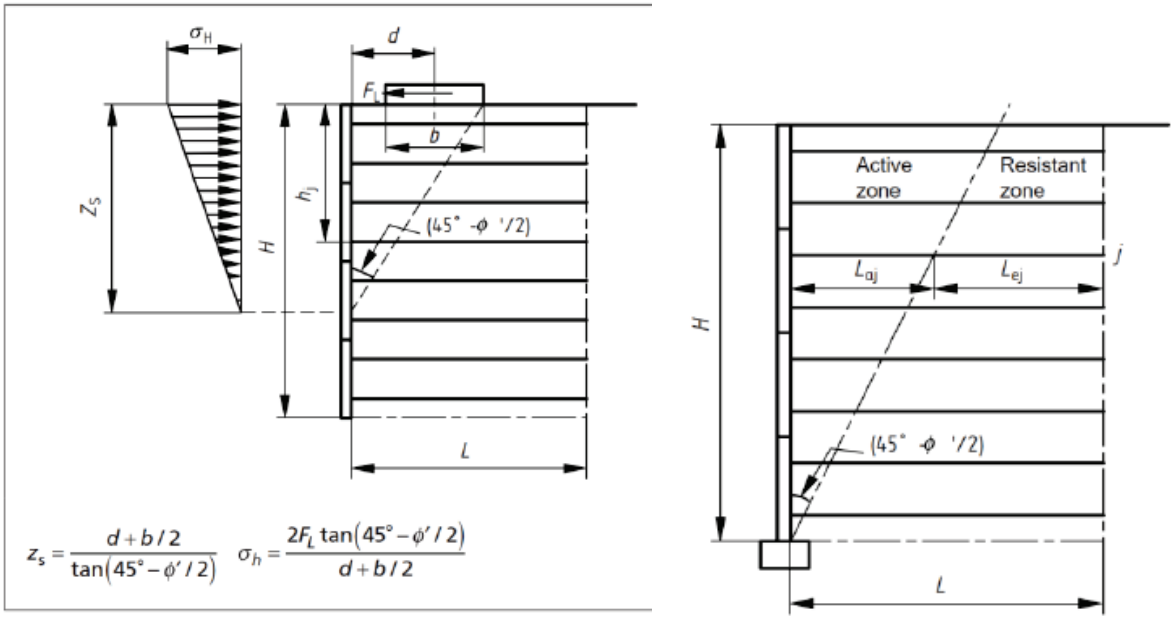
External stability was design based on BS-8004:2015, and BS EN 1997-1:2004+A1:2013.

5.2 Description and diagram of idealised structure to be used for analysis

The decks have been modelled as a plane grid using Midas Civil software or similar, using evolutive cross sections to take into account the different structural sections and actions depending on the construction stage considered.

Reinforced soil structures incorporating the steel strips must be designed in accordance with BS 8006-1 : 2010, Highways England requirements and the MCHW, Volume 1:





The maximum height of the MSE wall will be approximately 8m.

- The proposed spacing layout is 0.188 – 0.75m.
- The maximum length of the reinforcement shall be approximately 11m.

5.3 Assumptions intended for calculation of structural element stiffness

Precast concrete section properties will be based on the gross, uncracked concrete cross-section.

5.4 Proposed range of soil parameters to be used in the design of earth retaining elements

This applies for the abutments and lateral walls of the bridge. Earth pressures are obtained as per assumption values below.

Table 5-1: Ground parameters

Material	Soil type	Unit weight [kN/m3]	Internal friction angle [º]	c' [kPa]
MSE fill	Chalk - stabilised	20	30	0
Embankment fill	Chalk - stabilised	20	30	0
Subsoil	Chalk – natural	20	26	0

6 GEOTECHNICAL CONDITIONS

6.1 Acceptance of recommendations of the ground investigation report (reference/dates) to be used in the design and reasons for any proposed changes

A summary of the Geotechnical Report reviewed is included in **Appendix B**. Assessed preliminary design soil parameters are also included in **Appendix B**.

6.2 Summary of design for highway structure in the ground investigation report

Refer to **Appendix B** for preliminary soil design parameters.

