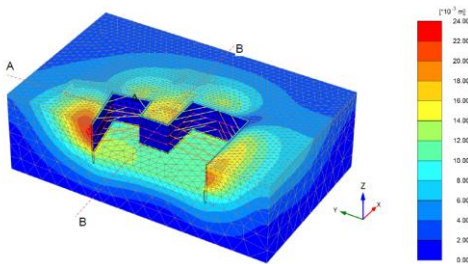




*Report for*  
Gilbert Ash Limited

# 115-119 Premier Inn Camden High Street London

## Retaining Wall Design



Oasys WALLAP PLAXIS



*Prepared by:*  
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*Approved by:*  
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*Location:*  
London



*Ref:*  
41713A3

*Date:*  
29<sup>th</sup> March 2021

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## Document Verification

Rev.	Date	Prepared	Approved	Comments
P01	29.03.2021	A. Munteanu, MSc Eng Design and Estimating Engineer 	S. Draghici, MSc Eng Technical Manager 	Preliminary issue. Design approval only

# Contents

1 Design Brief.....	1
2 Data Provided .....	1
3 Soil Assessment.....	2
3.1 Soil Properties .....	2
4 Design.....	3
4.1 Software .....	3
4.2 Structure dimensions .....	3
4.3 Existing neighbouring structures .....	3
4.4 Propping .....	3
4.5 Materials.....	3
4.6 Surcharges .....	4
4.7 Over-dig.....	4
4.8 Design Standard .....	4
4.9 Obtained results.....	5
4.10 Reinforcement design .....	6
4.11 Lateral wall deflections.....	6
4.12 On site recommendations .....	7
5 Bearing design .....	7
6 Design Risk Assessment.....	9
7 Piling mat .....	9
8 Validation .....	9
9 Environmental considerations.....	9
10 Disclaimer .....	10
11 References.....	10

# Appendices

- Appendix 1 – Design Line
- Appendix 2 – Reinforcement Design
- Appendix 3 – Pile Schedule
- Appendix 4 – Design Risk Assessment
- Appendix 5 – ACEC concrete class
- Appendix 6 – Piling mat design
- Appendix 7 – Wallap output report.
- Appendix 8 – Oasys Output Report. Bearing design

## 1 Design Brief

Enclosed is the contiguous piled retaining wall design for 115-119 Premier Inn Development, located in London, NW1 7JS.

The retaining wall is designed as a cantilever contiguous piled wall formed of 450mm piles at 600mm centres.

The typical length of the wall piles to accommodate the given excavation depth is 12.2m for a piling platform of up to +29.4mOD, considering a maximum retained height of approximately 5.1m in the temporary condition (excavation to formation level).

The wall will also bear vertical loads as specified by the structural engineer.

The proposed method for the installation of the piles will be continuous flight auger (CFA) using a Soilmec SF50 rig.

The Client for the present document and piling works is Gilbert Ash Ltd.

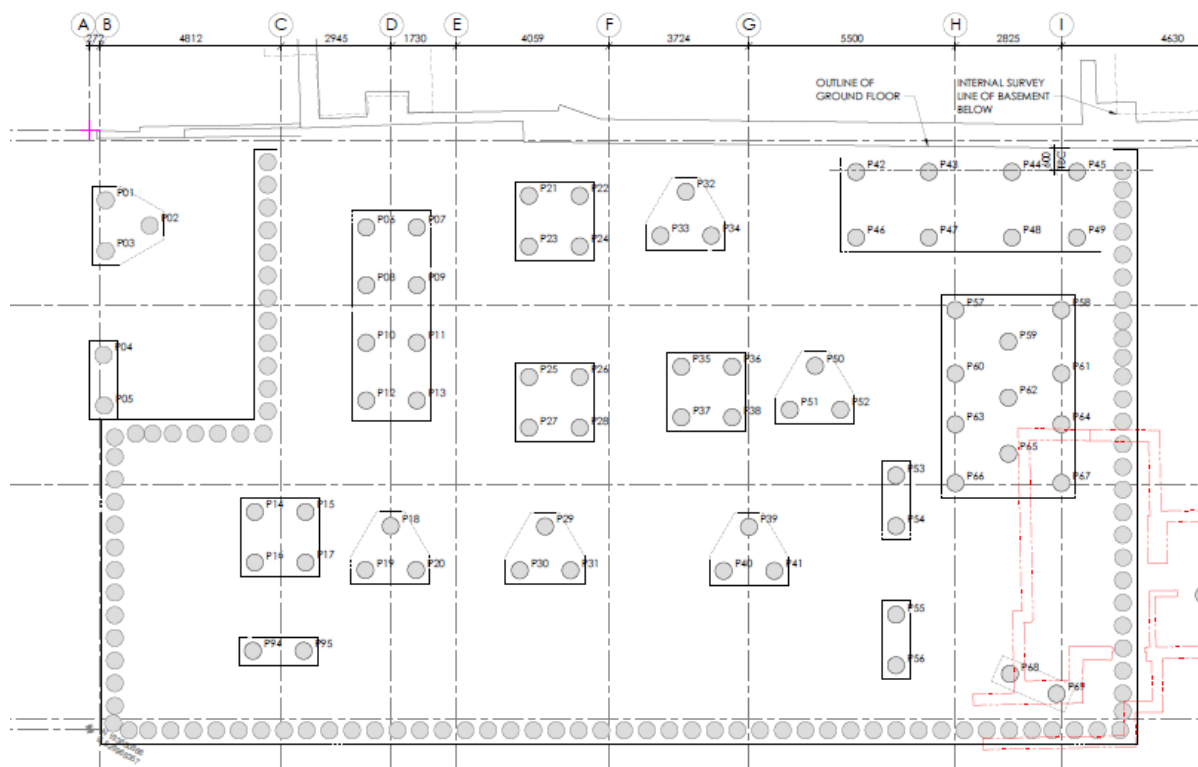


Figure 1. Contiguous piled wall layout – extract from drawing CCL-28791-S-CAM-GA-FN-0097-C1

## 2 Data Provided

Table 1. Documents used for pile design

Document type	No.	Rev.	Date	Issued by	Comments
Drawing	CCL-28791-S-CAM-GA-B1-0097	C1	Dec. 2020	Clancy Consulting	Piling GA

Drawing	CCL-28791-S-CAM-GA-B1-0098	C1	Dec. 2020	Clancy Consulting	Foundation GA
Drawing	CCL-28791-S-CAM-GA-B1-0099	C1	Dec. 2020	Clancy Consulting	Basement GA
Drawing	CCL-28791-S-CAM-SEC-SL-0200 to 204	C1	Dec. 2020	Clancy Consulting	Sections and details
Ground Investigation Report	10/1345	00	May 2020	Clancy Consulting	Phase II

### 3 Soil Assessment

#### 3.1 Soil Properties

Soil properties have been chosen based upon the data provided in the Clancy Consulting report and our experience of the local conditions. The design soil profile is indicated in Table 2, while the adopted values for the soil properties are summarized in Table 3 and presented into more detail in Appendix 7.

Table 2. Design soil profile, based on SI boreholes

Depth from ground level [m]	Levels (mAOD)	Soil Type
0...1.00		Made Ground (Soft dark sandy gravelly clay)
Below 1.00		London Clay (Firm becoming stiff laminated Clay)

The most recent site investigations were undertaken by Clancy Consulting in March 2020. The site investigations comprised two cable tool percussion boreholes drilled from ground level down to a maximum depth of 25.0mbgl and three window sample boreholes to depths of approx. 4.0mbgl. Standard penetration tests (SPT) were carried out within the borehole and samples taken for triaxial testing. Majority of the boreholes indicated a thickness of up to 1m for the Made Ground, apart from one window sample borehole located in the centre of the site, most likely a filled up area.

The results obtained from the SPT's were used to obtain most of the geotechnical parameters, based on well-known and generally accepted correlations indicated in the technical literature.

The existing ground level around the contiguous piled wall perimeter is expected to be on average +29.4mOD. The level of the piling platform will need to be confirmed by the client.

The soil investigations Report recommends a design concrete class of DC-3, as per BRE Special Digest 1, based on a potential sulphate concentration suggested by the possible presence of sulphides within the London Clay.

In regard to the groundwater level, the site investigations indicate groundwater seepages at 9.5mbgl. The design allowed for a ground water table at 1mbgl as worst case scenario in permanent condition.

Table 3. Soil properties

Soil type	Bulk density kN/m <sup>3</sup>	Young's modulus kN/m <sup>2</sup>	Cohesion <sup>a)</sup> kN/m <sup>2</sup>	Soil friction angle <sup>b)</sup> °
Made Ground	18	10000	-	22
London Clay*	20	45000+5475z [33750+4106z]	60+7.3z [ - ]	[22]

<sup>a)</sup> After Stroud, 1975, *The standard penetration test in insensitive clays*

<sup>b)</sup> After Peck et al., 1974, *Foundation Engineering*, 2<sup>nd</sup> Edition

$z$  indicates that the value is applied per metre depth (increasing linearly from the initial value).

[ ] drained conditions for London Clay (long term condition)

The standard penetration tests results were used to assess the cohesion in the London Clay layer, by considering the correlation  $c_u = 4.5 \cdot N_{SPT}$ . According to the site investigations, the undrained cohesion for the London Clay ranges between 60kPa at the top of the layer to 235kPa at 25m depth. The adopted Design Line for the undrained cohesion is presented in Appendix 1.

## 4 Design

### 4.1 Software

The software used for the piled wall design is Wallap version 6.05, developed by Geosolve, UK. The calculations are performed considering a subgrade reaction model. This model represents the soil as a system of independent springs, closely spaced, defined by a linearly elastic behaviour.

### 4.2 Structure dimensions

Pile diameter for the retaining wall piles is 450mm with 600mm centres. The length of the wall piles for the typical section is 12.2m. The length of the piles is indicative of the distance between the pile platform level and pile toes.

### 4.3 Existing neighbouring structures

As per the documentation provided with, tunnels associated with the Northern Line of London Underground are identified running along the eastern boundary of the site, with a crown level at approximately +16.9mOD and +12.2mOD. All bearing piles have been placed outside the 3m exclusion zone, as marked on drawing CCL-28791-S-CAM-GA-FN-0097-C1. At its closest point, the retaining wall is found approximately 8.5m distance in plan away from tunnels. As there is no stress relief due to excavation just above the tunnels, it's not expected for the basement to adversely affect the tunnels.

Alongside the tunnels there is also an existing main sewer with an invert level of +20.2mOD (approx. 9mbgl). As per CCL-28791-S-CAM-SEC-SL-0201-C1, the sewer is located at over 6.5m away from the piling works, outside the typical 45° interaction line drawn from the bearing piles cut-off level.

### 4.4 Propping

Given there are no adjacent buildings to the retaining wall and as per the scope of works, the retaining wall has been designed as cantilever (un-propped) in temporary condition (excavation down to formation level). In permanent condition the retaining wall will be propped by the basement and ground floor slab.

Where local excavations adjacent to the wall will increase the retained height in temporary condition beyond the general 5.11m (such as the lift pit) a local temporary retaining system will be needed. A specialist advise should be sought in this regard.

### 4.5 Materials

The materials used in the design are as follows:

- Concrete: C28/35 strength class and DC-3 ACEC class according to the recommendations of the BRE Special Digest 1 for concrete in aggressive ground and has been chosen in accordance with the site investigation report conclusions.
- Steel: yield resistance of 500N/mm<sup>2</sup>.

#### 4.6 Surcharges

Load surcharges were allowed as a variable surcharge of 10kPa on all sides, as recommended by CIRIA guide C760. Measures to prevent overloading the retained side of the wall should be taken.

#### 4.7 Over-dig

An over-dig of 500mm was allowed for in the design in the ultimate limit state, yet the importance of avoiding over-dig should be expressed to the construction team.

#### 4.8 Design Standard

The piles have been designed as a cantilever contiguous wall in accordance with BS EN:1997 to accommodate the indicated excavation depths.

The following construction sequence was considered in the design:

- Installation of piling platform
- Construction of the piles
- Trimming of the piles down to the cut-off level
- Construction of the capping beam
- Excavation down to the formation level
- Construction of the basement slab and lining wall
- Construction of the ground floor slab
- Application of long term loading from the structure

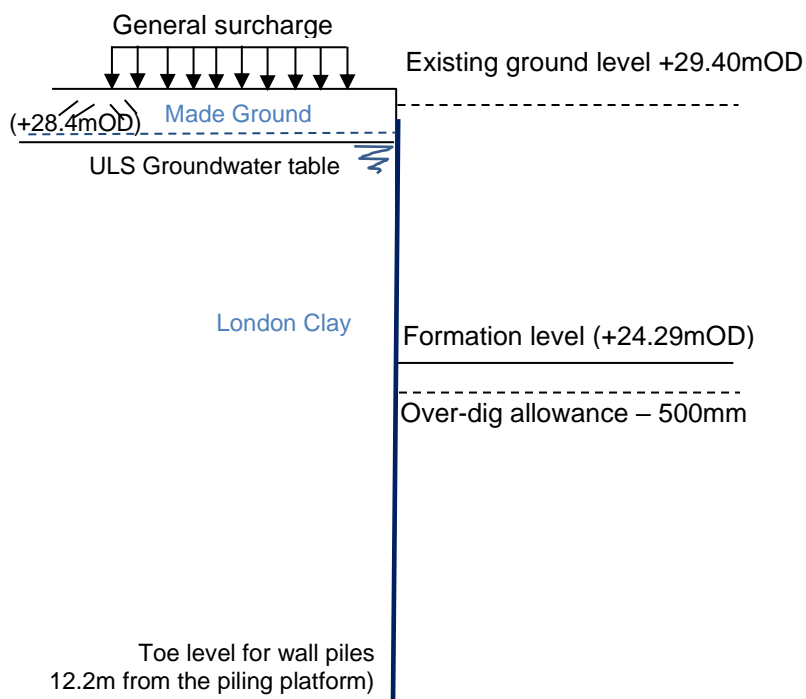


Figure 2. Sketch indicating the typical section for the contiguous piled wall

The analysis was performed for one section, named Section 1. According to the drawings provided, the SSL for the basement slab is +25.015mOD. For a 450mm slab, 225mm cellcore and 50mm blinding, the excavation level is +24.290mOD.

Table 4. Wall sections and retained height

Wall section	Ground level	Formation level	Temporary retained height (m)	Comments
Section 1	+29.40mOD	+24.29OD	5.11	Cantilever in temporary condition

An ultimate limit state approach (ULS) has been utilised for assessing the forces in the piled wall and a service limit state (SLS) was considered for the lateral displacements.

The serviceability limit state (SLS) considers the characteristic values of the soil parameters. In the ultimate limit state (ULS), in accordance with DA1 - Combination 02, partial factors on the soil parameters are applied (1.40 on undrained cohesion and 1.25 on the friction angle).

The analysis also includes the additional forces of 45kN/m lateral load and vertical loads, such as 200kN/m compression and 75kN/m tension.

#### 4.9 Obtained results

The calculations are presented in detail in Appendix 7. Output results in Appendix 7 are per linear metre of retaining wall.

For the structural design of the piles, an envelope of the bending moments and shear force was considered. The forces calculated for both limit states were considered (SLS and ULS). To obtain the design value for bending moment and shear force from those resulted in Wallap, a factor of 1.35 was considered for SLS and 1.0 for ULS. The summary of the results is tabulated in Table 5 and Table 6.

Table 5. Summary of results for SLS

Design section	Serviceability Limit State (SLS)					
	Prop force	Lateral displacement, y	Bending moment, M		Shear force, T	
	kN/m	mm	per metre kNm/m	per pile kNm	per metre kN/m	per pile kNm
01 Section 1	-	up to 33mm	194	116.4	121	72.6

Table 6. Summary of results for ULS

Design section	Ultimate Limit State (ULS)				
	Prop force	Bending moment, M		Shear force, T	
	kN/m	per metre kNm/m	per pile kNm	per metre kN/m	per pile kNm
01 Section 1 - Temporary	-	249	149.4	178	106.8



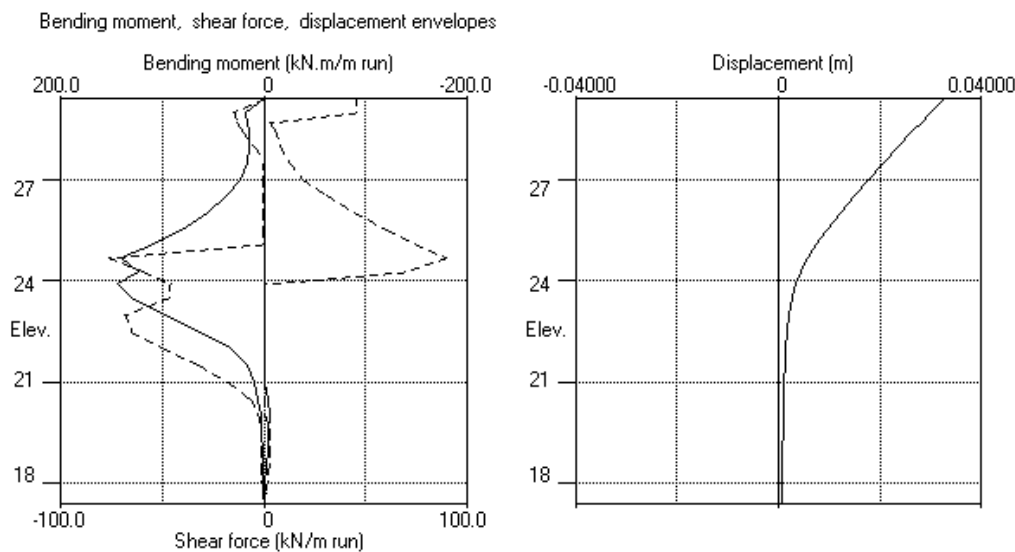


Figure 3. Graphical output from Wallap Report (SLS – Temporary case)

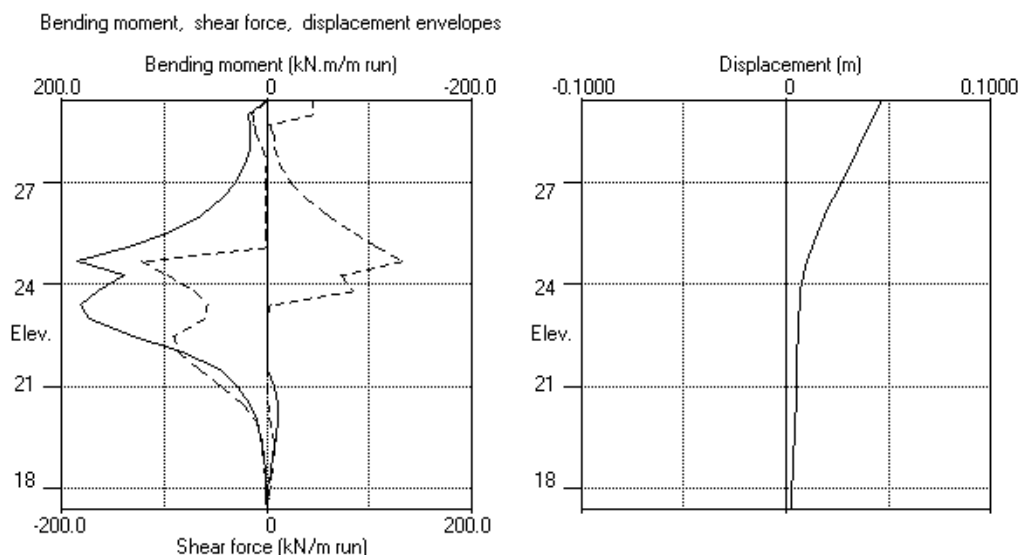


Figure 4. Graphical output from Wallap Report (SLS – Envelope for Permanent case)

#### 4.10 Reinforcement design

The reinforcement has been designed for the shear forces and bending moments generated by the Wallap output in accordance with Eurocode 2. The calculations for the reinforcement are presented in Appendix 8 (Pile calculations).

The section's capacity has been checked for both cases – temporary case (excavation) and permanent (long term). Reinforcement to be used is 6H25x12m in a H12 helical with 200mm pitch. Steel grade with a yield resistance of 500N/mm<sup>2</sup>. Concrete to be used is C28/35 strength class and DC-3 ACEC concrete class.

#### 4.11 Lateral wall deflections

Anticipated wall deflections are shown in the design section (Appendix 7) and Table 4. The calculated lateral displacement Section 1 is up to 33mm, value considered to be within the allowable range, for a retaining wall designed as cantilever and maximum retained height of approximately 5m.

The maximum lateral displacement values are expected to be in reality lower than the ones calculated, considering that the design is based on the following assumptions:

- The analysis was made considering conservative values for the soil parameters
- The method adopted (Winkler based subgrade reaction model) is a simplification of the soil behavior and disregards the interaction between soil particles (assumes independent soil elements modeled as linear elastic springs)
- A two-dimensional analysis was allowed for (thus disregarding the stiffening effect at the corners of the retaining wall).

#### 4.12 On site recommendations

The construction tolerances (agreed by the in force legislation – ICE Specification for piling) are 1 in 75 verticality tolerance (68mm at the formation level) and 75mm for plan positioning, given a guide wall will not be used for installing the piles. Therefore, the maximum deviation for the retaining wall could be  $68+75 = 143\text{mm}$ . This tolerance should be reflected in the positioning of piles and of the lining wall.

It is recommended that a survey of the neighbouring structures is carried out prior to commencement of works to note any cracks that may be present. Tell tales should then be applied in order to assess the impact of the pile installation and basement excavation.

In the permanent condition the basement slab and ground floor slab will provide additional support.

Please note that the excavation should not proceed beyond 1.0m prior to the installation of a capping beam. Some settlement is likely to be experienced and a provision should be made by the main contractor for making good. A non-negligent insurance policy should also be employed by the main contractor to cover more serious issues.

The reinforcement bars will be de-bonded in accordance with the provided cut-off levels for the piles, using de-bonding foam. A tolerance of 150mm is adopted for the lower level of the de-bonding foam, as per the attached figure.

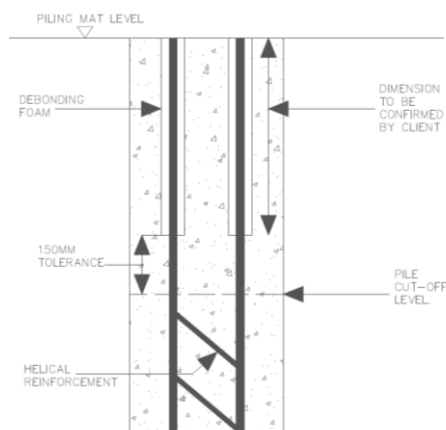


Figure 4. De-bonding detail

## 5 Bearing design

### 5.1 Bearing capacity

According to the information provided with, in the permanent condition the contiguous wall will participate in taking the vertical compression loads transmitted by the structure.

The vertical loads specified by the structural engineer are 200kN/m compression and 75kN/m tension, which given the typical spacing of 0.6m, reduce down to compression of 120kN/pile and tension of

45kN/pile. In order to apply the BS EN 1997 design approach of split of 70%-30% between permanent and variable loads was allowed for. The length of the wall piles to accommodate the specified loads is indicated in Appendix 3.

The required length has been assessed in accordance with BS EN 1997-1:1994, BS EN 1992-1-1:2004 and the relevant UK National Annexes.

The partial resistance factors used to assess the piles bearing capacity are as per the NA to BS 1997-1:2004, table A.NA.8, based on Design Approach 1, Combination 2.

Table 7. Partial resistance factors for pile design

Resistance	Symbol	Partial factor
Model factor	$\gamma_{rd}$	1.4
Base	$\gamma_b$	2.0
Shaft resistance for compression load	$\gamma_s$	1.6
Shaft resistance for tension load	$\gamma_{s,t}$	2.0

The bearing capacity of the piles is assessed using the following formulas, as per BS EN 1997-1:2004:

$$R_{c,d} = \frac{R_{b,k}}{\gamma_b \cdot \gamma_{rd}} + \frac{R_{s,k}}{\gamma_s \cdot \gamma_{rd}}$$

$$R_{b,k} = A_b \cdot N_c \cdot c_u$$

$$R_{s,k} = A_s \cdot \alpha \cdot c_u$$

Where:

$R_{c,d}$  - the pile bearing capacity for compression load

$R_{b,k}$  - the pile base resistance

$R_{s,k}$  - the pile shaft capacity

$N_c$  - bearing coefficient

$c_u$  - undrained cohesion

$\alpha$  - adhesion factor

The calculation for the required length of the wall piles is presented in Appendix 8, using Oasys Pile software. The Oasys Pile – used in its version 19.6 and developed by Arup - calculates the vertical load bearing capacities and vertical settlements of a range of individual piles in a layered soil deposit. The theory is based on both conventional and new methods for drained (frictional) and undrained (cohesive) soils.

## 5.2 Pile Settlement Calculations

The software used for the settlement calculations is Oasys version 19.6, developed by Arup.

The Oasys Pile, used in its version 19.6, calculates the vertical load bearing capacities and vertical settlements of a range of individual piles in a layered soil deposit. The theory is based on both conventional and new methods for drained (frictional) and undrained (cohesive) soils.

The Mindlin method was used to calculate the settlements. Mindlin method calculates relative displacements across a stratum directly from the applied loads.

Table 8. Load summary

Pile diameter (mm)	Unfactored compression load (kN)	Pile Depth (m)	Pile settlement (mm)
450	120	12.2	1.0

The full calculations are present in *Appendix 8 (Pile Calculations)*.

## 6 Design Risk Assessment

Appendix 6 contains the risk assessment for this project from a design point of view. A separate risk assessment from installation point of view is included in the method statements. Hazards associated with the design aspects of this project are described as follows:

- Hazard effect
- Severity
- Probability
- Initial risk (product of Severity and Probability)
- Control measures
- Residual risk (product of Severity and Probability after implementation of control measures).

## 7 Piling mat

Appendix 6 includes the piling mat design for the rig to be used for the piling works. The design was conducted in accordance with BRE 470. Based on a granular subgrade, the piling mat should be 470mm thick with the use of geosynthetic reinforcement ( $T_{ult}=30\text{kN/m}$ ) or 560mm without geosynthetic reinforcement thick with aggregate size no greater than 75mm crushed concrete, installed in layers no thicker than 150mm.

Plate load testing on the piling mat will be required to verify the installation and quality of the piling mat. The specification for testing is indicated in the Working Platform Certificate.

## 8 Validation

Sonic echo testing has been allowed for all contiguous wall piles. If required, this can be arranged by contacting Central Piling's office with a notice period of a minimum of three working days. Please note that piles should not be trimmed until seven days have elapsed following installation.

In regard to the concrete cube testing BS8500 suggests that where a standard mix is supplied by a readymix company their compliance testing methods will be sufficient and no site testing will be necessary. The ICE SPERW requirement for testing is a set of 4 cubes per day with one cube being tested at 7 days, two at 28 days and a spare being kept in the event of the failure of the 28-day result to reach the design strength. We currently have an allowance for one set of cubes per day, as required by the ICE SPERW.

We would suggest that testing requirements are discussed and agreed with your checking engineer and approving authority prior to commencement.

## 9 Environmental considerations

The piles are installed using the continuous flight auger method, considered as the most appropriate in terms of minimising the environmental impact due to noise and vibration.

The concrete resulted from trimming before the piles are put into use or at the end of the building's life cycle, may be recycled, being a potential source of recycled aggregate for a range of applications. The reinforcing steel bars are also suitable for recycling.

Together with all the relevant information and records, the piles installed can be further used in case the current building is subject to structural modifications or they can be used to support new buildings.

## 10 Disclaimer

This is the property of Central Piling and had been issued for the named Client.

No part of this document may be copied, changed or multiplied without the written permission of Central Piling.

## 11 References

BRE Construction Division. (2005). *Concrete in Aggressive Ground* (3rd ed.). Garston: BRE.

British Standards Institution. (2015). *Code of Practice for Foundations (BS 8004)*. BSI.

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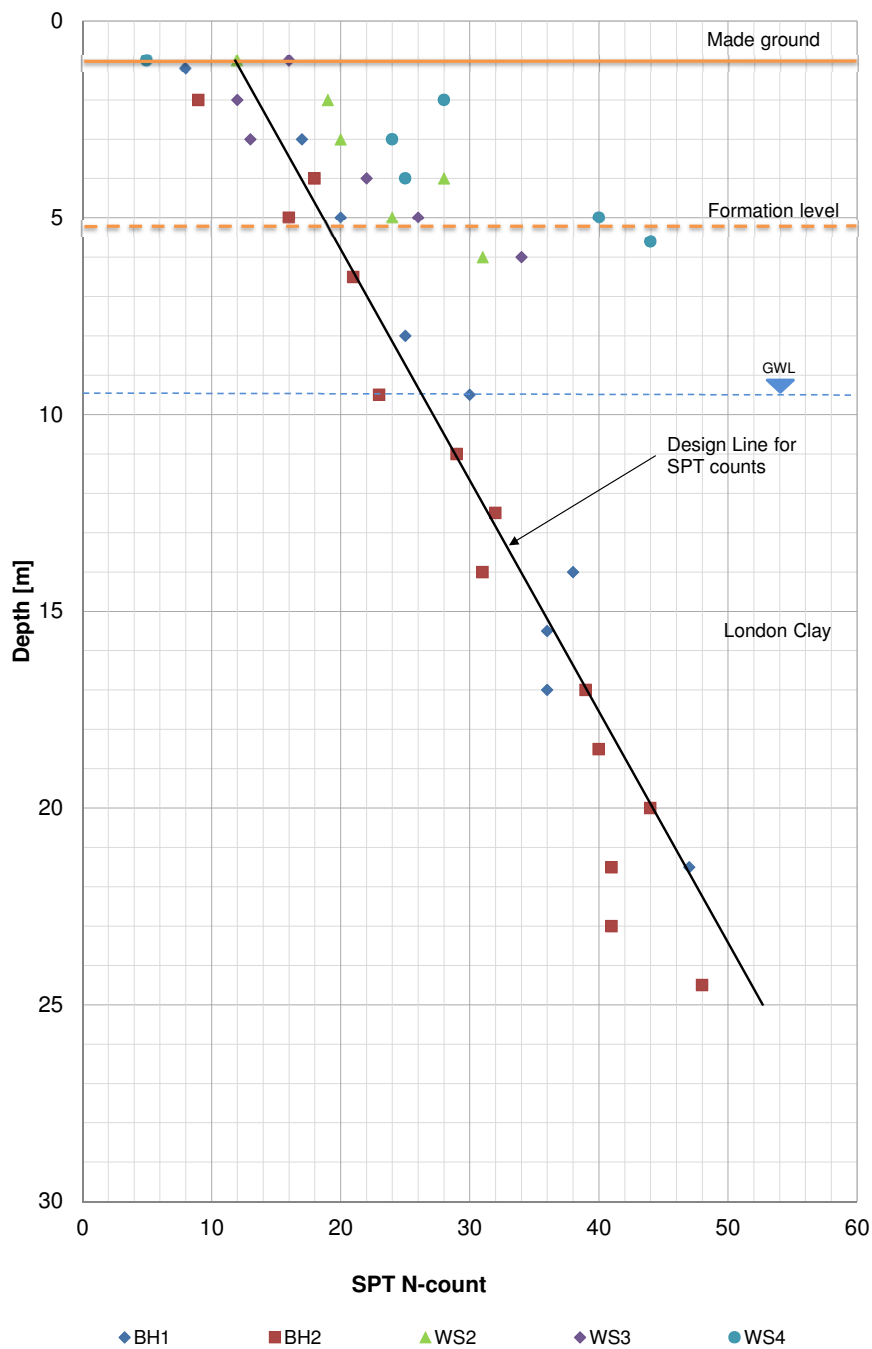
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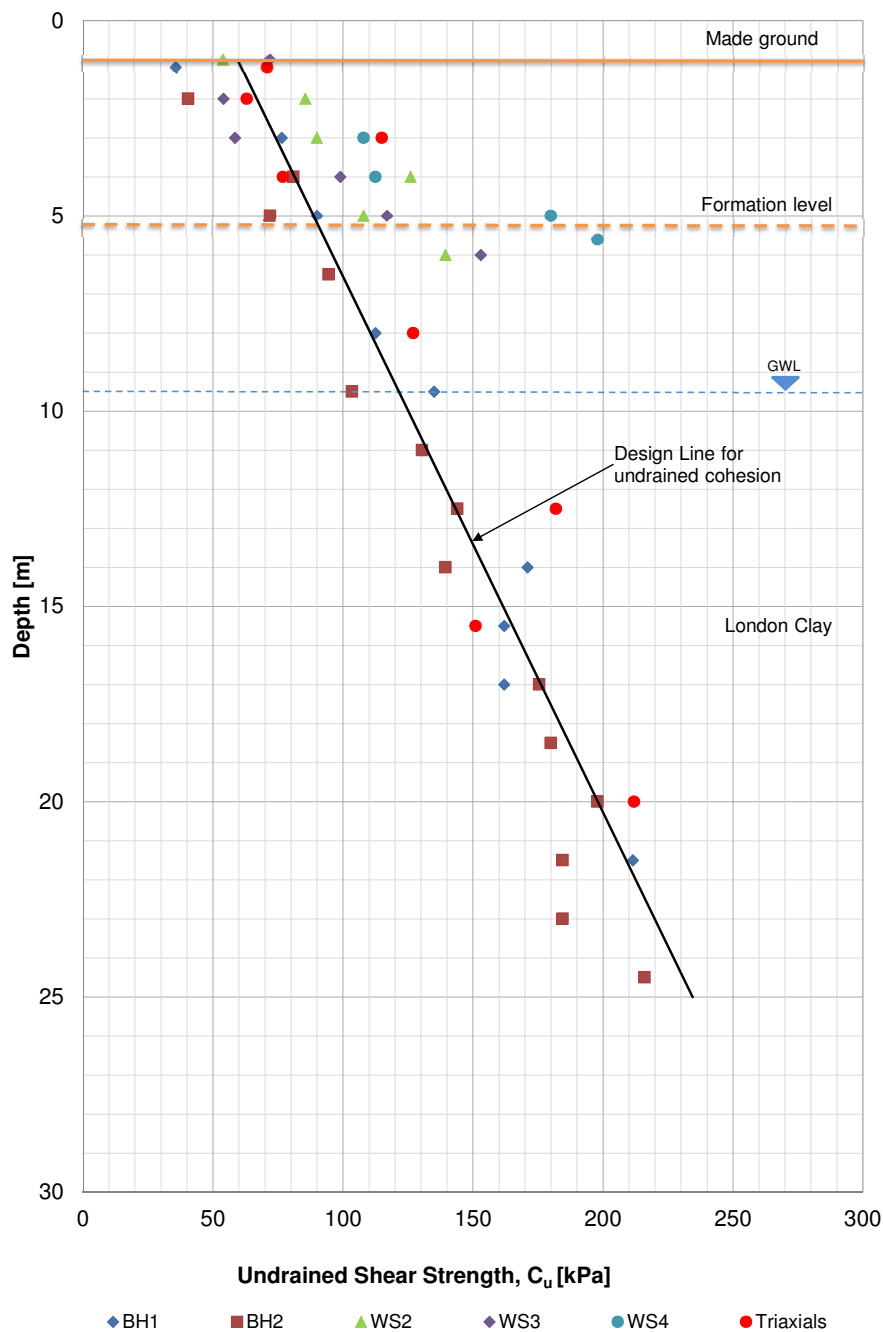
## **Appendix 1**

### *Design Line*



**Notes:**

Design properties have been derived in accordance with the Clancy Consulting site investigation reports.



**Notes:**

Design properties have been derived in accordance with the Clancy Consulting site investigation report.

Equivalent undrained shear strength derived from SPT N values converted by a multiple of 4.5.



## **Appendix 2**

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### *Reinforcement Design*

### Input Parameters

Pile diameter, B (m)	0.45
Ultimate bending moment, $M_u$ (kN-m/m)	245
Pile spacing, x (m)	0.6
Ultimate bending moment per pile, $M_u$ (kN-m)	147

### Concrete Parameters

Compression load, P (kN)	0
Concrete strength, $F_{ck}$ (N/mm <sup>2</sup> )	500

### Reinforcement Design

$M_u / (B^3 * F_{ck})$	0.058	
$N / (B^2 * F_{ck})$	0.000	
$(A_s * F_{yk}) / (A_c * F_{ck})$	0.270	(Minimum 0.02) (Steel strength $F_{yk} = 500$ N/mm <sup>2</sup> )
$A_c$ (mm <sup>2</sup> )	159043	
$A_s$ required (mm <sup>2</sup> )	2408	

### Steel Requirements

No. bars	6
Steel grade	H
Bar diameter (mm)	25
Depth of cage (m)	12
$A_{sc}$ allowed (mm <sup>2</sup> )	2945

### Notes:

### Shear Forces

Ultimate shear force, $V$ (kN/m)	178.0
Pile spacing, $x$	0.6
Ultimate shear force per pile, $V_u$ (kN)	106.8

### Concrete Parameters

Pile diameter, $B$ (m)	0.45
Cover (mm)	75
Concrete strength, $F_{ck}$ (N/mm <sup>2</sup> )	28

### Reinforcement Properties

Number of bars	6	
Main bar diameter (mm)	25	
Steel strength, $F_y$ (N/mm <sup>2</sup> )	500	(Main bar and helical reinforcement)
Helical bar diameter (mm)	12	

### Area Outputs

$A_c$ (mm <sup>2</sup> )	159043	Main bar $A_s$ (mm <sup>2</sup> )	2945
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### Equivalent Rectangular Section

Rectangular width (mm)	450	Effective width, $b$ (mm)	251
Rectangular depth (mm)	353	Effective depth, $z$ (mm)	254

### Area of Tension Reinforcement

Length of distance (mm)	811
Tension $A_s$ (mm <sup>2</sup> )	912
$100A_s / b \cdot d$	0.80

### Value of Design Concrete Shear Stress

$V_c$ (N/mm <sup>2</sup> ) (Table 4.17)	0.64
Shear resistance, $V_{rd}$ (kN)	40.8

### Design of Links

$v_w = V / (b \cdot z \cdot (1 - F_{ck} / 250) \cdot F_{ck})$	0.075
$A_{sv} / s = V / (F_y \cdot z \cdot \cot(\phi))$	0.374

### Shear Requirements

Steel grade	H
Bar diameter (mm)	12
Pitch (mm)	200
$A_{sv} / s_v$ allowed (mm <sup>2</sup> /mm) (From table 4.20)	0.78

### Notes:

Spacing must be less than or equal to  $0.75 \cdot z$

$0.75 \cdot z$  190

### Input Parameters

Pile diameter, B (m)	<input type="text" value="0.45"/>	
Factor of safety for steel area	<input type="text" value="1.5"/>	Variable nature
Factor of safety for shaft resistance	<input type="text" value="2.8"/>	Model factor 1.4 x Shaft factor 2.0
Steel yield strength (N/mm <sup>2</sup> )	<input type="text" value="500"/>	
Material partial safety factor, $\gamma_m$	<input type="text" value="1.15"/>	
Tension force DA1-C2 (kN)	<input type="text" value="60"/>	
Tension force DA1-C1 (kN)	<input type="text" value="70"/>	

### Output

$A_{sc}$ required (mm <sup>2</sup> )	<input type="text" value="161"/>
USC required (kN)	<input type="text" value="168"/>

### Reinforcement Design

Depth where USC exceeds (m)	<input type="text" value="12.0"/>
USC at depth (kN)	<input type="text" value="552"/>

### Steel Requirements

No. bars	<input type="text" value="6"/>
Steel grade	<input type="text" value="H"/>
Bar diameter (mm)	<input type="text" value="25"/>
Depth of cage (m)	<input type="text" value="12"/>
$A_{sc}$ allowed (mm <sup>2</sup> )	<input type="text" value="2945"/>
USC at depth (kN)	<input type="text" value="552"/>

### Notes:

Tension check



# CENTRAL PILING LIMITED

Camden High  
450mm diameter pile  
Section capacity check

Job No.	Sheet No.	Rev.
41713A1		
Drg. Ref.		
Made by SD	Date 26-Mar-2021	Checked

## Title & Specification

Job number 41713A1  
Job title Camden High  
Subtitle 450mm diameter pile  
Calc. heading Section capacity check  
File \\FILESERVER\Data\6. Contracts\41701-41725\41713\Technical\Design\03 Retaining Wall\01 C01 Construction Issue\AD01\_41713A1\_450mm\_6H25.ads  
Wall piles  
Notes 6H25 cages  
Code of Practice BS EN 1992-2:2005 [United Kingdom]  
Bending Axes Biaxial  
Number of sections 1  
Number of ULS cases 1  
Number of SLS cases 1

## Analysis Task

Section 1 : 450mm section  
Analysis type ULS strength  
Analysis case(s) 1 : ULS Case 1  
Number of iterations 2400  
Limit iteration step Yes  
Perturbation factor 0%

## Section : Definition

### 1 : 450mm section

Name 450mm section  
Type Concrete  
Material C28/35  
Origin Centre  
Dimensions  
Diameter 450.0mm  
Section Area 159000.0mm<sup>2</sup>  
Reinforcement Area 2945.0mm<sup>2</sup>  
Reinforcement 1.852%

## Section : Nodes

### 1 : 450mm section

Node	Y [mm]	Z [mm]
1	0.0	226.3
2	58.57	218.6
3	113.1	196.0
4	160.0	160.0
5	196.0	113.1
6	218.6	58.57
7	226.3	-9.892E-6
8	218.6	-58.57
9	196.0	-113.1
10	160.0	-160.0
11	113.1	-196.0
12	58.57	-218.6
13	-19.78E-6	-226.3
14	-58.57	-218.6
15	-113.1	-196.0
16	-160.0	-160.0
17	-196.0	-113.1
18	-218.6	-58.57
19	-226.3	2.699E-6
20	-218.6	58.57
21	-196.0	113.1
22	-160.0	160.0
23	-113.1	196.0
24	-58.57	218.6

## Section : Cover & Links

### 1 : 450mm section

Cover 75.00mm  
Link Size 10.00mm  
Link Material 500B

## Section : Bars

### 1 : 450mm section

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	127.5	0.0	25.00	490.9	490.9	Steel	500B			
2	63.75	110.4	25.00	490.9	490.9	Steel	500B			
3	-63.75	110.4	25.00	490.9	490.9	Steel	500B			
4	-127.5	-1.159E-6	25.00	490.9	490.9	Steel	500B			
5	-63.75	-110.4	25.00	490.9	490.9	Steel	500B			
6	63.75	-110.4	25.00	490.9	490.9	Steel	500B			

## Section : Elastic Properties

### 1 : 450mm section

Effective properties of the section, ignoring reinforcement.

Geometric Centroid	y	0.0mm
	z	0.0mm
Area		159000.0mm <sup>2</sup>
Second Moments of Area	I <sub>yy</sub>	2.013E+9mm <sup>4</sup>
	I <sub>zz</sub>	2.013E+9mm <sup>4</sup>
	I <sub>yz</sub>	0.0mm <sup>4</sup>
Principal Second Moments of Area	I <sub>uu</sub>	2.013E+9mm <sup>4</sup>
	I <sub>zz</sub>	2.013E+9mm <sup>4</sup>
	Angle	0.0°
Shear Area Factor	k <sub>y</sub>	0.8571
	k <sub>z</sub>	0.8571
Torsion Constant		4.026E+9mm <sup>4</sup>



# CENTRAL PILING LIMITED

Camden High  
450mm diameter pile  
Section capacity check

Job No.	Sheet No.	Rev.
41713A1		
Drg. Ref.		
Made by SD	Date 26-Mar-2021	Checked

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]		
Section Modulus			$Z_y$		$8.946E+6mm^3$					
			$Z_z$		$8.946E+6mm^3$					
Plastic Modulus			$Z_{py}$		$15.19E+6mm^3$					
			$Z_{pz}$		$15.19E+6mm^3$					
Radius of Gyration			$R_y$		112.5mm					
			$R_z$		112.5mm					

## Properties of gross section, including reinforcement.

Geometric Centroid		Y	0.0mm
		Z	0.0mm
EA			$5.632E+6kN$
EI		$EI_{yy}$	$69050.kNm^2$
		$EI_{zz}$	$69050.kNm^2$
		$EI_{yz}$	$0.0kNm^2$
Principal EI		$EI_{uu}$	$69050.kNm^2$
		$EI_{zz}$	$69050.kNm^2$
		Angle	$0.0^\circ$

## Material : Concrete

### 1 : C28/35

Name		C28/35
Cylinder Strength	$f_{ck}$	$28.00N/mm^2$
Tensile Strength	$f_{ctm}$	$2.766N/mm^2$
Weight		Normal Weight
Density	$\rho$	$2.400t/m^3$
Elastic Modulus	E	$32310.N/mm^2$
Poisson's Ratio	$\nu$	0.2000
Coeff. Thermal Expansion	$\alpha$	$10.00E-6/^\circ C$
Partial Factor	$\gamma_c$	1.500
Safety Factor Maximum Strain		0.003500
Strain Plateau		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		0.0mm

## Material : Rebar

### 1 : 500B

Type		Steel rebar
Strength	$f_{yk}$	$500.0N/mm^2$
Elastic Modulus	E	$200000.N/mm^2$
Hardening Modulus	$E_h$	$0.0N/mm^2$
Density	$\rho$	$7.850t/m^3$
Poisson's Ratio	$\nu$	0.3000
Coeff. Thermal Expansion	$\alpha$	$12.00E-6/^\circ C$
Ductility		Normal
Partial Safety Factor	$\gamma_s$	1.150
	$\gamma_{se}$	1.000
Maximum Strain	$\epsilon_{uk}$	0.05000
Maximum Strain	$\epsilon_{ud}$	0.04500
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	Load Case 1

### Applied loads

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



CENTRAL PILING  
LIMITED

Camden High  
450mm diameter pile  
Section capacity check

Job No.	Sheet No.	Rev.
41713A1		
Drg. Ref.		
Made by SD	Date 26-Mar-2021	Checked

Load Case	N [kN]	M <sub>yy</sub> [kNm]	M <sub>zz</sub> [kNm]	Note
-----------	--------	-----------------------	-----------------------	------

Section 1 Details

1.85% reinforcement in section 1 (450mm section). Check this against code requirements.

ULS Cases Analysed

Name	Section	Loading	Prestress Factor
ULS Case 1	1 : 450mm section	L1	1.000

Strength Analysis - Loads

Case	N [kN]	M <sub>yy</sub> [kNm]	M <sub>zz</sub> [kNm]	M [kNm]	θ [°]
1	0.0	0.0	0.0	0.0	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	0.0	0.0	0.0	150.8	0.0	B: Node 1	0.0	155.7

Strength Analysis - Details

Case	Moment Angle [°]	Description	N [kN]	M [kNm]	Warning
	138.7	Max. compressive strain	3655.	6.237E-6	
	842.5E-9	Max. tensile strain	-1281.	247.4E-9	
1	0.0	Axial strength at M	3756.	0.2282	
		Initial yield	-0.01352	131.4	
		Balanced yield	655.6	185.3	
		Bending strength at N=0	0.0	150.8	

Strain Planes at ULS Strength

Related to Reference Point

Case	Strain Plane	ε <sub>ax</sub> [-]	κ <sub>yy</sub> [/m]	κ <sub>zz</sub> [/m]
1	Reinforcement	-0.001587	0.02248	169.9E-12
	User Creep/Shrinkage	0.0	0.0	0.0
	Total (Concrete)	-0.001587	0.02248	169.9E-12

Section Material Stresses/Strains at ULS Strength

Case Point	Coordinates		Strain	Stress	Notes
	y [mm]	z [mm]	[-]	[N/mm <sup>2</sup> ]	
1	1	0.0	226.3	0.003500	15.87
1	2	58.57	218.6	0.003327	15.87
1	3	113.1	196.0	0.002818	15.87
1	4	160.0	160.0	0.002010	15.87
1	5	196.0	113.1	956.3E-6	11.55
1	6	218.6	58.57	-270.6E-6	0.0
1	7	226.3	-9.892E-6	-0.001587	0.0
1	8	218.6	-58.57	-0.002904	0.0
1	9	196.0	-113.1	-0.004131	0.0
1	10	160.0	-160.0	-0.005185	0.0
1	11	113.1	-196.0	-0.005993	0.0
1	12	58.57	-218.6	-0.006501	0.0
1	13	-19.78E-6	-226.3	-0.006675	0.0
1	14	-58.57	-218.6	-0.006501	0.0
1	15	-113.1	-196.0	-0.005993	0.0
1	16	-160.0	-160.0	-0.005185	0.0
1	17	-196.0	-113.1	-0.004131	0.0
1	18	-218.6	-58.57	-0.002904	0.0
1	19	-226.3	2.699E-6	-0.001587	0.0
1	20	-218.6	58.57	-270.6E-6	0.0
1	21	-196.0	113.1	956.3E-6	11.55
1	22	-160.0	160.0	0.002010	15.87
1	23	-113.1	196.0	0.002818	15.87
1	24	-58.57	218.6	0.003327	15.87

Reinforcement Stresses/Strains at ULS Strength

Case Bar	Coordinates		Strain	Stress	Notes
	y [mm]	z [mm]	[-]	[N/mm <sup>2</sup> ]	
1	1	127.5	0.0	-0.001587	-317.5 500B
1	2	63.75	110.4	895.0E-6	179.0 500B
1	3	-63.75	110.4	895.0E-6	179.0 500B
1	4	-127.5	-1.159E-6	-0.001587	-317.5 500B
1	5	-63.75	-110.4	-0.004070	-434.8 500B
1	6	63.75	-110.4	-0.004070	-434.8 500B

Job No.	Sheet No.	Rev.
41713A1		
Drg. Ref.		
Made by	Date	Checked
SD	26-Mar-2021	

### Force/Moment Interaction

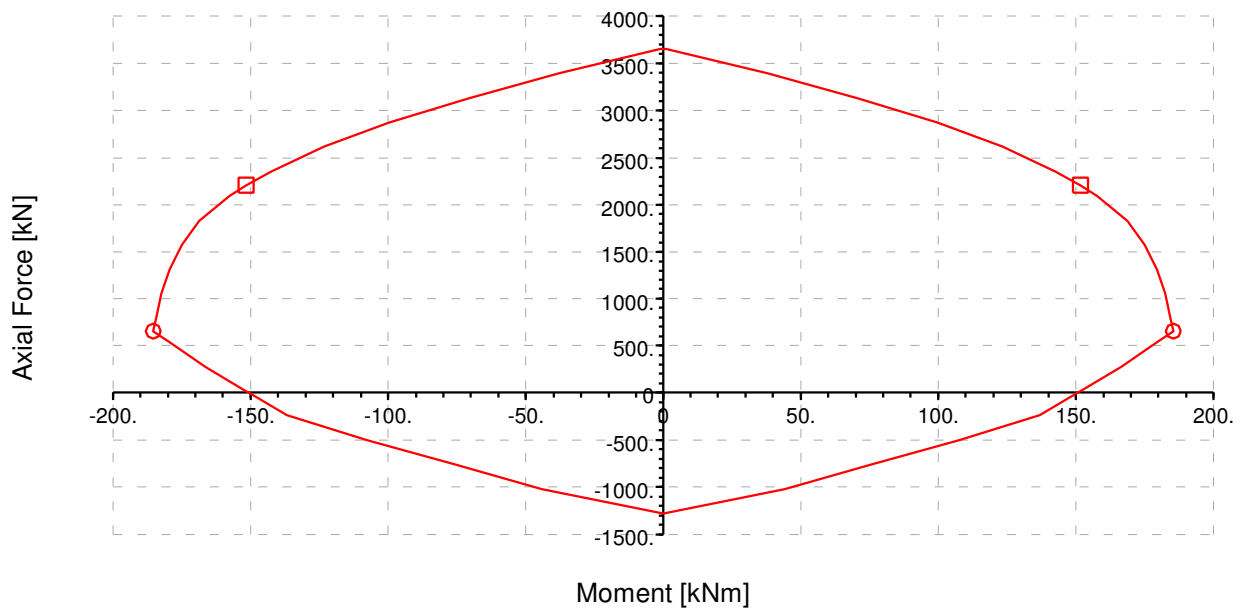
EC2-2 (GB) : 450mm section

Moment angle: 0.00

— Force/Moment Interaction

□ No tension point

○ Balanced yield point





## **Appendix 3**

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### *Pile schedule*

Plot	Pile Ref	Diameter (mm)	Working load per pile (kN)	Permanent Load G <sub>k</sub> (kN)	Variable Load Q <sub>k</sub> (kN)	Wind Load W <sub>k</sub> (kN)	Total Vertical DA1-C2 (kN)	Total Vertical DA1-C1 (kN)	Horizontal per pile (kN)	Tension DA1-C2 (kN)	Tension DA1-C1 (kN)	*Mat Level (m)	Cut-off Level (m)	Rebar Protruding (m)	Pile Depth (m)	No. Bars	Grade	Depth (m)	Helical Grade	Helical Pitch (mm)
Wall	CP1	450	120	84	36		135	170	30	60	70				12.2	6	H25	12	H12	200
Wall	CP2	450	120	84	36		135	170	30	60	70				12.2	6	H25	12	H12	200
Wall	CP3	450	120	84	36		135	170	30	60	70				12.2	6	H25	12	H12	200
Wall	CP4	450	120	84	36		135	170	30	60	70				12.2	6	H25	12	H12	200
Wall	CP5	450	120	84	36		135	170	30	60	70				12.2	6	H25	12	H12	200
Wall	CP6	450	120	84	36		135	170	30	60	70				12.2	6	H25	12	H12	200
Wall	CP7	450	120	84	36		135	170	30	60	70				12.2	6	H25	12	H12	200
Wall	CP8	450	120	84	36		135	170	30	60	70				12.2	6	H25	12	H12	200
Wall	CP9	450	120	84	36		135	170	30	60	70				12.2	6	H25	12	H12	200
Wall	CP10	450	120	84	36		135	170	30	60	70				12.2	6	H25	12	H12	200
Wall	CP11	450	120	84	36		135	170	30	60	70				12.2	6	H25	12	H12	200
Wall	CP12	450	120	84	36		135	170	30	60	70				12.2	6	H25	12	H12	200
Wall	CP13	450	120	84	36		135	170	30	60	70				12.2	6	H25	12	H12	200
Wall	CP14	450	120	84	36		135	170	30	60	70				12.2	6	H25	12	H12	200
Wall	CP15	450	120	84	36		135	170	30	60	70				12.2	6	H25	12	H12	200
Wall	CP16	450	120	84	36		135	170	30	60	70				12.2	6	H25	12	H12	200
Wall	CP17	450	120	84	36		135	170	30	60	70				12.2	6	H25	12	H12	200
Wall	CP18	450	120	84	36		135	170	30	60	70				12.2	6	H25	12	H12	200
Wall	CP19	450	120	84	36		135	170	30	60	70				12.2	6	H25	12	H12	200
Wall	CP20	450	120	84	36		135	170	30	60	70				12.2	6	H25	12	H12	200
Wall	CP21	450	120	84	36		135	170	30	60	70				12.2	6	H25	12	H12	200
Wall	CP22	450	120	84	36		135	170	30	60	70				12.2	6	H25	12	H12	200
Wall	CP23	450	120	84	36		135	170	30	60	70				12.2	6	H25	12	H12	200
Wall	CP24	450	120	84	36		135	170	30	60	70				12.2	6	H25	12	H12	200
Wall	CP25	450	120	84	36		135	170	30	60	70				12.2	6	H25	12	H12	200
Wall	CP26	450	120	84	36		135	170	30	60	70				12.2	6	H25	12	H12	200
Wall	CP27	450	120	84	36		135	170	30	60	70				12					



Compression DA1-C2 (kN)	Horizontal (kN)	Tension load DA1-C2 (kN)	Diameter (mm)	PileDepth (m)	Count of Piles
135	30	60	450	12.2	105
Grand Total					105

## **Appendix 4**

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### *Design risk assessment*

Central Piling Ltd		Risk Assessment				Assessment No: 41713A3	
Activity: <b>Design</b>							
Assessed by: A. Munteanu		Date Assessed: 29/03/2021				Review Date: 29/03/2022	
Hazard	Hazard effect	Severity	x	Probability	=	Initial Degree of Risk and Assessment	Residual Degree of Risk and Assessment
Sequencing of piling work.	Conflict with other parts of the project construction creating unsafe working conditions.	5		3	=	15 <b>High</b>	5 <b>Low</b>
Inadequately designed / constructed / maintained working platforms.	Rig overturning, unsafe working conditions for operatives.	5		3	=	15 <b>High</b>	5 <b>Low</b>
CFA auger changes.	Personal injury.	4		2	=	8 <b>Medium</b>	4 <b>Low</b>
Racking of reinforcement cages while lifting.	Injury to operatives from falling steel bars.	4		2	=	8 <b>Medium</b>	4 <b>Low</b>
Underground services.	Personal injury. Loss of amenity.	5		4	=	20 <b>High</b>	5 <b>Low</b>
Immediate environmental impact.	Unacceptable levels and/or vibration, hearing damage to operatives.	3		3	=	9 <b>Medium</b>	3 <b>Negligible</b>
Pile trimming to cut-off level and exposing of reinforcement.	Vibration white finger injuries.	3		2	=	6 <b>Low</b>	3 <b>Negligible</b>
Exposed end of reinforcement after pile trimming.	Personal injury.	4		2	=	8 <b>Medium</b>	4 <b>Low</b>
Inadequate access to piles for integrity testing.	Personal injury.	4		1	=	4 <b>Low</b>	4 <b>Low</b>
Congested reinforcement in pile caps around head of pile during integrity tests.	Inability to test piles.	3		2	=	6 <b>Low</b>	3 <b>Negligible</b>
Flighting of soils during pile installation.	Damage to/instability of adjacent buildings.	4		2	=	8 <b>Medium</b>	4 <b>Low</b>
Working in close proximity to TFL tunnels	Drilling in wrong location to the wrong depth could result in an interface between the tunnels and the pile, causing a potential major incident.	5		4	=	20 <b>High</b>	6 <b>Low</b>
Calculation or scheduling error	Damage/instability of adjacent structures	4		2	=	8 <b>Medium</b>	6 <b>Low</b>
Maximum Initial Degree of Risk						20	
<b>Initial Risk Assessment</b>						<b>High</b>	
Maximum Residual Degree of Risk						6	
<b>Residual Risk Assessment</b>						<b>Low</b>	

## **Appendix 5**

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### *ACEC concrete class*

# Concrete in aggressive ground BRE Special Digest 1:2005

## Part D: Specifying concrete and additional protective measures

Table D1 Selection of the DC Class and the number of APM's for concrete elements where the hydraulic gradient due to groundwater is 5 or less: for general in-situ use of concrete.		
ACEC Class from General Brownfield or Pyrite sheets	Intended working life	
	At least 50 years	At least 100 years
AC-1	DC-1	DC-1
AC-1s	DC-1	DC-1
AC-2	DC-2	DC-2
AC-2s	DC-2	DC-2
AC-2z	DC-2z	DC-2z
AC-3	DC-3	DC-3 + one APM of choice
AC-3s	DC-3	DC-3
AC-3z	DC-3z	DC-3z
AC-4	DC-4	DC-4 + one APM of choice
AC-4s	DC-4	DC-4
AC-4z	DC-4z	DC-4z
AC-4m	DC-4m	DC-4m + one APM of choice
AC-4ms	DC-4m	DC-4m
AC-5	DC-4 + APM3 <sup>f</sup>	DC-4 + APM3 <sup>f</sup>
AC-5m	DC-4m + APM3 <sup>f</sup>	DC-4m + APM3 <sup>f</sup>
AC-5z	DC-4z + APM3 <sup>f</sup>	DC-4z + APM3 <sup>f</sup>

### Notes

[a] Where the hydraulic gradient across a concrete element is greater than 5, one step in DC Class or one APM over and above the number indicated in this table should be applied except where the original provisions included APM3 is already required, or has been selected, an extra APM is not needed

[b] A section thickness of 140mm or less should be avoided in in-situ construction but, where this is not practical, apply one step higher DC Class or an extra APM except where the original provisions included APM3. Where APM3 is already required, or has been selected, an extra APM is not necessary

[c] Where a section thickness greater than 450mm is used and some surface chemical attack is acceptable, a relaxation of one step in DC Class may be applied For reinforced concrete, the cover should be sufficiently thick to allow for estimated surface degradation during the intended working life.

