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East Sussex County Council

East Sussex County Council
Transport and Environment

Bexhill to Hastings Link Road
S11 Powdermill Valley Underbridge
Approval in Principle

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Project: Bexhill to Hastings Link Road
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	Originated by	Checked by	Reviewed by	Approved by
ORIGINAL	NAME **R Hutt**	NAME **P Blackie**	NAME **P Blackie**	NAME **S Guruparan**
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1. HIGHWAY DETAILS

1.1 Type of highway

Over: Bexhill to Hastings Link Road (BHLR) which is a single carriageway 2-lane rural all purpose road. 12.0m carriageway with 1.2m verge on the north side and 1.2m verge on the south side.
Under: N/A

1.2 Permitted traffic speed

Over: 60 mph
Under: N/A

1.3 Existing restrictions

None.

2. SITE DETAILS

2.1 Obstacles crossed

The bridge crosses Powdermill Valley Stream which flows from north to south. The channel width, measured between the tops of opposing banks is approximately 5.47m at its widest point below the footprint of the structure.

3. PROPOSED STRUCTURE

3.1 Description of structure

The structure is a single span underbridge carrying BHLR over Powdermill Valley Stream. The deck consists of inverted prestressed concrete T-beams with concrete infill. The deck is integral with reinforced concrete abutment walls supported on a piled foundation. The reinforced concrete wingwalls are set perpendicular to the abutment walls.

The parapet stringcourse will be cast in situ reinforced concrete.

The OS grid reference for the structure is 576183E, 110655N.

An environmental noise barrier is attached to the outside of the parapet stringcourse along the north edge of the structure. A separate Category 0 technical approval submission covers the environmental barriers generally although framing and fixings specific to this structure will be designed as part of the bridge structure submission.

3.2 Structural type

The structure is a single span integral bridge designed as a frame-type integral bridge in accordance with BA 42/96. Wingwalls consist of a mixture of short sections cantilevering from the rear of the abutment and free-standing cantilever walls.

3.3 Foundation type

Reinforced CFA concrete piled foundation.

3.4 Span arrangements

Single clear span of 9.5m with zero skew.

3.5 Articulation arrangements

The structure is an integral bridge which does not require deck articulation or movement joints.

BD33/94 Type 2 (Asphaltic plug) joints are proposed at the approach embankment/deck interfaces.

Thermal movement of the bridge deck is resisted by passive earth pressure behind the abutment wall and rotational stiffness of the end supports.

3.6 Types of road restraint systems

The proposed road restraint system requirement has been confirmed by a RRRAP assessment. A metal N2/W4 vehicle parapet 1000mm high with mesh infill will be provided to comply with the requirements of TD19/06.

An environmental noise barrier is fixed behind the parapet system on the north side.

3.7 Proposed arrangements for maintenance and inspection

3.7.1 Traffic management

Close inspection or maintenance of the deck soffit over the waterway and the outer faces of the environmental barrier will require an underbridge unit and hence a single lane closure of the link road will be necessary.

3.7.2 Access

Over the waterway, the deck soffit can be accessed by underbridge unit from the carriageway above (with temporary removal of environmental noise barrier on the north side).

A minimum 2.0 wide clearance to top of bank will be provided in front of the abutments. 1.5m minimum clear headroom is provided from the maintenance platform level to the precast beam soffit.

Inspection and maintenance of the remaining deck soffit, abutments, environmental barrier (inner face) and wing walls can be carried out from ground level using a platform or ladder to reach upper levels.

Foundations will not be visible or accessible for inspection.

3.8.1 Materials and finishes

Concrete	Element	Limiting Exposure Class
C48/60	Prestressed T beams	XD1
C40/50	Infill deck slab	
	Top	XC3
	Cantilever soffit	XD3
	Parapet plinths	XD3
C32/40	Abutment, exposed face below deck	XD1
	Abutment, wingwalls exposed side faces	XD3
	Abutment, wingwalls buried	DC-1
C32/40	CFA Piles	DC-3z. Note A
Note A	ACEC class is AC-3z in natural ground therefore Design Chemical Class for pile design will be DC-3z. Refer to Geotechnical Summary Sheet for detail.	
Reinforcement	All reinforcement to be grade 500B or 500C deformed bars to BS 4449:2005	

Parapets and environmental barrier framing.	Painted (HA Type IV), galvanised steel.
Backfill to abutments and retaining walls	Fill material to structures to be Class 6N or 6P in accordance with DoT Specification for Highway Works.

Concrete Finishes

Deck soffit ie PC beam soffits	F5
Surfaces to receive waterproofing	U4
Top of parapet plinth	U3
Sides of parapet plinth	F3
Abutment	F2
Wingwalls (exposed vertical)	F6 (grooved patterned profile finish)
Buried formed surfaces	F1
Buried unformed surfaces	U1

Protection

The top deck surface will be protected with a proprietary spray applied bridge deck waterproofing system to SHW Cl 2003.

All accessible concrete surfaces greater than 150mm below finished ground level to receive waterproofing to below ground concrete surfaces in accordance with the SHW Cl 2004.

3.8.2 Sustainability issues

Conventional construction materials are proposed, therefore, no significant sustainability issues are foreseen.

3.9 Risks and hazards considered

Standard construction methods are anticipated with normally associated risks and hazards. A design hazard log and risk assessment process is active for the scheme.

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

The relative advantages, disadvantages and costs of various structural forms are discussed and appraised in Owen Williams reports No. 262701/012 'BHLR Structures Options Report'.

3.11 Proposed arrangements for construction

3.11.1 Traffic management

N/A

3.11.2 Service diversions

N/A

3.11.3 Interface with existing structures

N/A

4. DESIGN CRITERIA

4.1 Live loading , Headroom

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

Full HA loading in accordance with BD 37/01

4.1.2 Loading relating to General Order traffic under STGO regulations

37.5 units of HB loading on any one notional lane only in accordance with BD 37/01

4.1.3 Footway or footbridge live loading

Verge loading in accordance with BD 37/01

4.1.4 Loading relating to Special Order Traffic, provision for exceptional abnormal loads or indivisible loads, including location of vehicle track on deck cross-section

N/A

4.1.5 Any special loading not covered above

Approach embankments founded on soft ground will be subjected to advance works surcharging and/or ground treatment eg piled platform, band drains or controlled modulus column installation, in advance of structural piling. Any residual lateral load or negative skin friction effects resulting from approach embankment loadings will be assessed and included in the design loadings for the bridge piled foundations.

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

N/A

4.1.7 Minimum headroom provided

The minimum headroom below bridge beams and concrete infill shall not be less than 1.5m after allowing for deflections arising from dead load, live load and settlement.

In addition, the soffit level of the deck shall be at a level greater than or equal to the 100 year flood level +20% flood flow plus 600mm freeboard.

4.1.8 Authorities consulted and any special conditions required

Authority Consulted	Special Requirement
1: British Telecom	1x90mm PVC duct required over structure.
2: EDF Energy	1x150mm duct required over structure.
3: ESCC Planning	Planning Condition number 5. Bridge abutments are to be set back 2m from top of waterway channel banks to facilitate green corridor and soft bank solution.
4. ESCC	1.5m minimum maintenance headroom to underside of structure.
5. Environment Agency	600mm freeboard to be provided above water level during 100yr return period

flood + 20% flood flow.

4.2 List of relevant documents from the TAS

See Appendix A

4.2.1 Additional relevant standards

BS 8500; Part 1; 2006	Concrete; Complementary British Standard to BS EN 206-1; Method of specifying and guidance for the specifier
BS 8500; Part 2; 2006	Concrete; Complementary British Standard to BS EN 206-1; Specification for constituent materials and concrete
CHE Memorandum 227/08	The Impregnation of Reinforced and Prestressed Concrete Highway Structures Using Hydrophobic Pore Lining Impregnants

4.3 Proposed Departures from Standards given in 4.2 and 4.2.1

None

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

N/A

5. STRUCTURAL ANALYSIS

5.1 Methods of analysis proposed for superstructure, substructure and foundations

The structure will be analysed in accordance with the recommendations given in PCA publication 'Integral abutments for prestressed beam bridges' by B.A Nicholson.

