

PO Box 1720  
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**APPROVAL IN PRINCIPLE FOR DESIGN  
OF**

***Proposed Retaining Wall at Blue hills Farm  
Adjacent to PROW, Birkenshaw.***

**Structure reference:**

**Date:** 19.12.2023

**Revision:** B

**Status:** Final

**Prepared by:** Tom Hogan

**Checked by:** Paul Gill

Information is available in large print, braille,  
audio tape, or PC disk on request

**Scheme title: PROW Retaining Wall, Birkenshaw**  
**Structure title: Proposed Contiguous Piled Wall**

**Struc Ref:**  
**Rev A – 19/12/2023**

## DOCUMENT CONTROL

**Structure title: Proposed PROW Retaining Wall – Contiguous Piled Wall**

**Structure reference:**

**Date: 19/06/2024**

**Revision: B**

**Status: Final**

### Document issue record

Issue	Status	Prepared	Date	Checked	Date	Approved	Date
P1	S2	TH	Dec 23	PG	Dec 23	EE	Dec 23
A	S2	TH	Dec 23	PG	Dec 23	EE	Dec 23
B	S2	TH	Jun 24	PG	Jun 24	EE	Jun 24

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## PROJECT DETAILS

Name of project: Blue Hills Farm, Birkenshaw

Name of Bridge or Structure: Proposed PROW Contiguous Retaining Wall

Structure reference no:

Summary:

This report is the approval in principle submission for a proposed contiguous piled retaining wall which supports a PROW SPE/14/10 on site. The wall itself supports the PROW at high level from residential gardens. The site is located at Blue Hills Farm, Birkenshaw and is located behind plots 65 to 70

## 1. HIGHWAY DETAILS

### 1.1. Type of highway

#### 1.1.1. Location and OS Map / Grid reference

Location:	PROW SPE/14/10
OS Map:	SE210001 27688
Grid Ref (X, Y):	(419913, 427814)

### 1.2. Permitted traffic speed

PROW is for pedestrian access only.

### 1.3. Existing restrictions

None – PROW is an existing unmade footpath

## 2. SITE DETAILS

### 2.1. Obstacles crossed

None

### 3. PROPOSED STRUCTURE

#### 3.1. Description of structure and design working life

The retaining wall is to be a contiguous piled wall consisting of 600 dia piles at 750mm centres. A capping beam is to be cast on top of the piles in order to tie all pile heads together. The retaining wall will be designed and installed by M&D piling and will consist of a 1.8m fence fixed to the capping beam.

The maximum retained height for the wall will be 4.2m retained height located behind plots 65 to 70 and as indicated on drawing numbers 7021 and 7022.

The structure is to be designed to have a design working life of 120 years in accordance with CD 350.

#### 3.2. Structural type

Contiguous piled wall with insitu reinforced concrete capping beam.

#### 3.3. Foundation type

Contiguous piled wall will not have foundation, the piled wall will be free standing and designed as a cantilever. Piled wall to be installed to suitable depth to cantilever and retain the existing ground.

#### 3.4. Span arrangements

Maximum retained height of the structure will be 4.2m and be installed over a length of approximately 58.0m. Wall to cantilever vertically.

#### 3.5. Articulation arrangements

N/A. Construction / movement joints will be used between adjacent sections of capping beam where required to suit a maximum length of capping beam at 30.0m long.

#### 3.6. Classes and levels

##### 3.6.1. Consequence class – BS EN 1990-2002+A1-2005 B3.1

Consequence class to be CC2 medium consequence for loss of human life, economic, social or environmental consequences considerable.

##### 3.6.2. Reliability class – BS EN 1990-2002+A1-2005 B3.2 & B3.3

Reliability class is to be associated with the consequence class detailed in 3.6.1.

Reliability Class RC2

Factors for actions to be used KFI = 1.0

### 3.6.3. Inspection level

Inspection Level 2 – Normal Inspection (inspection in accordance with the procedures of the inspecting organisation)

### 3.7. Road restraint systems requirements

The retaining wall and capping beam will extend to approximately 150mm higher than corresponding existing levels and will act as a small upstand to stop materials falling onto the garden areas below. No vehicular traffic is possible on the top of the wall, once constructed. A 1.8m high timber fence will be installed to the top of the capping beam to provide privacy to the garden areas below.

### 3.8. Proposals for Water Management

A French drain will be installed in front of the wall at low level to catch any water seepage through the contiguous piled wall. The French drain discharges to the property drainage system. To avoid designing the wall for water pressure, perforated weep hole tubes will be pushed horizontally between the piles at 1000mm staggered vertical centres – all detailed by specialists.

### 3.9. Proposed arrangements for future maintenance and inspection.

#### 3.9.1. Traffic management

No traffic management will be required to inspect or maintain the retaining wall.

#### 3.9.2. Arrangements for future maintenance and inspection of structure. Access arrangements to structure.

Future maintenance and inspection is anticipated to be required within the design life of the structure. When maintenance is required, the wall can be inspected from the private dwellings. In order to inspect the rear face of the contiguous wall, temporary works measures would be required to remove backfill material.

The contiguous piled wall and fencing adjacent to the public right of way at the top of the wall, will remain the responsibility of the adjacent householders, to be cited on the property title deeds.

### 3.10. Environment and sustainability

Use of cement replacement materials such as GGBS & PFA can be used providing the specification of DC-2 is adhered to on site.

**3.11. Durability. Materials and finishes**

Item	Material	Finish / Location
Contiguous piles	Reinforced concrete to be C35N/mm <sup>2</sup> in accordance with BS 8500-1 and BS EN 206-1. B500B Steel reinforcement in accordance with BS 4449 and BS EN 10080.	Design sulphate class DC-2 Exposure class, XF1 to BS EN 206-1:2013 for minimum 100 years design working life. Corresponding location on the structure.
Reinforced concrete capping beam	Reinforced concrete to be C35N/mm <sup>2</sup> in accordance with BS 8500-1 and BS EN 206-1. B500B Steel reinforcement in accordance with BS 4449 and BS EN 10080.	Design sulphate class DC-2 Exposure class, XF1 to BS EN 206-1:2013 for minimum 100 years design working life. Corresponding location on the structure.
Masonry facade	Masonry to be facing stonework to match main dwellings on site	Concrete corbel detail required to sit masonry on below ground level in front of the wall.

**3.12. Risks and hazards considered for design, execution, maintenance and demolition. Consultation with and/or agreement from Overseeing Organisation**

Danger of falling into deep excavation during removal of fill to front of wall, suitable barrier around fall potential areas will be provided to mitigate the risk.

Danger of heavy lifting of reinforcement cages for capping beam.

RAMs details provided by Piling contractor – refer to appendix.

**3.13. 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)**

Structure costs are expected to be £100,000. Other proposals included an in-situ reinforced concrete wall however this was discounted, along with other traditional retaining walls as large disruption and land loss would be required to construct.

### **3.14. Proposed arrangements for construction**

#### **3.14.1. Construction of structure**

A Piling mat will be constructed at the top of pile capping beam level to the extents that the wall is required. A piling rig will then be used to install the contiguous piles from ground level. Once piling works have been completed the heads of the piles will be cropped and tied into an in-situ reinforced capping beam. Following installation of the capping beam an excavator will be used to remove the soil in front of the wall. Once excavated to full depth a low-level concrete nib will be installed onto the front of the contiguous piled wall via resin anchors. This nib will ultimately support the masonry leaf façade.

#### **3.14.2. Traffic management**

It is anticipated that the works can be undertaken with no effect to the adjacent PROW.

#### **3.14.3. Service diversions**

No service diversions are anticipated as part of these works. Prior to works commencing a full service survey will need to be undertaken along piling line.

#### **3.14.4. Interface with existing structures**

No existing structures are anticipated to be modified.

### **3.15. Resilience and security**

Contiguous piled wall will be constructed using 600 diameter piles. No design for any terrorist activities has been undertaken.

## 4. DESIGN CRITERIA

### 4.1. Actions

#### 4.1.1. Permanent actions

All permanent actions calculated using BS EN 1991-1-1 and UK national annex.

Lateral earth pressures.

Loading will be applied and combined in accordance with BS EN 1990 and BS EN 1991 as amended by the relevant national annex for both ULS and SLS.

In accordance with BS EN 1997-1:2004, for ULS design the level of excavation in front of the wall should, be lowered below the nominally expected level by an amount  $\Delta a$ . The value of  $\Delta a$  for a cantilever wall should equal 10% of the wall height above the excavation level, limited to a maximum of 0.5m.

#### 4.1.2. Snow, Wind and Thermal actions

Wind load allowed for fence to top of capping beam. In accordance with BS EN 1991 and national annex.

Snow loading not considered for embedded retaining walls.

Thermal actions not considered for embedded retaining walls.

#### 4.1.3. Actions relating to normal traffic under AW regulations and C&U regulations

None, Applied load is from a PROW accessed by pedestrian loading only.

#### 4.1.4. Actions relating to General Order traffic under STGO regulations

None

#### 4.1.5. Footway or footbridge variable actions

A surcharge load of 10kN/m<sup>2</sup> has been allowed for pedestrian loading in the design in accordance with BS8002:2015 table 7.

#### 4.1.6. Actions relating to Special Order traffic, provision for exceptional abnormal indivisible loads including location of vehicle track on deck cross-section

None

#### 4.1.7. Accidental actions

Large machinery and plant will not be able to access behind the wall once excavations have been completed to the wall frontage. No accidental actions to be allowed for.

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**4.1.8. Action during construction**

Geotechnical actions and construction loads to be in accordance with 4.3 and 4.11 of BS EN 1991-1-6 and NA to BS EN 1991-6

**4.1.9. Any special action not covered above**

None

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

None

**4.3. Proposed minimum headroom provided**

None

**4.4. Authorities consulted and any special conditions required**

Kirklees Council

**4.5. Standards and documents listed in the Technical Approval Schedule**

TAS dated November 2023 - See appendix A.

Additional relevant DoT standards published since the above edition of the TAS including amendments, are listed as follows:

None

**4.6. Proposed departures from standards listed in 4.5**

None

**4.7. Proposed departures from standards concerning methods for dealing with aspects not covered by standards listed in 4.5**

None

**4.8. Proposed safety critical fixings**

None

## 5. STRUCTURAL ANALYSIS

### 5.1. Methods of analysis proposed for superstructure, substructure and foundations

The contiguous piled wall will be designed as a cantilever structure to BS EN 1992-1-1:2004 Design of concrete structures and BS 8004:2015 + A1:2020 code of practise of foundations and BS EN 1997. All designs to be undertaken by specialists.

The contiguous piled wall shall be analysed within “CADS piled wall suite” a flexible retaining wall soil/structure interaction computer program that allows the used to study the deformations of, and stresses within, the structure through a specified sequence of construction.

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

The contiguous piled wall will be analysed to resist lateral forces imposed by earth pressures.to Eurocode 7 Refer to Appendices B, C and D.

Hydrostatic pressure has been ignored from the calculations in this instance. This is because he structure will have weepholes installed between the piles to relieve any hydrostatic pressure behind the wall.

### 5.3. Assumptions intended for calculation of structural element stiffness

600mm diameter piles at 750mm centres. Maximum length 10m to 11.5m from piling mat level. Wall stiffness for short term analysis stages shall be based on uncracked concrete properties, cracked concrete properties will be adjusted at later stages in the analysis.

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

Earth pressure coefficients  $K_a$  and  $K_p$  to be used in the design shall be calculated using rankines method. Coefficient of earth pressure at rest  $k_0'$  will be assessed from effective shear strength parameter and an assessment of stress history and likely over consolidation ratio.

## 6. GEOTECHNICAL CONDITIONS

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

The Ground investigations reports by Ian Farmer Associates are generally accepted in so far as those aspects relating to the design of a contiguous piled retaining wall.

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

General fill onto Clay and Mudstone.

Phi for load distribution 30.0 degrees.

Bulk density 20.0kN/m<sup>3</sup>

There is a relatively low risk of encountering Wheatley Lime Coal. If encountered, the coal should be over excavated and replaced with minimum 1m thick inert clay fill in all directions to prevent spontaneous combustion.

Refer to Appendix E

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

N/A

**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**

N/A

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## **7. CHECK**

### **7.1. Proposed Category and Design Supervision Level**

Category 1.

DSL2

### **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**

There are no Type S or Type P temporary works proposals.

**8. DRAWINGS AND DOCUMENTS**

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

**8.1.1. Drawings (See appendix B)**

Reference	Title
09.21001-ACE-ZZ-XX-DR-S-7021 – P4	Boundary Retaining Wall, Plots 65-70 (1)
09.21001-ACE-ZZ-XX-DR-S-7022 – P4	Boundary Retaining Wall, Plots 65-70 (2)
09.21001-ACE-ZZ-XX-DR-S-7023 – P2	Boundary Retaining Wall, Plots 65-70 (3)
09.21011-ACE-00-ZZ-DR-C-3201 - P11	External Levels Phase 1, Sheet 2 of 2
T30295 – Retaining wall Rev B	Proposed Pile Layout, House Type: Retaining Wall Plot: 65-70
09.21001-ACE-00-ZZ-DR-C-3600 – P4	PROW Sections Sheet 1 of 2

**8.1.2. Documents**

Reference	Title
Appendix A	Technical Approval Schedule TAS
Appendix B	Drawings
Appendix C	Idealised Structure
Appendix D	Not used
Appendix E	Geotechnical Information
Appendix F	Not used
T30295	Contract Design (M&D Foundations)

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## 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. [This statement is applicable to temporary works design AIP only]~~

### Design Team Leader

Signed \_\_\_\_\_

Name Paul Gill

Engineering Qualifications BEng (Hons)

Name of Organisation Adept Consulting Engineers Ltd

Date 20.11.23

### Check Team Leader

Signed \_\_\_\_\_

Name Erol Erturan

Engineering Qualifications BSc, MSc, BEng, MICE, MIStructE

Name of Organisation Adept Consulting Engineers Ltd

Date 20.11.23

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

Signed \_\_\_\_\_

Name Claire Richardson

Position held Principal Engineer - **Bridges & Structures**

Engineering Qualifications **BEng CEng MICE**

TAA **Kirklees Council**

Date 02-09-2024

For the avoidance of doubt, doc ref T30295 does not form part of the AIP.

*For and on behalf of Kirklees Council*

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## **APPENDIX A**

### ***LIST OF RELEVANT DESIGN DOCUMENTS***

Scheme title: PROW Retaining Wall, Birkenshaw  
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## TECHNICAL APPROVAL SCHEDULE (TAS)

### Schedule of Documents Relating to Design of Highway Bridges and Structures

(All documents are taken to include revisions current as of 18 December 2023)

**Additional standards needed for a particular design should be added to the section at the bottom of the TAS.**

**The Designer is responsible for ensuring that the standards and references given in the schedule are correct and up to date.** [Tick all the documents used](#) (✓)

Eurocodes and associated UK National Annexes				
Used	Eurocode part	Title	Amendment/Corrigenda	Notes
	<b>Eurocode 0</b>	<b>Basis of structural design</b>		
✓	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.  This document is to be used until 30 March 2028. After which it will be superseded by BS EN 1990:2023
✓	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.
	<b>Eurocode 1</b>	<b>Actions on structures</b>		
✓	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	
	<del>BS EN 1991-1-3:2003 +A1:2015</del>	<del>Eurocode 1: Actions on structures. General Actions. Snow loads</del>	<del>+A1:2015 Incorporating corrigenda December 2004 and March 2009</del>	
	<del>NA + A2:18 to BS EN 1991-1-3:2003+A1:2015</del>	<del>UK National Annex to Eurocode 1: Actions on structures. General Actions. Snow loads</del>	<del>+A2:2018 Incorporating corrigenda June 2007, December 2015 and October 2018</del>	
✓	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	
	<del>BS EN 1991-1-5:2003</del>	<del>Eurocode 1: Actions on structures. General Actions. Thermal actions</del>	<del>Corrigenda December 2004 and March 2009</del>	
	<del>NA to BS EN 1991-1-5:2003</del>	<del>UK National Annex to Eurocode 1: Actions on structures. General Actions. Thermal actions</del>	-	

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Eurocodes and associated UK National Annexes				
Used	Eurocode part	Title	Amendment/Corrigenda	Notes
	BS EN 1991-1-6:2005	<del>Eurocode 1: Actions on structures. General Actions. Actions during execution</del>	<del>Corrigenda July 2008, November 2012 and February 2013</del>	
	NA to BS EN 1991-1-6:2005	<del>UK National Annex to Eurocode 1: Actions on structures. General Actions. Actions during execution</del>	-	
✓	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 +A1:2020 to BS EN 1991-2:2003	UK National Annex to Eurocode 1: Actions on structures. Traffic loads on bridges	Corrigendum No.1 Amendment June 2020	See CD 350 section 7 for additional guidance.
	<b>Eurocode 2</b>	<b>Design of concrete structures</b>		
✓	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 1-1: 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	-	
	BS EN 1992-3:2006	<del>Eurocode 2: Design of concrete structures – Part 3: Liquid retaining and containment structures</del>	-	
	NA to BS EN 1992-3:2006	<del>UK National Annex to Eurocode 2: Design of concrete structures – Part 3: Liquid retaining and containment structures</del>	-	
	BS EN 1992-4:2018	Eurocode 2: Design of concrete structures – Part 4: Design of fastenings for use in concrete		
	NA to BS EN 1992-4:2018	UK National Annex to Eurocode 2: Design of concrete structures – Part 4: Design of fastenings for use in concrete		
	<b>Eurocode 3</b>	<b>Design of steel structures</b>		
	<del>BS EN 1993-1-1:2005 + A1:2014</del>	<del>Eurocode 3: Design of steel structures – Part 1-1 General rules and rules for buildings</del>	<del>Corrigenda February 2006 and April 2009</del>	<b>This document is to be used until 30 March 2028. After which it will be superseded by BS EN 1993-1-1:2022</b>
	NA + A1:2014 to BS EN 1993-1-1:2005 + A1:2014	UK National Annex to Eurocode 3: Design of steel structures – Part 1-1 General rules and rules for buildings	-	
	BS EN 1993-1-3:2006	Eurocode 3: Design of steel structures – Part 1-3 General rules – Supplementary rules for cold formed members and sheeting	Corrigendum November 2009	

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Eurocodes and associated UK National Annexes				
Used	Eurocode part	Title	Amendment/Corrigenda	Notes
	NA to BS EN 1993-1-3:2006	UK National Annex to Eurocode 3: Design of steel structures – Part 1-3 Supplementary rules for cold-formed members and sheeting	-	
	BS EN 1993-1-4:2006 + A2:2020	Eurocode 3: Design of steel structures – Part 1-4 General rules – Supplementary rules for stainless steels	+ A1:2015 Amendment No. 1 + A2:2020 Amendment No. 2	Supersedes BS EN 1993-1-4:2006 + A1:2015
	NA+A1:15 to BS EN 1993-1-4:2006+A1:2015	UK National Annex to Eurocode 3: Design of steel structures – Part 1-4 Supplementary rules for stainless steels	+ A1:2015 Amendment No. 1	
	BS EN 1993-1-5:2006+A2:2019	Eurocode 3: Design of steel structures – Part 1-5 Plated structural elements	Corrigendum April 2009, +A1:2017 Amendment No. 2, +A2:2019	
	NA+A1:2016 to BS EN 1993-1-5:2006	UK National Annex to Eurocode 3: Design of steel structures – Part 1-5 Plated structural elements	+ A1:2016 Amendment No. 1	
	BS EN 1993-1-6:2007+ A1:2017	Eurocode 3: Design of steel structures – Part 1-6 Strength and stability of shell structures	+ A1:2017 Amendment No. 1	
	BS EN 1993-1-7:2007	Eurocode 3: Design of steel structures – Part 1-7 Plated structures subject to out-of-plane loading	Corrigendum April 2009	
	BS EN 1993-1-8:2005	Eurocode 3: Design of steel structures – Part 1-8 Design of joints	Corrigenda December 2005, September 2006, July 2009 and August 2010	
	NA to BS EN 1993-1-8:2005	UK National Annex to Eurocode 3: Design of steel structures – Part 1-8 Design of joints	-	
	BS EN 1993-1-9:2005	Eurocode 3: Design of steel structures – Part 1-9 Fatigue	Corrigenda December 2005, September 2006 and April 2009	
	NA to BS EN 1993-1-9:2005	UK National Annex to Eurocode 3: Design of steel structures – Part 1-9 Fatigue	-	
	BS EN 1993-1-10:2005	Eurocode 3: Design of steel structures – Part 1-10 Material toughness and through-thickness properties	Corrigenda December 2005, September 2006 and March 2009	
	NA to BS EN 1993-1-10:2005	UK National Annex to Eurocode 3: Design of steel structures – Part 1-10 Material toughness and through thickness properties	-	
	BS EN 1993-1-11:2006	Eurocode 3: Design of steel structures – Part 1-11 Design of structures with tension components	Corrigendum April 2009	
	NA to BS EN 1993-1-11:2006	UK National Annex to Eurocode 3: Design of steel structures – Part 1-11 Design of structures with tension components	-	
	BS EN 1993-1-12:2007	Eurocode 3: Design of steel structures – Part 1-12 Additional rules for the extension of EN 1993 up to steel grades S 700	Corrigendum April 2009	
	NA to BS EN 1993-1-12:2007	UK National Annex to Eurocode 3: Design of steel structures – Part 1-12 Additional rules for the extension of EN 1993 up to steel grades S 700	-	
	BS EN 1993-2:2006	Eurocode 3: Design of steel structures – Part 2 Steel bridges	Corrigendum July 2009	
	NA + A1:2012 to BS EN 1993-2:2006	UK National Annex to Eurocode 3: Design of steel structures – Part 2 Steel bridges	+ A1:2012	

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Eurocodes and associated UK National Annexes				
Used	Eurocode part	Title	Amendment/Corrigenda	Notes
	BS EN 1993 5:2007	Eurocode 3: Design of steel structures – Part 5 Piling	Corrigendum May 2009	
	NA + A1:2012 to BS EN 1993 5:2007	UK National Annex to Eurocode 3: Design of steel structures – Part 5 Piling	+ A1:2012	
	<b>Eurocode 4</b>	<b>Design of composite steel and concrete structures</b>		
	BS EN 1994 1 1:2004	Eurocode 4: Design of composite steel and concrete structures – Part 1 1 General rules and rules for buildings	Corrigendum April 2009	
	NA to BS EN 1994 1 1:2004	UK National Annex to Eurocode 4: Design of composite steel and concrete structures – Part 1 1 General rules and rules for buildings	-	
	BS EN 1994 2:2005	Eurocode 4: Design of composite steel and concrete structures – Part 2 General rules and rules for bridges	Corrigendum July 2008	
	NA to BS EN 1994 2:2005	UK National Annex to Eurocode 4: Design of composite steel and concrete structures – Part 2 General rules and rules for bridges	-	
	<b>Eurocode 5</b>	<b>Design of timber structures</b>		
	BS EN 1995 1 1:2004 + A2:2014	Eurocode 5: Design of timber structures – Part 1 1 General – common rules and rules for buildings	+ A2:2014 Incorporating corrigendum June 2006	
	NA to BS EN 1995 1 1:2004 + A2:2014	UK National Annex to Eurocode 5: Design of timber structures – Part 1 1 General – common rules and rules for buildings	+ A2:2014	
	BS EN 1995 2:2004	Eurocode 5: Design of timber structures – Part 2 Bridges	-	
	NA to BS EN 1995 2:2004	UK National Annex to Eurocode 5: Design of timber structures – Part 2 Bridges	-	
	<b>Eurocode 6</b>	<b>Design of masonry structures</b>		
	BS EN 1996-1-1:2005+A1:2012	Eurocode 6: Design of masonry structures – Part 1-1 General rules for reinforced and unreinforced masonry structures	+A1:2012 Corrigenda February 2006 and July 2009	This document is to be used until 30 March 2028. After which it will be superseded by BS EN 1996-1-1:2022
	NA to BS EN 1996 1 1:2005 +A1:2012	UK National Annex to Eurocode 6: Design of masonry structures – Part 1 1 General rules for reinforced and unreinforced masonry structures	+A1:2012	
	BS EN 1996 2:2006	Eurocode 6: Design of masonry structures – Part 2 Design considerations, selection of materials and execution of masonry	Corrigendum September 2009	
	NA to BS EN 1996 2:2006	UK National Annex to Eurocode 6: Design of masonry structures – Part 2 Design considerations, selection of materials and execution of masonry	Corrigendum No.1	
	BS EN 1996 3:2006	Eurocode 6: Design of masonry structures – Part 3 Simplified calculation methods for unreinforced masonry structures	Corrigendum October 2009	
	NA +A1:2014 to BS EN 1996 3:2006	UK National Annex to Eurocode 6: Design of masonry structures – Part 3 Simplified calculation methods for unreinforced masonry structures	+A1:2014	
	<b>Eurocode 7</b>	<b>Geotechnical design</b>		

Scheme title: PROW Retaining Wall, Birkenshaw  
 Structure title: Proposed Contiguous Piled Wall

Struc Ref:  
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Eurocodes and associated UK National Annexes				
Used	Eurocode part	Title	Amendment/Corrigenda	Notes
✓	BS EN 1997-1:2004+A1:2013	<b>Eurocode 7: Geotechnical design – Part 1 General rules</b>	<b>+A1:2013 Corrigendum February 2009</b>	<b>This document is to be used until 30 March 2028. After which it will be superseded by BS EN 1990:2023</b>
✓	NA+A2:2022 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, Amendment 1 – July 2014 and Amendment 2 - 2022	Supersedes NA+A1:2014 to BS EN 1997-1:2004+A1:2013
✓	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	-	
	<b>Eurocode 8</b>	<b>Design of structures for earthquake resistance</b>		
	BS EN 1998-1:2004 + A1:2013	Eurocode 8: Design of structures for earthquake resistance – Part 1 General rules, seismic actions and rules for buildings	Corrigendum June 2009, January 2011 and March 2013	
	NA to BS EN 1998-1:2004	UK National Annex to Eurocode 8: Design of structures for earthquake resistance – Part 1 General rules, seismic actions and rules for buildings	-	
	BS EN 1998-2:2005+A2:2011	Eurocode 8: Design of structures for earthquake resistance – Part 2 Bridges	Corrigenda February 2010 and February 2012	
	NA to BS EN 1998-2:2005	UK National Annex to Eurocode 8: Design of structures for earthquake resistance – Part 2 Bridges	-	
	BS EN 1998-5:2004	Eurocode 8: Design of structures for earthquake resistance – Part 5 Foundations, retaining structures and geotechnical aspects	-	
	NA to BS EN 1998-5:2004	UK National Annex to Eurocode 8: Design of structures for earthquake resistance – Part 5 Foundations, retaining structures and geotechnical aspects	-	
	<b>Eurocode 9</b>	<b>Design of aluminium structures</b>		
	BS EN 1999-1-1:2007 + A2:2013	<b>Eurocode 9: Design of aluminium structures – Part 1-1 General structural rules</b>	<b>+ A2:2013 Incorporating corrigendum March 2014</b>	<b>This document is to be used until 30 March 2028. After which it will be superseded by BS EN 1999-1-1:2023</b>
	NA to BS EN 1999-1-1:2007 + A1:2009	UK National Annex to Eurocode 9: Design of aluminium structures – Part 1-1 General structural rules	National Amendment No.1 Corrigendum No.1	
	BS EN 1999-1-3:2007 + A1:2011	<b>Eurocode 9: Design of aluminium structures – Part 1-3 Structures susceptible to fatigue</b>	<b>+ A1:2011</b>	<b>This document is to be used until 30 March 2028. After which it will be superseded by BS EN 1999-1-3:2023</b>
	NA to BS EN 1999-1-3:2007 + A1:2011	UK National Annex to Eurocode 9: Design of aluminium structures – Part 1-3 Structures susceptible to fatigue	+ A1:2011	