[d] Foundation of low rise housing that have an intended working life of at least 100 years may be constructed with concrete selected from the column headed At least 50 years' (Section D7)

[e] Structures with an intended working life of at least 50 years but for which the consequences of failure would be relatively serious, should be classed as having an intended working life of at least 100 years for the selection of the DC Class and APM (Section D7)

[f] Where APM3 is not practical, see Section D6.1 for guidance.

### Explanation of suffix symbols to ACEC Class number

- Concrete placed in ACEC Classes that include the suffix 'z' primarily must be resist acid conditions and may be made with any of the cements listed in Table D2

- Suffix **m** relates to the higher levels of magnesium in Sulfate Classes 4 and 5.

**Concrete in aggressive ground BRE Special Digest 1:2005**

This General Sheet applies to all sites except those subject to brownfield development or pyritic oxidation

Part C5: Assessing the aggressive chemical environment

**Table C1 & C2 Aggressive Chemical Environment for Concrete (ACEC) site classification**

Sulfate and magnesium						Natural soil		Brownfield (3)		
Design Sulfate Class	2:1 Water/Soil Extract		Groundwater		Total Potential Sulfate (2)	Static Water	Mobile Water	Static Water	Mobile Water	ACEC Class
1	2	3	4	5	6	7	8	9	10	11
	SO4 g/l	Mg g/l	SO4 g/l	Mg g/l	SO4 %	pH	pH	pH (4)	pH (4)	
DS-1	<0.5		<0.4		<0.24	>=2.5		>=2.5		AC-1s
							>5.5		>6.5	AC-1
							2.5-5.5		5.5-6.5	AC-2z
									4.5-5.5	AC-3z
									2.5-4.5	AC-4z
DS-2	0.5-1.5		0.4-1.4		0.24-0.6	>3.5		>5.5		AC-1s
							>5.5		>6.5	AC-2
						2.5-3.5		2.5-5.5		AC-2s
							2.5-5.5		5.5-6.5	AC-3z
									4.5-5.5	AC-4z
									2.5-5.5	AC-5z
DS-3	1.6-3.0		1.5-3.0		0.7-1.2	>3.5		>5.5		AC-2s
							>5.5		>6.5	AC-3
						2.5-3.5		2.5-5.5		AC-3s
							2.5-5.5		5.5-6.5	AC-4
									2.5-5.5	AC-5
DS-4	3.1-6.0	<=1.2	3.1-6.0	<=1.0	1.3-2.4	>3.5		>5.5		AC-3s
							>5.5		>6.5	AC-4
						2.5-3.5		2.5-5.5		AC-4s
							2.5-5.5		2.5-6.5	AC-5
DS-4m	3.8-6.7	>1.2 (1)	3.1-6.0	>1.0 (1)	1.3-2.4	>3.5		>5.5		AC-3s
							>5.5		>6.5	AC-4m
						2.5-3.5		2.5-5.5		AC-4ms
							2.5-5.5		2.5-6.5	AC-5m
DS-5	>6.0	<=1.2	>6.0	<=1.0	>2.4	>3.5		>5.5		AC-4s
						2.5-3.5	>=2.5	2.5-5.5	>=2.5	AC-5
DS-5m	>6.7	>1.2 (1)	>6.0	>1.0 (1)	>2.4	>3.5		>5.5		AC-4ms
						2.5-3.5	>=2.5	2.5-5.5	>=2.5	AC-5m

**Notes**

- (1) The limit on water-soluble magnesium does not apply to brackish groundwater (chloride content between 12g/l and 18g/l). This allows **m** to be omitted from the relevant ACEC classification.
- (2) Applies only to sites where concrete will be exposed to sulfate ions (SO<sub>4</sub>) which may result from the oxidation of sulfides such as pyrite, following ground disturbance.
- (3) 'Brownfield' is defined as sites which may contain chemical wastes remaining from previous industrial use or from imported wastes.
- (4) An additional account is taken of hydrochloric and nitric acids by adjustment to sulfate content - see section C5.1.3.

**Explanation of suffix symbols to ACEC Class number**

- Suffix **s** indicates that, as the water has been classified as Static, no Additional Protective Measures are generally necessary.
- Concrete placed in ACEC Classes which include the suffix **z** have primarily to resist acid conditions and may be made with any of the cement in Table D2 on page 42
- Suffix **m** relates to the higher levels of magnesium in Sulfate Classes 4 and 5.



## **Appendix 6**

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### *Piling mat design*

Site Address: 115-119 Premier Inn, Camden High Street, London  
Contract Number: 41713A3  
Rig Type: SF-50

Designed by: AM  
Checked by: SD

Rig track dimensions and bearing pressures:

Wd=Wk= 0.7 m q1k= 135 kPa  
L1d=L1k= 2.52 m q2k= 216 kPa  
L2d=L2k= 1.59 m

Design for working platform on cohesionless subgrade

Design values for ground properties:

Subgrade

Φ'sd=Φ'sk= 30  
Nys= 22.4  
γsd=γpd= 18 kN/m3

Working platform

Φ'pd=Φ'pk= 45 °  
γpd=γpk= 21 kN/m3  
Nyp= 272 (From table A1)  
kptanδ= 10  
sc1=1+0.2[W/L]= 1.06  
sc1=1+0.2[W/L]= 1.09  
sy1=1-0.3[W/L]= 0.92  
sy2=1-0.3[W/L]= 0.87  
sp1=1+[W/L]= 1.28  
sp2=1+[W/L]= 1.44

Table A1. Design values for granular material

Φ'd	Nγ
25°	10.9
30°	22.4
35°	48
40°	109
45°	272
50°	763

Table A2. Design punching shearing resistance coefficient

Φ'd	kptanδ
35°	3.1
40°	5.5
45°	10

Check that subgrade cannot provide bearing resistance without a working platform

Rd=0.5 x γs x Wd x Nys x sy= 129.36 kPa

Design loading is calculated for two loading conditions.

case 1 loading: q1d=2 x q1k= 270 kPa  
case 2 loading: q2d=1.5 x q2k= 324 kPa

Working platform is required for plant support

Check that platform material is stronger than subgrade

Platform material is stronger than subgrade

Check that platform material can provide required bearing resistance

q1d=1.6 x q1k= 216 kPa  
q2d=1.2 x q2k= 259.2 kPa  
0.5 x γ x Wd x Nyp x sy = 1833 kPa

Platform material can provide the required bearing resistance

**Calculate required thickness of platform**

$$D1 = \{Wd[q1d - (0.5 \times \gamma_s \times Nys \times sy1)] / [\gamma_p \times Kp \times \tan \delta \times sp1]\}^{0.5} = 0.48 \text{ m}$$

$$D2 = \{Wd[q2d - (0.5 \times \gamma_s \times Nys \times sy2)] / [\gamma_p \times Kp \times \tan \delta \times sp2]\}^{0.5} = 0.56 \text{ m}$$

**0.56** platform required

**Use of geosynthetic reinforcement**

$$T_{ult} = 30 \text{ kN/m}$$

$$T_d = T_{ult}/2 = 15 \text{ kN/m}$$

**Calculate required thickness of platform with geosynthetic reinforcement**

$$D1 = \{Wd[q1d - (0.5 \times \gamma_s \times Wd \times Nys \times sy1) - (2 \times T_d/Wd)] / [\gamma_p \times Kp \times \tan \delta \times sp1]\}^{0.5} = 0.34 \text{ m}$$

$$D2 = \{Wd[q2d - (0.5 \times \gamma_s \times Wd \times Nys \times sy2) - (2 \times T_d/Wd)] / [\gamma_p \times Kp \times \tan \delta \times sp2]\}^{0.5} = 0.47 \text{ m}$$

**0.47** minimum necessary thickness of platform

**Checking conditions**

$$q1d = 1.25 \times q1k = 169 \text{ kPa}$$

$$q2d = 1.05 \times q2k = 227 \text{ kPa}$$

$$Rd1 = 0.5 \times \gamma_s \times Nys \times sy1 + (D^2/Wd) \times \gamma_p \times Kp \times \tan \delta \times sp1 = 268 \text{ kPa}$$

$$Rd2 = 0.5 \times \gamma_s \times Nys \times sy2 + (D^2/Wd) \times \gamma_p \times Kp \times \tan \delta \times sp2 = 269 \text{ kPa}$$

Conditions are satisfied for designed thickness of platform

**Summary**

A 470mm thick piling mat (with geogrid  $T_{ult}=30\text{kN/m}$ ) or 560mm without geogrid is required to support the piling rig.

The piling mat should be compacted in layers in accordance with the Highways Agency method for compaction of earthworks materials.

Platform material to conform to Type 1 or 6F1 type fill material. Other good quality granular material can be adopted but please note they must be:

- Free from organic material, contamination or substances hazardous to health
- Have less than 15% fines
- Free draining and durable
- Particle size should be less than 2/3 of the layers in which the mat is installed and not greater than 75mm

Plate load testing on the piling mat will be required to verify the installation and quality of the piling mat.

The specification for testing is indicated in the Working Platform Certificate.

The design is based on a granular subgrade. If subgrade is found to be different please contact Central Piling.

Topsoil should be removed prior to placement of mat material and in the event that made ground is encountered it will need to be vibrocompacted prior to it going down to improve its bearing capacity to that of a medium dense sand/gravel.

## **Appendix 7**

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*Wallap output report. Wall design*

CENTRAL PILING LTD  
Program: WALLAP Version 6.06 Revision A51.B69.R55  
Data filename/Run ID: Camden\_High\_ 450mm\_S1\_SLS  
Camden High  
Contiguous wall - S1 - SLS

| Sheet No.  
| Job No. 41713A1  
| Made by : SD  
| Date:26-03-2021  
| Checked :

Units: kN,m

# INPUT DATA

## SOIL PROFILE

Stratum no.	Elevation of top of stratum	Left side	Soil types	Right side
1	29.40	1 Made Ground	1	Made Ground
2	28.40	2 London Clay u.	2	London Clay u.

## SOIL PROPERTIES

-- Soil type --	Bulk density	Young's Modulus	At rest coeff.	Consol state.	Active limit	Passive limit	Cohesion
No. Description (Datum elev.)	kN/m3	Eh, kN/m2 (dEh/dy )	Ko (dKo/dy)	NC/OC ( Nu )	Ka ( Kac )	Kp ( Kpc )	kN/m2 ( dc/dy )
1 Made Ground	18.00	0 ( 10000)	0.625	NC (0.200)	0.399 (0.000)	2.894 ( 0.000)	
2 London Cl.. ( 28.40 )	20.00	45000 ( 5475)	1.000	OC (0.490)	1.000 (2.389)	1.000 ( 2.390)	60.00u ( 7.300)
3 London Cl.. ( 28.40 )	20.00	33750 ( 4106)	1.000	OC (0.200)	0.399 (0.000)	2.738 ( 0.000)	

## Additional soil parameters associated with Ka and Kp

--- parameters for Ka ---			--- parameters for Kp ---		
Soil	Wall	Back-	Soil	Wall	Back-
friction	adhesion	fill	friction	adhesion	fill
angle	coeff.	angle	angle	coeff.	angle
1 Made Ground	22.00	0.670	0.00	22.00	0.670
2 London Clay u.	0.00	0.500	0.00	0.00	0.500
3 London Clay dr.	22.00	0.670	0.00	21.00	0.670

## GROUND WATER CONDITIONS

Density of water = 10.00 kN/m3

Initial water table elevation

	Left side	Right side
	20.00	20.00

Automatic water pressure balancing at toe of wall : Yes

Left side				Right side			
Water press.	Point no.	Elev. m	Piezo elev. m	Water press. kN/m2	Point no.	Elev. m	Piezo elev. m
profile	1	28.40	28.40	0.0	1	23.79	23.79

## WALL PROPERTIES

Type of structure = Fully Embedded Wall  
Elevation of toe of wall = 17.40  
Maximum finite element length = 0.50 m  
Youngs modulus of wall E = 2.0000E+07 kN/m2  
Moment of inertia of wall I = 3.3500E-03 m4/m run  
E.I = 67000 kN.m2/m run  
Yield Moment of wall = Not defined

## STRUTS and ANCHORS

Strut/ anchor no.	Elev.	Strut spacing m	X-section area of strut sq.m	Youngs modulus kN/m2	Free length m	Inclin -ation (degs)	Pre-stress /strut kN	Tension allowed
1	29.00	1.00	0.250000	2.000E+07	10.00	0.00	0	Yes
2	24.70	1.00	0.450000	2.000E+07	10.00	0.00	0	Yes

**HORIZONTAL and MOMENT LOADS/RESTRAINTS**

Load no.	Elevation	Horizontal load kN/m run	Moment load kN.m/m run	Moment restraint kN.m/m/rad	Partial factor (Category)
1	29.40	45.00	0	0	1.00 (P/U)

**SURCHARGE LOADS**

Surch- -arge no.	Elev.	Distance from wall	Length parallel to wall	Width perpend. to wall	Surcharge ----- kN/m2 ----- Near edge Far edge		Equiv. soil type	Partial factor/ Category
1	29.40	0.20 (L)	10.00	10.00	10.00	=	N/A	1.00 Var

Note: L = Left side, R = Right side

Limit State Categories P/U = Permanent Unfavourable

P/F = Permanent Favourable

Var = Variable (unfavourable)

**CONSTRUCTION STAGES**

Construction stage no.	Stage description
1	Apply surcharge no.1 at elevation 29.40 No analysis at this stage
2	Excavate to elevation 24.29 on RIGHT side
3	Install strut or anchor no.2 at elevation 24.70
4	Install strut or anchor no.1 at elevation 29.00
5	Apply load no.1 at elevation 29.40
6	Change properties of soil type 2 to soil type 3 Ko pressures will not be reset
7	Change EI of wall to 46900 kN.m2/m run Yield moment not defined Allow wall to relax with new modulus value

**FACTORS OF SAFETY and ANALYSIS OPTIONS**

Limit State options: Serviceability Limit State

All loads and soil strengths are unfactored

Stability analysis:

Method of analysis - Strength Factor method

Factor on soil strength for calculating wall depth = 1.00

Parameters for undrained strata:

Minimum equivalent fluid density = 5.00 kN/m3

Maximum depth of water filled tension crack = 0.00 m

Bending moment and displacement calculation:

Method - Subgrade reaction model using Influence Coefficients

Open Tension Crack analysis? - No

Non-linear Modulus Parameter (L) = 10.00 m

Boundary conditions:

Length of wall (normal to plane of analysis) = 20.00 m

Width of excavation on Left side of wall = 20.00 m

Width of excavation on Right side of wall = 20.00 m

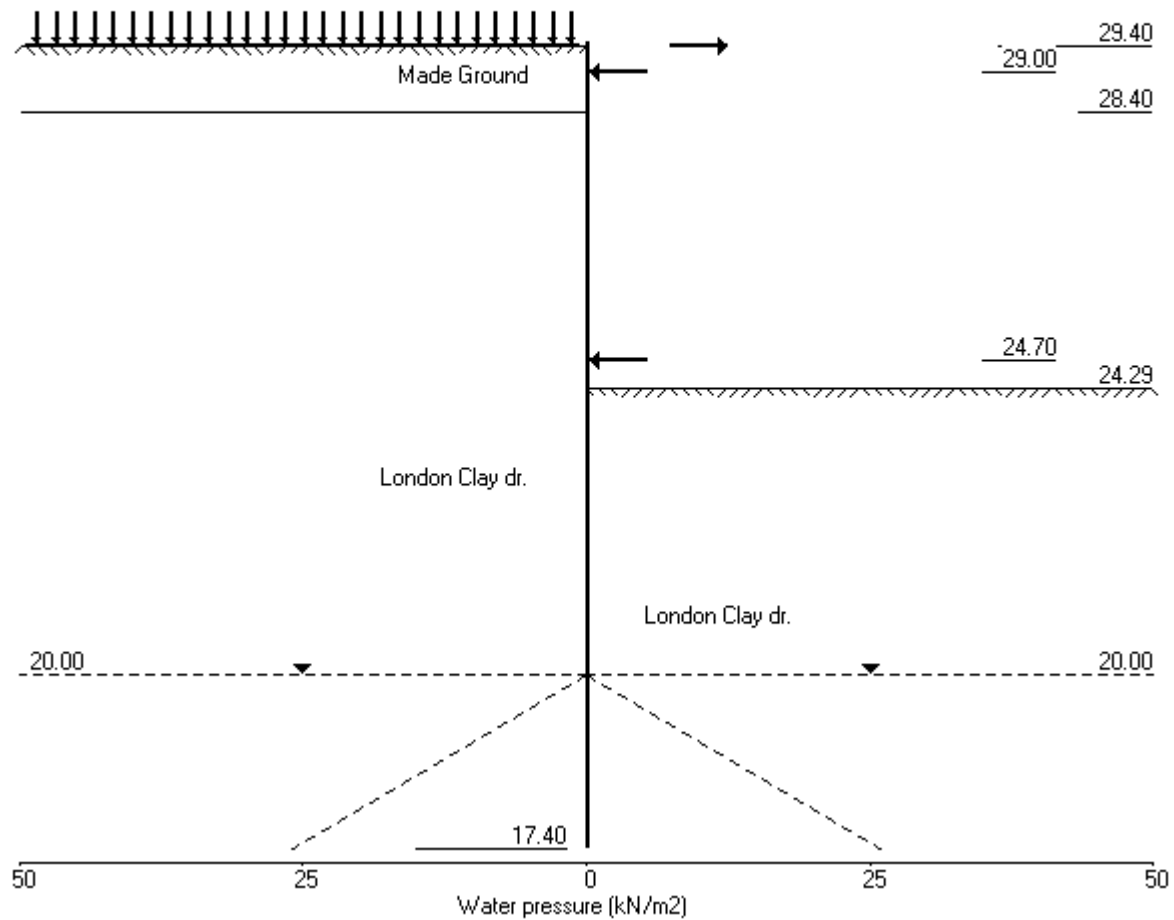
Distance to rigid boundary on Left side = 30.00 m

Distance to rigid boundary on Right side = 30.00 m

## OUTPUT OPTIONS

Stage no.	Stage description	Displacement Bending mom. Shear force	Active, Passive pressures	Graph. output
1	Apply surcharge no.1 at elev. 29.40	Yes	Yes	Yes
2	Excav. to elev. 24.29 on RIGHT side	Yes	Yes	Yes
3	Install strut no.2 at elev. 24.70	Yes	Yes	Yes
4	Install strut no.1 at elev. 29.00	Yes	Yes	Yes
5	Apply load no.1 at elev. 29.40	Yes	Yes	Yes
6	Change soil type 2 to soil type 3	No	No	No
7	Change EI of wall to 46900kN.m2/m run	Yes	Yes	Yes
*	Summary output	Yes	-	Yes

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Data filename/Run ID: Camden\_High\_ 450mm\_S1\_SLS  
Camden High  
Contiguous wall - S1 - SLS

| Sheet No.  
| Job No. 41713A1  
| Made by : SD  
| Date:26-03-2021  
| Checked :

Units: kN,m

Stage No. 1 Apply surcharge no.1 at elevation 29.40  
No analysis at this stage

**STABILITY ANALYSIS of Fully Embedded Wall according to Strength Factor method**  
Factor of safety on soil strength

				FoS for toe elev. = 17.40	Toe elev. for FoS = 1.000		
Stage	--- G.L. ---	Strut	Factor	Moment	Toe	Wall	Direction
No.	Act. Pass.	Elev.	of	of equilib.	elev.	Penetr	of
			Safety	at elev.		-ation	failure
1	29.40	29.40	Cant.	<u>Conditions not suitable for FoS calc.</u>			

**BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall**

**Analysis options**

Length of wall perpendicular to section = 20.00m  
Subgrade reaction model - Boussinesq Influence coefficients  
Soil deformations are elastic until the active or passive limit is reached  
Open Tension Crack analysis - No

Rigid boundaries: Left side 30.00 from wall  
Right side 30.00 from wall

**Limit State: Serviceability Limit State**

Calculated Bending Moments and Strut Forces are to be multiplied by a factor of 1.35 to obtain values for structural design. See summary for factored values.

Node no.	Y coord	Nett pressure kN/m2	Wall disp. m	Wall rotation rad.	Shear force kN/m	Bending moment kN.m/m	Strut forces kN/m	EI of wall kN.m2/m
1	29.40	0.00	0.000	7.93E-05	0.0	0.0		67000
2	29.00	2.05	0.000	7.91E-05	0.4	0.1		67000
3	28.70	2.84	0.000	7.82E-05	1.1	0.3		67000
4	28.40	3.02	0.000	7.58E-05	2.0	0.8		67000
		-3.40	0.000	7.58E-05	2.0	0.8		
5	27.95	-2.11	0.000	6.85E-05	0.8	1.4		67000
6	27.50	-1.21	0.000	5.88E-05	0.0	1.5		67000
7	27.00	-0.53	0.000	4.79E-05	-0.4	1.4		67000
8	26.50	-0.09	0.000	3.85E-05	-0.6	1.1		67000
9	26.00	0.15	0.000	3.12E-05	-0.5	0.8		67000
10	25.50	0.25	0.000	2.60E-05	-0.4	0.6		67000
11	25.10	0.27	0.000	2.31E-05	-0.3	0.4		67000
12	24.70	0.25	0.000	2.10E-05	-0.2	0.3		67000
13	24.29	0.20	0.000	1.95E-05	-0.1	0.2		67000
14	23.90	0.15	0.000	1.85E-05	-0.1	0.2		67000
15	23.50	0.11	0.000	1.76E-05	-0.0	0.1		67000
16	23.00	0.06	0.000	1.67E-05	0.0	0.1		67000
17	22.50	0.02	0.000	1.58E-05	0.0	0.1		67000
18	22.00	-0.01	0.000	1.49E-05	0.0	0.1		67000
19	21.50	-0.02	0.000	1.38E-05	0.0	0.1		67000
20	21.00	-0.03	0.000	1.28E-05	0.0	0.1		67000
21	20.50	-0.03	0.000	1.18E-05	0.0	0.1		67000
22	20.00	-0.03	0.000	1.08E-05	-0.0	0.1		67000
23	19.50	-0.03	0.000	9.99E-06	-0.0	0.1		67000
24	19.00	-0.02	0.000	9.30E-06	-0.0	0.1		67000
25	18.50	-0.00	0.000	8.81E-06	-0.0	0.0		67000
26	18.00	0.03	0.000	8.56E-06	-0.0	0.0		67000
27	17.70	0.06	0.000	8.51E-06	-0.0	0.0		67000
28	17.40	0.10	0.000	8.49E-06	0.0	0.0		---

(continued)

Stage No.1 Apply surcharge no.1 at elevation 29.40  
 No analysis at this stage

Node no.	Y coord	LEFT side						Coeff. of subgrade reaction
		Water press. kN/m2	Vertic -al kN/m2	Effective Active limit kN/m2	Effective Passive limit kN/m2	Earth pressure kN/m2	Total earth pressure kN/m2	
1	29.40	0.00	0.00	0.00	0.00	0.00	0.00	184
2	29.00	0.00	11.70	4.66	33.86	6.93	6.93	1103
3	28.70	0.00	19.14	7.63	55.38	11.33	11.33	1931
4	28.40	0.00	25.49	10.16	73.76	15.10	15.10	2759
		Total>	25.49	5.00m	168.88	19.90	19.90	17635
5	27.95	Total>	35.17	7.25m	186.42	29.87	29.87	18601
6	27.50	Total>	44.47	9.50m	203.57	39.46	39.46	19566
7	27.00	Total>	54.57	12.00m	222.39	49.85	49.85	20639
8	26.50	Total>	64.52	14.50m	241.07	60.05	60.05	21712
9	26.00	Total>	74.38	17.00m	259.65	70.10	70.10	22785
10	25.50	Total>	84.17	19.50m	278.16	80.05	80.05	23858
11	25.10	Total>	91.96	21.50m	292.93	87.96	87.96	24716
12	24.70	Total>	99.74	23.50m	307.69	95.84	95.84	25574
13	24.29	Total>	107.69	25.55m	322.80	103.90	103.90	26454
14	23.90	Total>	115.35	27.52m	337.34	111.66	111.66	27301
15	23.50	Total>	123.00	29.50m	351.89	119.42	119.42	28149
16	23.00	Total>	132.69	32.00m	370.30	129.24	129.24	29222
17	22.50	Total>	142.38	34.50m	388.71	139.07	139.07	30295
18	22.00	Total>	152.07	37.00m	407.13	148.91	148.91	31367
19	21.50	Total>	158.04	39.50m	421.82	158.77	158.77	32440
20	21.00	Total>	171.50	42.00m	444.00	168.63	168.63	33513
21	20.50	Total>	181.23	44.50m	462.45	178.50	178.50	34586
22	20.00	Total>	190.97	47.00m	480.92	188.37	188.37	35659
23	19.50	Total>	200.72	49.50m	499.40	198.26	198.26	36732
24	19.00	Total>	210.49	52.00m	517.89	208.15	208.15	37804
25	18.50	Total>	220.27	54.50m	536.39	218.05	218.05	38877
26	18.00	Total>	230.07	57.00m	554.91	227.97	227.97	39950
27	17.70	Total>	235.95	58.50m	566.02	233.93	233.93	40594
28	17.40	Total>	241.83	60.00m	577.14	239.89	239.89	41237

Node no.	Y coord	RIGHT side						Coeff. of subgrade reaction
		Water press. kN/m2	Vertic -al kN/m2	Effective Active limit kN/m2	Effective Passive limit kN/m2	Earth pressure kN/m2	Total earth pressure kN/m2	
1	29.40	0.00	0.00	0.00	0.00	0.00	0.00	184
2	29.00	0.00	7.20	2.87	20.84	4.88	4.88	1103
3	28.70	0.00	12.60	5.02	36.47	8.50	8.50	1931
4	28.40	0.00	18.00	7.17	52.09	12.08	12.08	2759
		Total>	18.00	5.00m	161.40	23.29	23.29	17635
5	27.95	Total>	27.00	7.25m	178.25	31.98	31.98	18601
6	27.50	Total>	36.00	9.50m	195.10	40.67	40.67	19566
7	27.00	Total>	46.00	12.00m	213.82	50.38	50.38	20639
8	26.50	Total>	56.00	14.50m	232.55	60.14	60.14	21712
9	26.00	Total>	66.00	17.00m	251.27	69.95	69.95	22785
10	25.50	Total>	76.00	19.50m	269.99	79.80	79.80	23858
11	25.10	Total>	84.00	21.50m	284.97	87.69	87.69	24716
12	24.70	Total>	92.00	23.50m	299.95	95.59	95.59	25574
13	24.29	Total>	100.20	25.55m	315.30	103.70	103.70	26454
14	23.90	Total>	108.10	27.52m	330.09	111.50	111.50	27301
15	23.50	Total>	116.00	29.50m	344.89	119.31	119.31	28149
16	23.00	Total>	126.00	32.00m	363.61	129.18	129.18	29222
17	22.50	Total>	136.00	34.50m	382.33	139.05	139.05	30295

Run ID. Camden\_High\_ 450mm\_S1\_SLS  
 Camden High  
 Contiguous wall - S1 - SLS

| Sheet No.  
 | Date:26-03-2021  
 | Checked :

(continued)

Stage No.1     Apply surcharge no.1 at elevation 29.40  
                   No analysis at this stage

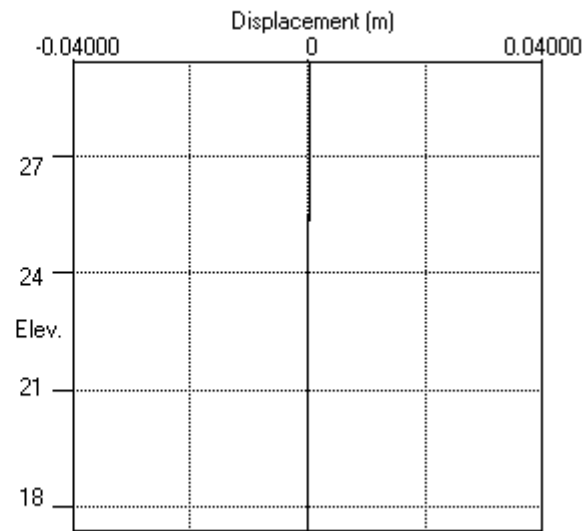
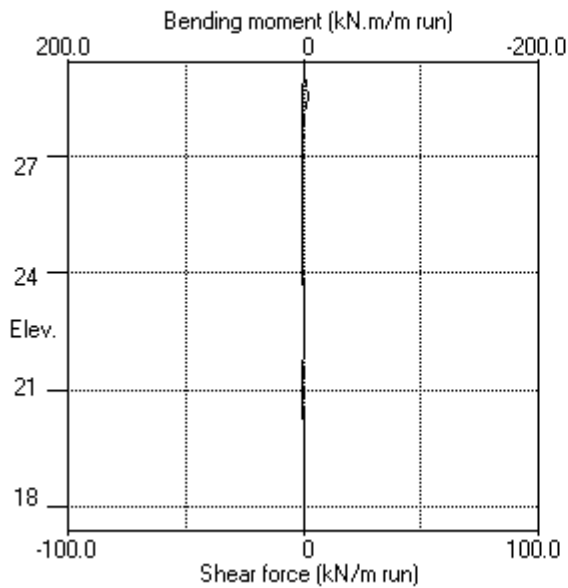
Node no.	Y coord	----- RIGHT side -----						
		Effective stresses -----					Total earth pressure	Coeff. of subgrade reaction
		Water press. kN/m2	Vertic -al kN/m2	Active limit kN/m2	Passive limit kN/m2	Earth pressure kN/m2		
18	22.00	Total>	146.00	37.00m	401.06	148.92	148.92	31367
19	21.50	Total>	156.00	39.50m	419.78	158.79	158.79	32440
20	21.00	Total>	166.00	42.00m	438.50	168.66	168.66	33513
21	20.50	Total>	176.00	44.50m	457.23	178.53	178.53	34586
22	20.00	Total>	186.00	47.00m	475.95	188.40	188.40	35659
23	19.50	Total>	196.00	49.50m	494.67	198.28	198.28	36732
24	19.00	Total>	206.00	52.00m	513.40	208.17	208.17	37804
25	18.50	Total>	216.00	54.50m	532.12	218.05	218.05	38877
26	18.00	Total>	226.00	57.00m	550.84	227.94	227.94	39950
27	17.70	Total>	232.00	58.50m	562.08	233.87	233.87	40594
28	17.40	Total>	238.00	60.00m	573.31	239.79	239.79	41237

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 Data filename/Run ID: Camden\_High\_ 450mm\_S1\_SLS  
 Camden High  
 Contiguous wall - S1 - SLS

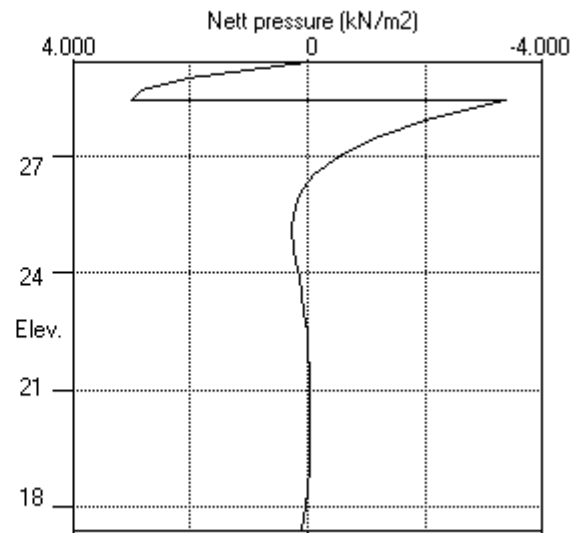
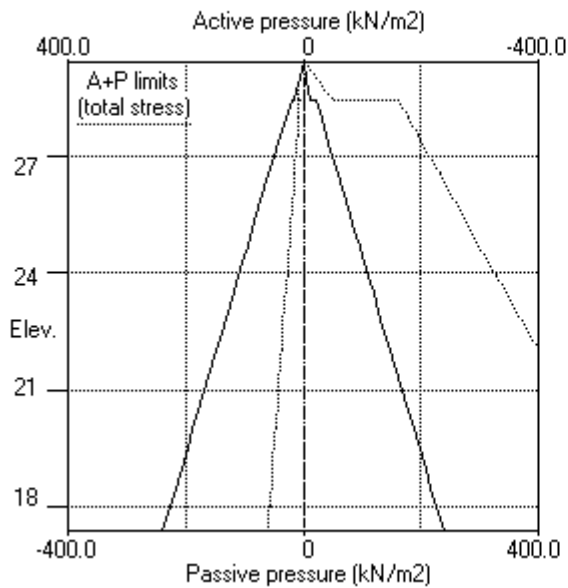
| Sheet No.  
 | Job No. 41713A1  
 | Made by : SD  
 | Date:26-03-2021  
 | Checked :

Units: kN,m

Stage No.1 Apply surcharge no.1 at elev. 29.40



Stage No.1 Apply surcharge no.1 at elev. 29.40



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Camden High  
Contiguous wall - S1 - SLS

| Sheet No.  
| Job No. 41713A1  
| Made by : SD  
| Date:26-03-2021  
| Checked :

Units: kN,m

Stage No. 2 Excavate to elevation 24.29 on RIGHT side

**STABILITY ANALYSIS of Fully Embedded Wall according to Strength Factor method**

Factor of safety on soil strength

				FoS for toe elev. = 17.40		Toe elev. for FoS = 1.000		
				-----		-----		
Stage	--- G.L. ---	Strut		Factor	Moment	Toe	Wall	Direction
No.	Act. Pass.	Elev.		of	equilib.	elev.	Penetr	of
				Safety	at elev.		-ation	failure
2	29.40 24.29	Cant.		3.459	18.14	22.20	2.09	L to R

**BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall**

**Analysis options**

Length of wall perpendicular to section = 20.00m

Subgrade reaction model - Boussinesq Influence coefficients

Soil deformations are elastic until the active or passive limit is reached

Open Tension Crack analysis - No

Rigid boundaries: Left side 30.00 from wall

Right side 30.00 from wall

**Limit State: Serviceability Limit State**

Calculated Bending Moments and Strut Forces are to be multiplied by a factor of 1.35 to obtain values for structural design. See summary for factored values.

Node no.	Y coord	Nett pressure kN/m2	Wall disp. m	Wall rotation rad.	Shear force kN/m	Bending moment kN.m/m	Strut forces kN/m	EI of wall kN.m2/m
1	29.40	0.00	0.032	6.10E-03	0.0	0.0		67000
2	29.00	4.66	0.030	6.10E-03	0.9	0.1		67000
3	28.70	7.63	0.028	6.10E-03	2.8	0.7		67000
4	28.40	10.16	0.026	6.09E-03	5.4	1.9		67000
		5.00	0.026	6.09E-03	5.4	1.9		
5	27.95	7.25	0.024	6.07E-03	8.2	4.9		67000
6	27.50	9.50	0.021	6.02E-03	12.0	9.4		67000
7	27.00	12.00	0.018	5.93E-03	17.3	16.6		67000
8	26.50	14.50	0.015	5.76E-03	24.0	26.9		67000
9	26.00	17.00	0.012	5.51E-03	31.8	40.8		67000
10	25.50	19.50	0.009	5.14E-03	41.0	58.9		67000
11	25.10	21.50	0.007	4.73E-03	49.2	76.9		67000
12	24.70	23.50	0.006	4.21E-03	58.2	98.4		67000
13	24.29	25.55	0.004	3.53E-03	68.2	124.2		67000
		-189.55	0.004	3.53E-03	68.2	124.2		
14	23.90	-157.76	0.003	2.74E-03	-0.4	143.8		67000
15	23.50	-77.14	0.002	1.93E-03	-46.8	131.4		67000
16	23.00	-10.05	0.001	1.07E-03	-68.6	98.3		67000
17	22.50	24.41	0.001	4.74E-04	-65.0	62.8		67000
18	22.00	35.95	0.001	1.16E-04	-49.9	33.3		67000
19	21.50	33.99	0.001	-5.61E-05	-32.4	12.9		67000
20	21.00	25.94	0.001	-1.07E-04	-17.4	0.9		67000
21	20.50	16.67	0.001	-9.39E-05	-6.8	-4.6		67000
22	20.00	8.77	0.001	-5.50E-05	-0.4	-5.9		67000
23	19.50	3.19	0.001	-1.45E-05	2.6	-5.0		67000
24	19.00	-0.18	0.001	1.64E-05	3.3	-3.3		67000
25	18.50	-1.89	0.001	3.50E-05	2.8	-1.7		67000
26	18.00	-2.64	0.001	4.32E-05	1.7	-0.5		67000
27	17.70	-2.85	0.001	4.46E-05	0.9	-0.1		67000
28	17.40	-2.98	0.001	4.49E-05	0.0	0.0		---

(continued)

Stage No.2 Excavate to elevation 24.29 on RIGHT side

Node no.	Y coord	----- LEFT side -----						Total earth pressure kN/m2	Coeff. of subgrade reaction kN/m3
		Water press. kN/m2	Vertic -al kN/m2	Effective Active limit kN/m2	Effective Passive limit kN/m2	Earth pressure kN/m2			
1	29.40	0.00	0.00	0.00	0.00	0.00	0.00	194	
2	29.00	0.00	11.70	4.66	33.86	4.66	4.66a	1164	
3	28.70	0.00	19.14	7.63	55.38	7.63	7.63a	2038	
4	28.40	0.00	25.49	10.16	73.76	10.16	10.16a	2911	
		Total>	25.49	5.00m	168.88	5.00	5.00a	18537	
5	27.95	Total>	35.17	7.25m	186.42	7.25	7.25a	19552	
6	27.50	Total>	44.47	9.50m	203.57	9.50	9.50a	20567	
7	27.00	Total>	54.57	12.00m	222.39	12.00	12.00a	21694	
8	26.50	Total>	64.52	14.50m	241.07	14.50	14.50a	22822	
9	26.00	Total>	74.38	17.00m	259.65	17.00	17.00a	23950	
10	25.50	Total>	84.17	19.50m	278.16	19.50	19.50a	25077	
11	25.10	Total>	91.96	21.50m	292.93	21.50	21.50a	25980	
12	24.70	Total>	99.74	23.50m	307.69	23.50	23.50a	26882	
13	24.29	Total>	107.69	25.55m	322.80	25.55	25.55a	27806	
14	23.90	Total>	115.35	27.52m	337.34	34.02	34.02	28697	
15	23.50	Total>	123.00	29.50m	351.89	66.42	66.42	29588	
16	23.00	Total>	132.69	32.00m	370.30	96.75	96.75	30716	
17	22.50	Total>	142.38	34.50m	388.71	117.13	117.13	31843	
18	22.00	Total>	152.07	37.00m	407.13	130.51	130.51	32971	
19	21.50	Total>	158.04	39.50m	421.82	139.78	139.78	34099	
20	21.00	Total>	171.50	42.00m	444.00	147.21	147.21	35226	
21	20.50	Total>	181.23	44.50m	462.45	154.27	154.27	36354	
22	20.00	Total>	190.97	47.00m	480.92	161.77	161.77	37482	
23	19.50	Total>	200.72	49.50m	499.40	169.99	169.99	38609	
24	19.00	Total>	210.49	52.00m	517.89	178.91	178.91	39737	
25	18.50	Total>	220.27	54.50m	536.39	188.34	188.34	40865	
26	18.00	Total>	230.07	57.00m	554.91	198.10	198.10	41992	
27	17.70	Total>	235.95	58.50m	566.02	204.03	204.03	42669	
28	17.40	Total>	241.83	60.00m	577.14	209.99	209.99	43346	

Node no.	Y coord	----- RIGHT side -----						Total earth pressure kN/m2	Coeff. of subgrade reaction kN/m3
		----- Effective stresses -----							
		Water press. kN/m2	Vertic -al kN/m2	Active limit kN/m2	Passive limit kN/m2	Earth pressure kN/m2			
1	29.40	0.00	0.00	0.00	0.00	0.00	0.00	0.0	
2	29.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0	
3	28.70	0.00	0.00	0.00	0.00	0.00	0.00	0.0	
4	28.40	0.00	0.00	0.00	0.00	0.00	0.00	0.0	
5	27.95	0.00	0.00	0.00	0.00	0.00	0.00	0.0	
6	27.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0	
7	27.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0	
8	26.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0	
9	26.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0	
10	25.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0	
11	25.10	0.00	0.00	0.00	0.00	0.00	0.00	0.0	
12	24.70	0.00	0.00	0.00	0.00	0.00	0.00	0.0	
13	24.29	0.00	0.00	0.00	0.00	0.00	0.00	0.0	
		Total>	0.00	0.00	215.10	215.10	215.10p	63232	
14	23.90	Total>	7.90	1.97m	229.89	191.78	191.78	65258	
15	23.50	Total>	15.80	3.95m	244.69	143.56	143.56	67284	
16	23.00	Total>	25.81	6.45m	263.42	106.80	106.80	69848	
17	22.50	Total>	35.83	8.95m	282.16	92.71	92.71	72412	
18	22.00	Total>	45.86	11.45m	300.92	94.56	94.56	74977	

Run ID. Camden\_High\_ 450mm\_S1\_SLS  
 Camden High  
 Contiguous wall - S1 - SLS

| Sheet No.  
 | Date:26-03-2021  
 | Checked :

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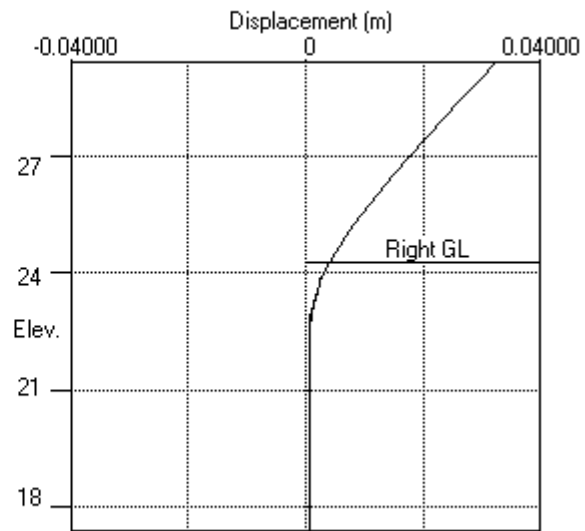
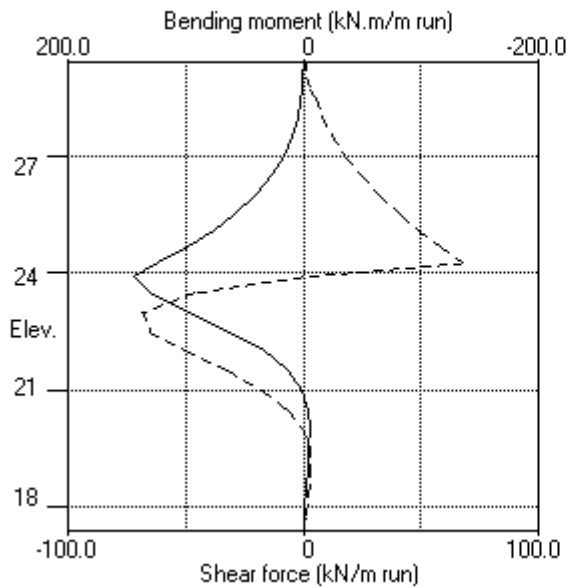
Stage No.2 Excavate to elevation 24.29 on RIGHT side

Node no.	Y coord	----- RIGHT side -----						
		Water press. kN/m2	Vertic -al kN/m2	Effective Active limit kN/m2	Effective Passive limit kN/m2	Earth pressure kN/m2	Total earth pressure kN/m2	Coeff. of subgrade reaction kN/m3
19	21.50	Total>	55.91	13.95m	319.69	105.79	105.79	77541
20	21.00	Total>	65.98	16.45m	338.49	121.27	121.27	80105
21	20.50	Total>	76.08	18.95m	357.30	137.61	137.61	82670
22	20.00	Total>	86.20	21.45m	376.15	153.00	153.00	85234
23	19.50	Total>	96.35	23.95m	395.02	166.81	166.81	87798
24	19.00	Total>	106.53	26.45m	413.92	179.08	179.08	90363
25	18.50	Total>	116.74	28.95m	432.85	190.24	190.24	92927
26	18.00	Total>	126.98	31.45m	451.82	200.73	200.73	95491
27	17.70	Total>	133.14	32.95m	463.22	206.88	206.88	97030
28	17.40	Total>	139.32	34.45m	474.63	212.97	212.97	98568

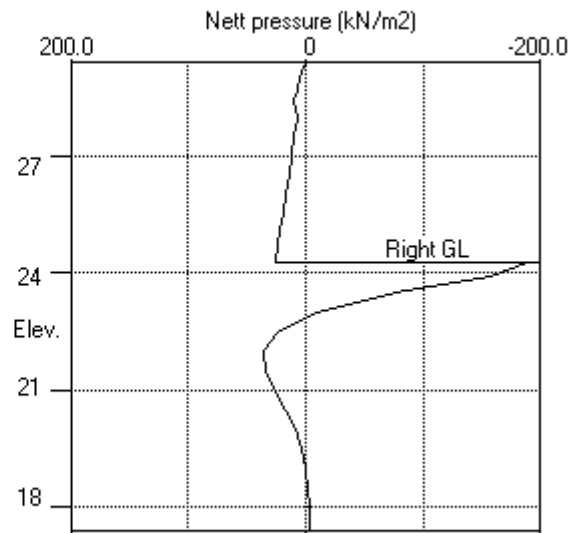
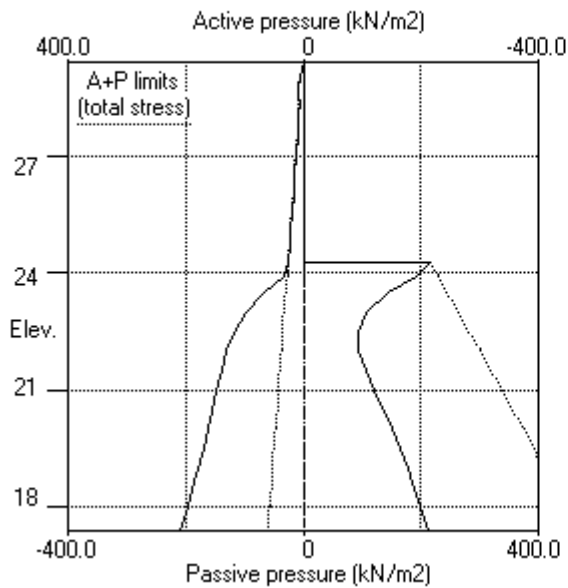
Note: 25.55a Soil pressure at active limit  
 215.10p Soil pressure at passive limit

Units: kN,m

Stage No.2 Excav. to elev. 24.29 on RIGHT side



Stage No.2 Excav. to elev. 24.29 on RIGHT side





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Data filename/Run ID: Camden\_High\_ 450mm\_S1\_SLS  
Camden High  
Contiguous wall - S1 - SLS

| Sheet No.  
| Job No. 41713A1  
| Made by : SD  
| Date:26-03-2021  
| Checked :

Units: kN,m

Stage No. 5 Apply load no.1 at elevation 29.40

**STABILITY ANALYSIS of Fully Embedded Wall according to Strength Factor method**

Factor of safety on soil strength

				FoS for toe elev. = 17.40	Toe elev. for FoS = 1.000		
Stage	--- G.L. ---	Strut	Factor	Moment	Toe	Wall	Direction
No.	Act.	Pass.	Elev.	of	elev.	Penetr	of
				equilib.		-ation	failure
				Safety at elev.			
5	29.40	24.29		More than one strut.	No	FoS calc.	

**BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall**

**Analysis options**

Length of wall perpendicular to section = 20.00m  
Subgrade reaction model - Boussinesq Influence coefficients  
Soil deformations are elastic until the active or passive limit is reached  
Open Tension Crack analysis - No

Rigid boundaries: Left side 30.00 from wall  
Right side 30.00 from wall

**Limit State: Serviceability Limit State**

Calculated Bending Moments and Strut Forces are to be multiplied by a factor of 1.35 to obtain values for structural design. See summary for factored values.