For the construction phase, the distribution of bending moments and shear forces in the deck will be determined by use of a simply supported line beam analysis.

For in service effects the deck analysis will be split into two stages. Firstly a grillage analysis will be undertaken assuming pinned supports at the abutments. The analysis will determine the maximum sagging moments in the deck, shear force distribution and vertical reactions. Transverse thermal and shrinkage effects will be considered in the design and appropriate measures taken to allow for these effects.

Secondly, a portal frame analysis of the deck and abutment stem walls will be undertaken, making allowance for the deck being monolithic with its supports and modelling soil structure interaction. The analysis will make allowance for the restraint to shrinkage and creep due to continuity over the supports. The analysis will return the maximum hogging moments in the deck and evaluate the rotation to be applied to the pile heads in the piled foundation design.

Load effects envelopes will be determined for the prestressed concrete beams which will be designed to Class 1 and Class 2 conditions.

Abutment stem walls will be designed for load effects determined from the portal frame analysis.

Retaining walls will be analysed by hand calculation.

Piled foundations will be analysed using appropriate industry standard software, considering a single representative pile and taking account of soil structure interaction effects including the lateral movements and rotational effects induced by deck load effects. Pile spacing is such that pile group effects are not considered to be appropriate.

Additional lateral loading on piles arising from potential approach embankment settlement will be analysed and added to pile loads arising from the deck and abutment analyses.

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

Refer to Appendix D for diagram of idealised structure(s).

5.3 Assumptions intended for calculation of structural element stiffness

Element stiffness for concrete members will be determined in accordance with BS5400; Part 4; 1990; Clause 4.4 using full elastic uncracked member cross sections ignoring the presence of reinforcement.

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

Earth pressure coefficients used in the calculation of lateral earth pressures at the rear of a full-height frame integral abutment will be calculated in accordance with the requirements and recommendations contained in BA 42/96 'The Design of Integral Bridges'. The earth pressure coefficients used in the calculation of the 'K*' and 'at rest' earth pressures at the rear of the abutment shall be based on upper bound 6N granular backfill properties of density = 22kN/m^3, maximum ø' = 45°, K_o = 0.6 and Kp = 12.6 when considering adverse effects.

The earth pressure coefficients used in the calculation of the earth pressures at the rear of the cantilever wingwalls will be based on the guidance presented in "Integral Abutments for Prestressed Beam Bridges" by BA Nicholson 1998.

For the analysis of the free standing earth retaining wingwalls a representative peak angle of friction of 35° will be used, for which k_a = 0.27; k_p = 3.69 and k_0 = 0.43 (calculated in accordance with BD 30/87). k_a will be used for stability calculations and k_0 for structural element design.

6. GEOTECHNICAL CONDITIONS

6.1 Acceptance of recommendations of Section 8 of the Geotechnical Report to be used in the design and reasons for any proposed changes.

Section 2 of the Geotechnical Report has not been completed at this stage.

6.2 Geotechnical Report Highway Structure Summary Information (Form C)

A draft Geotechnical Report Highway Structure Summary sheet based on the information available in Part 1 of the Geotechnical Report is attached in Appendix C. A full Geotechnical Report Highway Structure Summary sheet and extracts from the completed Geotechnical Report Section 2 will be produced following development of the Geotechnical Report.

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

The structure is founded on piles extending to the Ashdown Formation. A maximum differential settlement of 10mm between abutments will be considered.

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.

The preliminary choice of foundation is discussed in the draft Geotechnical Report Highway Structure Summary sheet contained in Appendix C. Part 2 of the Geotechnical Report, including Section 2 Highway Structures, is expected to be completed in Phase 2 of the project.

7. CHECKING

7.1 Proposed category of structure

Category 2 in accordance with BD2/05

7.2 If Category 3, name of proposed Independent checkers.

N/A

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.

N/A

8. DRAWINGS AND DOCUMENTS

8.1 List of drawings and documents accompanying the submission.

Appendix A	List of relevant documents from TAS dated February 2009	
Appendix B	Drawing No B1297000-PH2/1600.06a/9111	Title S11 Powdermill Valley Underbridge AIP General Arrangement
Appendix C	Geotechnical Information	Draft Geotechnical Report Highway Structure Summary Sheet.
Appendix D	Idealised Structure	

9 THE ABOVE IS SUBMITTED FOR ACCEPTANCE

9.1 Submission by designer

Signed 

Name: P Blackie
Position: Structures team leader, Jacobs
Engineering Qualifications: BEng (Hons), CEng MICE

Date 24/08/12

9.2 Endorsement by contractor

Signed

Name: .....

Engineering Qualifications:.....

Position:....., Hochtief Vinci Joint Venture

Date:

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

Reviewed .....

Name:.....

Engineering qualifications.....

Date: .....

Signed .....

Name:.....
TAA
Engineering qualifications.....

Date: .....

Appendix A List of Relevant Documents

Schedule of Design Documents Relating to Highway Bridges and Structures; February 2009

British Standards

~~BS 5268; Part 2; 2002~~	~~Structural Use of Timber~~
BS 5400	Steel concrete and composite bridges
Part 1; 1988	General Statement (see BD 1)
Part 2; 1978	Specification for loads (see BD 1)
~~Part 3; 2000~~	~~CP for design of steel bridges (see BD 1)~~
Part 4; 1990	CP for design of concrete bridges (see BD 2)
~~Part 5; 1979~~	~~CP for design of composite bridges (see BD 16)~~
~~Part 9; 1983~~	~~Bridge bearings (see BD 20)~~
~~Part 10; 1980~~	~~CP for fatigue (see BD 9)~~
~~BS 5628; Part 1; 1992~~	~~Unreinforced Masonry~~
BS 5930; 1999	Site Investigations
BS 6031; 1981	Earthworks
BS 8002; 1994	Earth retaining structures
BS 8004; 1986	Foundations
~~BS 8118; 1991~~	~~The structural use of aluminium~~
BS EN 1317-1-1998; Road Restraint Systems – Part 1	Terminology and general criteria for test methods
BS EN 1317-2-1998; Road Restraint Systems – Part 2	Performance classes, impact test acceptance criteria and test methods for safety barriers
~~BS EN 1317-3-2000; 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	Terminals and transitions
~~BS EN 14388; 2005~~	~~Road traffic noise reducing devices - Specification~~

Miscellaneous

~~Circular Roads No 61/72 - Routes for heavy and high abnormal loads.~~

~~Railway Group Approved Code of Practice GC/RC5510: Recommendations for the Design of Bridges (2000) (for full list of other Network Rail Standards, refer to RSSB, Railway Safety and Standards Board)~~

~~Simplified Tables of External Loads on Buried Pipelines (1986)~~

~~Traffic Management Act 2004~~

The Manual of Contract Documents for Highway Works (MCDHW)

Volume 1:Specification for Highway Works 1998, including amendments to November 2007

Volume 2: Notes for Guidance on the Specification for Highway Works 1998, including amendments to November 2007

Volume 3: Highway Construction Details 1991, including amendments to May 2007

The Design Manual for Roads and Bridges (DMRB)

Bridges and Structures (BA Series)	*Reproduced on following pages*
Bridges and Structures (BD Series)	*Reproduced on following pages*
Bridges and Structures, Technical Memoranda (BE Series)	*Reproduced on following pages*

Traffic Engineering and Control, Standards (TD Series)

TD 9/93	Road layout and geometry. Highway link design
TD 19/06	Requirement of Road Restraint Systems & correction No. 1
TD 27/05	Cross Sections and headroom
~~TD 36/93~~	~~Subways for pedestrians and cyclists, layout and dimensions~~