Scheme title: PROW Retaining Wall, Birkenshaw  
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Eurocodes and associated UK National Annexes				
Used	Eurocode part	Title	Amendment/ Corrigenda	Notes
	<b>BS EN 1999-1-4:2007 +A1:2011</b>	<b>Eurocode 9: Design of aluminium structures – Part 1-4 Cold formed structural sheeting</b>	<b>+ A1:2011 Corrigendum November 2009</b>	<b>This document is to be used until 30 March 2028. After which it will be superseded by BS EN 1999-1-4:2023</b>
	NA to BS EN 1999-1-4:2007	UK National Annex to Eurocode 9: Design of aluminium structures – Part 1-4 Cold formed structural sheeting	-	

BSI Published Documents			
<i>For guidance only unless clauses are otherwise specified in CD 350 Appendix A.</i>			
Used	Published Document reference	Title	Notes
	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 6688-1-4:2015	Background paper to the UK National Annex to BS EN 1991-1-4	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 + A1:2020	Recommendations for the design of structures subject to traffic loading to BS EN 1997-1	Incorporating Corrigendum January 2022  See CD 350 Appendix A for additional guidance.
	PD 6695-1-9:2008	Recommendations for the design of structures to BS EN 1993-1-9	See CD 350 Appendix A for additional guidance.
	PD 6695-1-10:2009	Recommendations for the design of structures to BS EN 1993-1-10	See CD 350 Appendix A for additional guidance.
	PD 6695-2:2008 + A1:2012 Incorporating Corrigendum No.1	Recommendation for the design of bridges to BS EN 1993	See CD 350 Appendix A for additional guidance.
	PD 6696-2:2007 + A1:2012	Background paper to BS EN 1994-2 and the UK National Annex to BS EN 1994-2	See CD 350 Appendix A for additional guidance.
	PD 6698:2009	Recommendations for the design of structures for earthquake resistance to BS EN 1998	See CD 350 section 7 for additional guidance.
	PD 6702-1:2000+A1:2019	Structural use of aluminium. Recommendations for the design of aluminium structures to BS EN 1999	Amended 31 May 2019
	PD 6703:2009	Structural bearings – Guidance on the use of structural bearings	
	PD 6705-2:2020	Structural use of steel and aluminium. Execution of steel bridges conforming to BS EN 1000-2. Guide	Replaces PD 6705-2:2010 + A1:2013
	PD 6705-3:2009	Recommendations on the execution of aluminium structures to BS EN 1000-3	

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 Structure title: Proposed Contiguous Piled Wall

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**Execution Standards referenced in British Standards or Eurocode**

Used	Execution Standard reference	Title	Notes
	BS EN 1090-1:2009+A1:2011	Execution of steel structures and aluminium structures – Part 1: Requirements for conformity assessment of structural components	
	BS EN 1090-2:2018	Execution of steel structures and aluminium structures. Technical requirements for the execution of steel structures	Supersedes BS EN 1090-2:2008+A1:2011
	BS EN 1090-3:2019	Execution of steel structures and aluminium structures – Part 3: Technical requirements for aluminium structures	Supersedes BS EN 1090-3:2008
	BS EN 13670:2009 Incorporating corrigenda October 2015 and November 2015	Execution of concrete structures	

**Product Standards referenced in British Standards or Eurocodes**

Used	Product Standard reference	Title	Notes
	BS EN 206:2013+A2:2021	Concrete – Specification, performance, production and conformity	Supersedes BS EN 206:2013+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.	<i>Draft BS EN 1317-4 for public comment published in June 2012</i>
	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 <i>Draft prEN 1317-5 for public comment published in December 2013</i>
	PD-CEN/TR 16949:2016	Road Restraint System – Pedestrian restraint system – Pedestrian parapets	<i>Bsi Published Document / CEN Technical Report published in July 2016</i>  <i>(This document should not be used. The requirements of BS 7918:1995 apply.)</i>

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 Structure title: Proposed Contiguous Piled Wall

Struc Ref:  
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Product Standards referenced in British Standards or Eurocodes			
Used	Product Standard reference	Title	Notes
	Draft prEN 1317-7	Road restraint systems—Part 7: Performance classes, impact test acceptance criteria and test methods for terminals of safety barriers	<i>Draft prEN 1317-7 for public comment published in June 2012</i>  <i>(This document should not be used. All terminals should continue to be in accordance with ENV1317-4.)</i>
	PD CEN/TS 17342:2019	Road restraint systems—Motorcycle road restraint systems which reduce the impact severity of motorcyclist collisions with safety barriers	<i>Replaces PD CEN/TS 1317-8:2012</i>  <i>(This document should not be used.)</i>
	PD CEN/TR 17081:2018	Design of fastenings for use in concrete—Plastic design of fastenings with headed and post installed fasteners	
	BS EN 1337 1:2000	Structural bearings—Part 1: General Design Rules	
	BS EN 1337 2:2004	Structural bearings—Part 2: Sliding elements	
	BS EN 1337 3:2005	Structural bearings—Part 3: Elastomeric bearings	
	BS EN 1337 4:2004	Structural bearings—Part 4: Roller bearings	Corrigendum No.1 March 2007
	BS EN 1337 5:2005	Structural bearings—Part 5: Pot bearings	
	BS EN 1337 6:2004	Structural bearings—Part 6: Rocker bearings	
	BS EN 1337 7:2004	Structural bearings—Part 7: Spherical and cylindrical PTFE bearings	
	BS EN 1337 8:2007	Structural bearings—Part 8: Guide bearings and restraint bearings	
	BS EN 1337 9:1998	Structural bearings—Part 9: Protection	
	BS EN 1337 10:2003	Structural bearings—Part 10: Inspection and maintenance	Corrigendum No.1 November 2003
	BS EN 1337 11:1998	Structural bearings—Part 11: Transport, Storage and Installation.	
	BS EN 10025 1:2004	Hot rolled products of structural steels Part 1: General technical delivery conditions.	
	BS EN 10025 2:2019	Hot rolled products of structural steels Part 2: Technical delivery conditions for non-alloy structural steels.	Supersedes BS EN 10025 1:2004
	BS EN 10025 3:2019	Hot rolled products of structural steels Part 3: Technical delivery conditions for normalized/normalized rolled weldable fine grain structural steels.	Supersedes BS EN 10025 3:2004
	<b>BS EN 10025 4:2019+A1:2022</b>	<b>Hot rolled products of structural steels Part 4: Technical delivery conditions for thermomechanical rolled weldable fine grain structural steels.</b>	<b>Supersedes BS EN 10025 4:2019</b>
	BS EN 10025 5:2019	Hot rolled products of structural steels—Part 5: Technical delivery conditions for structural steels with improved atmospheric corrosion resistance	Supersedes BS EN 10025 5:2004
	<b>BS EN 10025 6:2019+A1:2022</b>	<b>Hot rolled products of structural steels—Part 6: Technical delivery conditions for flat products of high yield strength structural steels in the quenched and tempered condition.</b>	<b>Supersedes BS EN 10025 6:2019</b>
	BS EN 10080:2005	Steel for the reinforcement of concrete—Weldable reinforcing steel—General	
	BS EN 10210 1:2006	Hot finished structural hollow sections of non-alloy and fine grain steels—Part 1: Technical delivery conditions	
	BS EN 10210 2:2019	Hot finished structural hollow sections—Part 2: Tolerances, dimensions and sectional properties	Supersedes BS EN 10210 2:2006
	BS EN 10248 1:2023	Hot rolled sheet piling of non-alloy steels. Technical delivery conditions	Supersedes BS EN 10248 1:1996
	BS EN 10248 2:1996	Hot rolled sheet piling of non-alloy steels. Tolerances on shape and dimensions	

Scheme title: PROW Retaining Wall, Birkenshaw  
 Structure title: Proposed Contiguous Piled Wall

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**Product Standards referenced in British Standards or Eurocodes**

Used	Product Standard reference	Title	Notes
	BS EN 12063:1999	Execution of special geotechnical work. Sheet pile walls.	
	BS EN 13369:2018	Common rules for precast concrete products	
	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 CD 350 clause 3.8.1 for additional guidance.
	BS EN 15258:2008	Precast concrete products – Retaining wall elements	

**British Standards**

Used	British Standard reference	Title	Notes
	BS 4449:2005+A3:2016	Steel for the reinforcement of concrete	No longer covers plain round bar. (See BS4482 up to 12mm dia, see BS EN 10025-1 for larger sizes and dowels. See BS EN 13877-3 for dowel bars in concrete pavements.)
	BS 5896:2012	Specification for high tensile steel wire and strand for the prestressing of concrete	
	BS 7818:1995	Specification for pedestrian restraint systems in metal	Incorporating Corrigendum No.1 May 2004 and Corrigendum No.2 September 2006  Currently the requirements of BS 7818:1995 are to be used instead of PD CEN/TR 16949:2016
	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+A2:2019	Concrete – Complementary British Standard to BS EN 206: Method of specifying and guidance for the specifier.	Incorporating Corrigendum No.1 and Corrigendum No.2 June 2020  Amendment +A2:2019
	BS 8500 2:2015+A2:2019	Concrete – Complementary British Standard to BS EN 206: Specification for constituent materials and concrete.	Amendment +A2:2019
	BS 8666:2020	Scheduling, dimensioning, bending and cutting of steel reinforcement for concrete	Supersedes BS 8666:2005

**The Manual of Contract Documents for Highway Works (MCHW)**

Used	MCHW reference	Title	Notes
✓	MCHW Volume 1: October 2022	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 October 2022 Supersedes April 2022 version
✓	MCHW Volume 2: October 2022	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

**Scheme title: PROW Retaining Wall, Birkenshaw**  
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			<i>where a compliant revision has not been published. Amendments October 2022 Supersedes November 2021 version</i>
✓	MCHW Volume 3: February 2017	Highway Construction Details	

The Design Manual for Roads and Bridges (DMRB)			
Used	DMRB reference	Title	Notes
✓	GG 101 Revision 0.1.0	Introduction to the Design Manual for Roads and Bridges	Replaces GG 101 Revision 0
	<del>GG 102 Revision 0</del>	<del>Quality Management Systems for Highway Design</del>	<del>Replaces GD 02/16</del>
	<del>GG 103 Revision 0</del>	<del>Introduction and general requirements for sustainable development and design</del>	
	<del>GG 104 Revision 0</del>	<del>Requirements for Safety Risk Assessment</del>	<del>Replaces GD04/12 and IAN 191/16</del>
	<del>GG 184 Revision 0</del>	<del>Specification for the use of Computer Aided Design</del>	<del>Replaces IAN 184/16</del>
✓	CG 300 Revision 0.1.0	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
	<del>CG 303 Revision 0</del>	<del>Quality assurance scheme for paints and similar protective coatings</del>	<del>Supersedes BD 35/14</del>
	<del>CG 305 Revision 0</del>	<del>Identification marking of highway structures</del>	<del>Supersedes BD 45/03</del>
	<del>CG 504 Revision 2</del>	<del>Design of highway drainage systems</del>	<del>Supersedes HD 33/16, TA 80/99</del>
	<del>CD 127 Revision 1.0.1</del>	<del>Cross-sections and headrooms</del>	<del>Replaces TD 27/05 and TD 70/08</del>
✓	CD 350 Revision 0	The design of highway structures	Supersedes BD 100/16, BA 57/01, BD 57/01 and IAN 124/11
✓	CD 351 Revision 0	The design and appearance of highway structures	Supersedes BA 41/98
	<del>CD 352 Revision 0</del>	<del>Design of road tunnels</del>	<del>Supersedes BD 78/99</del>
	<del>CD 353 Revision 0</del>	<del>Design criteria for footbridges</del>	<del>Supersedes BD 29/17</del>
	<del>CD 354 Revision 1.1.0</del>	<del>Design of minor structures</del>	<del>Supersedes CD 354 Revision 1</del>
	<del>CD 355 Revision 0</del>	<del>Application of whole life costs for design and maintenance of highway structures</del>	<del>Replaces BD 36/92 and BA 28/92</del>
	<del>CD 356 Revision 1</del>	<del>Design of highway structures for hydraulic action</del>	<del>Supersedes BA 59/94</del>
	<del>CD 357 Revision 1</del>	<del>Bridge expansion joints</del>	<del>Replaces BD 33/04, BA 26/94, IAN 168/12 and IAN 169/12</del>
	<del>CD 358 Revision 2.4.0</del>	<del>Waterproofing and surfacing of concrete bridge decks</del>	<del>Supersedes CD 358 Revision 2.3.0</del>
	<del>CD 359 Revision 0</del>	<del>Design requirements for permanent soffit formwork</del>	<del>Supersedes BA 36/90 and IAN 131/11</del>
	<del>CD 360 Revision 2</del>	<del>Use of compressive membrane action in bridge decks</del>	<del>Supersedes BD 81/02</del>
	<del>CD 361 Revision 0</del>	<del>Weathering steel for highway structures</del>	<del>Supersedes BD 7/01</del>
	<del>CD 362 Revision 1</del>	<del>Enclosure of bridges</del>	<del>Replaces BD 67/96 and BA 67/96</del>
	<del>CD 363 Revision 0</del>	<del>Design rules for aerodynamic effects on bridges</del>	<del>Replaces BD 49/01</del>
	<del>CD 364 Revision 0</del>	<del>Formation of continuity joints in bridge decks</del>	<del>Replaces BA 82/00</del>
	<del>CD 365 Revision 1</del>	<del>Portal and cantilever signs/signals gantries</del>	<del>Replaces BD 51/14, IAN 193/16, BE 7/04</del>
	<del>CD 366 Revision 0</del>	<del>Design criteria for collision protection beams</del>	<del>Replaces BD 65/14</del>
	<del>CD 367</del>	<del>Treatment of existing structures on highways widening schemes</del>	<del>Replaces BD 95/07</del>

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The Design Manual for Roads and Bridges (DMRB)			
Used	DMRB reference	Title	Notes
	Revision 0		
	CD 368 Revision 0	Design of fibre reinforced polymer bridges and highway structures	Replaces BD 90/05
	CD 369 Revision 0	Surface protection for concrete highway structures	Replaces BA 85/04
	CD 374 Revision 0	Strengthening highway structures using fibre reinforced polymers and externally bonded steel plates	Replaces BD 85/08, BD 84/02
	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 12/04
	CD 376 Revision 0	Unreinforced masonry arch bridges	Replaces BD 91/04
✓	CD 377 Revision 4	Requirements for road restraint systems	Supersedes TD 19/06
	CD 622 Revision 1	Managing geotechnical risk	Replaces HD 22/08, BD 10/97 and HA 120/08
	CS 461 Revision 0	Assessment and upgrading of in service parapets	Supersedes BA 37/02 and IAN 97/07
	CS 462 Revision 0	Repair and management of deteriorated concrete highway structures	Supersedes BA 35/00 and BA 52/04
	GD 304 Revision 2	Designing health and safety into maintenance	Replaces IAN 69/15
	LA 404 Revision 1	Environmental assessment and monitoring	Supersedes HA 205/08, HD 48/08, IAN 125/15, and IAN 133/10
	LA 406 Revision 1	Cultural heritage assessment	Supersedes HA 208/07, HA 60/92, HA 75/04
	LA 410 Revision 0	Material assets and waste	Supersedes IAN 153/11
	LA 413 Revision 1	Road drainage and the water environment	Supersedes HD 45/09
	LD 419 Revision 0	Roadside environmental mitigation and enhancement	Formerly LA 119, which superseded HA 65/04 and HA 66/05
<b>Interim Advice Notes</b>			
	<b>IAN reference</b>	<b>Title</b>	<b>Notes</b>
✓	IAN 105/08	Implementation of construction (design and management) 2007 and the withdrawal of SD 10 and SD 11	

Miscellaneous			
Used	Standard reference	Title	Notes
	CIRIA C643	Bridge Detailing Guide	
✓	CIRIA C686	Safe Access for Maintenance and Repair	
	CIRIA C760	Guidance on embedded retaining wall design	
	CIRIA C766	Control of cracking caused by restrained deformation in concrete	Supersedes C660
	CIRIA C777	General fixings – guidance on selection and whole life management	

**Scheme title: PROW Retaining Wall, Birkenshaw**  
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### Additional Standards

Additional standards needed for a particular design should be listed here.

Reference	Title	Notes

**Scheme title: PROW Retaining Wall, Birkenshaw**  
**Structure title: Proposed Contiguous Piled Wall**

**Struc Ref:**  
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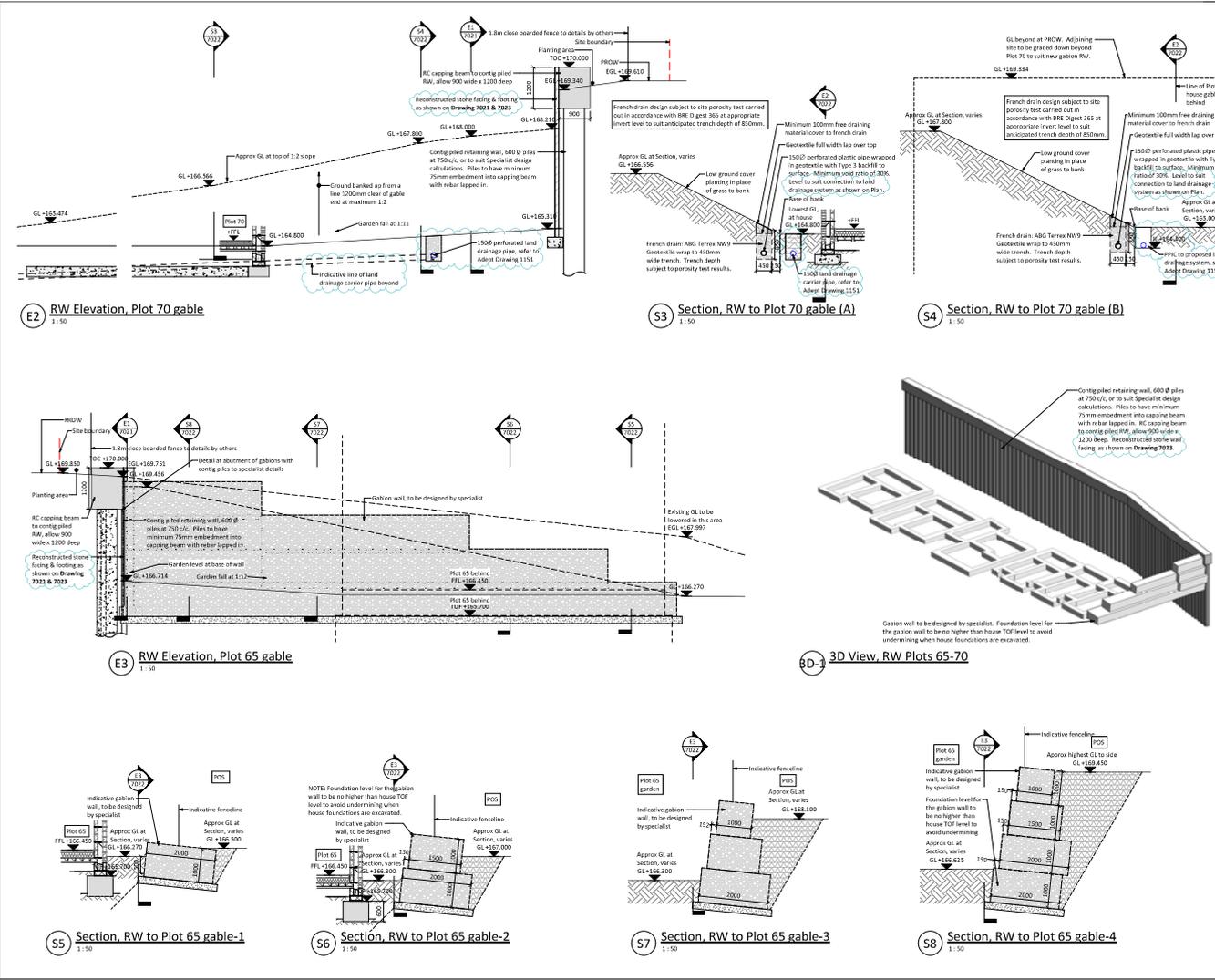
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## **APPENDIX B**

### ***DRAWINGS***

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Do Not Scale	
Design Review	
Design review by:	Checked by:
Residual hazards:	
<b>Drawing Notes</b>	
1. For General Notes read with Drawing 0151 & 0152.	
2. This drawing is to be read in conjunction with all architect's drawings from which all setting out details, dimensions, levels & waterprooing should be confirmed.	
3. The contractor is to check all drawings and report any discrepancies immediately.	
4. All work to be carried out in accordance with current edition of the Building Regulations and to the satisfaction of the Local Authority Building Inspector.	
5. All materials & workmanship to comply with Adopt Standard Specification for concrete works.	
6. This drawing is to be read in conjunction with all relevant Architects & ADP drawings.	
7. Nominal concrete cover to reinforcement is 40mm. Unless Noted Otherwise. Cover to reinforcement in foundations cast against ground is to be 50-75mm, refer to specific drawings.	
8. Concrete grade as per m/s schedule/specification.	
9. All precast reinforcement bars are to be provided with proprietary plastic protective cover to prevent impalement.	
10. Read with Adopt Civils Drawing External Levels Phase 1 Sheet 2 of 2 (01/21/01/ACE-00-24-00-01-0201).	
11. Concrete should have a minimum 28 day strength of 30 N/mm <sup>2</sup> .	
12. Reinforcing steel: High Yield Type bars e.g. B10, B12 ...	
13. Reinforcing steel: Fy=500 N/mm <sup>2</sup> .	
14. Laps to reinforcement:	
B10 = 400mm	
B12 = 500mm	
B16 = 600mm	
B20 = 800mm	
B25 = 1200mm	
B30 = 1500mm	
Mesh = 200mm	
Mesh to be provided with flying ends to allow in place reinforcement faces.	
15. Abbreviations:	
NF - Near Face	
FF - Far Face	
EF - East Face	
TF - Top	
BF - Bottom	
M - Middle	
CTD - Cut to suit	
C/C - Centre	
16. Concrete grade as per m/s schedule/specification.	
17. Provide Movement Joints in foundations below facing at 6m c/c maximum or in accordance with stone manufacturer's details.	
18. Read with Drawings 7021 & 7023.	