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

As the structures are a single span deck, simply supported on bank seats, differential settlements between supports do not affect the structural behavior of the deck. The expected settlement at abutments is up to 50 mm and the differential settlement and transition length in ramps expected are respectively 100mm in 50 m (TBC). The total settlement underneath the bankseats and along the embankments will be monitored with appropriate instrumentation throughout construction with hold periods and trigger levels specified at key points in the construction sequence. The intention of the proposed solution for ground improvement is to allow a transitory length to adapt the differential settlement between the abutments and the ramps beyond them.

6.4 If the ground investigation 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

A summary of the Geotechnical assessments including preliminary design soil parameters is included in **Appendix B**.

7 CHECK

7.1 Proposed category and design supervision level

Category 2 as per clause 3.9 of CG 300.

7.2 If category 3, name of proposed independent checker

N/A

7.3 Erection proposals or temporary works for which types S and P proposals will be required, listing structural parts of the permanent structure affected with reasons

TBD

8 DRAWINGS AND DOCUMENTS

8.1 List of drawings (including numbers) and documents accompanying the submission

Table 8-1: Drawings and Documents

Document	Number
General Plan and profile views	HE551506-BGR-SBR-Z4BRC00Z-DR-S-0001
Deck sections	HE551506-BGR-SBR-Z4BRC00Z-DR-S-0002
MSE wall section and details	HE551506-BGR-SBR-Z4BRC00Z-DR-S-0003

For embankments, refer to **Appendix D** for preliminary drawings.

9 THE ABOVE IS SUBMITTED FOR ACCEPTANCE

We confirm that details of the temporary works design will be/have been passed to the permanent works designer for review[16].

Signed _____
Name _____ Design Team Leader
Engineering Qualifications _____
Name of Organisation _____
Date _____

Signed _____
Name _____ Check Team Leader
Engineering Qualifications _____
Name of Organisation _____
Date _____

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

Signed _____
Name _____
Position held _____
Engineering Qualifications _____
TAA _____
Date _____

Appendix A – Technical Approval Schedule (TAS)

Schedule of Documents Relating to Design of Highway Bridges and Structures

Eurocodes and Associated UK National Annexes

Eurocode part	Title	Amendment / Corrigenda	
Eurocode 0	**Basis of structural design**		
BS EN 1990:2002 +A1:2005	Eurocode 0: Basis of structural design	+A1:2005 Incorporating corrigenda December 2008 and April 2010	See CD 350 section 7 for additional guidance.
NA to BS EN 1990:2002 + A1:2005	UK National Annex to Eurocode 0 Basis of structural design	National Amendment No.1	See CD 350 section 7 for additional guidance.
Eurocode 1	**Actions on structures**		
BS EN 1991-1-1:2002	Eurocode 1: Actions on structures. General Actions. Densities, self-weight, imposed load for buildings	Corrigenda December 2004 and March 2009	
NA to BS EN 1991-1-1:2002	UK National Annex to Eurocode 1: Actions on structures. General Actions. Densities, self-weight, imposed load for buildings	Corrigenda July 2019	
BS EN 1991-1-3:2003 +A1:2015	Eurocode 1: Actions on structures. General Actions. Snow loads	+A1:2015 Incorporating corrigenda December 2004 and March 2009	
NA + A2:18 to BS EN 1991-1-3:2003+A1:2015	UK National Annex to Eurocode 1: Actions on structures. General Actions. Snow loads	+A2:2018 Incorporating corrigenda June 2007, December 2015 and October 2018	
BS EN 1991-1-4:2005 +A1:2010	Eurocode 1: Actions on structures. General Actions. Wind actions	+A1:2010 Corrigenda July 2009 and January 2010	
NA to BS EN 1991-1-4:2005 + A1:2010	UK National Annex to Eurocode 1: Actions on structures. General Actions. Wind actions	National Amendment No.1	