Highways, Advice Notes (HA Series)

~~HA 59/92~~	~~Mitigating Against Effects on Badgers~~
HA 65/94	Design Guide for Environmental Barriers
HA 66/95	Environmental barriers Technical Requirements
~~HA 80/99~~	~~Nature Conservation Advice in Relation to Bats~~
~~HA 84/01 (1)~~	~~Nature Conservation and Biodiversity~~
~~HA 97/01~~	~~Nature Conservation Management Advice in Relation to Dormice~~
~~HA 98/01~~	~~Nature Conservation Management Advice in Relation to Amphibians~~

Highways, Standards (HD Series)

HD 22/08	Managing Geotechnical Risk

ADVICE NOTES - BRIDGES AND STRUCTURES (BA SERIES)

~~BA 9/81~~	~~The Use of BS 5400: Part 10: 1980. Code of Practice for Fatigue Amendment No. 1~~
~~BA 16/97~~	~~The Assessment of Highway Bridges and Structures. Amendment No. 1 Amendment No.2~~
~~BA 19/85~~	~~The Use of BS 5400: Part 3: 1982~~
BA 24/87	Early Thermal Cracking of Concrete Amendment No. 1
BA 26/94	Expansion Joints for Use in Highway Bridge Decks
BA 28/92	Evaluation of Maintenance Costs in Comparing Alternative Designs for Highway Structures
~~BA 30/94~~	~~Strengthening of Concrete Highway Structures Using Externally Bonded Plates~~
~~BA 34/90~~	~~Technical Requirements for the Assessment and Strengthening Programme for Highway Structures~~
~~BA 35/90~~	~~Inspection and Repair of Concrete Highway Structures~~
~~BA 36/90~~	~~The Use of Permanent Formwork~~
~~BA 37/92~~	~~Priority Ranking of Existing Parapets~~
~~BA 38/93~~	~~Assessment of the Fatigue Life of Corroded or Damaged Reinforcing Bars~~
~~BA 39/93~~	~~Assessment of Reinforced Concrete Half-joints~~
~~BA 40/93~~	~~Tack Welding of Reinforcing Bars~~
BA 41/98	The Design and Appearance of Bridges
BA 42/96	The Design of Integral Bridges [Incorporating Amendment No. 1 dated May 2003]
~~BA 43/94~~	~~Strengthening, Repair and Monitoring of Post- tensioned Concrete Bridge Decks~~
~~BA 44/96~~	~~Assessment of Concrete Highway Bridge and Structures~~
BA 47/99	Waterproofing and Surfacing Concrete Bridge Decks
~~BA 50/93~~	~~Post-tensioned Concrete Bridges: Planning, Organisation and Methods for Carrying Out Special Inspections~~
~~BA 51/95~~	~~The Assessment of Concrete Structures Affected by Steel Corrosion~~
~~BA 52/94~~	~~The Assessment of Concrete Highway Structures Affected by Alkali Silica Reaction~~
~~BA 53/94~~	~~Bracing Systems and the Use of U-Frames in Steel Highway Bridges~~
~~BA 54/94~~	~~Load Testing for Bridge Assessment~~
~~BA 55/06~~	~~The Assessment of Bridge Substructures and Foundations, Retaining Walls and Buried Structures~~
~~BA 56/96~~	~~The Assessment of Steel Highway Bridges and Structures~~
BA 57/01	Design for Durability
~~BA 58/94~~	~~Design of Bridges and Concrete Structures with External Unbonded Prestressing~~
BA 59/94	Design of Highway Bridges for Hydraulic Action
~~BA 61/96~~	~~The Assessment of Composite Highway Bridges~~
~~BA 67/96~~	~~Enclosure of Bridges~~
~~BA 68/97~~	~~Crib Retaining Walls~~
~~BA 72/03~~	~~Maintenance of Road Tunnels~~

ADVICE NOTES - BRIDGES AND STRUCTURES (BA SERIES)

~~BA 74/06~~	~~Assessment of Scour at Highway Bridges~~
~~BA 80/99~~	~~Use of Rock Bolts~~
~~BA 82/00~~	~~Formation of Continuity Joints in Bridge Decks~~
~~BA 83/02~~	~~Cathodic Protection for Use in Reinforced Concrete Highway Structures~~
BA 84/02	Use of Stainless Steel Reinforcement in Highway Structures
BA 85/04	Coatings for Concrete Highway Structures & Ancillary Structures
~~BA 86//06~~	~~Advice Notes on the Non-Destructive Testing of Highway Structures~~
~~BA 87//04~~	~~Management of Corrugated Steel Buried Structures~~
~~BA 88//04~~	~~Management of Buried Concrete Box Structures~~
BA 92/07	The Use of Recycled Concrete Aggregates in Structural Concrete
~~BA 93/09~~	~~Structural Assessment of Bridges with Deck Hinges~~

STANDARDS - BRIDGES AND STRUCTURES (BD SERIES)

BD 2/05	Technical Approval of Highway Structures
~~BD 7/01~~	~~Weathering Steel for Highway Structures~~
~~BD 9/81~~	~~Implementation of BS 5400: Part 10: 1980. Code of Practice for Fatigue~~
~~BD 10/97~~	~~Design of Highway Structures in Areas of Mining Subsidence~~
~~BD 12/01~~	~~Design of Corrugated Steel Buried Structures with Spans Greater than 0.9 Metres and up to 8.0 Metres~~
~~BD 13/06~~	~~Design of Steel Bridges. Use of BS 5400: Part 3: 2000~~
BD 15/92	General Principles for the Design and Construction of Bridges. Use of BS 5400: Part 1: 1988
~~BD 16/82~~	~~Design of Composite Bridges. Use of BS 5400: Part 5: I979 Amendment No. 1~~
~~BD 20/92~~	~~Bridge Bearings. Use of BS 5400: Part 9: 1983~~
~~BD 21/01~~	~~The Assessment of Highway Bridges and Structures~~
BD 24/92	Design of Concrete Bridges. Use of BS 5400: Part 4: I990
~~BD 27/86~~	~~Materials for the Repair of Concrete Highway Structures~~
BD 28/87	Early Thermal Cracking of Concrete Amendment No. 1
~~BD 29/04~~	~~Design Criteria for Footbridges~~
BD 30/87	Backfilled Retaining Walls and Bridge Abutments
~~BD 31/01~~	~~The Design of Buried Concrete Box and Portal Frame Structures~~
BD 33/94	Expansion Joints for Use in Highway Bridge Decks
~~BD 34/90~~	~~Technical Requirements for the Assessment and Strengthening Programme for Highway Structures~~
~~BD 35/06~~	~~Quality Assurance Scheme for Paints and Similar Protective Coatings~~
BD 36/92	Evaluation of Maintenance Costs in Comparing Alternative Designs for Highway Structures
BD 37/01	Loads for Highway Bridges

STANDARDS - BRIDGES AND STRUCTURES (BD SERIES)