Node no.	Y coord	Nett pressure kN/m2	Wall disp. m	Wall rotation rad.	Shear force kN/m	Bending moment kN.m/m	Strut forces kN/m	EI of wall kN.m2/m
1	29.40	0.00	0.033	6.46E-03	45.0	0.0	-45.0	67000
2	29.00	4.66	0.030	6.40E-03	45.9	18.1	52.6	67000
		4.66	0.030	6.40E-03	-6.7	18.1		
3	28.70	7.63	0.028	6.32E-03	-4.8	16.4		67000
4	28.40	10.25	0.026	6.25E-03	-2.2	15.3		67000
		5.59	0.026	6.25E-03	-2.2	15.3		
5	27.95	8.96	0.024	6.15E-03	1.1	15.0		67000
6	27.50	11.78	0.021	6.05E-03	5.8	16.5		67000
7	27.00	14.40	0.018	5.91E-03	12.3	20.9		67000
8	26.50	16.62	0.015	5.72E-03	20.1	28.9		67000
9	26.00	18.60	0.012	5.46E-03	28.9	41.2		67000
10	25.50	20.48	0.009	5.09E-03	38.7	58.0		67000
11	25.10	22.00	0.007	4.69E-03	47.2	75.2		67000
12	24.70	23.61	0.006	4.18E-03	56.3	95.8	-3.4	67000
		23.61	0.006	4.18E-03	59.7	95.8		
13	24.29	25.55	0.004	3.51E-03	69.7	122.3		67000
		-189.55	0.004	3.51E-03	69.7	122.3		
14	23.90	-158.39	0.003	2.73E-03	1.0	142.5		67000
15	23.50	-77.87	0.002	1.93E-03	-45.6	130.6		67000
16	23.00	-10.75	0.001	1.07E-03	-67.8	98.0		67000
17	22.50	23.85	0.001	4.80E-04	-64.5	62.7		67000
18	22.00	35.56	0.001	1.21E-04	-49.7	33.4		67000
19	21.50	33.76	0.001	-5.22E-05	-32.3	13.0		67000
20	21.00	25.83	0.001	-1.04E-04	-17.4	1.1		67000
21	20.50	16.63	0.001	-9.23E-05	-6.8	-4.4		67000
22	20.00	8.79	0.001	-5.42E-05	-0.5	-5.8		67000
23	19.50	3.23	0.001	-1.43E-05	2.5	-4.9		67000
24	19.00	-0.13	0.001	1.63E-05	3.3	-3.3		67000
25	18.50	-1.86	0.001	3.48E-05	2.8	-1.7		67000
26	18.00	-2.61	0.001	4.29E-05	1.7	-0.5		67000

| Sheet No.  
| Date:26-03-2021  
| Checked :

Stage No.5    Apply load no.1 at elevation 29.40

Node no.	Y coord	LEFT side						
		Effective stresses					Total earth pressure	Coeff. of subgrade reaction
		Water press. kN/m2	Vertic -al kN/m2	Active limit kN/m2	Passive limit kN/m2	Earth pressure kN/m2		
1	29.40	0.00	0.00	0.00	0.00	0.00	0.00	761
2	29.00	0.00	11.70	4.66	33.86	4.66	4.66a	4568
3	28.70	0.00	19.14	7.63	55.38	7.63	7.63a	7994
4	28.40	0.00	25.49	10.16	73.76	10.25	10.25	3092
		Total>	25.49	5.00m	168.88	5.59	5.59	19611
5	27.95	Total>	35.17	7.25m	186.42	8.96	8.96	20684
6	27.50	Total>	44.47	9.50m	203.57	11.78	11.78	21758
7	27.00	Total>	54.57	12.00m	222.39	14.40	14.40	22951
8	26.50	Total>	64.52	14.50m	241.07	16.62	16.62	24144
9	26.00	Total>	74.38	17.00m	259.65	18.60	18.60	25337
10	25.50	Total>	84.17	19.50m	278.16	20.48	20.48	26530
11	25.10	Total>	91.96	21.50m	292.93	22.00	22.00	27484
12	24.70	Total>	99.74	23.50m	307.69	23.61	23.61	28439
13	24.29	Total>	107.69	25.55m	322.80	25.55	25.55a	30717
14	23.90	Total>	115.35	27.52m	337.34	33.71	33.71	31701
15	23.50	Total>	123.00	29.50m	351.89	66.05	66.05	32685
16	23.00	Total>	132.69	32.00m	370.30	96.40	96.40	33931
17	22.50	Total>	142.38	34.50m	388.71	116.85	116.85	35177
18	22.00	Total>	152.07	37.00m	407.13	130.32	130.32	36423
19	21.50	Total>	158.04	39.50m	421.82	139.67	139.67	37668
20	21.00	Total>	171.50	42.00m	444.00	147.15	147.15	38914
21	20.50	Total>	181.23	44.50m	462.45	154.26	154.26	40160
22	20.00	Total>	190.97	47.00m	480.92	161.78	161.78	44616
23	19.50	Total>	200.72	49.50m	499.40	170.01	170.01	45958
24	19.00	Total>	210.49	52.00m	517.89	178.93	178.93	47301
25	18.50	Total>	220.27	54.50m	536.39	188.36	188.36	48643
26	18.00	Total>	230.07	57.00m	554.91	198.11	198.11	49985
27	17.70	Total>	235.95	58.50m	566.02	204.04	204.04	50791
28	17.40	Total>	241.83	60.00m	577.14	210.00	210.00	51596

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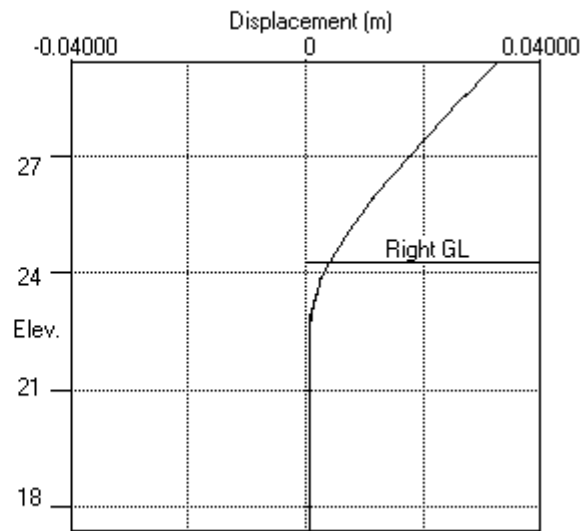
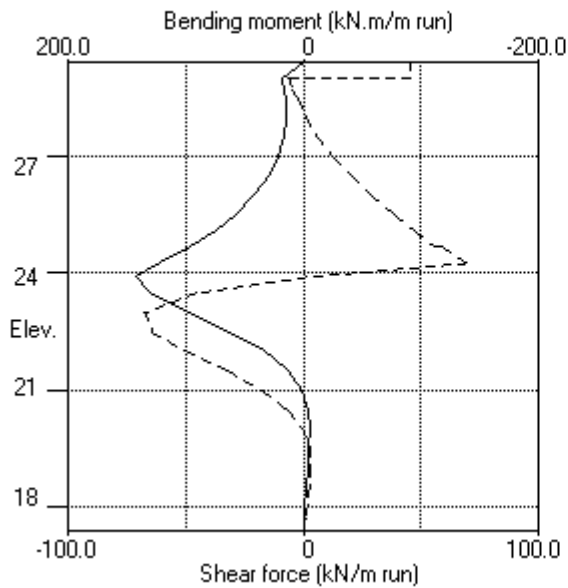
Stage No.5 Apply load no.1 at elevation 29.40

Node no.	Y coord	----- RIGHT side -----						
		Water press. kN/m2	----- Vertic -al kN/m2	Effective Active limit kN/m2	Stresses Passive limit kN/m2	Earth pressure kN/m2	Total earth pressure kN/m2	Coeff. of subgrade reaction kN/m3
12	24.70	0.00	0.00	0.00	0.00	0.00	0.00	0.0
13	24.29	0.00	0.00	0.00	0.00	0.00	0.00	0.0
		Total>	0.00	0.00	215.10	215.10	215.10p	30717
14	23.90	Total>	7.90	1.97m	229.89	192.10	192.10	31701
15	23.50	Total>	15.80	3.95m	244.69	143.92	143.92	32685
16	23.00	Total>	25.81	6.45m	263.42	107.15	107.15	33931
17	22.50	Total>	35.83	8.95m	282.16	92.99	92.99	35177
18	22.00	Total>	45.86	11.45m	300.92	94.76	94.76	36423
19	21.50	Total>	55.91	13.95m	319.69	105.91	105.91	37668
20	21.00	Total>	65.98	16.45m	338.49	121.32	121.32	38914
21	20.50	Total>	76.08	18.95m	357.30	137.62	137.62	40160
22	20.00	Total>	86.20	21.45m	376.15	152.99	152.99	44616
23	19.50	Total>	96.35	23.95m	395.02	166.79	166.79	45958
24	19.00	Total>	106.53	26.45m	413.92	179.06	179.06	47301
25	18.50	Total>	116.74	28.95m	432.85	190.22	190.22	48643
26	18.00	Total>	126.98	31.45m	451.82	200.72	200.72	49985
27	17.70	Total>	133.14	32.95m	463.22	206.87	206.87	50791
28	17.40	Total>	139.32	34.45m	474.63	212.97	212.97	51596

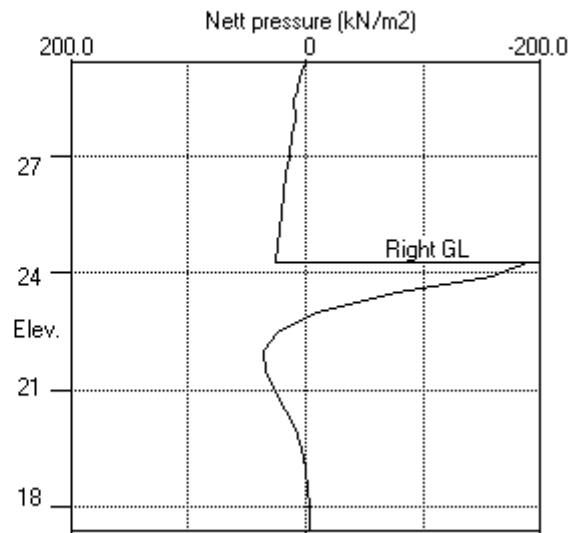
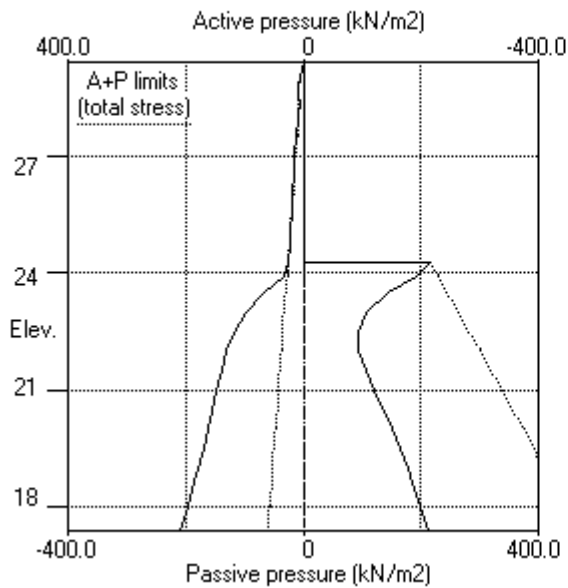
Note: 25.55a Soil pressure at active limit  
 215.10p Soil pressure at passive limit

Units: kN,m

Stage No.5 Apply load no.1 at elev. 29.40



Stage No.5 Apply load no.1 at elev. 29.40



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Camden High  
Contiguous wall - S1 - SLS

| Sheet No.  
| Job No. 41713A1  
| Made by : SD  
| Date:26-03-2021  
| Checked :

Units: kN,m

Stage No. 6 Change properties of soil type 2 to soil type 3  
Ko pressures will not be reset

**STABILITY ANALYSIS of Fully Embedded Wall according to Strength Factor method**  
Factor of safety on soil strength

				FoS for toe elev. = 17.40	Toe elev. for FoS = 1.000		
Stage	--- G.L. ---	Strut	Factor	Moment	Toe	Wall	Direction
No.	Act.	Pass.	Elev.	of equilib.	elev.	Penetr	of
				Safety at elev.		-ation	failure
6	29.40	24.29		More than one strut.	No FoS calc.		

**BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall**

**Analysis options**

Length of wall perpendicular to section = 20.00m  
Subgrade reaction model - Boussinesq Influence coefficients  
Soil deformations are elastic until the active or passive limit is reached  
Open Tension Crack analysis - No

Rigid boundaries: Left side 30.00 from wall  
Right side 30.00 from wall

**Limit State: Serviceability Limit State**

Calculated Bending Moments and Strut Forces are to be multiplied by a factor of 1.35 to obtain values for structural design. See summary for factored values.

Node no.	Y coord	Nett pressure kN/m2	Wall disp. m	Wall rotation rad.	Shear force kN/m	Bending moment kN.m/m	Strut forces kN/m	EI of wall kN.m2/m
1	29.40	0.00	0.033	6.52E-03	45.0	0.0	-45.0	67000
2	29.00	4.66	0.030	6.47E-03	45.9	18.1	53.8	67000
		4.66	0.030	6.47E-03	-7.8	18.1		
3	28.70	7.67	0.028	6.39E-03	-6.0	16.1		67000
4	28.40	10.37	0.026	6.32E-03	-3.3	14.6		67000
		10.16	0.026	6.32E-03	-3.3	14.6		
5	27.95	14.02	0.023	6.23E-03	2.2	14.3		67000
6	27.50	17.72	0.021	6.12E-03	9.3	16.7		67000
7	27.00	21.75	0.018	5.97E-03	19.2	23.7		67000
8	26.50	25.72	0.015	5.75E-03	31.0	36.2		67000
9	26.00	29.65	0.012	5.41E-03	44.9	55.1		67000
10	25.50	33.55	0.009	4.90E-03	60.7	81.4		67000
11	25.10	36.65	0.007	4.33E-03	74.7	108.5		67000
12	24.70	39.75	0.006	3.59E-03	90.0	141.4	166.2	67000
		39.75	0.006	3.59E-03	-76.2	141.4		
13	24.29	42.92	0.005	2.81E-03	-59.3	113.5		67000
14	23.90	24.35	0.004	2.18E-03	-46.0	99.6		67000
15	23.50	9.56	0.003	1.64E-03	-39.3	81.2		67000
16	23.00	11.13	0.002	1.12E-03	-34.1	60.1		67000
17	22.50	4.90	0.002	7.39E-04	-30.1	42.7		67000
18	22.00	12.11	0.001	4.73E-04	-25.9	28.4		67000
19	21.50	15.68	0.001	3.04E-04	-18.9	17.0		67000
20	21.00	13.11	0.001	2.05E-04	-11.7	9.5		67000
21	20.50	8.58	0.001	1.50E-04	-6.3	5.3		67000
22	20.00	4.40	0.001	1.19E-04	-3.0	3.2		67000
23	19.50	1.47	0.001	9.91E-05	-1.6	2.2		67000
24	19.00	-0.15	0.001	8.51E-05	-1.2	1.6		67000
25	18.50	0.27	0.001	7.59E-05	-1.2	0.9		67000
26	18.00	0.96	0.001	7.12E-05	-0.9	0.3		67000

| Sheet No.  
| Date:26-03-2021  
| Checked :

Stage No.6      Change properties of soil type 2 to soil type 3  
                    Ko pressures will not be reset

[illegible]

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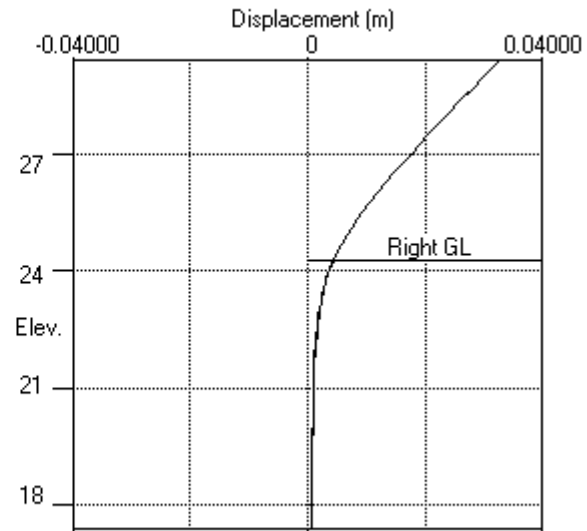
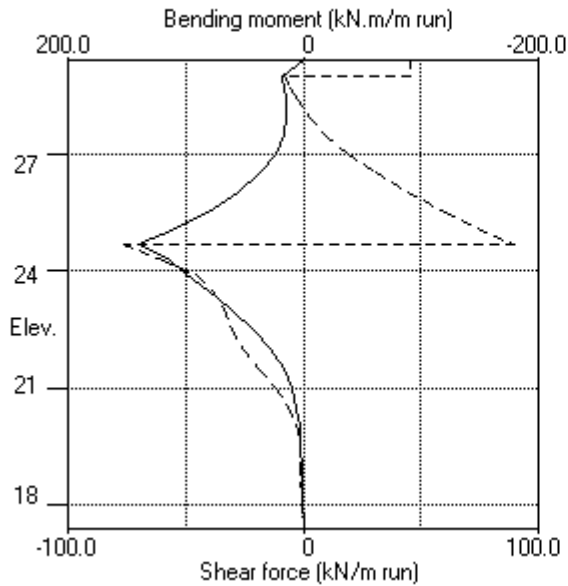
Stage No.6 Change properties of soil type 2 to soil type 3  
 Ko pressures will not be reset

Node no.	Y coord	----- RIGHT side -----						Coeff. of subgrade reaction
		Water press. kN/m2	----- Vertic -al kN/m2	Effective Active limit kN/m2	Effective stresses Passive limit kN/m2	Earth pressure kN/m2	Total earth pressure kN/m2	
11	25.10	0.00	0.00	0.00	0.00	0.00	0.00	0.0
12	24.70	0.00	0.00	0.00	0.00	0.00	0.00	0.0
13	24.29	0.00	0.00	0.00	0.00	0.00	0.00	0.0
		0.00	0.00	0.00	0.00	0.00	0.00	13977
14	23.90	0.00	7.90	3.15	21.63	21.63	21.63p	14425
15	23.50	0.00	15.80	6.30	43.27	43.27	43.27p	14873
16	23.00	0.00	25.81	10.29	70.67	70.67	70.67p	15440
17	22.50	0.00	35.83	14.28	98.10	98.10	98.10p	16007
18	22.00	0.00	45.86	18.28	125.57	106.48	106.48	16573
19	21.50	0.00	55.91	22.29	153.08	114.95	114.95	17140
20	21.00	0.00	65.98	26.30	180.66	127.68	127.68	17707
21	20.50	0.00	76.08	30.32	208.29	141.65	141.65	18274
22	20.00	0.00	86.20	34.36	236.00	155.19	155.19	18841
23	19.50	5.00	91.35	36.41	250.10	162.66	167.66	19407
24	19.00	10.00	96.53	38.47	264.28	169.07	179.07	19974
25	18.50	15.00	101.74	40.55	278.55	174.16	189.16	40202
26	18.00	20.00	106.98	42.64	292.90	178.93	198.93	41311
27	17.70	23.00	110.14	43.90	301.56	181.71	204.71	41977
28	17.40	26.00	113.32	45.17	310.26	184.45	210.45	42643

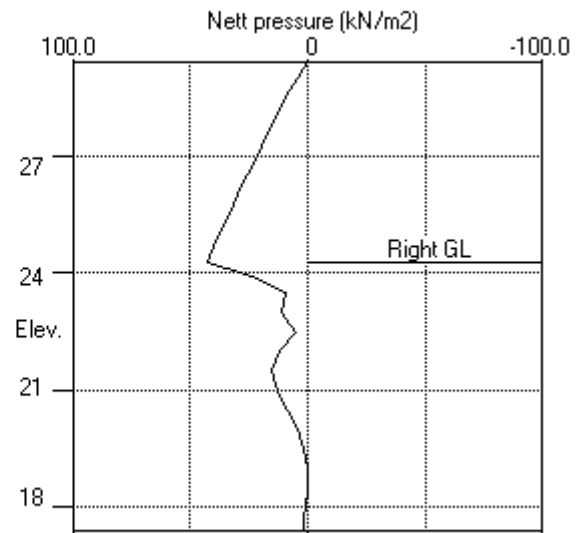
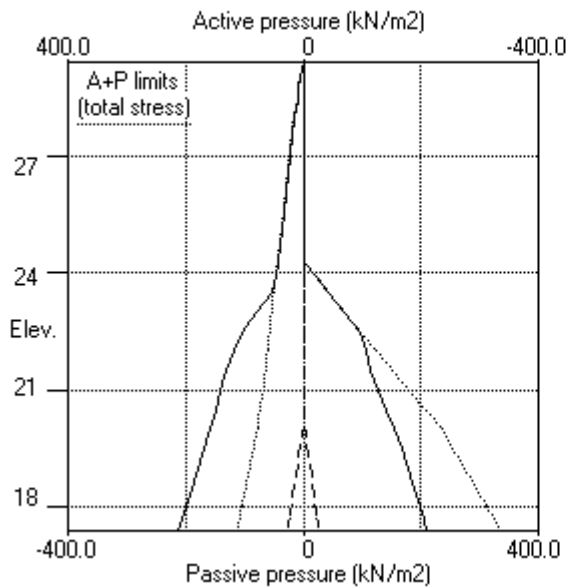
Note: 45.98a Soil pressure at active limit  
 98.10p Soil pressure at passive limit

Units: kN,m

Stage No.6 Change soil type 2 to soil type 3



Stage No.6 Change soil type 2 to soil type 3





CENTRAL PILING LTD  
Program: WALLAP Version 6.06 Revision A51.B69.R55  
Licensed from GEOSOLVE  
Data filename/Run ID: Camden\_High\_ 450mm\_S1\_SLS  
Camden High  
Contiguous wall - S1 - SLS

Sheet No.  
Job No. 41713A1  
Made by : SD  
Date:26-03-2021  
Checked :

Units: kN,m

Stage No. 7 Change EI of wall to 46900 kN.m<sup>2</sup>/m run  
Yield moment not defined  
Allow wall to relax with new modulus value

# **STABILITY ANALYSIS of Fully Embedded Wall according to Strength Factor method**

Factor of safety on soil strength

				FoS for toe elev. = 17.40	Toe elev. for FoS = 1.000		
Stage	--- G.L. ---	Strut	Factor	Moment	Toe	Wall	Direction
No.	Act.	Pass.	Elev.	of	elev.	Penetr	of
				equilib.		-ation	failure
				Safety at elev.			
7	29.40	24.29		More than one strut.	No FoS calc.		

# **BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall**

## **Analysis options**

Length of wall perpendicular to section = 20.00m  
Subgrade reaction model - Boussinesq Influence coefficients  
Soil deformations are elastic until the active or passive limit is reached  
Open Tension Crack analysis - No

Rigid boundaries: Left side 30.00 from wall  
Right side 30.00 from wall

## **Limit State: Serviceability Limit State**

Calculated Bending Moments and Strut Forces are to be multiplied by a factor of 1.35 to obtain values for structural design. See summary for factored values.

Node no.	Y coord	Nett pressure kN/m <sup>2</sup>	Wall disp. m	Wall rotation rad.	Shear force kN/m	Bending moment kN.m/m	Strut forces kN/m	EI of wall kN.m <sup>2</sup> /m
1	29.40	0.00	0.033	6.44E-03	45.0	0.0	-45.0	46900
2	29.00	4.66	0.030	6.36E-03	45.9	18.1	61.0	46900
		4.66	0.030	6.36E-03	-15.1	18.1		
3	28.70	7.63	0.028	6.26E-03	-13.2	14.4		46900
4	28.40	10.16	0.026	6.18E-03	-10.6	11.3		46900
5	27.95	14.02	0.024	6.10E-03	-5.1	8.4		46900
6	27.50	17.72	0.021	6.04E-03	2.0	8.4		46900
7	27.00	21.75	0.018	5.96E-03	11.9	12.6		46900
8	26.50	25.72	0.015	5.81E-03	23.8	22.2		46900
9	26.00	29.65	0.012	5.54E-03	37.6	38.3		46900
10	25.50	33.55	0.009	5.06E-03	53.4	61.9		46900
11	25.10	36.65	0.007	4.48E-03	67.4	86.7		46900
12	24.70	40.15	0.006	3.67E-03	82.8	117.3	152.3	46900
		40.15	0.006	3.67E-03	-69.5	117.3		
13	24.29	43.81	0.005	2.82E-03	-52.3	91.6		46900
14	23.90	26.24	0.004	2.15E-03	-38.5	79.9		46900
15	23.50	10.34	0.003	1.59E-03	-31.3	63.9		46900
16	23.00	10.85	0.002	1.05E-03	-26.0	45.9		46900
17	22.50	4.17	0.002	6.86E-04	-22.2	31.6		46900
18	22.00	9.92	0.001	4.40E-04	-18.7	20.3		46900
19	21.50	13.05	0.001	2.93E-04	-12.9	11.4		46900
20	21.00	10.38	0.001	2.14E-04	-7.1	6.0		46900
21	20.50	6.06	0.001	1.74E-04	-3.0	3.3		46900
22	20.00	2.29	0.001	1.49E-04	-0.9	2.2		46900
23	19.50	-0.14	0.001	1.29E-04	-0.3	1.9		46900
24	19.00	-1.26	0.001	1.11E-04	-0.7	1.6		46900
25	18.50	-0.41	0.001	9.74E-05	-1.1	1.0		46900
26	18.00	0.66	0.001	8.93E-05	-1.0	0.4		46900

Stage No.7    Change EI of wall to 46900 kN.m<sup>2</sup>/m run  
                   Yield moment not defined  
                   Allow wall to relax with new modulus value

Node no.	Y coord	Nett pressure kN/m2	Wall disp. m	Wall rotation rad.	Shear force kN/m	Bending moment kN.m/m	Strut forces kN/m	EI of wall kN.m2/m
27	17.70	1.38	0.001	8.74E-05	-0.7	0.1		46900
28	17.40	3.49	0.001	8.69E-05	0.0	0.0		---
At elev. 29.00		Strut force =		61.0 kN/strut =		61.0 kN/m run		
At elev. 24.70		Strut force =		152.3 kN/strut =		152.3 kN/m run		

Node no.	Y coord	LEFT side					Total earth pressure kN/m2	Coeff. of subgrade reaction kN/m3
		Effective stresses						
		Water press. kN/m2	Vertic -al kN/m2	Active limit kN/m2	Passive limit kN/m2	Earth pressure kN/m2		
1	29.40	0.00	0.00	0.00	0.00	0.00	0.00	1731
2	29.00	0.00	11.70	4.66	33.86	4.66	4.66a	1181
3	28.70	0.00	19.14	7.63	55.38	7.63	7.63a	2067
4	28.40	0.00	25.49	10.16	73.76	10.16	10.16a	2952
		0.00	25.49	10.16	69.78	10.16	10.16a	9964
5	27.95	0.00	35.17	14.02	96.29	14.02	14.02a	10510
6	27.50	0.00	44.47	17.72	121.75	17.72	17.72a	11055
7	27.00	0.00	54.57	21.75	149.40	21.75	21.75a	11661
8	26.50	0.00	64.52	25.72	176.66	25.72	25.72a	12268
9	26.00	0.00	74.38	29.65	203.64	29.65	29.65a	12874
10	25.50	0.00	84.17	33.55	230.44	33.55	33.55a	13480
11	25.10	0.00	91.96	36.65	251.78	36.65	36.65a	13965
12	24.70	0.00	99.74	39.75	273.07	40.15	40.15	25528
13	24.29	0.00	107.69	42.92	294.85	43.81	43.81	26406
14	23.90	0.00	115.35	45.98	315.81	46.78	46.78	27252
15	23.50	0.00	123.00	49.03	336.77	53.16	53.16	28098
16	23.00	0.00	132.69	52.89	363.28	81.52	81.52	14655
17	22.50	0.00	142.38	56.75	389.81	102.27	102.27	15193
18	22.00	0.00	152.07	60.61	416.36	117.50	117.50	15731
19	21.50	0.00	161.78	64.48	442.94	129.31	129.31	16269
20	21.00	0.00	171.50	68.36	469.54	139.43	139.43	16807
21	20.50	0.00	181.23	72.23	496.18	148.97	148.97	17345
22	20.00	0.00	190.97	76.12	522.86	158.53	158.53	17883
23	19.50	5.00	195.72	78.01	535.88	163.33	168.33	18421
24	19.00	10.00	200.49	79.91	548.93	168.37	178.37	18959
25	18.50	15.00	205.27	81.82	562.02	174.09	189.09	19497
26	18.00	20.00	210.07	83.73	575.14	179.74	199.74	20035
27	17.70	23.00	212.95	84.88	583.03	183.14	206.14	21538
28	17.40	26.00	215.83	86.03	590.93	187.23	213.23	258026

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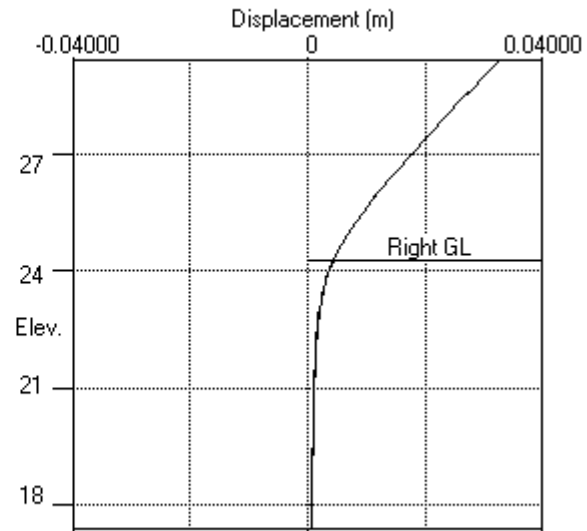
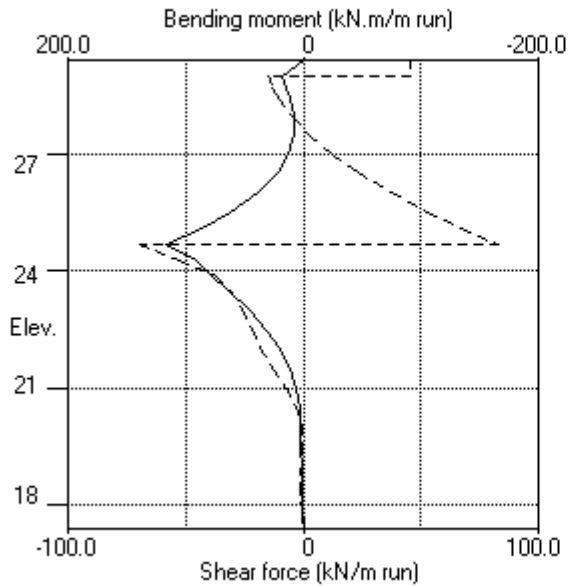
Stage No.7 Change EI of wall to 46900 kN.m2/m run  
 Yield moment not defined  
 Allow wall to relax with new modulus value

Node no.	Y coord	----- RIGHT side -----						Total earth pressure kN/m2	Coeff. of subgrade reaction kN/m3
		Water press. kN/m2	Vertic -al kN/m2	Active limit kN/m2	Passive limit kN/m2	Earth pressure kN/m2			
10	25.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0	
11	25.10	0.00	0.00	0.00	0.00	0.00	0.00	0.0	
12	24.70	0.00	0.00	0.00	0.00	0.00	0.00	0.0	
13	24.29	0.00	0.00	0.00	0.00	0.00	0.00	0.0	
		0.00	0.00	0.00	0.00	0.00	0.00	35975	
14	23.90	0.00	7.90	3.15	21.63	20.54	20.54	37127	
15	23.50	0.00	15.80	6.30	43.27	42.81	42.81	38280	
16	23.00	0.00	25.81	10.29	70.67	70.67	70.67p	14655	
17	22.50	0.00	35.83	14.28	98.10	98.10	98.10p	15193	
18	22.00	0.00	45.86	18.28	125.57	107.57	107.57	15731	
19	21.50	0.00	55.91	22.29	153.08	116.26	116.26	16269	
20	21.00	0.00	65.98	26.30	180.66	129.05	129.05	16807	
21	20.50	0.00	76.08	30.32	208.29	142.91	142.91	17345	
22	20.00	0.00	86.20	34.36	236.00	156.24	156.24	17883	
23	19.50	5.00	91.35	36.41	250.10	163.47	168.47	18421	
24	19.00	10.00	96.53	38.47	264.28	169.63	179.63	18959	
25	18.50	15.00	101.74	40.55	278.55	174.50	189.50	19497	
26	18.00	20.00	106.98	42.64	292.90	179.08	199.08	20035	
27	17.70	23.00	110.14	43.90	301.56	181.76	204.76	21538	
28	17.40	26.00	113.32	45.17	310.26	183.74	209.74	258026	

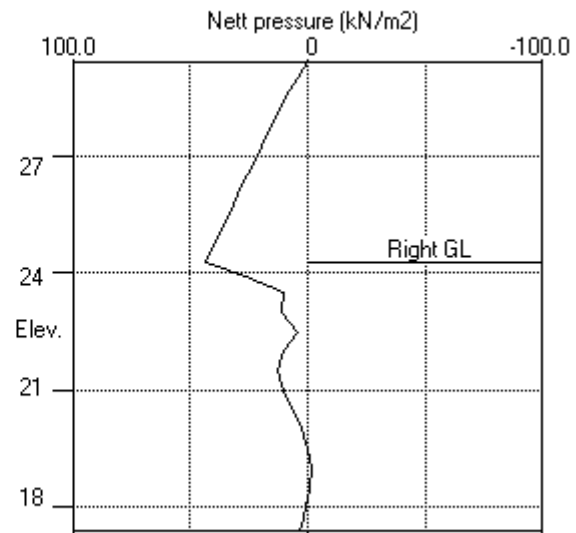
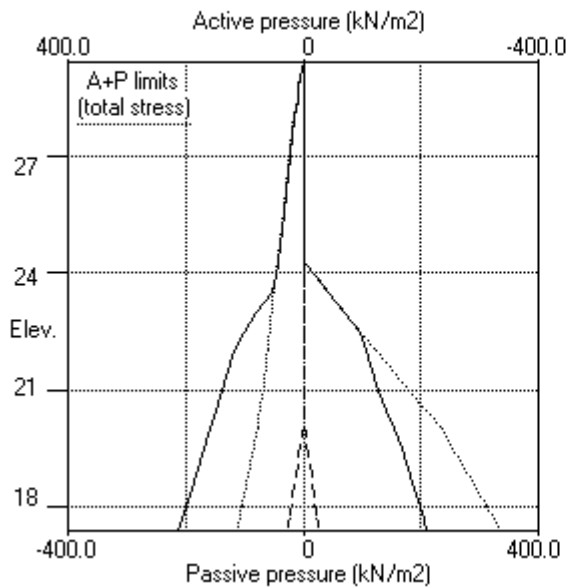
Note: 36.65a Soil pressure at active limit  
 98.10p Soil pressure at passive limit

Units: kN,m

Stage No.7 Change EI of wall to 46900kN.m<sup>2</sup>/m run



Stage No.7 Change EI of wall to 46900kN.m<sup>2</sup>/m run



CENTRAL PILING LTD	Sheet No.
Program: WALLAP Version 6.06 Revision A51.B69.R55	Job No. 41713A1
Licensed from GEOSOLVE	Made by : SD
Data filename/Run ID: Camden_High_ 450mm_S1_SLS	
Camden High	Date:26-03-2021
Contiguous wall - S1 - SLS	Checked :

-----  
Units: kN,m

### Summary of results

### LIMIT STATE PARAMETERS

Limit State: Serviceability Limit State  
All loads and soil strengths are unfactored

### STABILITY ANALYSIS of Fully Embedded Wall according to Strength Factor method

Factor of safety on soil strength

				FoS for toe		Toe elev. for		
				elev. = 17.40		FoS = 1.000		
				-----		-----		
Stage	--- G.L. ---		Strut	Factor	Moment	Toe	Wall	Direction
No.	Act.	Pass.	Elev.	of	equilib.	elev.	Penetr	of
				Safety	at elev.		-ation	failure
1	29.40	29.40	Cant.	Conditions not suitable for FoS calc.				
2	29.40	24.29	Cant.	3.459	18.14	22.20	2.09	L to R
3	29.40	24.29		No analysis at this stage				
All remaining stages have more than one strut - FoS calculation n/a								

Units: kN,m

**Summary of results****BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall****Analysis options**

Length of wall perpendicular to section = 20.00m

Subgrade reaction model - Boussinesq Influence coefficients

Soil deformations are elastic until the active or passive limit is reached

Open Tension Crack analysis - No

Rigid boundaries: Left side 30.00 from wall

Right side 30.00 from wall

**Limit State: Serviceability Limit State**

Calculated Bending Moments and Strut Forces have been multiplied by a factor of 1.35 to obtain values for structural design.

**Bending moment, shear force and displacement envelopes**

Node no.	Y coord	Displacement		---- Bending moment ----				----- Shear force -----			
				Calculated		Factored		Calculated		Factored	
		max.	min.	max.	min.	max.	min.	max.	min.	max.	min.
		m	m	kN.m/m		kN.m/m		kN/m	kN/m	kN/m	kN/m
1	29.40	0.033	0.000	0	0	0	0	45	0	61	0
2	29.00	0.030	0.000	18	0	24	0	46	-15	62	-20
3	28.70	0.028	0.000	16	0	22	0	3	-13	4	-18
4	28.40	0.026	0.000	15	0	21	0	5	-11	7	-14
5	27.95	0.024	0.000	15	0	20	0	8	-5	11	-7
6	27.50	0.021	0.000	17	0	23	0	12	0	16	0
7	27.00	0.018	0.000	24	0	32	0	19	-0	26	-1
8	26.50	0.015	0.000	36	0	49	0	31	-1	42	-1
9	26.00	0.012	0.000	55	0	74	0	45	-1	61	-1
10	25.50	0.009	0.000	81	0	110	0	61	-0	82	-1
11	25.10	0.007	0.000	108	0	146	0	75	-0	101	-0
12	24.70	0.006	0.000	141	0	191	0	90	-76	121	-103
13	24.29	0.005	0.000	124	0	168	0	70	-59	94	-80
14	23.90	0.004	0.000	144	0	194	0	1	-46	1	-62
15	23.50	0.003	0.000	131	0	177	0	0	-47	0	-63
16	23.00	0.002	0.000	98	0	133	0	0	-69	0	-93
17	22.50	0.002	0.000	63	0	85	0	0	-65	0	-88
18	22.00	0.001	0.000	33	0	45	0	0	-50	0	-67
19	21.50	0.001	0.000	17	0	23	0	0	-32	0	-44
20	21.00	0.001	0.000	9	0	13	0	0	-17	0	-24
21	20.50	0.001	0.000	5	-5	7	-6	0	-7	0	-9
22	20.00	0.001	0.000	3	-6	4	-8	0	-3	0	-4
23	19.50	0.001	0.000	2	-5	3	-7	3	-2	4	-2
24	19.00	0.001	0.000	2	-3	2	-4	3	-1	5	-2
25	18.50	0.001	0.000	1	-2	1	-2	3	-1	4	-2
26	18.00	0.001	0.000	0	-1	1	-1	2	-1	2	-1
27	17.70	0.001	0.000	0	-0	0	-0	1	-1	1	-1
28	17.40	0.001	0.000	0	0	0	0	0	0	0	0

### Summary of results (continued)

Calculated Bending Moments and Strut Forces have been multiplied by a factor of 1.35 to obtain values for structural design.

### Maximum and minimum bending moment and shear force at each stage

Stage no.	Bending moment						Shear force					
	Calculated			Factored			Calculated			Factored		
	max.	elev.	min.	elev.	max.	min.	max.	elev.	min.	elev.	max.	min.
	kN.m/m		kN.m/m		kN.m/m		kN/m		kN/m		kN/m	kN/m
1	2	27.50	0	29.40	2	0	2	28.40	-1	26.50	3	-1
2	144	23.90	-6	20.00	194	-8	68	24.29	-69	23.00	92	-93
3	No calculation at this stage											
4	No calculation at this stage											
5	143	23.90	-6	20.00	192	-8	70	24.29	-68	23.00	94	-92
6	141	24.70	0	29.40	191	0	90	24.70	-76	24.70	121	-103
7	117	24.70	0	29.40	158	0	83	24.70	-70	24.70	112	-94

### Maximum and minimum displacement at each stage

Stage no.	Displacement				Stage description
	maximum	elev.	minimum	elev.	
	m		m		
1	0.000	29.40	0.000	29.40	Apply surcharge no.1 at elev. 29.40
2	0.032	29.40	0.000	29.40	Excav. to elev. 24.29 on RIGHT side
3	No calculation at this stage				Install strut no.2 at elev. 24.70
4	No calculation at this stage				Install strut no.1 at elev. 29.00
5	0.033	29.40	0.000	29.40	Apply load no.1 at elev. 29.40
6	0.033	29.40	0.000	29.40	Change soil type 2 to soil type 3
7	0.033	29.40	0.000	29.40	Change EI of wall to 46900kN.m2/m run

### Strut forces at each stage (horizontal components)

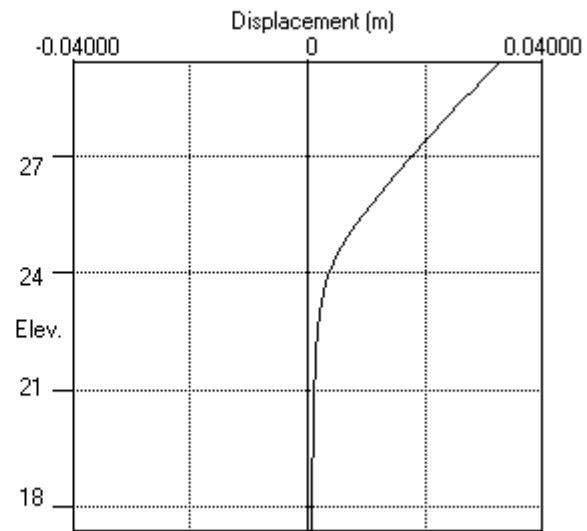
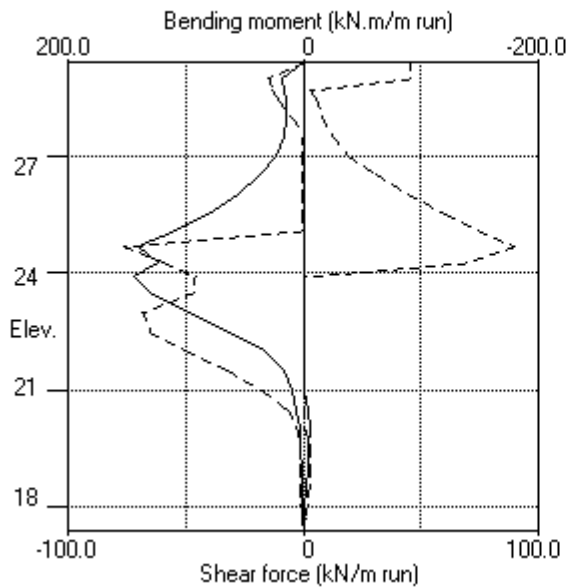
Stage no.	Strut no. 1			Strut no. 2		
	at elev. 29.00			at elev. 24.70		
	--Calculated--	Factored		--Calculated--	Factored	
	kN per	kN per	kN per	kN per	kN per	kN per
	m run	strut	strut	m run	strut	strut
5	53	53	71	-3	-3	-5
6	54	54	73	166	166	224
7	61	61	82	152	152	206

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Camden High  
Contiguous wall - S1 - SLS

| Sheet No.  
| Job No. 41713A1  
| Made by : SD  
|  
| Date:26-03-2021  
Checked :

Units: kN,m

Bending moment, shear force, displacement envelopes





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Data filename/Run ID: Camden\_High\_ 450mm\_S1\_ULS1  
Camden High  
Contiguous wall - S1 - ULS1

| Sheet No.  
| Job No. 41713A1  
| Made by : SD  
| Date:26-03-2021  
| Checked :

Units: kN,m

# INPUT DATA

## SOIL PROFILE

Stratum no.	Elevation of top of stratum	Left side	Soil types	Right side
1	29.40	1 Made Ground		1 Made Ground
2	28.40	2 London Clay u.		2 London Clay u.

## SOIL PROPERTIES (Unfactored SLS soil strengths)

-- Soil type --	Bulk density	Young's Modulus	At rest coeff.	Consol state.	Active limit	Passive limit	Cohesion
No. Description (Datum elev.)	kN/m3	Eh, kN/m2 (dEh/dy )	Ko (dKo/dy)	NC/OC ( Nu )	Ka ( Kac )	Kp ( Kpc )	kN/m2 ( dc/dy )
1 Made Ground	18.00	0 ( 10000)	0.625	NC (0.200)	0.399 (0.000)	2.894 ( 0.000)	
2 London Cl.. ( 28.40 )	20.00	45000 ( 5475)	1.000	OC (0.490)	1.000 (2.389)	1.000 ( 2.390)	60.00u ( 7.300)
3 London Cl.. ( 28.40 )	20.00	33750 ( 4106)	1.000	OC (0.200)	0.399 (0.000)	2.738 ( 0.000)	

## Additional soil parameters associated with Ka and Kp

--- parameters for Ka ---				--- parameters for Kp ---			
Soil type	friction angle	Wall adhesion coeff.	Back-fill angle	Soil friction angle	Wall adhesion coeff.	Back-fill angle	
1 Made Ground	22.00	0.670	0.00	22.00	0.670	0.00	
2 London Clay u.	0.00	0.500	0.00	0.00	0.500	0.00	
3 London Clay dr.	22.00	0.670	0.00	21.00	0.670	0.00	

## GROUND WATER CONDITIONS

Density of water = 10.00 kN/m3

Initial water table elevation

	Left side	Right side
Initial water table elevation	20.00	20.00

Automatic water pressure balancing at toe of wall : Yes

Left side				Right side				
Water profile	Point no.	Elev. m	Piezo elev. m	Water press. kN/m2	Point no.	Elev. m	Piezo elev. m	Water press. kN/m2
1	1	28.40	28.40	0.0	1	23.79	23.79	0.0 MC+WC

## WALL PROPERTIES

Type of structure = Fully Embedded Wall  
Elevation of toe of wall = 17.40  
Maximum finite element length = 0.50 m  
Youngs modulus of wall E = 2.0000E+07 kN/m2  
Moment of inertia of wall I = 3.3500E-03 m4/m run  
E.I = 67000 kN.m2/m run  
Yield Moment of wall = Not defined

## STRUTS and ANCHORS

Strut/ anchor no.	Elev.	Strut spacing m	X-section area of strut sq.m	Youngs modulus kN/m2	Free length m	Inclin -ation (degs)	Pre-stress /strut kN	Tension allowed
1	29.00	1.00	0.250000	2.000E+07	10.00	0.00	0	Yes
2	24.70	1.00	0.450000	2.000E+07	10.00	0.00	0	Yes

**HORIZONTAL and MOMENT LOADS/RESTRAINTS**

Load no.	Elevation	Horizontal load kN/m run	Moment load kN.m/m run	Moment restraint kN.m/m/rad	Partial factor (Category)
1	29.40	45.00	0	0	1.00 (P/U)

**SURCHARGE LOADS**

Surch -arge no.	Elev.	Distance from wall	Length parallel to wall	Width perpend. to wall	Surcharge ----- kN/m2 ----- Near edge Far edge	Equiv. soil type	Partial factor/ Category
1	29.40	0.20 (L)	10.00	10.00	10.00 =	N/A	1.10 Var

Note: L = Left side, R = Right side

Limit State Categories P/U = Permanent Unfavourable

P/F = Permanent Favourable

Var = Variable (unfavourable)

**CONSTRUCTION STAGES**

Construction stage no.	Stage description
1	Apply surcharge no.1 at elevation 29.40 No analysis at this stage
2	Excavate to elevation 23.79 on RIGHT side
3	Fill to elevation 24.29 on RIGHT side with soil type 2
4	Install strut or anchor no.2 at elevation 24.70
5	Install strut or anchor no.1 at elevation 29.00
6	Apply load no.1 at elevation 29.40
7	Change properties of soil type 2 to soil type 3 Ko pressures will not be reset
8	Change EI of wall to 46900 kN.m2/m run Yield moment not defined Allow wall to relax with new modulus value
9	Apply water pressure profile no.1 ( Mod. Conserv. )

**FACTORS OF SAFETY and ANALYSIS OPTIONS**

Limit State options: ULS DA1 Combination 1

Water pressures : Moderately Conservative

Partial factor on C' = 1.000

Partial factor on Phi' = 1.000

Partial factor on Cu = 1.000

Partial factor on Soil Modulus = 1.000

Partial factor on Permanent Unfavourable loads = 1.000

Partial factor on Permanent Favourable loads = 1.000

Partial factor on Variable Unfavourable loads = 1.100

Design factor on calculated Bending Moments = 1.350

Parameters for undrained strata:

Minimum equivalent fluid density = 5.00 kN/m3

Maximum depth of water filled tension crack = 0.00 m

Bending moment and displacement calculation:

Method - Subgrade reaction model using Influence Coefficients

Open Tension Crack analysis? - No

Non-linear Modulus Parameter (L) = 10.00 m

Boundary conditions:

Length of wall (normal to plane of analysis) = 20.00 m

Width of excavation on Left side of wall = 20.00 m

Width of excavation on Right side of wall = 20.00 m

Distance to rigid boundary on Left side = 30.00 m

Distance to rigid boundary on Right side = 30.00 m

## OUTPUT OPTIONS

Stage no.	Stage description	Displacement Bending mom. Shear force	Active, Passive pressures	Graph. output
1	Apply surcharge no.1 at elev. 29.40	Yes	Yes	Yes
2	Excav. to elev. 23.79 on RIGHT side	Yes	Yes	Yes
3	Fill to elev. 24.29 on RIGHT side	Yes	Yes	Yes
4	Install strut no.2 at elev. 24.70	Yes	Yes	Yes
5	Install strut no.1 at elev. 29.00	Yes	Yes	Yes
6	Apply load no.1 at elev. 29.40	Yes	Yes	Yes
7	Change soil type 2 to soil type 3	No	No	No
8	Change EI of wall to 46900kN.m2/m run	Yes	Yes	Yes
9	Apply water pressure profile no.1	Yes	Yes	Yes
*	Summary output	Yes	-	Yes

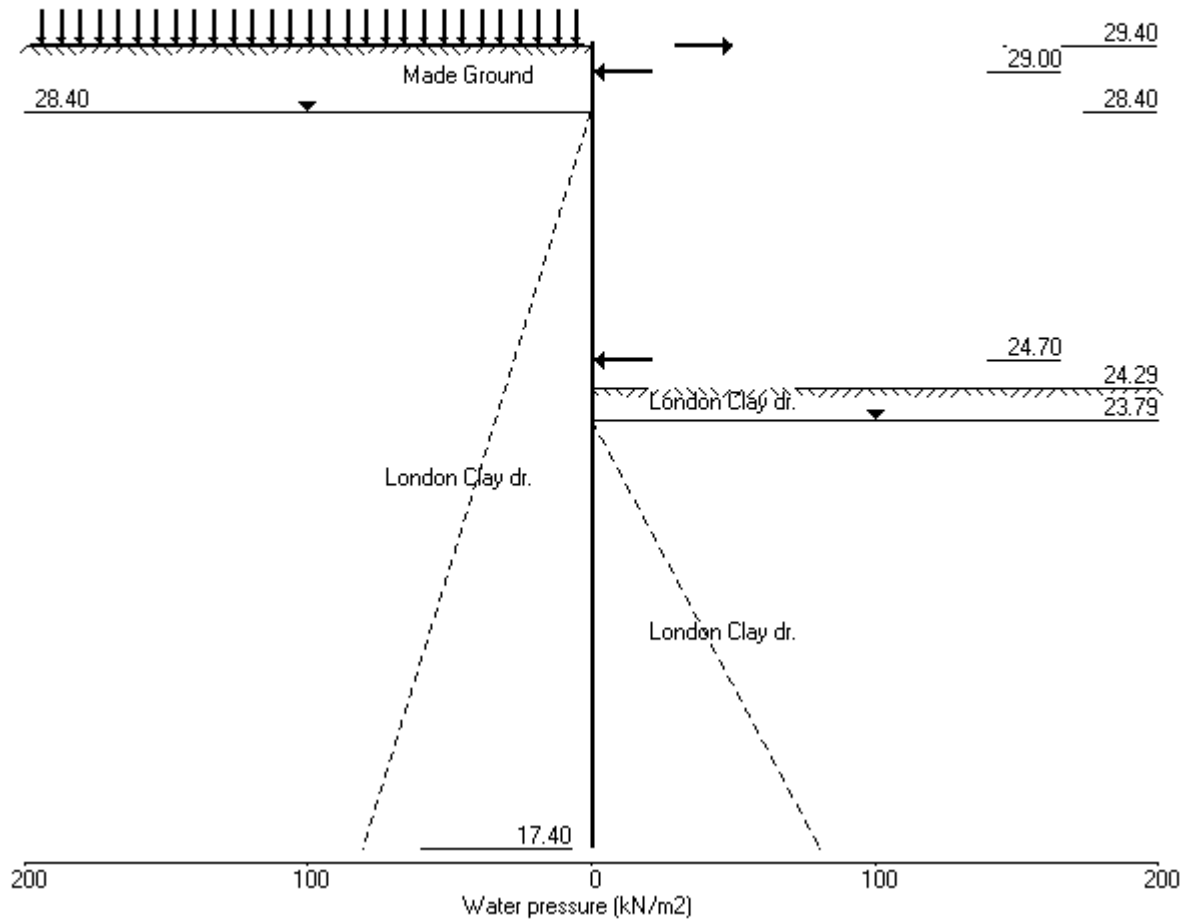
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 Contiguous wall - S1 - ULS1

| Sheet No.  
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 | Date:26-03-2021  
 | Checked :

Units: kN,m

Stage No.9 Apply water pressure profile no.1 ( Mod. Conserv. )



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 Contiguous wall - S1 - ULS1

| Sheet No.  
 | Job No. 41713A1  
 | Made by : SD  
 | Date:26-03-2021  
 | Checked :

Units: kN,m

Stage No. 1 Apply surcharge no.1 at elevation 29.40  
 No analysis at this stage

# **BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall**

## **Analysis options**

Length of wall perpendicular to section = 20.00m  
 Subgrade reaction model - Boussinesq Influence coefficients  
 Soil deformations are elastic until the active or passive limit is reached  
 Open Tension Crack analysis - No

Rigid boundaries: Left side 30.00 from wall  
 Right side 30.00 from wall

## **Limit State: ULS DA1 Combination 1**

Calculated Bending Moments and Strut Forces are to be multiplied by a factor of 1.35 to obtain values for structural design. See summary for factored values.