Eurocode part	Title	Amendment / Corrigenda	
BS EN 1991-1-5:2003	Eurocode 1: Actions on structures. General Actions. Thermal actions	Corrigenda December 2004 and March 2009	
NA to BS EN 1991-1-5:2003	UK National Annex to Eurocode 1: Actions on structures. General Actions. Thermal actions	-	
BS EN 1991-1-6:2005	Eurocode 1: Actions on structures. General Actions. Actions during execution	Corrigenda July 2008, November 2012 and February 2013	
NA to BS EN 1991-1-6:2005	UK National Annex to Eurocode 1: Actions on structures. General Actions. Actions during execution	-	
BS EN 1991-1-7:2006 +A1:2014	Eurocode 1: Actions on structures. General Actions. Accidental actions	+A1: 2014 Corrigendum February 2010	
NA+A1 to BS EN 1991-1-7:2006+A1:2014	UK National Annex to Eurocode 1: Actions on structures. Part 1-7: Accidental actions	+A1:2014 Incorporating corrigenda August 2014 and November 2015	See CD 350 for additional guidance.
BS EN 1991-2:2003	Eurocode 1: Actions on structures. Traffic loads on bridges	Corrigenda December 2004 and February 2010	See CD 350 section 7 for additional guidance.
NA to BS EN 1991-2:2003	UK National Annex to Eurocode 1: Actions on structures. Traffic loads on bridges	Corrigendum No.1	See CD 350 section 7 for additional guidance.
Eurocode 2	**Design of concrete structures**		
BS EN 1992-1-1:2004 + A1:2014	Eurocode 2: Design of concrete structures– Part 1-1: General rules and rules for buildings	Incorporating corrigendum January 2008, November 2010 and January 2014	
NA + A2:2014 to BS EN 1992-1-1:2004 + A1:2014	UK National Annex to Eurocode 2: Design of concrete structures – Part 1-		

Eurocode part	Title	Amendment / Corrigenda	
	1: General rules and rules for buildings		
BS EN 1992-2:2005	Eurocode 2: Design of concrete structures – Part 2: Concrete bridges – Design and detailing rules	Corrigendum July 2008	
NA to BS EN 1992-2:2005	UK National Annex to Eurocode 2: Design of concrete structure – Part 2: Concrete bridges – Design and detailing rules	-	
Eurocode 7	**Geotechnical design**		
BS EN 1997-1:2004+A1:2013	Eurocode 7: Geotechnical design – Part 1 General rules	+A1:2013 Corrigendum February 2009	
NA+A1 to BS EN 1997-1:2004+A1:2013	UK National Annex to Eurocode 7: Geotechnical design – Part 1 General rules	+A1:2013 Incorporating Corrigendum No.1	
BS EN 1997-2:2007	Eurocode 7: Geotechnical design – Part 2 Ground investigation and testing	Corrigendum June 2010	
NA to BS EN 1997-2:2007	UK National Annex to Eurocode 7: Geotechnical design – Part 2 Ground investigation and testing	-	

BSi Published Documents

For guidance only unless clauses are otherwise specified in BD 100/16 Annex B.

Doc No.	Title	
PD 6687-1:2020	Background paper to the UK National Annexes to BS EN 1992-1 and BS EN 1992-3	Supersedes PD 6687-1:2010 See CD 350 clauses 3.6, 4.1, 4.2 and Appendix A for additional guidance. Clause 3.6 in CD 350 refers to clause 2.5 in PD 6687-1, this is now clause 4.5 in PD 6687-1 Clause 4.2 in CD 350 refers to clause 2.22 in PD 6687-1, this is now clause 4.21.4 in PD 6687-1
PD 6687-2:2008	Recommendations for the design of structures to BS EN 1992-2:2005	See CD 350 clauses 4.1, 4.2 and Appendix A for additional guidance.
PD 6688-1-1:2011	Recommendations for the design of structures to BS EN 1991-1-1	See CD 350 Appendix A for additional guidance.
PD 6688-1-7:2009 +A1:2014	Recommendations for the design of structures to BS EN 1991-1-7	See CD350 clause 3.7 and Appendix B for additional guidance.
PD 6688-2:2011	Recommendations for the design of structures to BS EN 1991-2	See CD 350 Appendix A for additional guidance.
PD 6694-1:2011	Recommendations for the design of structures subject to traffic loading to BS EN 1997-1	See BD100 Annex B for additional guidance.