Date	Description	By	CHK	Rev
21/03/24	Issued to site for construction	AWH	TH	01
04/12/23	Revised to suit comments	AWH	TH	02
10/11/23	Revised to suit comments	AWH	PG	03
10/09/23	For issue (draft for comments)	AWH	PG	04

**ADEPT**  
 CIVIL AND STRUCTURAL CONSULTING ENGINEERS

Project: **Blue Hills**

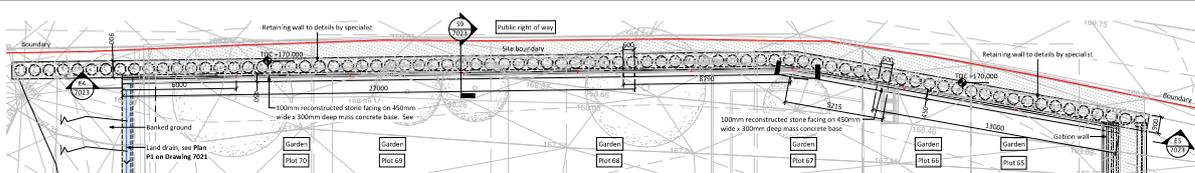
Task: **Boundary Retaining Wall, Plots 65-70 (2)**

Client: **Countryside**

Scale: A1: 1:50  
 Author: WWH  
 Designer: PG  
 Checker: PG  
 Date: Oct 2023

Rev: **S2** Preliminary **09.21.011**

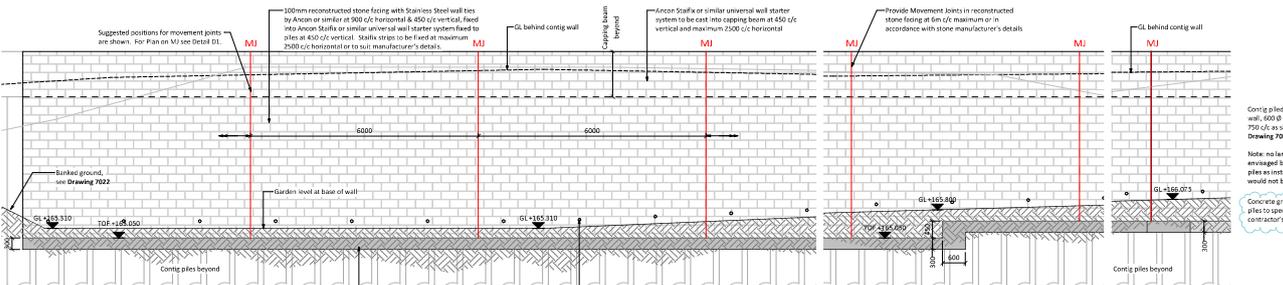
09.21.011-ACE-ZX-DR-S-7022 **P4**



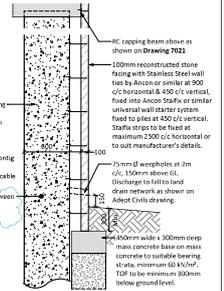
**P3 Plan on RW to boundary, Plot 65-70, facing**  
1:100



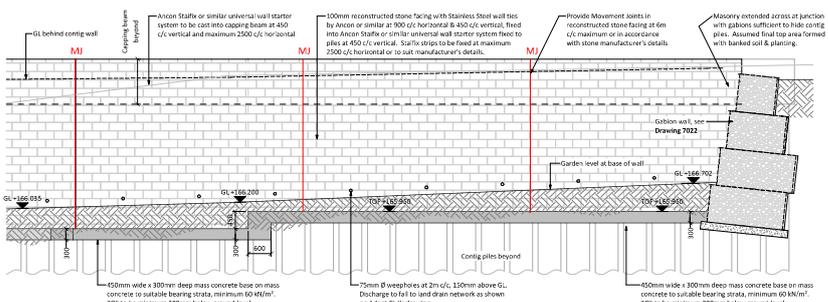
**D1 MJ in stone facing**  
1:10



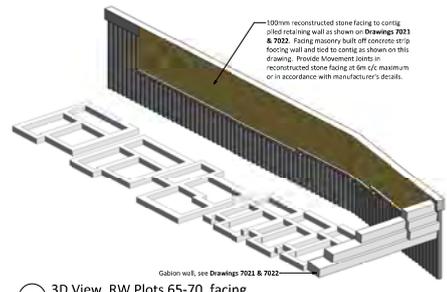
**E4 RW Elevation, Plots 65-70 facing (1)**  
1:50



**S9 Section, facing wall detail**  
1:25



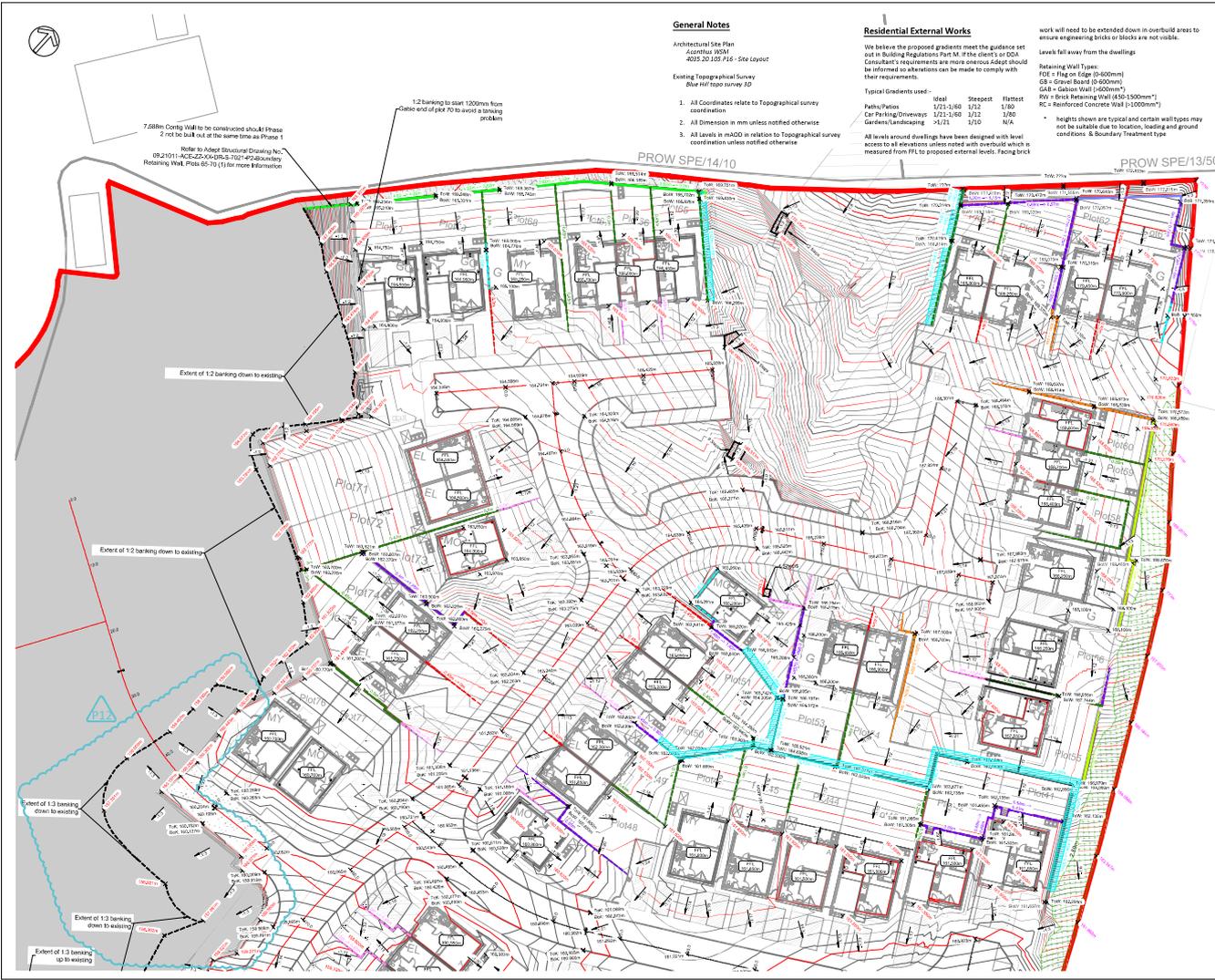
**E5 RW Elevation, Plots 65-70 facing (2)**  
1:50



**B-3 3D View, RW Plots 65-70, facing**

Do Not Scale	
Design Review	Checked by:
Design review by:	
Residual hazards:	
Drawing Notes	
1. For General Notes read with Drawing 0511 & 0512.	
2. This drawing to be read in conjunction with all architect's drawings from which all setting out details, dimensions, work & waterproofing should be confirmed.	
3. The contractor is to check all drawings and report any discrepancies immediately.	
4. All work to be carried out in accordance with current edition of The Building Regulations and to the satisfaction of the Local Authority Building Inspector.	
5. All materials & workmanship to comply with Adopt Standard Specification for concrete works.	
6. This drawing is to be read in conjunction with all relevant Architects & Adopt drawings.	
7. Read with Adopt Civils Drawing External Levels Phase 1 Sheet 2 of 2 Ref 02.1011-ACE-EZ-XX-DR-S-2021.	
8. Concrete should have a minimum 28 day strength of 30 N/mm².	
9. Concrete grade as per mix schedule/specification.	
10. Minimum ground bearing for strip foundation to facing wall to be 60 kN/m², extend base of foundation to suitable bearing in mass concrete to suit. Allow minimum 50mm concrete bedding in all cases.	
11. Concrete to be cured and protected from frost for minimum 7 days after casting.	
12. Strip positions and levels for facing have been shown, to be constructed to suit required site levels and contractor method.	
13. Provide Movement Joints in reconstructed stone facing at 6m c/c maximum or in accordance with stone manufacturer's details, suggested positions are shown.	
14. Read with Drawings 7021 & 7022.	

15.03.24	Issue noted as discussed	Who	By	When	By	When
21.02.24	Final issue					
Title		Description		By	CHK	Rev
 <b>ADEPT</b> CIVIL AND STRUCTURAL CONSULTING ENGINEERS 0153 466000 www.adeptce.com 0153 466000 0153 466000 0153 466000 0153 466000						
Project						
Blue Hills						
Title						
Boundary Retaining Wall, Plots 65-70 (3)						
Client						
Countryside						
Scale	As indicated	Author	W01	TH	PG	Rev'd Date
Sheet	S2	Number	Preliminary		09.21.011	09.2024
09.21011-ACE-EZ-XX-DR-S-7023						



**General Notes**

Architectural Site Plan  
 Acornhill WSM  
 4035 20 135 P16 - Site Layout  
 Existing Topographical Survey  
 Blue Hill topo survey 3D

- All Coordinates relate to Topographical survey coordination
- All Dimension in mm unless notified otherwise
- All Levels in mADD in relation to Topographical survey coordination unless notified otherwise

**Residential External Works**

We believe the proposed gradients meet the guidance set out in Building Regulations Part M, if the client or OIA. Consultant's requirements are more onerous, Adept should be informed so alterations can be made to comply with their requirements.

Typical Gradients used -

Goal	Steepest	Flattest
1/21-1/60	1/21	1/80
Car Parking/Driveway	1/21	1/20
Garden/Landscaping	>1/21	N/A

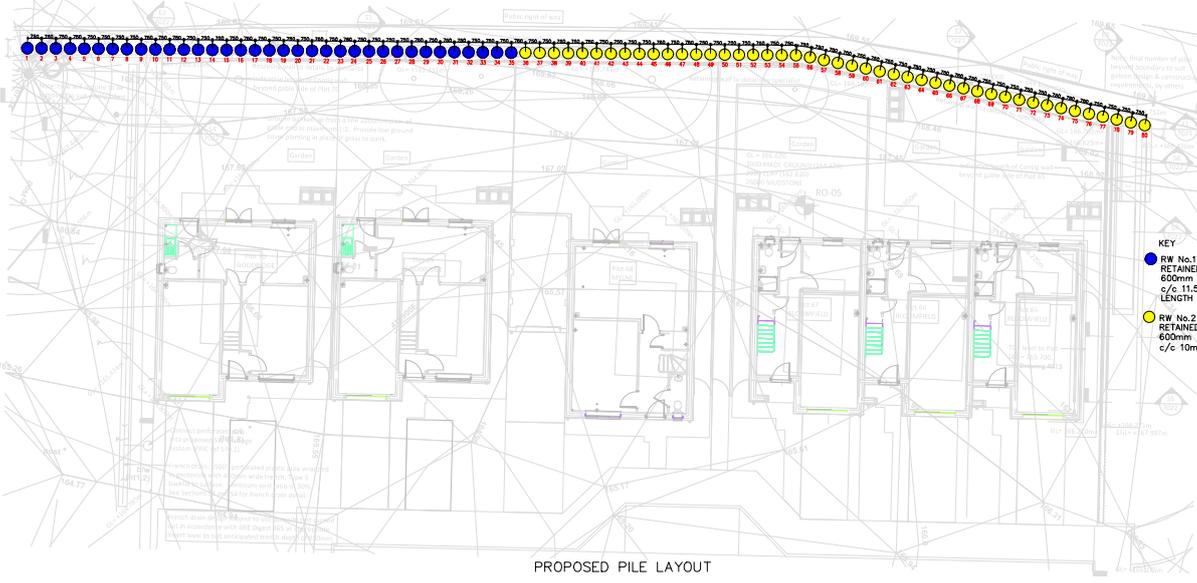
All levels around dwellings have been designed with level access to all elevations unless noted with overbuild which is measured from FFL to proposed external levels. Facing brick

work will need to be extended down in overbuild areas to ensure engineering bricks or blocks are not visible.

Levels fall away from the dwellings

- Retaining Wall Types:
- FDE = Flag on Edge (0-600mm)
  - GB = Gravel Board (0-600mm)
  - GAB = Gabion Wall (600mm<sup>2</sup>)
  - RFC = Reinforced Concrete Wall (1-1000mm<sup>2</sup>)
- Notes:
- heights shown are typical and certain wall types may not be suitable due to location, loading and ground conditions & Boundary Treatment type

Do Not Scale			
DESIGN REVIEW			
Design review by:	**	Checked by:	**
Residual hazards:			
Health, Safety & Environmental Notes			
NOTES			
<b>Key:</b>			
Land Ownership Boundary			
Retention < 600mm - Flag on Edge Type 2a & 2b (FDE) Note: Not to be used within Vehicle influence zone			
Retention < 600mm - Flag on Edge Type 2c & 2d (FDE) Note: Can be used within Vehicle influence zone			
Retention < 600mm - Gravel Board Type 1a, 1b & 1c (GB) Note: Not to be used within Vehicle influence zone			
Retention < 1500mm - Cavity Filled Wall Type 3E/4E/5E Retention Note: Not to be used within Vehicle influence zone			
Retention < 1500mm - Cavity Filled Wall Type 3F/4F/5F Retention Note: Can be used within Vehicle influence zone			
Retention > 1500mm - Retaining Wall Type 4a & 4b			
Retention Contiguous Piled Wall			
Retention Potential Contiguous Wall. Should Phase 2 not be constructed at the same time as Phase 1			
Retention Redeflex Wall or similar wall type to Highways approval			
Retention Maximum Extent of Potential Retainment, Structure type TBC			
Underbuild			
Overbuild			
Banking			
Contours, Minor (0.1m)			
Contours, Major (0.2m)			
Phase 2 Banking Extents			
Proposed Spot Elevations			
Existing Spot Elevations			
Gabion Wall			
Banking gradient to existing levels changed to 1 in 3	OCS	TT	P12
Gravel Boards removed from gabion basins. Gabion Basin at extents extended down to 41% slope and note updated to Ref 10) coping wall	OCS	TT	P11
15.06.20 Proposed retaining structure by previous revision notes			
Date	Description	By	CHK Rev
<b>ADEPT</b> CIVIL AND STRUCTURAL CONSULTING ENGINEERS			
100, Blue Hills Farm, Birkenshaw, Wiltshire, SN14 6LQ, UK Tel: 01249 814 814 Fax: 01249 814 814 Email: info@adept.co.uk Website: www.adept.co.uk			
Project: Blue Hills Farm, Birkenshaw			
Type: External Levels Phase 1, Sheet 2 of 2			
Client: Vistry Partnerships			
Drawn by: S2	Checked by: JS	Reviewed by: RP	Issue Date: JUN 22
Project: Preliminary 09.21011			
Revision: 09.21011-ACE-00-ZZ-DR-C-3201 P12			



PROPOSED PILE LAYOUT

REVISIONS			
No.	Description	Date	By
1	Issue	09/22/23	ME
A	AS PER THE 477/23/24/25/26 ALL THE PILES	20/02/23	ME
A	PROVIDED TO BEST CLIENT'S PRACTICE	20/02/23	ME
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-

**GENERAL**

- DO NOT SCALE THIS DRAWING.
- NOT TO BE USED FOR SETTING OUT PILE POSITIONS
- ALL PILES ARE EQUALLY SPACED UNLESS DIMENSIONED OTHERWISE

**CONCRETE**

ALL CONCRETE TO BE GRADE C35 USING 20mm AGGREGATE.

Min. CEMENT CONTENT = 350kg/m<sup>3</sup>  
 Max. WATER/CEMENT RATIO = 0.5  
 CEMENT TYPE = O.P.C.

CONCRETE COVER TO BE 75mm UNLESS NOTED OTHERWISE

- WORKS TO BE COMPLETED BY SUPERSTRUCTURE CONTRACTOR PRIOR TO PILING TEAM ATTENDING SITE.**
1. Provision of W.C.
  2. Provision of water supply (by external tap).
  3. Provision of empty skip (and subsequent exchange as required).
  4. Location and identification of all services or. Written notification to be supplied to M&D confirming there are no hazardous services in the vicinity of the piles.
  5. Any necessary repairs/diversions of services/frames prior to slabs being concreted.
  6. Accurate excavation to level shown.
  7. Provide continuous and unambiguous datum level 1.0m above level of proposed structural slab.
  8. Protection of access routes using plywood overlaying visqueen to all areas agreed at pre start meeting.
  9. Erection of safety / security fencing to screen off working area from house occupiers & general public.
  10. Completion of M&D form confirming above works are complete.

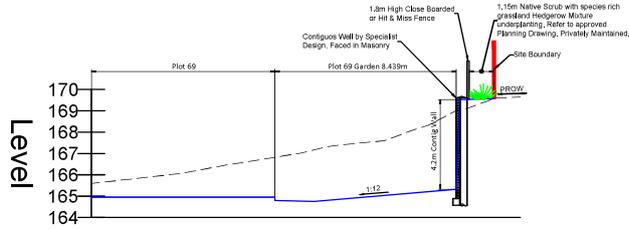
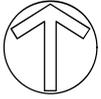
**NOTE**

Piles are to fit plastic safety caps to vertical pile base. P.C. crew to remove caps and return to consultant for re-use.

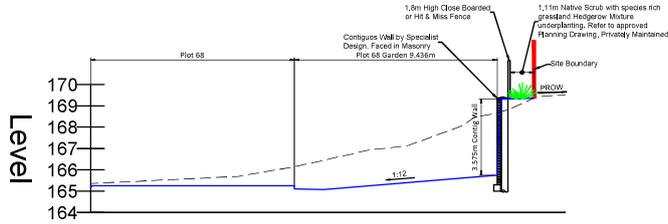
**File Copy**

Drawn By: ME Checked By: BS  
 Scale: 1:100 Date: 03/10/2023  
 Client: **Vistry**  
 Project: Blue Hills Farm, Off Whitehall - Rd West, Birkenshaw, BD11 2DU  
 Title: PROPOSED PILE LAYOUT HOUSE TYPE: RETAINING WALL PLOT: 65-70  
 Drawing No: T30295 - RETAINING WALL  
**M&D FOUNDATIONS** REV B  
 Brooklands Road, Adwick-Le-Street, Doncaster, South Yorkshire, DN6 7BA  
 Tel: 01302 337711 Fax: 01302 330335

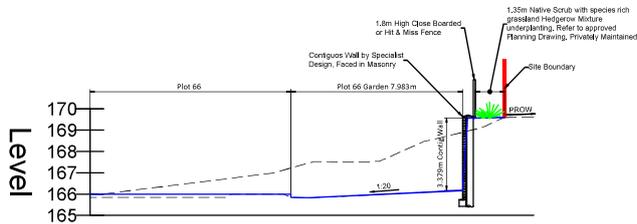
**CAUTION:** THIS DOCUMENT IS SUBJECT TO COPYRIGHT AND MAY NOT BE REPRODUCED IN PART OR IN WHOLE WITHOUT THE WRITTEN PERMISSION OF M&D FOUNDATIONS AND BUILDING SERVICES Ltd.



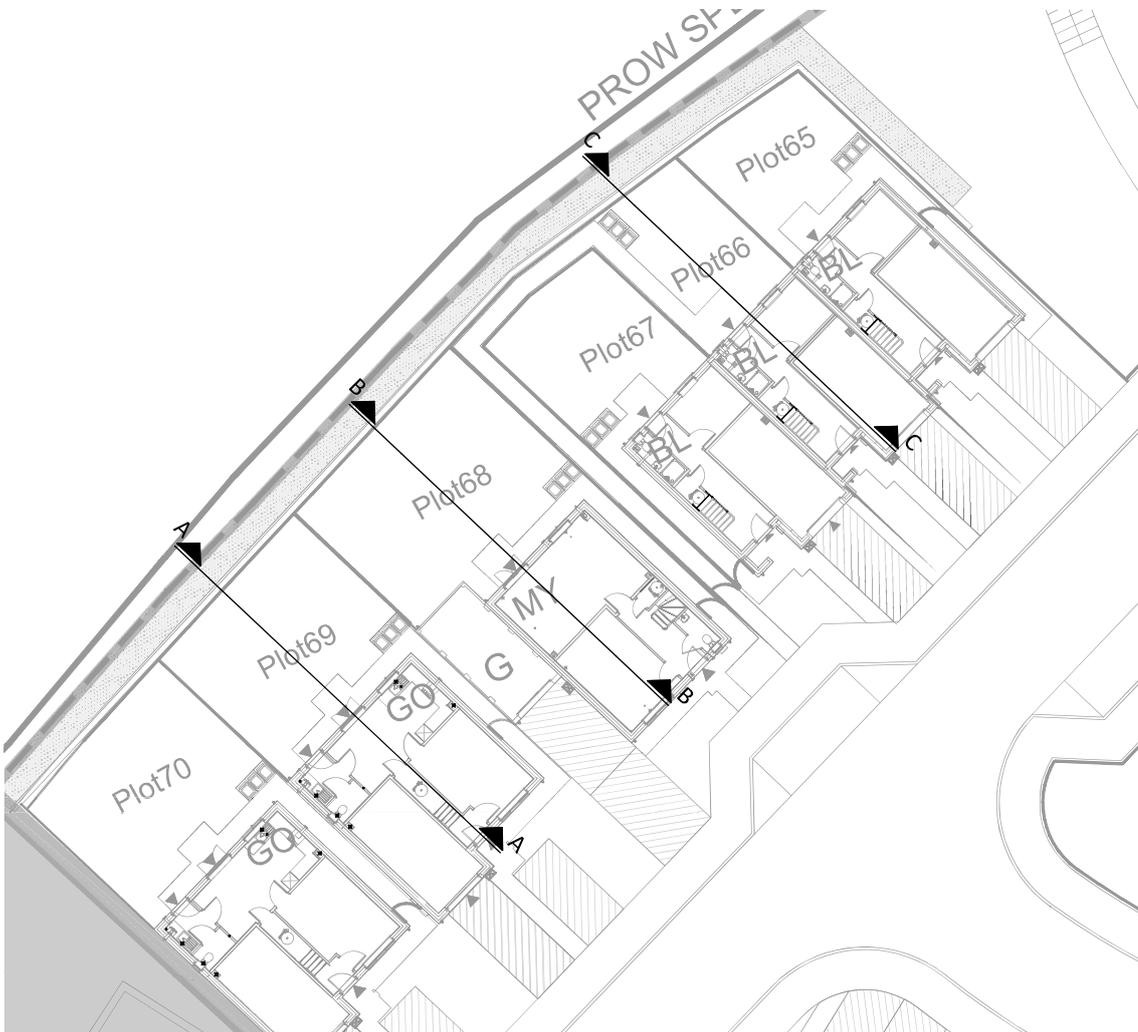
**A - A - LONGSECTION**  
SCALE: H 1:250,V 1:250. DATUM: 164.000



**B - B - LONGSECTION**  
SCALE: H 1:250,V 1:250. DATUM: 164.000



**C - C - LONGSECTION**  
SCALE: H 1:250,V 1:250. DATUM: 165.000



Do Not Scale

DESIGN REVIEW

Design review by: \*\* Checked by: \*\*

Residual hazards:

Health, Safety & Environmental Notes

NOTES

Notes:  
Reference Adept Structural Drawings for further information:

09.21011-ACE-ZZ-XX-DR-S-7021-P1-  
Boundary Retaining Wall, Plots 65-70

09.21011-ACE-ZZ-XX-DR-S-7022-P1-  
Boundary Retaining Wall, Plots 65-70

Key:

Proposed Surface ———

Existing Surface - - - - -

27.10.23	Drawings updated as per client comments	OCB	AL	P4
05.05.23	Contig Walls added	OCB	JS	P3
21.02.23	Sections altered	OCB	JS	P2
26.09.22	Initial Issue	RLP	JS	P1
Date	Description	By	Chk	Rev

**ADEPT**  
CIVIL AND STRUCTURAL CONSULTING ENGINEERS

Web: www.adeptcsce.com  
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Tel: 0113 239 4518 (Head Office)

Originating Office: Leeds  
1912 Mills, Sunny Bank Mills,  
Farnley, Leeds LS28 5UJ  
Tel: 0113 239 4518

Project  
Blue Hills Farm,  
Birkenshaw

Title  
PROW Sections  
Sheet 1 of 2

Client  
**Vistry**  
Partnerships

Scale (DAS)	1:250	Initial author	OCB	Initial checker	JS	Approver	RP	Initial Date	May 23
-------------	-------	----------------	-----	-----------------	----	----------	----	--------------	--------

Status	S2	Purpose	Preliminary	Date	09.21011
Project Number	09.21011-ACE-00-ZZ-DR-C-03600	Sheet	P4	Page	1 of 1

**Scheme title: PROW Retaining Wall, Birkenshaw**  
**Structure title: Proposed Contiguous Piled Wall**

**Struc Ref:**  
**Rev A – 19/12/2023**

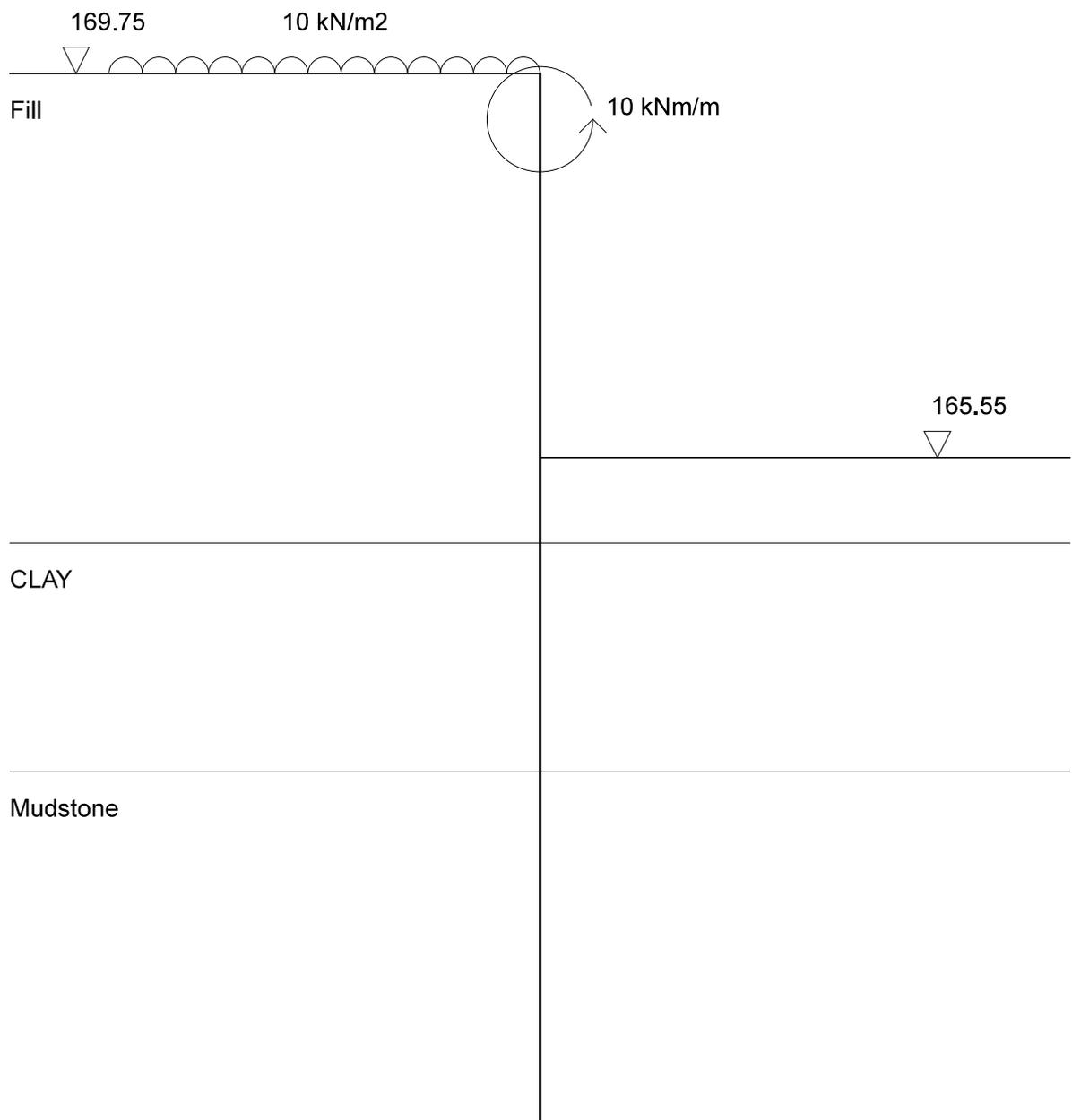
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## **APPENDIX C**