~~BD 41/97~~	~~Reinforced Clay Brickwork Retaining Walls of Pocket Type and Grouted Cavity type Construction Use of BS 5628: Part 2: 1995~~
~~BD 42/00~~	~~Design of Embedded Retaining Walls and Bridge Abutments~~
~~BD 43/03~~	~~The Impregnation of Reinforced and Prestressed Concrete Highway Structures using Hydrophobic Pore Lining Impregnants~~
~~BD 44/95~~	~~The Assessment of Concrete Highway Bridges and Structures~~
BD 45/93	Identification Marking of Highway Structures
~~BD 46/92~~	~~Technical Requirements for the Assessment and Strengthening Programme for Highway Structures [Stage 2 - Modern Short Span Bridges]~~
BD 47/99	Waterproofing and Surfacing of Concrete Bridge Decks
~~BD 48/93~~	~~The Assessment and Strengthening of Highway Bridge Supports~~
~~BD 49/01~~	~~Design Rules for Aerodynamic Effects on Bridges~~
~~BD 50/92~~	~~Technical Requirements for the Assessment and Strengthening Programme for Highway Structures Stage 3 – Long Span Bridges~~
~~BD 51/98~~	~~Portal and Cantilever Signs/Signal Gantries~~
~~BD 53/95~~	~~Inspection and Records for Road Tunnels~~
~~BD 54/93~~	~~Post-tensioned Concrete Bridges, Prioritisation of Special Inspections~~
~~BD 56/96~~	~~The Assessment of Steel Highway Bridges and Structures~~
BD 57/01	Design for Durability
~~BD 58/94~~	~~The Design of Concrete Highway Bridges and Structures with External and Unbonded Prestressing Design of Highway Bridges for Vehicle Collision Loads~~
~~BD 60/04~~	~~Design of Highway Bridges for Vehicle Collision Loads~~
~~BD 61/96~~	~~The Assessment of Composite Highway Bridges~~
BD 62/07	As Built, Operational and Maintenance Records for Highway Structures
BD 63/07	Inspection of Highway Structures
~~BD 65/97~~	~~Design Criteria for Collision Protector Beams~~
~~BD 67/96~~	~~Enclosure of Bridges~~
~~BD 68/97~~	~~Crib Retaining Walls~~
~~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)~~
BD 74/00	Foundations
~~BD 78/99~~	~~Design of Road Tunnels~~
~~BD 79/06~~	~~The Management of sub Standard Highway Structures~~
~~BD 81/02~~	~~Use of Compressive Membrane Action in Bridge Decks~~
~~BD 82/00~~	~~Design of Buried Rigid Pipes~~
~~BD 84/02~~	~~Strengthening of Concrete Bridge Supports Vehicle Impact Using Fibre Reinforced Polymers~~
~~BD 85/08~~	~~Strengthening Highway Structures Using Externally Bonded Fibre Reinforced Polymer~~
~~BD 86/07~~	~~The Assessment of Highway Bridges and Structures For The Effects of Special Types General Order (STGO) and Special Order (SO) Vehicles~~
~~BD 87/05~~	~~Maintenance Painting of Steelwork~~

STANDARDS - BRIDGES AND STRUCTURES (BD SERIES)

~~BD 89/03~~	~~The Conservation of Highway Structures~~
~~BD 90/05~~	~~Design of FRP Bridges and Highway Structures~~
~~BD 91/04~~	~~Unreinforced Masonry Arch Bridges~~
~~BD 94/07~~	~~Design of Minor Structures~~
~~BD 95/07~~	~~Treatment of Existing Structures on Highway widening Schemes~~

TECHNICAL MEMORANDA - BRIDGES (BE SERIES)

~~BE 13~~	~~Fatigue Risk in Bailey Bridges~~
~~BE 23~~	~~Shear Key Decks Amendment No. 1 to Annex~~
~~BE 5/75~~	~~Rules for the Design and Use of Freyssinet Concrete Hinges in Highway Structures~~
~~BE 7/04~~	~~Departmental Standard (Interim) Motorway Sign/Signal Gantries~~

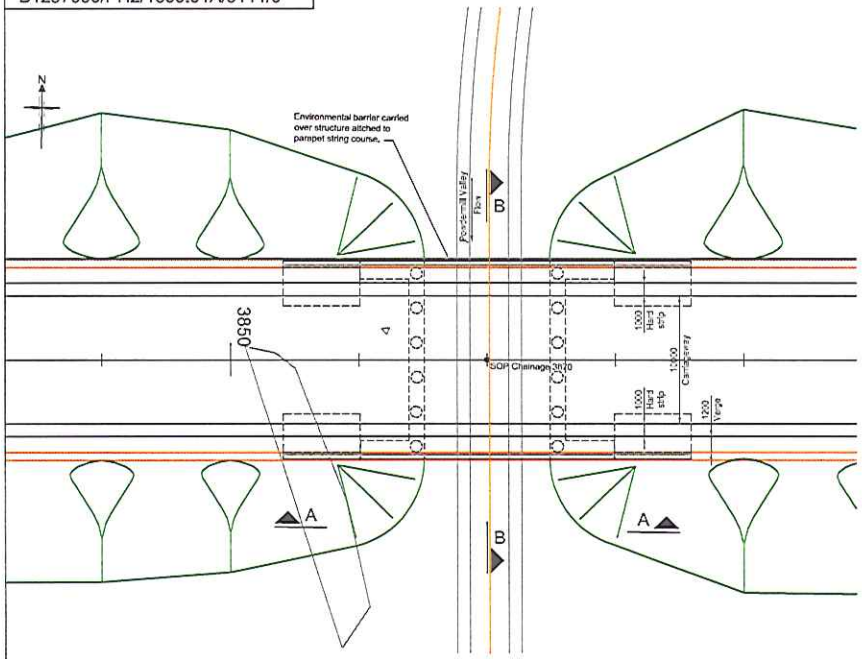
INTERIM ADVICE NOTES (IAN)

~~IAN 117/08 Rev 1~~	~~Certification of combined kerb and drainage products~~
~~IAN 116/08~~	~~Nature conservation advice in relation to bats~~
~~IAN 104/07~~	~~The Anchorage of Reinforcement and Fixings in Hardened Concrete~~
~~IAN 97/07~~	~~Assessment and upgrading of existing parapets~~
IAN 96/07r1	Guidance on implementing Results of Research on Bridge Deck Waterproofing
IAN 95/07	Revised Guidance Regarding the Use of BS8500(2006) For the Design and Construction of Structures Using Concrete
~~IAN 91/07~~	~~Interim Advice on the identification of "Particularly at Risk" supports~~
IAN 70/06	Implementation of New Reinforcement Standards
IAN 69/05	Design for Maintenance
IAN 48/03	Measures To Minimise The Risk of Sulphate Attack (Including Thaumasite) - New Construction and Structures Under Construction
~~IAN 47/02~~	~~Post Tensioned Grouted Duct concrete Bridges~~
IAN 41/02	European Cement Standards
IAN 05/96	BD 24/92 The Design of Concrete Highway Bridges and Structures. Use of BS 5400: Part 4:1990
~~IAN 04/96~~	~~BD 44/95 The Assessment of Concrete Highway Bridges and Structures~~
~~IAN 03/96~~	~~BA 50/93 Post Tensioned concrete Bridges~~

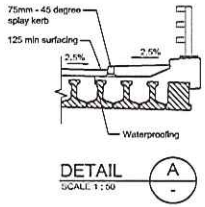
Appendix B Drawings

Drawing No	Title
B1297000-PH2/1600.06a/9111	S11 Powdermill Valley Underbridge AIP General Arrangement

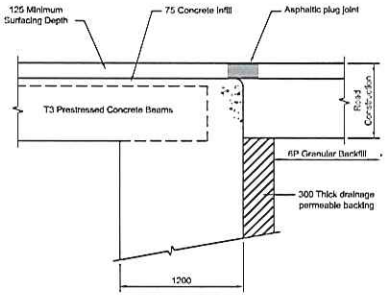
Drawing number / Rev
B1297000/PH2/1600.01A/9111/0



