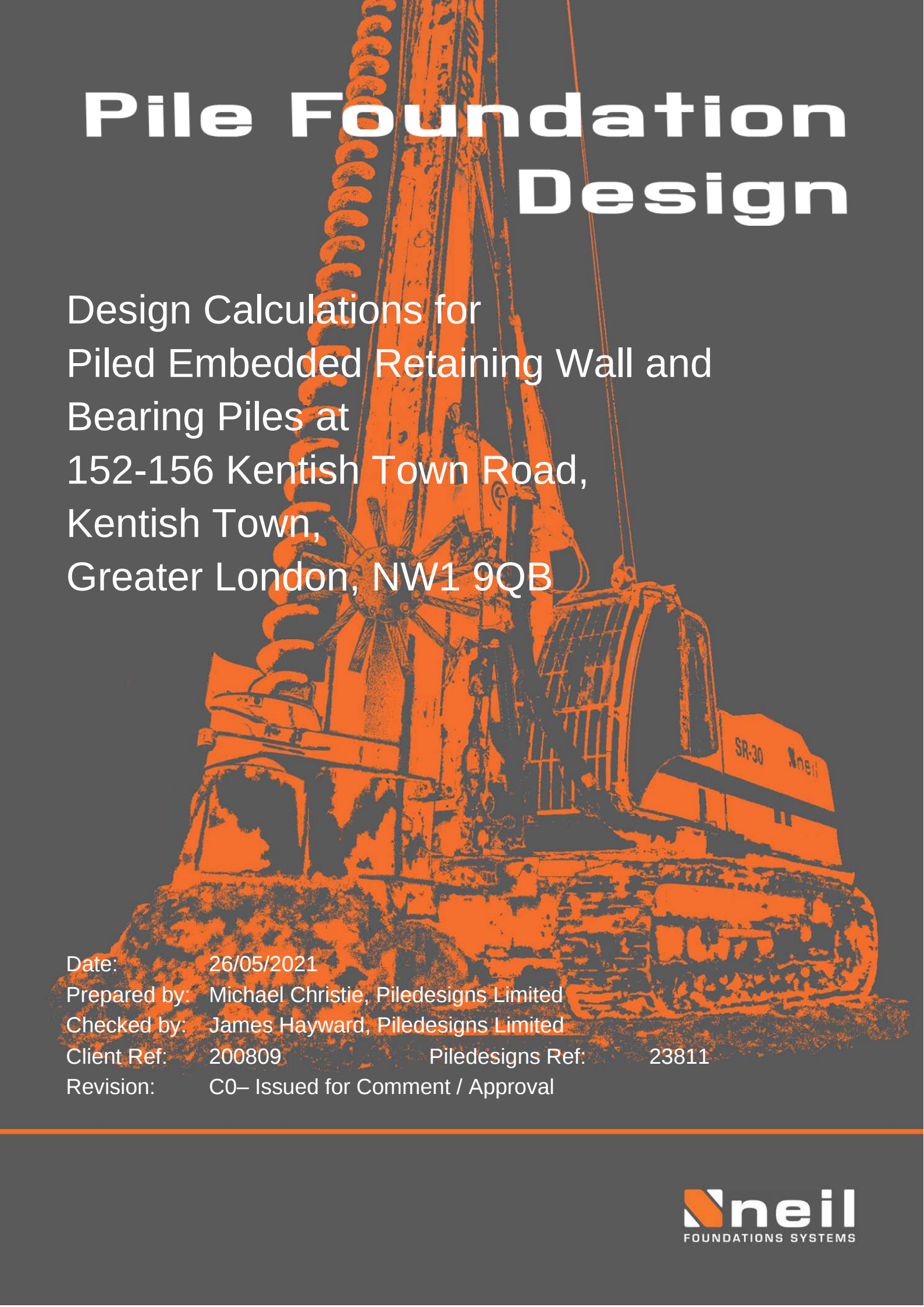


Pile Foundation Design



Design Calculations for
Piled Embedded Retaining Wall and
Bearing Piles at
152-156 Kentish Town Road,
Kentish Town,
Greater London, NW1 9QB

Date: 26/05/2021

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Revision: C0– Issued for Comment / Approval

Contents

1.0 Introduction	3
2.0 Information Provided.....	4
2.1 Drawings	4
2.2 Soil Report	4
2.3 Ground Movement Assessment	4
2.4 Specification Documentation	4
2.5 Pile Details and Additional Information.....	4
3.0 Ground Conditions	5
3.1 Soils Profile	5
3.2 Ground Movement Analysis.....	6
4.0 Embedded Retaining Wall Design	7
4.1 Design Scope.....	7
4.2 Construction Sequence	7
4.3 Structural Design Parameters.....	8
4.4 Geotechnical Analysis for Contiguous Bored Pile Retaining Wall	8
4.5 Wall Movement	11
4.6 Firm Pile	11
5.0 Vertical Design.....	12
5.1 Design Approach	12
5.2 Shaft Adhesion, R_{sk}	13
5.3 Base Resistance, R_{bk}	13
5.4 Wall Piles	13
5.5 Pile Length	13
6.0 Lateral Design (Bearing Piles)	14
7.0 Structural Analysis	16
7.1 Axial Structural Analysis	16
7.2 Retaining Wall Reinforcement Design.....	16
7.3 Bearing Pile Reinforcement Design.....	17
7.4 Reinforcement Tension Check	17
7.5 Pile reinforcement projection	18
8.0 Piling Summary.....	19
8.1 Design Realisation.....	19

1.0 Introduction

These calculations are for the design of the embedded retaining wall and bearing piles for the redevelopment 152-156 Kentish Town Road, Kentish Town, Greater London. It is understood that the existing structures on site will be demolished and replaced with a new residential apartment development with a single level basement. A piled retaining wall has been selected to form the basement walls and allow for the excavation.

The site fronts onto Kentish Town Road to the west and is bounded by a dental practice to the north, a shop to the south and a timber merchants to the east. The site may be additionally located by National Grid Reference 528980,184712. Figure 1 - site location plan.

Figure 1 – Site Location



A relevant pile design for the scheme is provided below and has been carried out in accordance with BS EN 1997 and other relevant documents for the bearing piles, retaining wall and for the axial loads on the retaining wall.

2.0 Information Provided

The main documents that have been consulted in preparing these calculations can be summarised as follows.

2.1 Drawings

Table 1 – Design documents

Author	Reference	Rev	Details
BJB Consulting	2394-BJB-00-FN-DR-S-0100	P05	Foundation Works GA
	2394-BJB-00-FN-DR-S-0101	P05	Foundation Details Sheet 1
	2394-BJB-00-FN-DR-S-0104	P04	Piling Works GA
	2394-BJB-00-GD-DR-S-0200	P04	Ground Floor GA
	2394-BJB-00-ZZ-DR-S-0206	P01	Sections Through Building Sheet 1
	2394-BJB-00-ZZ-DR-S-0207	P01	Sections Through Building Sheet 2

2.2 Soil Report

Table 2 – Site Investigation Data

Author	Reference	Date	Details
Ground & Environmental Services Ltd (GEA)	J15359	June 2016	Desk Study & Ground Investigation Report

2.3 Ground Movement Assessment

Table 3 – Ground Movement Assessment

Author	Reference	Date	Details
Dunelm Geotechnical & Environmental	D8002/01	11.05.17	Ground Movement Review Report In Relation to LUL Tunnels 152-156 Kentish Town Road
Parmarbrook	PB-1599-BIA01 Rev 1	June 2016	Basement Impact Assessment

2.4 Specification Documentation

No specific project Specification has been provided so consequently reference has been made to the Institute of Civil Engineers publication, ICE Specification for Piling and Embedded Retaining Walls, SPERW, Third Edition published 2017. This is an administrative document for good working practice of piling works and the design has been carried out in general accordance with this document.

2.5 Pile Details and Additional Information.

The piled retaining walls will be secant as detailed by BJB Consulting, the structural engineers for the scheme. The section drawings provided for the retaining walls show approximate retained heights of 5.3m in the temporary condition and supported in the permanent condition by the structural basement and ground floor slabs. The wall piles are subject to vertical load and have been reviewed accordingly.

Piling platform level has been taken as 30.6mAD for all piles.

3.0 Ground Conditions

Information on the ground conditions was taken from the data provided in the site investigation report as noted above. The site is currently occupied by a two storey brick built mixed residential and commercial building, which occupies nearly the entire site footprint. The site is divided into two, with a bookmakers in the northern third of the site, and a carpet shop occupying the remaining two thirds.

The proposed basement is understood to extend across the majority of the footprint of the site. The site is understood to be relatively flat and devoid of vegetation.

It is understood that the London Underground Northern Line runs north-south under the Kentish Town Road. The tunnel is understood to be at a depth of 19.2m and is approximately 5m from the western boundary of the site.

Within the GEA investigation, one cable percussive borehole was drilled to a maximum depth of 15m in addition to two shallower windowless sampler boreholes to 7m. The investigation details a ground model of Made Ground, varying in nature and in turn London Clay to depth. This ground profile is consistent with that given the BGS Map for the area.