### ***Idealised Structure***

600mm diameter Piles at 750mm c/c	Page No 3 Analysis
CADS Piled Wall Suite Version 6.07 Design of embedded retaining walls and cofferdams	Project T30295 File Name ... wall_am_cbsi_01.pws
Blue Hills Farm, Off Whitehall Rd West, Birkenshaw Retained Height = 4.2m	Engineer AM Date 27/11/2023

Stage ref. 3  
Stage type Moment load



**Scheme title: PROW Retaining Wall, Birkenshaw**  
**Structure title: Proposed Contiguous Piled Wall**

**Struc Ref:**  
**Rev A – 19/12/2023**

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## **APPENDIX E**

### ***Geotechnical Information***

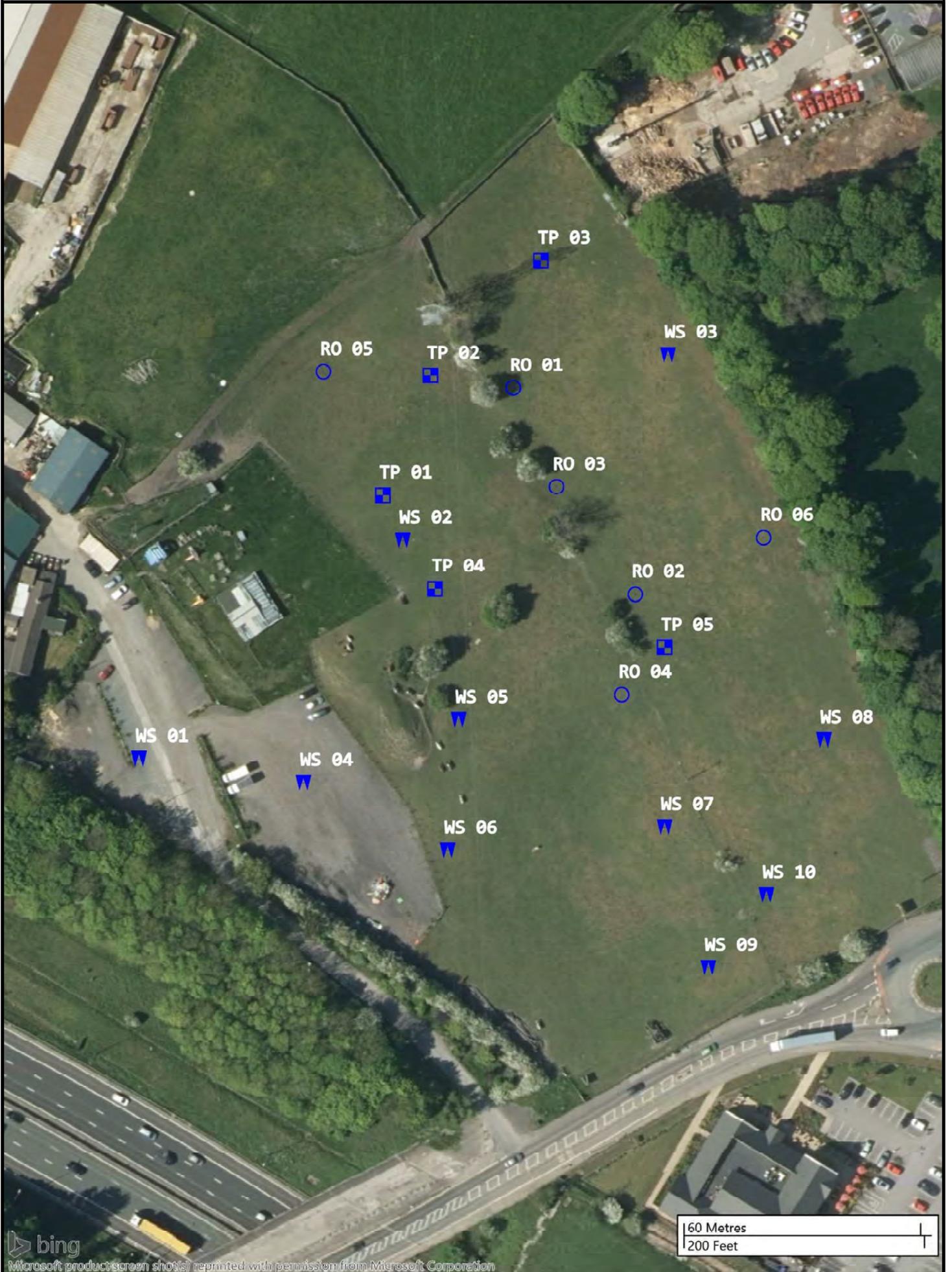
Project Id: 2230244

Title: Fig A1.2 Exploratory Hole Location Plan

Project Title: Blue Hills Farm

Scale: 1:1250

Client: Mr. C. Ives







Plant used: <b>Mazenza M13</b>	Project: <b>Blue Hills Farm</b>		Location ID: <b>RO 05</b>
Dates: <b>13/11/2020</b>	Client: <b>Mr. C. Ives</b>		Sheet 2 of 3
<b>Rotary Borehole Log</b>	Location: <b>419910,93E 427826,83N</b>	Ground level: <b>166.62mOD</b>	Logged by: <b>JS</b>
		Vertical scale: <b>1:50</b>	Project ID: <b>2230244</b>

Coring, Samples & In Situ Testing			Strata Details				Groundwater		
Depth	TCR/SCR/RQD	FI	Samples & Test Result	Level (mOD)	Depth (m) (Thickness)	Strata Description	Legend	Water Strike	Backfill/Installation
		OH			(24.50)	Grey MUDSTONE with orange sandstone and occasional coal fragments.			
						Continued next sheet			

Flush Details				Borehole Diameter		Boring Progress			Remarks:	
Top (m)	Base (m)	Flush Type	Flush Return %	Depth (m)	Dia (mm)	Date	Time	Depth (m)	Cased (m)	Water (m)
				Casing Diameter		Water Strikes			Monitoring Installations	
Depth (m)		Dia (mm)		Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks	Top (m)   Base (m)   Pipe Type   Dia (mm)
Checked by:	TD	IFA RC								
Log status:	DRAFT	v01.01								



<b>Plant used:</b> Mazenza M13	<b>Project:</b> Blue Hills Farm		<b>Location ID:</b> <b>RO 05</b>		
	<b>Dates:</b> 13/11/2020	<b>Client:</b> Mr. C. Ives			
<b>Rotary Borehole Log</b>	<b>Location:</b> 419910,93E 427826,83N	<b>Ground level:</b> 166.62mOD	<b>Logged by:</b> JS	<b>Vertical scale:</b> 1:50	<b>Sheet 3 of 3</b> <b>Project ID:</b> 2230244

Coring, Samples & In Situ Testing			Strata Details				Groundwater		
Depth	TCR/SCR/RQD	FI	Samples & Test Result	Level (mOD)	Depth (m) (Thickness)	Strata Description	Legend	Water Strike	Backfill/Installation
		OH		136,62	30,00	Grey MUDSTONE with orange sandstone and occasional coal fragments.			
						End of Borehole at 30.00m			

<b>Flush Details</b> Top (m)   Base (m)   Flush Type   Flush Return %				<b>Borehole Diameter</b> Depth (m)   Dia (mm)		<b>Boring Progress</b> Date   Time   Depth (m)   Cased (m)   Water (m)			<b>Remarks:</b>	
				<b>Casing Diameter</b> Depth (m)   Dia (mm)		<b>Water Strikes</b> Strike (m)   Cased (m)   Sealed (m)   Time (mins)   Rose to (m)			<b>Monitoring Installations</b> Top (m)   Base (m)   Pipe Type   Dia (mm)	
<b>Checked by:</b> Log status:		TD DRAFT	IFA RC v01.01							



Plant used: <b>JCB 3CX</b>	Project: <b>Blue Hills Farm</b>		Location ID: <b>TP 02</b>		
	Dates: <b>09/11/2020</b>	Client: <b>Mr. C. Ives</b>			
Trial Pit Log	Location: <b>419938,15E 427825,96N</b>	Ground level: <b>166.99mOD</b>	Logged by: <b>JS</b>	Vertical scale: <b>1:25</b>	Sheet 1 of 1 Contract ID: <b>2230244</b>

Samples & In Situ Testing			Strata Details					Scale	Water Strike	Backfill/ Installation
Depth	Sample ID	Test Result	Level (mOD)	Depth (m) (Thickness)	Strata Description	Legend				
0.10 - 0.20 0.10 - 0.20	D2 ES1		166.59	(0.40)	MADE GROUND: Grass over, soft, dark brown, slightly sandy, slightly gravelly CLAY with frequent rootlets. Gravel is subangular to subrounded, fine to coarse including coal, brick, mudstone and sandstone. (Topsoil).		1			
0.50 - 0.70 0.50 - 0.70	D4 ES3			0.40	MADE GROUND: Soft - firm, orange brown, friable, slightly sandy, gravelly CLAY. Gravel is subangular to subrounded, fine to coarse including coal and mudstone.					
1.30 - 1.50 1.30 - 1.50	D6 ES5		165.69	1.30	MADE GROUND: Firm, orange brown, friable, slightly sandy, gravelly CLAY. Gravel is subangular to subrounded, fine to coarse including mudstone and coal.		2	▼		
1.60 - 1.80 1.60 - 1.80	D8 ES7		165.49	1.50	Firm, orangish brown, friable, slightly sandy, gravelly CLAY with low cobble content. Gravel is subangular to subrounded, fine to coarse including mudstone, carbonaceous mudstone and coal. Cobbles are angular to subangular up to 150mm including mudstone.					
			164.79	2.20	End of Trial Pit at 2.20m		3			
							4			
							5			

Termination:			Stability: Walls remained vertical		Remarks:		
Dimensions (Length m x Width m): 3.00 x 0.90							
Water Strikes							
Strike (m)	Time (mins)	Rose to (m)	Remarks				
1.60	0	1.60	Seepage				
Checked by:			TD		IFA TP v01.01		
Status:			DRAFT				



<b>Plant used:</b> JCB 3CX	<b>Project:</b> Blue Hills Farm		<b>Location ID:</b> <b>TP 03</b>
<b>Dates:</b> 09/11/2020	<b>Client:</b> Mr. C. Ives		Sheet 1 of 1
<b>Trial Pit Log</b>	<b>Location:</b> 419966,31E 427855,60N	<b>Ground level:</b> 170,23mOD	<b>Logged by:</b> JS
		<b>Vertical scale:</b> 1:25	<b>Contract ID:</b> 2230244

Samples & In Situ Testing			Strata Details					Scale	Water Strike	Backfill/ Installation
Depth	Sample ID	Test Result	Level (mOD)	Depth (m) (Thickness)	Strata Description	Legend				
0.10 - 0.20	D2		170.03	0.20	MADE GROUND: Grass over, soft, dark brown, slightly sandy, slightly gravelly CLAY with frequent rootlets. Gravel is subangular to subrounded, fine and medium including coal, brick, mudstone and sandstone. (Topsoil).		1			
0.10 - 0.20	ES1			(0.30)	MADE GROUND: Soft to firm, orange brown, friable, slightly sandy, slightly gravelly CLAY. Gravel is subangular to subrounded, fine to coarse including mudstone and coal.					
0.30 - 0.50	D4		169.73	0.50	MADE GROUND: Soft to firm, orange brown, friable, slightly sandy, very gravelly CLAY. Gravel is subangular to subrounded, fine to coarse including mudstone, carbonaceous mudstone and coal.		1			
0.30 - 0.50	ES3			(0.40)	MADE GROUND: Soft to firm, orange brown, friable, slightly sandy, very gravelly CLAY. Gravel is subangular to subrounded, fine to coarse including mudstone, carbonaceous mudstone and coal.					
0.70 - 0.90	D6		169.33	0.90	MADE GROUND: Orangish brown, subangular to subrounded, fine to coarse slightly sandy, clayey GRAVEL including mudstone, carbonaceous mudstone and coal.		1			
0.70 - 0.90	ES5			(1.40)	Stiff, orangish brown, friable, slightly sandy, gravelly CLAY with low to medium cobble content. Gravel is subangular to subrounded, fine to coarse including mudstone, carbonaceous mudstone and coal. Cobbles are angular to subangular up to 200mm including mudstone. (Possibly re-worked in upper part)					
0.95 - 1.10	D8		169.13	1.10			2			
0.95 - 1.10	ES7									
1.20 - 1.50	D10		167.73	2.50	End of Trial Pit at 2.50m		3			
1.20 - 1.50	ES9									
							4			
							5			

<b>Termination:</b>			<b>Stability:</b> Walls remained vertical		<b>Remarks:</b>
<b>Dimensions (Length m x Width m):</b> 3,00 x 0,90					
<b>Water Strikes</b>					
<b>Strike (m)</b>	<b>Time (mins)</b>	<b>Rose to (m)</b>	<b>Remarks</b>		
2.10	0	2.10	Seepage		
<b>Checked by:</b>			TD		IFA TP v01,01
<b>Status:</b>			DRAFT		



## **CONTRACT DESIGN**

**Project: Blue Hills Farm, Off Whitehall Rd West, Birkenshaw**

**Location: Off Whitehall Rd West, Birkenshaw, BD11 2DU**

**Client: Vistry Partnerships**

**Ref. No.: T30295**

**Date: 07 December 2023**

## **HEAD OFFICE**

M&D Foundations & Building Services Limited  
Brooklands Road  
Adwick Le Street  
Doncaster  
DN6 7BA

Tel.: 01302 337 711  
Fax.: 01302 330 335

BSI-CDP-00

**DOCUMENT CONTROL SHEET**

Project Ref	Revision	Design prepared by	Design Approved by
T30295	Rev 3	Aksar Mahmood	Bharani Iyengar

---



M & D Foundations & Building  
Services Ltd  
Brooklands Road  
Adwick Le Street  
Doncaster

Project		Job Ref.	
Blue Hills Farm, Off Whitehall Rd West, Birkenshaw		T30295	
Document Title		Sheet no./rev.	
Contract Design Package		0	
Calc. by	Date	Chk'd by	App'd by
BSI	07 December 2023	BSI	BSI

## Table of Contents

### **600mm Diameter CFA Retaining Wall Pile Design Calculations ..... 1**

1.	Design Brief.....	1
2.	Data Provided.....	1
3.	Geotechnical Soil Profile Adopted .....	1
4.	Contiguous Pile Design Calculations.....	2
5.	Structural Design.....	2
6.	Construction Sequence .....	3
7.	Action required by client for realisation of design .....	3



M & D Foundations & Building  
Services Ltd  
Brooklands Road  
Adwick Le Street  
Doncaster

Project Blue Hills Farm, Off Whitehall Rd West, Birkenshaw		Job Ref. T30295	
Document Title Contract Design Package		Sheet no./rev. 1	
Calc. by BSI	Date 07 December 2023	Chk'd by BSI	App'd by BSI

## 600mm Diameter CFA Retaining Wall Pile Design Calculations

### 1. Design Brief

M&D Foundations have been instructed to design and install bearing piles, contiguous wall piles for the above project. It is proposed that the foundation system will utilise 600 mm diameter Continuous Flight Auger (CFA) Piles.

The piles have been designed in accordance with British Standards BS 8004:2015+A1:2020 + NA.

### 2. Data Provided

Specification:- None provided  
 BS EN 1992-1-1:2004 Eurocode 2: Design of Concrete Structures  
 BS 8004:2015 + A1:2020 Code of practice of Foundations  
 PD 6687-2:2008  
 BS EN 1536:2010  
 Ciria C760  
 AIP Revision P1, Status S2, Draft Copy, dated 17/11/2023

Drawings: - 09.21011-ACE-00-ZZ-DR-C-3201 P9  
 09.21011-ACE-ZZ-XX-DR-S-7021 P2  
 09.21011-ACE-ZZ-XX-DR-S-7022 P2

Ground Investigation Report: - Ground Investigation Report – 2230244 March 2021  
 Liquid and Plastic Limit Testing – Land at Blue Hills Farm, Birkenshaw,  
 BD11 2DU. Ref: 2281661/1) dated 05/10/2023

### 3. Geotechnical Soil Profile Adopted

Design Parameters adopted.

Level (m AOD)	Description	Bulk Density	Saturated Density	E (kN/m <sup>2</sup> )	Phi degrees	Wall friction	Ka Kp
169.75	Fill	18	20	16000	25	0.5	0.36 3.22
164.62	Clay	20	20	15000	27	0.5	0.33 3.6
162.12	Mudstone	23	23	18667	28	0.5	0.32 3.81

The Ground water has been taken as being below the toe of the pile.



M & D Foundations & Building  
Services Ltd  
Brooklands Road  
Adwick Le Street  
Doncaster

Project Blue Hills Farm, Off Whitehall Rd West, Birkenshaw		Job Ref. T30295	
Document Title Contract Design Package		Sheet no./rev. 2	
Calc. by BSI	Date 07 December 2023	Chk'd by BSI	App'd by BSI

#### 4. Contiguous Pile Design Calculations

The geotechnical design of the retaining wall has been carried out in accordance with BS EN 1997-1:2004 Eurocode 7: Geotechnical design – Part 1: General Rules and with respect to the UK National Annex to this document. The structural design has been carried out in accordance with BS EN 1992-1-1:2004 and the UK National Annex. The recommendations of CIRIA C760 are also taken into account.

The CADS software package has been used to calculate the required minimum toe level and loads for design of the Contiguous piled wall. Calculations for Design Approach 1 have been completed as allowed in the UK National Annex. Combination 1 and 2 ultimate limit state (ULS) analyses have been carried out in accordance with BS 80021:2015 to assess the stability and loads on the wall. The relevant EC7 Combinations and Factors are included in Appendix B.

A serviceability limit state (SLS) analysis has also been carried out to assess likely wall deflections. This analysis has also been carried out using CADS software.

The calculation is presented for 600mm diameter CFA piles for a maximum safe working load surcharge of 10kN/m<sup>2</sup> and as per the additional loads specified in the AIP document calculated using the CADS Pile Wall software and is found onto suitable founding stratum.

The calculation is presented for a 600 mm diameter @ 750 mm c/c CFA contiguous pile wall calculated using CADS Pile Wall Suite software.

#### 5. Structural Design

A Pile diameter of 600 mm pile with the reinforcement shown in the table below is sufficient to cater for the shear loads provided.

Pile Summary table:

Retaining Wall	Retained Height (m)	Pile Diameter/ Spacing (mm)	Pile Length (m)	Reinforcement Cage Detail
No.1	4.2	600 @ 750c/c	11.5	8B32 with B10 Helical at 150mm c/c
No.2	3.65	600 @ 750c/c	10	8B25 with B10 Helical at 150mm c/c

Please note that we have not assessed the required projection/anchorage length of reinforcement into the pile caps, any such connection detail should be provided by others. They should also check that sufficient length is available in the difference between PPL and COL. The maximum working stress for both the 8B25 and 8B32 cage is 434.8N/mm<sup>2</sup>. for further information, please refer to the calculations to facilitate the assessment of anchorage length.



M & D Foundations & Building  
Services Ltd  
Brooklands Road  
Adwick Le Street  
Doncaster

Project Blue Hills Farm, Off Whitehall Rd West, Birkenshaw		Job Ref. T30295	
Document Title Contract Design Package		Sheet no./rev. 3	
Calc. by BSI	Date 07 December 2023	Chk'd by BSI	App'd by BSI

Concrete to be 35 N/mm<sup>2</sup> strength to Class DC-2 of BRE Special Digest 1. This satisfies the direct stress and durability requirements and we would require confirmation of the acceptability of the above concrete class. Please note that we have not assessed the required projection/anchorage length of reinforcement into the capping beam, any such connection detail should be provided by others. They should also check that sufficient length is available in the difference between PPL and COL. At present,

It is recommended to use a reinforced capping beam, as it provides a mechanism for the distribution of bending moments, shear forces and vertical load (if applicable) onto several wall piles.

#### **6. Construction Sequence**

The construction sequence below should be adhered too:

1. Install piles from PPL level
2. Minimal dig of 0.50m and capping beam installation
3. Dig to formation level of 3.65m, 4.2m BGL

#### **7. Action required by client for realisation of design**

- Acceptance of this design and any qualification therein at least one week prior to site commencement.
- Any instruction issued to commence works on site verbally or otherwise prior to the receipt of any formal acceptance of this design and qualification therein will be deemed to be confirmation of "acceptance of this design and any qualifications therein, in its entirety."
- The Mudstone level is assumed to be at 162.12m BGL, the pile length is to be confirmed on site.
- Piling platform level assumed within the pile schedule has been confirmed by Client
- A surcharge of 10kPa has been assumed in design, the client should confirm this is sufficient.
- The maximum retained height including overall dig is 3.00m, 3.65m and 4.2m BGL. The client should ensure the assumed formation level is not exceeded; any variations should be notified to the designer immediately.
- Blinding (or other technique) should be placed upon excavation of the wall to ensure passive softening of the wall does not occur.
- The maximum retained height assumed should not be exceeded, any variations should be notified to the designer immediately.
- Appropriate drainage measures are assumed to be installed in the wall, so that the water level does not exceed the formation level during its lifetime.
- The wall should be monitored to ensure that the actual deflections do not exceed 50% of the theoretical values quoted within this design. If the deflections differ, the designer should be notified immediately.
- Fines migration of soil through the wall is the responsibility of the client.

# BS 8004 : 2015 Geotechnical Design Factors

## Design Approach for UK Design

<p><b>2.4.7.3.4.2 Design Approach 1</b></p> <p>Combination 1: <math>A1 "+" M1 "+" R1</math></p> <p>Combination 2: <math>A2 "+" M2 "+" R1</math></p>	<p>Where:</p> <p>A = Action Factors</p> <p>M = Material Factors</p> <p>R = Resistance Factors</p>
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## Action Factors

**Table A 2 – Table A.3 of Eurocode 7: Partial factors on actions or the effects of actions**

Action	Symbol	Set	
		A1	A2
Permanent unfavourable	$\gamma_G$	1.35	1
Permanent favourable	$\gamma_G$	1	1
Variable unfavourable	$\gamma_Q$	1.5	1.3
Variable favourable	$\gamma_Q$	0	0

## Material Factors

**Table A.NA.4 Partial factors for soil parameters ( $\gamma_M$ ) for the STR and GEO limit state**

Soil parameter	Symbol	Set	
		M1	M2
Angle of shearing resistance <sup>A)</sup>	$\gamma_{\phi'}$	1.0	1.25
Effective cohesion	$\gamma_c$	1.0	1.25
Undrained shear strength	$\gamma_{cu}$	1.0	1.4
Unconfined strength	$\gamma_{qu}$	1.0	1.4

<sup>A)</sup> Applied to  $\tan \phi'$  and  $\tan \phi'_{cv}$  although it might be more appropriate to determine the design value of  $\phi'_{cv}$  directly.