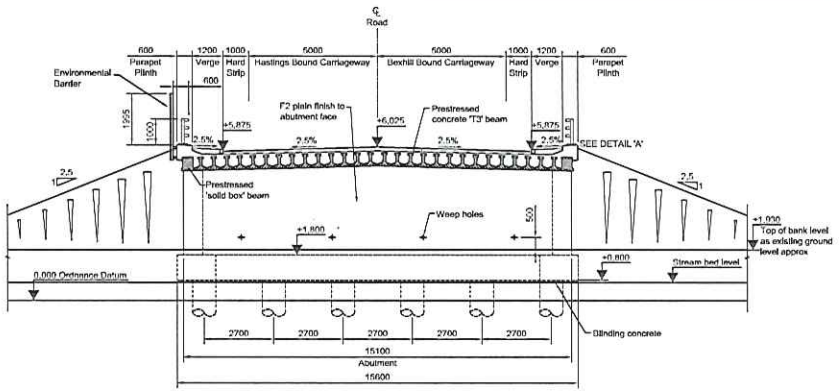
PLAN
SCALE 1 : 200



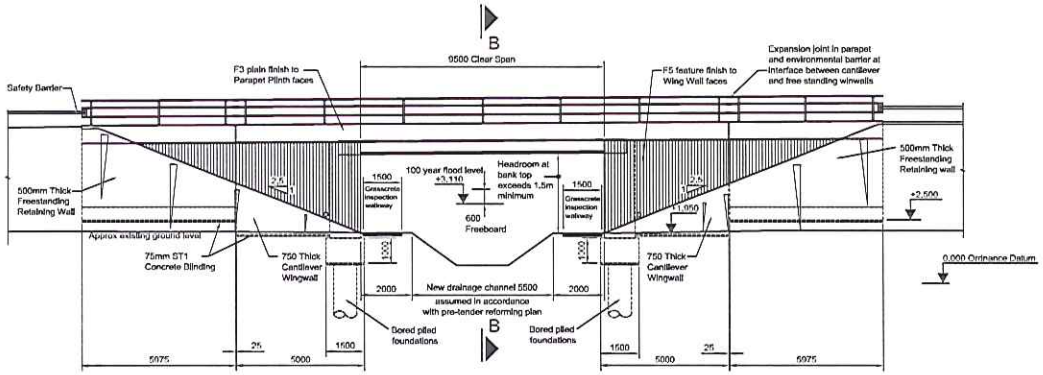
DETAIL A
SCALE 1 : 50



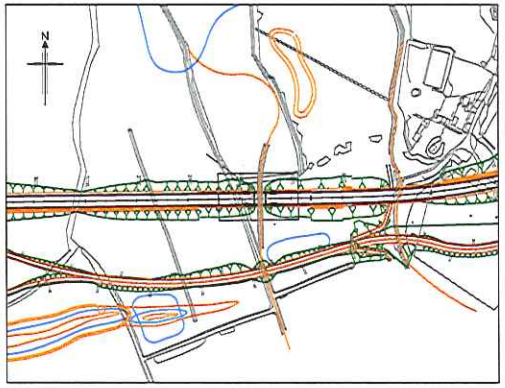
FULLY INTEGRATED ABUTMENT DECK CONNECTION
SCALE 1 : 25



SECTION B
SCALE 1 : 100



ELEVATION A
SCALE 1 : 100



LOCATION PLAN
SCALE 1 : 2500

Notes

1. All dimensions in millimetres unless noted otherwise.
2. All levels in metres above Ordnance Datum - Newlyn.
3. Do not scale from this drawing.
4. Backfill to be 6N or 6P.
5. All external arrises to have 25 x 25mm chamfers.
6. Gulleys shall be provided in the roadside channels immediately to the east (uphill) side of the bridge to minimise the flow of surface water across the pavement / abutment interface.
7. Approach embankments constructed in advance of bridge works. Ground treatment below approach embankments to limit differential settlement where necessary.
8. Both abutments to be backfilled simultaneously with a level difference not exceeding 0.5m.
9. All section thicknesses are approximate and subject to change at detailed design stage.

0 0.5 1.0 1.5 2.0 2.5 m
SCALE 1 : 25
0 1 2 3 4 5 m
SCALE 1 : 50
0 1 2 3 4 5 6 7 8 9 10 m
SCALE 1 : 100
0 5 10 15 20 m
SCALE 1 : 200
0 50 100 150 200 250 m
SCALE 1 : 2500

Rev	Rev. Date	Purpose of revision	Drawn	Checkd	Revd	Apprvd
0	24/08/12	FOR AIP	HN	PB	PB	SG

JACOBS
Sinclair House, 6 Cherry Orchard Road, Croydon, CR0 6BF
Tel:+44(0)208 686 8212 Fax:+44(0)208 681 2400
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Client: HOCHTIEF/VINCI JOINT VENTURE
Employer: EAST SUSSEX COUNTY COUNCIL
Project:

Drawing title: POWDERMILL VALLEY UNDERBRIDGE GENERAL ARRANGEMENT OPTION 2

Drawing status: FOR INITIAL COMMENT

Scale	AS SHOWN @ A1	DO NOT SCALE
Jacobs No.	B1297000	
Client no.		

Drawing number: B1297000-PH2/1600.01A/9111 Rev 0

Appendix C Geotechnical Information

BEXHILL TO HASTINGS LINK ROAD

GEOTECHICAL SUMMARY INFORMATION

STRUCTURE NAME S11 - Powderrmill Valley Underbridge	**CHAINAGE and OS Grid Reference** Ch 3860 OS: 576183E, 110655N
Rev: 3	**DESIGN LIFE:** 120 years
SOILS/GEOLOGY	**RELEVANT EXPLORATORY HOLES:** BH15, TP66 (May Gurney, 2006) BH143 (URS Investigation, 2009)
Strata	**Typical depths**
Alluvium Ashdown Formation	1.84 to -8.36 m OD below -8.36 m OD
PREVIOUS GROUND HISTORY	Agricultural land and floodplain
CONTAMINATED GROUND RISK ASSESSMENT REQUIRED	No

GROUNDWATER

In BH15 groundwater was encountered, within the Alluvium layer, initially at 0.74m OD (1.10m bgl) and rose to 0.84m OD (1m bgl). A second groundwater strike was encountered at the top of Ashdown Formation at -8.36m OD (10.2m bgl). This rose to 1.74m OD (0.1m bgl) in 20 minutes. This behaviour indicated presence of a confined acquifer under pressure. Monitoring results from March 2010 show groundwater level at 1.83m bgl.

Two groundwater strikes were recorded in BH143. The first strike was at 1.58m OD (0.50m bgl) within the Alluvium layer. The second strike was at -8.42m OD (10.50m bgl) and rose to 0.84m OD (0.5m bgl – BH 143) in 20 minutes. This strike was just beneath the top of Ashdown Formation. The behaviour of the groundwater rise indicates presence of a confined acquifer under pressure.

The preliminary design groundwater level is taken at the ground level.

EARTH PRESSURE VALUE K_0* K_a* Kp*

Refer to Section 5.4 of AIP.

TYPE OF FOUNDATION	Pile foundation

BEARING CAPACITY				
Structure Element	Founding Stratum	Founding Level (m OD)	Footing Size	Allowable Bearing Pressure (kN/m2)

PILE DESIGN					
Structure Element	Founding Stratum	Toe Level (m OD)	Pile dia (m)	Pile length (m)	Pile working Load (kN)
East and West abutment	Ashdown Formation	-21.2	0.9	22	1350kN

Note: Pile lengths and toe levels are approximate.

Pile type: Bored/CFA

Criteria for selecting pile toe level: Pile capacity`

Allowance for negative skin friction within design: Yes

SETTLEMENT

Differential settlement to be allowed for between adjacent supports: TBC

Differential settlement to be allowed between structure and approach embankment: 20mm (within 10 metres of the interface between structures and approach embankments)

CHEMICAL ANALYSIS

Buried Concrete classification:

The results of chemical tests on soil samples taken within the rural areas indicate pH values ranging between 3.8 to 9.4 and sulfates (2:1 Water Extract) values of between 10 to 900mg/l. The recommended Design Sulfate and Concrete Classification based on BRE Special Digest 1 (2005) are DS-2 and AC-3z respectively.