Node no.	Y coord	Nett pressure kN/m2	Wall disp. m	Wall rotation rad.	Shear force kN/m	Bending moment kN.m/m	Strut forces kN/m	EI of wall kN.m2/m
1	29.40	0.00	0.000	8.72E-05	0.0	-0.0		67000
2	29.00	2.25	0.000	8.70E-05	0.5	0.1		67000
3	28.70	3.12	0.000	8.60E-05	1.3	0.3		67000
4	28.40	3.32	0.000	8.33E-05	2.2	0.9		67000
		-3.74	0.000	8.33E-05	2.2	0.9		
5	27.95	-2.32	0.000	7.54E-05	0.9	1.5		67000
6	27.50	-1.34	0.000	6.46E-05	0.0	1.7		67000
7	27.00	-0.58	0.000	5.27E-05	-0.4	1.5		67000
8	26.50	-0.10	0.000	4.23E-05	-0.6	1.2		67000
9	26.00	0.16	0.000	3.43E-05	-0.6	0.9		67000
10	25.50	0.28	0.000	2.86E-05	-0.5	0.6		67000
11	25.10	0.29	0.000	2.54E-05	-0.4	0.4		67000
12	24.70	0.27	0.000	2.31E-05	-0.3	0.3		67000
13	24.29	0.22	0.000	2.15E-05	-0.2	0.2		67000
14	23.79	0.16	0.000	2.01E-05	-0.1	0.2		67000
15	23.40	0.10	0.000	1.92E-05	-0.0	0.1		67000
16	23.00	0.06	0.000	1.84E-05	0.0	0.1		67000
17	22.50	0.02	0.000	1.74E-05	0.0	0.1		67000
18	22.00	-0.01	0.000	1.63E-05	0.0	0.1		67000
19	21.50	-0.02	0.000	1.52E-05	0.0	0.2		67000
20	21.00	-0.03	0.000	1.41E-05	0.0	0.2		67000
21	20.50	-0.03	0.000	1.30E-05	0.0	0.1		67000
22	20.00	-0.03	0.000	1.19E-05	-0.0	0.1		67000
23	19.50	-0.03	0.000	1.09E-05	-0.0	0.1		67000
24	19.00	-0.02	0.000	1.02E-05	-0.0	0.1		67000
25	18.50	-0.00	0.000	9.69E-06	-0.0	0.1		67000
26	18.00	0.03	0.000	9.42E-06	-0.0	0.0		67000
27	17.70	0.07	0.000	9.36E-06	-0.0	0.0		67000
28	17.40	0.11	0.000	9.34E-06	0.0	0.0		---

Node no.	Y coord	LEFT side					Total earth pressure	Coeff. of subgrade reaction
		Water press.	Vertic -al	Active limit	Passive limit	Earth pressure		
		kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m3
1	29.40	0.00	0.00	0.00	0.00	0.00	0.00	184
2	29.00	0.00	12.15	4.84	35.16	7.17	7.17	1103
3	28.70	0.00	19.79	7.89	57.27	11.68	11.68	1931
4	28.40	0.00	26.23	10.46	75.93	15.49	15.49	2759
		Total>	26.23	5.00m	169.64	20.09	20.09	17636

(continued)

Stage No.1 Apply surcharge no.1 at elevation 29.40  
 No analysis at this stage

Node no.	Y coord	LEFT side						Total earth pressure kN/m2	Coeff. of subgrade reaction kN/m3
		Water press. kN/m2	Vertic -al kN/m2	Effective Active limit kN/m2	stresses Passive limit kN/m2	Earth pressure kN/m2			
5	27.95	Total>	35.99	7.25m	187.24	30.16	30.16	18601	
6	27.50	Total>	45.31	9.50m	204.42	39.81	39.81	19567	
7	27.00	Total>	55.43	12.00m	223.26	50.24	50.24	20640	
8	26.50	Total>	65.37	14.50m	241.94	60.45	60.45	21713	
9	26.00	Total>	75.22	17.00m	260.50	70.51	70.51	22785	
10	25.50	Total>	84.98	19.50m	278.99	80.45	80.45	23858	
11	25.10	Total>	92.76	21.50m	293.75	88.35	88.35	24717	
12	24.70	Total>	100.51	23.50m	308.48	96.22	96.22	25575	
13	24.29	Total>	108.44	25.55m	323.57	104.27	104.27	26455	
14	23.79	Total>	118.10	28.05m	341.96	114.07	114.07	27527	
15	23.40	Total>	125.73	30.02m	356.48	121.82	121.82	28375	
16	23.00	Total>	133.36	32.00m	371.00	129.56	129.56	29222	
17	22.50	Total>	143.01	34.50m	389.38	139.38	139.38	30295	
18	22.00	Total>	152.68	37.00m	407.77	149.21	149.21	31368	
19	21.50	Total>	158.27	39.50m	422.09	159.04	159.04	32441	
20	21.00	Total>	172.05	42.00m	444.59	168.89	168.89	33514	
21	20.50	Total>	181.75	44.50m	463.02	178.75	178.75	34587	
22	20.00	Total>	191.47	47.00m	481.46	188.61	188.61	35660	
23	19.50	Total>	201.20	49.50m	499.92	198.48	198.48	36732	
24	19.00	Total>	210.94	52.00m	518.39	208.36	208.36	37805	
25	18.50	Total>	220.70	54.50m	536.87	218.26	218.26	38878	
26	18.00	Total>	230.47	57.00m	555.36	228.16	228.16	39951	
27	17.70	Total>	236.34	58.50m	566.47	234.12	234.12	40595	
28	17.40	Total>	242.22	60.00m	577.58	240.08	240.08	41238	

Node no.	Y coord	RIGHT side					Total earth pressure kN/m2	Coeff. of subgrade reaction kN/m3
		Effective stresses						
		Water press. kN/m2	Vertic -al kN/m2	Active limit kN/m2	Passive limit kN/m2	Earth pressure kN/m2		
1	29.40	0.00	0.00	0.00	0.00	0.00	0.00	184
2	29.00	0.00	7.20	2.87	20.84	4.92	4.92	1103
3	28.70	0.00	12.60	5.02	36.47	8.56	8.56	1931
4	28.40	0.00	18.00	7.17	52.09	12.16	12.16	2759
		Total>	18.00	5.00m	161.40	23.82	23.82	17636
5	27.95	Total>	27.00	7.25m	178.25	32.48	32.48	18601
6	27.50	Total>	36.00	9.50m	195.11	41.14	41.14	19567
7	27.00	Total>	46.00	12.00m	213.83	50.82	50.82	20640
8	26.50	Total>	56.00	14.50m	232.56	60.56	60.56	21713
9	26.00	Total>	66.00	17.00m	251.28	70.35	70.35	22785
10	25.50	Total>	76.00	19.50m	270.01	80.18	80.18	23858
11	25.10	Total>	84.00	21.50m	284.99	88.06	88.06	24717
12	24.70	Total>	92.00	23.50m	299.97	95.95	95.95	25575
13	24.29	Total>	100.20	25.55m	315.33	104.05	104.05	26455
14	23.79	Total>	110.20	28.05m	334.05	113.92	113.92	27527
15	23.40	Total>	118.10	30.02m	348.85	121.71	121.71	28375
16	23.00	Total>	126.00	32.00m	363.64	129.50	129.50	29222
17	22.50	Total>	136.00	34.50m	382.36	139.36	139.36	30295
18	22.00	Total>	146.00	37.00m	401.09	149.21	149.21	31368
19	21.50	Total>	156.00	39.50m	419.82	159.07	159.07	32441
20	21.00	Total>	166.00	42.00m	438.54	168.92	168.92	33514
21	20.50	Total>	176.00	44.50m	457.27	178.78	178.78	34587
22	20.00	Total>	186.00	47.00m	475.99	188.64	188.64	35660

Run ID. Camden\_High\_ 450mm\_S1\_ULS1  
 Camden High  
 Contiguous wall - S1 - ULS1

| Sheet No.  
 | Date:26-03-2021  
 | Checked :

(continued)

Stage No.1    Apply surcharge no.1 at elevation 29.40  
                  No analysis at this stage

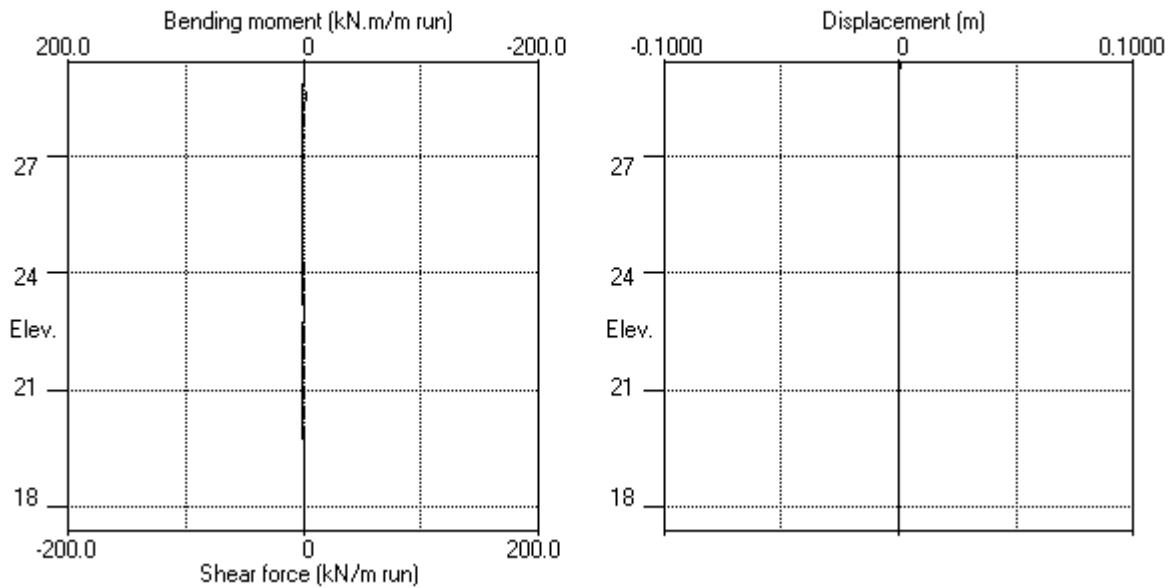
Node no.	Y coord	----- RIGHT side -----						
		----- Effective stresses -----					Total earth pressure kN/m2	Coeff. of subgrade reaction kN/m3
		Water press. kN/m2	Vertic -al kN/m2	Active limit kN/m2	Passive limit kN/m2	Earth pressure kN/m2		
		Total>						
23	19.50	Total>	196.00	49.50m	494.72	198.51	198.51	36732
24	19.00	Total>	206.00	52.00m	513.44	208.39	208.39	37805
25	18.50	Total>	216.00	54.50m	532.17	218.26	218.26	38878
26	18.00	Total>	226.00	57.00m	550.89	228.13	228.13	39951
27	17.70	Total>	232.00	58.50m	562.13	234.05	234.05	40595
28	17.40	Total>	238.00	60.00m	573.36	239.97	239.97	41238

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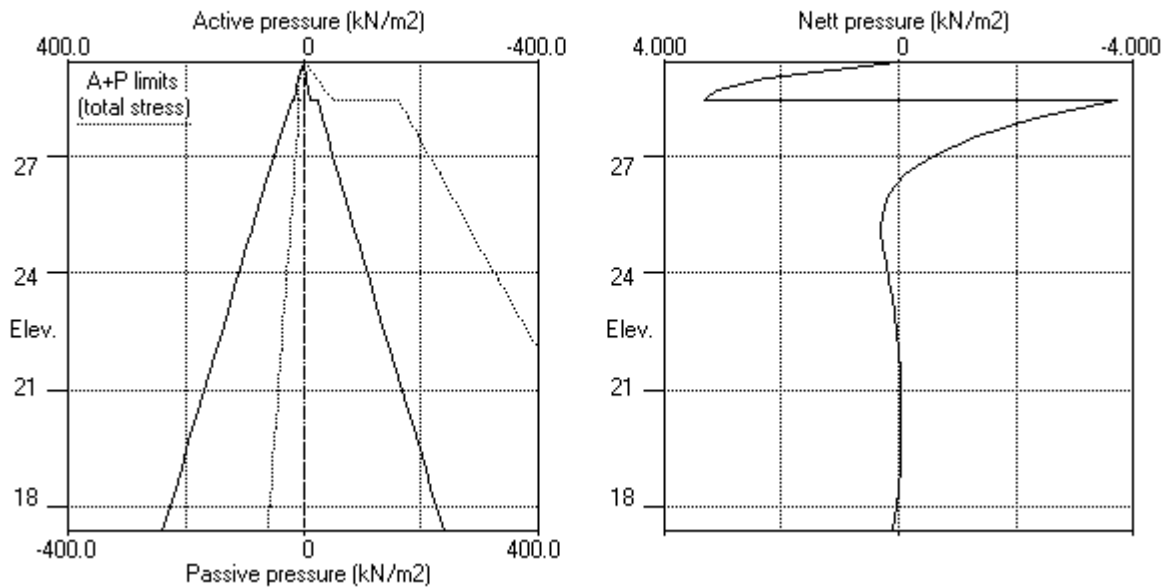
| Sheet No.  
 | Job No. 41713A1  
 | Made by : SD  
 | Date:26-03-2021  
 | Checked :

Units: kN,m

Stage No.1 Apply surcharge no.1 at elev. 29.40



Stage No.1 Apply surcharge no.1 at elev. 29.40





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 Data filename/Run ID: Camden\_High\_ 450mm\_S1\_ULS1  
 Camden High  
 Contiguous wall - S1 - ULS1

| Sheet No.  
 | Job No. 41713A1  
 | Made by : SD  
 | Date:26-03-2021  
 | Checked :

Units: kN,m

Stage No. 2 Excavate to elevation 23.79 on RIGHT side

# **BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall**

## **Analysis options**

Length of wall perpendicular to section = 20.00m  
 Subgrade reaction model - Boussinesq Influence coefficients  
 Soil deformations are elastic until the active or passive limit is reached  
 Open Tension Crack analysis - No

Rigid boundaries: Left side 30.00 from wall  
 Right side 30.00 from wall

## **Limit State: ULS DAI Combination 1**

Calculated Bending Moments and Strut Forces are to be multiplied by a factor of 1.35 to obtain values for structural design. See summary for factored values.

Node no.	Y coord	Nett pressure kN/m2	Wall disp. m	Wall rotation rad.	Shear force kN/m	Bending moment kN.m/m	Strut forces kN/m	EI of wall kN.m2/m
1	29.40	0.00	0.047	8.21E-03	0.0	-0.0		67000
2	29.00	4.84	0.043	8.21E-03	1.0	0.2		67000
3	28.70	7.89	0.041	8.20E-03	2.9	0.7		67000
4	28.40	10.46	0.038	8.20E-03	5.6	2.0		67000
		5.00	0.038	8.20E-03	5.6	2.0		
5	27.95	7.25	0.035	8.17E-03	8.4	5.1		67000
6	27.50	9.50	0.031	8.12E-03	12.2	9.6		67000
7	27.00	12.00	0.027	8.02E-03	17.5	17.0		67000
8	26.50	14.50	0.023	7.86E-03	24.2	27.3		67000
9	26.00	17.00	0.019	7.60E-03	32.0	41.3		67000
10	25.50	19.50	0.015	7.23E-03	41.2	59.5		67000
11	25.10	21.50	0.013	6.82E-03	49.4	77.6		67000
12	24.70	23.50	0.010	6.29E-03	58.4	99.1		67000
13	24.29	25.55	0.008	5.60E-03	68.4	125.1		67000
14	23.79	28.05	0.005	4.53E-03	81.8	162.5		67000
		-195.78	0.005	4.53E-03	81.8	162.5		
15	23.40	-208.59	0.003	3.52E-03	1.9	179.3		67000
16	23.00	-106.29	0.002	2.49E-03	-60.2	171.9		67000
17	22.50	-14.17	0.001	1.37E-03	-90.4	128.5		67000
18	22.00	32.78	0.001	5.89E-04	-85.7	81.5		67000
19	21.50	48.22	0.001	1.25E-04	-65.5	42.8		67000
20	21.00	45.35	0.001	-9.39E-05	-42.1	16.1		67000
21	20.50	34.37	0.001	-1.56E-04	-22.1	0.7		67000
22	20.00	21.92	0.001	-1.36E-04	-8.1	-6.1		67000
23	19.50	11.38	0.001	-8.55E-05	0.3	-7.4		67000
24	19.00	3.83	0.001	-3.59E-05	4.1	-5.9		67000
25	18.50	-1.05	0.001	-1.31E-06	4.8	-3.4		67000
26	18.00	-4.23	0.001	1.56E-05	3.4	-1.2		67000
27	17.70	-5.76	0.001	1.89E-05	1.9	-0.3		67000
28	17.40	-7.19	0.001	1.96E-05	0.0	0.0		---

Node no.	Y coord	LEFT side						
		Water press.	Vertical	Active limit	Passive limit	Earth pressure	Total earth pressure	Coeff. of subgrade reaction
		kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m3
1	29.40	0.00	0.00	0.00	0.00	0.00	0.00	187
2	29.00	0.00	12.15	4.84	35.16	4.84	4.84a	1121
3	28.70	0.00	19.79	7.89	57.27	7.89	7.89a	1962
4	28.40	0.00	26.23	10.46	75.93	10.46	10.46a	2803
		Total>	26.23	5.00m	169.64	5.00	5.00a	17897

(continued)

Stage No.2 Excavate to elevation 23.79 on RIGHT side

Node no.	Y coord	LEFT side						Total earth pressure kN/m2	Coeff. of subgrade reaction kN/m3
		Water press. kN/m2	Vertic -al kN/m2	Effective Active limit kN/m2	Effective Passive limit kN/m2	Earth pressure kN/m2			
5	27.95	Total>	35.99	7.25m	187.24	7.25	7.25a	18877	
6	27.50	Total>	45.31	9.50m	204.42	9.50	9.50a	19857	
7	27.00	Total>	55.43	12.00m	223.26	12.00	12.00a	20945	
8	26.50	Total>	65.37	14.50m	241.94	14.50	14.50a	22034	
9	26.00	Total>	75.22	17.00m	260.50	17.00	17.00a	23123	
10	25.50	Total>	84.98	19.50m	278.99	19.50	19.50a	24212	
11	25.10	Total>	92.76	21.50m	293.75	21.50	21.50a	25083	
12	24.70	Total>	100.51	23.50m	308.48	23.50	23.50a	25954	
13	24.29	Total>	108.44	25.55m	323.57	25.55	25.55a	26846	
14	23.79	Total>	118.10	28.05m	341.96	28.05	28.05a	27935	
15	23.40	Total>	125.73	30.02m	356.48	30.02	30.02a	28795	
16	23.00	Total>	133.36	32.00m	371.00	67.93	67.93	29655	
17	22.50	Total>	143.01	34.50m	389.38	104.51	104.51	30744	
18	22.00	Total>	152.68	37.00m	407.77	127.99	127.99	31833	
19	21.50	Total>	158.27	39.50m	422.09	142.32	142.32	32922	
20	21.00	Total>	172.05	42.00m	444.59	151.35	151.35	34010	
21	20.50	Total>	181.75	44.50m	463.02	158.05	158.05	35099	
22	20.00	Total>	191.47	47.00m	481.46	164.32	164.32	36188	
23	19.50	Total>	201.20	49.50m	499.92	171.17	171.17	37277	
24	19.00	Total>	210.94	52.00m	518.39	178.90	178.90	38365	
25	18.50	Total>	220.70	54.50m	536.87	187.43	187.43	39454	
26	18.00	Total>	230.47	57.00m	555.36	196.46	196.46	40543	
27	17.70	Total>	236.34	58.50m	566.47	202.01	202.01	41196	
28	17.40	Total>	242.22	60.00m	577.58	207.59	207.59	41849	

Node no.	Y coord	RIGHT side						Total earth pressure kN/m2	Coeff. of subgrade reaction kN/m3
		Effective stresses							
		Water press. kN/m2	Vertic -al kN/m2	Active limit kN/m2	Passive limit kN/m2	Earth pressure kN/m2			
1	29.40	0.00	0.00	0.00	0.00	0.00	0.00	0.0	
2	29.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0	
3	28.70	0.00	0.00	0.00	0.00	0.00	0.00	0.0	
4	28.40	0.00	0.00	0.00	0.00	0.00	0.00	0.0	
5	27.95	0.00	0.00	0.00	0.00	0.00	0.00	0.0	
6	27.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0	
7	27.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0	
8	26.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0	
9	26.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0	
10	25.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0	
11	25.10	0.00	0.00	0.00	0.00	0.00	0.00	0.0	
12	24.70	0.00	0.00	0.00	0.00	0.00	0.00	0.0	
13	24.29	0.00	0.00	0.00	0.00	0.00	0.00	0.0	
14	23.79	0.00	0.00	0.00	0.00	0.00	0.00	0.0	
		Total>	0.00	0.00	223.83	223.83	223.83p	68253	
15	23.40	Total>	7.90	1.97m	238.62	238.62	238.62p	70355	
16	23.00	Total>	15.80	3.95m	253.42	174.22	174.22	72456	
17	22.50	Total>	25.81	6.45m	272.15	118.68	118.68	75116	
18	22.00	Total>	35.83	8.95m	290.90	95.21	95.21	77777	
19	21.50	Total>	45.87	11.45m	309.66	94.10	94.10	80437	
20	21.00	Total>	55.92	13.95m	328.44	106.01	106.01	83097	
21	20.50	Total>	66.00	16.45m	347.24	123.67	123.67	85757	
22	20.00	Total>	76.11	18.95m	366.07	142.40	142.40	88417	
23	19.50	Total>	86.24	21.45m	384.93	159.79	159.79	91077	

Run ID. Camden\_High\_ 450mm\_S1\_ULS1  
 Camden High  
 Contiguous wall - S1 - ULS1

| Sheet No.  
 | Date:26-03-2021  
 | Checked :

(continued)

Stage No.2 Excavate to elevation 23.79 on RIGHT side

Node no.	Y coord	----- RIGHT side -----						
		----- Effective stresses -----					Total earth pressure	Coeff. of subgrade reaction
		Water	Vertic	Active	Passive	Earth		
		press.	-al	limit	limit	pressure		
		kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m3
24	19.00	Total>	96.40	23.95m	403.82	175.07	175.07	93737
25	18.50	Total>	106.60	26.45m	422.74	188.47	188.47	96397
26	18.00	Total>	116.83	28.95m	441.69	200.70	200.70	99057
27	17.70	Total>	122.99	30.45m	453.09	207.77	207.77	100653
28	17.40	Total>	129.16	31.95m	464.49	214.78	214.78	102249

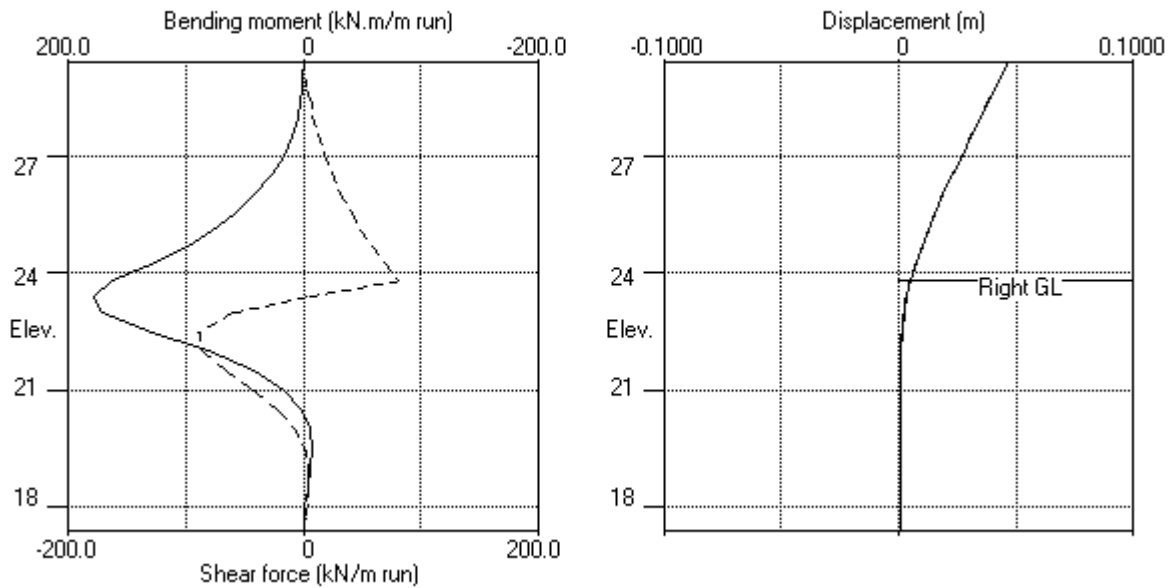
Note: 30.02a Soil pressure at active limit  
 238.62p Soil pressure at passive limit

CENTRAL PILING LTD  
 Program: WALLAP Version 6.06 Revision A51.B69.R55  
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 Camden High  
 Contiguous wall - S1 - ULS1

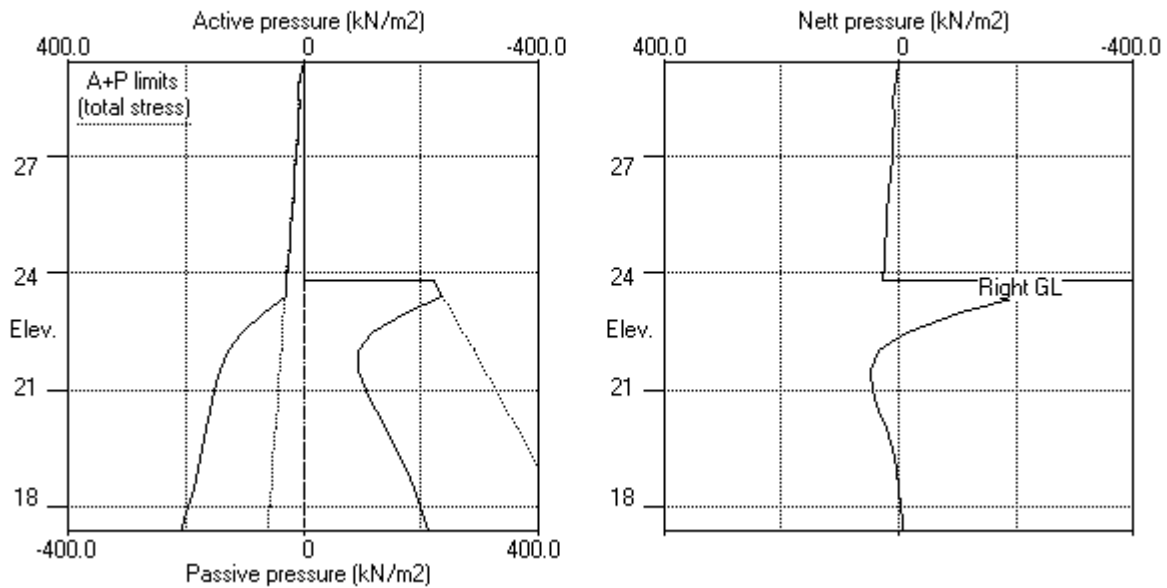
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 | Made by : SD  
 | Date:26-03-2021  
 | Checked :

Units: kN,m

Stage No.2 Excav. to elev. 23.79 on RIGHT side



Stage No.2 Excav. to elev. 23.79 on RIGHT side



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Contiguous wall - S1 - ULS1

| Sheet No.  
| Job No. 41713A1  
| Made by : SD  
| Date:26-03-2021  
| Checked :

Units: kN,m

Stage No. 3 Fill to elevation 24.29 on RIGHT side with soil type 2

# **BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall**

## **Analysis options**

Length of wall perpendicular to section = 20.00m  
Subgrade reaction model - Boussinesq Influence coefficients  
Soil deformations are elastic until the active or passive limit is reached  
Open Tension Crack analysis - No

Rigid boundaries: Left side 30.00 from wall  
Right side 30.00 from wall

## **Limit State: ULS DAI Combination 1**

Calculated Bending Moments and Strut Forces are to be multiplied by a factor of 1.35 to obtain values for structural design. See summary for factored values.

Node no.	Y coord	Nett pressure kN/m2	Wall disp. m	Wall rotation rad.	Shear force kN/m	Bending moment kN.m/m	Strut forces kN/m	EI of wall kN.m2/m
1	29.40	0.00	0.047	8.28E-03	0.0	-0.0		67000
2	29.00	4.84	0.044	8.28E-03	1.0	0.2		67000
3	28.70	7.89	0.041	8.28E-03	2.9	0.7		67000
4	28.40	10.46	0.039	8.28E-03	5.6	2.0		67000
		5.00	0.039	8.28E-03	5.6	2.0		
5	27.95	7.25	0.035	8.25E-03	8.4	5.1		67000
6	27.50	9.50	0.031	8.20E-03	12.2	9.6		67000
7	27.00	12.00	0.027	8.10E-03	17.5	17.0		67000
8	26.50	14.50	0.023	7.94E-03	24.2	27.3		67000
9	26.00	17.00	0.019	7.68E-03	32.0	41.3		67000
10	25.50	20.13	0.015	7.31E-03	41.3	59.5		67000
11	25.10	22.67	0.013	6.90E-03	49.9	77.7		67000
12	24.70	25.25	0.010	6.37E-03	59.5	99.5		67000
13	24.29	27.91	0.007	5.68E-03	70.4	126.1		67000
14	23.79	24.64	0.005	4.59E-03	83.5	164.4		67000
		-199.19	0.005	4.59E-03	83.5	164.4		
15	23.40	-210.97	0.003	3.57E-03	2.5	181.5		67000
16	23.00	-107.79	0.002	2.52E-03	-60.5	174.2		67000
17	22.50	-14.82	0.001	1.39E-03	-91.1	130.5		67000
18	22.00	32.69	0.001	5.95E-04	-86.7	83.1		67000
19	21.50	48.47	0.000	1.21E-04	-66.4	43.8		67000
20	21.00	45.75	0.000	-1.03E-04	-42.8	16.7		67000
21	20.50	34.81	0.000	-1.69E-04	-22.7	1.0		67000
22	20.00	22.31	0.001	-1.50E-04	-8.4	-6.0		67000
23	19.50	11.68	0.001	-1.00E-04	0.1	-7.5		67000
24	19.00	4.04	0.001	-5.04E-05	4.0	-6.0		67000
25	18.50	-0.96	0.001	-1.53E-05	4.8	-3.4		67000
26	18.00	-4.26	0.001	1.93E-06	3.5	-1.2		67000
27	17.70	-5.86	0.001	5.32E-06	2.0	-0.3		67000
28	17.40	-7.38	0.001	6.05E-06	0.0	0.0		---

Node no.	Y coord	LEFT side						
		Water press.	Vertical	Active limit	Passive limit	Earth pressure	Total earth pressure	Coeff. of subgrade reaction
		kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m3
1	29.40	0.00	0.00	0.00	0.00	0.00	0.00	255
2	29.00	0.00	12.15	4.84	35.16	4.84	4.84a	1532
3	28.70	0.00	19.79	7.89	57.27	7.89	7.89a	2680
4	28.40	0.00	26.23	10.46	75.93	10.46	10.46a	3829
		Total>	26.23	5.00m	169.64	5.00	5.00a	23997

(continued)

Stage No.3 Fill to elevation 24.29 on RIGHT side with soil type 2

Node no.	Y coord	LEFT side						Total earth pressure kN/m2	Coeff. of subgrade reaction kN/m3
		Water press. kN/m2	Vertic -al kN/m2	Effective Active limit kN/m2	Effective Passive limit kN/m2	Earth pressure kN/m2			
		Total>							
5	27.95	Total>	35.99	7.25m	187.24	7.25	7.25a	25311	
6	27.50	Total>	45.31	9.50m	204.42	9.50	9.50a	26625	
7	27.00	Total>	55.43	12.00m	223.26	12.00	12.00a	28085	
8	26.50	Total>	65.37	14.50m	241.94	14.50	14.50a	29545	
9	26.00	Total>	75.22	17.00m	260.50	17.00	17.00a	31005	
10	25.50	Total>	84.98	19.50m	278.99	20.13	20.13	16187	
11	25.10	Total>	92.76	21.50m	293.75	22.67	22.67	16769	
12	24.70	Total>	100.51	23.50m	308.48	25.25	25.25	17351	
13	24.29	Total>	108.44	25.55m	323.57	27.91	27.91	17948	
14	23.79	Total>	118.10	28.05m	341.96	31.13	31.13	18676	
15	23.40	Total>	125.73	30.02m	356.48	33.62	33.62	19251	
16	23.00	Total>	133.36	32.00m	371.00	71.96	71.96	19826	
17	22.50	Total>	143.01	34.50m	389.38	108.97	108.97	20554	
18	22.00	Total>	152.68	37.00m	407.77	132.73	132.73	21282	
19	21.50	Total>	158.27	39.50m	422.09	147.24	147.24	22010	
20	21.00	Total>	172.05	42.00m	444.59	156.36	156.36	22737	
21	20.50	Total>	181.75	44.50m	463.02	163.07	163.07	23465	
22	20.00	Total>	191.47	47.00m	481.46	169.33	169.33	24193	
23	19.50	Total>	201.20	49.50m	499.92	176.14	176.14	24921	
24	19.00	Total>	210.94	52.00m	518.39	183.83	183.83	25649	
25	18.50	Total>	220.70	54.50m	536.87	192.31	192.31	26377	
26	18.00	Total>	230.47	57.00m	555.36	201.30	201.30	27105	
27	17.70	Total>	236.34	58.50m	566.47	206.81	206.81	27541	
28	17.40	Total>	242.22	60.00m	577.58	212.35	212.35	27978	

Node no.	Y coord	RIGHT side						Total earth pressure kN/m2	Coeff. of subgrade reaction kN/m3
		Water press. kN/m2	Vertic -al kN/m2	Effective Active limit kN/m2	Effective Passive limit kN/m2	Earth pressure kN/m2			
1	29.40	0.00	0.00	0.00	0.00	0.00	0.00	0.0	
2	29.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0	
3	28.70	0.00	0.00	0.00	0.00	0.00	0.00	0.0	
4	28.40	0.00	0.00	0.00	0.00	0.00	0.00	0.0	
5	27.95	0.00	0.00	0.00	0.00	0.00	0.00	0.0	
6	27.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0	
7	27.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0	
8	26.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0	
9	26.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0	
10	25.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0	
11	25.10	0.00	0.00	0.00	0.00	0.00	0.00	0.0	
12	24.70	0.00	0.00	0.00	0.00	0.00	0.00	0.0	
13	24.29	0.00	0.00	0.00	0.00	0.00	0.00	0.0	
		Total>	0.00	0.00	215.10	0.00	0.00a	18184	
14	23.79	Total>	10.00	2.50m	233.83	6.49	6.49	18922	
		Total>	10.00	2.50m	233.83	230.31	230.31	18922	
15	23.40	Total>	17.90	4.47m	248.63	244.59	244.59	19504	
16	23.00	Total>	25.81	6.45m	263.43	179.75	179.75	20087	
17	22.50	Total>	35.83	8.95m	282.17	123.79	123.79	20824	
18	22.00	Total>	45.86	11.45m	300.93	100.04	100.04	21562	
19	21.50	Total>	55.91	13.95m	319.70	98.77	98.77	22299	
20	21.00	Total>	65.98	16.45m	338.50	110.60	110.60	23037	
21	20.50	Total>	76.08	18.95m	357.32	128.26	128.26	23774	
22	20.00	Total>	86.20	21.45m	376.17	147.02	147.02	24512	

Run ID. Camden\_High\_ 450mm\_S1\_ULS1  
 Camden High  
 Contiguous wall - S1 - ULS1

| Sheet No.  
 | Date:26-03-2021  
 | Checked :

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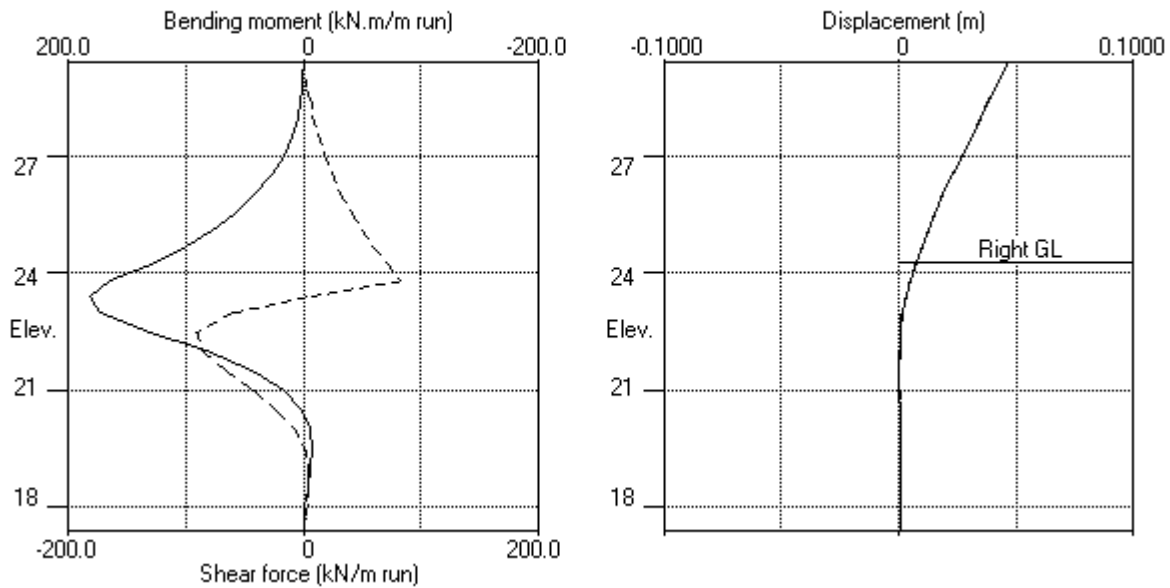
Stage No.3 Fill to elevation 24.29 on RIGHT side with soil type 2

Node no.	Y coord	----- RIGHT side -----						
		Water press. kN/m2	Vertic -al kN/m2	Effective Active limit kN/m2	Effective stresses Passive limit kN/m2	Earth pressure kN/m2	Total earth pressure kN/m2	Coeff. of subgrade reaction kN/m3
23	19.50	Total>	96.35	23.95m	395.04	164.46	164.46	25249
24	19.00	Total>	106.53	26.45m	413.94	179.80	179.80	25987
25	18.50	Total>	116.74	28.95m	432.88	193.27	193.27	26724
26	18.00	Total>	126.98	31.45m	451.85	205.55	205.55	27461
27	17.70	Total>	133.14	32.95m	463.25	212.67	212.67	27904
28	17.40	Total>	139.32	34.45m	474.66	219.73	219.73	28346

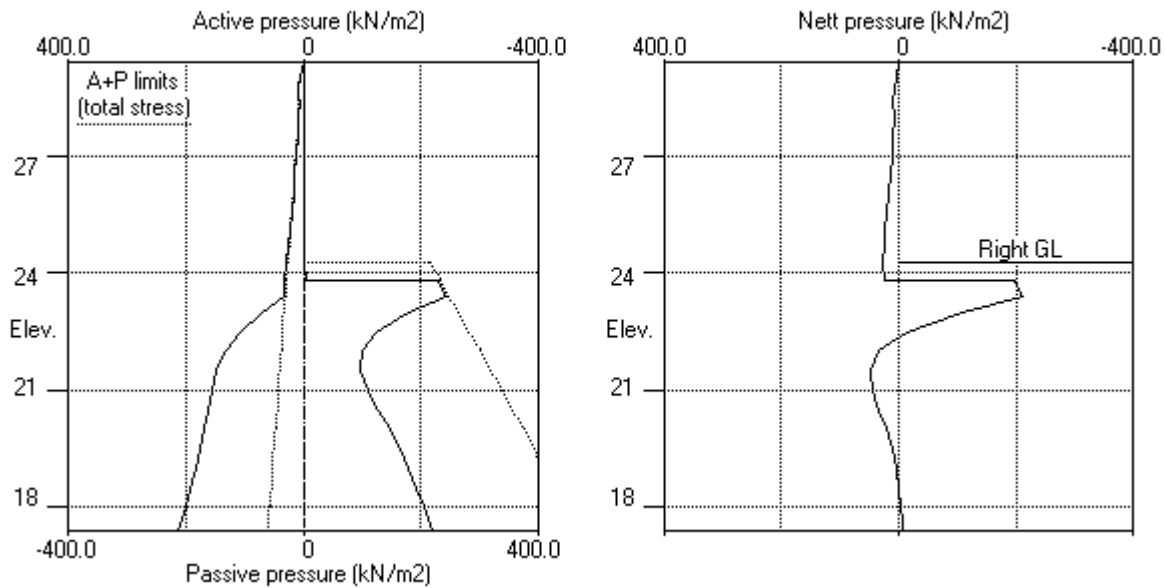
Note: 0.00a Soil pressure at active limit  
 123.45p Soil pressure at passive limit

Units: kN,m

Stage No.3 Fill to elev. 24.29 on RIGHT side



Stage No.3 Fill to elev. 24.29 on RIGHT side





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 Data filename/Run ID: Camden\_High\_ 450mm\_S1\_ULS1  
 Camden High  
 Contiguous wall - S1 - ULS1

| Sheet No.  
 | Job No. 41713A1  
 | Made by : SD  
 | Date:26-03-2021  
 | Checked :

Units: kN,m

Stage No. 6 Apply load no.1 at elevation 29.40

# **BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall**

## **Analysis options**

Length of wall perpendicular to section = 20.00m  
 Subgrade reaction model - Boussinesq Influence coefficients  
 Soil deformations are elastic until the active or passive limit is reached  
 Open Tension Crack analysis - No

Rigid boundaries: Left side 30.00 from wall  
 Right side 30.00 from wall

## **Limit State: ULS DAI Combination 1**

Calculated Bending Moments and Strut Forces are to be multiplied by a factor of 1.35 to obtain values for structural design. See summary for factored values.

Node no.	Y coord	Nett pressure kN/m2	Wall disp. m	Wall rotation rad.	Shear force kN/m	Bending moment kN.m/m	Strut forces kN/m	EI of wall kN.m2/m
1	29.40	0.00	0.047	8.64E-03	45.0	-0.0	-45.0	67000
2	29.00	4.84	0.044	8.58E-03	46.0	18.2	52.6	67000
		4.84	0.044	8.58E-03	-6.6	18.2		
3	28.70	7.89	0.041	8.51E-03	-4.7	16.4		67000
4	28.40	10.55	0.039	8.43E-03	-2.0	15.4		67000
		5.59	0.039	8.43E-03	-2.0	15.4		
5	27.95	8.96	0.035	8.33E-03	1.3	15.1		67000
6	27.50	11.78	0.031	8.22E-03	6.0	16.7		67000
7	27.00	14.40	0.027	8.08E-03	12.5	21.2		67000
8	26.50	16.62	0.023	7.89E-03	20.3	29.4		67000
9	26.00	18.60	0.019	7.63E-03	29.1	41.7		67000
10	25.50	21.11	0.015	7.26E-03	39.0	58.6		67000
11	25.10	23.18	0.013	6.85E-03	47.9	75.9		67000
12	24.70	25.36	0.010	6.34E-03	57.6	97.0	-3.5	67000
		25.36	0.010	6.34E-03	61.0	97.0		
13	24.29	27.74	0.007	5.66E-03	71.9	124.2		67000
		27.58	0.007	5.66E-03	71.9	124.2		
14	23.79	23.98	0.005	4.59E-03	84.8	163.3		67000
		-199.85	0.005	4.59E-03	84.8	163.3		
15	23.40	-211.70	0.003	3.57E-03	3.5	180.8		67000
16	23.00	-108.48	0.002	2.53E-03	-59.7	173.9		67000
17	22.50	-15.37	0.001	1.39E-03	-90.7	130.5		67000
18	22.00	32.31	0.001	6.00E-04	-86.4	83.2		67000
19	21.50	48.24	0.000	1.25E-04	-66.3	44.0		67000
20	21.00	45.64	0.000	-1.01E-04	-42.8	16.8		67000
21	20.50	34.78	0.000	-1.68E-04	-22.7	1.1		67000
22	20.00	22.32	0.001	-1.49E-04	-8.5	-5.9		67000
23	19.50	11.72	0.001	-1.00E-04	0.0	-7.4		67000
24	19.00	4.08	0.001	-5.04E-05	4.0	-5.9		67000
25	18.50	-0.92	0.001	-1.55E-05	4.8	-3.4		67000
26	18.00	-4.24	0.001	1.68E-06	3.5	-1.2		67000
27	17.70	-5.84	0.001	5.06E-06	2.0	-0.3		67000
28	17.40	-7.37	0.001	5.79E-06	0.0	0.0		---
At elev. 29.00 Strut force =				52.6 kN/strut =	52.6 kN/m run			
At elev. 24.70 Strut force =				-3.5 kN/strut =	-3.5 kN/m run			

(continued)

Stage No.6 Apply load no.1 at elevation 29.40

Node no.	Y coord	----- LEFT side -----						
		Water	Vertic	Effective	Passive	Earth	Total	Coeff. of
		press. kN/m2	-al kN/m2	limit kN/m2	limit kN/m2	pressure kN/m2	earth pressure kN/m2	subgrade reaction kN/m3
1	29.40	0.00	0.00	0.00	0.00	0.00	0.00	761
2	29.00	0.00	12.15	4.84	35.16	4.84	4.84a	4568
3	28.70	0.00	19.79	7.89	57.27	7.89	7.89a	7994
4	28.40	0.00	26.23	10.46	75.93	10.55	10.55	3092
		Total>	26.23	5.00m	169.64	5.59	5.59	19612
5	27.95	Total>	35.99	7.25m	187.24	8.96	8.96	20685
6	27.50	Total>	45.31	9.50m	204.42	11.78	11.78	21759
7	27.00	Total>	55.43	12.00m	223.26	14.40	14.40	22952
8	26.50	Total>	65.37	14.50m	241.94	16.62	16.62	24145
9	26.00	Total>	75.22	17.00m	260.50	18.60	18.60	25338
10	25.50	Total>	84.98	19.50m	278.99	21.11	21.11	26531
11	25.10	Total>	92.76	21.50m	293.75	23.18	23.18	27486
12	24.70	Total>	100.51	23.50m	308.48	25.36	25.36	28440
13	24.29	Total>	108.44	25.55m	323.57	27.74	27.74	30738
14	23.79	Total>	118.10	28.05m	341.96	30.80	30.80	31985
15	23.40	Total>	125.73	30.02m	356.48	33.25	33.25	32969
16	23.00	Total>	133.36	32.00m	371.00	71.62	71.62	33954
17	22.50	Total>	143.01	34.50m	389.38	108.69	108.69	35201
18	22.00	Total>	152.68	37.00m	407.77	132.54	132.54	36447
19	21.50	Total>	158.27	39.50m	422.09	147.13	147.13	37694
20	21.00	Total>	172.05	42.00m	444.59	156.30	156.30	38940
21	20.50	Total>	181.75	44.50m	463.02	163.05	163.05	40187
22	20.00	Total>	191.47	47.00m	481.46	169.34	169.34	44625
23	19.50	Total>	201.20	49.50m	499.92	176.16	176.16	45968
24	19.00	Total>	210.94	52.00m	518.39	183.85	183.85	47310
25	18.50	Total>	220.70	54.50m	536.87	192.33	192.33	48653
26	18.00	Total>	230.47	57.00m	555.36	201.31	201.31	49995
27	17.70	Total>	236.34	58.50m	566.47	206.81	206.81	50801
28	17.40	Total>	242.22	60.00m	577.58	212.35	212.35	51606

Node no.	Y coord	----- RIGHT side -----						
		----- Effective stresses -----					Total earth pressure kN/m2	Coeff. of subgrade reaction kN/m3
		Water press. kN/m2	Vertic -al kN/m2	Active limit kN/m2	Passive limit kN/m2	Earth pressure kN/m2		
1	29.40	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	29.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
3	28.70	0.00	0.00	0.00	0.00	0.00	0.00	0.0
4	28.40	0.00	0.00	0.00	0.00	0.00	0.00	0.0
5	27.95	0.00	0.00	0.00	0.00	0.00	0.00	0.0
6	27.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
7	27.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
8	26.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
9	26.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
10	25.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
11	25.10	0.00	0.00	0.00	0.00	0.00	0.00	0.0
12	24.70	0.00	0.00	0.00	0.00	0.00	0.00	0.0
13	24.29	0.00	0.00	0.00	0.00	0.00	0.00	0.0
		Total>	0.00	0.00	215.10	0.17	0.17	30738
14	23.79	Total>	10.00	2.50m	233.83	6.82	6.82	31985
		Total>	10.00	2.50m	233.83	230.65	230.65	31985
15	23.40	Total>	17.90	4.47m	248.63	244.95	244.95	32969
16	23.00	Total>	25.81	6.45m	263.43	180.09	180.09	33954
17	22.50	Total>	35.83	8.95m	282.17	124.07	124.07	35201

Run ID. Camden\_High\_ 450mm\_S1\_ULS1  
 Camden High  
 Contiguous wall - S1 - ULS1

| Sheet No.  
 | Date:26-03-2021  
 | Checked :

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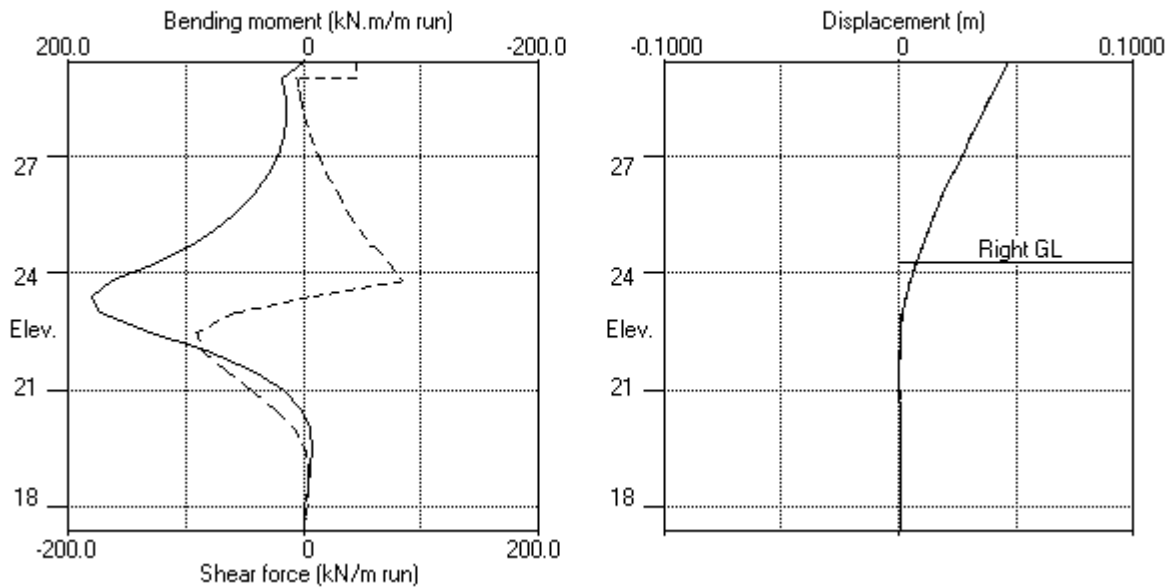
Stage No.6 Apply load no.1 at elevation 29.40

Node no.	Y coord	----- RIGHT side -----						
		Water press. kN/m2	Vertic -al kN/m2	Effective Active limit kN/m2	Effective Passive limit kN/m2	Earth pressure kN/m2	Total earth pressure kN/m2	Coeff. of subgrade reaction kN/m3
18	22.00	Total>	45.86	11.45m	300.93	100.23	100.23	36447
19	21.50	Total>	55.91	13.95m	319.70	98.89	98.89	37694
20	21.00	Total>	65.98	16.45m	338.50	110.66	110.66	38940
21	20.50	Total>	76.08	18.95m	357.32	128.28	128.28	40187
22	20.00	Total>	86.20	21.45m	376.17	147.02	147.02	44625
23	19.50	Total>	96.35	23.95m	395.04	164.44	164.44	45968
24	19.00	Total>	106.53	26.45m	413.94	179.78	179.78	47310
25	18.50	Total>	116.74	28.95m	432.88	193.25	193.25	48653
26	18.00	Total>	126.98	31.45m	451.85	205.54	205.54	49995
27	17.70	Total>	133.14	32.95m	463.25	212.66	212.66	50801
28	17.40	Total>	139.32	34.45m	474.66	219.72	219.72	51606

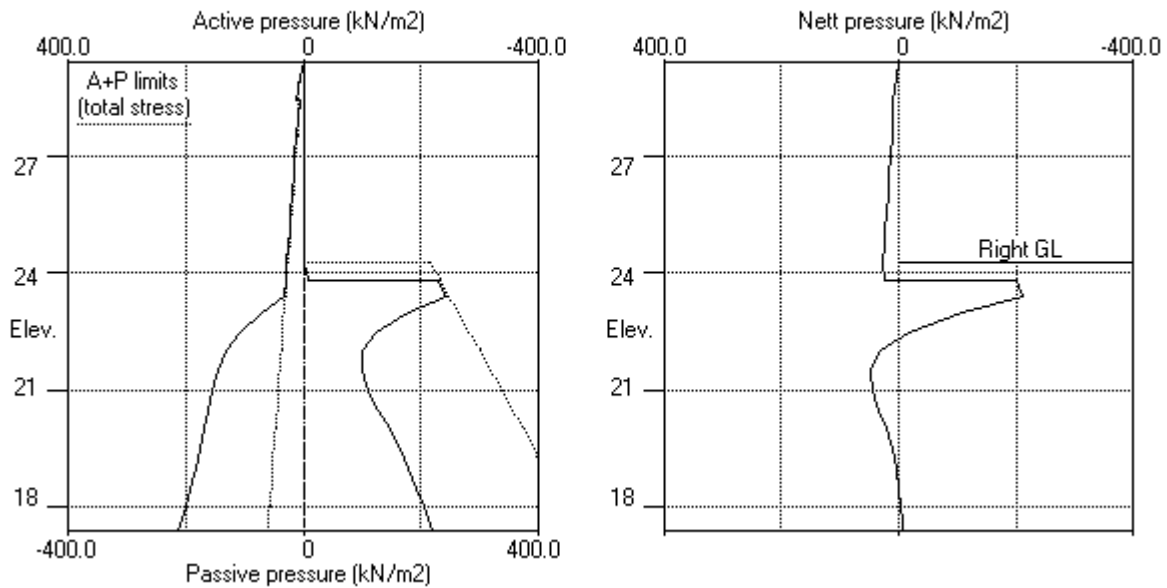
Note: 7.89a Soil pressure at active limit  
 123.45p Soil pressure at passive limit

Units: kN,m

Stage No.6 Apply load no.1 at elev. 29.40



Stage No.6 Apply load no.1 at elev. 29.40



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Camden High  
Contiguous wall - S1 - ULS1

| Sheet No.  
| Job No. 41713A1  
| Made by : SD  
| Date:26-03-2021  
| Checked :

Units: kN,m

Stage No. 7 Change properties of soil type 2 to soil type 3  
Ko pressures will not be reset

# **BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall**

## **Analysis options**

Length of wall perpendicular to section = 20.00m  
Subgrade reaction model - Boussinesq Influence coefficients  
Soil deformations are elastic until the active or passive limit is reached  
Open Tension Crack analysis - No

Rigid boundaries: Left side 30.00 from wall  
Right side 30.00 from wall

## **Limit State: ULS DA1 Combination 1**

Calculated Bending Moments and Strut Forces are to be multiplied by a factor of 1.35 to obtain values for structural design. See summary for factored values.