Groundwater has been taken as 0.45m below ground level with an additional check undertaken for a temporary high water condition for the retaining wall. The lateral load to the bearing piles will be applied within the clay and therefore no water has been considered in the lateral analysis of bearing piles.

3.1 Soils Profile

We have used all the relevant test data available and have based our design on a single ground model. From the borehole and soil strength profile plots (see Appendix B) the following ground model has been taken;

Piling Platform Levels (PPL), has been taken as 30.6mAD.

Table 4 – Ground Model

Level (mAD)			Soil
30.6	to	27.3	Made Ground
27.3	to	22.0	London Clay (1)
22.0	to	---	London Clay (2)

The main geotechnical strength data was in the form of Standard Penetration Test (SPT N values). See plot in Appendix B. From the above the following soil properties have been determined and used within these design calculations.

Table 5 – Soil Properties

Soil	γ (kN/m ³)	Cu (kN/m ²)	c'	ϕ' (°)	Ko	Eu (kN/m ²)	E' (kN/m ²)
Made Ground	19	n/a	0	27	0.54	10,000	N/A
London Clay (1)	20	90	0	24	1.2	72,000	55,440
London Clay (2)	20	90 + 9.88z	0	24	1.2	72,000 + 7904z	51,200 + 6086z

The above tables are Service Limit State (SLS) values and have not had any partial factors applied.

For the retaining wall the above profile will be used in the analysis. For the vertical load capacity, no positive contribution from the ground will be applied above dig level.

3.2 Ground Movement Analysis

A ground movement analysis has been undertaken with respect to the London Underground, with the reports referenced in table 3. No additional allowance has been made for the tunnels within this retaining wall and bearing pile design.

4.0 Embedded Retaining Wall Design

4.1 Design Scope

An embedded retaining wall has been indicated on the drawings by BJB Consulting. The wall has been detailed as a secant bored pile retaining wall utilising 600mm diameter piles. It is proposed to install the piles at 840mm centres. The wall is to be reviewed as a propped in the temporary condition with permanent long support from the sub / super structure.

Piling levels have been taken as approximately 30.6mOD, this has also been taken as retained height with the exception of design case 3. Four wall sections have been identified for this analysis, reference Design Case 1 - 4, detailed below and in Appendix C.

Table 6 – Embedded Retaining Wall Design Cases

Design Case	Retained Level (mAD)	Excavation Level (mAD)	Retained Height (m)	Surcharges
1	30.6	25.29	5.31	10kPa General
2	30.6	25.29	5.31*	10kPa General 100kN/m - footing at 1.0m offset over 1m width at a depth of 1m.
3	31.25	25.29	5.96	10kPa General 100kN/m - footing at 1.0m offset over 1m width at a depth of 1m.
4	30.6	25.29	5.31	10kPa General 120kN/m - footing at 0.75m offset over 1m width at a depth of 1m.

* It should be noted that on the drawings, piles between gridline 3-5 are noted to have a retained height of 5.65m. This condition has been reviewed within the ULS conditions. The reinforcement has been slightly increased for these piles and referenced Design Case 2a in the structural reinforcement section.

The sections identified have been chosen to represent the general soil and structural criteria for the site. The sections have been reviewed for a general surcharge of 10kPa, taken as an imposed load within the analysis.

The wall will be designed to cater for earth and surcharge pressures, along with the vertical loads identified in drawing noted above.

4.2 Construction Sequence

The general construction sequence adopted for the retaining wall has been assumed as follows;

Design Section 1, 2 & 4

1. Install Wall Piles (+30.6mAD).
2. Construct capping beam (allow capping beam to cure).
3. Install temporary props on capping beam/corbels. Taken at a level of 31.0mOD.
4. Excavate to level 25.29mAD (SLS) / 24.79mAD (ULS)

5. Construct 450mm RC basement slab, SSL = 25.99mAD (c/l of slab @ 25.765mAD)
6. Construct 275mm RC ground floor slab, SSL = 30.588mAD (c/l of slab @ 30.45mAD)
7. Remove temporary prop.
8. Apply long term pile stiffness and soil parameters.

Design Section 3

9. Install Wall Piles (+30.6mAD).
10. Construct capping beam (allow capping beam to cure).
11. Install temporary props on capping beam/corbels. Taken at a level of 31.0mOD.
12. Install RC upstand for raised ground level and backfill where required.
13. Excavate to level 25.29mAD (SLS) / 24.79mAD (ULS)
14. Construct 450mm RC basement slab, SSL = 25.99mAD (c/l of slab @ 25.765mAD)
15. Construct 275mm RC ground floor slab, SSL = 30.588mAD (c/l of slab @ 30.45mAD)
16. Remove temporary prop.
17. Apply long term pile stiffness and soil parameters.

4.3 Structural Design Parameters

The contiguous bored pile retaining wall will be constructed using Continuous Flight Auger (CFA) piling techniques with a C30/37 designed concrete pump mix and 'B' (500N/mm²) grade main reinforcement bars with helical shear links. A minimum of 75mm cover to the main reinforcement will be provided by propriety spacers. The main structural design parameters used in the retaining wall analysis have been summarized in table 7, for 600mm diameter piles at approximately 840mm centres.

Table 7 – Retaining Wall Structural Design Parameters

Material	Short Term Parameters	Long Term Parameters
Concrete 600mm diameter	$E = 1.96 \times 10^{+7} \text{ kN/m}^2$ $I = 7.573 \times 10^{-3} \text{ m}^4/\text{m run}$ $E.I = 148,732 \text{ kN.m}^2 / \text{m run}$	$E = 1.40 \times 10^{+7} \text{ kN/m}^2$ $I = 7.573 \times 10^{-3} \text{ m}^4/\text{m run}$ $E.I = 106,237 \text{ kN.m}^2 / \text{m run}$
Steel	$E = 2.05 \times 10^{+8} \text{ kN/m}^2$	$E = 2.05 \times 10^{+8} \text{ kN/m}^2$

Notes: Short term EI = 70% of the initial value, Long Term EI – 50% of the initial value

4.4 Geotechnical Analysis for Contiguous Bored Pile Retaining Wall

The retaining wall analysis has been carried out using the computer program 'WALLAP' Version 6.05 developed by Geosolve.

The design has been carried out using the 'Strength Factor' approach with partial factors in accordance with Ciria 760 & BS EN 1997-1: 2004 Eurocode 7 and to the approach as prescribed in the UK National Annex of BS EN 1997-1. Using this approach three runs for each section may be carried out and these are typically referenced as: -

SLS	service limit state
ULS-comb 1	ultimate limit state – structural (STR)
ULS-comb 2	ultimate limit state – geotechnical (GEO)

With respect to the above the wall design is checked in its ultimate state by applying partial factors and carrying out two separate checks (combinations), as shown in Table 8 which have been taken from Tables NA.A1. (B) and (C) of

the UK National Annex to BA EN 1990+A1; 2005 for the actions and Table A. NA.4 of the National annex to BS EN 1997-1: 2004 for the soil parameters.

Both represent ultimate conditions with combination 1, with ULS -comb 1 a structural ultimate case (STR-ULS), and combination 2 is the geotechnical ultimate case (GEO-ULS). Combination 1 applies partial factors to actions (A) - (temporary/permanent actions, G_k , and variable actions, Q_k) while soil parameters (M1) and pile resistances (R1) are kept un-factored ($R1$ & $M1 = 1.0$). Combination 2 applies partial factors to the soil parameters (M2) and with partial factors of smaller magnitude to the variable actions (A). For both these cases the design is mainly to verify that the proposed embedment length i.e. reinforced pile length / toe level, provides a nominal factor of safety against failure. Bending and shear forces are unfactored in any subsequent structural calculations for ULS-comb 2, but factored by 1.35 for ULS-comb 1. An allowance for 0.5m overdig within both ultimate cases is included on the basis that the excavations will be carried out under controlled conditions.

A further analysis is included which represents SLS conditions and usually carried out to determine wall deflections. The analysis assumes moderately conservative soil parameters, with a partial factor (M2) taken as 1.0 and no allowance for overdig. This calculation also provides bending moments and shear forces which are factored up by 1.35 in any subsequent structural calculations. The results from this analysis are provided per metre run and therefore amended to the pile diameter and spacing.

The Ultimate Limit State (ULS) conditions employ factored soil parameters as required for the (ULS – GEO), DA1 Combination 2 conditions.

Table 8 - Partial factors adopted for design (Retaining Wall Earth Pressures).

	Notation	Partial Factor		
		SLS	DA1 Comb. 1	DA1 Comb. 2
ACTIONS: (A)				
Permanent Action (Unfavourable)	G _k	1.0	1.35 (A1)	1.0 (A2)
Variable Action (Unfavourable)	Q _k	1.0	1.50 (A1)	1.3 (A2)
SOIL FACTORS: (M)				
Effective angle of shearing resistance	tan Ø'	1.0	1.0 (M1)	1.25 (M2)
Effective cohesion	C'	1.0	1.0 (M1)	1.25 (M2)
Undrained shear strength	C _u	1.0	1.0 (M1)	1.40 (M2)
RESISTANCES: (R)				
Earth resistance	γ _{Re}	1.0	1.0 (R1)	1.0 (R1)

Notes – factors given above apply to Actions refer to unfavourable conditions

- Combination 1 (ULS - STR): A1 + M1 + R1.
- Combination 2 (ULS – GEO): A2 + M2 + R1.