Execution Standards referenced in British Standards or Eurocodes

Doc No.	Title	
BS EN 13670:2009 Incorporating corrigenda October 2015 and November 2015	Execution of concrete structures	

Product Standards referenced in British Standards or Eurocodes

Doc No.	Title	
BS EN 206:2013+A1:2016	Concrete – Specification, performance, production and conformity	+A1:2016
BS EN 1317-1:2010	Road Restraint Systems – Part 1 – Terminology and general criteria for test methods	
BS EN 1317-2:2010	Road Restraint Systems – Part 2 – Performance classes, impact test acceptance criteria and test methods for safety barriers.	
BS EN 1317-3:2010	Road Restraint Systems – Part 3 – Performance classes, impact test acceptance criteria and test methods for crash cushions.	
DD ENV 1317-4:2002	Road Restraint Systems – Part 4 – Performance classes, impact test acceptance criteria and test methods for terminals and transitions of safety barriers.	*Draft BS EN 1317-4 for public comment published in June 2012*
BS EN 1317-5:2007+A2:2012	Road Restraint Systems – Part 5 - Product requirements and evaluation of conformity for vehicle restraint systems	Incorporating corrigendum August 2012 *Draft prEN 1317-5 for public comment published in December 2013*
BS EN 206:2013	Concrete – Specification, performance, production and conformity	Corrigendum May 2014
BS EN 10080:2005	Steel for the reinforcement of concrete – Weldable reinforcing steel - General	
BS EN 14388:2005	Road traffic noise reducing devices	There is a 2015 version, however the 2015 version is not harmonised.
BS EN 15050:2007 + A1:2012	Precast concrete products – Bridge elements	See BD100 clause 2.18 for additional guidance.

British Standards

Doc No.	Title	
BS 4449:2005+A2:2009	Steel for the reinforcement of concrete	
BS 5896:2012	Specification for high tensile steel wire and strand for the prestressing of concrete	
BS 8002:2015	Code of practice for earth retaining structures	
BS 8004:2015 +A1 2020	Code of practice for foundations	Amendment +A1:2020
BS 8006-1:2010+A1:2016	Code of practice for strengthened/reinforced soils and other fills	

BS 8500-1:2015+A1:2016	Concrete – Complementary British Standard to BS EN 206: Method of specifying and guidance for the specifier.	Incorporating Corrigendum No.1
BS 8500-2:2015+A1:2016	Concrete – Complementary British Standard to BS EN 206: Specification for constituent materials and concrete.	Incorporating Corrigendum No.1 and Corrigendum No.2 June 2020 Amendment +A2:2019
BS 8666:2020	Scheduling, dimensioning, bending and cutting of steel reinforcement for concrete	Supersedes BS 8666:2005

The Manual Contract Document for Highway Works (MCHW)

Doc No.	Title	
MCHW Volume 1: March 2020	Specification for Highway Works	*Specification compliant with the execution standards must be used. A Departure is necessary for the parts where a compliant revision has not been published. Amendments March 2020*
MCHW Volume 2: March 2020	Notes for guidance on the Specification for Highway Works	*Notes for guidance compliant with the execution standards must be used. A Departure is necessary for the parts where a compliant revision has not been published. Amendments March 2020*

The Design Manual for Roads and Bridges (DMRB)

DMRB reference	Title	Notes
GG 101 Revision 0	Introduction to the Design Manual for Roads and Bridges	Replaces GD 01/16
GG 102 Revision 0	Quality Management Systems for Highway Design	Replaces GD 02/16
GG 103 Revision 0	Introduction and general requirements for sustainable development and design	
GG 104 Revision 0	Requirements for Safety Risk Assessment	Replaces GD04/12 and IAN 191/16
GG 184	Specification for the use of Computer Aided Design	Replaces IAN 184/16
CG 300 Revision 0	Technical approval of highway structures	Supersedes BD 2/12
CG 302 Revision 0	As-built, operational and maintenance records for highway structures	Supersedes BD 62/07
CG 303 Revision 0	Quality assurance scheme for paints and similar protective coatings	Supersedes BD 35/14
CG 305 Revision 0	Identification marking of highway structures	Supersedes BD 45/93
CG 501 Revision 2	Design of highway drainage systems	Supersedes HD 33/16, TA 80/99
CD 127 Revision 1	Cross-sections and headrooms	Replaces TD 27/05 and TD 70/08
CD 350 Revision 0	The design of highway structures	Supersedes BD 100/16, BA 57/01, BD 57/01 and IAN 124/11