Node no.	Y coord	Nett pressure kN/m2	Wall disp. m	Wall rotation rad.	Shear force kN/m	Bending moment kN.m/m	Strut forces kN/m	EI of wall kN.m2/m
1	29.40	0.00	0.047	8.83E-03	45.0	-0.0	-45.0	67000
2	29.00	4.85	0.044	8.78E-03	46.0	18.2	51.3	67000
		4.85	0.044	8.78E-03	-5.4	18.2		
3	28.70	8.01	0.041	8.70E-03	-3.4	16.8		67000
4	28.40	10.89	0.038	8.62E-03	-0.6	16.2		67000
		10.46	0.038	8.62E-03	-0.6	16.2		
5	27.95	14.34	0.035	8.51E-03	5.0	17.0		67000
6	27.50	18.06	0.031	8.38E-03	12.3	20.8		67000
7	27.00	22.09	0.027	8.20E-03	22.3	29.4		67000
8	26.50	26.06	0.023	7.93E-03	34.3	43.4		67000
9	26.00	29.98	0.019	7.53E-03	48.4	64.0		67000
10	25.50	33.87	0.015	6.94E-03	64.3	92.1		67000
11	25.10	36.97	0.012	6.31E-03	78.5	120.6		67000
12	24.70	40.06	0.010	5.48E-03	93.9	155.0	154.8	67000
		40.06	0.010	5.48E-03	-60.9	155.0		
13	24.29	43.22	0.008	4.60E-03	-43.8	133.5		67000
14	23.79	24.57	0.006	3.67E-03	-26.9	116.7		67000
		19.69	0.006	3.67E-03	-26.9	116.7		
15	23.40	1.09	0.005	3.01E-03	-22.8	107.1		67000
16	23.00	-17.52	0.004	2.39E-03	-26.0	103.2		67000
17	22.50	-12.85	0.003	1.68E-03	-33.6	85.3		67000
18	22.00	-9.25	0.002	1.12E-03	-39.1	65.8		67000
19	21.50	14.88	0.001	7.12E-04	-37.7	45.1		67000
20	21.00	21.16	0.001	4.39E-04	-28.7	28.1		67000
21	20.50	18.44	0.001	2.73E-04	-18.8	16.3		67000
22	20.00	12.65	0.001	1.78E-04	-11.0	9.2		67000
23	19.50	7.03	0.001	1.24E-04	-6.1	5.3		67000
24	19.00	2.85	0.001	9.29E-05	-3.6	3.1		67000
25	18.50	1.62	0.001	7.54E-05	-2.5	1.6		67000
26	18.00	2.19	0.001	6.75E-05	-1.6	0.5		67000
27	17.70	2.60	0.001	6.60E-05	-0.9	0.1		67000
28	17.40	3.08	0.001	6.57E-05	0.0	0.0		---
At elev. 29.00 Strut force =				51.3 kN/strut =	51.3 kN/m run			
At elev. 24.70 Strut force =				154.8 kN/strut =	154.8 kN/m run			

(continued)

Stage No.7 Change properties of soil type 2 to soil type 3  
Ko pressures will not be reset

Node no.	Y coord	LEFT side						Coeff. of subgrade reaction
		Water press. kN/m2	Vertic -al kN/m2	Effective Active limit kN/m2	Effective Passive limit kN/m2	Earth pressure kN/m2	Total earth pressure kN/m2	
1	29.40	0.00	0.00	0.00	0.00	0.00	0.00	1222
2	29.00	0.00	12.15	4.84	35.16	4.85	4.85a	1166
3	28.70	0.00	19.79	7.89	57.27	8.01	8.01	2040
4	28.40	0.00	26.23	10.46	75.93	10.89	10.89	2914
		0.00	26.23	10.46	71.83	10.46	10.46a	9836
5	27.95	0.00	35.99	14.34	98.53	14.34	14.34a	10374
6	27.50	0.00	45.31	18.06	124.06	18.06	18.06a	10913
7	27.00	0.00	55.43	22.09	151.75	22.09	22.09a	11511
8	26.50	0.00	65.37	26.06	178.99	26.06	26.06a	12109
9	26.00	0.00	75.22	29.98	205.93	29.98	29.98a	12708
10	25.50	0.00	84.98	33.87	232.67	33.87	33.87a	13306
11	25.10	0.00	92.76	36.97	253.96	36.97	36.97a	13784
12	24.70	0.00	100.51	40.06	275.19	40.06	40.06a	13370
13	24.29	0.00	108.44	43.22	296.90	43.22	43.22a	13830
14	23.79	0.00	118.10	47.07	323.35	47.07	47.07a	14391
15	23.40	0.00	125.73	50.11	344.23	50.11	50.11a	14834
16	23.00	0.00	133.36	53.15	365.11	53.15	53.15a	15277
17	22.50	0.00	143.01	57.00	391.56	85.25	85.25	15838
18	22.00	0.00	152.68	60.85	418.02	111.76	111.76	16399
19	21.50	0.00	162.36	64.71	444.52	130.45	130.45	16959
20	21.00	0.00	172.05	68.57	471.05	144.06	144.06	17520
21	20.50	0.00	181.75	72.44	497.61	154.88	154.88	18081
22	20.00	0.00	191.47	76.31	524.21	164.50	164.50	18642
23	19.50	5.00	196.20	78.20	537.17	168.82	173.82	19203
24	19.00	10.00	200.94	80.09	550.16	173.24	183.24	19764
25	18.50	15.00	205.70	81.99	563.19	178.60	193.60	48565
26	18.00	20.00	210.47	83.89	576.25	184.52	204.52	49905
27	17.70	23.00	213.34	85.03	584.11	188.04	211.04	50709
28	17.40	26.00	216.22	86.18	591.97	191.57	217.57	51513

Node no.	Y coord	RIGHT side						Coeff. of subgrade reaction
		Water press. kN/m2	Vertic -al kN/m2	Effective Active limit kN/m2	Effective Passive limit kN/m2	Earth pressure kN/m2	Total earth pressure kN/m2	
1	29.40	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	29.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
3	28.70	0.00	0.00	0.00	0.00	0.00	0.00	0.0
4	28.40	0.00	0.00	0.00	0.00	0.00	0.00	0.0
5	27.95	0.00	0.00	0.00	0.00	0.00	0.00	0.0
6	27.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
7	27.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
8	26.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
9	26.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
10	25.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
11	25.10	0.00	0.00	0.00	0.00	0.00	0.00	0.0
12	24.70	0.00	0.00	0.00	0.00	0.00	0.00	0.0
13	24.29	0.00	0.00	0.00	0.00	0.00	0.00	0.0
		0.00	0.00	0.00	0.00	0.00	0.00	13830
14	23.79	0.00	10.00	3.99	27.38	22.50	22.50	14391
		0.00	10.00	3.99	27.38	27.38	27.38p	14391
15	23.40	0.00	17.90	7.14	49.02	49.02	49.02p	14834
16	23.00	0.00	25.81	10.29	70.67	70.67	70.67p	15277

Run ID. Camden\_High\_ 450mm\_S1\_ULS1  
 Camden High  
 Contiguous wall - S1 - ULS1

| Sheet No.  
 | Date:26-03-2021  
 | Checked :

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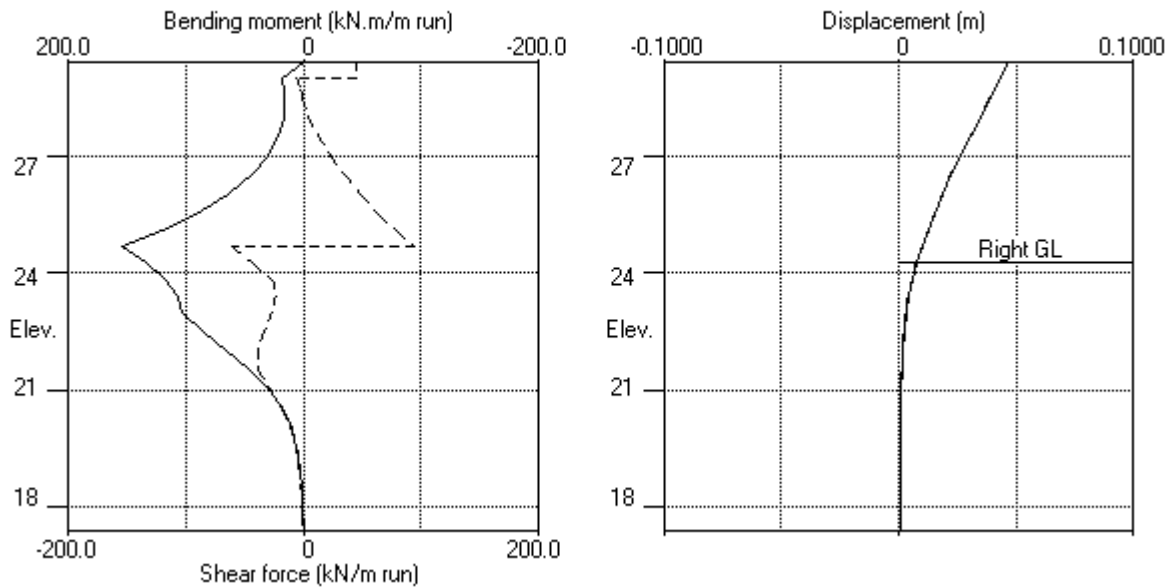
Stage No.7 Change properties of soil type 2 to soil type 3  
 Ko pressures will not be reset

Node no.	Y coord	----- RIGHT side -----						
		Water press. kN/m2	----- Vertic -al kN/m2	Effective Active limit kN/m2	Effective stresses Passive limit kN/m2	Earth pressure kN/m2	Total earth pressure kN/m2	Coeff. of subgrade reaction kN/m3
17	22.50	0.00	35.83	14.28	98.10	98.10	98.10p	15838
18	22.00	0.00	45.86	18.28	125.57	121.01	121.01	16399
19	21.50	0.00	55.91	22.29	153.08	115.56	115.56	16959
20	21.00	0.00	65.98	26.30	180.65	122.90	122.90	17520
21	20.50	0.00	76.08	30.32	208.29	136.45	136.45	18081
22	20.00	0.00	86.20	34.36	236.00	151.85	151.85	18642
23	19.50	5.00	91.35	36.41	250.10	161.78	166.78	19203
24	19.00	10.00	96.53	38.47	264.28	170.39	180.39	19764
25	18.50	15.00	101.74	40.55	278.54	176.98	191.98	48565
26	18.00	20.00	106.98	42.64	292.90	182.33	202.33	49905
27	17.70	23.00	110.14	43.90	301.56	185.43	208.43	50709
28	17.40	26.00	113.32	45.17	310.25	188.50	214.50	51513

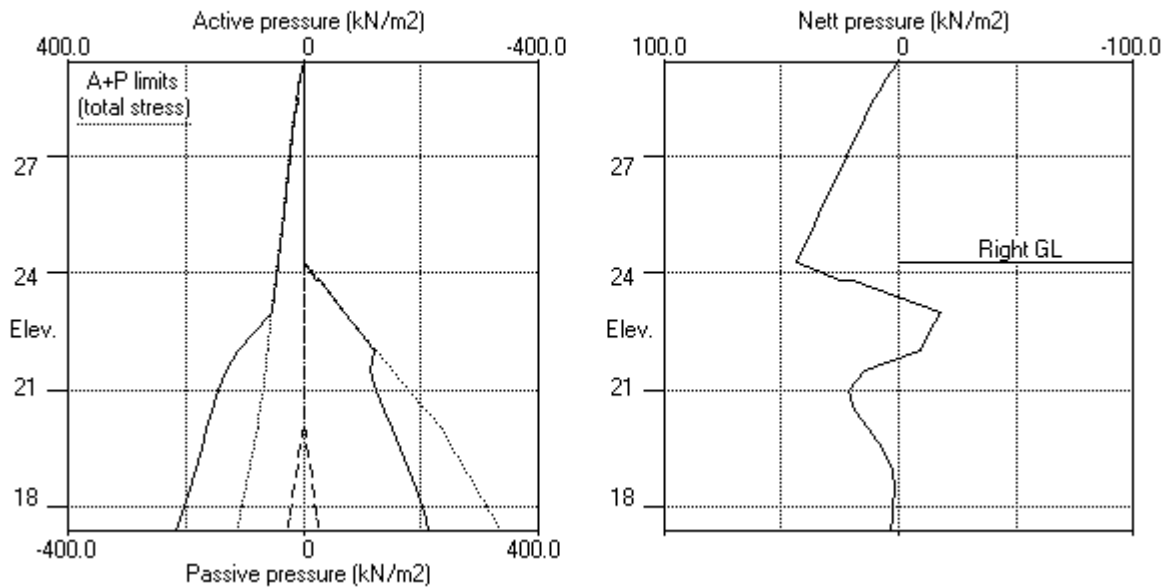
Note: 53.15a Soil pressure at active limit  
 98.10p Soil pressure at passive limit

Units: kN,m

Stage No.7 Change soil type 2 to soil type 3



Stage No.7 Change soil type 2 to soil type 3





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Data filename/Run ID: Camden\_High\_ 450mm\_S1\_ULS1  
Camden High  
Contiguous wall - S1 - ULS1

| Sheet No.  
| Job No. 41713A1  
| Made by : SD  
| Date:26-03-2021  
| Checked :

Units: kN,m

Stage No. 8 Change EI of wall to 46900 kN.m2/m run  
Yield moment not defined  
Allow wall to relax with new modulus value

# **BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall**

## **Analysis options**

Length of wall perpendicular to section = 20.00m  
Subgrade reaction model - Boussinesq Influence coefficients  
Soil deformations are elastic until the active or passive limit is reached  
Open Tension Crack analysis - No

Rigid boundaries: Left side 30.00 from wall  
Right side 30.00 from wall

## **Limit State: ULS DA1 Combination 1**

Calculated Bending Moments and Strut Forces are to be multiplied by a factor of 1.35 to obtain values for structural design. See summary for factored values.

Node no.	Y coord	Nett pressure kN/m2	Wall disp. m	Wall rotation rad.	Shear force kN/m	Bending moment kN.m/m	Strut forces kN/m	EI of wall kN.m2/m
1	29.40	0.00	0.047	8.72E-03	45.0	-0.0	-45.0	46900
2	29.00	4.84	0.044	8.64E-03	46.0	18.2	59.7	46900
		4.84	0.044	8.64E-03	-13.8	18.2		
3	28.70	7.89	0.041	8.54E-03	-11.8	14.9		46900
4	28.40	10.57	0.039	8.46E-03	-9.1	12.3		46900
		10.46	0.039	8.46E-03	-9.1	12.3		
5	27.95	14.34	0.035	8.36E-03	-3.5	10.2		46900
6	27.50	18.06	0.031	8.29E-03	3.8	11.1		46900
7	27.00	22.09	0.027	8.18E-03	13.8	16.3		46900
8	26.50	26.06	0.023	7.99E-03	25.9	27.2		46900
9	26.00	29.98	0.019	7.67E-03	39.9	44.5		46900
10	25.50	33.87	0.015	7.13E-03	55.8	69.3		46900
11	25.10	36.97	0.012	6.49E-03	70.0	95.2		46900
12	24.70	40.30	0.010	5.61E-03	85.5	127.0	142.2	46900
		40.30	0.010	5.61E-03	-56.7	127.0		
13	24.29	44.08	0.008	4.66E-03	-39.4	106.8		46900
14	23.79	27.01	0.006	3.68E-03	-21.6	91.8		46900
		22.13	0.006	3.68E-03	-21.6	91.8		
15	23.40	3.65	0.005	3.00E-03	-16.5	84.0		46900
16	23.00	-15.15	0.003	2.36E-03	-18.8	82.1		46900
17	22.50	-11.34	0.002	1.63E-03	-25.4	67.2		46900
18	22.00	-9.11	0.002	1.05E-03	-30.6	51.0		46900
19	21.50	13.78	0.001	6.45E-04	-29.4	33.5		46900
20	21.00	19.02	0.001	3.94E-04	-21.2	19.6		46900
21	20.50	15.66	0.001	2.56E-04	-12.5	10.6		46900
22	20.00	9.70	0.001	1.84E-04	-6.2	5.6		46900
23	19.50	4.29	0.001	1.46E-04	-2.7	3.3		46900
24	19.00	0.55	0.001	1.22E-04	-1.5	2.1		46900
25	18.50	-0.11	0.001	1.06E-04	-1.4	1.2		46900
26	18.00	1.07	0.001	9.86E-05	-1.1	0.4		46900
27	17.70	1.86	0.001	9.68E-05	-0.7	0.1		46900
28	17.40	2.72	0.001	9.64E-05	0.0	0.0		---
At elev. 29.00 Strut force =				59.7 kN/strut =	59.7 kN/m run			
At elev. 24.70 Strut force =				142.2 kN/strut =	142.2 kN/m run			

(continued)

Stage No.8 Change EI of wall to 46900 kN.m2/m run  
 Yield moment not defined  
 Allow wall to relax with new modulus value

Node no.	Y coord	----- LEFT side -----						Total earth pressure kN/m2	Coeff. of subgrade reaction kN/m3
		Water press. kN/m2	Vertic -al kN/m2	Effective Active limit kN/m2	Effective Passive limit kN/m2	Earth pressure kN/m2			
1	29.40	0.00	0.00	0.00	0.00	0.00	0.00	1685	
2	29.00	0.00	12.15	4.84	35.16	4.84	4.84a	1165	
3	28.70	0.00	19.79	7.89	57.27	7.89	7.89a	2039	
4	28.40	0.00	26.23	10.46	75.93	10.57	10.57	2913	
		0.00	26.23	10.46	71.83	10.46	10.46a	9833	
5	27.95	0.00	35.99	14.34	98.53	14.34	14.34a	10371	
6	27.50	0.00	45.31	18.06	124.06	18.06	18.06a	10909	
7	27.00	0.00	55.43	22.09	151.75	22.09	22.09a	11507	
8	26.50	0.00	65.37	26.06	178.99	26.06	26.06a	12106	
9	26.00	0.00	75.22	29.98	205.93	29.98	29.98a	12704	
10	25.50	0.00	84.98	33.87	232.67	33.87	33.87a	13302	
11	25.10	0.00	92.76	36.97	253.96	36.97	36.97a	13780	
12	24.70	0.00	100.51	40.06	275.19	40.30	40.30	16797	
13	24.29	0.00	108.44	43.22	296.90	44.08	44.08	17375	
14	23.79	0.00	118.10	47.07	323.35	48.25	48.25	18080	
15	23.40	0.00	125.73	50.11	344.23	51.35	51.35	18636	
16	23.00	0.00	133.36	53.15	365.11	54.30	54.30	19193	
17	22.50	0.00	143.01	57.00	391.56	85.98	85.98	19898	
18	22.00	0.00	152.68	60.85	418.02	111.83	111.83	20602	
19	21.50	0.00	162.36	64.71	444.52	129.90	129.90	17044	
20	21.00	0.00	172.05	68.57	471.05	142.99	142.99	17608	
21	20.50	0.00	181.75	72.44	497.61	153.50	153.50	18171	
22	20.00	0.00	191.47	76.31	524.21	163.03	163.03	18735	
23	19.50	5.00	196.20	78.20	537.17	167.44	172.44	19298	
24	19.00	10.00	200.94	80.09	550.16	172.09	182.09	19862	
25	18.50	15.00	205.70	81.99	563.19	177.73	192.73	20426	
26	18.00	20.00	210.47	83.89	576.25	183.96	203.96	20989	
27	17.70	23.00	213.34	85.03	584.11	187.66	210.66	21328	
28	17.40	26.00	216.22	86.18	591.97	191.39	217.39	21666	

Node no.	Y coord	----- RIGHT side -----						
		Water	Vertic	Effective	Passive	Earth	Total	Coeff. of
		press. kN/m2	-al kN/m2	Active limit kN/m2	limit kN/m2	pressure kN/m2	earth pressure kN/m2	subgrade reaction kN/m3
1	29.40	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	29.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
3	28.70	0.00	0.00	0.00	0.00	0.00	0.00	0.0
4	28.40	0.00	0.00	0.00	0.00	0.00	0.00	0.0
5	27.95	0.00	0.00	0.00	0.00	0.00	0.00	0.0
6	27.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
7	27.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
8	26.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
9	26.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
10	25.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
11	25.10	0.00	0.00	0.00	0.00	0.00	0.00	0.0
12	24.70	0.00	0.00	0.00	0.00	0.00	0.00	0.0
13	24.29	0.00	0.00	0.00	0.00	0.00	0.00	0.0
		0.00	0.00	0.00	0.00	0.00	0.00	18438
14	23.79	0.00	10.00	3.99	27.38	21.25	21.25	19186
		0.00	10.00	3.99	27.38	26.13	26.13	19186
15	23.40	0.00	17.90	7.14	49.02	47.70	47.70	19777

Run ID. Camden\_High\_ 450mm\_S1\_ULS1  
 Camden High  
 Contiguous wall - S1 - ULS1

| Sheet No.  
 | Date:26-03-2021  
 | Checked :

(continued)

Stage No.8      Change EI of wall to 46900 kN.m2/m run  
                  Yield moment not defined  
                  Allow wall to relax with new modulus value

Node no.	Y coord	----- RIGHT side -----						
		----- Effective stresses -----					Total earth pressure kN/m2	Coeff. of subgrade reaction kN/m3
		Water	Vertic	Active	Passive	Earth		
		press. kN/m2	-al kN/m2	limit kN/m2	limit kN/m2	pressure kN/m2		
16	23.00	0.00	25.81	10.29	70.67	69.45	69.45	20367
17	22.50	0.00	35.83	14.28	98.10	97.32	97.32	21115
18	22.00	0.00	45.86	18.28	125.57	120.94	120.94	21863
19	21.50	0.00	55.91	22.29	153.08	116.11	116.11	17044
20	21.00	0.00	65.98	26.30	180.65	123.97	123.97	17608
21	20.50	0.00	76.08	30.32	208.29	137.83	137.83	18171
22	20.00	0.00	86.20	34.36	236.00	153.33	153.33	18735
23	19.50	5.00	91.35	36.41	250.10	163.16	168.16	19298
24	19.00	10.00	96.53	38.47	264.28	171.54	181.54	19862
25	18.50	15.00	101.74	40.55	278.54	177.84	192.84	20426
26	18.00	20.00	106.98	42.64	292.90	182.89	202.89	20989
27	17.70	23.00	110.14	43.90	301.56	185.81	208.81	21328
28	17.40	26.00	113.32	45.17	310.25	188.68	214.68	21666

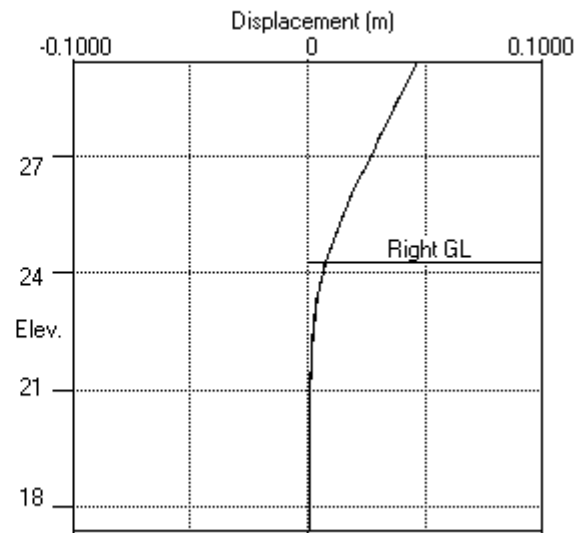
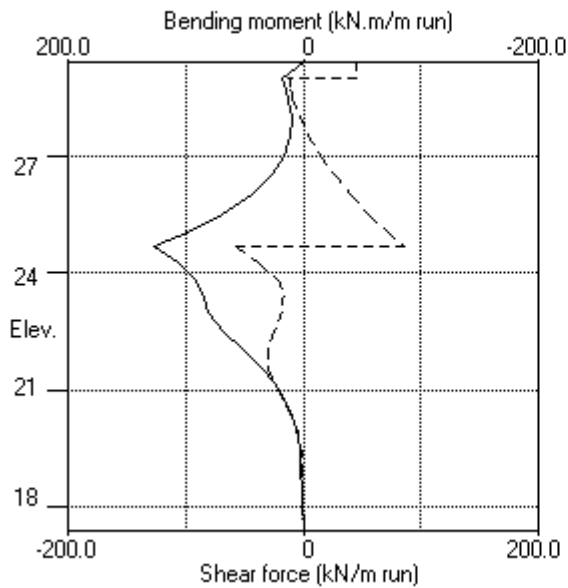
Note:          36.97a    Soil pressure at active limit  
                  123.45p    Soil pressure at passive limit

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 Camden High  
 Contiguous wall - S1 - ULS1

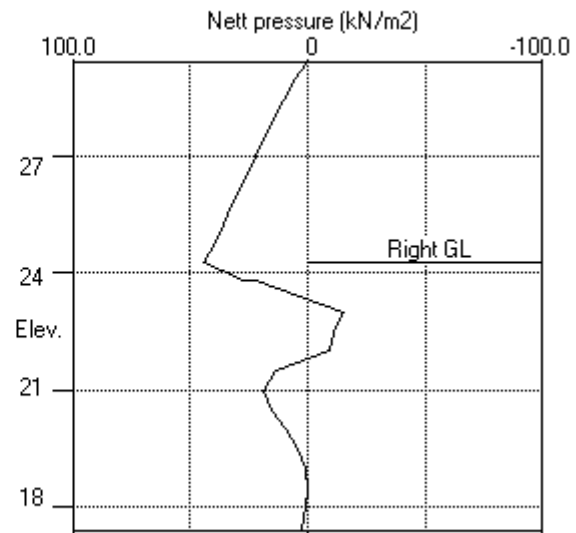
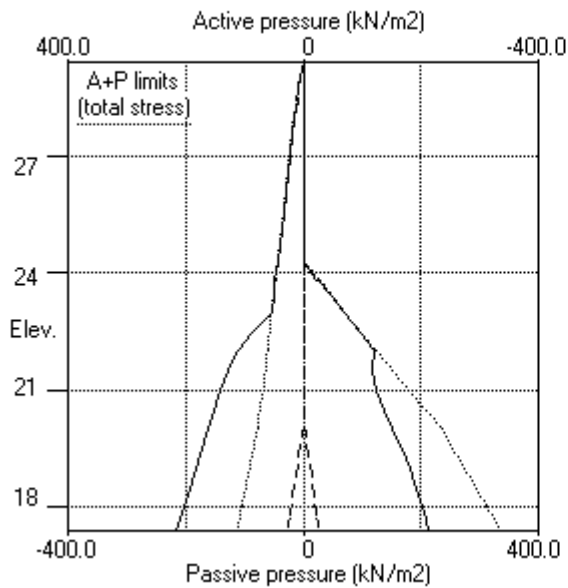
| Sheet No.  
 | Job No. 41713A1  
 | Made by : SD  
 | Date:26-03-2021  
 | Checked :

Units: kN,m

Stage No.8 Change EI of wall to 46900kN.m<sup>2</sup>/m run



Stage No.8 Change EI of wall to 46900kN.m<sup>2</sup>/m run



| Checked :

Node no.	Y coord	Nett pressure kN/m <sup>2</sup>	Wall disp. m	Wall rotation rad.	Shear force kN/m	Bending moment kN.m/m	Strut forces kN/m	EI of wall kN.m <sup>2</sup> /m
1	29.40	0.00	0.047	8.83E-03	45.0	-0.0	-45.0	46900
2	29.00	4.84	0.044	8.75E-03	46.0	18.2	61.2	46900
		4.84	0.044	8.75E-03	-15.2	18.2		
3	28.70	7.95	0.041	8.65E-03	-13.3	14.4		46900
4	28.40	10.77	0.038	8.57E-03	-10.5	11.4		46900
		11.13	0.038	8.57E-03	-10.5	11.4		
5	27.95	18.14	0.035	8.49E-03	-3.9	8.9		46900
6	27.50	25.10	0.031	8.42E-03	5.8	10.0		46900
7	27.00	32.86	0.027	8.32E-03	20.3	17.2		46900
8	26.50	40.56	0.023	8.10E-03	38.6	32.7		46900
9	26.00	47.85	0.019	7.67E-03	60.7	58.4		46900
10	25.50	54.04	0.015	6.91E-03	86.2	96.0		46900
11	25.10	57.45	0.012	5.99E-03	108.5	135.7		46900
12	24.70	59.49	0.010	4.69E-03	131.9	184.6	253.5	46900
		59.49	0.010	4.69E-03	-121.6	184.6		
13	24.29	61.39	0.009	3.34E-03	-96.8	139.4		46900
14	23.79	40.07	0.007	2.16E-03	-71.4	97.6		46900
15	23.40	31.90	0.006	1.51E-03	-57.2	71.8		46900
16	23.00	23.72	0.006	1.03E-03	-46.2	56.3		46900
17	22.50	13.55	0.006	6.15E-04	-36.9	33.4		46900
18	22.00	19.48	0.005	4.10E-04	-28.7	15.0		46900
19	21.50	19.54	0.005	3.65E-04	-18.9	1.3		46900
20	21.00	16.55	0.005	4.27E-04	-9.9	-6.9		46900
21	20.50	12.72	0.005	5.42E-04	-2.6	-10.6		46900
22	20.00	9.43	0.004	6.72E-04	3.0	-10.9		46900
23	19.50	3.60	0.004	7.86E-04	6.2	-8.8		46900
24	19.00	-0.93	0.004	8.68E-04	6.9	-5.8		46900
25	18.50	-3.63	0.003	9.17E-04	5.8	-2.9		46900
26	18.00	-5.18	0.003	9.38E-04	3.6	-0.9		46900
27	17.70	-5.95	0.002	9.42E-04	1.9	-0.2		46900
28	17.40	-6.59	0.002	9.43E-04	0.0	-0.0		---
At elev. 29.00 Strut force =				61.2 kN/strut =	61.2 kN/m run			
At elev. 24.70 Strut force =				253.5 kN/strut =	253.5 kN/m run			

(continued)

Stage No.9 Apply water pressure profile no.1 ( Mod. Conserv. )

Node no.	Y coord	LEFT side						
		Effective stresses					Total earth pressure kN/m2	Coeff. of subgrade reaction kN/m3
		Water press. kN/m2	Vertic -al kN/m2	Active limit kN/m2	Passive limit kN/m2	Earth pressure kN/m2		
1	29.40	0.00	0.00	0.00	0.00	0.00	0.00	1128
2	29.00	0.00	12.15	4.84	35.16	4.84	4.84a	6770
3	28.70	0.00	19.79	7.89	57.27	7.95	7.95	2172
4	28.40	0.00	26.23	10.46	75.93	10.77	10.77	3103
		0.00	26.23	10.46	71.83	11.13	11.13	10472
5	27.95	3.31	32.68	13.03	89.47	14.83	18.14	11045
6	27.50	6.61	38.70	15.42	105.96	18.48	25.10	11619
7	27.00	10.29	45.14	17.99	123.58	22.57	32.86	12256
8	26.50	13.96	51.41	20.49	140.76	26.59	40.56	12893
9	26.00	17.64	57.58	22.95	157.64	30.21	47.85	13530
10	25.50	21.31	63.67	25.38	174.32	32.72	54.04	14167
11	25.10	24.25	68.51	27.30	187.56	33.19	57.45	14676
12	24.70	27.19	73.32	29.22	200.74	32.30	59.49	9712
13	24.29	30.20	78.24	31.18	214.20	31.18	61.39a	10047
14	23.79	33.88	84.22	33.57	230.59	33.57	67.45a	10454
15	23.40	36.78	88.95	35.45	243.53	35.45	72.23a	10776
16	23.00	39.68	93.67	37.33	256.46	37.33	77.02a	11098
17	22.50	43.36	99.65	39.72	272.84	39.93	83.29	11505
18	22.00	47.03	105.65	42.11	289.25	58.66	105.69	11913
19	21.50	50.71	111.65	44.50	305.68	71.57	122.28	12320
20	21.00	54.38	117.66	46.90	322.15	81.48	135.86	12727
21	20.50	58.06	123.69	49.30	338.66	90.62	148.67	13135
22	20.00	61.73	129.73	51.71	355.20	100.37	162.11	13542
23	19.50	65.41	135.79	54.12	371.78	107.66	173.07	13950
24	19.00	69.08	141.86	56.54	388.40	116.33	185.41	14357
25	18.50	72.76	147.95	58.97	405.06	126.92	199.67	14764
26	18.00	76.43	154.04	61.40	421.75	138.75	215.18	15172
27	17.70	78.63	157.71	62.86	431.78	146.05	224.69	15416
28	17.40	80.84	161.38	64.32	441.83	153.52	234.36	15661

Node no.	Y coord	RIGHT side						
		Effective stresses					Total earth pressure kN/m2	Coeff. of subgrade reaction kN/m3
		Water press. kN/m2	Vertic -al kN/m2	Active limit kN/m2	Passive limit kN/m2	Earth pressure kN/m2		
1	29.40	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	29.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
3	28.70	0.00	0.00	0.00	0.00	0.00	0.00	0.0
4	28.40	0.00	0.00	0.00	0.00	0.00	0.00	0.0
5	27.95	0.00	0.00	0.00	0.00	0.00	0.00	0.0
6	27.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
7	27.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
8	26.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
9	26.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
10	25.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
11	25.10	0.00	0.00	0.00	0.00	0.00	0.00	0.0
12	24.70	0.00	0.00	0.00	0.00	0.00	0.00	0.0
13	24.29	0.00	0.00	0.00	0.00	0.00	0.00	0.0
		0.00	0.00	0.00	0.00	0.00	0.00	10047
14	23.79	0.00	10.00	3.99	27.38	27.38	27.38p	10454
15	23.40	5.00	12.91	5.14	35.34	35.34	40.33p	10776
16	23.00	9.99	15.82	6.30	43.31	43.31	53.30p	11098
17	22.50	16.32	19.51	7.78	53.42	53.42	69.74p	11505
18	22.00	22.65	23.22	9.25	63.57	63.57	86.21p	11913

Run ID. Camden\_High\_ 450mm\_S1\_ULS1  
 Camden High  
 Contiguous wall - S1 - ULS1

| Sheet No.  
 | Date:26-03-2021  
 | Checked :

(continued)

Stage No.9 Apply water pressure profile no.1 ( Mod. Conserv. )

Node no.	Y coord	----- RIGHT side -----						
		----- Effective stresses -----					Total earth pressure	Coeff. of subgrade reaction
		Water press. kN/m2	Vertic -al kN/m2	Active limit kN/m2	Passive limit kN/m2	Earth pressure kN/m2		
19	21.50	28.97	26.94	10.74	73.76	73.76	102.74p	12320
20	21.00	35.30	30.69	12.23	84.02	84.02	119.31p	12727
21	20.50	41.62	34.46	13.73	94.34	94.34	135.96p	13135
22	20.00	47.95	38.25	15.25	104.73	104.73	152.67p	13542
23	19.50	54.27	42.07	16.77	115.19	115.19	169.47p	13950
24	19.00	60.60	45.93	18.31	125.74	125.74	186.34p	14357
25	18.50	66.92	49.81	19.85	136.38	136.38	203.31p	14764
26	18.00	73.25	53.73	21.42	147.11	147.11	220.36p	15172
27	17.70	77.04	56.10	22.36	153.59	153.59	230.64p	15416
28	17.40	80.84	58.48	23.31	160.11	160.11	240.95p	15661

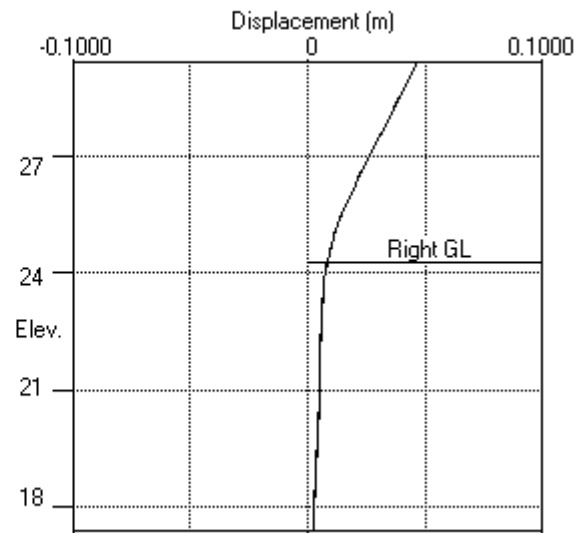
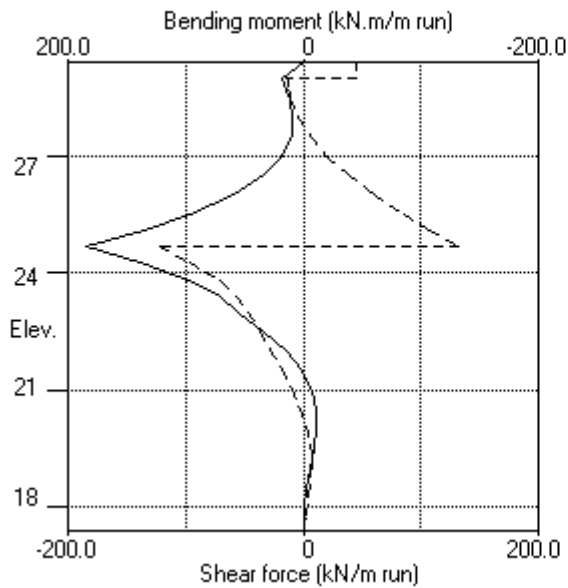
Note: 77.02a Soil pressure at active limit  
 240.95p Soil pressure at passive limit

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 Contiguous wall - S1 - ULS1

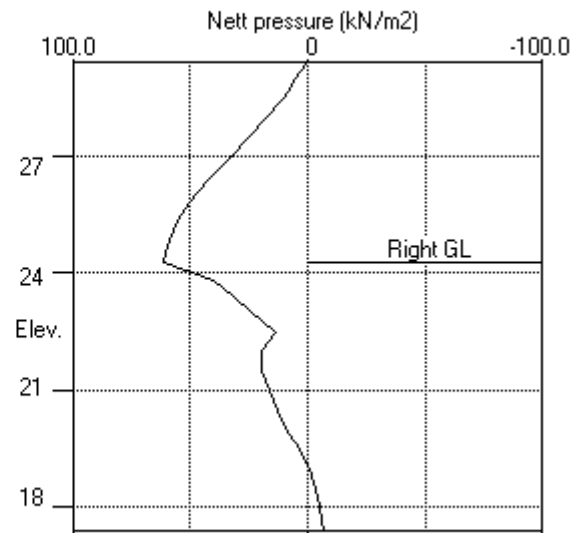
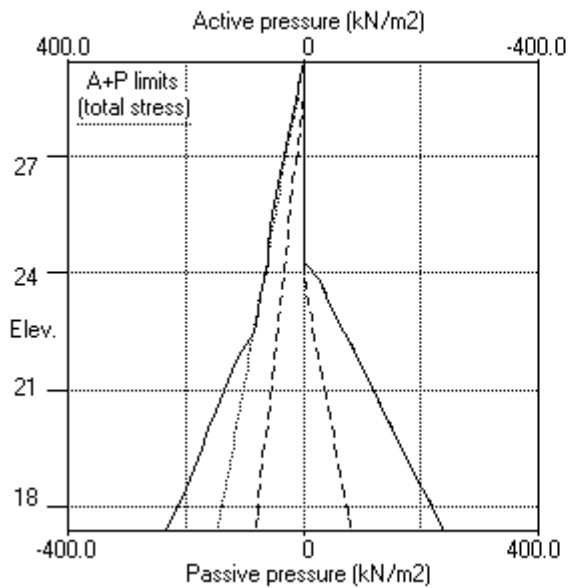
| Sheet No.  
 | Job No. 41713A1  
 | Made by : SD  
 | Date:26-03-2021  
 | Checked :

Units: kN,m

Stage No.9 Apply water pressure profile no.1 ( Mod. Conserv. )



Stage No.9 Apply water pressure profile no.1 ( Mod. Conserv. )





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Data filename/Run ID: Camden\_High\_ 450mm\_S1\_ULS1

Camden High

Contiguous wall - S1 - ULS1

| Sheet No.

| Job No. 41713A1

| Made by : SD

| Date:26-03-2021

| Checked :

Units: kN,m

**Summary of results****BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall****Analysis options**

Length of wall perpendicular to section = 20.00m

Subgrade reaction model - Boussinesq Influence coefficients

Soil deformations are elastic until the active or passive limit is reached

Open Tension Crack analysis - No

Rigid boundaries: Left side 30.00 from wall

Right side 30.00 from wall

**Limit State: ULS DAL Combination 1**

Calculated Bending Moments and Strut Forces have been multiplied by a factor of 1.35 to obtain values for structural design.

**Bending moment, shear force and displacement envelopes**

Node no.	Y coord	Displacement		---- Bending moment ----				----- Shear force -----			
				Calculated		Factored		Calculated		Factored	
		max. m	min. m	max. kN.m/m	min. kN.m/m	max. kN.m/m	min. kN.m/m	max. kN/m	min. kN/m	max. kN/m	min. kN/m
1	29.40	0.047	0.000	0	-0	0	-0	45	0	61	0
2	29.00	0.044	0.000	18	0	25	0	46	-15	62	-21
3	28.70	0.041	0.000	17	0	23	0	3	-13	4	-18
4	28.40	0.039	0.000	16	0	22	0	6	-11	8	-14
5	27.95	0.035	0.000	17	0	23	0	8	-4	11	-5
6	27.50	0.031	0.000	21	0	28	0	12	0	17	0
7	27.00	0.027	0.000	29	0	40	0	22	-0	30	-1
8	26.50	0.023	0.000	43	0	59	0	39	-1	52	-1
9	26.00	0.019	0.000	64	0	86	0	61	-1	82	-1
10	25.50	0.015	0.000	96	0	130	0	86	-0	116	-1
11	25.10	0.013	0.000	136	0	183	0	109	-0	146	-1
12	24.70	0.010	0.000	185	0	249	0	132	-122	178	-164
13	24.29	0.009	0.000	139	0	188	0	72	-97	97	-131
14	23.79	0.007	0.000	164	0	222	0	85	-71	114	-96
15	23.40	0.006	0.000	182	0	245	0	4	-57	5	-77
16	23.00	0.006	0.000	174	0	235	0	0	-60	0	-82
17	22.50	0.006	0.000	130	0	176	0	0	-91	0	-123
18	22.00	0.005	0.000	83	0	112	0	0	-87	0	-117
19	21.50	0.005	0.000	45	0	61	0	0	-66	0	-90
20	21.00	0.005	0.000	28	-7	38	-9	0	-43	0	-58
21	20.50	0.005	0.000	16	-11	22	-14	0	-23	0	-31
22	20.00	0.004	0.000	9	-11	12	-15	3	-11	4	-15
23	19.50	0.004	0.000	5	-9	7	-12	6	-6	8	-8
24	19.00	0.004	0.000	3	-6	4	-8	7	-4	9	-5
25	18.50	0.003	0.000	2	-3	2	-5	6	-3	8	-3
26	18.00	0.003	0.000	1	-1	1	-2	4	-2	5	-2
27	17.70	0.002	0.000	0	-0	0	-0	2	-1	3	-1
28	17.40	0.002	0.000	0	-0	0	-0	0	0	0	0

### Summary of results (continued)

Calculated Bending Moments and Strut Forces have been multiplied by a factor of 1.35 to obtain values for structural design.

### Maximum and minimum bending moment and shear force at each stage

Stage no.	Bending moment						Shear force					
	Calculated			Factored			Calculated			Factored		
	max.	elev.	min.	max.	min.		max.	elev.	min.	max.	min.	
	kN.m/m		kN.m/m	kN.m/m			kN/m		kN/m	kN/m		kN/m
1	2	27.50	-0	29.40	2	-0	2	28.40	-1	26.50	3	-1
2	179	23.40	-7	19.50	242	-10	82	23.79	-90	22.50	110	-122
3	182	23.40	-7	19.50	245	-10	83	23.79	-91	22.50	113	-123
4	No calculation at this stage											
5	No calculation at this stage											
6	181	23.40	-7	19.50	244	-10	85	23.79	-91	22.50	114	-122
7	155	24.70	-0	29.40	209	-0	94	24.70	-61	24.70	127	-82
8	127	24.70	-0	29.40	171	-0	85	24.70	-57	24.70	115	-77
9	185	24.70	-11	20.00	249	-15	132	24.70	-122	24.70	178	-164

### Maximum and minimum displacement at each stage

Stage no.	Displacement				Stage description
	maximum	elev.	minimum	elev.	
	m		m		
1	0.000	29.40	0.000	29.40	Apply surcharge no.1 at elev. 29.40
2	0.047	29.40	0.000	29.40	Excav. to elev. 23.79 on RIGHT side
3	0.047	29.40	0.000	29.40	Fill to elev. 24.29 on RIGHT side
4	No calculation at this stage				Install strut no.2 at elev. 24.70
5	No calculation at this stage				Install strut no.1 at elev. 29.00
6	0.047	29.40	0.000	29.40	Apply load no.1 at elev. 29.40
7	0.047	29.40	0.000	29.40	Change soil type 2 to soil type 3
8	0.047	29.40	0.000	29.40	Change EI of wall to 46900kN.m2/m run
9	0.047	29.40	0.000	29.40	Apply water pressure profile no.1

### Strut forces at each stage (horizontal components)

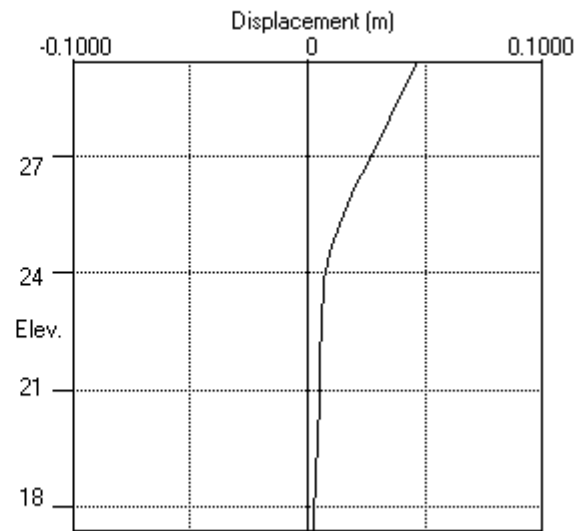
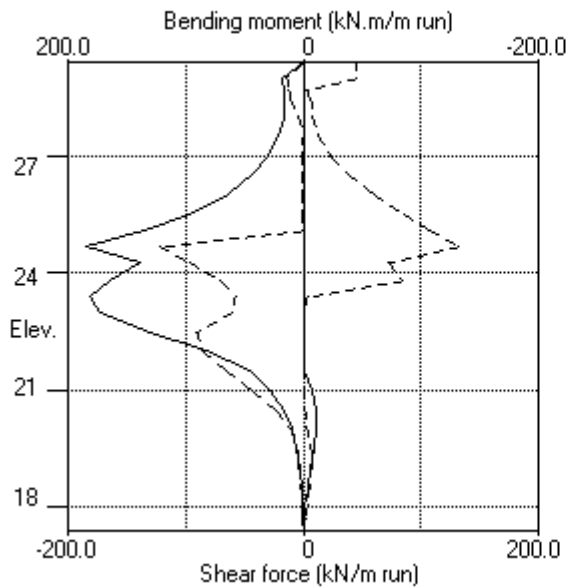
Stage no.	Strut no. 1			Strut no. 2		
	at elev. 29.00			at elev. 24.70		
	--Calculated--	Factored		--Calculated--	Factored	
	kN per	kN per	kN per	kN per	kN per	kN per
	m run	strut	strut	m run	strut	strut
6	53	53	71	-3	-3	-5
7	51	51	69	155	155	209
8	60	60	81	142	142	192
9	61	61	83	253	253	342

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|  
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Units: kN,m

Bending moment, shear force, displacement envelopes



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Camden High  
Contiguous wall - S1 - ULS2

| Sheet No.  
| Job No. 41713A1  
| Made by : SD  
| Date:26-03-2021  
| Checked :

Units: kN,m

# INPUT DATA

## SOIL PROFILE

Stratum no.	Elevation of top of stratum	Left side	Soil types	Right side
1	29.40	1 Made Ground		1 Made Ground
2	28.40	2 London Clay u.		2 London Clay u.

## SOIL PROPERTIES (Unfactored SLS soil strengths)

-- Soil type --	Bulk density	Young's Modulus	At rest coeff.	Consol state.	Active limit	Passive limit	Cohesion
No. Description	kN/m3	Eh, kN/m2	Ko	NC/OC	Ka	Kp	kN/m2
(Datum elev.)		(dEh/dy )	(dKo/dy)	( Nu )	( Kac )	( Kpc )	( dc/dy )
1 Made Ground	18.00	0	0.625	NC	0.399	2.894	
		( 10000)		(0.200)	(0.000)	( 0.000)	
2 London Cl..	20.00	45000	1.000	OC	1.000	1.000	60.00u
( 28.40 )		( 5475)		(0.490)	(2.389)	( 2.390)	( 7.300)
3 London Cl..	20.00	33750	1.000	OC	0.399	2.738	
( 28.40 )		( 4106)		(0.200)	(0.000)	( 0.000)	

## Additional soil parameters associated with Ka and Kp

--- parameters for Ka ---				--- parameters for Kp ---			
Soil	Wall	Back-		Soil	Wall	Back-	
friction	adhesion	fill		friction	adhesion	fill	
angle	coeff.	angle		angle	coeff.	angle	
1 Made Ground	22.00	0.670	0.00	22.00	0.670	0.00	
2 London Clay u.	0.00	0.500	0.00	0.00	0.500	0.00	
3 London Clay dr.	22.00	0.670	0.00	21.00	0.670	0.00	

## GROUND WATER CONDITIONS

Density of water = 10.00 kN/m3

	Left side	Right side
Initial water table elevation	20.00	20.00

Automatic water pressure balancing at toe of wall : Yes

Left side				Right side			
Water press.							
profile	Point no.	Elev. m	Piezo elev. m	Water press. kN/m2	Point no.	Elev. m	Piezo elev. m
	1	28.40	28.40	0.0	1	23.79	23.79
							0.0 MC+WC

## WALL PROPERTIES

Type of structure = Fully Embedded Wall  
Elevation of toe of wall = 17.40  
Maximum finite element length = 0.50 m  
Youngs modulus of wall E = 2.0000E+07 kN/m2  
Moment of inertia of wall I = 3.3500E-03 m4/m run  
E.I = 67000 kN.m2/m run  
Yield Moment of wall = Not defined

## STRUTS and ANCHORS

Strut/ anchor no.	Elev.	Strut spacing m	X-section area of strut sq.m	Youngs modulus kN/m2	Free length m	Inclin -ation (deg)	Pre-stress /strut kN	Tension allowed
1	29.00	1.00	0.250000	2.000E+07	10.00	0.00	0	Yes
2	24.70	1.00	0.450000	2.000E+07	10.00	0.00	0	Yes

**HORIZONTAL and MOMENT LOADS/RESTRAINTS**

Load no.	Elevation	Horizontal load kN/m run	Moment load kN.m/m run	Moment restraint kN.m/m/rad	Partial factor (Category)
1	29.40	45.00	0	0	1.00 (P/U)

**SURCHARGE LOADS**

Surch -arge no.	Distance from wall	Length parallel to wall	Width perpend. to wall	Surcharge ----- kN/m2 ----- Near edge Far edge	Equiv. Partial soil factor/ type Category
1	29.40	0.20 (L)	10.00	10.00 =	N/A 1.30 Var

Note: L = Left side, R = Right side

Limit State Categories P/U = Permanent Unfavourable

P/F = Permanent Favourable

Var = Variable (unfavourable)

**CONSTRUCTION STAGES**

Construction stage no.	Stage description
1	Apply surcharge no.1 at elevation 29.40 No analysis at this stage
2	Excavate to elevation 23.79 on RIGHT side
3	Fill to elevation 24.29 on RIGHT side with soil type 2
4	Install strut or anchor no.2 at elevation 24.70
5	Install strut or anchor no.1 at elevation 29.00
6	Apply load no.1 at elevation 29.40
7	Change properties of soil type 2 to soil type 3 Ko pressures will not be reset
8	Change EI of wall to 46900 kN.m2/m run Yield moment not defined Allow wall to relax with new modulus value
9	Apply water pressure profile no.1 ( Worst Cred. )

**FACTORS OF SAFETY and ANALYSIS OPTIONS**

Limit State options: ULS DA1 Combination 2

Water pressures : Worst Credible

Partial factor on C' = 1.250

Partial factor on Phi' = 1.250

Partial factor on Cu = 1.400

Partial factor on Soil Modulus = 1.000

Partial factor on Permanent Unfavourable loads = 1.000

Partial factor on Permanent Favourable loads = 1.000

Partial factor on Variable Unfavourable loads = 1.300

Stability analysis:

Method of analysis - Strength Factor method

Overall factor on soil strength for calculating wall depth = 1.00

Parameters for undrained strata:

Minimum equivalent fluid density = 5.00 kN/m3

Maximum depth of water filled tension crack = 0.00 m

Bending moment and displacement calculation:

Method - Subgrade reaction model using Influence Coefficients

Open Tension Crack analysis? - No

Non-linear Modulus Parameter (L) = 10.00 m

Boundary conditions:

Length of wall (normal to plane of analysis) = 20.00 m

Width of excavation on Left side of wall = 20.00 m

Width of excavation on Right side of wall = 20.00 m

Distance to rigid boundary on Left side = 30.00 m

Distance to rigid boundary on Right side = 30.00 m

## OUTPUT OPTIONS

Stage no.	Stage description	Displacement Bending mom. Shear force	Active, Passive pressures	Graph. output
1	Apply surcharge no.1 at elev. 29.40	Yes	Yes	Yes
2	Excav. to elev. 23.79 on RIGHT side	Yes	Yes	Yes
3	Fill to elev. 24.29 on RIGHT side	Yes	Yes	Yes
4	Install strut no.2 at elev. 24.70	Yes	Yes	Yes
5	Install strut no.1 at elev. 29.00	Yes	Yes	Yes
6	Apply load no.1 at elev. 29.40	Yes	Yes	Yes
7	Change soil type 2 to soil type 3	No	No	No
8	Change EI of wall to 46900kN.m2/m run	Yes	Yes	Yes
9	Apply water pressure profile no.1	Yes	Yes	Yes
*	Summary output	Yes	-	Yes

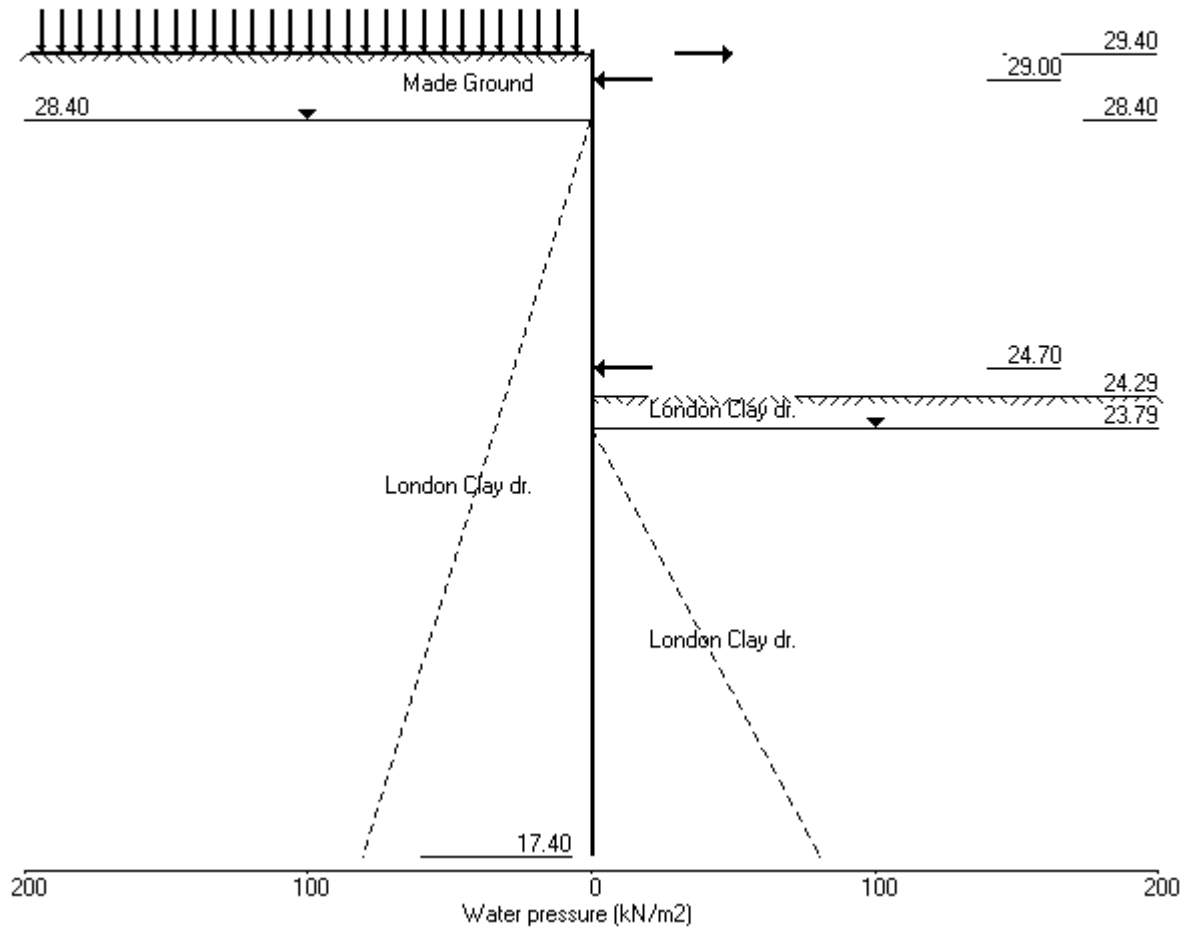
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 Contiguous wall - S1 - ULS2

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Stage No.9 Apply water pressure profile no.1 ( Worst Cred. )



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| Job No. 41713A1  
| Made by : SD  
| Date:26-03-2021  
| Checked :

Units: kN,m

Stage No. 1 Apply surcharge no.1 at elevation 29.40  
No analysis at this stage

**STABILITY ANALYSIS of Fully Embedded Wall according to Strength Factor method**  
Factor of safety on soil strength

				Overall				
				FoS for toe		Toe elev. for		
				elev. = 17.40		FoS = 1.000		
				-----		-----		
Stage	--- G.L. ---	Strut	Factor	Moment	Toe	Wall	Direction	
No.	Act. Pass.	Elev.	of	of equilib.	elev.	Penetr	of	
			Safety	at elev.		-ation	failure	
1	29.40 29.40	Cant.	<u>Conditions not suitable for FoS calc.</u>					

**BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall**

**Analysis options**

Length of wall perpendicular to section = 20.00m  
Subgrade reaction model - Boussinesq Influence coefficients  
Soil deformations are elastic until the active or passive limit is reached  
Open Tension Crack analysis - No