*NOTE The value of the partial factor should be taken as the reciprocal of the specified value if such a reciprocal value produces a more onerous effect than the specified value (but see also the Note to 2.4.2(9)P in BS EN 1997-1:2004).*

## Resistance Factors

Resistance factors 'R' are taken to be 1.0 in retaining wall design

600mm diameter Piles at 750mm c/c	Page No 1 Analysis
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Blue Hills Farm, Off Whitehall Rd West, Birkenshaw Retained Height = 3.65m	Engineer AM Date 27/11/2023

### Pile geometry

Pile top Level 169.75 m  
Pile Length 10 m  
Pile toe level 159.75 m

### Soils and ground water initial data (Soils data given for active and passive sides)

Initial Ground Water level 0

Top Level m	Description	Bulk Dens kN/m <sup>3</sup>	Sat' Dens kN/m <sup>3</sup>	Young Mod kN/m <sup>2</sup>	Young Inc. kN/m <sup>3</sup>	Cu C' kN/m <sup>2</sup>	C Inc. kN/m <sup>3</sup>	Phi Deg	Wall Shear Ratio	Ka Kp	Kac Kpc
169.75	Fill	18.00	20.00	16000	0			25	.50	.36	
								25	.50	3.22	
164.62	CLAY	20.00	20.00	15000	0			27	.50	.33	
								27	.50	3.60	
162.12	Mudstone	23.00	23.00	18667	0			28	.50	.32	
								28	.50	3.81	

### Construction sequence

Stage Ref	Stage Type	Level or Angle m/deg.	Load kN(/m)	Offset m	Width m	Length m
1	Active surcharge	169.75	10.0	.0		
2 A	Passive side excavation	166.10				
3 A	Moment load					

### Code of practice

Code of practice or reference document	Custom parameters (user selection)
Application of pressures for stability	Not applicable for FOS=1 on moments
FOS on moments (stability check)	1.00
ULS factor on Tan(Phi) values	1.00
ULS fFactor on drained cohesion values	1.00
ULS factor on undrained cohesion values	1.00
ULS factor on active soil pressures	1.00
ULS factor on passive soil pressures	1.00
ULS factor on active water pressures	1.00
ULS factor on passive water pressures	1.00
ULS factor on loads applied to the soil	1.00
ULS factor on loads applied to the wall	1.00
FOS on embedment (stability check)	1.00
Correction factor on cantilever embedment	1.20

600mm diameter Piles at 750mm c/c	Page No 2 Analysis
CADS Piled Wall Suite Version 6.07 Design of embedded retaining walls and cofferdams	Project T30295 File Name ...5m Wall_cBSI_00.pws"
Blue Hills Farm, Off Whitehall Rd West, Birkenshaw Retained Height = 3.65m	Engineer AM Date 27/11/2023

#### Wall analysis detail options

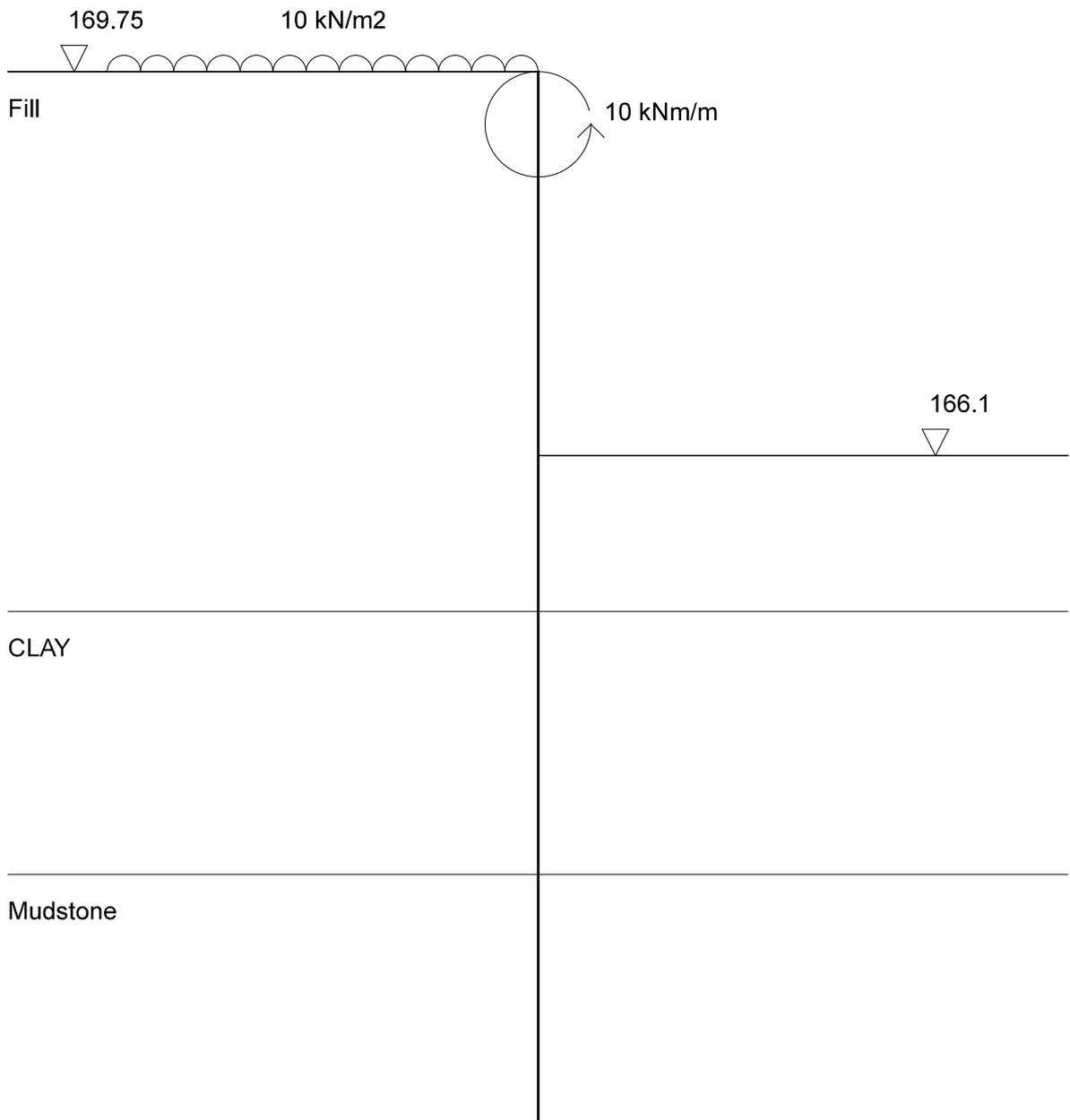
Nominal Phi for load distribution	30.0 Degrees
Depth of water filled tension cracks	.0 m
Density of water	10.0 kN/m <sup>3</sup>
Minimum equivalent fluid density	5.0 kN/m <sup>3</sup>
Depth of passive softened soil	1.0 m
Continuity model for wall analysis	Pins at second and lower props

#### Deflection parameters

Wall moment of inertia	848230 cm <sup>4</sup> /m
Wall Youngs modulus	27000000 kN/m <sup>2</sup>

600mm diameter Piles at 750mm c/c	Page No 3 Analysis
CADS Piled Wall Suite Version 6.07 Design of embedded retaining walls and cofferdams	Project T30295 File Name ...5m Wall_cBSI_00.pws"
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Stage ref. 3  
Stage type Moment load



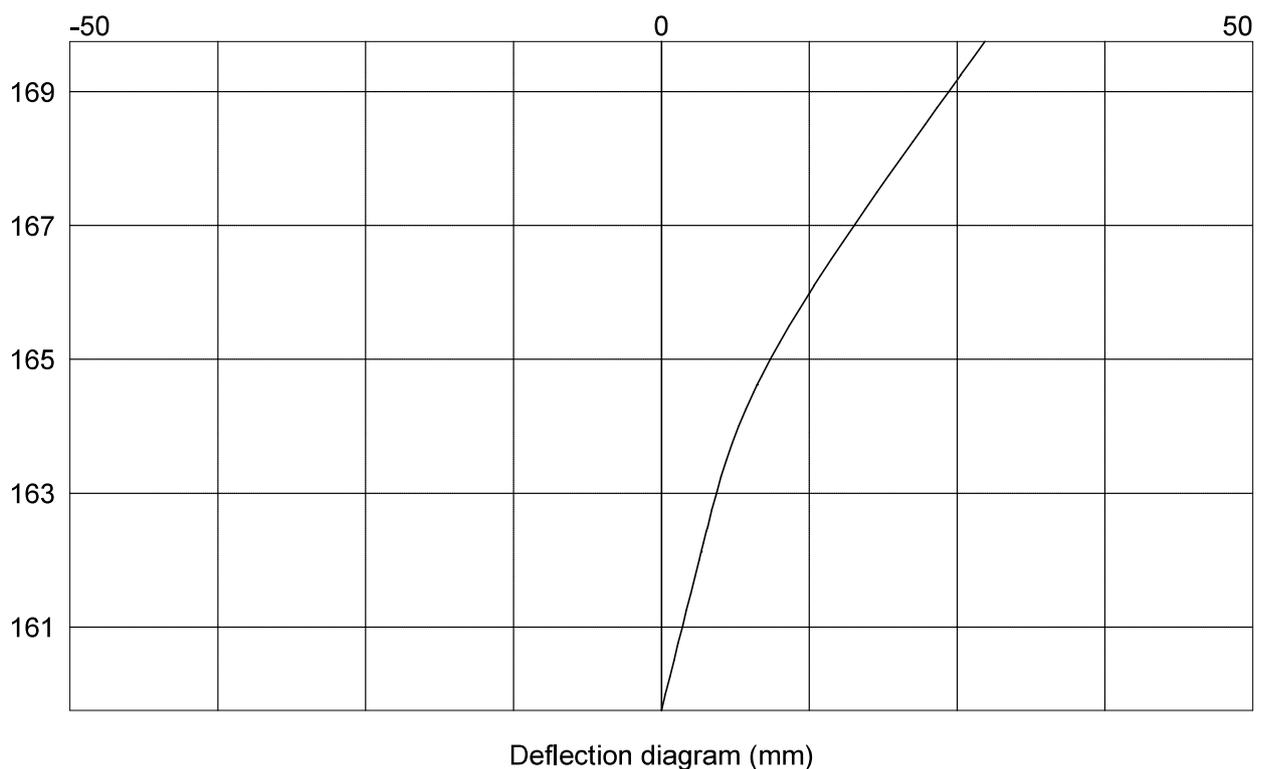
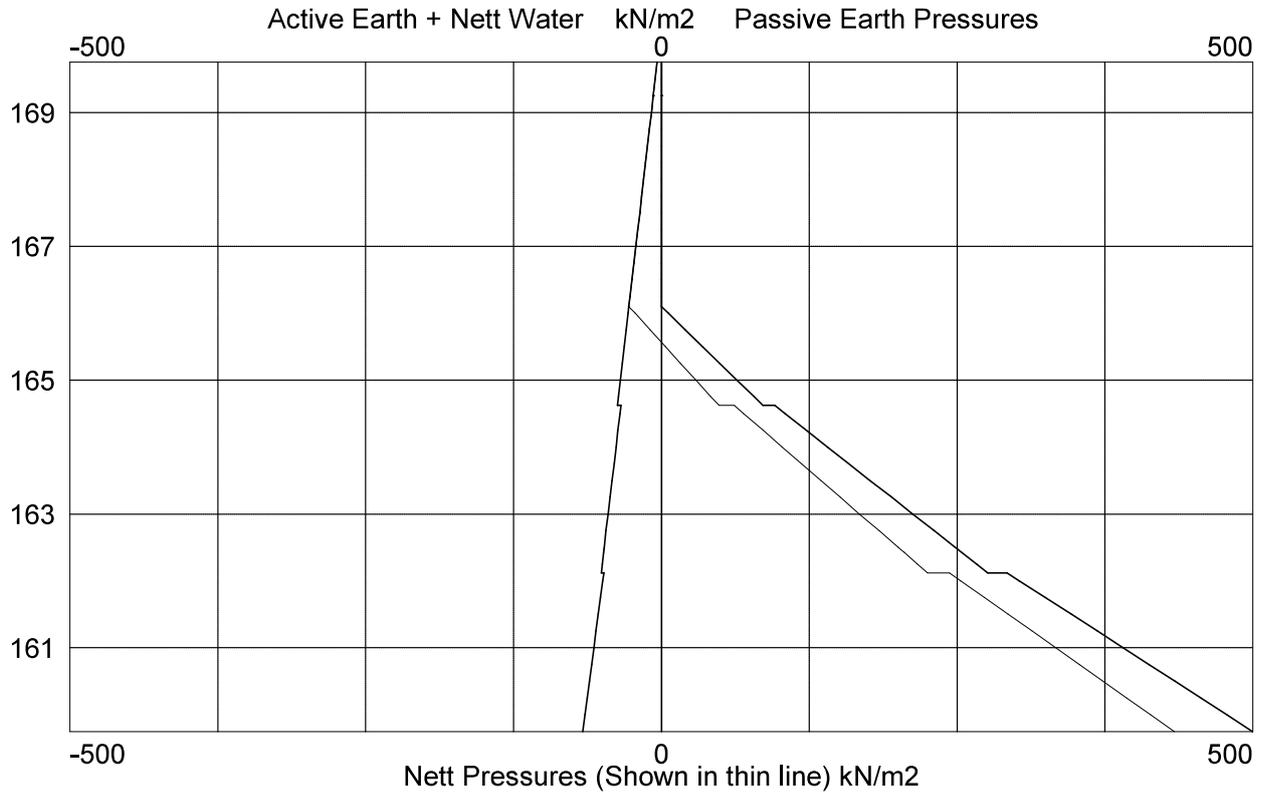
600mm diameter Piles at 750mm c/c	Page No 4 Analysis
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Tabular results from analysis of stage ref 3

Calc Level m	Active Vert kN/m <sup>2</sup>	Active Earth kN/m <sup>2</sup>	Active Water kN/m <sup>2</sup>	Pas' Vert kN/m <sup>2</sup>	Pas' Earth kN/m <sup>2</sup>	Pas' Water kN/m <sup>2</sup>	Total Nett kN/m <sup>2</sup>	Bend. Moment kNm/m	Shear Force kN/m	Defl't mm	Prop Force kN/m	FOS
169.75	10.0	3.6	.0	.0	.0	.0	3.6	0	0	27.4		.00
169.25	19.0	6.9	.0	.0	.0	.0	6.9	.6	-2.6	25.3		.00
169.25	19.0	6.9	.0	.0	.0	.0	6.9	10.6	-2.6	25.3		.00
169.00	23.5	8.5	.0	.0	.0	.0	8.5	11.5	-4.6	24.3		.00
168.00	41.5	15.0	.0	.0	.0	.0	15.0	21.4	-16.3	20.2		.00
167.00	59.5	21.6	.0	.0	.0	.0	21.6	46.3	-34.7	16.3		.00
166.10	75.7	27.4	.0	.0	.0	.0	27.4	86.9	-56.7	12.9		.00
166.10	75.7	27.5	.0	.0	.0	.0	27.5	87.1	-56.7	12.9		.00
166.00	77.5	28.1	.0	1.8	5.8	.0	22.3	92.9	-59.2	12.5		.00
165.00	95.5	34.6	.0	19.8	63.8	.0	-29.2	154.6	-55.8	9.2		.05
164.62	102.3	37.1	.0	26.6	85.8	.0	-48.7	173.3	-41.0	8.1		.10
164.62	102.3	34.2	.0	26.6	95.9	.0	-61.8	173.3	-41.0	8.1		.10
164.00	114.7	38.3	.0	39.0	140.6	.0	-102.3	184.2	9.9	6.5		.22
163.00	134.7	45.0	.0	59.0	212.6	.0	-167.6	112.3	144.8	4.6		.51
162.47	145.4	48.5	.0	69.7	251.0	.0	-202.4	9.7	243.4	3.9		.70
162.43	146.2	48.8	.0	70.5	253.8	.0	-205.0	0	251.5	3.8		.72
162.12	152.3	50.9	.0	76.6	276.0	.0	-225.1	-22.5	146.4	3.4		.83
162.12	152.3	48.8	.0	76.6	292.2	.0	-243.4	-22.5	146.4	3.4		.83
162.00	155.1	49.7	.0	79.4	302.7	.0	-253.0	-22.5	105.3	3.2		.88
161.00	178.1	57.0	.0	102.4	390.4	.0	-333.3	0	0	1.8		1.28
160.00	201.1	64.4	.0	125.4	478.1	.0	-413.7	0	0	.4		1.71
159.75	206.9	66.2	.0	131.2	500.0	.0	-433.7	0	0	0		1.82

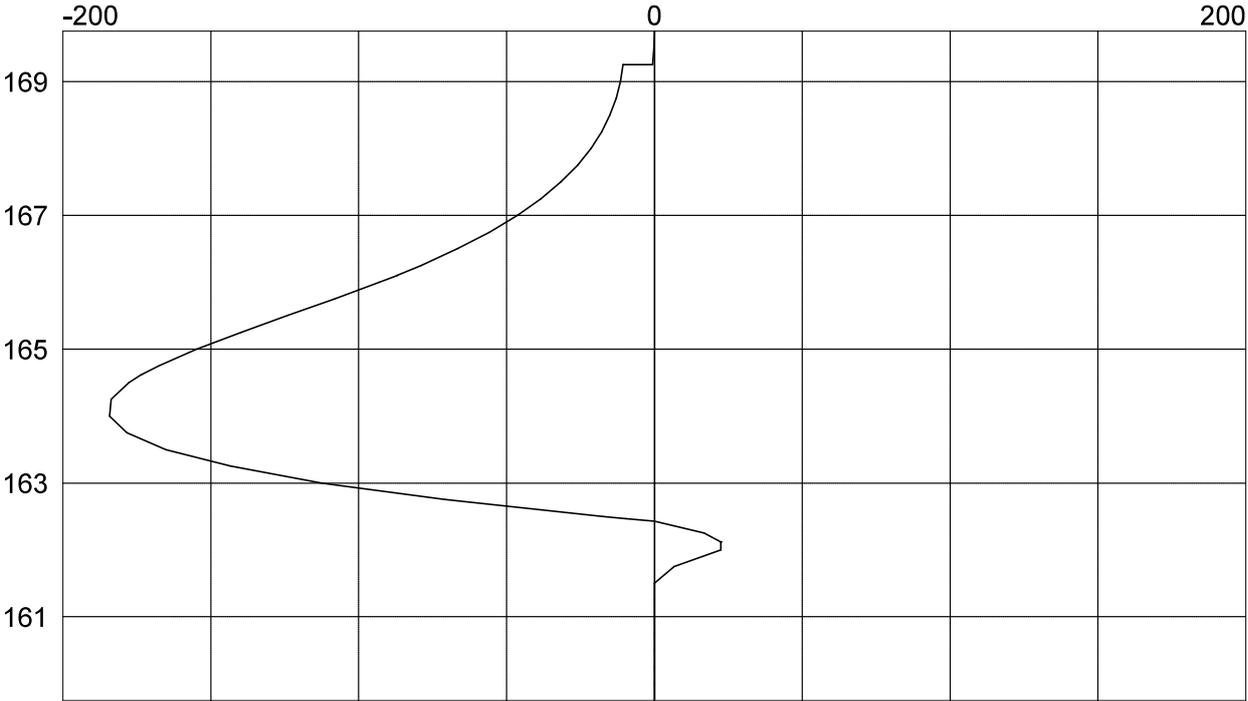
600mm diameter Piles at 750mm c/c	Page No 5 Analysis
CADS Piled Wall Suite Version 6.07 Design of embedded retaining walls and cofferdams	Project T30295 File Name ...5m Wall_cBSI_00.pws"
Blue Hills Farm, Off Whitehall Rd West, Birkenshaw Retained Height = 3.65m	Engineer AM Date 27/11/2023

Graphical results from analysis of stage ref 3

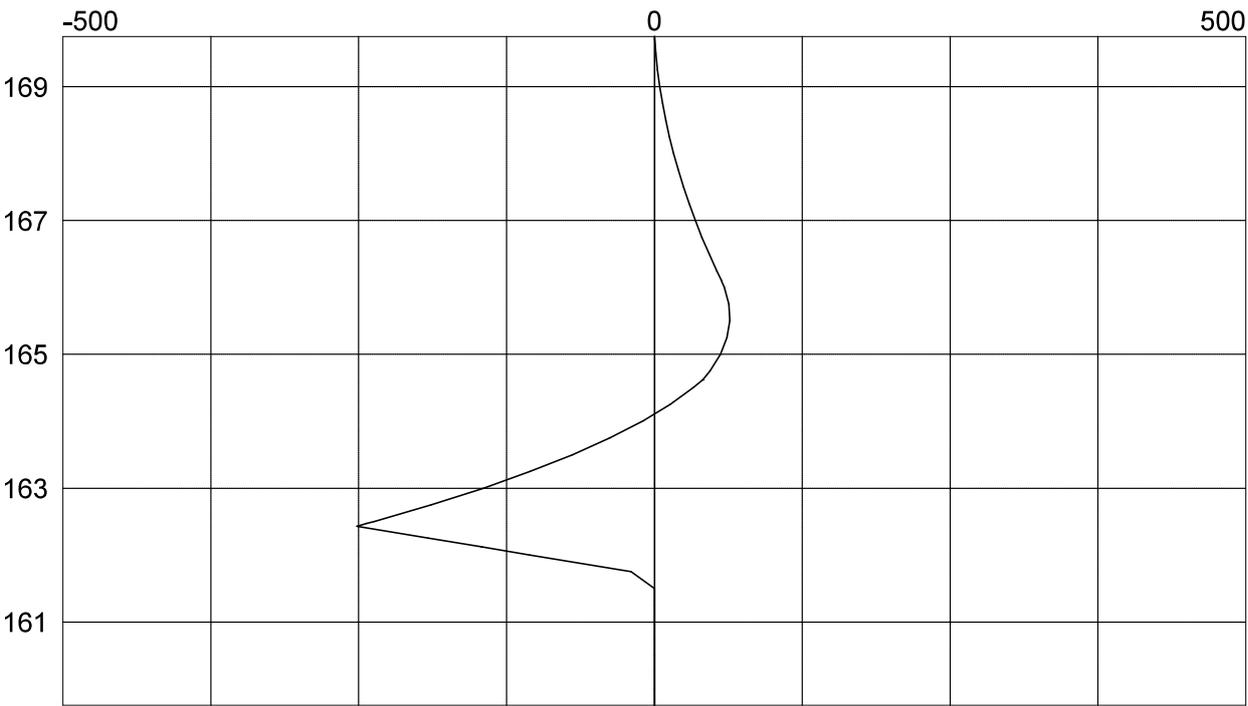


600mm diameter Piles at 750mm c/c	Page No 6 Analysis
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Graphical results from analysis of stage ref 3 continued



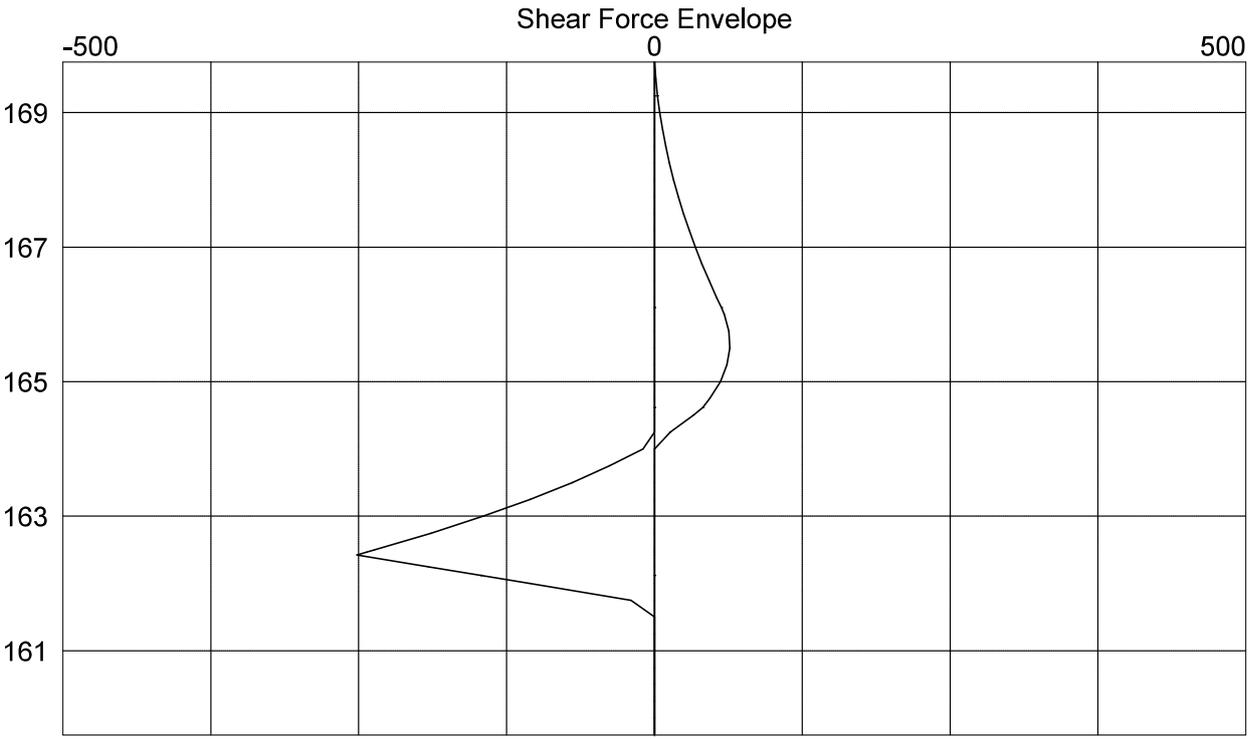
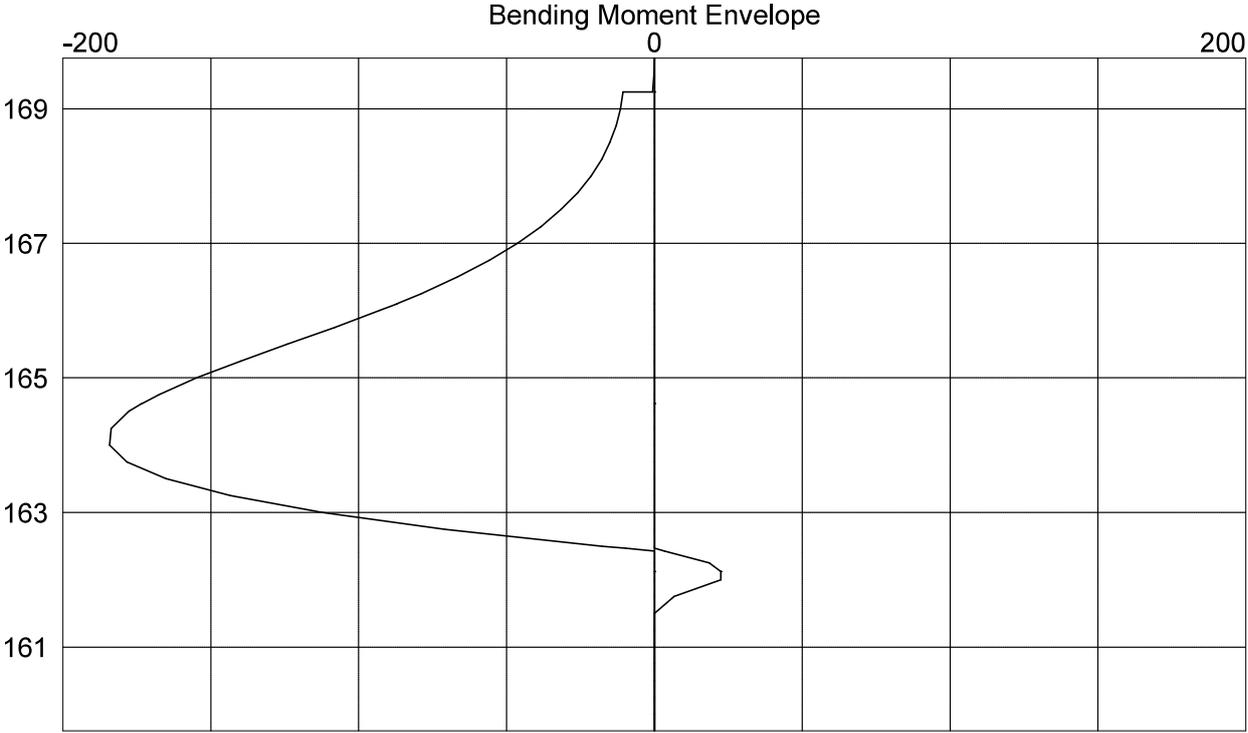
Bending Moment Diagram (kNm/m)



Shear Force Diagram (kN/m)

600mm diameter Piles at 750mm c/c	Page No 7 Analysis
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Graphical plot of envelope from selected construction stages



600mm diameter Piles at 750mm c/c	Page No 8 Analysis
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Table of envelope for wall forces