The detailed results of the WALLAP analysis are given in Appendix D, and summarised below in table 9. It includes varying sets of bending moments and shear forces, the DA1-1 and SLS outputs have been factored by 1.35 in accordance with the above. Reinforcement calculations are based on the worst case bending moments and shear values determined from the un-factored ULS-comb 2 and factored SLS and ULS-comb 1 results. Table 9 shows the details of the sections with the proposed pile length.

Table 9 – WALLAP Summary (600mm Piles at 840mm c/c)

Design Case	Combination	BM/m (kNm/m)	SF (kN/m)	BM/pile (kNm/pile)	SF (kN/pile)	Movement (mm)	Toe Level (mOD)
1	DA1-1	167	162	140	-	n/a	21.6
	DA1-2	129	133	-	-	n/a	
	SLS x 1.35	147	166	-	139	6	
2	DA1-1	189	195	159	-	n/a	21.6
	DA1-2	150	161	-	-	n/a	
	SLS x 1.35	169	200	-	168	7	
3	DA1-1	187	180	157	-	n/a	21.6
	DA1-2	152	148	-	-	n/a	
	SLS x 1.35	166	185	-	155	6	
4	DA1-1	200	210	168	-	n/a	21.6
	DA1-2	162	141	-	-	n/a	
	SLS x 1.35	179	216	-	181	8	

As noted previously all design cases have been analysed with a temporary prop and the sub / super structure concrete basement and ground floor slab acting as a permanent restraint, the following table summarises the prop loading calculated from the analysis, the loads given for DA1-1 and SLS conditions include the 1.35 factor.

Table 10 – Propping Summary

Design Case	Combination	Temporary Prop @ 31.0mOD (kN/m)	Basement @ 26mOD (kN/m)	Ground @ 30.6mOD (kN/m)
1	DA1-1	68	198	85
	DA1-2	55	174	68
	SLS x 1.35	60	206	78
2	DA1-1	77	252	96
	DA1-2	64	221	78
	SLS x 1.35	68	260	88
3	DA1-1	88	227	107
	DA1-2	74	198	89
	SLS x 1.35	79	235	99
4	DA1-1	84	274	104
	DA1-2	71	239	86
	SLS x 1.35	75	284	96

4.5 Wall Movement

Calculated wall displacements and corresponding program outputs may be considered to be an upper bound estimate of long-term movements, due to the following factors:

- a) Geotechnical parameters, pile stiffness and surcharges are considered to be reasonably conservative values. A more accurate assessment of wall displacements would require the input of 'actual' parameters to be obtained from more sophisticated laboratory testing.
- b) The computer program does not consider the beneficial effects of structural elements such as a capping beam in this instance.
- c) The computer program is a two-dimensional analysis program and does not consider the beneficial effects of geometrical features such as internal or external wall corners which increase its overall stiffness.
- d) The computer program uses a Winkler spring analysis to determine the wall displacements, in which springs are used to represent a continuum and there is no transfer of shear stresses between springs. In general, the application of this concept leads to an overestimation of structural deformations; hence the resulting displacements may be over-predicted.
- e) It is not possible to input time limits within the analysis software, subsequently each stage of construction is modelled against an infinite amount of time; while the full deflections are not likely to be realised within the actual construction periods.

Noting all the above the estimated actual deflections could be less than the calculated SLS figures calculated.

We would suggest the wall is monitored during the works against a predetermined monitoring regime, with appropriate mitigation measures if target levels are reached.

4.6 Firm Pile

Firm piles to be 600mm diameter and to terminate into London Clay at a depth of 6.0m

5.0 Vertical Design

The wall piles are further subject to vertical structural load. Loads have been provided on the Piling Works GA by BJB Consulting. The vertical loads are from 350kN/m to 400kN/m Dead and 100kN/m Live load.

Bearing pile loads have been provided as Dead and Live loads. Some bearing piles are further subjected to tower crane loads, provided as max compression, tension and horizontal. The crane base loads have been taken as representative F.rep loads, for which we have considered fully variable in assessing Eurocode actions. The piles have been designed to the maximum temporary or permanent loads, whichever is greater.

5.1 Design Approach

The design has been carried out in general in accordance with Eurocode (BS EN 1997-1:2004) with reference made to the UK National Annex. This is an ultimate limit state design approach with partial factors applied to actions (A), materials (M) and resistances (R). Pile lengths have been determined to satisfy a structural check (STR), with partial factors only applied to actions, and a geotechnical check (GEO), with partial factors applied to both actions and resistances. These are in accordance with the Eurocode Design Approach 1 and referred to as combinations DA1-1 and DA1-2 respectively.

An explanation of the appropriate partial factors as usually derived for these combinations is indicated below in Table 10. Resistance and Model factors have been selected based upon no validation on service or ultimate condition, i.e. no load testing. The design resistance is calculated as follows;

$$R_{des} = \left\{ \frac{R_{bk}}{\gamma_{b.re}} + \frac{R_{sk}}{\gamma_{s.re}} \right\}$$

Table 11 - Partial factors adopted for design

	Notation	Partial Factor	
		DA1 Comb. 1	DA1 Comb. 2
Actions: (A)			
Permanent Action (Unfavourable)	G _{k.unfav}	1.35 (A1)	1.0 (A2)
Permanent Action (Favourable)	G _{k.fav}	1.0 (A1)	1.0 (A2)
Variable Action (Unfavourable)	Q _{k.unfav}	1.50 (A1)	1.3 (A2)
Variable Action (Favourable)	Q _{k.fav}	0 (A1)	0 (A2)
Soil factors: (M)			
Effective angle of shearing resistance	tan Ø'	1.0 (M1)	1.0 (M1)
Effective cohesion	C'	1.0 (M1)	1.0 (M1)
Undrained shear strength	C _u	1.0 (M1)	1.0 (M1)
Resistances: (R)			
Pile Base	Y _{bRe}	1.0 (R1)	2.0 (R4)
Pile Shaft (compression)	Y _{sRe}	1.0 (R1)	1.6 (R4)
Pile Shaft (tension)	Y _{tRe}	1.0 (R1)	2.0 (R4)
Model Factor			1.4 (R4)
Pile Shaft (compression SLS)	Y _{s.sls}		1.4 (R4)

Notes – factors given above apply to Actions refer to unfavourable conditions

- Combination 1 (ULS - STR): A1 + M1 + R1.
- Combination 2 (ULS – GEO): A2 + M1 + R4.

STR & GEO Loading - Detailed below are the workings to the Design Approach 1 Combination 1 & 2 loadings.

$$\begin{aligned} \text{DA1} - 1_{\min} &= (G_k * 1.0) - (T_k * 1.5) \\ \text{DA1} - 1_{\max} &= (G_k * 1.35) + (Q_k * 1.5) \\ \text{DA1} - 2_{\min} &= (G_k * 1.0) - (T_k * 1.3) \\ \text{DA1} - 2_{\max} &= (G_k * 1.0) + (Q_k * 1.3) \end{aligned}$$

5.2 Shaft Adhesion, R_{sk}

The shaft resistance will be calculated using effective stress soil parameters detailed in section 3 and below;

$$\text{In London Clay} \quad R_{sk} = C_u \cdot \alpha \cdot A_s$$

$$\begin{aligned} \text{Where;} \quad A_s &= \text{Area of Shaft} \\ \alpha &= \text{Adhesion Factor - Taken as 0.6} \\ C_u &= \text{Soil Shear Strength - see table 5.} \end{aligned}$$

5.3 Base Resistance, R_{bk}

The base resistance will be calculated using soil parameters detailed in section and below;

$$\text{In London Clay} \quad R_{bk} = 9 \cdot C_u$$

$$\text{Where,} \quad C_u = \text{Shear Strength value at base. - see table 5.}$$

5.4 Wall Piles

For piles in a retaining wall a reduction factor is applicable due to the close centres of the piles within the wall. This factor is applied to the shaft resistance only.

For the 600mm diameter piles at a spacing of 840mm, take the surface area per metre depth as 1.68m², i.e. the wall is considered as a straight sided section, (2 * 0.84m pile spacing). Relating this value to the surface area of an isolated 600mm diameter pile (1.88m²/m), the reduction factor for shaft friction is determined to be 0.89. Therefore, the associated shaft resistances, f_s , will be reduced by this factor.

No reduction factor is applicable to the end bearing since the base surface area per metre per pile in the wall (0.84m²) is larger than the base area of a single pile (0.282m²).

5.5 Pile Length

The above calculations have been carried out using the OASYS Pile program, version 19.6 which allows the appropriate partial factors to be applied to the soil parameters, the results are given in Appendix F. Design approach Case 2 (DA1-2) dictates pile length.

For the piles within the wall design case 1 rotational stability governs the final pile length, with the remaining sections governed by axial load.

6.0 Lateral Design (Bearing Piles)

Some bearing piles are further subject to lateral loads, of up to 30kN which have conservatively considered as fully variable.

As with the vertical capacity the lateral design load cases have been carried out in general accordance with Eurocode (BS EN 1997-1:2004) with reference made to the UK National Annex. An explanation of the appropriate partial factors as usually derived for these combinations is indicated in Table 7 below.