NOTES	

1. The ground sequence at the site is Top Soil/Alluvium and Ashdown Formation. The available information from boreholes indicates Ashdown Formation layer at 9.9m bgl to 10.50m bgl

2. The maximum thickness of Alluvium is approximately 10.20m. The low shear strength of the Alluvium prevents the use of these layers as a bearing stratum due to the risk of excessive settlements and failure. The structural load will need to be transferred to the competent stiff to very stiff /very weak to weak interbedded Ashdown Formation. Thus, pile foundations are recommended.

3. Groundwater behaviour indicates presence of confined aquifer. This factor should be considered during construction

Contract No: 49325727

Project: Bexhill - Hastings Link Road

Client: East Sussex County Council

URS

Record of Borehole

BH143

SAMPLES & In situ TESTS			Water	STRATA				
Depth	Type/ No.	SPT/U4 (Blows)		Reduced Level (mOD)	Legend	Depth (Thick-ness)	DESCRIPTION	Instru-ment/ Backfill
0.10	CS1 D1			1.78		0.30	Firm light brown silt clay TOPSOIL. Fine rootlets.	
0.50	CS2 D2		1	1.18		0.90	Firm light brown and light grey mottled orange-brown slightly silty CLAY. Rare fine rootlets. (Zone V) (ALLUVIUM)	
1.00	B3 CS3 P4			0.58		1.50	Firm light grey and orange-brown mottled orange-brown CLAY. (Zone V) (ALLUVIUM)	
			2				Soft brown organic rich clayey SILT. Organic material is spongy and amorphous to pseudo-fibrous. Rapid oxidation of silt and wood remains to very dark brown-black. (Zone V) (ALLUVIUM)	
2.50	VANE5 D6							
3.00	P7							
4.00	D8						At 4.0m bgl soft to firm brown slightly silty organic material/PEAT (good sample base of piston). Organic material is spongy and amorphous to pseudo-fibrous. Rapid oxidation of silt and wood remains to very dark brown-black.	
4.50	VANE9 D10							
5.00	D11 VANE12			-3.32		5.40	At 5.0m bgl organic rich SILT. Recovery of fine to coarse dark brown-black slightly silty gravel and cobble mixed fragments of wood. Organic material is pseudo-fibrous to fibrous. Fresh wood surfaces rapidly oxidise to dark brown-black. At 5.4m bgl pseudo-fibrous to fibrous wood recovered >150mm (cut in U100 shoe), possible large branch or trunk.	
5.50	D13						Soft to firm green-grey slightly clayey SILT. (Zone V) (ALLUVIUM)	
6.00	P14 B15							
7.00	D17a							
7.50	VANE16							

Boring Progress and Water Observations

Date	Time	Hole Depth	Cas'g Depth	Cas'g Dia	Water Depth	Rose to	Time (mins)	Sealed (m)
25/02/09	00.00	5.50	5.50	150	0.50			

Chiselling

From	To	Time (hh:mm)

Water Added

From	To

GENERAL REMARKS

Draft
During logging no visible or olfactory evidence of contamination. Zone of weathering interpreted from from Spinks et al. 1993: (V); (IV); (III); (II); (I).

Logged by: JB	Equipment: Cable Percussion Rig - Dando 2000	Location: 576067.5 E 110666.8 N	Ground Level: 2.08 mAOD	Date: 25/02/2009 Start 27/02/2009 End	Scale: 1:40.0
Checked by: CAB	Contractor: Southern Testing Laboratories Ltd				Sheet 1 of 3
Status: Draft					

Contract No: 49325727

Project: Bexhill - Hastings Link Road

Client: East Sussex County Council

URS

Record of Borehole

BH143

SAMPLES & In situ TESTS			Water	STRATA				
Depth	Type/ No.	SPT/U4 (Blows)		Reduced Level (mOD)	Legend	Depth (Thick-ness)	DESCRIPTION	Instru-ment/ Backfill
	P18 D17b							
8.50	D19							
9.00	VANE20 D21						At 9.0m bgl slightly lighter green-grey and slightly sandy SILT. Sand is fine. Oxidising to a grey-brown. (ALLUVIUM)	
				-7.82		9.90		
10.00	D22 U23						Firm grey and dark orange-brown (possibly colour banded) slightly sandy slightly gravelly SILT/CLAY. Sand is fine. Gravel is very weak to weak orange-brown sub-rounded fine to medium siltstone and sandstone. (Zone V) (ASHDOWN BEDS)	
10.50	D24 W27		▼					
				-8.62		10.70		
11.00	SPT25 B26	N=25 (3/3/5/6/6/7)					Stiff yellow-brown slightly sandy slightly clayey GRAVEL. Gravel is weak yellow-brown, orange brown and grey stained dark orange-brown flat subangular to sub-rounded SILTSTONE and weak dark orange-brown sub-rounded SANDSTONE. Sand is fine to coarse. (Zone V) (ASHDOWN BEDS)	
				-9.72		11.80		
12.00	D28 U29						Very stiff laminated brown-grey CLAY. Clay exhibits plasticity. (Zone V to III) (ASHDOWN BEDS)	
12.50	D30							
13.50	B31 U32						At 13.5m bgl very stiff light brown-grey slightly silty slightly gravelly CLAY. Gravel is weak grey subangular to sub-rounded fine to medium siltstone (possible lamination to very thin bed of siltstone).	
14.00	D33 SPT34	N=52 (6/8/9/12/12/17)						
15.00	D35							

Boring Progress and Water Observations

Date	Time	Hole Depth	Cas'g Depth	Cas'g Dia	Water Depth	Rose to	Time (mins)	Sealed (m)

Chiselling

From	To	Time (hh:mm)

Water Added

From	To

GENERAL REMARKS

Draft
During logging no visible or olfactory evidence of contamination. Zone of weathering interpreted from from Spinks et al. 1993: (V); (IV); (III); (II); (I).

Logged by: JB	Equipment: Cable Percussion Rig - Dando 2000	Location: 576067.5 E 110666.8 N	Ground Level: 2.08 mAOD	Date: 25/02/2009 Start 27/02/2009 End	Scale: 1:40.0
Checked by: CAB	Contractor: Southern Testing Laboratories Ltd				Sheet 2 of 3
Status: Draft					

Contract No: 49325727

Project: Bexhill - Hastings Link Road

Client: East Sussex County Council

URS

Record of Borehole

BH143

SAMPLES & In situ TESTS			Water	STRATA				
Depth	Type/ No.	SPT/U4 (Blows)		Reduced Level (mOD)	Legend	Depth (Thick-ness)	DESCRIPTION	Instru-ment/ Backfill
	U36							
15.30	D37							
16.50	D38 U39							
17.00	D40 SPT41	N=86 (6/16/20/22/20/24)					At 17.0m bgl very stiff brown-grey slightly clayey SILT.	
18.00	D42 U43							
18.30	D44						At 18.3m bgl very stiff extremely thinly to thickly laminated green-grey and light grey slightly gravelly clayey SILT. Gravel is strong brown-grey flat subangular medium to coarse siltstone (possible thick lamination of strong siltstone). Light grey laminations are silt partings.	
				-16.92		19.00		
19.00	D45						Very weak thinly to thickly laminated green-grey to light grey MUDSTONE partially weathered to a clay with horizontally aligned lithorelics of very weak green-grey flat angular fine to coarse mudstone. Light grey laminations are silt partings. (Zone III)	
19.50	SPT46	N=>130 (25/20mm/-/40/40/50/60mm/-)				(1.00)	At 19.0m bgl very slightly gravelly. Gravel is strong brown-grey sub-rounded coarse siltstone and weak thinly laminated brown-grey sub-rounded coarse siltstone (possible very thin bed of siltstone). Thin laminations are black lignite. (ASHDOWN BEDS)	
				-17.92		20.00		
20.00	D47						**End of Borehole at 20.00m**	

Boring Progress and Water Observations

Date	Time	Hole Depth	Cas'g Depth	Cas'g Dia	Water Depth	Rose to	Time (mins)	Sealed (m)
26/02/09	00.00	15.30	12.50	150	10.50	2.10	20	12.00
27/02/09	00.00	20.00	12.50	150				

Chiselling

From	To	Time (hh:mm)

Water Added

From	To

GENERAL REMARKS

Draft
During logging no visible or olfactory evidence of contamination. Zone of weathering interpreted from from Spinks et al. 1993: (V); (IV); (III); (II); (I).