Calc Level m	Bending Minimum kNm/m	Bending Maximum kNm/m	Shear Minimum kN/m	Shear Maximum kN/m	Prop Force kN/m
169.75	.0	.0	.0	.0	
169.25	.0	.6	-2.6	.0	
169.25	.0	10.6	-2.6	.0	
169.00	.0	11.5	-4.6	.0	
168.00	.0	21.4	-16.3	.0	
167.00	.0	46.3	-34.7	.0	
166.10	.0	86.9	-56.7	.0	
166.10	.0	87.1	-56.7	.0	
166.00	.0	92.9	-59.2	.0	
165.00	.0	154.6	-55.8	.0	
164.62	.0	173.3	-41.0	.0	
164.62	.0	173.3	-41.0	.0	
164.00	.0	184.2	.0	9.9	
163.00	.0	112.3	.0	144.8	
162.47	.0	9.7	.0	243.4	
162.43	-3.4	.0	.0	251.5	
162.12	-22.5	.0	.0	146.4	
162.12	-22.5	.0	.0	146.4	
162.00	-22.5	.0	.0	105.3	
161.00	.0	.0	.0	.0	
160.00	.0	.0	.0	.0	
159.75	.0	.0	.0	.0	

600mm diameter Piles at 750mm c/c	Page No 9 Analysis
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Blue Hills Farm, Off Whitehall Rd West, Birkenshaw Retained Height = 3.65m	Engineer AM Date 27/11/2023

## Structural design of wall

### Wall section properties

Primary pile diameter	600 mm
Primary pile spacing	750 mm
Infill pile diameter	mm
Main rebar bar diameter	25 mm
Main rebar number of bars	8
Links/Helix bar diameter	10 mm
Links/Helix spacing/pitch	150 mm

### Wall material properties

Concrete cube strength	35 N/mm <sup>2</sup>
Concrete cover	75 mm
Main rebar steel grade	500 N/mm <sup>2</sup>
Link rebar steel grade	500 N/mm <sup>2</sup>
Ultimate load factor	1.40

### Wall structural design checks

Check description	Required or Limit	Provided or Actual	Units
Bending resistance, EC2 plane strain model	193	309	kNm
Max main steel, EC2 9.5.2(3), 4%	11310	3927	mm <sup>2</sup>
Min main steel, EC2 9.8.5(3)	1414	3927	mm <sup>2</sup>
Shear resistance, EC2 variable angle truss model	264	408	kN
Max main steel spc, BS EN 1536+A1:2015	400	130	mm
Min main steel spc, BS EN 1536+A1:2015	100	130	mm
Min link diameter, EC2 9.5.3(1), 0.25x long. bar dia.	8	10	mm
Max link spc, EC2 9.5.3(2) + 9.2.2(6), 400mm/20xbar/0.309	309	150	mm
Min link spc, BS EN 1536:2010+A1:2015	100	150	mm

600mm diameter Piles at 750mm c/c	Page No 1 Analysis
CADS Piled Wall Suite Version 6.07 Design of embedded retaining walls and cofferdams	Project T30295 File Name ... wall_am_cbsi_01.pws
Blue Hills Farm, Off Whitehall Rd West, Birkenshaw Retained Height = 4.2m	Engineer AM Date 27/11/2023

### Pile geometry

Pile top Level 169.75 m  
Pile Length 11.5 m  
Pile toe level 158.25 m

### Soils and ground water initial data (Soils data given for active and passive sides)

Initial Ground Water level 0

Top Level m	Description	Bulk Dens kN/m <sup>3</sup>	Sat' Dens kN/m <sup>3</sup>	Young Mod kN/m <sup>2</sup>	Young Inc. kN/m <sup>3</sup>	Cu C' kN/m <sup>2</sup>	C Inc. kN/m <sup>3</sup>	Phi Deg	Wall Shear Ratio	Ka	Kac
169.75	Fill	18.00	20.00	16000	0			25	.50	.36	
								25	.50	3.22	
164.62	CLAY	20.00	20.00	15000	0			27	.50	.33	
								27	.50	3.60	
162.12	Mudstone	23.00	23.00	18667	0			28	.50	.32	
								28	.50	3.81	

### Construction sequence

Stage Ref	Stage Type	Level or Angle m/deg.	Load kN(/m)	Offset m	Width m	Length m
1	Active surcharge	169.75	10.0	.0		
2 A	Passive side excavation	165.55				
3 A	Moment load					

### Code of practice

Code of practice or reference document	Custom parameters (user selection)
Application of pressures for stability	Not applicable for FOS=1 on moments
FOS on moments (stability check)	1.00
ULS factor on Tan(Phi) values	1.00
ULS fFactor on drained cohesion values	1.00
ULS factor on undrained cohesion values	1.00
ULS factor on active soil pressures	1.00
ULS factor on passive soil pressures	1.00
ULS factor on active water pressures	1.00
ULS factor on passive water pressures	1.00
ULS factor on loads applied to the soil	1.00
ULS factor on loads applied to the wall	1.00
FOS on embedment (stability check)	1.00
Correction factor on cantilever embedment	1.20

600mm diameter Piles at 750mm c/c	Page No 2 Analysis
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Blue Hills Farm, Off Whitehall Rd West, Birkenshaw Retained Height = 4.2m	Engineer AM Date 27/11/2023

#### Wall analysis detail options

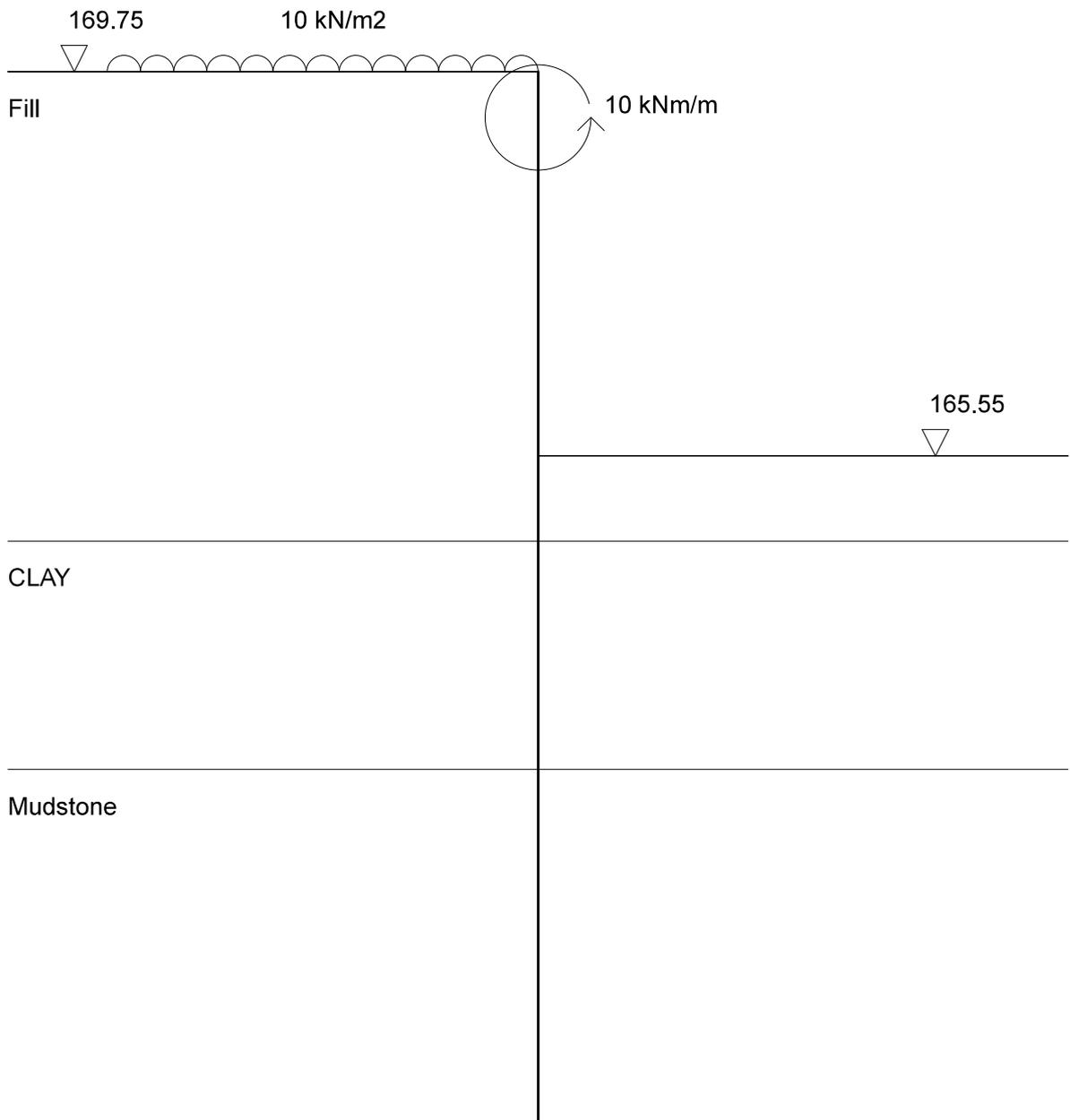
Nominal Phi for load distribution	30.0 Degrees
Depth of water filled tension cracks	.0 m
Density of water	10.0 kN/m <sup>3</sup>
Minimum equivalent fluid density	5.0 kN/m <sup>3</sup>
Depth of passive softened soil	1.0 m
Continuity model for wall analysis	Pins at second and lower props

#### Deflection parameters

Wall moment of inertia	848230 cm <sup>4</sup> /m
Wall Youngs modulus	27000000 kN/m <sup>2</sup>

600mm diameter Piles at 750mm c/c	Page No 3 Analysis
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Blue Hills Farm, Off Whitehall Rd West, Birkenshaw Retained Height = 4.2m	Engineer AM Date 27/11/2023

Stage ref. 3  
Stage type Moment load



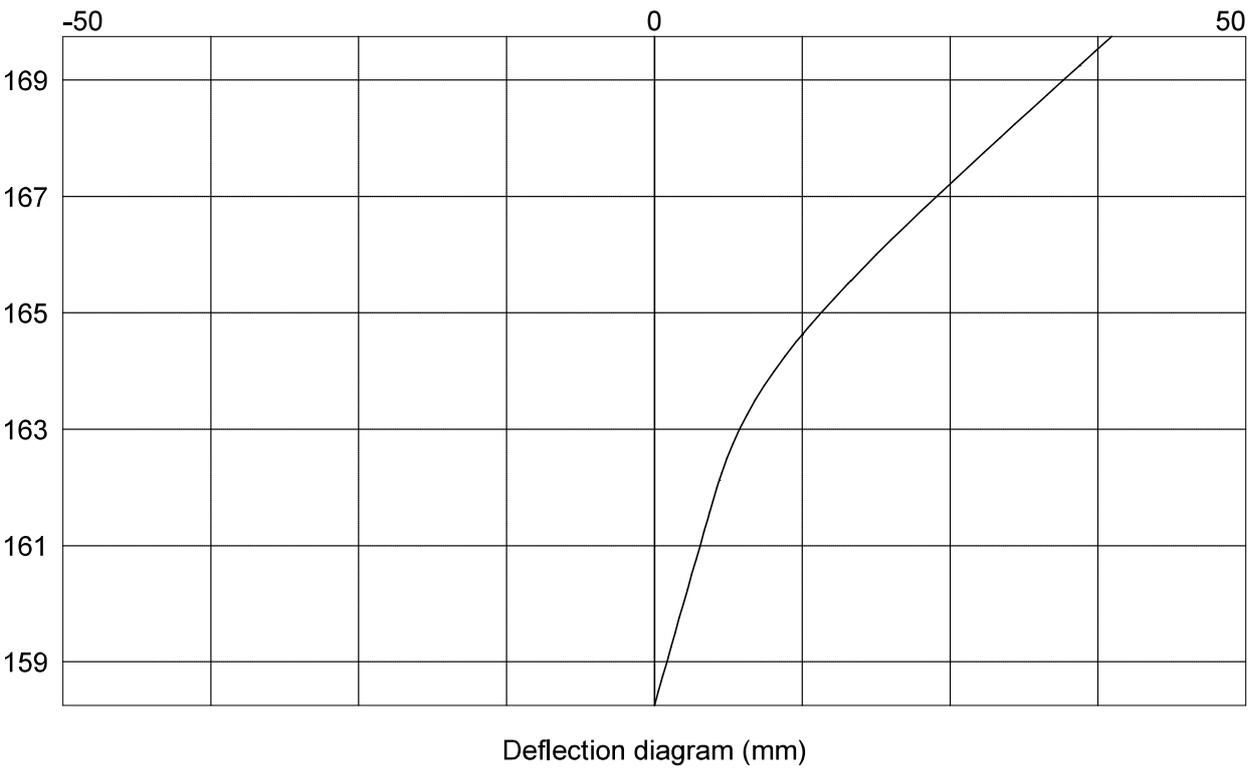
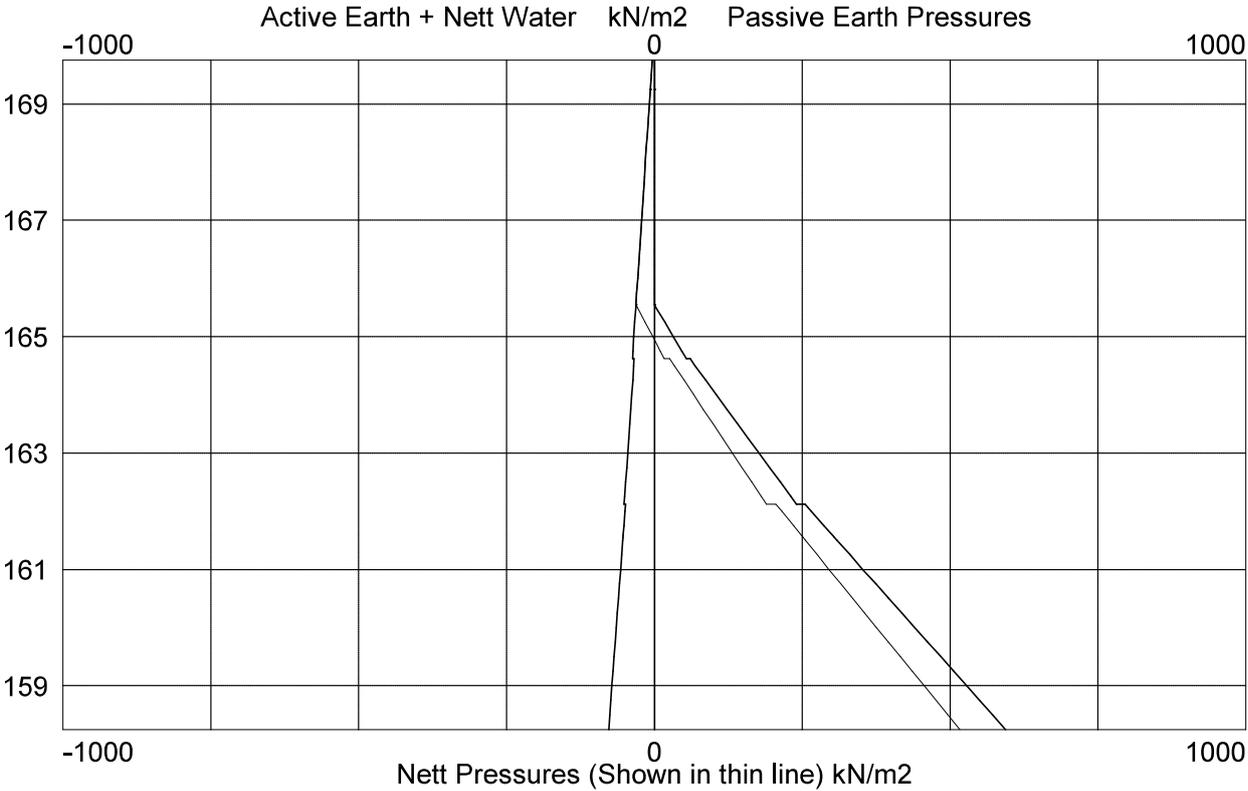
600mm diameter Piles at 750mm c/c	Page No 4 Analysis
CADS Piled Wall Suite Version 6.07 Design of embedded retaining walls and cofferdams	Project T30295 File Name ... wall_am_cbsi_01.pws
Blue Hills Farm, Off Whitehall Rd West, Birkenshaw Retained Height = 4.2m	Engineer AM Date 27/11/2023

Tabular results from analysis of stage ref 3

Calc Level m	Active Vert kN/m2	Active Earth kN/m2	Active Water kN/m2	Pas' Vert kN/m2	Pas' Earth kN/m2	Pas' Water kN/m2	Total Nett kN/m2	Bend. Moment kNm/m	Shear Force kN/m	Defl't mm	Prop Force kN/m	FOS
169.75	10.0	3.6	.0	.0	.0	.0	3.6	0	0	38.7		.00
169.25	19.0	6.9	.0	.0	.0	.0	6.9	.6	-2.6	35.9		.00
169.25	19.0	6.9	.0	.0	.0	.0	6.9	10.6	-2.6	35.9		.00
169.00	23.5	8.5	.0	.0	.0	.0	8.5	11.5	-4.6	34.6		.00
168.00	41.5	15.0	.0	.0	.0	.0	15.0	21.4	-16.3	29.2		.00
167.00	59.5	21.6	.0	.0	.0	.0	21.6	46.3	-34.7	23.9		.00
166.00	77.5	28.1	.0	.0	.0	.0	28.1	92.9	-59.5	18.8		.00
165.55	85.6	31.0	.0	.0	.0	.0	31.0	122.4	-72.7	16.6		.00
165.55	85.6	31.0	.0	.0	.0	.0	31.0	122.6	-72.8	16.6		.00
165.00	95.5	34.6	.0	9.9	31.9	.0	2.7	165.9	-82.1	14.1		.01
164.62	102.3	37.1	.0	16.7	53.9	.0	-16.8	196.8	-79.4	12.5		.02
164.62	102.3	34.2	.0	16.7	60.3	.0	-26.1	196.9	-79.4	12.5		.02
164.00	114.7	38.3	.0	29.1	104.9	.0	-66.6	238.4	-50.7	10.1		.09
163.00	134.7	45.0	.0	49.1	176.9	.0	-132.0	244.9	48.6	7.2		.28
162.12	152.3	50.9	.0	66.7	240.3	.0	-189.4	143.6	190.0	5.5		.53
162.12	152.3	48.8	.0	66.7	254.4	.0	-205.6	143.4	190.0	5.5		.53
162.00	155.1	49.7	.0	69.5	265.0	.0	-215.3	119.3	215.3	5.3		.57
161.58	164.7	52.7	.0	79.1	301.6	.0	-248.9	9.6	312.3	4.7		.71
161.55	165.4	53.0	.0	79.8	304.4	.0	-251.4	0	320.3	4.6		.72
161.00	178.1	57.0	.0	92.5	352.6	.0	-295.6	-27.5	100.1	3.9		.91
160.00	201.1	64.4	.0	115.5	440.3	.0	-375.9	0	0	2.5		1.29
159.00	224.1	71.8	.0	138.5	528.0	.0	-456.2	0	0	1.1		1.69
158.25	241.4	77.3	.0	155.8	593.8	.0	-516.5	0	0	0		1.99

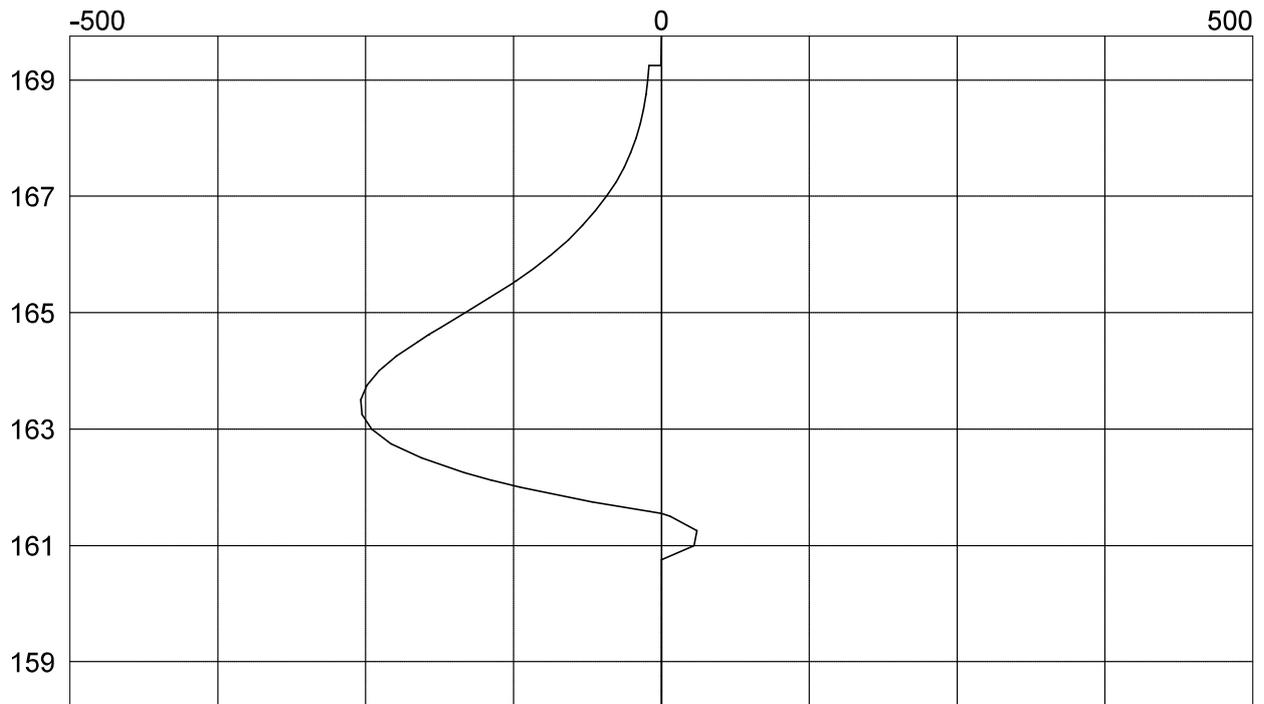
600mm diameter Piles at 750mm c/c	Page No 5 Analysis
CADS Piled Wall Suite Version 6.07 Design of embedded retaining walls and cofferdams	Project T30295 File Name ... wall_am_cbsi_01.pws
Blue Hills Farm, Off Whitehall Rd West, Birkenshaw Retained Height = 4.2m	Engineer AM Date 27/11/2023

Graphical results from analysis of stage ref 3

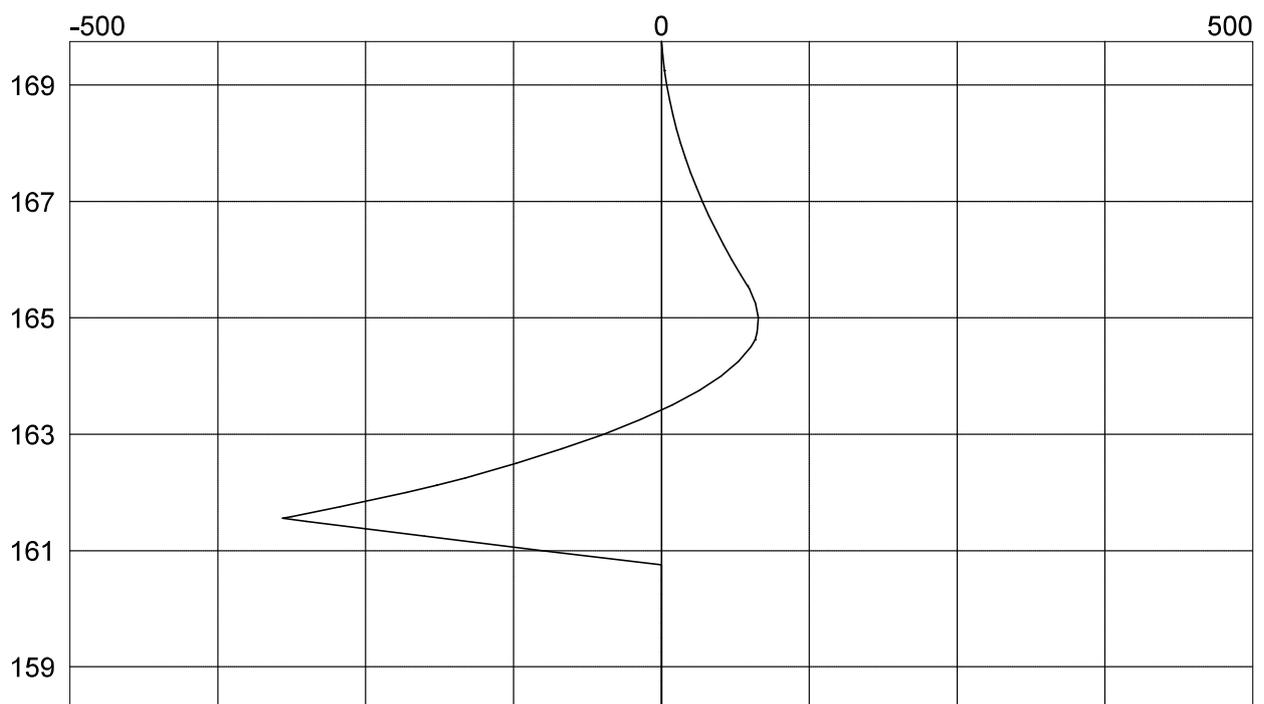


600mm diameter Piles at 750mm c/c	Page No 6 Analysis
CADS Piled Wall Suite Version 6.07 Design of embedded retaining walls and cofferdams	Project T30295 File Name ... wall_am_cbsi_01.pws
Blue Hills Farm, Off Whitehall Rd West, Birkenshaw Retained Height = 4.2m	Engineer AM Date 27/11/2023