Table 7 - Partial factors adopted for the design of laterally loaded piles

	Notation	Partial Factor	
		DA1 Comb. 1	DA1 Comb. 2
Actions: (A)			
Permanent Action (Unfavourable)	G _k	1.35 (A1)	1.0 (A2)
Variable Action (Unfavourable)	Q _k	1.50 (A1)	1.3 (A2)
Soil factors: (M)			
Effective angle of shearing resistance	tan Ø'	1.0 (M1)	1.25 (M2)
Effective cohesion	C'	1.0 (M1)	1.25 (M2)
Undrained shear strength	C _u	1.0 (M1)	1.40 (M2)
Resistances: (R)			
Pile Base	Y _{bRe}	1.0 (R1)	1.0 (R1)
Pile Shaft (compression)	Y _{sRe}	1.0 (R1)	1.0 (R1)
Pile Shaft (tension)	Y _{tRe}	1.0 (R1)	1.0 (R1)

Notes – factors given above apply to Actions refer to unfavourable conditions

- Combination 1 (ULS - STR): A1 + M1 + R1.
- Combination 2 (ULS – GEO): A2 + M2 + R1.

Analysis of the pile under horizontal load has been carried out using the OASYS Limited computer program ALP; version 19.3. The program models the interaction between the pile and the surrounding soil, predicts the pressures, horizontal movements, shear forces and the bending moments induced in the pile.

The pile is modelled as a series of elastic beam elements. The soil is modelled as a series of non-interactive, non-linear springs. The soil deflection has been modelled assuming an elastic plastic behaviour. Two stiffness matrices relating nodal forces to displacements are developed - one represents the pile in bending the other represents the soil.

The assumed soil profile and soil parameters are detailed in the vertical pile calculations.

For the piles at this site the pile head is likely to be intermediate between both free and fixed conditions. For design a nominal restraint of 20,000kN.m/rad has been considered. The flexural rigidity (EI) of the pile is calculated as follows:-

$$EI = E_{concrete} \cdot I_{pile}$$

- Therefore, for a 400mm dia.:

$$EI = 20 \times 10^9 \cdot \frac{\pi \cdot 0.4^4}{64 \cdot 10^3}$$

$$EI = 25133 \text{ kN/m}^2$$

The lateral loads have been taken as applied at cut-off level. Details of the ALP analysis carried out are given in the Table below, and details results given in Appendix G.

The results of the ALP analysis are shown in the table below. For the analysis the lateral force has been considered for both lateral actions of DA1-1 (STR) and DA1-2 (GEO).

Table 12 – ALP Analysis

Load Case	Pile Diameter mm	Cut-off level	Lateral Load (kN)	Lateral Load DA1-1/DA1-2 (kN)	Moment DA1-1/DA1-2 (kN.m)	Depth to dissipate (m below COL)
1	400	24.563mOD (Max)	30	45 / 39	29 / 26	4

7.0 Structural Analysis

Pile section design has been carried out on the basis of the reinforced concrete design code BS EN 1992-1-1:2004 (Eurocode 2) using the following parameters;

Pile Diameter, d_{nom}	=	400 & 600mm
Design Concrete strength, f_{ck}	=	30 N/mm ² { f_{cu} = 37N/mm ² (C30/37)}
Steel f_{yk}	=	500 N/mm ² [high yield] (BS EN 1992-1-1:2004)
Design Concrete Cover	=	75mm
Sulphate Class	=	DC3 for intended working life in excess of 50 years or DC3

+ one additional protective measure if greater than 100 year working life.

Secant primary piles to be unreinforced constructed with C8/10 concrete, or similar with no sulphate requirements assuming permanent water resistance in the permanent basement structure, i.e. lining wall.

7.1 Axial Structural Analysis

The axial compressive stress of concrete has been checked in accordance with BS EN 1992-1-1:2004 where the value of design compressive strength, f_{cd} , of concrete is defined as:

$$f_{cd} = (\alpha_{cc} \cdot f_{ck}) / (\gamma_c \cdot k_f)$$

Where, α_{cc} = taken as 0.6 for unreinforced section

γ_c = 1.5

k_f = 1.1

Considering C30/37 grade concrete, the following axial compressive resistance for 400 and 600mm diameter piles has been calculated as 1691kN and 3804kN respectively. The maximum STR loading could be up to 1125kN for 400mm diameter and 580kN for 600mm diameter and therefore considered satisfactory.

7.2 Retaining Wall Reinforcement Design

Reinforcement requirements have been analysed for the shear forces and bending moments indicated within the WALLAP outputs (Appendix E) and summarized in Table 13. Using the Oasys ADCOL software, all bending moments and shear force calculations have been carried out in accordance with the requirements of BS EN 1992, Eurocode No. 2 'Design of Concrete Structures'.

The results of the ADCOL analyses are given in Appendix G. For all cases, the concrete grade has been taken as C30/37, 75mm cover and a worst case axial load of 0kN compression. From the analysis, the following reinforcement requirements are obtained;

Table 13 – Retaining Wall Reinforcement Summary

Design Case	Pile Dia (mm)	STR Vertical Load (kN)	STR Pile BM (kNm)	STR Pile SF (kN)	Reinforcement Cage	Ult BM of Cage (kNm)	Mult / Mu
1	600	0	140	139	6B20/B10@250c/c x 9m	n/a	n/a
2	600	0	159	168	6B20/B10@250c/c x 9m	n/a	n/a
2a	600	0	159	168	7B20/B10@250c/c x 9m	n/a	n/a
3	600	0	157	155	6B20/B10@250c/c x 9m	200	0.89
4	600	0	168	181	7B20/B10@250c/c x 9m	200	0.84

7.3 Bearing Pile Reinforcement Design

The results are as follows; with each case analysed for specific pile diameter, reinforcement, and axial load. For all cases, the concrete has been taken as C30/37. From the results of the STR / GEO (DA1-1 and DA1-2) ALP analyses the Adcol check allow for a safety factor of at least unity on the equivalent derived ultimate moments.

Table 14 - Adcol Analysis

Load Case	Pile Dia (mm)	Vertical Load DA1-1 (kN)	Ult Pile Shear Force (kN)	Ult Pile Moment, (kN.m)	Reinforcement Cage	Ult moment of section, Mu (kN.m)	Mstr / Mu
1	400	150 (min) 1125 (max)	n/a	n/a	4B16/B8@200c/c	n/a	n/a
2	400	-225 (min) 1325 (max)	45	37	6B16/B8@175c/c	42 (min) 93 (max)	0.88

The proposed steel represents the minimum reinforcement required the number/size of the reinforcement bars may be increased for installation / construction purposes. A helical design check has also been carried out. Outputs for the section analysis for bending and shear are presented in Appendix G.

7.4 Reinforcement Tension Check

Check for minimum reinforcement proposed

Area of reinforcement for tension condition, Ast, check

$$\text{Use } A_{st} = T_e / 0.87 * F_y$$

where A_{st} = area of reinforcement
 T_e = direct tension force - (DA1-1 Max Tension)
 0.87 = material factor on reinforcement
 F_y = grade of reinforcement, taken as 500MN/m²

By design in table 14 the radial cage is satisfactory to cater for the tension load, with embedment into the cap based upon the radial cage.

For all tension piles, the tension at depth will be considered on the central bar, with a check for tension capacity undertaken below;

Area of reinforcement for tension condition, Ast, check

$$\begin{aligned} A_{st} &= 225\text{kN} * 1000 / 0.87 * 500 \\ &= 517\text{mm}^2 \end{aligned}$$

Reinforcement - use 1 number B32mm with - Ast = 804mm²

7.5 Pile reinforcement projection

The Basic Anchorage Length has been calculated in accordance with EC2 cl. 8.4.3 with the expression:

$$l_{b,rqd} = (\phi/4)(\sigma_{sd}/f_{bd})$$

The design anchorage length is then calculated in accordance with EC2 8.7.3:

$$l_{bd} = \alpha_1 \alpha_2 \alpha_3 \alpha_4 \alpha_5 l_{b,rqd}$$

Where:

ϕ	= Bar diameter
σ_{sd}	= design stress of the bar
f_{bd}	= design ultimate bond stress = $2.25 \times \eta_1 \times \eta_2 \times f_{ctd}$
f_{ctd}	= 1.33MPa
η_1	= 1.0 when 'good' conditions are obtained
η_2	= 1.0 for $\leq 32\text{mm}$ bar diameter
α_2	= $0.7 < 1 - 0.15(75 - \phi)/\phi$ (all other $\alpha = 1.0$)

This generates a design anchorage, l_{bd} , of 415mm for 16mm and 450mm for 20mm reinforcement. The above reinforcement anchorage (minimum) is to be supplied for the radial cages to achieve a full moment connection.