Rigid boundaries: Left side 30.00 from wall  
Right side 30.00 from wall

**Limit State: ULS DA1 Combination 2**

Node no.	Y coord	Nett pressure kN/m2	Wall disp. m	Wall rotation rad.	Shear force kN/m	Bending moment kN.m/m	Strut forces kN/m	EI of wall kN.m2/m
1	29.40	0.00	0.000	1.03E-04	0.0	0.0		67000
2	29.00	2.66	0.000	1.02E-04	0.5	0.1		67000
3	28.70	3.69	0.000	1.01E-04	1.5	0.4		67000
4	28.40	3.93	0.000	9.85E-05	2.6	1.0		67000
		-4.42	0.000	9.85E-05	2.6	1.0		
5	27.95	-2.74	0.000	8.91E-05	1.0	1.8		67000
6	27.50	-1.58	0.000	7.64E-05	0.0	2.0		67000
7	27.00	-0.69	0.000	6.23E-05	-0.5	1.8		67000
8	26.50	-0.12	0.000	5.00E-05	-0.7	1.5		67000
9	26.00	0.19	0.000	4.06E-05	-0.7	1.1		67000
10	25.50	0.33	0.000	3.38E-05	-0.6	0.7		67000
11	25.10	0.35	0.000	3.00E-05	-0.4	0.5		67000
12	24.70	0.32	0.000	2.73E-05	-0.3	0.4		67000
13	24.29	0.26	0.000	2.54E-05	-0.2	0.3		67000
14	23.79	0.18	0.000	2.37E-05	-0.1	0.2		67000
15	23.40	0.12	0.000	2.27E-05	-0.0	0.2		67000
16	23.00	0.07	0.000	2.17E-05	0.0	0.2		67000
17	22.50	0.02	0.000	2.06E-05	0.0	0.2		67000
18	22.00	-0.01	0.000	1.93E-05	0.1	0.2		67000
19	21.50	-0.03	0.000	1.80E-05	0.0	0.2		67000
20	21.00	-0.04	0.000	1.67E-05	0.0	0.2		67000
21	20.50	-0.04	0.000	1.53E-05	0.0	0.2		67000
22	20.00	-0.04	0.000	1.41E-05	-0.0	0.2		67000
23	19.50	-0.04	0.000	1.29E-05	-0.0	0.1		67000
24	19.00	-0.03	0.000	1.20E-05	-0.0	0.1		67000
25	18.50	-0.01	0.000	1.14E-05	-0.1	0.1		67000
26	18.00	0.04	0.000	1.11E-05	-0.0	0.0		67000
27	17.70	0.08	0.000	1.10E-05	-0.0	0.0		67000
28	17.40	0.13	0.000	1.10E-05	0.0	0.0		---



(continued)

Stage No.1 Apply surcharge no.1 at elevation 29.40  
 No analysis at this stage

Node no.	Y coord	LEFT side						Coeff. of subgrade reaction
		Water press. kN/m2	Vertic -al kN/m2	Effective Active limit kN/m2	Effective Passive limit kN/m2	Earth pressure kN/m2	Total earth pressure kN/m2	
1	29.40	0.00	0.00	0.00	0.00	0.00	0.00	184
2	29.00	0.00	13.05	6.17	30.27	7.66	7.66	1103
3	28.70	0.00	21.10	9.97	48.94	12.37	12.37	1931
4	28.40	0.00	27.73	13.10	64.34	16.26	16.26	2759
		Total>	27.73	5.00m	130.16	20.47	20.47	17636
5	27.95	Total>	37.62	7.25m	145.66	30.73	30.73	18601
6	27.50	Total>	47.01	9.50m	160.66	40.50	40.50	19567
7	27.00	Total>	57.14	12.00m	177.03	51.01	51.01	20640
8	26.50	Total>	67.08	14.50m	193.20	61.26	61.26	21713
9	26.00	Total>	76.89	17.00m	209.24	71.33	71.33	22785
10	25.50	Total>	86.61	19.50m	225.20	81.26	81.26	23858
11	25.10	Total>	94.35	21.50m	237.92	89.15	89.15	24717
12	24.70	Total>	102.06	23.50m	250.62	96.99	96.99	25575
13	24.29	Total>	109.94	25.55m	263.61	105.01	105.01	26455
14	23.79	Total>	119.54	28.05m	279.44	114.78	114.78	27527
15	23.40	Total>	127.12	30.02m	291.94	122.49	122.49	28375
16	23.00	Total>	134.69	32.00m	304.45	130.21	130.21	29222
17	22.50	Total>	144.29	34.50m	320.28	139.99	139.99	30295
18	22.00	Total>	153.90	37.00m	336.11	149.79	149.79	31368
19	21.50	Total>	158.69	39.50m	347.14	159.60	159.60	32441
20	21.00	Total>	173.15	42.00m	367.83	169.41	169.41	33514
21	20.50	Total>	182.80	44.50m	383.71	179.24	179.24	34587
22	20.00	Total>	192.46	47.00m	399.61	189.08	189.08	35660
23	19.50	Total>	202.14	49.50m	415.53	198.93	198.93	36732
24	19.00	Total>	211.84	52.00m	431.46	208.79	208.79	37805
25	18.50	Total>	221.56	54.50m	447.40	218.67	218.67	38878
26	18.00	Total>	231.29	57.00m	463.37	228.56	228.56	39951
27	17.70	Total>	237.13	58.50m	472.95	234.50	234.50	40595
28	17.40	Total>	242.98	60.00m	482.54	240.46	240.46	41238

Node no.	Y coord	RIGHT side						Coeff. of subgrade reaction
		Water press. kN/m2	Vertic -al kN/m2	Effective Active limit kN/m2	Effective Passive limit kN/m2	Earth pressure kN/m2	Total earth pressure kN/m2	
1	29.40	0.00	0.00	0.00	0.00	0.00	0.00	184
2	29.00	0.00	7.20	3.40	16.70	5.00	5.00	1103
3	28.70	0.00	12.60	5.95	29.23	8.69	8.69	1931
4	28.40	0.00	18.00	8.51	41.76	12.33	12.33	2759
		Total>	18.00	5.00m	120.43	24.88	24.88	17636
5	27.95	Total>	27.00	7.25m	135.04	33.47	33.47	18601
6	27.50	Total>	36.00	9.50m	149.65	42.08	42.08	19567
7	27.00	Total>	46.00	12.00m	165.88	51.70	51.70	20640
8	26.50	Total>	56.00	14.50m	182.12	61.38	61.38	21713
9	26.00	Total>	66.00	17.00m	198.35	71.14	71.14	22785
10	25.50	Total>	76.00	19.50m	214.58	80.94	80.94	23858
11	25.10	Total>	84.00	21.50m	227.57	88.80	88.80	24717
12	24.70	Total>	92.00	23.50m	240.56	96.67	96.67	25575
13	24.29	Total>	100.20	25.55m	253.87	104.75	104.75	26455
14	23.79	Total>	110.20	28.05m	270.10	114.59	114.59	27527
15	23.40	Total>	118.10	30.02m	282.93	122.37	122.37	28375
16	23.00	Total>	126.00	32.00m	295.75	130.14	130.14	29222
17	22.50	Total>	136.00	34.50m	311.98	139.97	139.97	30295

Run ID. Camden\_High\_ 450mm\_S1\_ULS2  
 Camden High  
 Contiguous wall - S1 - ULS2

| Sheet No.  
 | Date:26-03-2021  
 | Checked :

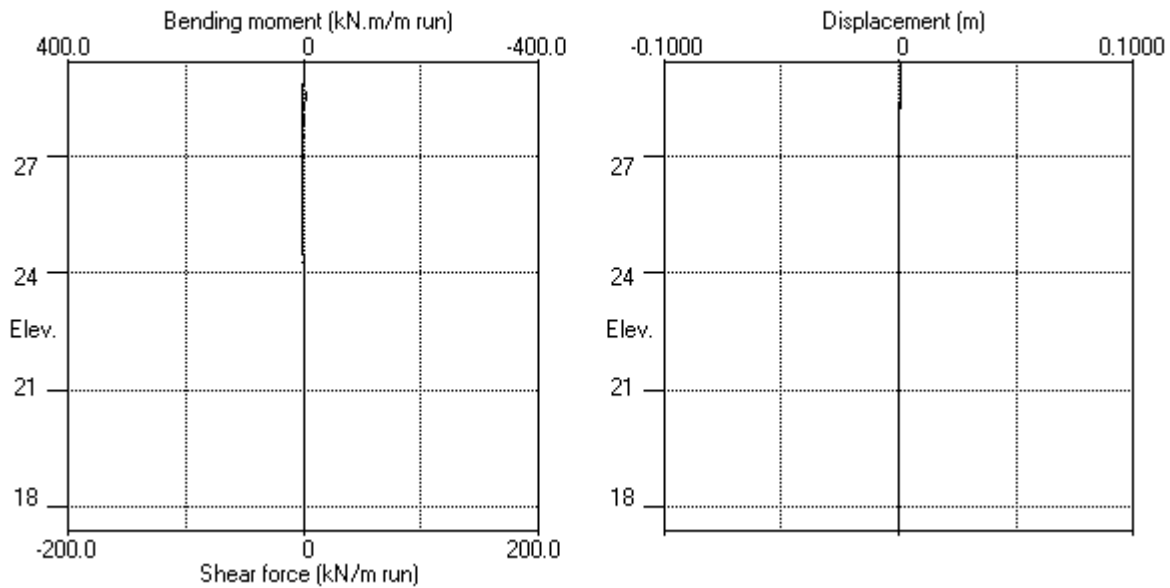
(continued)

Stage No.1      Apply surcharge no.1 at elevation 29.40  
                     No analysis at this stage

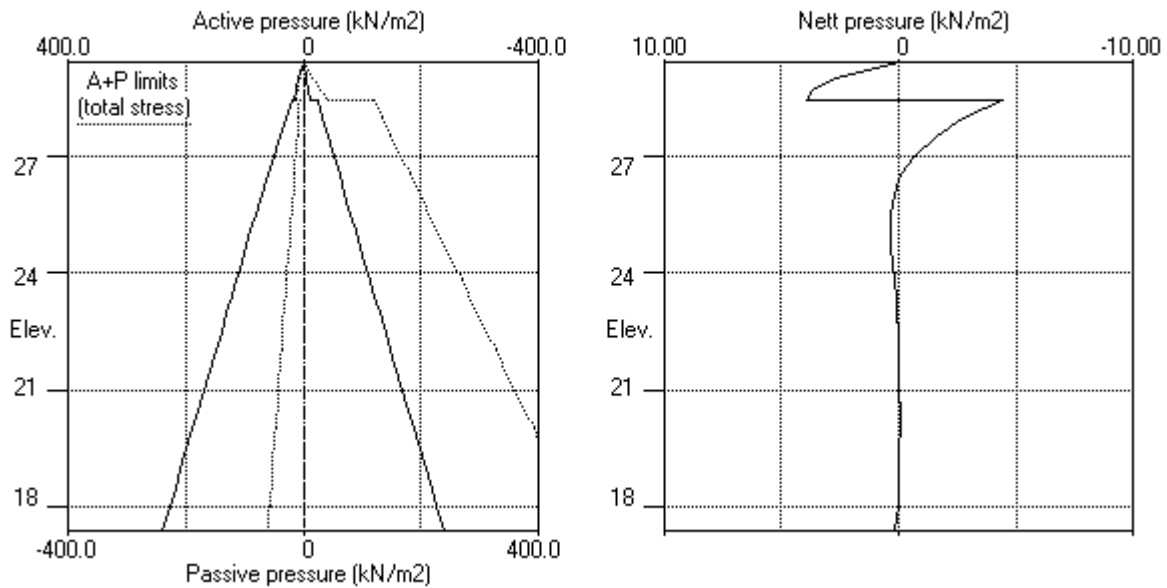
Node no.	Y coord	----- RIGHT side -----						
		----- Effective stresses -----					Total earth pressure	Coeff. of subgrade reaction
		Water press. kN/m2	Vertic -al kN/m2	Active limit kN/m2	Passive limit kN/m2	Earth pressure kN/m2		
18	22.00	Total>	146.00	37.00m	328.22	149.80	149.80	31368
19	21.50	Total>	156.00	39.50m	344.45	159.62	159.62	32441
20	21.00	Total>	166.00	42.00m	360.68	169.45	169.45	33514
21	20.50	Total>	176.00	44.50m	376.92	179.28	179.28	34587
22	20.00	Total>	186.00	47.00m	393.15	189.12	189.12	35660
23	19.50	Total>	196.00	49.50m	409.38	198.97	198.97	36732
24	19.00	Total>	206.00	52.00m	425.61	208.82	208.82	37805
25	18.50	Total>	216.00	54.50m	441.85	218.67	218.67	38878
26	18.00	Total>	226.00	57.00m	458.08	228.52	228.52	39951
27	17.70	Total>	232.00	58.50m	467.82	234.43	234.43	40595
28	17.40	Total>	238.00	60.00m	477.56	240.33	240.33	41238

Units: kN,m

Stage No.1 Apply surcharge no.1 at elev. 29.40



Stage No.1 Apply surcharge no.1 at elev. 29.40



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Program: WALLAP Version 6.06 Revision A51.B69.R55

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Data filename/Run ID: Camden\_High\_ 450mm\_S1\_ULS2

Camden High

Contiguous wall - S1 - ULS2

| Sheet No.

| Job No. 41713A1

| Made by : SD

| Date:26-03-2021

| Checked :

Units: kN,m

Stage No. 2 Excavate to elevation 23.79 on RIGHT side

**STABILITY ANALYSIS of Fully Embedded Wall according to Strength Factor method**

Factor of safety on soil strength

			Overall		Toe elev. for			
			FoS for toe		FoS = 1.000			
			elev. = 17.40					
			-----		-----			
Stage	--- G.L. ---	Strut	Factor	Moment	Toe	Wall	Direction	
No.	Act. Pass.	Elev.	of	of equilib.	elev.	Penetr	of	
			Safety	at elev.		-ation	failure	
2	29.40	23.79	Cant.	2.183	18.17	20.91	2.88	L to R

**BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall****Analysis options**

Length of wall perpendicular to section = 20.00m

Subgrade reaction model - Boussinesq Influence coefficients

Soil deformations are elastic until the active or passive limit is reached

Open Tension Crack analysis - No

Rigid boundaries: Left side 30.00 from wall

Right side 30.00 from wall

**Limit State: ULS DA1 Combination 2**

Node	Y	Nett	Wall	Wall	Shear	Bending	Strut	EI of
no.	coord	pressure	disp.	rotation	force	moment	forces	wall
		kN/m2	m	rad.	kN/m	kN.m/m	kN/m	kN.m2/m
1	29.40	0.00	0.057	9.70E-03	0.0	-0.0		67000
2	29.00	6.17	0.053	9.70E-03	1.2	0.2		67000
3	28.70	9.97	0.050	9.70E-03	3.7	0.9		67000
4	28.40	13.10	0.047	9.69E-03	7.1	2.5		67000
		5.00	0.047	9.69E-03	7.1	2.5		
5	27.95	7.25	0.042	9.66E-03	9.9	6.3		67000
6	27.50	9.50	0.038	9.61E-03	13.6	11.5		67000
7	27.00	12.00	0.033	9.49E-03	19.0	19.6		67000
8	26.50	14.50	0.029	9.30E-03	25.6	30.7		67000
9	26.00	17.00	0.024	9.02E-03	33.5	45.4		67000
10	25.50	19.50	0.020	8.61E-03	42.6	64.3		67000
11	25.10	21.50	0.016	8.17E-03	50.8	83.0		67000
12	24.70	23.50	0.013	7.61E-03	59.8	105.1		67000
13	24.29	25.55	0.010	6.88E-03	69.9	131.7		67000
14	23.79	28.05	0.007	5.76E-03	83.3	169.9		67000
		-131.83	0.007	5.76E-03	83.3	169.9		
15	23.40	-142.68	0.005	4.69E-03	29.1	192.2		67000
16	23.00	-147.35	0.003	3.55E-03	-28.2	194.8		67000
17	22.50	-70.16	0.002	2.19E-03	-82.6	169.0		67000
18	22.00	8.37	0.001	1.12E-03	-98.0	119.0		67000
19	21.50	44.22	0.001	4.13E-04	-84.9	71.0		67000
20	21.00	52.11	0.001	2.16E-05	-60.8	34.0		67000
21	20.50	44.99	0.001	-1.43E-04	-36.5	10.1		67000
22	20.00	32.21	0.001	-1.71E-04	-17.2	-2.5		67000
23	19.50	19.36	0.001	-1.35E-04	-4.3	-7.1		67000
24	19.00	8.93	0.001	-8.38E-05	2.7	-6.9		67000
25	18.50	1.26	0.001	-4.18E-05	5.3	-4.4		67000
26	18.00	-4.49	0.001	-1.94E-05	4.5	-1.6		67000
27	17.70	-7.50	0.001	-1.48E-05	2.7	-0.5		67000
28	17.40	-10.44	0.001	-1.37E-05	0.0	-0.0		---

(continued)

Stage No.2 Excavate to elevation 23.79 on RIGHT side

Node no.	Y coord	----- LEFT side -----						Total earth pressure kN/m2	Coeff. of subgrade reaction kN/m3
		Water press. kN/m2	Vertic -al kN/m2	Effective Active limit kN/m2	Effective Passive limit kN/m2	Earth pressure kN/m2			
1	29.40	0.00	0.00	0.00	0.00	0.00	0.00	184	
2	29.00	0.00	13.05	6.17	30.27	6.17	6.17a	1104	
3	28.70	0.00	21.10	9.97	48.94	9.97	9.97a	1932	
4	28.40	0.00	27.73	13.10	64.34	13.10	13.10a	2761	
		Total>	27.73	5.00m	130.16	5.00	5.00a	17647	
5	27.95	Total>	37.62	7.25m	145.66	7.25	7.25a	18613	
6	27.50	Total>	47.01	9.50m	160.66	9.50	9.50a	19579	
7	27.00	Total>	57.14	12.00m	177.03	12.00	12.00a	20653	
8	26.50	Total>	67.08	14.50m	193.20	14.50	14.50a	21726	
9	26.00	Total>	76.89	17.00m	209.24	17.00	17.00a	22800	
10	25.50	Total>	86.61	19.50m	225.20	19.50	19.50a	23873	
11	25.10	Total>	94.35	21.50m	237.92	21.50	21.50a	24732	
12	24.70	Total>	102.06	23.50m	250.62	23.50	23.50a	25591	
13	24.29	Total>	109.94	25.55m	263.61	25.55	25.55a	26471	
14	23.79	Total>	119.54	28.05m	279.44	28.05	28.05a	27545	
15	23.40	Total>	127.12	30.02m	291.94	30.02	30.02a	28393	
16	23.00	Total>	134.69	32.00m	304.45	38.18	38.18	29241	
17	22.50	Total>	144.29	34.50m	320.28	87.61	87.61	30314	
18	22.00	Total>	153.90	37.00m	336.11	120.79	120.79	31388	
19	21.50	Total>	158.69	39.50m	347.14	141.28	141.28	32461	
20	21.00	Total>	173.15	42.00m	367.83	153.46	153.46	33535	
21	20.50	Total>	182.80	44.50m	383.71	161.19	161.19	34608	
22	20.00	Total>	192.46	47.00m	399.61	167.26	167.26	35682	
23	19.50	Total>	202.14	49.50m	415.53	173.32	173.32	36755	
24	19.00	Total>	211.84	52.00m	431.46	180.12	180.12	37829	
25	18.50	Total>	221.56	54.50m	447.40	187.76	187.76	38902	
26	18.00	Total>	231.29	57.00m	463.37	196.00	196.00	39976	
27	17.70	Total>	237.13	58.50m	472.95	201.08	201.08	40620	
28	17.40	Total>	242.98	60.00m	482.54	206.20	206.20	41264	

Node no.	Y coord	----- RIGHT side -----						
		----- Effective stresses -----					Total earth pressure kN/m2	Coeff. of subgrade reaction kN/m3
		Water press. kN/m2	Vertic -al kN/m2	Active limit kN/m2	Passive limit kN/m2	Earth pressure kN/m2		
1	29.40	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	29.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
3	28.70	0.00	0.00	0.00	0.00	0.00	0.00	0.0
4	28.40	0.00	0.00	0.00	0.00	0.00	0.00	0.0
5	27.95	0.00	0.00	0.00	0.00	0.00	0.00	0.0
6	27.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
7	27.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
8	26.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
9	26.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
10	25.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
11	25.10	0.00	0.00	0.00	0.00	0.00	0.00	0.0
12	24.70	0.00	0.00	0.00	0.00	0.00	0.00	0.0
13	24.29	0.00	0.00	0.00	0.00	0.00	0.00	0.0
14	23.79	0.00	0.00	0.00	0.00	0.00	0.00	0.0
		Total>	0.00	0.00	159.88	159.88	159.88p	65022
15	23.40	Total>	7.90	1.97m	172.70	172.70	172.70p	67024
16	23.00	Total>	15.80	3.95m	185.53	185.53	185.53p	69026
17	22.50	Total>	25.81	6.45m	201.77	157.77	157.77	71560
18	22.00	Total>	35.83	8.95m	218.02	112.41	112.41	74094

Run ID. Camden\_High\_ 450mm\_S1\_ULS2  
 Camden High  
 Contiguous wall - S1 - ULS2

| Sheet No.  
 | Date:26-03-2021  
 | Checked :

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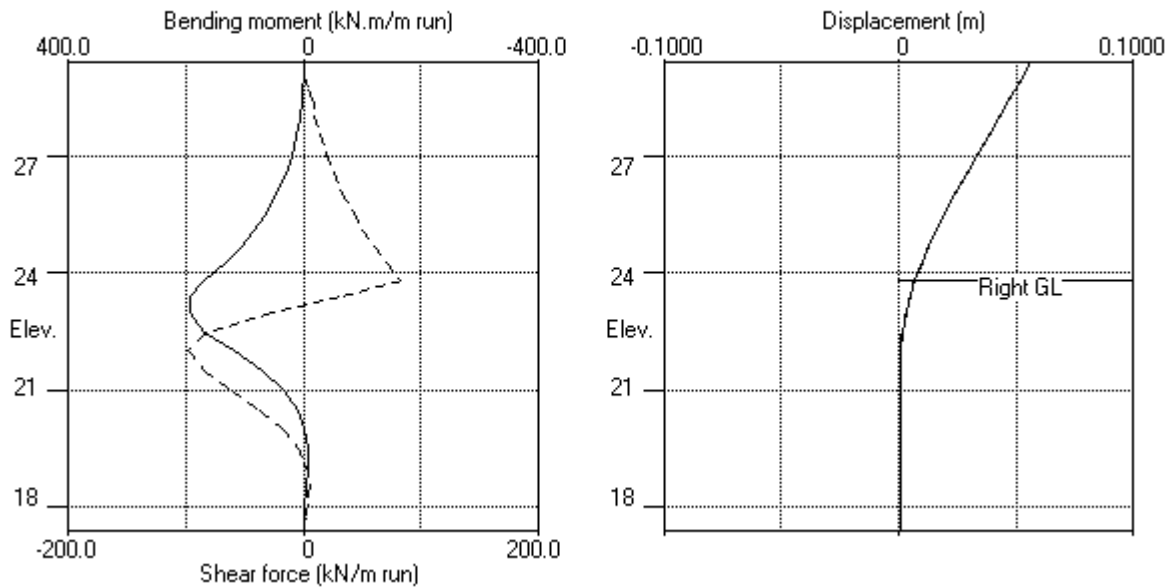
Stage No.2 Excavate to elevation 23.79 on RIGHT side

Node no.	Y coord	----- RIGHT side -----						
		Water press. kN/m2	Vertic -al kN/m2	Effective Active limit kN/m2	Effective Passive limit kN/m2	Earth pressure kN/m2	Total earth pressure kN/m2	Coeff. of subgrade reaction kN/m3
19	21.50	Total>	45.87	11.45m	234.29	97.05	97.05	76628
20	21.00	Total>	55.92	13.95m	250.58	101.35	101.35	79162
21	20.50	Total>	66.00	16.45m	266.89	116.21	116.21	81696
22	20.00	Total>	76.11	18.95m	283.23	135.05	135.05	84230
23	19.50	Total>	86.24	21.45m	299.59	153.96	153.96	86764
24	19.00	Total>	96.40	23.95m	315.99	171.19	171.19	89299
25	18.50	Total>	106.60	26.45m	332.42	186.51	186.51	91833
26	18.00	Total>	116.83	28.95m	348.88	200.49	200.49	94367
27	17.70	Total>	122.99	30.45m	358.78	208.58	208.58	95887
28	17.40	Total>	129.16	31.95m	368.69	216.63	216.63	97408

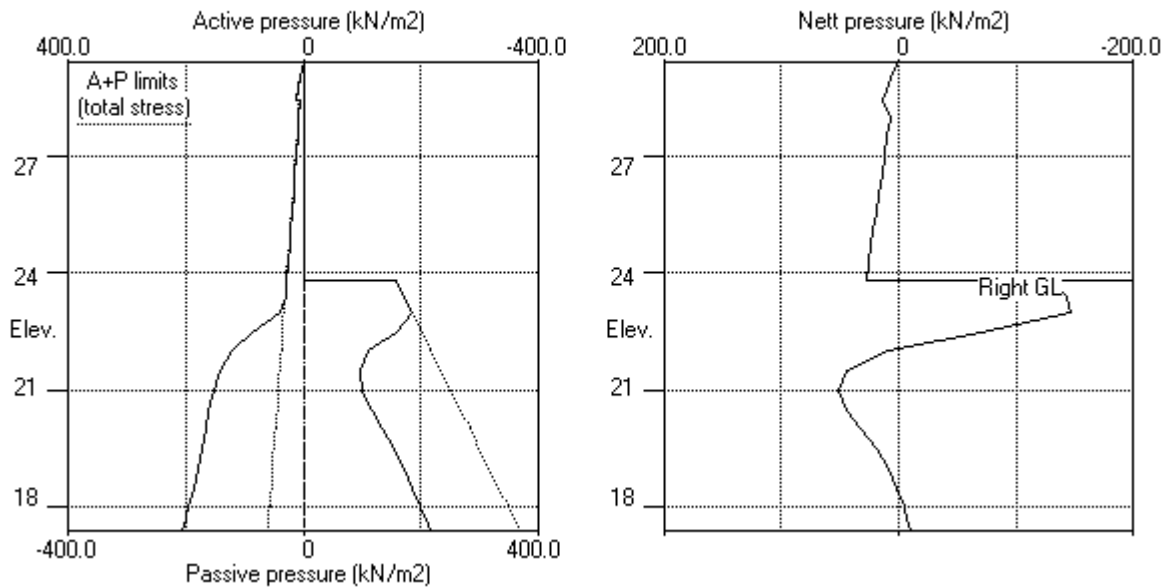
Note: 30.02a Soil pressure at active limit  
 185.53p Soil pressure at passive limit

Units: kN,m

Stage No.2 Excav. to elev. 23.79 on RIGHT side



Stage No.2 Excav. to elev. 23.79 on RIGHT side



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Data filename/Run ID: Camden\_High\_ 450mm\_S1\_ULS2  
Camden High  
Contiguous wall - S1 - ULS2

| Sheet No.  
| Job No. 41713A1  
| Made by : SD  
| Date:26-03-2021  
| Checked :

Units: kN,m

Stage No. 3 Fill to elevation 24.29 on RIGHT side with soil type 2

**STABILITY ANALYSIS of Fully Embedded Wall according to Strength Factor method**

Factor of safety on soil strength

			Overall		Toe elev. for			
			FoS for toe		FoS = 1.000			
			elev. = 17.40					
			-----		-----			
Stage	--- G.L. ---	Strut	Factor	Moment	Toe	Wall	Direction	
No.	Act. Pass.	Elev.	of	of equilib.	elev.	Penetr	of	
			Safety	at elev.		-ation	failure	
3	29.40	24.29	Cant.	2.418	18.14	21.71	2.58	L to R

**BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall**

**Analysis options**

Length of wall perpendicular to section = 20.00m

Subgrade reaction model - Boussinesq Influence coefficients

Soil deformations are elastic until the active or passive limit is reached

Open Tension Crack analysis - No

Rigid boundaries: Left side 30.00 from wall

Right side 30.00 from wall

**Limit State: ULS DAI Combination 2**

Node	Y	Nett	Wall	Wall	Shear	Bending	Strut	EI of
no.	coord	pressure	disp.	rotation	force	moment	forces	wall
		kN/m2	m	rad.	kN/m	kN.m/m	kN/m	kN.m2/m
1	29.40	0.00	0.057	9.78E-03	0.0	-0.0		67000
2	29.00	6.17	0.053	9.78E-03	1.2	0.2		67000
3	28.70	9.97	0.050	9.78E-03	3.7	0.9		67000
4	28.40	13.10	0.047	9.77E-03	7.1	2.5		67000
		5.00	0.047	9.77E-03	7.1	2.5		
5	27.95	7.25	0.043	9.74E-03	9.9	6.3		67000
6	27.50	9.50	0.038	9.68E-03	13.6	11.5		67000
7	27.00	12.00	0.033	9.57E-03	19.0	19.6		67000
8	26.50	14.50	0.029	9.38E-03	25.6	30.7		67000
9	26.00	17.00	0.024	9.10E-03	33.5	45.4		67000
10	25.50	20.13	0.020	8.69E-03	42.8	64.3		67000
11	25.10	22.67	0.016	8.25E-03	51.4	83.1		67000
12	24.70	25.25	0.013	7.68E-03	60.9	105.5		67000
13	24.29	27.91	0.010	6.96E-03	71.8	132.7		67000
14	23.79	24.64	0.007	5.82E-03	85.0	171.8		67000
		-135.24	0.007	5.82E-03	85.0	171.8		
15	23.40	-145.05	0.005	4.74E-03	29.6	194.5		67000
16	23.00	-148.85	0.003	3.58E-03	-28.4	197.1		67000
17	22.50	-70.82	0.002	2.21E-03	-83.3	171.0		67000
18	22.00	8.29	0.001	1.12E-03	-99.0	120.5		67000
19	21.50	44.47	0.000	4.09E-04	-85.8	72.0		67000
20	21.00	52.52	0.000	1.18E-05	-61.5	34.7		67000
21	20.50	45.42	0.000	-1.56E-04	-37.1	10.4		67000
22	20.00	32.60	0.000	-1.86E-04	-17.5	-2.4		67000
23	19.50	19.67	0.001	-1.50E-04	-4.5	-7.1		67000
24	19.00	9.13	0.001	-9.83E-05	2.7	-6.9		67000
25	18.50	1.35	0.001	-5.58E-05	5.3	-4.5		67000
26	18.00	-4.51	0.001	-3.31E-05	4.6	-1.6		67000
27	17.70	-7.60	0.001	-2.84E-05	2.7	-0.5		67000
28	17.40	-10.62	0.001	-2.73E-05	0.0	0.0		---



(continued)

Stage No.3 Fill to elevation 24.29 on RIGHT side with soil type 2

Node no.	Y coord	LEFT side						
		Effective stresses					Total earth pressure kN/m2	Coeff. of subgrade reaction kN/m3
		Water press. kN/m2	Vertic -al kN/m2	Active limit kN/m2	Passive limit kN/m2	Earth pressure kN/m2		
1	29.40	0.00	0.00	0.00	0.00	0.00	0.00	255
2	29.00	0.00	13.05	6.17	30.27	6.17	6.17a	1532
3	28.70	0.00	21.10	9.97	48.94	9.97	9.97a	2680
4	28.40	0.00	27.73	13.10	64.34	13.10	13.10a	3829
		Total>	27.73	5.00m	130.16	5.00	5.00a	23997
5	27.95	Total>	37.62	7.25m	145.66	7.25	7.25a	25311
6	27.50	Total>	47.01	9.50m	160.66	9.50	9.50a	26625
7	27.00	Total>	57.14	12.00m	177.03	12.00	12.00a	28085
8	26.50	Total>	67.08	14.50m	193.20	14.50	14.50a	29545
9	26.00	Total>	76.89	17.00m	209.24	17.00	17.00a	31005
10	25.50	Total>	86.61	19.50m	225.20	20.13	20.13	16187
11	25.10	Total>	94.35	21.50m	237.92	22.67	22.67	16769
12	24.70	Total>	102.06	23.50m	250.62	25.25	25.25	17351
13	24.29	Total>	109.94	25.55m	263.61	27.91	27.91	17948
14	23.79	Total>	119.54	28.05m	279.44	31.13	31.13	18676
15	23.40	Total>	127.12	30.02m	291.94	33.62	33.62	19251
16	23.00	Total>	134.69	32.00m	304.45	42.21	42.21	19826
17	22.50	Total>	144.29	34.50m	320.28	92.06	92.06	20554
18	22.00	Total>	153.90	37.00m	336.11	125.53	125.53	21282
19	21.50	Total>	158.69	39.50m	347.14	146.20	146.20	22010
20	21.00	Total>	173.15	42.00m	367.83	158.46	158.46	22737
21	20.50	Total>	182.80	44.50m	383.71	166.22	166.22	23465
22	20.00	Total>	192.46	47.00m	399.61	172.27	172.27	24193
23	19.50	Total>	202.14	49.50m	415.53	178.30	178.30	24921
24	19.00	Total>	211.84	52.00m	431.46	185.06	185.06	25649
25	18.50	Total>	221.56	54.50m	447.40	192.65	192.65	26377
26	18.00	Total>	231.29	57.00m	463.37	200.83	200.83	27105
27	17.70	Total>	237.13	58.50m	472.95	205.88	205.88	27541
28	17.40	Total>	242.98	60.00m	482.54	210.95	210.95	27978

Node no.	Y coord	RIGHT side					Total earth pressure kN/m2	Coeff. of subgrade reaction kN/m3
		Effective stresses						
		Water press. kN/m2	Vertic -al kN/m2	Active limit kN/m2	Passive limit kN/m2	Earth pressure kN/m2		
1	29.40	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	29.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
3	28.70	0.00	0.00	0.00	0.00	0.00	0.00	0.0
4	28.40	0.00	0.00	0.00	0.00	0.00	0.00	0.0
5	27.95	0.00	0.00	0.00	0.00	0.00	0.00	0.0
6	27.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
7	27.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
8	26.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
9	26.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
10	25.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
11	25.10	0.00	0.00	0.00	0.00	0.00	0.00	0.0
12	24.70	0.00	0.00	0.00	0.00	0.00	0.00	0.0
13	24.29	0.00	0.00	0.00	0.00	0.00	0.00	0.0
		Total>	0.00	0.00	153.64	0.00	0.00a	18184
14	23.79	Total>	10.00	2.50m	169.88	6.49	6.49	18922
		Total>	10.00	2.50m	169.88	166.36	166.36	18922
15	23.40	Total>	17.90	4.47m	182.71	178.67	178.67	19504
16	23.00	Total>	25.81	6.45m	195.54	191.06	191.06	20087
17	22.50	Total>	35.83	8.95m	211.79	162.88	162.88	20824

Run ID. Camden\_High\_ 450mm\_S1\_ULS2  
 Camden High  
 Contiguous wall - S1 - ULS2

| Sheet No.  
 | Date:26-03-2021  
 | Checked :

(continued)

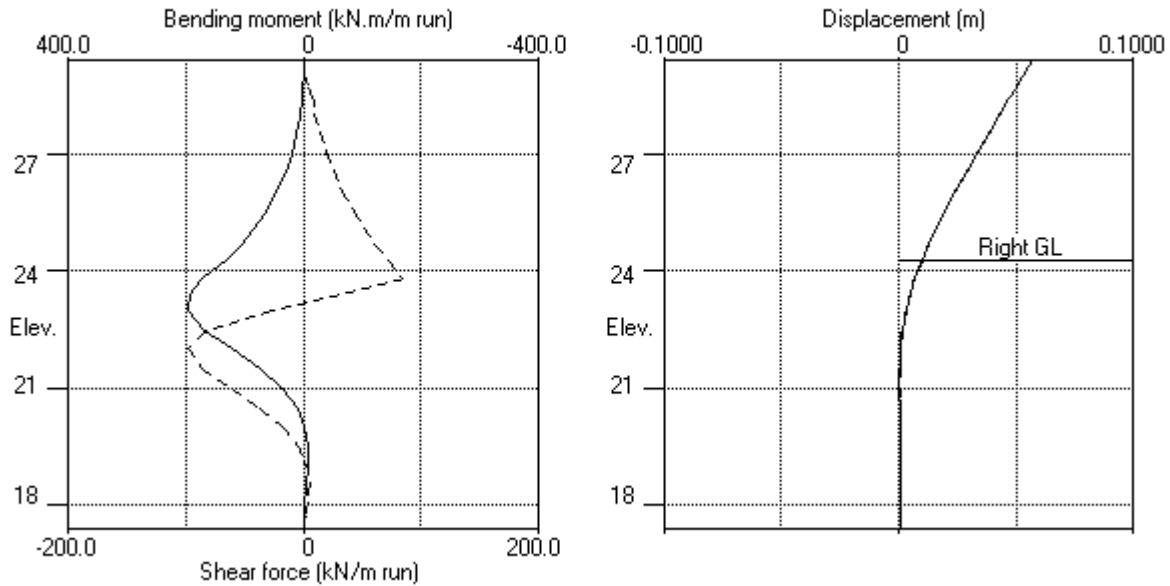
Stage No.3 Fill to elevation 24.29 on RIGHT side with soil type 2

Node no.	Y coord	----- RIGHT side -----						
		Water press. kN/m2	Vertic -al kN/m2	Effective Active limit kN/m2	Effective Passive limit kN/m2	Earth pressure kN/m2	Total earth pressure kN/m2	Coeff. of subgrade reaction kN/m3
18	22.00	Total>	45.86	11.45m	228.06	117.24	117.24	21562
19	21.50	Total>	55.91	13.95m	244.34	101.72	101.72	22299
20	21.00	Total>	65.98	16.45m	260.64	105.95	105.95	23037
21	20.50	Total>	76.08	18.95m	276.97	120.80	120.80	23774
22	20.00	Total>	86.20	21.45m	293.32	139.67	139.67	24512
23	19.50	Total>	96.35	23.95m	309.71	158.63	158.63	25249
24	19.00	Total>	106.53	26.45m	326.12	175.92	175.92	25987
25	18.50	Total>	116.74	28.95m	342.56	191.30	191.30	26724
26	18.00	Total>	126.98	31.45m	359.04	205.35	205.35	27461
27	17.70	Total>	133.14	32.95m	368.94	213.48	213.48	27904
28	17.40	Total>	139.32	34.45m	378.85	221.58	221.58	28346

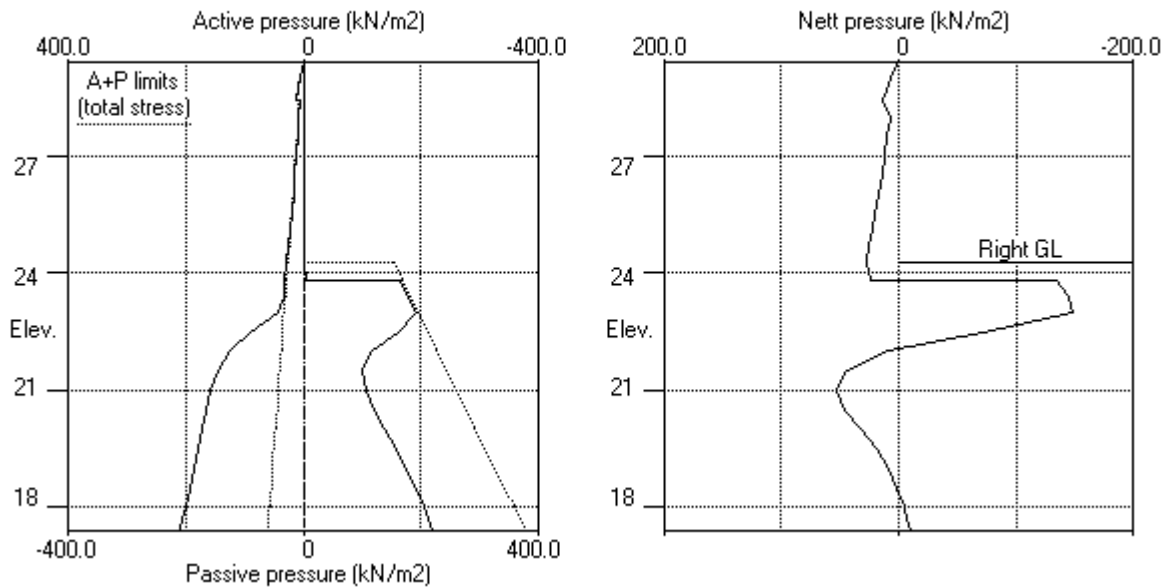
Note: 0.00a Soil pressure at active limit  
 123.45p Soil pressure at passive limit

Units: kN,m

Stage No.3 Fill to elev. 24.29 on RIGHT side



Stage No.3 Fill to elev. 24.29 on RIGHT side



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Data filename/Run ID: Camden\_High\_ 450mm\_S1\_ULS2  
Camden High  
Contiguous wall - S1 - ULS2

| Sheet No.  
| Job No. 41713A1  
| Made by : SD  
| Date:26-03-2021  
| Checked :

Units: kN,m

Stage No. 6 Apply load no.1 at elevation 29.40

**STABILITY ANALYSIS of Fully Embedded Wall according to Strength Factor method**

Factor of safety on soil strength

				Overall FoS for toe elev. = 17.40	Toe elev. for FoS = 1.000		
Stage	--- G.L. ---	Strut		Factor Moment	Toe Wall	Direction	
No.	Act. Pass.	Elev.		of equilib.	elev. Penetr	of	
				Safety at elev.	-ation	failure	
6	29.40	24.29		More than one strut.	No FoS calc.		

**BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall**

**Analysis options**

Length of wall perpendicular to section = 20.00m  
Subgrade reaction model - Boussinesq Influence coefficients  
Soil deformations are elastic until the active or passive limit is reached  
Open Tension Crack analysis - No

Rigid boundaries: Left side 30.00 from wall  
Right side 30.00 from wall

**Limit State: ULS DAI Combination 2**

Node no.	Y coord	Nett pressure kN/m2	Wall disp. m	Wall rotation rad.	Shear force kN/m	Bending moment kN.m/m	Strut forces kN/m	EI of wall kN.m2/m
1	29.40	0.00	0.057	1.01E-02	45.0	-0.0	-45.0	67000
2	29.00	6.17	0.053	1.00E-02	46.2	18.2	52.6	67000
		6.17	0.053	1.00E-02	-6.4	18.2		
3	28.70	9.97	0.050	1.00E-02	-4.0	16.6		67000
4	28.40	13.20	0.047	9.93E-03	-0.5	15.9		67000
		5.59	0.047	9.93E-03	-0.5	15.9		
5	27.95	8.96	0.043	9.82E-03	2.8	16.3		67000
6	27.50	11.78	0.038	9.71E-03	7.5	18.5		67000
7	27.00	14.40	0.033	9.55E-03	14.0	23.8		67000
8	26.50	16.62	0.029	9.34E-03	21.8	32.7		67000
9	26.00	18.60	0.024	9.04E-03	30.6	45.7		67000
10	25.50	21.11	0.020	8.64E-03	40.5	63.4		67000
11	25.10	23.18	0.016	8.20E-03	49.3	81.3		67000
12	24.70	25.36	0.013	7.65E-03	59.1	103.0	-3.5	67000
		25.36	0.013	7.65E-03	62.5	103.0		
13	24.29	27.74	0.010	6.94E-03	73.4	130.8		67000
		27.58	0.010	6.94E-03	73.4	130.8		
14	23.79	23.98	0.007	5.81E-03	86.3	170.6		67000
		-135.90	0.007	5.81E-03	86.3	170.6		
15	23.40	-145.78	0.005	4.74E-03	30.6	193.8		67000
16	23.00	-149.54	0.003	3.59E-03	-27.7	196.8		67000
17	22.50	-71.37	0.002	2.22E-03	-82.9	171.0		67000
18	22.00	7.91	0.001	1.13E-03	-98.8	120.6		67000
19	21.50	44.24	0.000	4.13E-04	-85.7	72.2		67000
20	21.00	52.40	0.000	1.45E-05	-61.6	34.8		67000
21	20.50	45.39	0.000	-1.54E-04	-37.1	10.6		67000
22	20.00	32.61	0.000	-1.85E-04	-17.6	-2.3		67000
23	19.50	19.70	0.001	-1.50E-04	-4.5	-7.1		67000
24	19.00	9.18	0.001	-9.84E-05	2.7	-6.9		67000
25	18.50	1.38	0.001	-5.60E-05	5.3	-4.4		67000
26	18.00	-4.49	0.001	-3.34E-05	4.5	-1.6		67000

| Sheet No.  
| Date:26-03-2021  
| Checked :

Stage No.6    Apply load no.1 at elevation 29.40

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Run ID. Camden\_High\_ 450mm\_S1\_ULS2  
 Camden High  
 Contiguous wall - S1 - ULS2

| Sheet No.  
 | Date:26-03-2021  
 | Checked :

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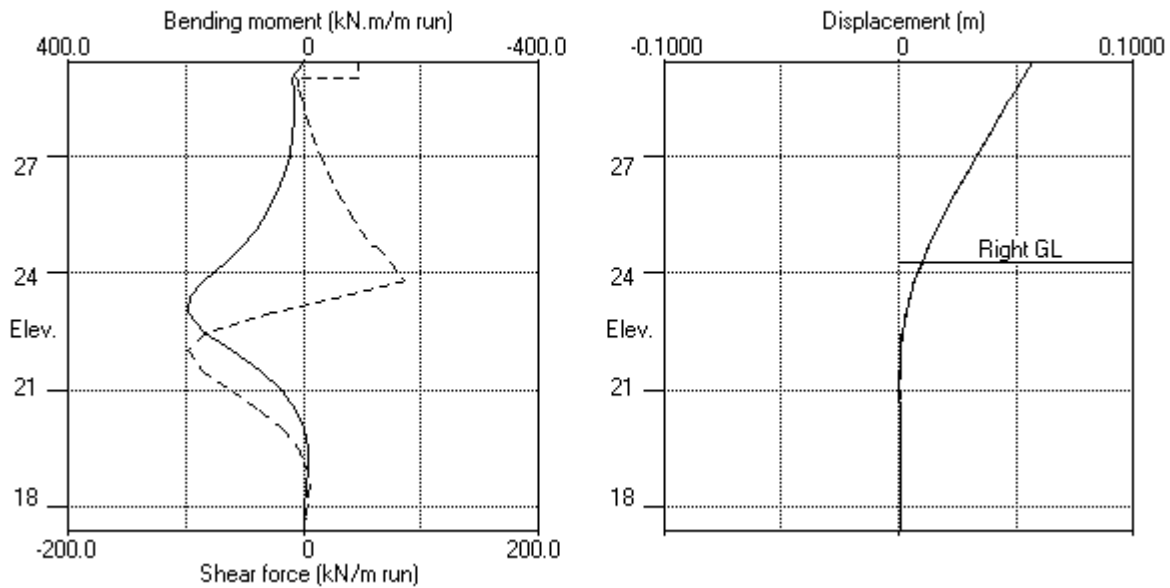
Stage No.6 Apply load no.1 at elevation 29.40

Node no.	Y coord	----- RIGHT side -----						
		Water press. kN/m2	----- Vertic -al kN/m2	Effective Active limit kN/m2	stresses Passive limit kN/m2	Earth pressure kN/m2	Total earth pressure kN/m2	Coeff. of subgrade reaction kN/m3
12	24.70	0.00	0.00	0.00	0.00	0.00	0.00	0.0
13	24.29	0.00	0.00	0.00	0.00	0.00	0.00	0.0
		Total>	0.00	0.00	153.64	0.17	0.17	30738
14	23.79	Total>	10.00	2.50m	169.88	6.82	6.82	31985
		Total>	10.00	2.50m	169.88	166.70	166.70	31985
15	23.40	Total>	17.90	4.47m	182.71	179.04	179.04	32969
16	23.00	Total>	25.81	6.45m	195.54	191.40	191.40	33954
17	22.50	Total>	35.83	8.95m	211.79	163.16	163.16	35201
18	22.00	Total>	45.86	11.45m	228.06	117.43	117.43	36447
19	21.50	Total>	55.91	13.95m	244.34	101.84	101.84	37694
20	21.00	Total>	65.98	16.45m	260.64	106.00	106.00	38940
21	20.50	Total>	76.08	18.95m	276.97	120.81	120.81	40187
22	20.00	Total>	86.20	21.45m	293.32	139.67	139.67	44625
23	19.50	Total>	96.35	23.95m	309.71	158.61	158.61	45968
24	19.00	Total>	106.53	26.45m	326.12	175.90	175.90	47310
25	18.50	Total>	116.74	28.95m	342.56	191.28	191.28	48653
26	18.00	Total>	126.98	31.45m	359.04	205.33	205.33	49995
27	17.70	Total>	133.14	32.95m	368.94	213.47	213.47	50801
28	17.40	Total>	139.32	34.45m	378.85	221.57	221.57	51606

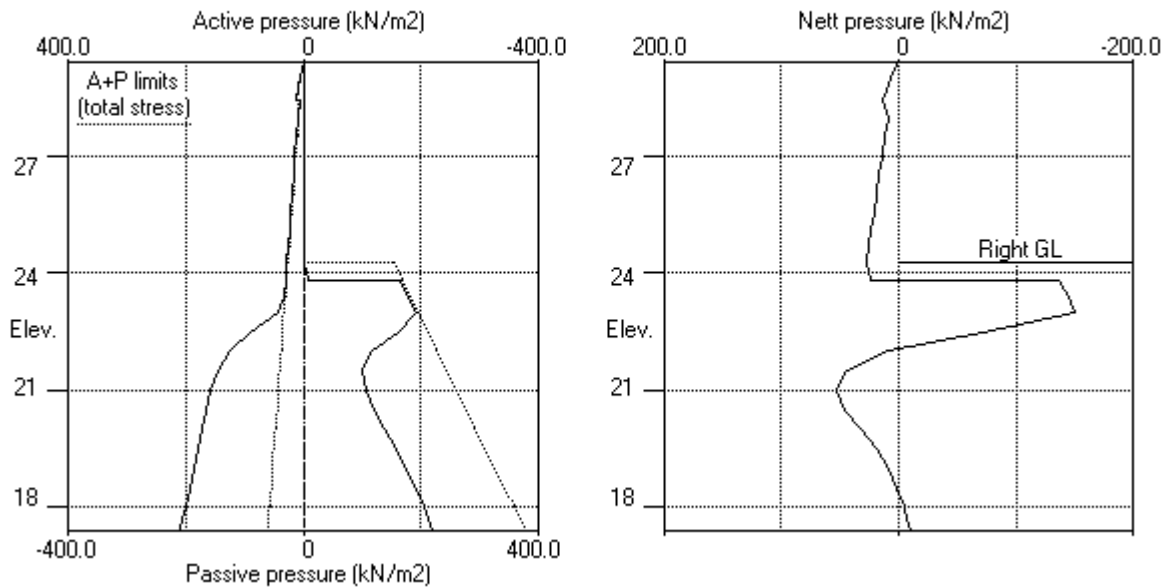
Note: 9.97a Soil pressure at active limit  
 123.45p Soil pressure at passive limit

Units: kN,m

Stage No.6 Apply load no.1 at elev. 29.40



Stage No.6 Apply load no.1 at elev. 29.40



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 Data filename/Run ID: Camden\_High\_ 450mm\_S1\_ULS2  
 Camden High  
 Contiguous wall - S1 - ULS2

| Sheet No.  
 | Job No. 41713A1  
 | Made by : SD  
 | Date:26-03-2021  
 | Checked :

Units: kN,m

Stage No. 7 Change properties of soil type 2 to soil type 3  
 Ko pressures will not be reset

**STABILITY ANALYSIS of Fully Embedded Wall according to Strength Factor method**  
 Factor of safety on soil strength

				Overall				
				FoS for toe		Toe elev. for		
				elev. = 17.40		FoS = 1.000		
				-----		-----		
Stage	--- G.L. ---	Strut	Factor	Moment	Toe	Wall	Direction	
No.	Act. Pass.	Elev.	of	equilib.	elev.	Penetr	of	
			Safety	at elev.		-ation	failure	
7	29.40	24.29	More than one strut.	No FoS calc.				

**BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall**

**Analysis options**

Length of wall perpendicular to section = 20.00m  
 Subgrade reaction model - Boussinesq Influence coefficients  
 Soil deformations are elastic until the active or passive limit is reached  
 Open Tension Crack analysis - No

Rigid boundaries: Left side 30.00 from wall  
 Right side 30.00 from wall

**Limit State: ULS DA1 Combination 2**

Node no.	Y coord	Nett pressure kN/m2	Wall disp. m	Wall rotation rad.	Shear force kN/m	Bending moment kN.m/m	Strut forces kN/m	EI of wall kN.m2/m
1	29.40	0.00	0.057	1.03E-02	45.0	-0.0	-45.0	67000
2	29.00	6.17	0.053	1.02E-02	46.2	18.2	53.6	67000
		6.17	0.053	1.02E-02	-7.4	18.2		
3	28.70	10.08	0.050	1.01E-02	-5.0	16.3		67000
4	28.40	13.52	0.047	1.01E-02	-1.4	15.3		67000
		13.10	0.047	1.01E-02	-1.4	15.3		
5	27.95	17.78	0.042	1.00E-02	5.5	16.1		67000
6	27.50	22.21	0.038	9.89E-03	14.5	20.5		67000
7	27.00	27.00	0.033	9.70E-03	26.8	30.7		67000
8	26.50	31.70	0.028	9.41E-03	41.5	47.7		67000
9	26.00	36.33	0.024	8.96E-03	58.5	72.6		67000
10	25.50	40.93	0.019	8.29E-03	77.8	106.5		67000
11	25.10	44.59	0.016	7.55E-03	94.9	141.0		67000
12	24.70	48.23	0.013	6.58E-03	113.5	182.6	196.4	67000
		48.23	0.013	6.58E-03	-82.9	182.6		
13	24.29	51.95	0.011	5.56E-03	-62.4	152.8		67000
14	23.79	34.28	0.008	4.51E-03	-40.8	127.2		67000
15	23.40	20.31	0.007	3.80E-03	-30.0	113.3		67000
16	23.00	6.33	0.005	3.16E-03	-24.8	105.1		67000
17	22.50	-11.39	0.004	2.41E-03	-26.0	96.2		67000
18	22.00	-8.16	0.003	1.75E-03	-30.9	79.8		67000
19	21.50	-4.74	0.002	1.22E-03	-34.2	61.8		67000
20	21.00	11.45	0.002	8.30E-04	-32.5	45.0		67000
21	20.50	16.59	0.001	5.50E-04	-25.5	30.2		67000
22	20.00	14.31	0.001	3.65E-04	-17.7	19.5		67000
23	19.50	9.66	0.001	2.46E-04	-11.8	12.4		67000
24	19.00	5.18	0.001	1.71E-04	-8.0	7.7		67000
25	18.50	2.18	0.001	1.26E-04	-6.2	4.3		67000
26	18.00	5.41	0.001	1.04E-04	-4.3	1.5		67000
27	17.70	7.17	0.001	1.00E-04	-2.4	0.4		67000



Stage No.7    Change properties of soil type 2 to soil type 3  
                  Ko pressures will not be reset

Node no.	Y coord	Nett pressure kN/m2	Wall disp. m	Wall rotation rad.	Shear force kN/m	Bending moment kN.m/m	Strut forces kN/m	EI of wall kN.m2/m ---
28	17.40	8.96	0.001	9.96E-05	0.0	0.0		
At elev. 29.00		Strut force =		53.6 kN/strut =		53.6 kN/m	run	
At elev. 24.70		Strut force =		196.4 kN/strut =		196.4 kN/m	run	

Node no.	Y coord	LEFT side						Total earth pressure kN/m <sup>2</sup>	Coeff. of subgrade reaction kN/m <sup>3</sup>
		Effective stresses							
		Water press. kN/m <sup>2</sup>	Vertic -al kN/m <sup>2</sup>	Active limit kN/m <sup>2</sup>	Passive limit kN/m <sup>2</sup>	Earth pressure kN/m <sup>2</sup>			
1	29.40	0.00	0.00	0.00	0.00	0.00	0.00	1164	
2	29.00	0.00	13.05	6.17	30.27	6.17	6.17a	6986	
3	28.70	0.00	21.10	9.97	48.94	10.08	10.08	2085	
4	28.40	0.00	27.73	13.10	64.34	13.52	13.52	2979	
		0.00	27.73	13.10	61.59	13.10	13.10a	10053	
5	27.95	0.00	37.62	17.78	83.55	17.78	17.78a	10604	
6	27.50	0.00	47.01	22.21	104.39	22.21	22.21a	11154	
7	27.00	0.00	57.14	27.00	126.89	27.00	27.00a	11766	
8	26.50	0.00	67.08	31.70	148.97	31.70	31.70a	12377	
9	26.00	0.00	76.89	36.33	170.76	36.33	36.33a	12989	
10	25.50	0.00	86.61	40.93	192.36	40.93	40.93a	13600	
11	25.10	0.00	94.35	44.59	209.53	44.59	44.59a	14090	
12	24.70	0.00	102.06	48.23	226.65	48.23	48.23a	12985	
13	24.29	0.00	109.94	51.95	244.16	51.95	51.95a	13432	
14	23.79	0.00	119.54	56.49	265.47	56.49	56.49a	13977	
15	23.40	0.00	127.12	60.07	282.30	60.07	60.07a	14407	
16	23.00	0.00	134.69	63.65	299.13	63.65	63.65a	14837	
17	22.50	0.00	144.29	68.18	320.44	68.18	68.18a	15382	
18	22.00	0.00	153.90	72.72	341.77	93.69	93.69	15927	
19	21.50	0.00	163.51	77.27	363.13	119.43	119.43	16472	
20	21.00	0.00	173.15	81.82	384.53	137.93	137.93	17016	
21	20.50	0.00	182.80	86.38	405.95	151.80	151.80	17561	
22	20.00	0.00	192.46	90.95	427.42	163.13	163.13	18106	
23	19.50	5.00	197.14	93.16	437.82	168.30	173.30	18650	
24	19.00	10.00	201.84	95.38	448.25	173.08	183.08	19195	
25	18.50	15.00	206.56	97.61	458.72	178.06	193.06	56387	
26	18.00	20.00	211.29	99.84	469.22	185.79	205.79	57943	
27	17.70	23.00	214.13	101.19	475.54	190.26	213.26	58876	
28	17.40	26.00	216.98	102.53	481.87	194.75	220.75	59810	

[illegible]

Run ID. Camden\_High\_ 450mm\_S1\_ULS2  
 Camden High  
 Contiguous wall - S1 - ULS2

| Sheet No.  
 | Date:26-03-2021  
 | Checked :

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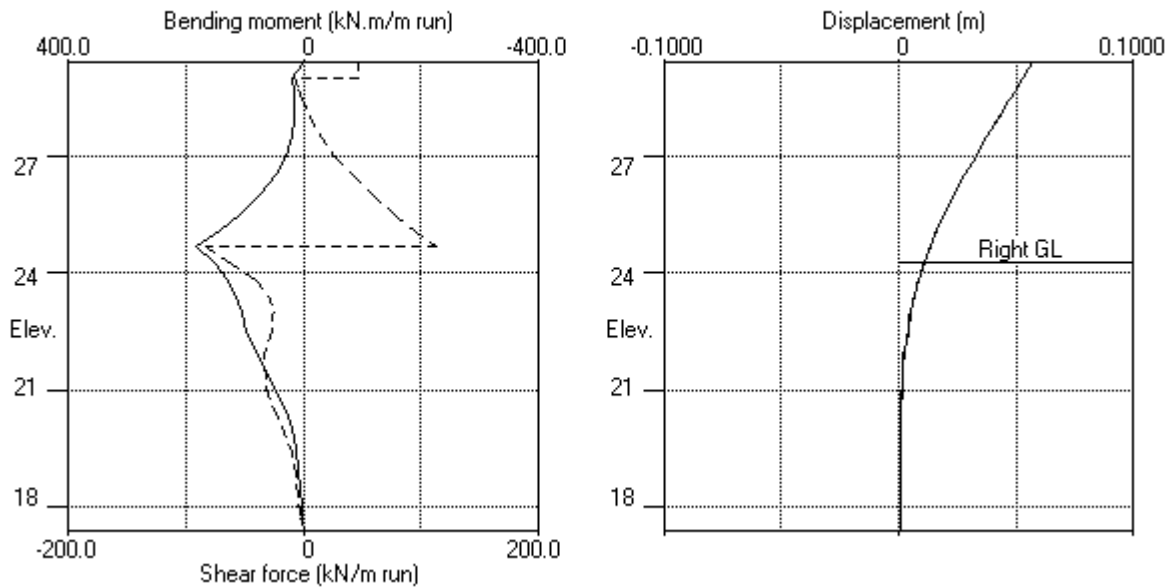
Stage No.7 Change properties of soil type 2 to soil type 3  
 Ko pressures will not be reset

Node no.	Y coord	----- RIGHT side -----						
		Water press. kN/m2	----- Vertic -al kN/m2	Effective Active limit kN/m2	Effective stresses Passive limit kN/m2	Earth pressure kN/m2	Total earth pressure kN/m2	Coeff. of subgrade reaction kN/m3
12	24.70	0.00	0.00	0.00	0.00	0.00	0.00	0.0
13	24.29	0.00	0.00	0.00	0.00	0.00	0.00	0.0
		0.00	0.00	0.00	0.00	0.00	0.00	13432
14	23.79	0.00	10.00	4.73	22.21	22.21	22.21p	13977
15	23.40	0.00	17.90	8.46	39.76	39.76	39.76p	14407
16	23.00	0.00	25.81	12.20	57.32	57.32	57.32p	14837
17	22.50	0.00	35.83	16.93	79.57	79.57	79.57p	15382
18	22.00	0.00	45.86	21.67	101.85	101.85	101.85p	15927
19	21.50	0.00	55.91	26.42	124.17	124.17	124.17p	16472
20	21.00	0.00	65.98	31.18	146.54	126.48	126.48	17016
21	20.50	0.00	76.08	35.95	168.95	135.21	135.21	17561
22	20.00	0.00	86.20	40.73	191.43	148.82	148.82	18106
23	19.50	5.00	91.35	43.17	202.86	158.63	163.63	18650
24	19.00	10.00	96.53	45.61	214.36	167.90	177.90	19195
25	18.50	15.00	101.74	48.08	225.94	175.89	190.89	56387
26	18.00	20.00	106.98	50.55	237.58	180.38	200.38	57943
27	17.70	23.00	110.14	52.05	244.61	183.10	206.10	58876
28	17.40	26.00	113.32	53.55	251.66	185.78	211.78	59810

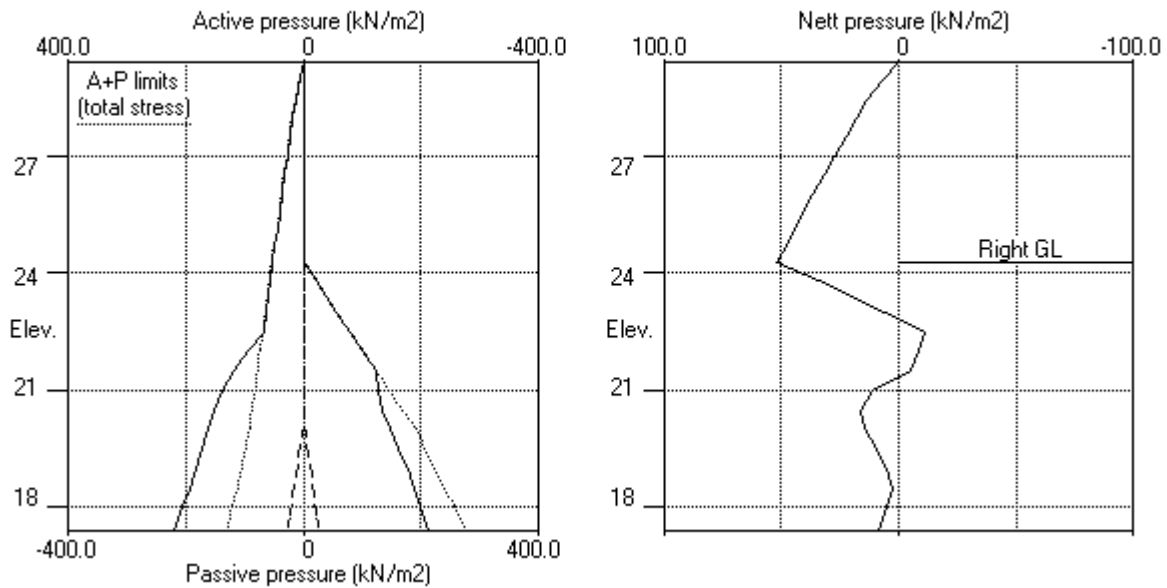
Note: 68.18a Soil pressure at active limit  
 124.17p Soil pressure at passive limit

Units: kN,m

Stage No.7 Change soil type 2 to soil type 3



Stage No.7 Change soil type 2 to soil type 3



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Data filename/Run ID: Camden\_High\_ 450mm\_S1\_ULS2  
Camden High  
Contiguous wall - S1 - ULS2

Sheet No.  
Job No. 41713A1  
Made by : SD  
Date:26-03-2021  
Checked :

Units: kN,m

Stage No. 8 Change EI of wall to 46900 kN.m2/m run  
Yield moment not defined  
Allow wall to relax with new modulus value

# **STABILITY ANALYSIS of Fully Embedded Wall according to Strength Factor method**

Factor of safety on soil strength

			Overall				
			FoS for toe		Toe elev. for		
			elev. = 17.40		FoS = 1.000		
			-----		-----		
Stage	--- G.L. ---	Strut	Factor	Moment	Toe	Wall	Direction
No.	Act. Pass.	Elev.	of	equilib.	elev.	Penetr	of
			Safety	at elev.		-ation	failure
8	29.40 24.29		More than one strut.	No FoS calc.			

# **BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall**

## **Analysis options**

Length of wall perpendicular to section = 20.00m  
Subgrade reaction model - Boussinesq Influence coefficients  
Soil deformations are elastic until the active or passive limit is reached  
Open Tension Crack analysis - No

Rigid boundaries: Left side 30.00 from wall  
Right side 30.00 from wall

## **Limit State: ULS DA1 Combination 2**

Node no.	Y coord	Nett pressure kN/m2	Wall disp. m	Wall rotation rad.	Shear force kN/m	Bending moment kN.m/m	Strut forces kN/m	EI of wall kN.m2/m
1	29.40	0.00	0.057	1.01E-02	45.0	-0.0	-45.0	46900
2	29.00	6.17	0.053	1.00E-02	46.2	18.2	63.1	46900
		6.17	0.053	1.00E-02	-16.9	18.2		
3	28.70	9.97	0.050	9.98E-03	-14.5	14.1		46900
4	28.40	13.11	0.047	9.91E-03	-11.0	10.9		46900
5	27.95	17.78	0.043	9.83E-03	-4.1	8.4		46900
6	27.50	22.21	0.038	9.78E-03	4.9	9.5		46900
7	27.00	27.00	0.033	9.68E-03	17.2	16.0		46900
8	26.50	31.70	0.029	9.49E-03	31.9	29.3		46900
9	26.00	36.33	0.024	9.13E-03	48.9	50.5		46900
10	25.50	40.93	0.019	8.51E-03	68.2	80.8		46900
11	25.10	44.59	0.016	7.76E-03	85.3	112.3		46900
12	24.70	48.50	0.013	6.71E-03	104.0	151.0	181.8	46900
		48.50	0.013	6.71E-03	-77.9	151.0		
13	24.29	52.77	0.011	5.59E-03	-57.1	122.7		46900
14	23.79	36.24	0.008	4.50E-03	-34.9	99.3		46900
15	23.40	22.11	0.007	3.79E-03	-23.3	87.3		46900
16	23.00	7.88	0.005	3.14E-03	-17.4	81.2		46900
17	22.50	-10.30	0.004	2.38E-03	-18.0	75.3		46900
18	22.00	-7.91	0.003	1.71E-03	-22.6	62.2		46900
19	21.50	-5.03	0.002	1.17E-03	-25.8	47.3		46900
20	21.00	10.10	0.002	7.86E-04	-24.5	33.8		46900
21	20.50	14.59	0.001	5.21E-04	-18.4	21.9		46900
22	20.00	11.92	0.001	3.53E-04	-11.7	13.7		46900
23	19.50	7.14	0.001	2.49E-04	-7.0	8.7		46900
24	19.00	2.71	0.001	1.82E-04	-4.5	5.6		46900
25	18.50	-0.14	0.001	1.39E-04	-3.9	3.4		46900
26	18.00	3.26	0.001	1.16E-04	-3.1	1.2		46900
27	17.70	5.12	0.001	1.12E-04	-1.8	0.3		46900

| Sheet No.  
| Date:26-03-2021  
| Checked :

Stage No.8    Change EI of wall to 46900 kN.m<sup>2</sup>/m run  
Yield moment not defined  
Allow wall to relax with new modulus value

[illegible]

Run ID. Camden\_High\_ 450mm\_S1\_ULS2  
 Camden High  
 Contiguous wall - S1 - ULS2

| Sheet No.  
 | Date:26-03-2021  
 | Checked :

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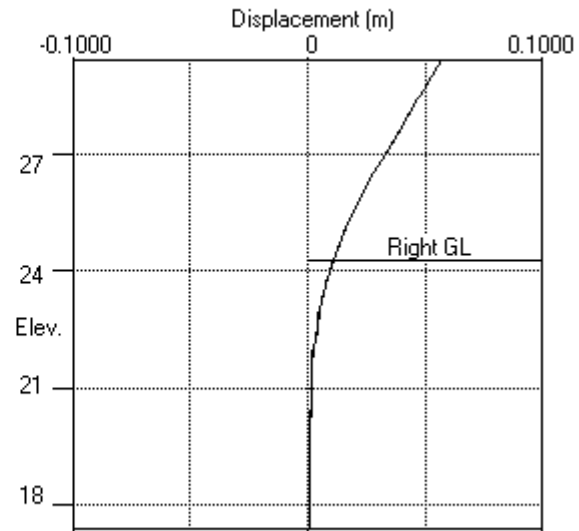
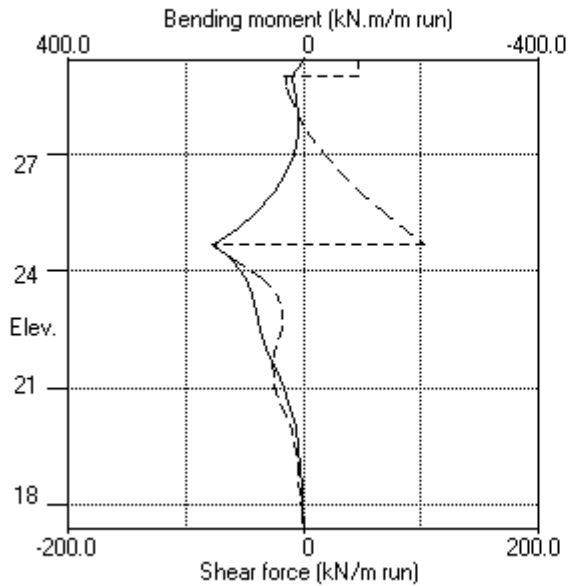
Stage No.8 Change EI of wall to 46900 kN.m2/m run  
 Yield moment not defined  
 Allow wall to relax with new modulus value

Node no.	Y coord	----- RIGHT side -----						Total earth pressure kN/m2	Coeff. of subgrade reaction kN/m3
		Water press. kN/m2	Vertic -al kN/m2	Active limit kN/m2	Passive limit kN/m2	Earth pressure kN/m2			
11	25.10	0.00	0.00	0.00	0.00	0.00	0.00	0.0	
12	24.70	0.00	0.00	0.00	0.00	0.00	0.00	0.0	
13	24.29	0.00	0.00	0.00	0.00	0.00	0.00	0.0	
		0.00	0.00	0.00	0.00	0.00	0.00	18764	
14	23.79	0.00	10.00	4.73	22.21	21.19	21.19	19525	
15	23.40	0.00	17.90	8.46	39.76	38.82	38.82	20126	
16	23.00	0.00	25.81	12.20	57.32	56.51	56.51	20727	
17	22.50	0.00	35.83	16.93	79.57	79.01	79.01	21488	
18	22.00	0.00	45.86	21.67	101.85	101.72	101.72	22249	
19	21.50	0.00	55.91	26.42	124.17	124.17	124.17p	15054	
20	21.00	0.00	65.98	31.18	146.54	127.16	127.16	15551	
21	20.50	0.00	76.08	35.95	168.95	136.21	136.21	16049	
22	20.00	0.00	86.20	40.73	191.43	150.01	150.01	16547	
23	19.50	5.00	91.35	43.17	202.86	159.90	164.90	17045	
24	19.00	10.00	96.53	45.61	214.36	169.13	179.13	17543	
25	18.50	15.00	101.74	48.08	225.94	177.04	192.04	18040	
26	18.00	20.00	106.98	50.55	237.58	181.46	201.46	18538	
27	17.70	23.00	110.14	52.05	244.61	184.12	207.12	18837	
28	17.40	26.00	113.32	53.55	251.66	186.76	212.76	19136	

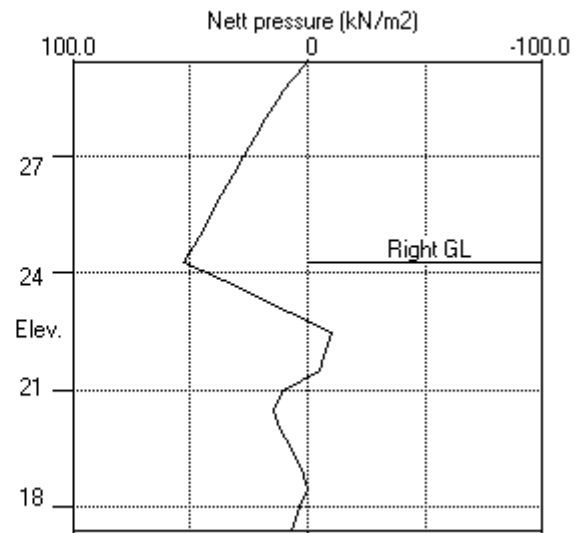
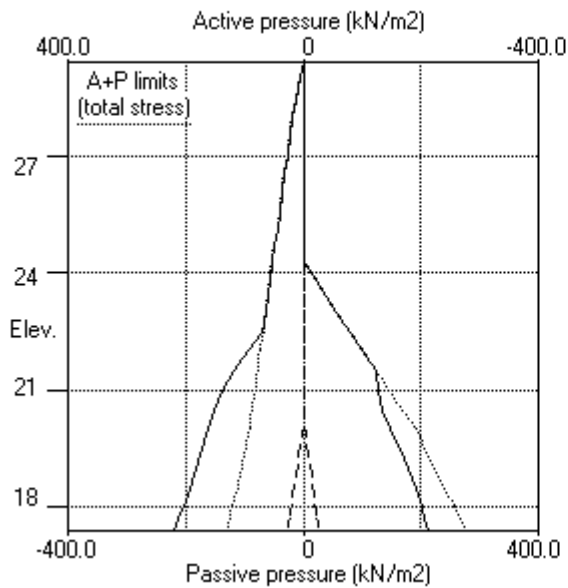
Note: 44.59a Soil pressure at active limit  
 124.17p Soil pressure at passive limit

Units: kN,m

Stage No.8 Change EI of wall to 46900kN.m<sup>2</sup>/m run



Stage No.8 Change EI of wall to 46900kN.m<sup>2</sup>/m run



CENTRAL PILING LTD	Sheet No.
Program: WALLAP Version 6.06 Revision A51.B69.R55	Job No. 41713A1
Licensed from GEOSOLVE	Made by : SD
Data filename/Run ID: Camden_High_ 450mm_S1_ULS2	
Camden High	Date:26-03-2021
Contiguous wall - S1 - ULS2	Checked :

Units: kN,m

Stage No. 9    Apply water pressure profile no.1    ( Worst Cred. )

## STABILITY ANALYSIS of Fully Embedded Wall according to Strength Factor method

Factor of safety on soil strength

			Overall				
			FoS for toe		Toe elev. for		
			elev. = 17.40		FoS = 1.000		
			-----		-----		
Stage	--- G.L. ---	Strut	Factor	Moment	Toe	Wall	Direction
No.	Act.	Pass.	Elev.	of	elev.	Penetr	of
				equilib.		-ation	failure
				Safety	at elev.		
9	29.40	24.29		More than one strut.	No FoS calc.		

## BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall

## Analysis options

Length of wall perpendicular to section = 20.00m

Subgrade reaction model - Boussinesq Influence coefficients

Soil deformations are elastic until the active or passive limit is reached

Open Tension Crack analysis - No

Rigid boundaries: Left side 30.00 from wall

Right side 30.00 from wall

Limit State: ULS DA1 Combination 2

Node no.	Y coord	Nett pressure kN/m2	Wall disp. m	Wall rotation rad.	Shear force kN/m	Bending moment kN.m/m	Strut forces kN/m	EI of wall kN.m2/m
1	29.40	0.00	0.057	1.03E-02	45.0	-0.0	-45.0	46900
2	29.00	6.17	0.053	1.02E-02	46.2	18.2	63.9	46900
		6.17	0.053	1.02E-02	-17.7	18.2		
3	28.70	10.09	0.050	1.01E-02	-15.2	13.9		46900
4	28.40	13.47	0.047	1.01E-02	-11.7	10.5		46900
		14.29	0.047	1.01E-02	-11.7	10.5		
5	27.95	22.48	0.042	1.00E-02	-3.4	7.9		46900
6	27.50	30.55	0.038	9.98E-03	8.5	9.8		46900
7	27.00	39.46	0.033	9.87E-03	26.0	19.2		46900
8	26.50	48.15	0.028	9.61E-03	47.9	38.6		46900
9	26.00	56.19	0.023	9.10E-03	74.0	70.0		46900
10	25.50	62.75	0.019	8.19E-03	103.7	115.4		46900
11	25.10	66.06	0.016	7.07E-03	129.5	162.9		46900
12	24.70	67.59	0.013	5.51E-03	156.2	221.1	305.6	46900
		67.59	0.013	5.51E-03	-149.3	221.1		
13	24.29	68.18	0.011	3.90E-03	-121.5	165.2		46900
14	23.79	52.15	0.010	2.52E-03	-91.4	111.1		46900
15	23.40	45.81	0.009	1.79E-03	-72.1	78.3		46900
16	23.00	39.46	0.008	1.30E-03	-55.2	55.0		46900
17	22.50	31.41	0.008	8.95E-04	-37.5	34.5		46900
18	22.00	23.32	0.007	6.84E-04	-23.8	16.5		46900
19	21.50	15.21	0.007	6.24E-04	-14.2	4.4		46900
20	21.00	9.26	0.007	6.36E-04	-8.1	1.0		46900
21	20.50	8.84	0.007	6.77E-04	-3.6	-2.9		46900
22	20.00	7.72	0.006	7.38E-04	0.6	-4.2		46900
23	19.50	3.18	0.006	7.95E-04	3.3	-3.7		46900
24	19.00	-0.59	0.005	8.35E-04	4.0	-2.2		46900
25	18.50	-3.33	0.005	8.56E-04	3.0	-0.8		46900
26	18.00	-2.78	0.005	8.63E-04	1.5	-0.2		46900
27	17.70	-2.44	0.004	8.64E-04	0.7	-0.0		46900
28	17.40	-2.00	0.004	8.64E-04	0.0	0.0		---
At elev. 29.00 Strut force =				63.9 kN/strut =	63.9 kN/m run			
At elev. 24.70 Strut force =				305.6 kN/strut =	305.6 kN/m run			



(continued)

Stage No.9 Apply water pressure profile no.1 ( Worst Cred. )

Node no.	Y coord	LEFT side						
		Effective stresses					Total earth pressure	Coeff. of subgrade reaction
		Water press. kN/m2	Vertic -al kN/m2	Active limit kN/m2	Passive limit kN/m2	Earth pressure kN/m2		
1	29.40	0.00	0.00	0.00	0.00	0.00	0.00	1172
2	29.00	0.00	13.05	6.17	30.27	6.17	6.17a	7031
3	28.70	0.00	21.10	9.97	48.94	10.09	10.09	2081
4	28.40	0.00	27.73	13.10	64.34	13.47	13.47	2972
		0.00	27.73	13.10	61.59	14.29	14.29	10032
5	27.95	3.31	34.31	16.22	76.20	19.17	22.48	10581
6	27.50	6.61	40.39	19.09	89.71	23.94	30.55	11130
7	27.00	10.29	46.85	22.14	104.05	29.17	39.46	11740
8	26.50	13.96	53.12	25.10	117.96	34.19	48.15	12351
9	26.00	17.64	59.25	28.00	131.59	38.55	56.19	12961
10	25.50	21.31	65.30	30.86	145.02	41.43	62.75	13571
11	25.10	24.25	70.10	33.12	155.67	41.80	66.06	14059
12	24.70	27.19	74.87	35.38	166.26	40.39	67.59	9488
13	24.29	30.20	79.74	37.68	177.08	37.98	68.18	9815
14	23.79	33.88	85.66	40.48	190.23	40.48	74.36a	10213
15	23.40	36.78	90.33	42.69	200.61	42.69	79.47a	10527
16	23.00	39.68	95.01	44.90	210.99	44.90	84.58a	10842
17	22.50	43.36	100.93	47.69	224.15	47.69	91.05a	11240
18	22.00	47.03	106.86	50.50	237.32	50.50	97.53a	11638
19	21.50	50.71	112.81	53.31	250.52	53.31	104.01a	12036
20	21.00	54.38	118.76	56.12	263.75	58.32	112.70	12434
21	20.50	58.06	124.74	58.94	277.02	68.93	126.99	12832
22	20.00	61.73	130.73	61.78	290.32	78.88	140.61	13230
23	19.50	65.41	136.74	64.61	303.66	85.48	150.89	13628
24	19.00	69.08	142.76	67.46	317.04	92.92	162.00	14026
25	18.50	72.76	148.80	70.32	330.46	101.46	174.22	14424
26	18.00	76.43	154.86	73.18	343.90	113.37	189.80	14822
27	17.70	78.63	158.50	74.90	351.99	120.55	199.19	15061
28	17.40	80.84	162.14	76.62	360.09	127.87	208.71	15300

Node no.	Y coord	RIGHT side						
		Effective stresses					Total earth pressure kN/m2	Coeff. of subgrade reaction kN/m3
		Water press. kN/m2	Vertic -al kN/m2	Active limit kN/m2	Passive limit kN/m2	Earth pressure kN/m2		
1	29.40	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	29.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
3	28.70	0.00	0.00	0.00	0.00	0.00	0.00	0.0
4	28.40	0.00	0.00	0.00	0.00	0.00	0.00	0.0
5	27.95	0.00	0.00	0.00	0.00	0.00	0.00	0.0
6	27.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
7	27.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
8	26.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
9	26.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
10	25.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
11	25.10	0.00	0.00	0.00	0.00	0.00	0.00	0.0
12	24.70	0.00	0.00	0.00	0.00	0.00	0.00	0.0
13	24.29	0.00	0.00	0.00	0.00	0.00	0.00	0.0
		0.00	0.00	0.00	0.00	0.00	0.00	9815
14	23.79	0.00	10.00	4.73	22.21	22.21	22.21p	10213
15	23.40	5.00	12.91	6.10	28.66	28.66	33.66p	10527
16	23.00	9.99	15.82	7.47	35.13	35.13	45.12p	10842
17	22.50	16.32	19.51	9.22	43.33	43.33	59.65p	11240
18	22.00	22.65	23.22	10.97	51.56	51.56	74.21p	11638

Run ID. Camden\_High\_ 450mm\_S1\_ULS2  
 Camden High  
 Contiguous wall - S1 - ULS2

| Sheet No.  
 | Date:26-03-2021  
 | Checked :

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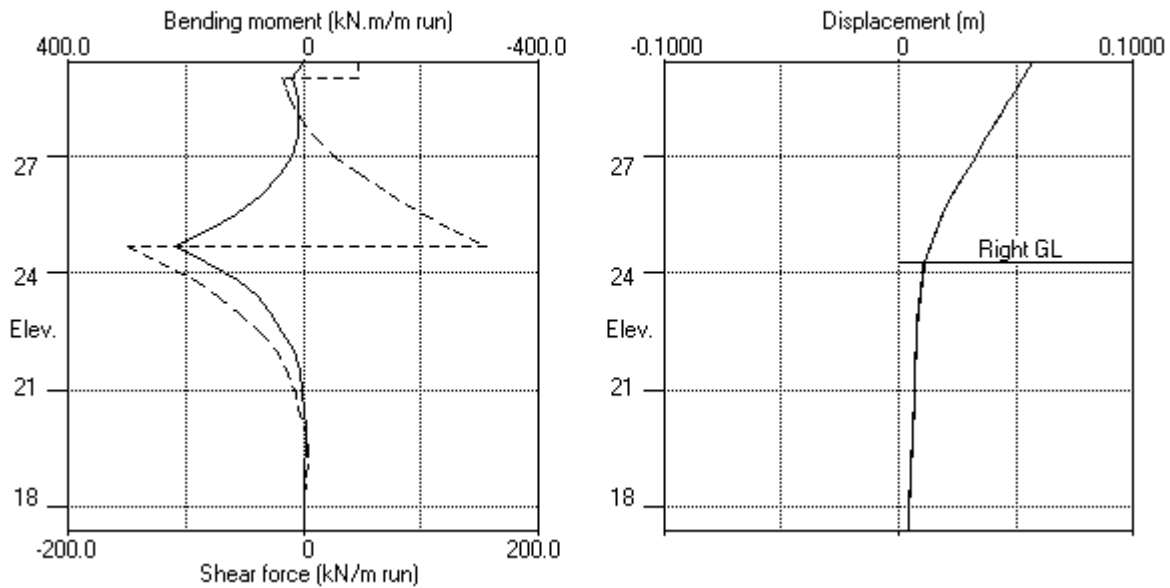
Stage No.9    Apply water pressure profile no.1    ( Worst Cred. )

Node no.	Y coord	----- RIGHT side -----						
		----- Effective stresses -----					Total earth pressure	Coeff. of subgrade reaction
		Water press. kN/m2	Vertic -al kN/m2	Active limit kN/m2	Passive limit kN/m2	Earth pressure kN/m2		
19	21.50	28.97	26.94	12.73	59.83	59.83	88.80p	12036
20	21.00	35.30	30.69	14.50	68.15	68.15	103.45p	12434
21	20.50	41.62	34.46	16.28	76.52	76.52	118.14p	12832
22	20.00	47.95	38.25	18.08	84.95	84.95	132.89p	13230
23	19.50	54.27	42.07	19.88	93.44	93.44	147.71p	13628
24	19.00	60.60	45.93	21.70	102.00	102.00	162.59p	14026
25	18.50	66.92	49.81	23.54	110.63	110.63	177.55p	14424
26	18.00	73.25	53.73	25.39	119.33	119.33	192.58p	14822
27	17.70	77.04	56.10	26.51	124.59	124.59	201.63p	15061
28	17.40	80.84	58.48	27.63	129.87	129.87	210.71p	15300

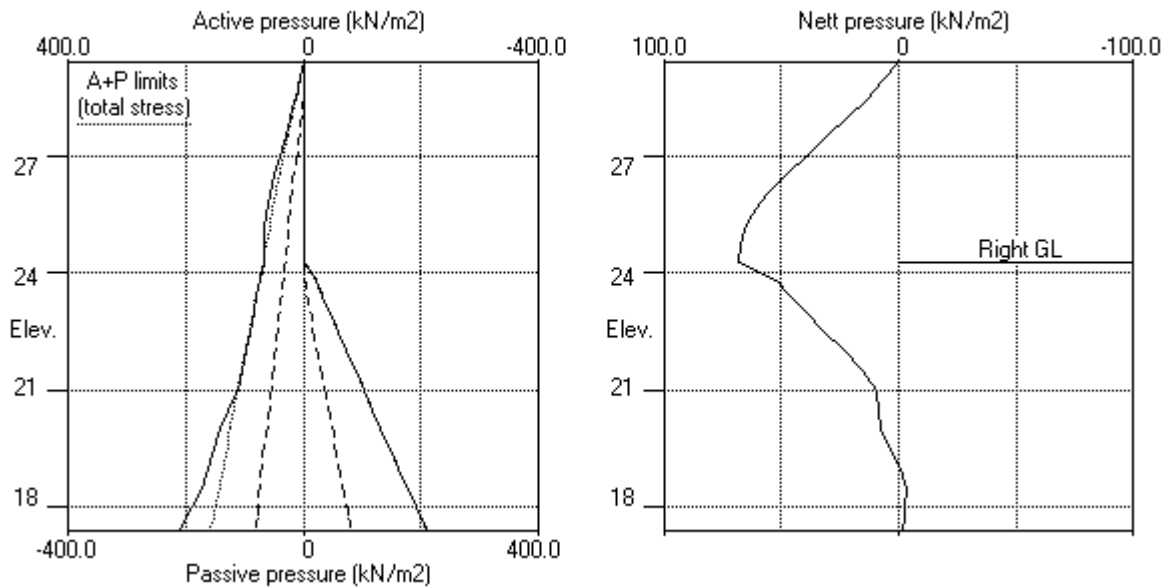
Note:        104.01a    Soil pressure at active limit  
               210.71p    Soil pressure at passive limit

Units: kN,m

Stage No.9 Apply water pressure profile no.1 ( Worst Cred. )



Stage No.9 Apply water pressure profile no.1 ( Worst Cred. )



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Program: WALLAP Version 6.06 Revision A51.B69.R55	Job No. 41713A1
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Data filename/Run ID: Camden_High_ 450mm_S1_ULS2	
Camden High	Date:26-03-2021
Contiguous wall - S1 - ULS2	Checked :

Units: kN,m

## Summary of results

### LIMIT STATE PARAMETERS

Limit State: ULS DA1 Combination 2  
 Water pressures : Worst Credible  
 Partial factor on C' = 1.250  
 Partial factor on Phi' = 1.250  
 Partial factor on Cu = 1.400  
 Partial factor on Soil Modulus = 1.000  
 Partial factor on Permanent Unfavourable loads = 1.000  
 Partial factor on Permanent Favourable loads = 1.000  
 Partial factor on Variable Unfavourable loads = 1.300

### STABILITY ANALYSIS of Fully Embedded Wall according to Strength Factor method

Factor of safety on soil strength

			Overall					
			FoS for toe		Toe elev. for			
			elev. = 17.40		FoS = 1.000			
			-----		-----			
Stage	--- G.L. ---	Strut	Factor	Moment	Toe	Wall	Direction	
No.	Act.	Pass.	Elev.	of	elev.	Penetr	of	
				Safety	at elev.	-ation	failure	
1	29.40	29.40	Cant.	Conditions not suitable for FoS calc.				
2	29.40	23.79	Cant.	2.183	18.17	20.91	2.88	L to R
3	29.40	24.29	Cant.	2.418	18.14	21.71	2.58	L to R
4	29.40	24.29	No analysis at this stage					
All remaining stages have more than one strut - FoS calculation n/a								

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Data filename/Run ID: Camden\_High\_ 450mm\_S1\_ULS2

Camden High

Contiguous wall - S1 - ULS2

| Sheet No.

| Job No. 41713A1

| Made by : SD

|

| Date:26-03-2021

| Checked :

Units: kN,m

## Summary of results

### BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall

#### Analysis options

Length of wall perpendicular to section = 20.00m

Subgrade reaction model - Boussinesq Influence coefficients

Soil deformations are elastic until the active or passive limit is reached

Open Tension Crack analysis - No

Rigid boundaries: Left side 30.00 from wall

Right side 30.00 from wall

Limit State: ULS DAI Combination 2

### Bending moment, shear force and displacement envelopes

Node no.	Y coord	Displacement		Bending moment		Shear force	
		maximum m	minimum m	maximum kN.m/m	minimum kN.m/m	maximum kN/m	minimum kN/m
1	29.40	0.057	0.000	0.0	-0.0	45.0	0.0
2	29.00	0.053	0.000	18.2	0.0	46.2	-17.7
3	28.70	0.050	0.000	16.6	0.0	3.7	-15.2
4	28.40	0.047	0.000	15.9	0.0	7.1	-11.7
5	27.95	0.043	0.000	16.3	0.0	9.9	-4.1
6	27.50	0.038	0.000	20.5	0.0	14.5	0.0
7	27.00	0.033	0.000	30.7	0.0	26.8	-0.5
8	26.50	0.029	0.000	47.7	0.0	47.9	-0.7
9	26.00	0.024	0.000	72.6	0.0	74.0	-0.7
10	25.50	0.020	0.000	115.4	0.0	103.7	-0.6
11	25.10	0.016	0.000	162.9	0.0	129.5	-0.4
12	24.70	0.013	0.000	221.1	0.0	156.2	-149.3
13	24.29	0.011	0.000	165.2	0.0	73.4	-121.5
14	23.79	0.010	0.000	171.8	0.0	86.3	-91.4
15	23.40	0.009	0.000	194.5	0.0	30.6	-72.1
16	23.00	0.008	0.000	197.1	0.0	0.0	-55.2
17	22.50	0.008	0.000	171.0	0.0	0.0	-83.3
18	22.00	0.007	0.000	120.6	0.0	0.1	-99.0
19	21.50	0.007	0.000	72.2	0.0	0.0	-85.8
20	21.00	0.007	0.000	45.0	0.0	0.0	-61.6
21	20.50	0.007	0.000	30.2	-2.9	0.0	-37.1
22	20.00	0.006	0.000	19.5	-4.2	0.6	-17.7
23	19.50	0.006	0.000	12.4	-7.1	3.3	-11.8
24	19.00	0.005	0.000	7.7	-6.9	4.0	-8.0
25	18.50	0.005	0.000	4.3	-4.5	5.3	-6.2
26	18.00	0.005	0.000	1.5	-1.6	4.6	-4.3
27	17.70	0.004	0.000	0.4	-0.5	2.7	-2.4
28	17.40	0.004	0.000	0.0	-0.0	0.0	0.0

**Summary of results (continued)**

**Maximum and minimum bending moment and shear force at each stage**

Stage no.	Bending moment				Shear force			
	maximum	elev.	minimum	elev.	maximum	elev.	minimum	elev.
	kN.m/m		kN.m/m		kN/m		kN/m	
1	2.0	27.50	0.0	29.40	2.6	28.40	-0.7	26.50
2	194.8	23.00	-7.1	19.50	83.3	23.79	-98.0	22.00
3	197.1	23.00	-7.1	19.50	85.0	23.79	-99.0	22.00
4	No calculation at this stage							
5	No calculation at this stage							
6	196.8	23.00	-7.1	19.50	86.3	23.79	-98.8	22.00
7	182.6	24.70	-0.0	29.40	113.5	24.70	-82.9	24.70
8	151.0	24.70	-0.0	29.40	104.0	24.70	-77.9	24.70
9	221.1	24.70	-4.2	20.00	156.2	24.70	-149.3	24.70

**Maximum and minimum displacement at each stage**

Stage no.	Displacement				Stage description
	maximum	elev.	minimum	elev.	
	m		m		
1	0.000	29.40	0.000	29.40	Apply surcharge no.1 at elev. 29.40
2	0.057	29.40	0.000	29.40	Excav. to elev. 23.79 on RIGHT side
3	0.057	29.40	0.000	29.40	Fill to elev. 24.29 on RIGHT side
4	No calculation at this stage				Install strut no.2 at elev. 24.70
5	No calculation at this stage				Install strut no.1 at elev. 29.00
6	0.057	29.40	0.000	29.40	Apply load no.1 at elev. 29.40
7	0.057	29.40	0.000	29.40	Change soil type 2 to soil type 3
8	0.057	29.40	0.000	29.40	Change EI of wall to 46900kN.m2/m run
9	0.057	29.40	0.000	29.40	Apply water pressure profile no.1

**Strut forces at each stage (horizontal components)**

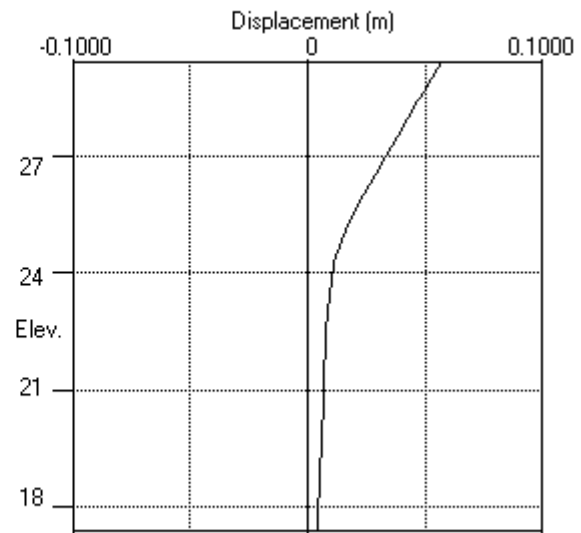
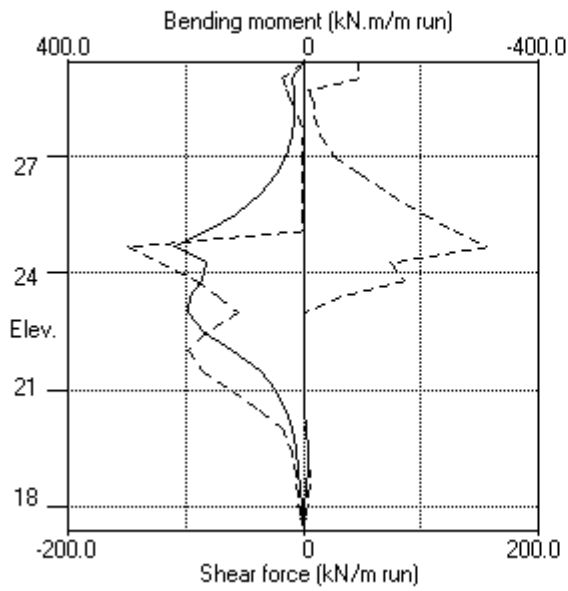
Stage no.	Strut no. 1		Strut no. 2	
	at elev. 29.00		at elev. 24.70	
	kN/m run	kN/strut	kN/m run	kN/strut
6	52.62	52.62	-3.45	-3.45
7	53.64	53.64	196.40	196.40
8	63.13	63.13	181.82	181.82
9	63.89	63.89	305.56	305.56

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 Camden High  
 Contiguous wall - S1 - ULS2

| Sheet No.  
 | Job No. 41713A1  
 | Made by : SD  
 |  
 | Date:26-03-2021  
Checked :

Units: kN,m

Bending moment, shear force, displacement envelopes



## **Appendix 8**

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*Oasys output report. Bearing design*



Job No.	Sheet No.	Rev.
40631A3		
Drg. Ref.		
Made by AM	Date	Checked

## Notes

450mm diameter  
BS EN 1997-1:2004

## Analysis Options

Design approach:	DA1 (C1 + C2)
Pile type:	CFA
Model factor:	1.40
Partial factor on negative skin friction - Set A1:	1.00
Partial factor on negative skin friction - Set A2:	1.00
Serviceability verified by load tests (preliminary/working)	No
carried out on more than 1% of constructed piles to loads not less than 1.5 times the representative load for which they are designed?	
Resistance verified by a maintained load test taken to the calculated, unfactored, ultimate resistance?	No
Datum type	Depth based
Effective stress profile	Calculated

## Pile Properties

Pile type	Solid
Pile cross-section	Circular
Under-ream	No
Calculation profile	Range
Minimum pile length	8.0000 m
Maximum pile length	25.000 m
Increment size	0.10000

Cross-section	Number of cross sections	Top Diameter [m]	Second Diameter location [m]	Second Diameter [m]	Third Diameter location [m]	Third Diameter [m]
Cross-section 1	1	0.45000				

## Undrained Materials - General Data

No.	Material description	Bulk unit weight [kN/m <sup>3</sup> ]	Cu material factor	Top Cu [kPa]	Base Cu [kPa]
1	London Clay	20.000	NA	90.000	235.00
2	London Clay Base	20.000	NA	235.00	235.00

## Undrained Materials - Skin Friction Data

No.	Material description	Skin friction computation	Alpha	q <sub>s</sub> Top [kPa]	q <sub>s</sub> Base [kPa]	Spec.	Value [kPa]
1	London Clay	Alpha specified	0.50000	NA	NA	Yes	140.00
2	London Clay Base	Alpha specified	0.50000	NA	NA	Yes	140.00

## Undrained Materials - End Bearing Data

No.	Material description	End bearing computation	Nc	q <sub>b</sub> Top [kPa]	q <sub>b</sub> Base [kPa]	Spec.	Value [kPa]
1	London Clay	Nc specified	9.0000	NA	NA	Yes	2500.0
2	London Clay Base	Nc specified	9.0000	NA	NA	Yes	2500.0

## Undrained Materials - Material Factors (Code Based)

No.	Material	Qs factors	Nc factors	Qb factors
-----	----------	------------	------------	------------

Job No.	Sheet No.	Rev.
40631A3		
Drg. Ref.		
Made by AM	Date	Checked

	description	M1	M2	M1	M2	M1	M2
1	London Clay	N.A.	N.A.	1.0000	1.0000	N.A.	N.A.
2	London Clay Base	N.A.	N.A.	1.0000	1.0000	N.A.	N.A.

### Drained Materials - General Data

No.	Material description	Bulk unit weight [kN/m <sup>3</sup> ]	Tan(δ) material factor
1	Made Ground	18.000	NA

### Drained Materials - Friction Data

No.	Material description	Skin friction computation	Beta	Delta (δ) [deg]	Coefficient of earth pressure K	q <sub>s</sub> Top [kPa]	q <sub>s,lim</sub> Base Spec. Value [kPa]
1	Made Ground	qs specified	NA	NA	NA	0.0	0.0 No NA

### Drained Materials - End Bearing Data

No.	Material description	End bearing computation	Nq	Phi' [deg]	PhiD [deg]	Phicv' [deg]	Ir	q <sub>b</sub> Top [kPa]	q <sub>b,lim</sub> Base Spec. Value [kPa]	Nq-Phi curves
1	Made Ground	qb specified	NA	NA	NA	NA	NA	0.0	0.0 No NA	NA

### Drained Materials - Material Factors (Code Based)

No.	Material description	Qs factors		Nq factors		Qb factors	
		M1	M2	M1	M2	M1	M2
1	Made Ground	1.0000	1.0000	N.A.	N.A.	1.0000	1.0000

### Nq-Phi curve data

Curve 1 : Nq-Phi Curve 1

Nq Phi'  
[deg]

## STAGE SPECIFIC DATA

### Stage 0 : Initial Stage

#### Groundwater

No.	Level [m]	Pressure [kPa]	Unit weight of water [kN/m <sup>3</sup> ]
1	9.5000	0.0	10.000

#### Soil Profiles

##### Soil Profile 1: Soil Profile 1

No.	Depth [m]	Material description	Contributes to negative skin friction
1	0.0	Made Ground	No
2	5.2000	London Clay	No

Job No.	Sheet No.	Rev.
40631A3		
Drg. Ref.		
Made by AM	Date	Checked

No.	Depth	Material description	Contributes to negative skin friction
	[m]		
3	25.000	London Clay Base	No

## Soil Profile - Groundwater Map

No.	Soil Profile	Groundwater
1	Soil Profile 1	Groundwater Profile 1

## Stage specific warnings

- 1 - Stage 0 - The bottom most layer in Soil Profile 1 is assigned "Total stress" material. For this layer the cohesion is assumed to be constant at "Cu-Top", i.e cohesion specified at the top of this layer. The user specified value of cohesion at the bottom of this layer, "Cu-Bottom" is ignored. (Material Properties)

## CAPACITY RESULTS

### Partial Resistance Factors Used:

#### DA1 C1

Shaft resistance factor for set R1 (Compression):	1.00
Base resistance factor for set R1:	1.00
Shaft resistance factor for set R1 (Tension):	1.00

#### DA1 C2

Shaft resistance factor for set R4 (Compression):	1.60
Base resistance factor for set R4:	2.00
Shaft resistance factor for set R4 (Tension):	2.00

Model factor:	1.40
---------------	------

## Stress Profiles

### Soil Profile 1: Soil Profile 1

Depth	Density	Undrained Cohesion	Nq	Total vertical stress	Porewater pressure	Effective vertical stress	Effective horizontal stress*	Cumulative skin friction per unit perimeter
[m]	[kN/m³]	[kPa]		[kPa]	[kPa]	[kPa]	[kPa]	[kN/m]
0.0	18.000	0.0	N.A.	0.0	0.0	0.0	NA	0.0
5.2000	18.000	0.0	N.A.	93.600	0.0	93.600	NA	0.0
5.2000	20.000	90.000	N.A.	93.600	0.0	93.600	NA	0.0
8.0000	20.000	110.51	N.A.	149.60	0.0	149.60	NA	140.35
8.1000	20.000	111.24	N.A.	151.60	0.0	151.60	NA	145.90
8.2000	20.000	111.97	N.A.	153.60	0.0	153.60	NA	151.48
8.3000	20.000	112.70	N.A.	155.60	0.0	155.60	NA	157.09
8.4000	20.000	113.43	N.A.	157.60	0.0	157.60	NA	162.75
8.5000	20.000	114.17	N.A.	159.60	0.0	159.60	NA	168.44
8.6000	20.000	114.90	N.A.	161.60	0.0	161.60	NA	174.16
8.7000	20.000	115.63	N.A.	163.60	0.0	163.60	NA	179.93
8.8000	20.000	116.36	N.A.	165.60	0.0	165.60	NA	185.73
8.9000	20.000	117.10	N.A.	167.60	0.0	167.60	NA	191.56
9.0000	20.000	117.83	N.A.	169.60	0.0	169.60	NA	197.44
9.1000	20.000	118.56	N.A.	171.60	0.0	171.60	NA	203.35
9.2000	20.000	119.29	N.A.	173.60	0.0	173.60	NA	209.29
9.3000	20.000	120.03	N.A.	175.60	0.0	175.60	NA	215.28
9.4000	20.000	120.76	N.A.	177.60	0.0	177.60	NA	221.30
9.5000	20.000	121.49	N.A.	179.60	0.0	179.60	NA	227.35
9.6000	20.000	122.22	N.A.	181.60	1.0000	180.60	NA	233.44
9.7000	20.000	122.95	N.A.	183.60	2.0000	181.60	NA	239.57
9.8000	20.000	123.69	N.A.	185.60	3.0000	182.60	NA	245.74
9.9000	20.000	124.42	N.A.	187.60	4.0000	183.60	NA	251.94
10.000	20.000	125.15	N.A.	189.60	5.0000	184.60	NA	258.18
10.100	20.000	125.88	N.A.	191.60	6.0000	185.60	NA	264.46
10.200	20.000	126.62	N.A.	193.60	7.0000	186.60	NA	270.77
10.300	20.000	127.35	N.A.	195.60	8.0000	187.60	NA	277.12
10.400	20.000	128.08	N.A.	197.60	9.0000	188.60	NA	283.51



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Job No.	Sheet No.	Rev.
40631A3		
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Depth	Density	Undrained Cohesion	Nq	Total vertical stress	Porewater pressure	Effective vertical stress	Effective horizontal stress*	Cumulative skin friction per unit
10.500	20.000	128.81	N.A.	199.60	10.000	189.60	NA	289.93
10.600	20.000	129.55	N.A.	201.60	11.000	190.60	NA	296.39
10.700	20.000	130.28	N.A.	203.60	12.000	191.60	NA	302.88
10.800	20.000	131.01	N.A.	205.60	13.000	192.60	NA	309.41
10.900	20.000	131.74	N.A.	207.60	14.000	193.60	NA	315.98
11.000	20.000	132.47	N.A.	209.60	15.000	194.60	NA	322.59
11.100	20.000	133.21	N.A.	211.60	16.000	195.60	NA	329.23
11.200	20.000	133.94	N.A.	213.60	17.000	196.60	NA	335.91
11.300	20.000	134.67	N.A.	215.60	18.000	197.60	NA	342.62
11.400	20.000	135.40	N.A.	217.60	19.000	198.60	NA	349.38
11.500	20.000	136.14	N.A.	219.60	20.000	199.60	NA	356.16
11.600	20.000	136.87	N.A.	221.60	21.000	200.60	NA	362.99
11.700	20.000	137.60	N.A.	223.60	22.000	201.60	NA	369.85
11.800	20.000	138.33	N.A.	225.60	23.000	202.60	NA	376.75
11.900	20.000	139.07	N.A.	227.60	24.000	203.60	NA	383.68
12.000	20.000	139.80	N.A.	229.60	25.000	204.60	NA	390.66
12.100	20.000	140.53	N.A.	231.60	26.000	205.60	NA	397.66
12.200	20.000	141.26	N.A.	233.60	27.000	206.60	NA	404.71
12.300	20.000	141.99	N.A.	235.60	28.000	207.60	NA	411.79
12.400	20.000	142.73	N.A.	237.60	29.000	208.60	NA	418.91
12.500	20.000	143.46	N.A.	239.60	30.000	209.60	NA	426.06
12.600	20.000	144.19	N.A.	241.60	31.000	210.60	NA	433.26
12.700	20.000	144.92	N.A.	243.60	32.000	211.60	NA	440.48
12.800	20.000	145.66	N.A.	245.60	33.000	212.60	NA	447.75
12.900	20.000	146.39	N.A.	247.60	34.000	213.60	NA	455.05
13.000	20.000	147.12	N.A.	249.60	35.000	214.60	NA	462.39
13.100	20.000	147.85	N.A.	251.60	36.000	215.60	NA	469.76
13.200	20.000	148.59	N.A.	253.60	37.000	216.60	NA	477.17
13.300	20.000	149.32	N.A.	255.60	38.000	217.60	NA	484.62
13.400	20.000	150.05	N.A.	257.60	39.000	218.60	NA	492.10
13.500	20.000	150.78	N.A.	259.60	40.000	219.60	NA	499.62
13.600	20.000	151.52	N.A.	261.60	41.000	220.60	NA	507.18
13.700	20.000	152.25	N.A.	263.60	42.000	221.60	NA	514.78
13.800	20.000	152.98	N.A.	265.60	43.000	222.60	NA	522.41
13.900	20.000	153.71	N.A.	267.60	44.000	223.60	NA	530.07
14.000	20.000	154.44	N.A.	269.60	45.000	224.60	NA	537.78
14.100	20.000	155.18	N.A.	271.60	46.000	225.60	NA	545.52
14.200	20.000	155.91	N.A.	273.60	47.000	226.60	NA	553.30
14.300	20.000	156.64	N.A.	275.60	48.000	227.60	NA	561.11
14.400	20.000	157.37	N.A.	277.60	49.000	228.60	NA	568.96
14.500	20.000	158.11	N.A.	279.60	50.000	229.60	NA	576.85
14.600	20.000	158.84	N.A.	281.60	51.000	230.60	NA	584.77
14.700	20.000	159.57	N.A.	283.60	52.000	231.60	NA	592.73
14.800	20.000	160.30	N.A.	285.60	53.000	232.60	NA	600.73
14.900	20.000	161.04	N.A.	287.60	54.000	233.60	NA	608.76
15.000	20.000	161.77	N.A.	289.60	55.000	234.60	NA	616.83
15.100	20.000	162.50	N.A.	291.60	56.000	235.60	NA	624.94
15.200	20.000	163.23	N.A.	293.60	57.000	236.60	NA	633.08
15.300	20.000	163.96	N.A.	295.60	58.000	237.60	NA	641.26
15.400	20.000	164.70	N.A.	297.60	59.000	238.60	NA	649.48
15.500	20.000	165.43	N.A.	299.60	60.000	239.60	NA	657.73
15.600	20.000	166.16	N.A.	301.60	61.000	240.60	NA	666.02
15.700	20.000	166.89	N.A.	303.60	62.000	241.60	NA	674.35
15.800	20.000	167.63	N.A.	305.60	63.000	242.60	NA	682.71
15.900	20.000	168.36	N.A.	307.60	64.000	243.60	NA	691.11
16.000	20.000	169.09	N.A.	309.60	65.000	244.60	NA	699.55
16.100	20.000	169.82	N.A.	311.60	66.000	245.60	NA	708.02
16.200	20.000	170.56	N.A.	313.60	67.000	246.60	NA	716.53
16.300	20.000	171.29	N.A.	315.60	68.000	247.60	NA	725.07
16.400	20.000	172.02	N.A.	317.60	69.000	248.60	NA	733.66
16.500	20.000	172.75	N.A.	319.60	70.000	249.60	NA	742.28
16.600	20.000	173.48	N.A.	321.60	71.000	250.60	NA	750.93
16.700	20.000	174.22	N.A.	323.60	72.000	251.60	NA	759.62
16.800	20.000	174.95	N.A.	325.60	73.000	252.60	NA	768.35
16.900	20.000	175.68	N.A.	327.60	74.000	253.60	NA	777.12
17.000	20.000	176.41	N.A.	329.60	75.000	254.60	NA	785.92
17.100	20.000	177.15	N.A.	331.60	76.000	255.60	NA	794.76
17.200	20.000	177.88	N.A.	333.60	77.000	256.60	NA	803.64
17.300	20.000	178.61	N.A.	335.60	78.000	257.60	NA	812.55
17.400	20.000	179.34	N.A.	337.60	79.000	258.60	NA	821.50
17.500	20.000	180.08	N.A.	339.60	80.000	259.60	NA	830.48
17.600	20.000	180.81	N.A.	341.60	81.000	260.60	NA	839.50
17.700	20.000	181.54	N.A.	343.60	82.000	261.60	NA	848.56
17.800	20.000	182.27	N.A.	345.60	83.000	262.60	NA	857.66
17.900	20.000	183.01	N.A.	347.60	84.000	263.60	NA	866.79
18.000	20.000	183.74	N.A.	349.60	85.000	264.60	NA	875.96
18.100	20.000	184.47	N.A.	351.60	86.000	265.60	NA	885.16