DMRB reference	Title	Notes
CD 351 Revision 0	The design and appearance of highway structures	Supersedes BA 41/98
CD 355 Revision 0	Application of whole-life costs for design and maintenance of highway structures	Replaces BD 36/92 and BA 28/92
CD 358 Revision 1	Waterproofing and surfacing of concrete bridge decks	Replaces BD 47/99, BA 47/99 and IAN 96/07
CD 359 Revision 0	Design requirements for permanent soffit formwork	Supersedes BA 36/90 and IAN 131/11
CD 362 Revision 1	Enclosure of bridges	Replaces BD 67/96 and BA 67/96
CD 364 Revision 0	Formation of continuity joints in bridge decks	Replaces BA 82/00
CD 366 Revision 0	Design criteria for collision protection beams	Replaces BD 65/14
CD 369 Revision 0	Surface protection for concrete highway structures	Replaces BA 85/04
CD 372 Revision 0	Design of post-installed anchors and reinforcing bar connections in concrete	Supersedes IAN 104/15
CD 373 Revision 0	Impregnation of reinforced and prestressed concrete highway structures using hydrophobic pore-lining impregnants	Supersedes BD 43/03
CD 374 Revision 0	The use of recycled aggregates in structural concrete	Supersedes BA 92/07
CD 375 Revision 1	Design of corrugated steel buried structures	Supersedes BD 12/01
CD 377 Revision 3	Requirements for road restraint systems	Supersedes TD 19/06

Interim Advice Notes

Doc No.	Title
IAN 105/08	Implementation of construction (design and management) 2007 and the withdrawal of SD 10 and SD 11

Miscellaneous

Standard reference	Title	Notes
CIRIA C543	Bridge Detailing Guide	
CIRIA C766	Control of cracking caused by restrained deformation in concrete	Supersedes C660
CIRIA C686	Safe Access for Maintenance and Repair	
CIRIA C760	Guidance on embedded retaining wall design	

Project Specific Documents

A303 Amesbury to Berwick Down (Stonehenge). Volume 2 – Scope. Part 2 – Design and Technical Requirements. April 2020. Doc Ref: A303-Proc-PD-009-V2-P2-Design and Technical

Appendix B – Geotechnical Design Report Summary

GEOTECHNICAL ASSESSMENT SHEET			
Project:	A303 Amesbury to Berwick Down	Rev: 1	Calc No: XXXXXX
Structure name:	Foundation of Countess roundabout flyover (East and West structures)		Date: 2021-03-16
Prepared: CRB	Checked: CRP	Reviewed: XX	Job No: XXXXXXXX

Relevant exploratory boreholes:

COUNTESS ROUNDABOUT FLYOVER STRUCTURE (EAST AND WEST STRUCTURES)

Chainage	Relevant boreholes	Ground elevation (m)	Borehole depth (m)
11+710.48 to 11+830.66	21762-R166	+71.25	20m
	21762-R167	+71.07	20m

References:

[1] Jacobs UK Ltd. (2020) A303 Amesbury to Berwick Down - Exploratory Hole Location Plan and Geological Long Section. Drawings HE551506-BGR-GEN-SWMLM00Z-DR-GE-0009 and 0010
[2] A303 Tunnel Ground Model Technical Note HE551506-BGR-HGT-SWGN000Z-RP-Z-0001

[3] pGIR. Preliminary Ground Investigation Report, Oct 2018. HE551506-AMW-HGT-SW_GN_000_Z-RP-CE-0005-P02
[4] 21762_A303 Stonehenge Imp_Ph. 1A Supplementary GI_HG 2003 (merged)
[5] 24822_A303 Countess Roundabout GIR_MM 2010 (merged)

[6] CIRIA C574 Engineering in chalk
[7] Eurocode 7: Geotechnical Design - Part 1: General rules
[8] NA+A1:2014 to BS EN 1997-1:2004+A1:2013_UK National Annex to Eurocode 7: Geotechnical design - Part 1: General rules

Ground model for foundation design:

- Reference borehole for ground model are the two 20m long boreholes R166 and R167, which are very similar
- There are other ground investigation points in the area, but they are mostly trial pits and too shallow, and only serve to check on the thickness of the Made Ground layer
- Design groundwater GW elevation (m) as per 20% Climate change level