8.0 Piling Summary

See piling schedule issued separately for detailed piling information, summarised below in table 15;

Table 15 – Piling Summary

Element	Design Section/Ref	PPL (mOD)	Pile Dia, mm	Vert. Load (kN or kN/m)	Pile Length (Max) (m)	Reinforcement
Wall	1	30.6	600	9	9.0	6B20/B10@250c/c x 9m
	2	30.6	600	403	11.8	6B20/B10@250c/c x 9m
	2a	30.6	600	403	11.8	7B20/B10@250c/c x 9m
	3	30.6	600	403	11.8	6B20/B10@250c/c x 9m
	4	30.6	600	445	12.5	7B20/B10@250c/c x 9m
Bearing	1	30.6	400	1125	22.3	4B16/B8@175c/c x see schedule for length.
	2	30.6	400	-225/1043	24.5	6B16/B8@175c/c x 9m + 1B32 see schedule for length.

All piles to adopt C30/37 concrete with 75mm cover.

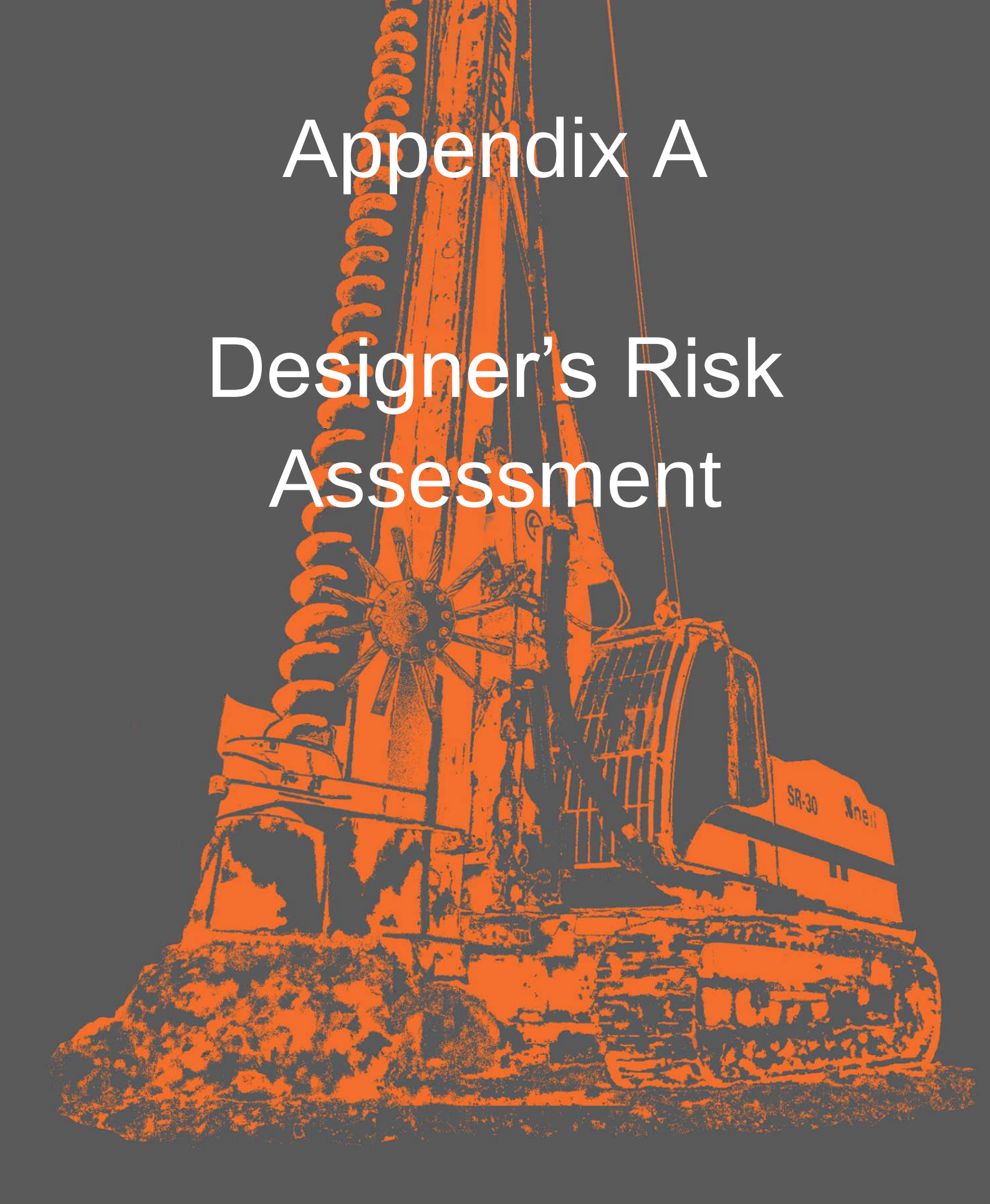
Design based upon factors of safety that do not require validation by testing, therefore no static load tests are required.

Wall to be monitored for movement during construction.

Any deviation from the soils parameters noted within the report to be notified to the designer.

8.1 Design Realisation

Approval of pile design.



Appendix A

Designer's Risk Assessment

			CDM Risk Register
Project: Kentish Town – 152-156 Kentish Town Road			Date: 26/05/21
Design By: MJC	Job No:	Design Ref: 23811	Rev: C0

STATEMENT ON CDM REGULATIONS (2015) AND RESIDUAL RISKS

CDM Regulations (2015)

The Client and Designer for this project are subject to certain duties under the CDM (2015) Regulations. It is the duty of the Designer to ensure that the client is aware of these duties prior to commencing the design. Piledesigns Ltd are responsible for an 'elemental' part of the design only and are not the 'overall' scheme designer. This 'elemental' design has been undertaken on the premise that this duty has been carried out by the scheme designer, and that no separate approach, in respect of this elemental design, by Piledesign Ltd is required.

Residual Risks – In accordance with the CDM Regulations (2015) any specific residual design risks and construction sequences relevant to this design are given below. As stated in the CDM Regulations (2015), whilst we have assessed the design risks for our works we have only listed the risks we consider significant to the design and which we consider are not likely to be obvious to a competent contractor or other designer. It does not constitute or remove the need for task related risk assessments for the activities carried out in the implementation of the design. Furthermore, it is the responsibility of the client and principal designer to ensure a competent principal contractor is appointed for these works.

The residual risks below should be added to any relevant construction drawing or method statements and copied to relevant designers and contractors on site.

Item No	Risk	Potential Effects	Risk Management / Mitigation
1	Unforeseen ground conditions	Pile performance could be compromised.	Ground conditions encountered during pile construction should be logged and checked against the assumed design profile and any variations from that assumed in the design must be reported immediately to the designer.
2	Services	Injury to site operatives / public and damage to equipment	No works should be carried out until a permit to work has been provided to the piling contractor by the Principle Contractor. Where it is necessary to carry out works close to any services the main contractor must positively locate (visually) the

			CDM Risk Register
Project: Kentish Town – 152-156 Kentish Town Road			Date: 26/05/21
Design By: MJC	Job No:	Design Ref: 23811	Rev: C0