Logged by: JB	Equipment: Cable Percussion Rig - Dando 2000	Location: 576067.5 E 110666.8 N	Ground Level: 2.08 mAOD	Date: 25/02/2009 Start 27/02/2009 End	Scale: 1:40.0
Checked by: CAB	Contractor: Southern Testing Laboratories Ltd				Sheet 3 of 3
Status: Draft					

MAY GURNEY

Site	Borehole Number
Bexhill to Hastings Link Road	BH15

Boring Method	Casing Diameter	Ground Level (mOD)	Client	Job Number
Cable Percussion	150mm cased to 20.00m	1.84	East Sussex County Council	SI1085
	Location	**Dates**	**Engineer**	**Sheet**
	576028.548 E 110628.216 N	15/03/2006	Owen Williams	1/3

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	Instr
0.00-0.50	B1				1.74	(0.10)	TOPSOIL. Firm brown slightly gravelly sandy CLAY. Gravel is angular to subrounded fine and medium flint.			
0.30	W1					0.10			▼2	
0.50	D1					(0.70)	Firm mottled orange brown, light brown and light grey sandy CLAY.			
0.80-1.00	B2				1.04	0.80	Soft brown amorphous peaty CLAY with occasional roots and plant debris. Organic odour.		▼1 ▽1	
1.50	D2			Slow(1) at 1.10m, rose to 1.00m in 20 mins, sealed at 6.00m.						
1.50	U1			1 blows						
2.50-2.95	SPT N=1	2.50	2.40	1,0/0,0,0,1						
2.50-2.95	D3									
2.50-3.00	B3					(4.40)				
3.50	D4									
3.50	U2			2 blows						
4.50-4.95	SPT N=2	4.50	4.45	1,0/0,1,0,1						
4.50-4.95	D5									
4.50-5.00	B4									
					-3.36	5.20	Very soft to soft blue grey SILT with bands of brown amorphous peat, roots and wood fragments.			
5.50	U3			2 blows						
5.50	D6					(1.20)				
6.00-6.50	B5									
					-4.56	6.40	Very soft blue, grey and brown sandy CLAY.			
6.50-6.95	SPT N=1	6.50	WET	1,0/0,0,1,0						
6.50-6.95	D7					(1.90)				
7.50	D8									
7.50	U4			2 blows						
8.00-8.50	B6									
					-6.46	8.30	Very soft to soft blue and grey sandy CLAY.			
8.50-8.95	SPT N=2	8.50		1,0/0,1,0,1						
8.50-8.95	D9					(1.90)				
9.50	D10									
9.50	U5			5 blows						

Remarks
Hand excavated pit to 1.20m
50mm diameter standpipe installed with flush cover
PID reading adjacent to BH at 0.30m bgl = 0.5ppm

Scale (approx)	Logged By
1:50	AE/AK

Figure No.
SI1085.BH15

MAY GURNEY

Site	Borehole Number
Bexhill to Hastings Link Road	BH15

Boring Method	Casing Diameter	Ground Level (mOD)	Client	Job Number
Cable Percussion	150mm cased to 20.00m	1.84	East Sussex County Council	SI1085
	Location	**Dates**	**Engineer**	**Sheet**
	576028.548 E 110628.216 N	15/03/2006	Owen Williams	2/3

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	Instr
						(1.90)			▽2	
					-8.36	10.20				
10.20	D11			Very Fast(2) at 10.20m, rose to 0.30m in 20 mins.			Orange and brown sandy clayey angular to subrounded fine to coarse mudstone GRAVEL. With bands of orange clayey gravelly sand.			
10.20-10.50	B7									
10.50-10.95	D12									
10.50-10.95	SPT N=13	10.50	0.30	1,1/2,3,4,4						
11.50-11.95	SPT N=23	11.50	2.00	1,3/5,5,6,7		(2.90)				
11.50-11.95	D13									
12.00-12.50	B8									
12.50-12.95	SPT N=20	12.50	2.20	2,2/4,4,5,7						
12.50-12.95	D14									
					-11.26	13.10				
13.10	D15						Very stiff blue grey CLAY			
13.50	U6			95 blows						
14.00-14.50	B9									
14.50-14.83	SPT 50/175	14.50	3.60	6,18/20,22,8		(3.10)				
14.50	D16									
15.50-15.63	SPT 25*/55 50/70	15.50	6.30	25/50						
15.50-15.95	D17									
					-14.36	16.20				
16.20-16.50	B10						Very stiff pinkish grey CLAY			
16.50	U7			100 blows						
16.50	D18									
17.50-17.95	SPT N=37	17.50	5.30	3,5/8,9,10,10		(2.90)				
18.00-18.50	B11									
18.50	D20									
18.50	U8			100 blows						
					-17.26	19.10				
19.10	D21						Very weak MUDSTONE recovered as a blue grey CLAY.			
19.50	D22									
19.50-17.95	D19 50/115					(1.35)				
20.00-20.19	SPT 25*/75	20.00	9.80	25/29,21						

Remarks

Scale (approx)	Logged By
1:50	AE/AK

Figure No. SI1085.BH15

MAY GURNEY

Site	Borehole Number
Bexhill to Hastings Link Road	BH15

Boring Method	Casing Diameter	Ground Level (mOD)	Client	Job Number
Cable Percussion	150mm cased to 20.00m	1.84	East Sussex County Council	SI1085
	Location	**Dates**	**Engineer**	**Sheet**
	576028.548 E 110628.216 N	15/03/2006	Owen Williams	3/3

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	Instr
20.00 20.00-20.45	D23 D24				-18.61	(1.35) 20.45	Complete at 20.50m			