Job No.	Sheet No.	Rev.
40631A3		
Drg. Ref.		
Made by AM	Date	Checked

Depth	Density	Undrained Cohesion	Nq	Total vertical stress	Porewater pressure	Effective vertical stress	Effective horizontal stress*	Cumulative skin friction per unit
18.200	20.000	185.20	N.A.	353.60	87.000	266.60	NA	894.41
18.300	20.000	185.93	N.A.	355.60	88.000	267.60	NA	903.68
18.400	20.000	186.67	N.A.	357.60	89.000	268.60	NA	913.00
18.500	20.000	187.40	N.A.	359.60	90.000	269.60	NA	922.35
18.600	20.000	188.13	N.A.	361.60	91.000	270.60	NA	931.74
18.700	20.000	188.86	N.A.	363.60	92.000	271.60	NA	941.16
18.800	20.000	189.60	N.A.	365.60	93.000	272.60	NA	950.63
18.900	20.000	190.33	N.A.	367.60	94.000	273.60	NA	960.12
19.000	20.000	191.06	N.A.	369.60	95.000	274.60	NA	969.66
19.100	20.000	191.79	N.A.	371.60	96.000	275.60	NA	979.23
19.200	20.000	192.53	N.A.	373.60	97.000	276.60	NA	988.84
19.300	20.000	193.26	N.A.	375.60	98.000	277.60	NA	998.48
19.400	20.000	193.99	N.A.	377.60	99.000	278.60	NA	1008.2
19.500	20.000	194.72	N.A.	379.60	100.00	279.60	NA	1017.9
19.600	20.000	195.45	N.A.	381.60	101.00	280.60	NA	1027.6
19.700	20.000	196.19	N.A.	383.60	102.00	281.60	NA	1037.4
19.800	20.000	196.92	N.A.	385.60	103.00	282.60	NA	1047.3
19.900	20.000	197.65	N.A.	387.60	104.00	283.60	NA	1057.1
20.000	20.000	198.38	N.A.	389.60	105.00	284.60	NA	1067.0
20.100	20.000	199.12	N.A.	391.60	106.00	285.60	NA	1077.0
20.200	20.000	199.85	N.A.	393.60	107.00	286.60	NA	1086.9
20.300	20.000	200.58	N.A.	395.60	108.00	287.60	NA	1096.9
20.400	20.000	201.31	N.A.	397.60	109.00	288.60	NA	1107.0
20.500	20.000	202.05	N.A.	399.60	110.00	289.60	NA	1117.1
20.600	20.000	202.78	N.A.	401.60	111.00	290.60	NA	1127.2
20.700	20.000	203.51	N.A.	403.60	112.00	291.60	NA	1137.4
20.800	20.000	204.24	N.A.	405.60	113.00	292.60	NA	1147.5
20.900	20.000	204.97	N.A.	407.60	114.00	293.60	NA	1157.8
21.000	20.000	205.71	N.A.	409.60	115.00	294.60	NA	1168.0
21.100	20.000	206.44	N.A.	411.60	116.00	295.60	NA	1178.3
21.200	20.000	207.17	N.A.	413.60	117.00	296.60	NA	1188.7
21.300	20.000	207.90	N.A.	415.60	118.00	297.60	NA	1199.1
21.400	20.000	208.64	N.A.	417.60	119.00	298.60	NA	1209.5
21.500	20.000	209.37	N.A.	419.60	120.00	299.60	NA	1219.9
21.600	20.000	210.10	N.A.	421.60	121.00	300.60	NA	1230.4
21.700	20.000	210.83	N.A.	423.60	122.00	301.60	NA	1240.9
21.800	20.000	211.57	N.A.	425.60	123.00	302.60	NA	1251.5
21.900	20.000	212.30	N.A.	427.60	124.00	303.60	NA	1262.1
22.000	20.000	213.03	N.A.	429.60	125.00	304.60	NA	1272.7
22.100	20.000	213.76	N.A.	431.60	126.00	305.60	NA	1283.4
22.200	20.000	214.49	N.A.	433.60	127.00	306.60	NA	1294.1
22.300	20.000	215.23	N.A.	435.60	128.00	307.60	NA	1304.8
22.400	20.000	215.96	N.A.	437.60	129.00	308.60	NA	1315.6
22.500	20.000	216.69	N.A.	439.60	130.00	309.60	NA	1326.4
22.600	20.000	217.42	N.A.	441.60	131.00	310.60	NA	1337.3
22.700	20.000	218.16	N.A.	443.60	132.00	311.60	NA	1348.2
22.800	20.000	218.89	N.A.	445.60	133.00	312.60	NA	1359.1
22.900	20.000	219.62	N.A.	447.60	134.00	313.60	NA	1370.1
23.000	20.000	220.35	N.A.	449.60	135.00	314.60	NA	1381.1
23.100	20.000	221.09	N.A.	451.60	136.00	315.60	NA	1392.1
23.200	20.000	221.82	N.A.	453.60	137.00	316.60	NA	1403.2
23.300	20.000	222.55	N.A.	455.60	138.00	317.60	NA	1414.3
23.400	20.000	223.28	N.A.	457.60	139.00	318.60	NA	1425.4
23.500	20.000	224.02	N.A.	459.60	140.00	319.60	NA	1436.6
23.600	20.000	224.75	N.A.	461.60	141.00	320.60	NA	1447.8
23.700	20.000	225.48	N.A.	463.60	142.00	321.60	NA	1459.1
23.800	20.000	226.21	N.A.	465.60	143.00	322.60	NA	1470.4
23.900	20.000	226.94	N.A.	467.60	144.00	323.60	NA	1481.7
24.000	20.000	227.68	N.A.	469.60	145.00	324.60	NA	1493.1
24.100	20.000	228.41	N.A.	471.60	146.00	325.60	NA	1504.5
24.200	20.000	229.14	N.A.	473.60	147.00	326.60	NA	1515.9
24.300	20.000	229.87	N.A.	475.60	148.00	327.60	NA	1527.4
24.400	20.000	230.61	N.A.	477.60	149.00	328.60	NA	1538.9
24.500	20.000	231.34	N.A.	479.60	150.00	329.60	NA	1550.5
24.600	20.000	232.07	N.A.	481.60	151.00	330.60	NA	1562.0
24.700	20.000	232.80	N.A.	483.60	152.00	331.60	NA	1573.7
24.800	20.000	233.54	N.A.	485.60	153.00	332.60	NA	1585.3
24.900	20.000	234.27	N.A.	487.60	154.00	333.60	NA	1597.0
25.000	20.000	235.00	N.A.	489.60	155.00	334.60	NA	1608.7

\* Effective horizontal stress not calculated for "Total Stress" materials and for Beta Method.

### Cross-section 1 results:

Uniform pile with top shaft diameter = 0.45 m

Job No.	Sheet No.	Rev.
40631A3		
Drg. Ref.		
Made by AM	Date	Checked

Depth	Density	Undrained Cohesion	Nq	Total vertical stress	Porewater pressure	Effective vertical stress	Effective horizontal stress*	Cumulative skin friction per unit
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## Results - Compression

## Soil Profile 1: Soil Profile 1

Depth	Pile length	Ultimate base capacity	Cumulative external Friction	Negative skin friction	Net ultimate resistance	Design resistance	Combination with least resistance	Factored load*
		(Q <sub>b</sub> )	(Q <sub>s</sub> )	(Q <sub>nsf</sub> )			#	
[m]	[m]	[kN]	[kN]	[kN]	[kN]	[kN]		[kN]
8.0000	8.0000	158.18	198.42	0.0	356.60	254.71	2	0.0 (C)
8.1000	8.1000	159.22	206.26	0.0	365.48	261.06	2	0.0 (C)
8.2000	8.2000	160.27	214.15	0.0	374.42	267.44	2	0.0 (C)
8.3000	8.3000	161.32	222.09	0.0	383.41	273.86	2	0.0 (C)
8.4000	8.4000	162.37	230.08	0.0	392.45	280.32	2	0.0 (C)
8.5000	8.5000	163.42	238.12	0.0	401.54	286.81	2	0.0 (C)
8.6000	8.6000	164.47	246.22	0.0	410.68	293.35	2	0.0 (C)
8.7000	8.7000	165.51	254.37	0.0	419.88	299.91	2	0.0 (C)
8.8000	8.8000	166.56	262.57	0.0	429.13	306.52	2	0.0 (C)
8.9000	8.9000	167.61	270.82	0.0	438.43	313.16	2	0.0 (C)
9.0000	9.0000	168.66	279.12	0.0	447.78	319.84	2	0.0 (C)
9.1000	9.1000	169.71	287.47	0.0	457.18	326.56	2	0.0 (C)
9.2000	9.2000	170.75	295.88	0.0	466.64	333.31	2	0.0 (C)
9.3000	9.3000	171.80	304.34	0.0	476.14	340.10	2	0.0 (C)
9.4000	9.4000	172.85	312.85	0.0	485.70	346.93	2	0.0 (C)
9.5000	9.5000	173.90	321.41	0.0	495.31	353.79	2	0.0 (C)
9.6000	9.6000	174.95	330.02	0.0	504.97	360.69	2	0.0 (C)
9.7000	9.7000	176.00	338.69	0.0	514.69	367.63	2	0.0 (C)
9.8000	9.8000	177.04	347.41	0.0	524.45	374.61	2	0.0 (C)
9.9000	9.9000	178.09	356.18	0.0	534.27	381.62	2	0.0 (C)
10.000	10.000	179.14	365.00	0.0	544.14	388.67	2	0.0 (C)
10.100	10.100	180.19	373.87	0.0	554.06	395.75	2	0.0 (C)
10.200	10.200	181.24	382.79	0.0	564.03	402.88	2	0.0 (C)
10.300	10.300	182.29	391.77	0.0	574.05	410.04	2	0.0 (C)
10.400	10.400	183.33	400.80	0.0	584.13	417.24	2	0.0 (C)
10.500	10.500	184.38	409.88	0.0	594.26	424.47	2	0.0 (C)
10.600	10.600	185.43	419.01	0.0	604.44	431.74	2	0.0 (C)
10.700	10.700	186.48	428.19	0.0	614.67	439.05	2	0.0 (C)
10.800	10.800	187.53	437.42	0.0	624.95	446.39	2	0.0 (C)
10.900	10.900	188.57	446.71	0.0	635.28	453.77	2	0.0 (C)
11.000	11.000	189.62	456.05	0.0	645.67	461.19	2	0.0 (C)
11.100	11.100	190.67	465.44	0.0	656.11	468.65	2	0.0 (C)
11.200	11.200	191.72	474.88	0.0	666.60	476.14	2	0.0 (C)
11.300	11.300	192.77	484.37	0.0	677.14	483.67	2	0.0 (C)
11.400	11.400	193.82	493.92	0.0	687.73	491.24	2	0.0 (C)
11.500	11.500	194.86	503.52	0.0	698.38	498.84	2	0.0 (C)
11.600	11.600	195.91	513.16	0.0	709.08	506.48	2	0.0 (C)
11.700	11.700	196.96	522.87	0.0	719.83	514.16	2	0.0 (C)
11.800	11.800	198.01	532.62	0.0	730.63	521.88	2	0.0 (C)
11.900	11.900	199.06	542.42	0.0	741.48	529.63	2	0.0 (C)
12.000	12.000	200.11	552.28	0.0	752.38	537.42	2	0.0 (C)
12.100	12.100	201.15	562.19	0.0	763.34	545.24	2	0.0 (C)
12.200	12.200	202.20	572.14	0.0	774.35	553.10	2	0.0 (C)
12.300	12.300	203.25	582.16	0.0	785.41	561.00	2	0.0 (C)
12.400	12.400	204.30	592.22	0.0	796.52	568.94	2	0.0 (C)
12.500	12.500	205.35	602.33	0.0	807.68	576.91	2	0.0 (C)
12.600	12.600	206.39	612.50	0.0	818.89	584.92	2	0.0 (C)
12.700	12.700	207.44	622.72	0.0	830.16	592.97	2	0.0 (C)
12.800	12.800	208.49	632.99	0.0	841.48	601.06	2	0.0 (C)
12.900	12.900	209.54	643.31	0.0	852.85	609.18	2	0.0 (C)
13.000	13.000	210.59	653.68	0.0	864.27	617.34	2	0.0 (C)
13.100	13.100	211.64	664.11	0.0	875.74	625.53	2	0.0 (C)
13.200	13.200	212.68	674.59	0.0	887.27	633.76	2	0.0 (C)
13.300	13.300	213.73	685.11	0.0	898.85	642.03	2	0.0 (C)
13.400	13.400	214.78	695.70	0.0	910.48	650.34	2	0.0 (C)
13.500	13.500	215.83	706.33	0.0	922.16	658.68	2	0.0 (C)
13.600	13.600	216.88	717.01	0.0	933.89	667.06	2	0.0 (C)
13.700	13.700	217.93	727.75	0.0	945.67	675.48	2	0.0 (C)
13.800	13.800	218.97	738.53	0.0	957.51	683.93	2	0.0 (C)
13.900	13.900	220.02	749.37	0.0	969.40	692.43	2	0.0 (C)
14.000	14.000	221.07	760.27	0.0	981.34	700.95	2	0.0 (C)
14.100	14.100	222.12	771.21	0.0	993.33	709.52	2	0.0 (C)
14.200	14.200	223.17	782.20	0.0	1005.4	718.12	2	0.0 (C)
14.300	14.300	224.21	793.25	0.0	1017.5	726.76	2	0.0 (C)
14.400	14.400	225.26	804.35	0.0	1029.6	735.44	2	0.0 (C)
14.500	14.500	226.31	815.50	0.0	1041.8	744.15	2	0.0 (C)



# CENTRAL PILING LIMITED

115-119 Premier Inn, Camden High Street, London  
Wall Piles

Job No.	Sheet No.	Rev.
40631A3		
Drg. Ref.		
Made by AM	Date	Checked

Depth	Pile length	Ultimate base capacity	Cumulative external Friction	Negative skin friction	Net ultimate resistance	Design resistance	Combination with least resistance	Factored load*
								#
14.600	14.600	227.36	826.70	0.0	1054.1	752.90	450.26	2 0.0 (C) 0.0 (C)
14.700	14.700	228.41	837.95	0.0	1066.4	761.69	455.66	2 0.0 (C) 0.0 (C)
14.800	14.800	229.46	849.26	0.0	1078.7	770.51	461.08	2 0.0 (C) 0.0 (C)
14.900	14.900	230.50	860.62	0.0	1091.1	779.37	466.53	2 0.0 (C) 0.0 (C)
15.000	15.000	231.55	872.02	0.0	1103.6	788.27	471.99	2 0.0 (C) 0.0 (C)
15.100	15.100	232.60	883.48	0.0	1116.1	797.20	477.48	2 0.0 (C) 0.0 (C)
15.200	15.200	233.65	895.00	0.0	1128.6	806.18	483.00	2 0.0 (C) 0.0 (C)
15.300	15.300	234.70	906.56	0.0	1141.3	815.18	488.54	2 0.0 (C) 0.0 (C)
15.400	15.400	235.75	918.18	0.0	1153.9	824.23	494.10	2 0.0 (C) 0.0 (C)
15.500	15.500	236.79	929.84	0.0	1166.6	833.31	499.68	2 0.0 (C) 0.0 (C)
15.600	15.600	237.84	941.56	0.0	1179.4	842.43	505.28	2 0.0 (C) 0.0 (C)
15.700	15.700	238.89	953.34	0.0	1192.2	851.59	510.91	2 0.0 (C) 0.0 (C)
15.800	15.800	239.94	965.16	0.0	1205.1	860.78	516.57	2 0.0 (C) 0.0 (C)
15.900	15.900	240.99	977.03	0.0	1218.0	870.01	522.24	2 0.0 (C) 0.0 (C)
16.000	16.000	242.03	988.96	0.0	1231.0	879.28	527.94	2 0.0 (C) 0.0 (C)
16.100	16.100	243.08	1000.9	0.0	1244.0	888.59	533.66	2 0.0 (C) 0.0 (C)
16.200	16.200	244.13	1013.0	0.0	1257.1	897.93	539.41	2 0.0 (C) 0.0 (C)
16.300	16.300	245.18	1025.0	0.0	1270.2	907.31	545.18	2 0.0 (C) 0.0 (C)
16.400	16.400	246.23	1037.2	0.0	1283.4	916.72	550.97	2 0.0 (C) 0.0 (C)
16.500	16.500	247.28	1049.4	0.0	1296.6	926.17	556.78	2 0.0 (C) 0.0 (C)
16.600	16.600	248.32	1061.6	0.0	1309.9	935.66	562.62	2 0.0 (C) 0.0 (C)
16.700	16.700	249.37	1073.9	0.0	1323.3	945.19	568.48	2 0.0 (C) 0.0 (C)
16.800	16.800	250.42	1086.2	0.0	1336.7	954.75	574.36	2 0.0 (C) 0.0 (C)
16.900	16.900	251.47	1098.6	0.0	1350.1	964.35	580.27	2 0.0 (C) 0.0 (C)
17.000	17.000	252.52	1111.1	0.0	1363.6	973.99	586.20	2 0.0 (C) 0.0 (C)
17.100	17.100	253.57	1123.6	0.0	1377.1	983.67	592.15	2 0.0 (C) 0.0 (C)
17.200	17.200	254.61	1136.1	0.0	1390.7	993.38	598.13	2 0.0 (C) 0.0 (C)
17.300	17.300	255.66	1148.7	0.0	1404.4	1003.1	604.13	2 0.0 (C) 0.0 (C)
17.400	17.400	256.71	1161.4	0.0	1418.1	1012.9	610.15	2 0.0 (C) 0.0 (C)
17.500	17.500	257.76	1174.1	0.0	1431.8	1022.7	616.19	2 0.0 (C) 0.0 (C)
17.600	17.600	258.81	1186.8	0.0	1445.6	1032.6	622.26	2 0.0 (C) 0.0 (C)
17.700	17.700	259.85	1199.6	0.0	1459.5	1042.5	628.35	2 0.0 (C) 0.0 (C)
17.800	17.800	260.90	1212.5	0.0	1473.4	1052.4	634.47	2 0.0 (C) 0.0 (C)
17.900	17.900	261.95	1225.4	0.0	1487.3	1062.4	640.61	2 0.0 (C) 0.0 (C)
18.000	18.000	263.00	1238.4	0.0	1501.4	1072.4	646.77	2 0.0 (C) 0.0 (C)
18.100	18.100	264.05	1251.4	0.0	1515.4	1082.4	652.95	2 0.0 (C) 0.0 (C)
18.200	18.200	265.10	1264.4	0.0	1529.5	1092.5	659.16	2 0.0 (C) 0.0 (C)
18.300	18.300	266.14	1277.6	0.0	1543.7	1102.6	665.39	2 0.0 (C) 0.0 (C)
18.400	18.400	267.19	1290.7	0.0	1557.9	1112.8	671.64	2 0.0 (C) 0.0 (C)
18.500	18.500	268.24	1303.9	0.0	1572.2	1123.0	677.92	2 0.0 (C) 0.0 (C)
18.600	18.600	269.29	1317.2	0.0	1586.5	1133.2	684.22	2 0.0 (C) 0.0 (C)
18.700	18.700	270.34	1330.5	0.0	1600.9	1143.5	690.54	2 0.0 (C) 0.0 (C)
18.800	18.800	271.39	1343.9	0.0	1615.3	1153.8	696.89	2 0.0 (C) 0.0 (C)
18.900	18.900	272.43	1357.3	0.0	1629.8	1164.1	703.25	2 0.0 (C) 0.0 (C)
19.000	19.000	273.48	1370.8	0.0	1644.3	1174.5	709.65	2 0.0 (C) 0.0 (C)
19.100	19.100	274.53	1384.4	0.0	1658.9	1184.9	716.06	2 0.0 (C) 0.0 (C)
19.200	19.200	275.58	1397.9	0.0	1673.5	1195.4	722.50	2 0.0 (C) 0.0 (C)
19.300	19.300	276.63	1411.6	0.0	1688.2	1205.9	728.96	2 0.0 (C) 0.0 (C)
19.400	19.400	277.67	1425.3	0.0	1702.9	1216.4	735.45	2 0.0 (C) 0.0 (C)
19.500	19.500	278.72	1439.0	0.0	1717.7	1226.9	741.95	2 0.0 (C) 0.0 (C)
19.600	19.600	279.77	1452.8	0.0	1732.6	1237.5	748.48	2 0.0 (C) 0.0 (C)
19.700	19.700	280.82	1466.6	0.0	1747.4	1248.2	755.04	2 0.0 (C) 0.0 (C)
19.800	19.800	281.87	1480.5	0.0	1762.4	1258.8	761.61	2 0.0 (C) 0.0 (C)
19.900	19.900	282.92	1494.5	0.0	1777.4	1269.6	768.21	2 0.0 (C) 0.0 (C)
20.000	20.000	283.96	1508.5	0.0	1792.4	1280.3	774.84	2 0.0 (C) 0.0 (C)
20.100	20.100	285.01	1522.5	0.0	1807.5	1291.1	781.48	2 0.0 (C) 0.0 (C)
20.200	20.200	286.06	1536.6	0.0	1822.7	1301.9	788.15	2 0.0 (C) 0.0 (C)
20.300	20.300	287.11	1550.8	0.0	1837.9	1312.8	794.85	2 0.0 (C) 0.0 (C)
20.400	20.400	288.16	1565.0	0.0	1853.1	1323.7	801.56	2 0.0 (C) 0.0 (C)
20.500	20.500	289.21	1579.2	0.0	1868.4	1334.6	808.30	2 0.0 (C) 0.0 (C)
20.600	20.600	290.25	1593.5	0.0	1883.8	1345.6	815.06	2 0.0 (C) 0.0 (C)
20.700	20.700	291.30	1607.9	0.0	1899.2	1356.6	821.85	2 0.0 (C) 0.0 (C)
20.800	20.800	292.35	1622.3	0.0	1914.7	1367.6	828.65	2 0.0 (C) 0.0 (C)
20.900	20.900	293.40	1636.8	0.0	1930.2	1378.7	835.48	2 0.0 (C) 0.0 (C)
21.000	21.000	294.45	1651.3	0.0	1945.7	1389.8	842.34	2 0.0 (C) 0.0 (C)
21.100	21.100	295.49	1665.8	0.0	1961.3	1401.0	849.22	2 0.0 (C) 0.0 (C)
21.200	21.200	296.54	1680.5	0.0	1977.0	1412.1	856.12	2 0.0 (C) 0.0 (C)
21.300	21.300	297.59	1695.1	0.0	1992.7	1423.4	863.04	2 0.0 (C) 0.0 (C)
21.400	21.400	298.64	1709.9	0.0	2008.5	1434.6	869.99	2 0.0 (C) 0.0 (C)
21.500	21.500	299.69	1724.6	0.0	2024.3	1445.9	876.96	2 0.0 (C) 0.0 (C)
21.600	21.600	300.74	1739.5	0.0	2040.2	1457.3	883.95	2 0.0 (C) 0.0 (C)
21.700	21.700	301.78	1754.3	0.0	2056.1	1468.7	890.97	2 0.0 (C) 0.0 (C)
21.800	21.800	302.83	1769.3	0.0	2072.1	1480.1	898.00	2 0.0 (C) 0.0 (C)
21.900	21.900	303.88	1784.2	0.0	2088.1	1491.5	905.07	2 0.0 (C) 0.0 (C)
22.000	22.000	304.93	1799.3	0.0	2104.2	1503.0	912.15	2 0.0 (C) 0.0 (C)
22.100	22.100	305.98	1814.4	0.0	2120.3	1514.5	919.26	2 0.0 (C) 0.0 (C)
22.200	22.200	307.03	1829.5	0.0	2136.5	1526.1	926.39	2 0.0 (C) 0.0 (C)

Job No.	Sheet No.	Rev.
40631A3		
Drg. Ref.		
Made by AM	Date	Checked

Depth	Pile length	Ultimate base capacity	Cumulative external Friction	Negative skin friction	Net ultimate resistance	Design resistance	Combination with least resistance	Factored load*
							#	
22.300	22.300	308.07	1844.7	0.0	2152.8	1537.7	933.55	2 0.0 (C) 0.0 (C)
22.400	22.400	309.12	1859.9	0.0	2169.0	1549.3	940.72	2 0.0 (C) 0.0 (C)
22.500	22.500	310.17	1875.2	0.0	2185.4	1561.0	947.92	2 0.0 (C) 0.0 (C)
22.600	22.600	311.22	1890.6	0.0	2201.8	1572.7	955.15	2 0.0 (C) 0.0 (C)
22.700	22.700	312.27	1906.0	0.0	2218.2	1584.4	962.40	2 0.0 (C) 0.0 (C)
22.800	22.800	313.31	1921.4	0.0	2234.7	1596.2	969.67	2 0.0 (C) 0.0 (C)
22.900	22.900	314.36	1936.9	0.0	2251.3	1608.0	976.96	2 0.0 (C) 0.0 (C)
23.000	23.000	315.41	1952.4	0.0	2267.9	1619.9	984.27	2 0.0 (C) 0.0 (C)
23.100	23.100	316.46	1968.0	0.0	2284.5	1631.8	991.61	2 0.0 (C) 0.0 (C)
23.200	23.200	317.51	1983.7	0.0	2301.2	1643.7	998.98	2 0.0 (C) 0.0 (C)
23.300	23.300	318.56	1999.4	0.0	2318.0	1655.7	1006.4	2 0.0 (C) 0.0 (C)
23.400	23.400	319.60	2015.2	0.0	2334.8	1667.7	1013.8	2 0.0 (C) 0.0 (C)
23.500	23.500	320.65	2031.0	0.0	2351.6	1679.7	1021.2	2 0.0 (C) 0.0 (C)
23.600	23.600	321.70	2046.8	0.0	2368.5	1691.8	1028.7	2 0.0 (C) 0.0 (C)
23.700	23.700	322.75	2062.7	0.0	2385.5	1703.9	1036.1	2 0.0 (C) 0.0 (C)
23.800	23.800	323.80	2078.7	0.0	2402.5	1716.1	1043.6	2 0.0 (C) 0.0 (C)
23.900	23.900	324.85	2094.7	0.0	2419.6	1728.3	1051.2	2 0.0 (C) 0.0 (C)
24.000	24.000	325.89	2110.8	0.0	2436.7	1740.5	1058.7	2 0.0 (C) 0.0 (C)
24.100	24.100	326.94	2126.9	0.0	2453.9	1752.8	1066.3	2 0.0 (C) 0.0 (C)
24.200	24.200	327.99	2143.1	0.0	2471.1	1765.1	1073.9	2 0.0 (C) 0.0 (C)
24.300	24.300	329.04	2159.3	0.0	2488.3	1777.4	1081.5	2 0.0 (C) 0.0 (C)
24.400	24.400	330.09	2175.6	0.0	2505.7	1789.8	1089.1	2 0.0 (C) 0.0 (C)
24.500	24.500	331.14	2191.9	0.0	2523.0	1802.2	1096.8	2 0.0 (C) 0.0 (C)
24.600	24.600	332.18	2208.3	0.0	2540.5	1814.6	1104.5	2 0.0 (C) 0.0 (C)
24.700	24.700	333.23	2224.7	0.0	2557.9	1827.1	1112.2	2 0.0 (C) 0.0 (C)
24.800	24.800	334.28	2241.2	0.0	2575.5	1839.6	1119.9	2 0.0 (C) 0.0 (C)
24.900	24.900	335.33	2257.7	0.0	2593.1	1852.2	1127.7	2 0.0 (C) 0.0 (C)
25.000	25.000	336.38	2274.3	0.0	2610.7	1864.8	1135.5	2 0.0 (C) 0.0 (C)

# Limiting criteria :

1 : DA1 C1

2 : DA1 C2

\*(C)-> Compression load, (T)-> Tension load

Note: Design resistance does not include any consideration of negative skin friction.

## Nq Calculation Details

### Soil Profile 1: Soil Profile 1 - Material Factor Set - 1

There are no pile toe levels in any drained material (with Berezhantzev/Bolton option) in the given soil profile.

### Soil Profile 1: Soil Profile 1 - Material Factor Set - 2

There are no pile toe levels in any drained material (with Berezhantzev/Bolton option) in the given soil profile.

## Results - Tension

### Soil Profile 1: Soil Profile 1

Depth	Pile length	Cumulative external Friction	Net ultimate resistance	Design resistance	Combination with least resistance	Factored load*
		(Q <sub>s</sub> )				
[m]	[m]	[kN]	[kN]	[kN]	[kN]	
8.0000	8.0000	198.42	198.42	141.73	70.864	2 N.A. N.A.
8.1000	8.1000	206.26	206.26	147.33	73.663	2 N.A. N.A.
8.2000	8.2000	214.15	214.15	152.96	76.481	2 N.A. N.A.
8.3000	8.3000	222.09	222.09	158.63	79.317	2 N.A. N.A.
8.4000	8.4000	230.08	230.08	164.34	82.171	2 N.A. N.A.
8.5000	8.5000	238.12	238.12	170.09	85.044	2 N.A. N.A.
8.6000	8.6000	246.22	246.22	175.87	87.935	2 N.A. N.A.
8.7000	8.7000	254.37	254.37	181.69	90.845	2 N.A. N.A.
8.8000	8.8000	262.57	262.57	187.55	93.773	2 N.A. N.A.
8.9000	8.9000	270.82	270.82	193.44	96.720	2 N.A. N.A.
9.0000	9.0000	279.12	279.12	199.37	99.686	2 N.A. N.A.
9.1000	9.1000	287.47	287.47	205.34	102.67	2 N.A. N.A.
9.2000	9.2000	295.88	295.88	211.34	105.67	2 N.A. N.A.
9.3000	9.3000	304.34	304.34	217.39	108.69	2 N.A. N.A.
9.4000	9.4000	312.85	312.85	223.46	111.73	2 N.A. N.A.
9.5000	9.5000	321.41	321.41	229.58	114.79	2 N.A. N.A.
9.6000	9.6000	330.02	330.02	235.73	117.87	2 N.A. N.A.
9.7000	9.7000	338.69	338.69	241.92	120.96	2 N.A. N.A.
9.8000	9.8000	347.41	347.41	248.15	124.07	2 N.A. N.A.





# CENTRAL PILING LIMITED

115-119 Premier Inn, Camden High Street, London  
Wall Piles

Job No.	Sheet No.	Rev.
40631A3		
Drg. Ref.		
Made by AM	Date	Checked

Depth	Pile length	Cumulative external Friction	Net ultimate resistance	Design resistance	Combination resistance	Factored load* with least resistance	#	
9.9000	9.9000	356.18	356.18	254.41	127.21	2	N.A.	N.A.
10.000	10.000	365.00	365.00	260.71	130.36	2	N.A.	N.A.
10.100	10.100	373.87	373.87	267.05	133.52	2	N.A.	N.A.
10.200	10.200	382.79	382.79	273.42	136.71	2	N.A.	N.A.
10.300	10.300	391.77	391.77	279.83	139.92	2	N.A.	N.A.
10.400	10.400	400.80	400.80	286.28	143.14	2	N.A.	N.A.
10.500	10.500	409.88	409.88	292.77	146.38	2	N.A.	N.A.
10.600	10.600	419.01	419.01	299.29	149.65	2	N.A.	N.A.
10.700	10.700	428.19	428.19	305.85	152.92	2	N.A.	N.A.
10.800	10.800	437.42	437.42	312.45	156.22	2	N.A.	N.A.
10.900	10.900	446.71	446.71	319.08	159.54	2	N.A.	N.A.
11.000	11.000	456.05	456.05	325.75	162.87	2	N.A.	N.A.
11.100	11.100	465.44	465.44	332.46	166.23	2	N.A.	N.A.
11.200	11.200	474.88	474.88	339.20	169.60	2	N.A.	N.A.
11.300	11.300	484.37	484.37	345.98	172.99	2	N.A.	N.A.
11.400	11.400	493.92	493.92	352.80	176.40	2	N.A.	N.A.
11.500	11.500	503.52	503.52	359.65	179.83	2	N.A.	N.A.
11.600	11.600	513.16	513.16	366.55	183.27	2	N.A.	N.A.
11.700	11.700	522.87	522.87	373.48	186.74	2	N.A.	N.A.
11.800	11.800	532.62	532.62	380.44	190.22	2	N.A.	N.A.
11.900	11.900	542.42	542.42	387.44	193.72	2	N.A.	N.A.
12.000	12.000	552.28	552.28	394.48	197.24	2	N.A.	N.A.
12.100	12.100	562.19	562.19	401.56	200.78	2	N.A.	N.A.
12.200	12.200	572.14	572.14	408.67	204.34	2	N.A.	N.A.
12.300	12.300	582.16	582.16	415.83	207.91	2	N.A.	N.A.
12.400	12.400	592.22	592.22	423.01	211.51	2	N.A.	N.A.
12.500	12.500	602.33	602.33	430.24	215.12	2	N.A.	N.A.
12.600	12.600	612.50	612.50	437.50	218.75	2	N.A.	N.A.
12.700	12.700	622.72	622.72	444.80	222.40	2	N.A.	N.A.
12.800	12.800	632.99	632.99	452.13	226.07	2	N.A.	N.A.
12.900	12.900	643.31	643.31	459.51	229.75	2	N.A.	N.A.
13.000	13.000	653.68	653.68	466.92	233.46	2	N.A.	N.A.
13.100	13.100	664.11	664.11	474.36	237.18	2	N.A.	N.A.
13.200	13.200	674.59	674.59	481.85	240.92	2	N.A.	N.A.
13.300	13.300	685.11	685.11	489.37	244.68	2	N.A.	N.A.
13.400	13.400	695.70	695.70	496.92	248.46	2	N.A.	N.A.
13.500	13.500	706.33	706.33	504.52	252.26	2	N.A.	N.A.
13.600	13.600	717.01	717.01	512.15	256.08	2	N.A.	N.A.
13.700	13.700	727.75	727.75	519.82	259.91	2	N.A.	N.A.
13.800	13.800	738.53	738.53	527.52	263.76	2	N.A.	N.A.
13.900	13.900	749.37	749.37	535.27	267.63	2	N.A.	N.A.
14.000	14.000	760.27	760.27	543.05	271.52	2	N.A.	N.A.
14.100	14.100	771.21	771.21	550.86	275.43	2	N.A.	N.A.
14.200	14.200	782.20	782.20	558.72	279.36	2	N.A.	N.A.
14.300	14.300	793.25	793.25	566.61	283.30	2	N.A.	N.A.
14.400	14.400	804.35	804.35	574.53	287.27	2	N.A.	N.A.
14.500	14.500	815.50	815.50	582.50	291.25	2	N.A.	N.A.
14.600	14.600	826.70	826.70	590.50	295.25	2	N.A.	N.A.
14.700	14.700	837.95	837.95	598.54	299.27	2	N.A.	N.A.
14.800	14.800	849.26	849.26	606.61	303.31	2	N.A.	N.A.
14.900	14.900	860.62	860.62	614.73	307.36	2	N.A.	N.A.
15.000	15.000	872.02	872.02	622.87	311.44	2	N.A.	N.A.
15.100	15.100	883.48	883.48	631.06	315.53	2	N.A.	N.A.
15.200	15.200	895.00	895.00	639.28	319.64	2	N.A.	N.A.
15.300	15.300	906.56	906.56	647.54	323.77	2	N.A.	N.A.
15.400	15.400	918.18	918.18	655.84	327.92	2	N.A.	N.A.
15.500	15.500	929.84	929.84	664.17	332.09	2	N.A.	N.A.
15.600	15.600	941.56	941.56	672.55	336.27	2	N.A.	N.A.
15.700	15.700	953.34	953.34	680.95	340.48	2	N.A.	N.A.
15.800	15.800	965.16	965.16	689.40	344.70	2	N.A.	N.A.
15.900	15.900	977.03	977.03	697.88	348.94	2	N.A.	N.A.
16.000	16.000	988.96	988.96	706.40	353.20	2	N.A.	N.A.
16.100	16.100	1000.9	1000.9	714.96	357.48	2	N.A.	N.A.
16.200	16.200	1013.0	1013.0	723.55	361.77	2	N.A.	N.A.
16.300	16.300	1025.0	1025.0	732.18	366.09	2	N.A.	N.A.
16.400	16.400	1037.2	1037.2	740.84	370.42	2	N.A.	N.A.
16.500	16.500	1049.4	1049.4	749.55	374.77	2	N.A.	N.A.
16.600	16.600	1061.6	1061.6	758.29	379.14	2	N.A.	N.A.
16.700	16.700	1073.9	1073.9	767.07	383.53	2	N.A.	N.A.
16.800	16.800	1086.2	1086.2	775.88	387.94	2	N.A.	N.A.
16.900	16.900	1098.6	1098.6	784.73	392.37	2	N.A.	N.A.
17.000	17.000	1111.1	1111.1	793.62	396.81	2	N.A.	N.A.
17.100	17.100	1123.6	1123.6	802.55	401.27	2	N.A.	N.A.
17.200	17.200	1136.1	1136.1	811.51	405.76	2	N.A.	N.A.
17.300	17.300	1148.7	1148.7	820.51	410.25	2	N.A.	N.A.
17.400	17.400	1161.4	1161.4	829.55	414.77	2	N.A.	N.A.
17.500	17.500	1174.1	1174.1	838.62	419.31	2	N.A.	N.A.



# CENTRAL PILING LIMITED

115-119 Premier Inn, Camden High Street, London  
Wall Piles

Job No.	Sheet No.	Rev.
40631A3		
Drg. Ref.		
Made by AM	Date	Checked

Depth	Pile length	Cumulative external Friction	Net ultimate resistance	Design resistance	Combination resistance	Factored load* with least resistance	#		
17.600	17.600	1186.8	1186.8	847.73	423.87	2	N.A.	N.A.	
17.700	17.700	1199.6	1199.6	856.88	428.44	2	N.A.	N.A.	
17.800	17.800	1212.5	1212.5	866.06	433.03	2	N.A.	N.A.	
17.900	17.900	1225.4	1225.4	875.28	437.64	2	N.A.	N.A.	
18.000	18.000	1238.4	1238.4	884.54	442.27	2	N.A.	N.A.	
18.100	18.100	1251.4	1251.4	893.84	446.92	2	N.A.	N.A.	
18.200	18.200	1264.4	1264.4	903.17	451.58	2	N.A.	N.A.	
18.300	18.300	1277.6	1277.6	912.54	456.27	2	N.A.	N.A.	
18.400	18.400	1290.7	1290.7	921.95	460.97	2	N.A.	N.A.	
18.500	18.500	1303.9	1303.9	931.39	465.69	2	N.A.	N.A.	
18.600	18.600	1317.2	1317.2	940.87	470.43	2	N.A.	N.A.	
18.700	18.700	1330.5	1330.5	950.39	475.19	2	N.A.	N.A.	
18.800	18.800	1343.9	1343.9	959.94	479.97	2	N.A.	N.A.	
18.900	18.900	1357.3	1357.3	969.53	484.77	2	N.A.	N.A.	
19.000	19.000	1370.8	1370.8	979.16	489.58	2	N.A.	N.A.	
19.100	19.100	1384.4	1384.4	988.82	494.41	2	N.A.	N.A.	
19.200	19.200	1397.9	1397.9	998.53	499.26	2	N.A.	N.A.	
19.300	19.300	1411.6	1411.6	1008.3	504.13	2	N.A.	N.A.	
19.400	19.400	1425.3	1425.3	1018.0	509.02	2	N.A.	N.A.	
19.500	19.500	1439.0	1439.0	1027.9	513.93	2	N.A.	N.A.	
19.600	19.600	1452.8	1452.8	1037.7	518.85	2	N.A.	N.A.	
19.700	19.700	1466.6	1466.6	1047.6	523.80	2	N.A.	N.A.	
19.800	19.800	1480.5	1480.5	1057.5	528.76	2	N.A.	N.A.	
19.900	19.900	1494.5	1494.5	1067.5	533.74	2	N.A.	N.A.	
20.000	20.000	1508.5	1508.5	1077.5	538.74	2	N.A.	N.A.	
20.100	20.100	1522.5	1522.5	1087.5	543.75	2	N.A.	N.A.	
20.200	20.200	1536.6	1536.6	1097.6	548.79	2	N.A.	N.A.	
20.300	20.300	1550.8	1550.8	1107.7	553.84	2	N.A.	N.A.	
20.400	20.400	1565.0	1565.0	1117.8	558.92	2	N.A.	N.A.	
20.500	20.500	1579.2	1579.2	1128.0	564.01	2	N.A.	N.A.	
20.600	20.600	1593.5	1593.5	1138.2	569.12	2	N.A.	N.A.	
20.700	20.700	1607.9	1607.9	1148.5	574.25	2	N.A.	N.A.	
20.800	20.800	1622.3	1622.3	1158.8	579.39	2	N.A.	N.A.	
20.900	20.900	1636.8	1636.8	1169.1	584.56	2	N.A.	N.A.	
21.000	21.000	1651.3	1651.3	1179.5	589.74	2	N.A.	N.A.	
21.100	21.100	1665.8	1665.8	1189.9	594.95	2	N.A.	N.A.	
21.200	21.200	1680.5	1680.5	1200.3	600.17	2	N.A.	N.A.	
21.300	21.300	1695.1	1695.1	1210.8	605.41	2	N.A.	N.A.	
21.400	21.400	1709.9	1709.9	1221.3	610.66	2	N.A.	N.A.	
21.500	21.500	1724.6	1724.6	1231.9	615.94	2	N.A.	N.A.	
21.600	21.600	1739.5	1739.5	1242.5	621.23	2	N.A.	N.A.	
21.700	21.700	1754.3	1754.3	1253.1	626.55	2	N.A.	N.A.	
21.800	21.800	1769.3	1769.3	1263.8	631.88	2	N.A.	N.A.	
21.900	21.900	1784.2	1784.2	1274.5	637.23	2	N.A.	N.A.	
22.000	22.000	1799.3	1799.3	1285.2	642.60	2	N.A.	N.A.	
22.100	22.100	1814.4	1814.4	1296.0	647.99	2	N.A.	N.A.	
22.200	22.200	1829.5	1829.5	1306.8	653.39	2	N.A.	N.A.	
22.300	22.300	1844.7	1844.7	1317.6	658.82	2	N.A.	N.A.	
22.400	22.400	1859.9	1859.9	1328.5	664.26	2	N.A.	N.A.	
22.500	22.500	1875.2	1875.2	1339.4	669.72	2	N.A.	N.A.	
22.600	22.600	1890.6	1890.6	1350.4	675.20	2	N.A.	N.A.	
22.700	22.700	1906.0	1906.0	1361.4	680.70	2	N.A.	N.A.	
22.800	22.800	1921.4	1921.4	1372.4	686.21	2	N.A.	N.A.	
22.900	22.900	1936.9	1936.9	1383.5	691.75	2	N.A.	N.A.	
23.000	23.000	1952.4	1952.4	1394.6	697.30	2	N.A.	N.A.	
23.100	23.100	1968.0	1968.0	1405.7	702.87	2	N.A.	N.A.	
23.200	23.200	1983.7	1983.7	1416.9	708.46	2	N.A.	N.A.	
23.300	23.300	1999.4	1999.4	1428.1	714.07	2	N.A.	N.A.	
23.400	23.400	2015.2	2015.2	1439.4	719.70	2	N.A.	N.A.	
23.500	23.500	2031.0	2031.0	1450.7	725.35	2	N.A.	N.A.	
23.600	23.600	2046.8	2046.8	1462.0	731.01	2	N.A.	N.A.	
23.700	23.700	2062.7	2062.7	1473.4	736.69	2	N.A.	N.A.	
23.800	23.800	2078.7	2078.7	1484.8	742.40	2	N.A.	N.A.	
23.900	23.900	2094.7	2094.7	1496.2	748.12	2	N.A.	N.A.	
24.000	24.000	2110.8	2110.8	1507.7	753.85	2	N.A.	N.A.	
24.100	24.100	2126.9	2126.9	1519.2	759.61	2	N.A.	N.A.	
24.200	24.200	2143.1	2143.1	1530.8	765.39	2	N.A.	N.A.	
24.300	24.300	2159.3	2159.3	1542.4	771.18	2	N.A.	N.A.	
24.400	24.400	2175.6	2175.6	1554.0	776.99	2	N.A.	N.A.	
24.500	24.500	2191.9	2191.9	1565.6	782.82	2	N.A.	N.A.	
24.600	24.600	2208.3	2208.3	1577.3	788.67	2	N.A.	N.A.	
24.700	24.700	2224.7	2224.7	1589.1	794.54	2	N.A.	N.A.	
24.800	24.800	2241.2	2241.2	1600.9	800.43	2	N.A.	N.A.	
24.900	24.900	2257.7	2257.7	1612.7	806.33	2	N.A.	N.A.	
25.000	25.000	2274.3	2274.3	1624.5	812.26	2	N.A.	N.A.	



**CENTRAL PILING  
LIMITED**

115-119 Premier Inn, Camden High Street, London  
Wall Piles

Job No.	Sheet No.	Rev.
40631A3		
Drg. Ref.		
Made by AM	Date	Checked

Depth	Pile length	Cumulative external Friction	Net ultimate resistance	Design resistance	Combination with least resistance	Factored load*
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Note - The weight of the pile has not been included in the factored load.

# Limiting criteria :

1 : DA1 C1 [Shaft Tension]

2 : DA1 C2 [Shaft Tension]

\*(C)-> Compression load, (T)-> Tension load

Note: Design resistance does not include any consideration of negative skin friction.

Job No.	Sheet No.	Rev.
40631A3		
Drg. Ref.		
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### Notes

450mm diameter  
L=12.2m  
SWL=120kN

### Analysis Options

Datum type	Depth based
Effective stress profile	Calculated
Depth of rigid boundary	20.000 m
Poisson's ratio of soil	0.25000
Young's modulus of soil above toe level of pile	30000. kPa
Young's modulus of soil below toe level of pile	50000. kPa
Number of pile elements	10
Increment type:	Both loads and displacements
Number of load & displacement increments	100
Increment results would be printed once every	100 increments
Include effect of soil above pile base in base displacement calculation	Yes

### Pile Properties

Pile type	Solid
Pile cross-section	Circular
Under-ream	No
Use different values of Young's modulus for compression and tension	No
Young's modulus of pile	20.000E+6 kPa
Is fixed head boundary condition active?	No
Calculation profile	Single
Pile length	12.200 m

Cross-section	Number of cross sections	Top Diameter [m]	Second Diameter location [m]	Second Diameter [m]	Third Diameter location [m]	Third Diameter [m]
Cross-section 1	1	0.45000				

### Undrained Materials - General Data

No.	Material description	Bulk unit weight [kN/m <sup>3</sup> ]	Cu material factor	Top Cu [kPa]	Base Cu [kPa]
1	London Clay	20.000	NA	90.000	235.00
2	London Clay Base	20.000	NA	235.00	235.00

### Undrained Materials - Skin Friction Data

No.	Material description	Skin friction computation	Alpha	q <sub>s</sub> Top [kPa]	Base Spec. [kPa]	q <sub>s,lim</sub> Value [kPa]
1	London Clay	Alpha specified	0.50000	NA	NA Yes	140.00
2	London Clay Base	Alpha specified	0.50000	NA	NA Yes	140.00

### Undrained Materials - End Bearing Data

No.	Material description	End bearing computation	Nc	q <sub>b</sub> Top [kPa]	Base Spec. [kPa]	q <sub>b,lim</sub> Value [kPa]
1	London Clay	Nc specified	9.0000	NA	NA Yes	2500.0
2	London Clay Base	Nc specified	9.0000	NA	NA Yes	2500.0

### Undrained Materials - Material Factors (Code Based)

Job No.	Sheet No.	Rev.
40631A3		
Drg. Ref.		
Made by AM	Date	Checked

No.	Material description	End bearing computation	Nc	Qb	Qb, lim
				Top [kPa]	Base Spec. Value [kPa]

No.	Material description	Qs factors		Nc factors		Qb factors	
		M1	M2	M1	M2	M1	M2
1	London Clay	N.A.	N.A.	1.0000	1.0000	N.A.	N.A.
2	London Clay Base	N.A.	N.A.	1.0000	1.0000	N.A.	N.A.

### Drained Materials - General Data

No.	Material description	Bulk unit weight [kN/m³]	Tan(δ) material factor
1	Made Ground	18.000	NA

### Drained Materials - Friction Data

No.	Material description	Skin friction computation	Beta	Delta (δ) [deg]	Coefficient of earth pressure K	Qs Top [kPa]	Qs Base [kPa]	Qs Spec.	Qs, lim Value [kPa]
1	Made Ground	qs specified	NA	NA	NA	0.0	0.0	No	NA

### Drained Materials - End Bearing Data

No.	Material description	End bearing computation	Nq [deg]	Phi' [deg]	PhiD [deg]	Phicv' [deg]	Ir	Qb Top [kPa]	Qb Base [kPa]	Qb Spec.	Nq-Phi curves Value [kPa]
1	Made Ground	qb specified	NA	NA	NA	NA	NA	0.0	0.0	No	NA NA

### Drained Materials - Material Factors (Code Based)

No.	Material description	Qs factors		Nq factors		Qb factors	
		M1	M2	M1	M2	M1	M2
1	Made Ground	1.0000	1.0000	N.A.	N.A.	1.0000	1.0000

### Nq-Phi curve data

#### Curve 1 : Nq-Phi Curve 1

Nq Phi'  
[deg]

### Convergence Control Data

Maximum number of iterations	1000
Tolerance for displacement	0.010000 mm
Tolerance for skin friction	1.0000 kPa
Damping coefficient	1.0000

## STAGE SPECIFIC DATA

### Stage 0 : Initial Stage

#### Groundwater

No.	Level [m]	Pressure [kPa]	Unit weight of water [kN/m³]
1	9.5000	0.0	10.000

#### Soil Profiles

Job No.	Sheet No.	Rev.
40631A3		
Drg. Ref.		
Made by AM	Date	Checked

No.	Level	Pressure	Unit weight of water
	[m]	[kPa]	[kN/m <sup>3</sup> ]

**Soil Profile 1: Soil Profile 1**

No.	Depth	Material description	Contributes to negative skin friction
	[m]		
1	0.0	Made Ground	No
2	5.2000	London Clay	No
3	25.000	London Clay Base	No

**Soil Profile - Groundwater Map**

No.	Soil Profile	Groundwater
1	Soil Profile 1	Groundwater Profile 1

**Static Loads & Displacements**

Depth	Applied load	Prescribed soil displacement	Load factor	
	[kN]	[mm]	A1	A2
[m]				
0.0	120.00	0.0	1.0000	1.0000

**Calculated Limiting shaft skin friction****Soil Profile 1: Soil Profile 1****Cross Section 1**

Depth	Limiting shaft skin friction
[m]	[kPa]
0.0	0.0
5.2000	0.0
5.2000	45.000
12.200	70.631

**Stage specific warnings**

- 1 - Stage 0 - The bottom most layer in Soil Profile 1 is assigned "Total stress" material. For this layer the cohesion is assumed to be constant at "Cu-Top", i.e cohesion specified at the top of this layer. The user specified value of cohesion at the bottom of this layer, "Cu-Bottom" is ignored. (Material Properties)

**SETTLEMENT RESULTS****Soil Profile 1: Soil Profile 1****Results for Length 12.200 [m] Cross-section 1 Load & Displacement increment 100**

Load applied to pile = 120.00 kN  
 Converged at iteration number = 3  
 Maximum displacement = 0.77119 mm at node 1  
 Displacement error = 512.35E-6 mm  
 Skin friction error = 0.048959 kPa

**Stresses and Displacements along Pile**

Depth	Shaft skin friction	Pile stress	Pile displacement
[m]	[kPa]	[kPa]	[mm]
-0.61000	0.0	754.51	0.77119



# CENTRAL PILING LIMITED

115-119 Premier Inn, Camden High Street, London

Wall Piles

Settlement check

Job No.	Sheet No.	Rev.
40631A3		
Drg. Ref.		
Made by	Date	Checked
AM		

Depth	Shaft skin	Pile	Pile
[m]	friction	stress	displacement
	[kPa]	[kPa]	[mm]
-1.8300	0.0	754.51	0.72519
-3.0500	0.0	754.51	0.67922
-4.2700	0.0	754.51	0.63328
-5.4900	13.836	679.49	0.58736
-6.7100	8.6993	557.30	0.55060
-7.9300	7.9458	467.05	0.51959
-9.1500	7.5321	383.12	0.49383
-10.370	7.4542	301.86	0.47306
-11.590	10.518	204.42	0.45722

Base pressure = 151.47 kPa      Base displacement = 0.45178 mm