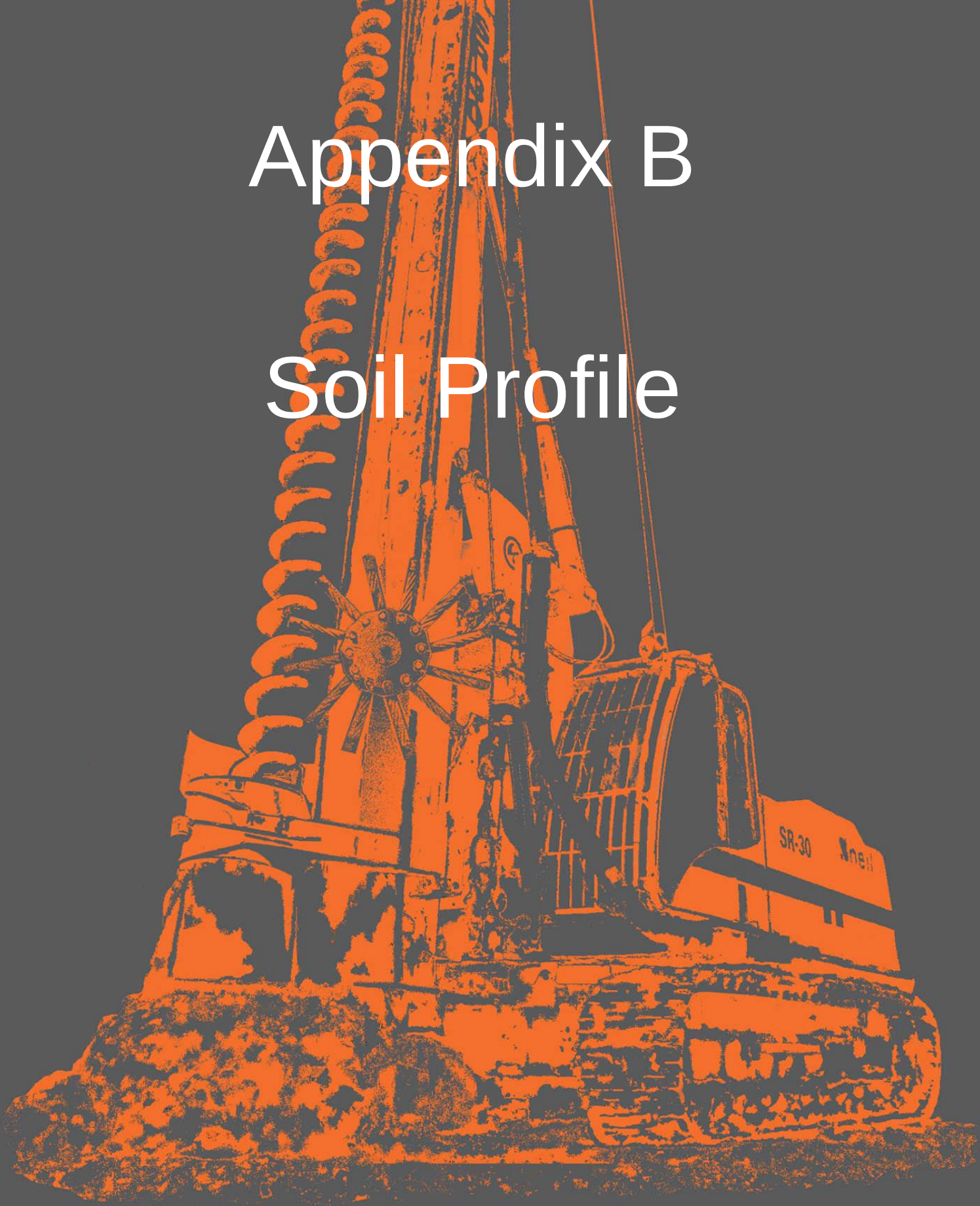
Item No	Risk	Potential Effects	Risk Management / Mitigation
			service, or divert and decommission the service prior to the commencement of any piling works.
3	Working Platform	Rig instability which could make unsafe working conditions for site personnel	Ensure working platform is designed, constructed and maintained in accordance with published guidance or other appropriate best practice. Construct platform according to specification, inspect regularly and maintain to original specification.
4	Obstructions	Unable to achieve proposed design lengths, damage to equipment.	Ensure all known existing obstructions are removed prior to piling works.
5	Unable to install reinforcement cages in CFA piles	Pile reinforcement does not achieve the required to level.	Reinforcement stated within the design is the minimum required. Reinforcement can be increased in bar diameter and number to increase cage stiffness for pile installation. to ensure adequate rigidity for temporary lifting and also provision of lifting etc.
6	Lifting reinforcement cages	Damage cages, injury to personnel	Ensure all lifting operations are carried out to an agreed method statement / lift plan. All reinforcement cages to have designed lifting points
7	Construction sequence	Excessive deflection / wall failure	The design construction sequence shown below must be followed to ensure stability.
8	Deflection of pile walls	Movement of adjacent ground and structures	Monitor retaining wall and compare actual wall movements to that calculated throughout the construction process.
9	Falls from the top of the retaining wall	Injury to site workers	Provide adequate edge protection or establish a suitable exclusion zone to the top of the retaining wall.
10	Prop	Failure of wall	The required SLS slab forces are provided within

			CDM Risk Register
Project: Kentish Town – 152-156 Kentish Town Road			Date: 26/05/21
Design By: MJC	Job No:	Design Ref: 23811	Rev: C0

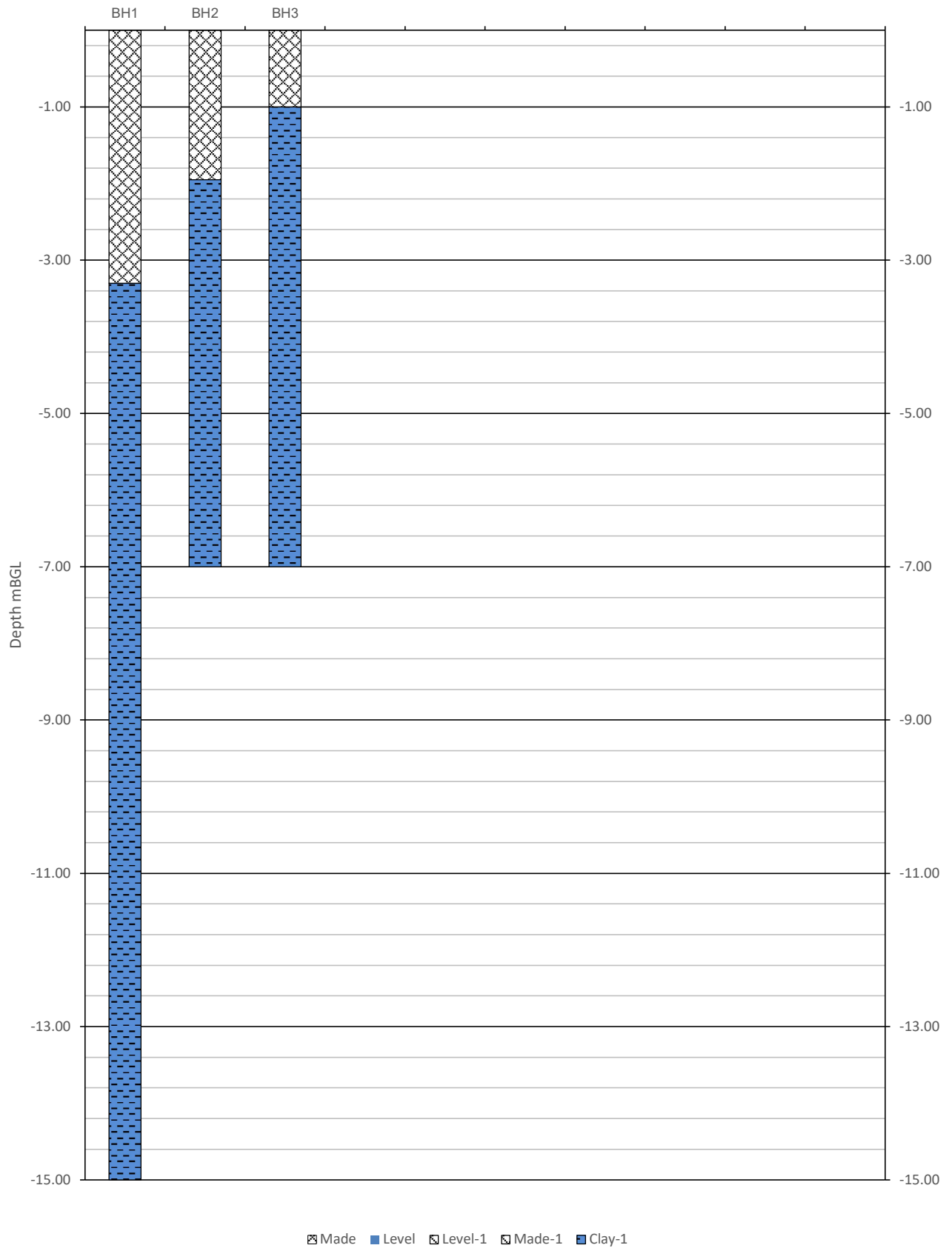
Item No	Risk	Potential Effects	Risk Management / Mitigation
	(basement structure) failure		the design report. The basement structure (which provides the propping), must therefore be adequately designed to provide the prop forces.
11	Piling adjacent Highway	Damage to Highway	Ensure all piling activities are agreed with the required third parties and the appropriate sign off have been completed before commencement.
12	Piling adjacent to neighbouring structures.	Damage to structures	Ensure all piling activities are agreed with the required third parties and the appropriate sign off have been completed before commencement.