Graphical results from analysis of stage ref 3 continued



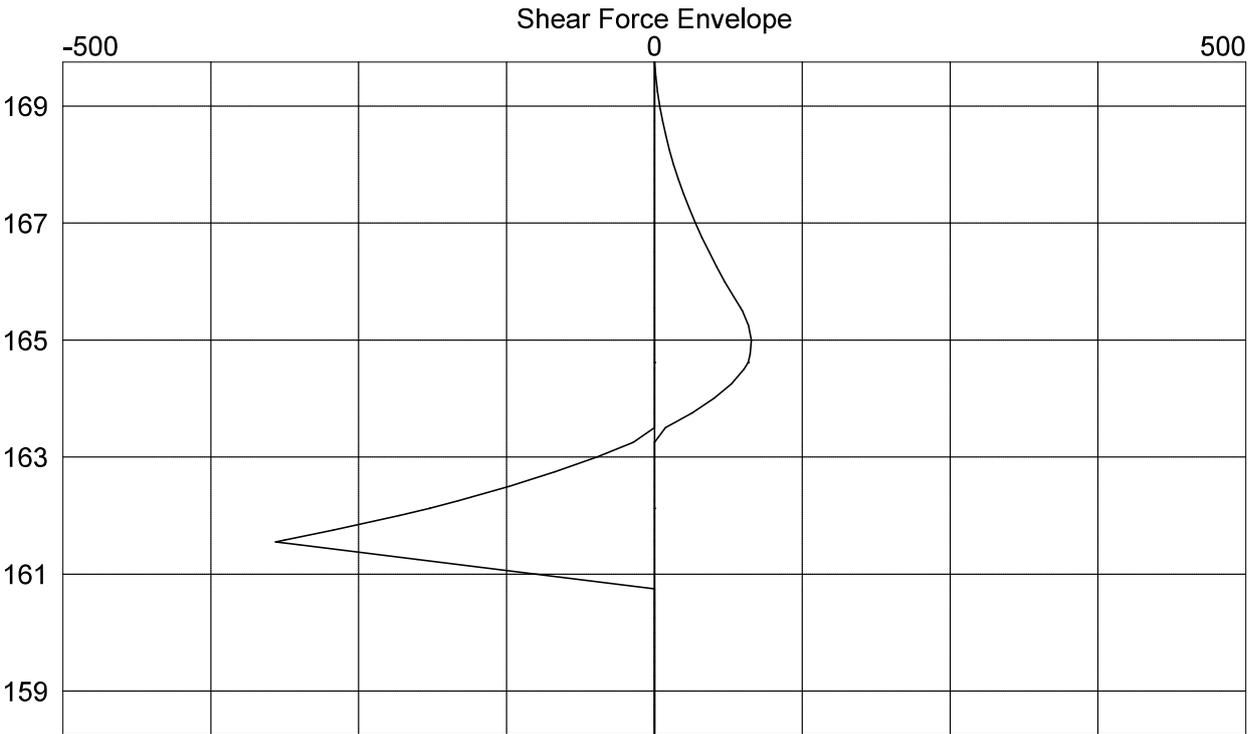
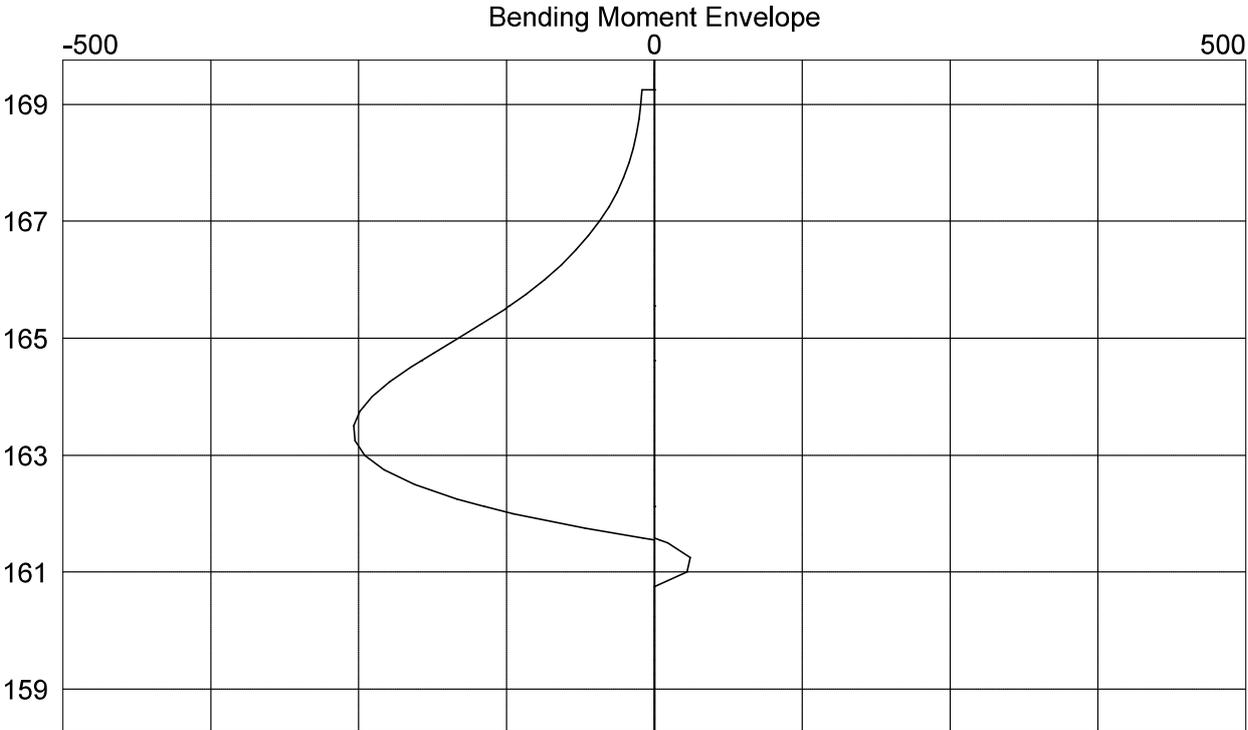
Bending Moment Diagram (kNm/m)



Shear Force Diagram (kN/m)

600mm diameter Piles at 750mm c/c	Page No 7 Analysis
CADS Piled Wall Suite Version 6.07 Design of embedded retaining walls and cofferdams	Project T30295 File Name ... wall_am_cbsi_01.pws
Blue Hills Farm, Off Whitehall Rd West, Birkenshaw Retained Height = 4.2m	Engineer AM Date 27/11/2023

Graphical plot of envelope from selected construction stages



600mm diameter Piles at 750mm c/c	Page No 8 Analysis
CADS Piled Wall Suite Version 6.07 Design of embedded retaining walls and cofferdams	Project T30295 File Name ... wall_am_cbsi_01.pws
Blue Hills Farm, Off Whitehall Rd West, Birkenshaw Retained Height = 4.2m	Engineer AM Date 27/11/2023

Table of envelope for wall forces

Calc Level m	Bending Minimum kNm/m	Bending Maximum kNm/m	Shear Minimum kN/m	Shear Maximum kN/m	Prop Force kN/m
169.75	.0	.0	.0	.0	
169.25	.0	.6	-2.6	.0	
169.25	.0	10.6	-2.6	.0	
169.00	.0	11.5	-4.6	.0	
168.00	.0	21.4	-16.3	.0	
167.00	.0	46.3	-34.7	.0	
166.00	.0	92.9	-59.5	.0	
165.55	.0	122.4	-72.7	.0	
165.55	.0	122.6	-72.8	.0	
165.00	.0	165.9	-82.1	.0	
164.62	.0	196.8	-79.4	.0	
164.62	.0	196.9	-79.4	.0	
164.00	.0	238.4	-50.7	.0	
163.00	.0	244.9	.0	48.6	
162.12	.0	143.6	.0	190.0	
162.12	.0	143.4	.0	190.0	
162.00	.0	119.3	.0	215.3	
161.58	.0	9.6	.0	312.3	
161.55	-4.5	.0	.0	320.3	
161.00	-27.5	.0	.0	100.1	
160.00	.0	.0	.0	.0	
159.00	.0	.0	.0	.0	
158.25	.0	.0	.0	.0	

600mm diameter Piles at 750mm c/c	Page No 9 Analysis
CADS Piled Wall Suite Version 6.07 Design of embedded retaining walls and cofferdams	Project T30295 File Name ... wall_am_cbsi_01.pws
Blue Hills Farm, Off Whitehall Rd West, Birkenshaw Retained Height = 4.2m	Engineer AM Date 27/11/2023

## Structural design of wall

### Wall section properties

Primary pile diameter	600 mm
Primary pile spacing	750 mm
Infill pile diameter	mm
Main rebar bar diameter	32 mm
Main rebar number of bars	8
Links/Helix bar diameter	10 mm
Links/Helix spacing/pitch	150 mm

### Wall material properties

Concrete cube strength	35 N/mm <sup>2</sup>
Concrete cover	75 mm
Main rebar steel grade	500 N/mm <sup>2</sup>
Link rebar steel grade	500 N/mm <sup>2</sup>
Ultimate load factor	1.40

### Wall structural design checks

Check description	Required or Limit	Provided or Actual	Units
Bending resistance, EC2 plane strain model	267	440	kNm
Max main steel, EC2 9.5.2(3), 4%	11310	6434	mm <sup>2</sup>
Min main steel, EC2 9.8.5(3)	1414	6434	mm <sup>2</sup>
Shear resistance, EC2 variable angle truss model	336	484	kN
Max main steel spc, BS EN 1536+A1:2015	400	120	mm
Min main steel spc, BS EN 1536+A1:2015	100	120	mm
Min link diameter, EC2 9.5.3(1), 0.25x long. bar dia.	8	10	mm
Max link spc, EC2 9.5.3(2) + 9.2.2(6), 400mm/20xbar/0.25d	250	150	mm
Min link spc, BS EN 1536:2010+A1:2015	100	150	mm



## Title & Specification

Job number T30019  
 Job title  
 Subtitle  
 Calc. heading  
 File X:\Job Files\M and  
 D\T30000 - T30999\T30295  
 - Blue Hills Farm, Off  
 Whitehall Rd West,  
 Birkenshaw, BD11 2DU\08  
 - M&D Design  
 Calculations\8.2  
 Contract Design\600 dia  
 with 8 B25 cage.ads  
 Notes (none)  
 Code of Practice BS EN 1992-1-1:2004  
 [United Kingdom]  
 Bending Axes Biaxial  
 Number of sections 1  
 Number of ULS cases 1  
 Number of SLS cases 0

## Section : Definition

### 1 : 600mm dia piles

Name 600mm dia piles  
 Type Concrete  
 Material C30/37  
 Origin Centre  
 Dimensions  
 Diameter 600.0mm  
 Section Area 282700.mm<sup>2</sup>  
 Reinforcement Area 3927.mm<sup>2</sup>  
 Reinforcement 1.389%

## Section : Nodes

### 1 : 600mm dia piles

Node	Y [mm]	Z [mm]
1	0.0	301.3
2	67.04	293.7
3	130.7	271.4
4	187.8	235.5
5	235.5	187.8
6	271.4	130.7
7	293.7	67.04
8	301.3	-13.17E-6
9	293.7	-67.04
10	271.4	-130.7
11	235.5	-187.8
12	187.8	-235.5
13	130.7	-271.4
14	67.04	-293.7
15	-26.34E-6	-301.3
16	-67.04	-293.7
17	-130.7	-271.4
18	-187.8	-235.5
19	-235.5	-187.8
20	-271.4	-130.7
21	-293.7	-67.04
22	-301.3	3.593E-6
23	-293.7	67.04
24	-271.4	130.7
25	-235.5	187.8
26	-187.8	235.5
27	-130.7	271.4
28	-67.04	293.7

## Section : Cover & Links

### 1 : 600mm dia piles

Cover 75.00mm  
 Link Size 10.00mm  
 Link Material 500B

## Section : Bars

### 1 : 600mm dia piles

Bar	Y [mm]	Z [mm]	Diameter [mm]	Area [mm <sup>2</sup> ]	Effective Area [mm <sup>2</sup> ]	Type	Material	Prestress Force [kN]	Prestress Strain	Appl. loads include/exclude prestress
1	202.5	0.0	25.00	490.9	490.9	Steel	500B	490.9		
2	143.2	143.2	25.00	490.9	490.9	Steel	500B	490.9		
3	11.54E-6	202.5	25.00	490.9	490.9	Steel	500B	490.9		
4	-143.2	143.2	25.00	490.9	490.9	Steel	500B	490.9		
5	-202.5	23.09E-6	25.00	490.9	490.9	Steel	500B	490.9		
6	-143.2	-143.2	25.00	490.9	490.9	Steel	500B	490.9		
7	-9.436E-6	-202.5	25.00	490.9	490.9	Steel	500B	490.9		
8	143.2	-143.2	25.00	490.9	490.9	Steel	500B	490.9		

## Section : Elastic Properties

### 1 : 600mm dia piles

#### Effective properties of the section, ignoring reinforcement.

Geometric Centroid	y	0.0mm
	z	0.0mm
Area		282700.mm <sup>2</sup>
Second Moments of Area	I <sub>yy</sub>	6.362E+9mm <sup>4</sup>
	I <sub>zz</sub>	6.362E+9mm <sup>4</sup>
	I <sub>yz</sub>	0.0mm <sup>4</sup>
Principal Second Moments of Area	I <sub>uu</sub>	6.362E+9mm <sup>4</sup>
	I <sub>zz</sub>	6.362E+9mm <sup>4</sup>
Shear Area Factor	Angle	0.0°
	k <sub>y</sub>	0.8571
	k <sub>z</sub>	0.8571
Torsion Constant		12.72E+9mm <sup>4</sup>
Section Modulus	Z <sub>y</sub>	21.21E+6mm <sup>3</sup>
	Z <sub>z</sub>	21.21E+6mm <sup>3</sup>

Bar	Y	Z	Diameter	Area	Effective Area	Type	Material	Prestress Force	Prestress Strain	Appl. loads include/exclude prestress
	[mm]	[mm]	[mm]	[mm <sup>2</sup> ]	[mm <sup>2</sup> ]			[kN]		
Plastic Modulus			$Z_{py}$		$36.00E+6mm^3$					
			$Z_{pz}$		$36.00E+6mm^3$					
Radius of Gyration			$R_y$		150.0mm					
			$R_z$		150.0mm					

#### Properties of gross section, including reinforcement.

Geometric Centroid	Y	0.0mm
	Z	769.1E-9mm
EA		9.941E+6kN
EI	$EI_{yy}$	222400. kNm <sup>2</sup>
	$EI_{zz}$	222400. kNm <sup>2</sup>
	$EI_{yz}$	0.0kNm <sup>2</sup>
Principal EI	$EI_{uu}$	222400. kNm <sup>2</sup>
	$EI_{zz}$	222400. kNm <sup>2</sup>
	Angle	0.0°

#### Material : Concrete

##### 1 : C30/37

Name	C30/37 (Standard)
Cylinder Strength	$f_{ck}$ 30.00N/mm <sup>2</sup>
Tensile Strength	$f_{ctm}$ 2.896N/mm <sup>2</sup>
Weight	Normal Weight
Density	$\rho$ 2.400t/m <sup>3</sup>
Elastic Modulus	E 32840. N/mm <sup>2</sup>
Poisson's Ratio	$\nu$ 0.2000
Coeff. Thermal Expansion	$\alpha$ 10.00E-6/°C
Partial Factor	$\gamma_c$ 1.500
Safety Factor	
Maximum Strain	0.003500
Plateau Strain	0.002000
UFS	Parabola
Compression Curve	rectangle
UFS Tension Curve	No-tension
SLS	FIB Model
Compression Curve	Code
SLS Tension Curve	Interpolated
Design strength factor	$\alpha_{cc}$ 0.8500
Aggregate Size	20.00mm

#### Material : Rebar

##### 1 : 500B

Type	Steel rebar
Strength	$f_{yk}$ 500.0N/mm <sup>2</sup>
Elastic Modulus	E 200000. N/mm <sup>2</sup>
Hardening Modulus	$E_h$ 0.0N/mm <sup>2</sup>
Density	$\rho$ 7.850t/m <sup>3</sup>
Poisson's Ratio	$\nu$ 0.3000
Coeff. Thermal Expansion	$\alpha$ 12.00E-6/°C
Ductility	Normal
Partial Safety Factor	$\gamma_s$ 1.150
	$\gamma_{se}$ 1.000
Maximum Strain	$\epsilon_{uk}$ 0.05000
Maximum Strain	$\epsilon_{ud}$ 0.05000
Stress/Strain Curve	Elastic-plastic

#### Loading

##### Reference Point

All loading acts through the Reference Point.  
All strain planes are defined relative to the Reference Point.

Definition	Geometric Centroid
Reference Point Coordinates	Y 0.0mm
	Z 0.0mm

##### Load Case Titles

Load Case	Title
1	L1

##### Applied loads

Load Case	N	$M_{yy}$	$M_{zz}$	Note
	[kN]	[kNm]	[kNm]	
1	0.0	185.0	0.0	

##### Section 1 Details

1.39% reinforcement in section 1 (600mm dia piles). Check this against code requirements.

##### ULS Cases Analysed

Load Case	N [kN]	M <sub>yy</sub> [kNm]	M <sub>zz</sub> [kNm]	Note
1	277.5	0.0	277.5	

Name	Section	Loading	Prestress Factor
ULS Case 1	1 : 600mm dia piles	1.5L1	1.000

### Strength Analysis - Loads

Case	N	M <sub>yy</sub>	M <sub>zz</sub>	M	θ
	[kN]	[kNm]	[kNm]	[kNm]	[°]
1	0.0	277.5	0.0	277.5	0.0

### Strength Analysis - Summary

Governing conditions are defined as:  
 A - reinforcing steel tension strain limit  
 B - concrete compression strain limit  
 C - concrete pure compression strain limit  
 Eurocode 2 Section 6.1  
 Effective centroid is reported relative to the reference point.

Case	Eff. Centroid (y)	Eff. Centroid (z)	N [kN]	M [kNm]	M <sub>u</sub> [kNm]	M/M <sub>u</sub>	Governing Condition	Neutral Axis Angle [°]	Neutral Axis Depth [mm]
1	0.0	769.1E-9	0.0	277.5	326.7	0.8494	B: Node 1	0.0	175.2

### Strength Analysis - Details

Case	Moment Angle [°]	Description	N [kN]	M [kNm]	Warning
	19.20	Max. compressive strain	6311.	17.91E-6	
	178.9	Max. tensile strain	-1707.	24.01E-6	
1	0.0	Axial strength at M	4743.	277.3	
		Initial yield	0.04303	240.6	
		Balanced yield	1941.	458.3	
		Bending strength at N=0	0.0	326.7	

### Strain Planes at ULS Strength

Related to Reference Point

Case	Strain Plane	ε <sub>ax</sub> [-]	κ <sub>yy</sub> [1/m]	κ <sub>zz</sub> [1/m]
1	Reinforcement	-0.002517	0.01997	-75.82E-12
	User Creep/Shrinkage	0.0	0.0	0.0
	Total (Concrete)	-0.002517	0.01997	-75.82E-12

### Section Material Stresses/Strains at ULS Strength

Case Point	Coordinates (y, z) [mm]	Strain [-]	Stress [N/mm <sup>2</sup> ]	Notes
1	1 0.0 301.3	0.003500	17.00	
1	2 67.04 293.7	0.003349	17.00	
1	3 130.7 271.4	0.003904	17.00	
1	4 187.8 235.5	0.002187	17.00	
1	5 235.5 187.8	0.001235	14.51	
1	6 271.4 130.7	93.76E-6	1.557	
1	7 293.7 67.04	-0.001178	0.0	
1	8 301.3 -13.17E-6	-0.002517	0.0	
1	9 293.7 -67.04	-0.003856	0.0	
1	10 271.4 -130.7	-0.005127	0.0	
1	11 235.5 -187.8	-0.006268	0.0	
1	12 187.8 -235.5	-0.007221	0.0	
1	13 130.7 -271.4	-0.007938	0.0	
1	14 67.04 -293.7	-0.008383	0.0	
1	15 -26.34E-6 -301.3	-0.008534	0.0	
1	16 -67.04 -293.7	-0.008383	0.0	
1	17 -130.7 -271.4	-0.007938	0.0	
1	18 -187.8 -235.5	-0.007221	0.0	
1	19 -235.5 -187.8	-0.006268	0.0	
1	20 -271.4 -130.7	-0.005127	0.0	
1	21 -293.7 -67.04	-0.003856	0.0	
1	22 -301.3 3.593E-6	-0.002517	0.0	
1	23 -293.7 67.04	-0.001178	0.0	
1	24 -271.4 130.7	93.76E-6	1.557	
1	25 -235.5 187.8	0.001235	14.51	
1	26 -187.8 235.5	0.002187	17.00	
1	27 -130.7 271.4	0.002904	17.00	
1	28 -67.04 293.7	0.003349	17.00	

### Reinforcement Stresses/Strains at ULS Strength

Case Bar	Coordinates (y, z) [mm]	Strain [-]	Stress [N/mm <sup>2</sup> ]	Notes
1	1 202.5 0.0	-0.002517	-434.8	500B
1	2 143.2 143.2	342.9E-6	68.59	500B
1	3 11.54E-6 202.5	0.001527	305.5	500B
1	4 -143.2 143.2	342.9E-6	68.59	500B
1	5 -202.5 23.09E-6	-0.002517	-434.8	500B
1	6 -143.2 -143.2	-0.005377	-434.8	500B
1	7 -9.43E-6 -202.5	-0.006561	-434.8	500B
1	8 143.2 -143.2	-0.005377	-434.8	500B



## Title & Specification

Job number T30295  
 Job title Bluehills  
 Subtitle 600dia contig piles  
 Calc. heading Max Stress calculation  
 File X:\Job Files\M and DT30000 - T30999\T30295  
 - Blue Hills Farm, Off Whitehall Rd West, Birkenshaw, BD11 2DU\08 - M&D Design  
 Calculations\8.2 Contract Design\600 dia with 8 B32 cage.ads  
 Notes (none)  
 Code of Practice BS EN 1992-1-1:2004 [United Kingdom]  
 Bending Axes Biaxial  
 Number of sections 1  
 Number of ULS cases 1  
 Number of SLS cases 0

## Section : Definition

### 1 : 600mm dia piles

Name 600mm dia piles  
 Type Concrete  
 Material C30/37  
 Origin Centre  
**Dimensions**  
 Diameter 600.0mm  
 Section Area 282700.0mm<sup>2</sup>  
 Reinforcement Area 6434.0mm<sup>2</sup>  
 Reinforcement 2.276%

## Section : Nodes

### 1 : 600mm dia piles

Node	Y [mm]	Z [mm]
1	0.0	301.3
2	67.04	293.7
3	130.7	271.4
4	187.8	235.5
5	235.5	187.8
6	271.4	130.7
7	293.7	67.04
8	301.3	-13.17E-6
9	293.7	-67.04
10	271.4	-130.7
11	235.5	-187.8
12	187.8	-235.5
13	130.7	-271.4
14	67.04	-293.7
15	-26.34E-6	-301.3
16	-67.04	-293.7
17	-130.7	-271.4
18	-187.8	-235.5
19	-235.5	-187.8
20	-271.4	-130.7
21	-293.7	-67.04
22	-301.3	3.593E-6
23	-293.7	67.04
24	-271.4	130.7
25	-235.5	187.8
26	-187.8	235.5
27	-130.7	271.4
28	-67.04	293.7

## Section : Cover & Links

### 1 : 600mm dia piles

Cover 75.00mm  
 Link Size 10.00mm  
 Link Material 500B

## Section : Bars

### 1 : 600mm dia piles

Bar	Y	Z	Diameter	Area	Effective Area	Type	Material	Prestress Force	Prestress Strain	Appl. loads include/exclude prestress
	[mm]	[mm]	[mm]	[mm <sup>2</sup> ]	[mm <sup>2</sup> ]			[kN]		
1	199.0	0.0	32.00	804.2	804.2	Steel	500B			
2	140.7	140.7	32.00	804.2	804.2	Steel	500B			
3	12.97E-6	199.0	32.00	804.2	804.2	Steel	500B			
4	-140.7	140.7	32.00	804.2	804.2	Steel	500B			
5	-199.0	25.94E-6	32.00	804.2	804.2	Steel	500B			
6	-140.7	-140.7	32.00	804.2	804.2	Steel	500B			
7	-10.60E-6	-199.0	32.00	804.2	804.2	Steel	500B			
8	140.7	-140.7	32.00	804.2	804.2	Steel	500B			

## Section : Elastic Properties

### 1 : 600mm dia piles

#### Effective properties of the section, ignoring reinforcement.

Geometric Centroid	y	0.0mm
	z	0.0mm
Area		282700.0mm <sup>2</sup>
Second Moments of Area	I <sub>yy</sub>	6.362E+9mm <sup>4</sup>
	I <sub>zz</sub>	6.362E+9mm <sup>4</sup>
	I <sub>yz</sub>	0.0mm <sup>4</sup>
Principal Second Moments of Area	I <sub>uu</sub>	6.362E+9mm <sup>4</sup>
	I <sub>zz</sub>	6.362E+9mm <sup>4</sup>
	Angle	0.0°
Shear Area Factor	k <sub>y</sub>	0.8571
	k <sub>z</sub>	0.8571
Torsion Constant		12.72E+9mm <sup>4</sup>
Section Modulus	Z <sub>y</sub>	21.21E+6mm <sup>3</sup>
	Z <sub>z</sub>	21.21E+6mm <sup>3</sup>
Plastic Modulus	Z <sub>py</sub>	36.00E+6mm <sup>3</sup>
	Z <sub>pz</sub>	36.00E+6mm <sup>3</sup>
Radius of Gyration	R <sub>y</sub>	150.0mm
	R <sub>z</sub>	150.0mm

#### Properties of gross section, including reinforcement.

Bar	Y	Z	Diameter	Area	Effective Area	Type	Material	Prestress Force	Prestress Strain	Appl. loads include/exclude prestress
	[mm]	[mm]	[mm]	[mm <sup>2</sup> ]	[mm <sup>2</sup> ]			[kN]		
Geometric Centroid			y		-369.0E-9mm					
			z		1.107E-6mm					
EA					10.36E+6kN					
EI			EI <sub>yy</sub>		230200.kNm <sup>2</sup>					
			EI <sub>zz</sub>		230200.kNm <sup>2</sup>					
			EI <sub>yz</sub>		-238.9E-6kNm <sup>2</sup>					
Principal EI			EI <sub>uu</sub>		230200.kNm <sup>2</sup>					
			EI <sub>zz</sub>		230200.kNm <sup>2</sup>					
			Angle		-45.00°					

## Material : Concrete

### 1 : C30/37

Name		C30/37 (Standard)
Cylinder Strength	$f_{ck}$	30.00N/mm <sup>2</sup>
Tensile Strength	$f_{ctm}$	2.896N/mm <sup>2</sup>
Weight		Normal Weight
Density	$\rho$	2.400t/m <sup>3</sup>
Elastic Modulus	E	32840.N/mm <sup>2</sup>
Poisson's Ratio	$\nu$	0.2000
Thermal Expansion Coeff.	$\alpha$	10.00E-6/°C
Partial Safety Factor	$\gamma_c$	1.500
Safety Factor		
Maximum Strain		0.003500
Plateau Strain		0.002000
ULS Compression Curve		Parabola rectangle
ULS Tension Curve		No-tension
SLS Compression Curve		FIB Model Code
SLS Tension Curve		Interpolated
Design strength factor	$\alpha_{cc}$	0.8500
Aggregate Size		20.00mm

## Material : Rebar

### 1 : 500B

Type		Steel rebar
Strength	$f_{yk}$	500.0N/mm <sup>2</sup>
Elastic Modulus	E	200000.N/mm <sup>2</sup>
Hardening Modulus	$E_H$	0.0N/mm <sup>2</sup>
Density	$\rho$	7.850t/m <sup>3</sup>
Poisson's Ratio	$\nu$	0.3000
Coeff. Thermal Expansion	$\alpha$	12.00E-6/°C
Ductility		Normal <i>Modified</i>
Partial Safety Factor	$\gamma_s$	1.150
	$\gamma_{se}$	1.000
Maximum Strain	$\epsilon_{uk}$	0.05000 <i>Modified</i>
Maximum Strain	$\epsilon_{ud}$	0.05000 <i>Modified</i>
Stress/Strain Curve		Elastic-plastic

## Loading

### Reference Point

All loading acts through the Reference Point.  
All strain planes are defined relative to the Reference Point.