Remarks

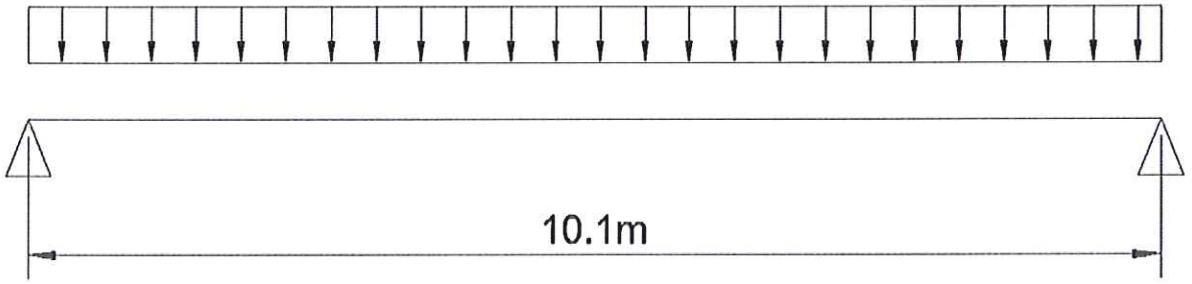
Scale (approx)	Logged By
1:50	AE/AK

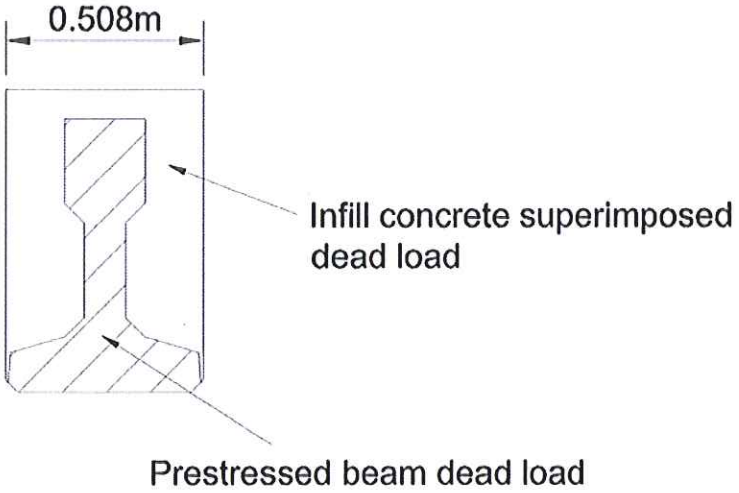
Figure No. SI1085.BH15

Appendix D Idealised Structure

Step 1 Simply supported line beam analysis

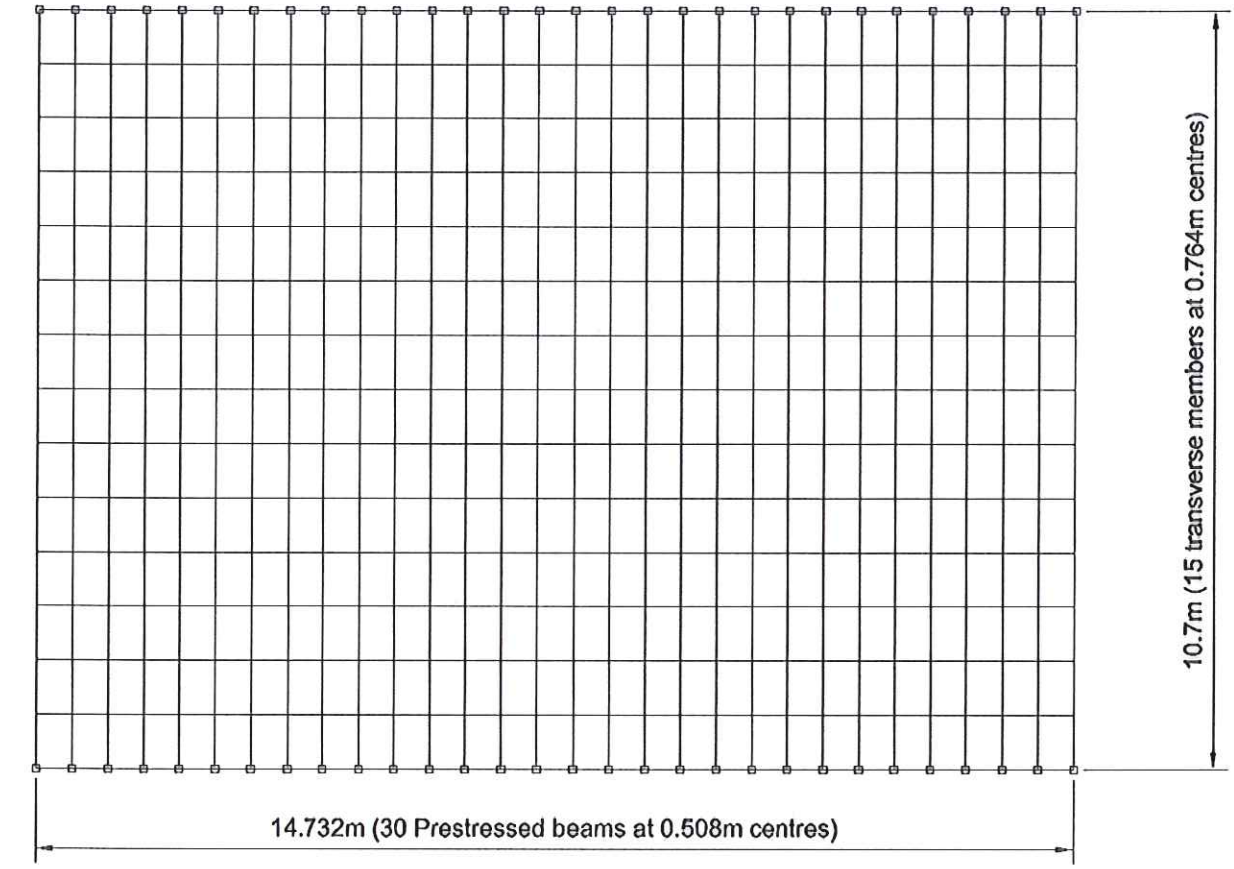
- Determine dead and superimposed dead bending moment and shear force distributions.
- 0.508m width beam

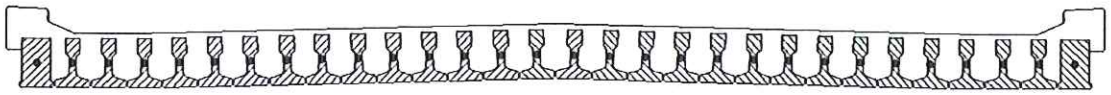




Step 2: Grillage analysis of deck

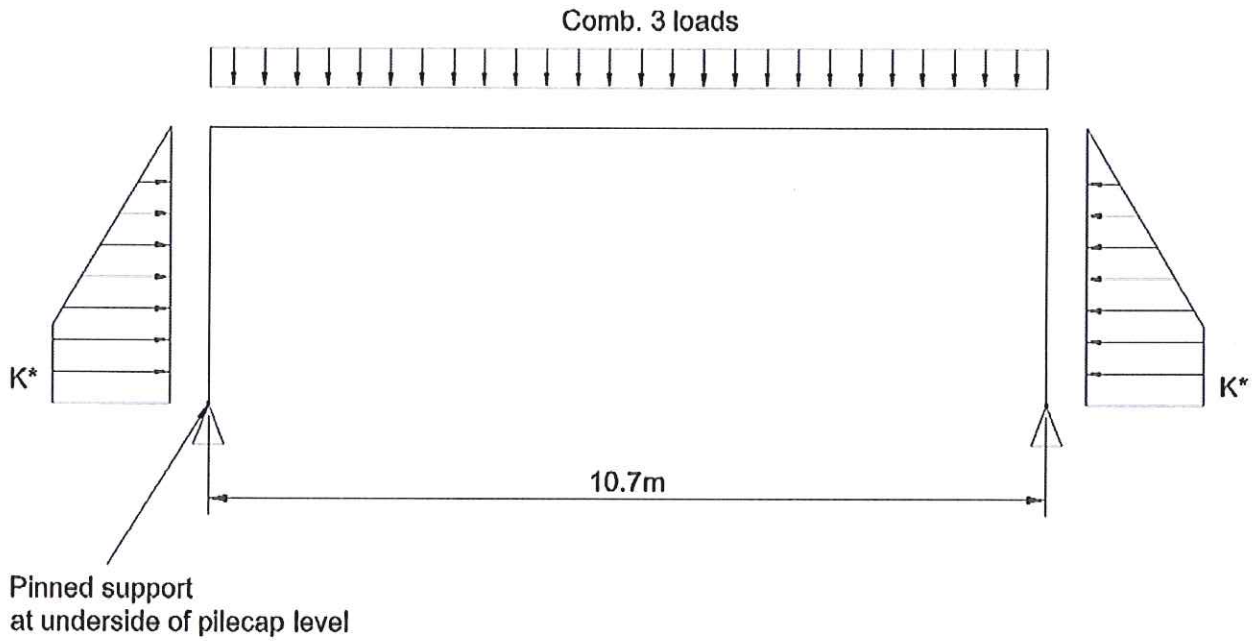
- Determine live loading combinations 1 and 3 maximum sagging moment
- Determine live loading combinations 1 and 3 shear force distributions
- Determine vertical deck design load for piles





Step 3: Soil structure interaction analysis

- 0.508m width of deck
- Apply combination 3 live loads to deck and passive earth pressures to abutments
- Determine hogging moments at beam ends
- Determine bending moments for pile design
- Determine bending moment and shear force distribution in abutment stem walls



Step 4: Pile design

- Abutment movement and rotation applied to pile heads