Appendix B

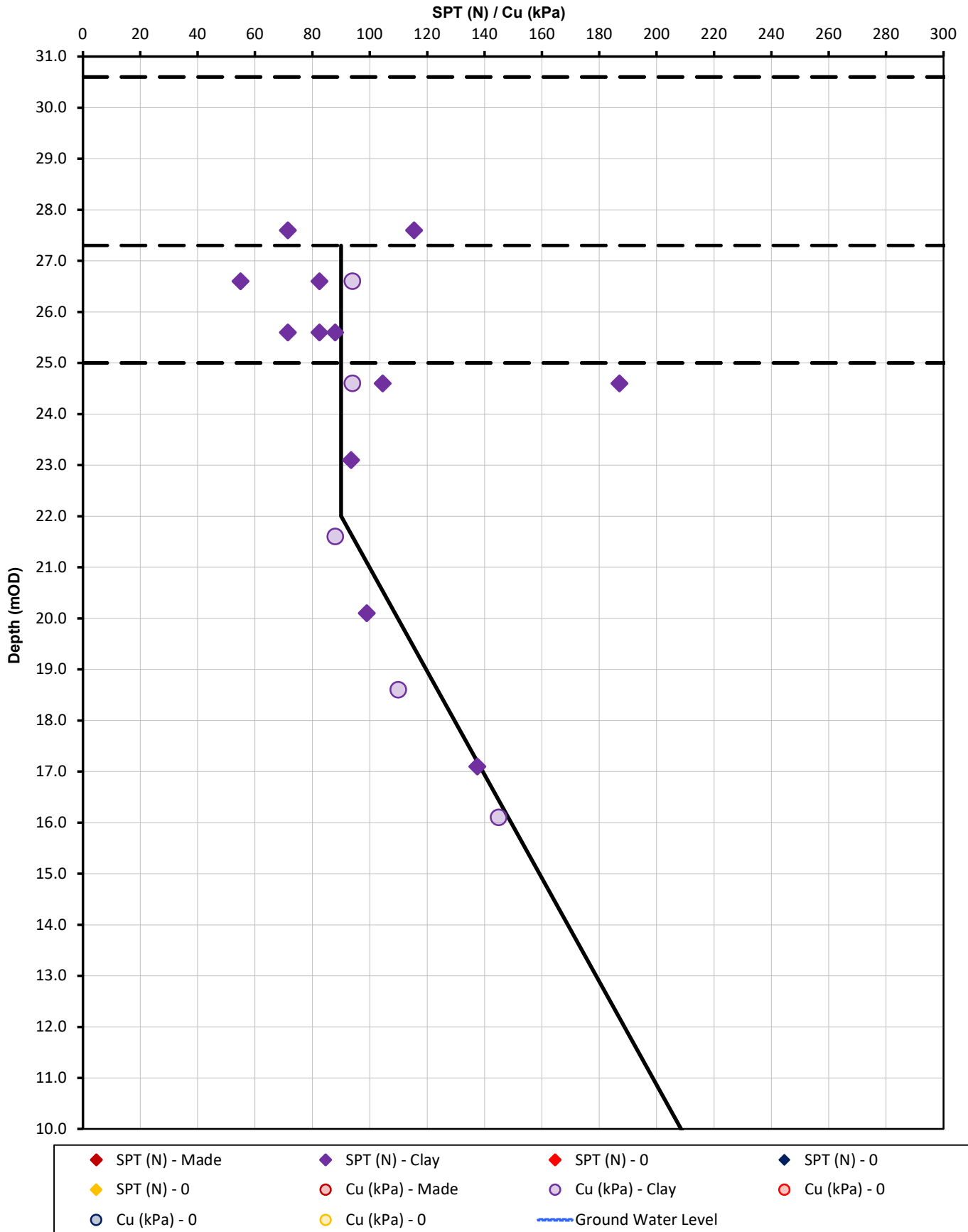
Soil Profile



Borehole Profile



SPT (N) & Cu (kPa) against Level for Clay for all boreholes

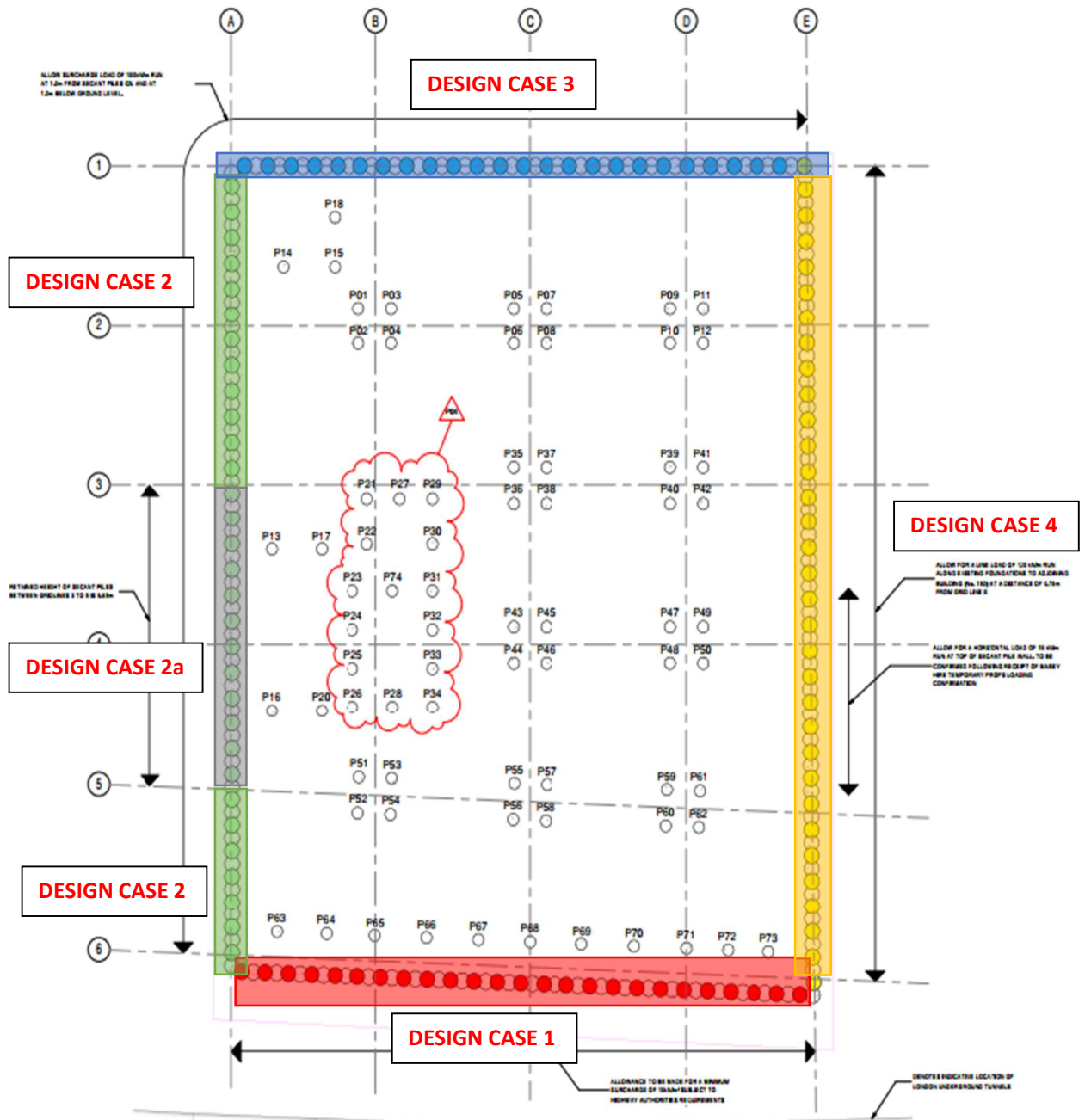


Appendix C

Design Sections



Retaining Wall Section Layout





PILEDESIGNS
GEOTECHNICAL EXPERTISE

Unit 23 Chiltern Trading Estate, Earl Howe Road, Bucks HP15 6QT
01494 216333 • www.piledesigns.co.uk • enquiries@piledesigns.co.uk

CONTRACT TITLE

KENTISH TOWN

CONTRACT NO.

23811

SHEET NO.

ELEMENT

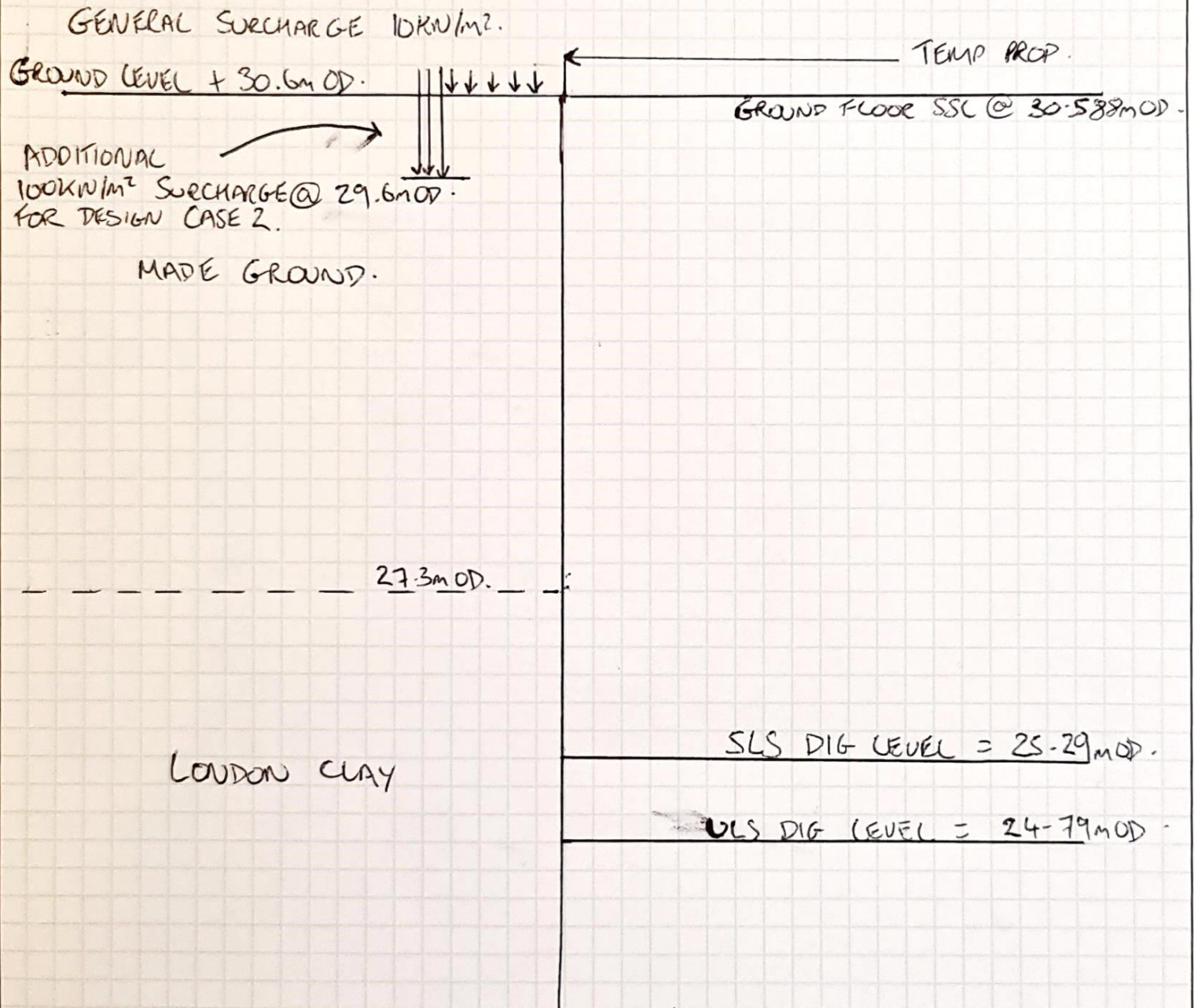
DESIGN CASES 1 & 2.