Definition		Geometric Centroid
Reference Point Coordinates	y	0.0mm
	z	0.0mm

### Load Case Titles

Load Case	Title
1 LL	

### Applied loads

Load Case	N [kN]	$M_{yy}$ [kNm]	$M_{zz}$ [kNm]	Note
1	0.0	255.0	0.0	

## Section 1 Details

2.28% reinforcement in section 1 (600mm dia piles). Check this against code requirements.

### ULS Cases Analysed

ULS Case	Name	Section	Loading	Prestress Factor
1	1 : 600mm dia piles		1.5L1	1.000

### Strength Analysis - Loads

Case	N [kN]	$M_{yy}$ [kNm]	$M_{zz}$ [kNm]	M [kNm]	$\theta$ [°]
1	0.0	382.5	0.0	382.5	0.0

### Strength Analysis - Summary

Governing conditions are defined as:  
A - reinforcing steel tension strain limit  
B - concrete compression strain limit  
C - concrete pure compression strain limit

Case N  $M_{yy}$   $M_{zz}$  M  $\theta$   
 [kN] [kNm] [kNm] [kNm] [°]

**Eurocode 2 Section 6.1**

Effective centroid is reported relative to the reference point.

Case	Eff. Centroid (y)	Eff. Centroid (z)	N [kN]	M [kNm]	$M_u$ [kNm]	$M/M_u$	Governing Condition	Neutral Axis Angle [°]	Neutral Axis Depth [mm]
1	-369.0E-9	1.107E-6	0.0	382.5	468.9	0.8157	B: Node 1	0.0	205.2

**Strength Analysis - Details**

Case Moment Angle [°]	Description	N [kN]	M [kNm]	Warning
10.07	Max. compressive strain	7271	31.79E-6	
178.8	Max. tensile strain	-2797	40.34E-6	
1	0.0 Axial strength at M	4929	382.3	
	Initial yield	0.1457	363.2	
	Balanced yield	1925	561.6	
	Bending strength at N=0	0.0	468.9	

**Strain Planes at ULS Strength**

Related to Reference Point

Case	Strain Plane	$\epsilon_{ax}$ [-]	$\kappa_{yy}$ [1/m]	$\kappa_{zz}$ [1/m]
1	Reinforcement	-0.001639	0.01706	508.2E-12
	User Creep/Shrinkage	0.0	0.0	0.0
	Total (Concrete)	-0.001639	0.01706	508.2E-12

**Section Material Stresses/Strains at ULS Strength**

Case Point	Coordinates [mm]		Strain [-]	Stress [N/mm <sup>2</sup> ]	Notes
	y	z			
1	1	0.0	301.3	0.003500	17.00
1	2	67.04	293.7	0.003371	17.00
1	3	130.7	271.4	0.002991	17.00
1	4	187.8	235.5	0.002379	17.00
1	5	235.5	187.8	0.001565	16.20
1	6	271.4	130.7	591.0E-6	8.562
1	7	293.7	67.04	-495.1E-6	0.0
1	8	301.3	-13.17E-6	-0.001639	0.0
1	9	293.7	-67.04	-0.002782	0.0
1	10	271.4	-130.7	-0.003868	0.0
1	11	235.5	-187.8	-0.004842	0.0
1	12	187.8	-235.5	-0.005656	0.0
1	13	130.7	-271.4	-0.006268	0.0
1	14	67.04	-293.7	-0.006648	0.0
1	15	-26.34E-6	-301.3	-0.006777	0.0
1	16	-67.04	-293.7	-0.006648	0.0
1	17	-130.7	-271.4	-0.006268	0.0
1	18	-187.8	-235.5	-0.005656	0.0
1	19	-235.5	-187.8	-0.004842	0.0
1	20	-271.4	-130.7	-0.003868	0.0
1	21	-293.7	-67.04	-0.002782	0.0
1	22	-301.3	3.593E-6	-0.001639	0.0
1	23	-293.7	67.04	-495.1E-6	0.0
1	24	-271.4	130.7	591.0E-6	8.562
1	25	-235.5	187.8	0.001565	16.20
1	26	-187.8	235.5	0.002379	17.00
1	27	-130.7	271.4	0.002991	17.00
1	28	-67.04	293.7	0.003371	17.00

**Reinforcement Stresses/Strains at ULS Strength**

Case Bar	Coordinates [mm]		Strain [-]	Stress [N/mm <sup>2</sup> ]	Notes
	y	z			
1	1	199.0	0.0	-0.001639	-327.7 500B
1	2	140.7	140.7	761.5E-6	152.3 500B
1	3	12.97E-6	199.0	0.001756	351.1 500B
1	4	-140.7	140.7	761.5E-6	152.3 500B
1	5	-199.0	25.94E-6	-0.001639	-327.7 500B
1	6	-140.7	-140.7	-0.004039	-434.8 500B
1	7	-10.60E-6	-199.0	-0.005033	-434.8 500B
1	8	140.7	-140.7	-0.004039	-434.8 500B



Omitted Pile [REDACTED]

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<b>Rev</b>	<b>Comment</b>	<b>Date</b>	<b>Drawings</b>	<b>Rev</b>	<b>Piling Requirements</b>
0	First Issue	22/09/2023	Piled Retaining Wall - T30295 - 01	-	Concrete Grade <b>C28/35</b>
1	Updated with additional Piles	04/10/2023	09.21011-ACE-ZZ-XX-DR-S-7021	P2	Concrete Class <b>DC-2</b>
2	Revised drawing Issued by Client showing an additional Pile.	27/11/2023	09.21011-ACE-ZZ-XX-DR-S-7022	P2	Integrity Test <b>TBC</b>
					Prelim Test Pile <b>NIL</b>
					Working Test Pile <b>TBC</b>
					Site crew to check 'working drawing on site' is the same as the drawings referenced above.

CFA Pile No.	Pile DIA (mm)	P.P.L (m OD)	COL (m OD)	Pile Length (m)	De-Bond Length (m) DIM 'A'	Depth of Cage from PPL (m)	Main Reinforcement	Secondary Reinforcement	Cage Type	Theoretical Concrete Volume (m³)	Design Pile Length (m)	Installed Pile Length (m)	Date of Installation	Comments
RW 1 - P1	600 @750c/c	169.750	TBC	11.50	TBC	11.50	8 B 32 x 11.50	B 10 @ 150 mm c/c	A	3.739	11.50			
RW 1 - P2	600 @750c/c	169.750	TBC	11.50	TBC	11.50	8 B 32 x 11.50	B 10 @ 150 mm c/c	A	3.739	11.50			
RW 1 - P3	600 @750c/c	169.750	TBC	11.50	TBC	11.50	8 B 32 x 11.50	B 10 @ 150 mm c/c	A	3.739	11.50			
RW 1 - P4	600 @750c/c	169.750	TBC	11.50	TBC	11.50	8 B 32 x 11.50	B 10 @ 150 mm c/c	A	3.739	11.50			
RW 1 - P5	600 @750c/c	169.750	TBC	11.50	TBC	11.50	8 B 32 x 11.50	B 10 @ 150 mm c/c	A	3.739	11.50			
RW 1 - P6	600 @750c/c	169.750	TBC	11.50	TBC	11.50	8 B 32 x 11.50	B 10 @ 150 mm c/c	A	3.739	11.50			
RW 1 - P7	600 @750c/c	169.750	TBC	11.50	TBC	11.50	8 B 32 x 11.50	B 10 @ 150 mm c/c	A	3.739	11.50			
RW 1 - P8	600 @750c/c	169.750	TBC	11.50	TBC	11.50	8 B 32 x 11.50	B 10 @ 150 mm c/c	A	3.739	11.50			
RW 1 - P9	600 @750c/c	169.750	TBC	11.50	TBC	11.50	8 B 32 x 11.50	B 10 @ 150 mm c/c	A	3.739	11.50			
RW 1 - P10	600 @750c/c	169.750	TBC	11.50	TBC	11.50	8 B 32 x 11.50	B 10 @ 150 mm c/c	A	3.739	11.50			
RW 1 - P11	600 @750c/c	169.750	TBC	11.50	TBC	11.50	8 B 32 x 11.50	B 10 @ 150 mm c/c	A	3.739	11.50			
RW 1 - P12	600 @750c/c	169.750	TBC	11.50	TBC	11.50	8 B 32 x 11.50	B 10 @ 150 mm c/c	A	3.739	11.50			
RW 1 - P13	600 @750c/c	169.750	TBC	11.50	TBC	11.50	8 B 32 x 11.50	B 10 @ 150 mm c/c	A	3.739	11.50			
RW 1 - P14	600 @750c/c	169.750	TBC	11.50	TBC	11.50	8 B 32 x 11.50	B 10 @ 150 mm c/c	A	3.739	11.50			
RW 1 - P15	600 @750c/c	169.750	TBC	11.50	TBC	11.50	8 B 32 x 11.50	B 10 @ 150 mm c/c	A	3.739	11.50			
RW 1 - P16	600 @750c/c	169.750	TBC	11.50	TBC	11.50	8 B 32 x 11.50	B 10 @ 150 mm c/c	A	3.739	11.50			
RW 1 - P17	600 @750c/c	169.750	TBC	11.50	TBC	11.50	8 B 32 x 11.50	B 10 @ 150 mm c/c	A	3.739	11.50			
RW 1 - P18	600 @750c/c	169.750	TBC	11.50	TBC	11.50	8 B 32 x 11.50	B 10 @ 150 mm c/c	A	3.739	11.50			



Omitted Pile [REDACTED]

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<b>Rev</b>	<b>Comment</b>	<b>Date</b>	<b>Drawings</b>		<b>Rev</b>	<b>Piling Requirements</b>	
0	First Issue	22/09/2023	Piled Retaining Wall - T30295 - 01		-	Concrete Grade <b>C28/35</b>	
1	Updated with additional Piles	04/10/2023	09.21011-ACE-ZZ-XX-DR-S-7021		P2	Concrete Class <b>DC-2</b>	
2	Revised drawing Issued by Client showing an additional Pile.	27/11/2023	09.21011-ACE-ZZ-XX-DR-S-7022		P2	Integrity Test <b>TBC</b>	
						Prelim Test Pile <b>NIL</b>	
						Working Test Pile <b>TBC</b>	
						Site crew to check 'working drawing on site' is the same as the drawings referenced above.	

CFA Pile No.	Pile DIA (mm)	P.P.L (m OD)	COL (m OD)	Pile Length (m)	De-Bond Length (m) DIM 'A'	Depth of Cage from PPL (m)	Main Reinforcement	Secondary Reinforcement	Cage Type	Theoretical Concrete Volume (m³)	Design Pile Length (m)	Installed Pile Length (m)	Date of Installation	Comments
RW 1 - P19	600 @750c/c	169.750	TBC	11.50	TBC	11.50	8 B 32 x 11.50	B 10 @ 150 mm c/c	A	3.739	11.50			
RW 1 - P20	600 @750c/c	169.750	TBC	11.50	TBC	11.50	8 B 32 x 11.50	B 10 @ 150 mm c/c	A	3.739	11.50			
RW 1 - P21	600 @750c/c	169.750	TBC	11.50	TBC	11.50	8 B 32 x 11.50	B 10 @ 150 mm c/c	A	3.739	11.50			
RW 1 - P22	600 @750c/c	169.750	TBC	11.50	TBC	11.50	8 B 32 x 11.50	B 10 @ 150 mm c/c	A	3.739	11.50			
RW 1 - P23	600 @750c/c	169.750	TBC	11.50	TBC	11.50	8 B 32 x 11.50	B 10 @ 150 mm c/c	A	3.739	11.50			
RW 1 - P24	600 @750c/c	169.750	TBC	11.50	TBC	11.50	8 B 32 x 11.50	B 10 @ 150 mm c/c	A	3.739	11.50			
RW 1 - P25	600 @750c/c	169.750	TBC	11.50	TBC	11.50	8 B 32 x 11.50	B 10 @ 150 mm c/c	A	3.739	11.50			
RW 1 - P26	600 @750c/c	169.750	TBC	11.50	TBC	11.50	8 B 32 x 11.50	B 10 @ 150 mm c/c	A	3.739	11.50			
RW 1 - P27	600 @750c/c	169.750	TBC	11.50	TBC	11.50	8 B 32 x 11.50	B 10 @ 150 mm c/c	A	3.739	11.50			
RW 2 - P28	600 @750c/c	169.750	TBC	11.50	TBC	11.50	8 B 32 x 11.50	B 10 @ 150 mm c/c	A	3.739	11.50			
RW 2 - P29	600 @750c/c	169.750	TBC	11.50	TBC	11.50	8 B 32 x 11.50	B 10 @ 150 mm c/c	A	3.739	11.50			
RW 2 - P30	600 @750c/c	169.750	TBC	11.50	TBC	11.50	8 B 32 x 11.50	B 10 @ 150 mm c/c	A	3.739	11.50			
RW 2 - P31	600 @750c/c	169.750	TBC	11.50	TBC	11.50	8 B 32 x 11.50	B 10 @ 150 mm c/c	A	3.739	11.50			
RW 2 - P32	600 @750c/c	169.750	TBC	11.50	TBC	11.50	8 B 32 x 11.50	B 10 @ 150 mm c/c	A	3.739	11.50			
RW 2 - P33	600 @750c/c	169.750	TBC	11.50	TBC	11.50	8 B 32 x 11.50	B 10 @ 150 mm c/c	A	3.739	11.50			
RW 2 - P34	600 @750c/c	169.750	TBC	11.50	TBC	11.50	8 B 32 x 11.50	B 10 @ 150 mm c/c	A	3.739	11.50			
RW 2 - P35	600 @750c/c	169.750	TBC	11.50	TBC	11.50	8 B 32 x 11.50	B 10 @ 150 mm c/c	A	3.739	11.50			
RW 2 - P36	600 @750c/c	169.750	TBC	10.00	TBC	10.00	8 B 25 x 10.00	B 10 @ 150 mm c/c	B	3.252	10.00			



Omitted Pile [REDACTED]

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0	First Issue	22/09/2023	Piled Retaining Wall - T30295 - 01	-	Concrete Grade <b>C28/35</b>
1	Updated with additional Piles	04/10/2023	09.21011-ACE-ZZ-XX-DR-S-7021	P2	Concrete Class <b>DC-2</b>
2	Revised drawing Issued by Client showing an additional Pile.	27/11/2023	09.21011-ACE-ZZ-XX-DR-S-7022	P2	Integrity Test <b>TBC</b>
					Prelim Test Pile <b>NIL</b>
					Working Test Pile <b>TBC</b>
					Site crew to check 'working drawing on site' is the same as the drawings referenced above.

CFA Pile No.	Pile DIA (mm)	P.P.L (m OD)	COL (m OD)	Pile Length (m)	De-Bond Length (m) DIM 'A'	Depth of Cage from PPL (m)	Main Reinforcement	Secondary Reinforcement	Cage Type	Theoretical Concrete Volume (m³)	Design Pile Length (m)	Installed Pile Length (m)	Date of Installation	Comments
RW 2 - P37	600 @750c/c	169.750	TBC	10.00	TBC	10.00	8 B 25 x 10.00	B 10 @ 150 mm c/c	B	3.252	10.00			
RW 2 - P38	600 @750c/c	169.750	TBC	10.00	TBC	10.00	8 B 25 x 10.00	B 10 @ 150 mm c/c	B	3.252	10.00			
RW 2 - P39	600 @750c/c	169.750	TBC	10.00	TBC	10.00	8 B 25 x 10.00	B 10 @ 150 mm c/c	B	3.252	10.00			
RW 2 - P40	600 @750c/c	169.750	TBC	10.00	TBC	10.00	8 B 25 x 10.00	B 10 @ 150 mm c/c	B	3.252	10.00			
RW 2 - P41	600 @750c/c	169.750	TBC	10.00	TBC	10.00	8 B 25 x 10.00	B 10 @ 150 mm c/c	B	3.252	10.00			
RW 2 - P42	600 @750c/c	169.750	TBC	10.00	TBC	10.00	8 B 25 x 10.00	B 10 @ 150 mm c/c	B	3.252	10.00			
RW 2 - P43	600 @750c/c	169.750	TBC	10.00	TBC	10.00	8 B 25 x 10.00	B 10 @ 150 mm c/c	B	3.252	10.00			
RW 2 - P44	600 @750c/c	169.750	TBC	10.00	TBC	10.00	8 B 25 x 10.00	B 10 @ 150 mm c/c	B	3.252	10.00			
RW 2 - P45	600 @750c/c	169.750	TBC	10.00	TBC	10.00	8 B 25 x 10.00	B 10 @ 150 mm c/c	B	3.252	10.00			
RW 2 - P46	600 @750c/c	169.750	TBC	10.00	TBC	10.00	8 B 25 x 10.00	B 10 @ 150 mm c/c	B	3.252	10.00			
RW 2 - P47	600 @750c/c	169.750	TBC	10.00	TBC	10.00	8 B 25 x 10.00	B 10 @ 150 mm c/c	B	3.252	10.00			
RW 2 - P48	600 @750c/c	169.750	TBC	10.00	TBC	10.00	8 B 25 x 10.00	B 10 @ 150 mm c/c	B	3.252	10.00			
RW 2 - P49	600 @750c/c	169.750	TBC	10.00	TBC	10.00	8 B 25 x 10.00	B 10 @ 150 mm c/c	B	3.252	10.00			
RW 2 - P50	600 @750c/c	169.750	TBC	10.00	TBC	10.00	8 B 25 x 10.00	B 10 @ 150 mm c/c	B	3.252	10.00			
RW 2 - P51	600 @750c/c	169.750	TBC	10.00	TBC	10.00	8 B 25 x 10.00	B 10 @ 150 mm c/c	B	3.252	10.00			
RW 2 - P52	600 @750c/c	169.750	TBC	10.00	TBC	10.00	8 B 25 x 10.00	B 10 @ 150 mm c/c	B	3.252	10.00			
RW 2 - P53	600 @750c/c	169.750	TBC	10.00	TBC	10.00	8 B 25 x 10.00	B 10 @ 150 mm c/c	B	3.252	10.00			
RW 2 - P54	600 @750c/c	169.750	TBC	10.00	TBC	10.00	8 B 25 x 10.00	B 10 @ 150 mm c/c	B	3.252	10.00			



Omitted Pile [REDACTED]

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<b>Rev</b>	<b>Comment</b>	<b>Date</b>	<b>Drawings</b>	<b>Rev</b>	<b>Piling Requirements</b>
0	First Issue	22/09/2023	Piled Retaining Wall - T30295 - 01	-	Concrete Grade <b>C28/35</b>
1	Updated with additional Piles	04/10/2023	09.21011-ACE-ZZ-XX-DR-S-7021	P2	Concrete Class <b>DC-2</b>
2	Revised drawing Issued by Client showing an additional Pile.	27/11/2023	09.21011-ACE-ZZ-XX-DR-S-7022	P2	Integrity Test <b>TBC</b>
					Prelim Test Pile <b>NIL</b>
					Working Test Pile <b>TBC</b>
					Site crew to check 'working drawing on site' is the same as the drawings referenced above.

CFA Pile No.	Pile DIA (mm)	P.P.L (m OD)	COL (m OD)	Pile Length (m)	De-Bond Length (m) DIM 'A'	Depth of Cage from PPL (m)	Main Reinforcement	Secondary Reinforcement	Cage Type	Theoretical Concrete Volume (m³)	Design Pile Length (m)	Installed Pile Length (m)	Date of Installation	Comments
RW 2 - P55	600 @750c/c	169.750	TBC	10.00	TBC	10.00	8 B 25 x 10.00	B 10 @ 150 mm c/c	B	3.252	10.00			
RW 2 - P56	600 @750c/c	169.750	TBC	10.00	TBC	10.00	8 B 25 x 10.00	B 10 @ 150 mm c/c	B	3.252	10.00			
RW 2 - P57	600 @750c/c	169.750	TBC	10.00	TBC	10.00	8 B 25 x 10.00	B 10 @ 150 mm c/c	B	3.252	10.00			
RW 2 - P58	600 @750c/c	169.750	TBC	10.00	TBC	10.00	8 B 25 x 10.00	B 10 @ 150 mm c/c	B	3.252	10.00			
RW 2 - P59	600 @750c/c	169.750	TBC	10.00	TBC	10.00	8 B 25 x 10.00	B 10 @ 150 mm c/c	B	3.252	10.00			
RW 2 - P60	600 @750c/c	169.750	TBC	10.00	TBC	10.00	8 B 25 x 10.00	B 10 @ 150 mm c/c	B	3.252	10.00			
RW 2 - P61	600 @750c/c	169.750	TBC	10.00	TBC	10.00	8 B 25 x 10.00	B 10 @ 150 mm c/c	B	3.252	10.00			
RW 2 - P62	600 @750c/c	169.750	TBC	10.00	TBC	10.00	8 B 25 x 10.00	B 10 @ 150 mm c/c	B	3.252	10.00			
RW 2 - P63	600 @750c/c	169.750	TBC	10.00	TBC	10.00	8 B 25 x 10.00	B 10 @ 150 mm c/c	B	3.252	10.00			
RW 2 - P64	600 @750c/c	169.750	TBC	10.00	TBC	10.00	8 B 25 x 10.00	B 10 @ 150 mm c/c	B	3.252	10.00			
RW 2 - P65	600 @750c/c	169.750	TBC	10.00	TBC	10.00	8 B 25 x 10.00	B 10 @ 150 mm c/c	B	3.252	10.00			
RW 2 - P66	600 @750c/c	169.750	TBC	10.00	TBC	10.00	8 B 25 x 10.00	B 10 @ 150 mm c/c	B	3.252	10.00			
RW 2 - P67	600 @750c/c	169.750	TBC	10.00	TBC	10.00	8 B 25 x 10.00	B 10 @ 150 mm c/c	B	3.252	10.00			
RW 2 - P68	600 @750c/c	169.750	TBC	10.00	TBC	10.00	8 B 25 x 10.00	B 10 @ 150 mm c/c	B	3.252	10.00			
RW 2 - P69	600 @750c/c	169.750	TBC	10.00	TBC	10.00	8 B 25 x 10.00	B 10 @ 150 mm c/c	B	3.252	10.00			
RW 2 - P70	600 @750c/c	169.750	TBC	10.00	TBC	10.00	8 B 25 x 10.00	B 10 @ 150 mm c/c	B	3.252	10.00			
RW 2 - P71	600 @750c/c	169.750	TBC	10.00	TBC	10.00	8 B 25 x 10.00	B 10 @ 150 mm c/c	B	3.252	10.00			
RW 3 - P72	600 @750c/c	169.750	TBC	10.00	TBC	10.00	8 B 25 x 10.00	B 10 @ 150 mm c/c	B	3.252	10.00			



Omitted Pile [REDACTED]

<b>Contract No:</b> T30295		<b>Contract Title:</b> Blue Hills Farm, Off Whitehall Rd West, Birkenshaw		<b>Page No.:</b> SCHED/01	
<b>Rev</b>	<b>Comment</b>	<b>Date</b>	<b>Drawings</b>	<b>Rev</b>	<b>Piling Requirements</b>
0	First Issue	22/09/2023	Piled Retaining Wall - T30295 - 01	-	Concrete Grade <b>C28/35</b>
1	Updated with additional Piles	04/10/2023	09.21011-ACE-ZZ-XX-DR-S-7021	P2	Concrete Class <b>DC-2</b>
2	Revised drawing Issued by Client showing an additional Pile.	27/11/2023	09.21011-ACE-ZZ-XX-DR-S-7022	P2	Integrity Test <b>TBC</b>
					Prelim Test Pile <b>NIL</b>
					Working Test Pile <b>TBC</b>
					Site crew to check 'working drawing on site' is the same as the drawings referenced above.

CFA Pile No.	Pile DIA (mm)	P.P.L (m OD)	COL (m OD)	Pile Length (m)	De-Bond Length (m) DIM 'A'	Depth of Cage from PPL (m)	Main Reinforcement	Secondary Reinforcement	Cage Type	Theoretical Concrete Volume (m³)	Design Pile Length (m)	Installed Pile Length (m)	Date of Installation	Comments
RW 3 - P73	600 @750c/c	169.750	TBC	10.00	TBC	10.00	8 B 25 x 10.00	B 10 @ 150 mm c/c	B	3.252	10.00			
RW 3 - P74	600 @750c/c	169.750	TBC	10.00	TBC	10.00	8 B 25 x 10.00	B 10 @ 150 mm c/c	B	3.252	10.00			
RW 3 - P75	600 @750c/c	169.750	TBC	10.00	TBC	10.00	8 B 25 x 10.00	B 10 @ 150 mm c/c	B	3.252	10.00			
RW 3 - P76	600 @750c/c	169.750	TBC	10.00	TBC	10.00	8 B 25 x 10.00	B 10 @ 150 mm c/c	B	3.252	10.00			
RW 3 - P77	600 @750c/c	169.750	TBC	10.00	TBC	10.00	8 B 25 x 10.00	B 10 @ 150 mm c/c	B	3.252	10.00			
RW 3 - P78	600 @750c/c	169.750	TBC	10.00	TBC	10.00	8 B 25 x 10.00	B 10 @ 150 mm c/c	B	3.252	10.00			
RW 3 - P79	600 @750c/c	169.750	TBC	10.00	TBC	10.00	8 B 25 x 10.00	B 10 @ 150 mm c/c	B	3.252	10.00			
RW 3 - P80	600 @750c/c	169.750	TBC	10.00	TBC	10.00	8 B 25 x 10.00	B 10 @ 150 mm c/c	B	3.252	10.00			