BY

MSC

DATE.

24/05





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GEOTECHNICAL EXPERTISE

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CONTRACT TITLE	KENTISH TOWN	CONTRACT NO.	23811	SHEET NO.	
ELEMENT	DESIGN CASE 3.	BY	MSC.	DATE.	

GENERAL SURCHARGE

GROUND LEVEL + 31.25mOD.

100kN/m² ADDITIONAL SURCHARGE

TEMP PROP.

GROUND FLOOR SSL
@ 30.588mOD.

SLS PIG LEVEL = 25.29mOD.

ULS DIG LEVEL + 24.79mOD.



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CONTRACT TITLE	KENTISH TOWN	CONTRACT NO.	23811	SHEET NO.	
ELEMENT	DESIGN CASE 4.	BY	MJC	DATE.	26/05

GENERAL SURCHARGE 10KN/m^2

GROUND LEVEL + 30.6mOD.

ADDITIONAL SURCHARGE of

170KN/m AT 0.75m OFFSET
TAKEN OVER 1m WIDTH AT 0.8m
DEPTH.

MADE GROUND.

27.3mOD.

LONDON CLAY

TEMPORARY PROP.

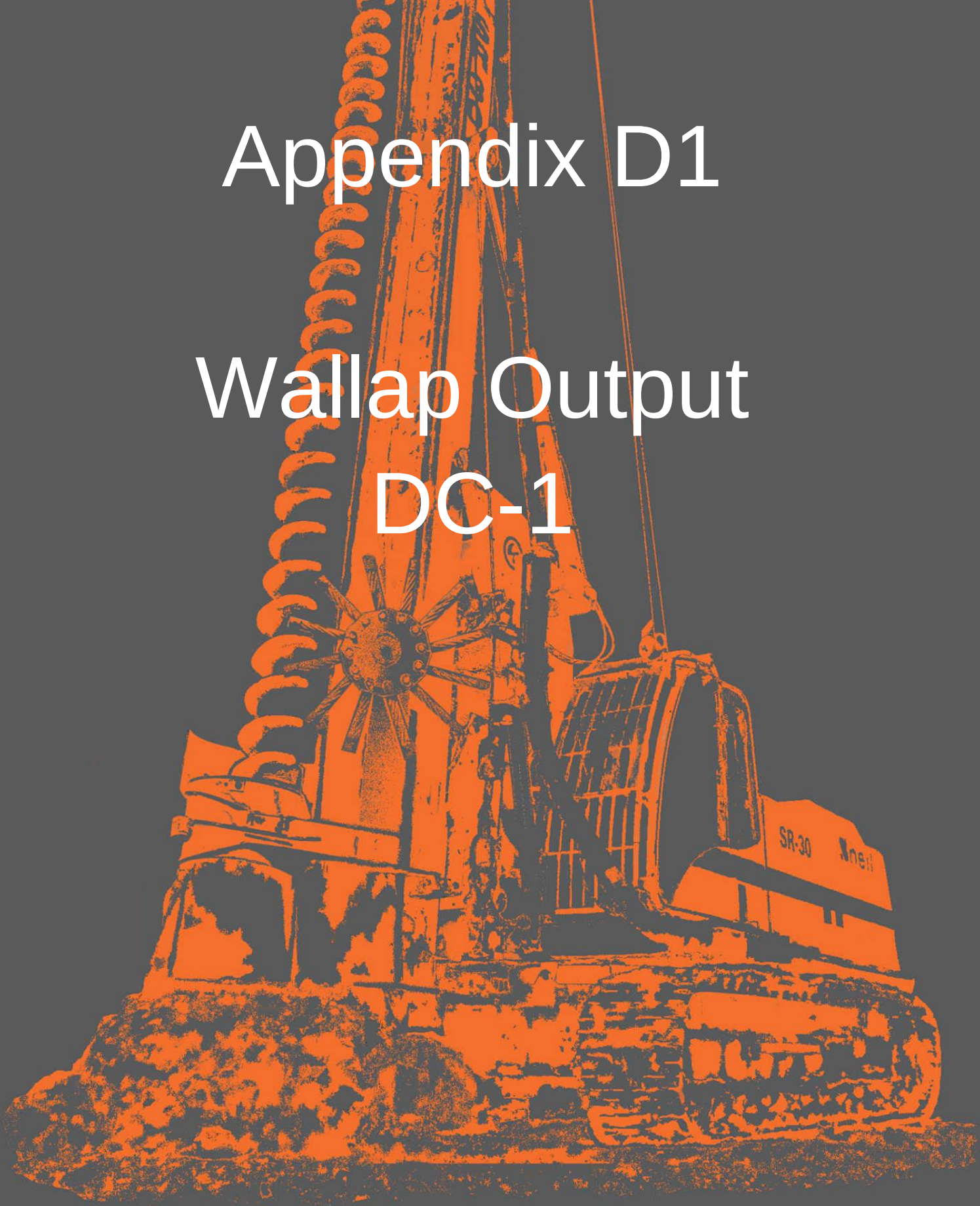
GROUND FLOOR SSC @
30.588mOD.

SLS DIG LEVEL + 25.29mOD

ULS DIG LEVEL + 24.79mOD.

Appendix D1

Wallap Output DC-1



PILEDESIGNS LIMITED	Sheet No.
Program: WALLAP Version 6.06 Revision A51.B69.R54	Job No. 23811
Licensed from GEOSOLVE	Made by : MJC
Data filename/Run ID: 23811_Kentish_Town_Section1_04_SLS	
KENTISH TOWN	Date:26-05-2021
Design Case 1 - 600 dia @ 840	Checked :

Units: kN,m

INPUT DATA

SOIL PROFILE

Stratum no.	Elevation of top of stratum	----- Left side	Soil types ----- Right side
1	30.60	1 Made Ground dr	1 Made Ground dr
2	27.30	2 London Clay 1 und	2 London Clay 1 und
3	22.00	3 London Clay 2 und	2 London Clay 1 und

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 dr	19.00	10000	0.540	OC (0.250)	0.376 (0.000)	2.663 (0.000)	
2 London Clay 1 und	20.00	72000	1.200	OC (0.490)	1.000 (2.389)	1.000 (2.390)	90.00u
3 London Cl.. (22.00)	20.00	72000 (7904)	1.200	OC (0.490)	1.000 (2.389)	1.000 (2.390)	90.00u (9.880)
4 London Clay 1 dr	20.00	55440	1.200	OC (0.200)	0.422 (1.299)	2.371 (3.080)	0.0d
5 London Cl.. (22.00)	20.00	55440 (6086)	1.200	OC (0.200)	0.422 (1.299)	2.371 (3.080)	0.0d

Additional soil parameters associated with Ka and Kp

----- Soil type -----	--- parameters for Ka ---	--- parameters for Kp ---
No. Description	Soil friction angle	Soil friction angle
1 Made Ground dr	27.00	27.00
2 London Clay 1 und	0.00	0.00
3 London Clay 2 und	0.00	0.00
4 London Clay 1 dr	24.00	24.00
5 London Clay 2 dr	24.00	24.00

GROUND WATER CONDITIONS

Density of water = 10.00 kN/m3

	Left side	Right side
Initial water table elevation	25.00	25.00

Automatic water pressure balancing at toe of wall : Yes

Water press.	Left side				Right side			
profile no.	Point no.	Elev. m	Piezo elev. m	Water press. kN/m2	Point no.	Elev. m	Piezo elev. m	Water press. kN/m2
1	1	30.15	30.15	0.0	1	25.00	25.00	0.0 MC+WC
	2	27.30	30.15	28.5	2	25.00	25.00	0.0
2	1	30.60	30.60	0.0	1	25.34	25.34	0.0 MC+WC
					2	25.34	30.60	52.6

WALL PROPERTIES

Type of structure = Fully Embedded Wall
Elevation of toe of wall = 21.60
Maximum finite element length = 0.50 m
Youngs modulus of wall E = 1.9600E+07 kN/m2
Moment of inertia of wall I = 7.5700E-03 m4/m run
E.I = 148372 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	30.45	1.00	0.275000	1.400E+07	5.00	0.00	0	No
2	25.77	1.00	0.450000	1.400E+07	5.00	0.00	0	No
3	31.00	1.00	1.000000	30000	1.00	0.00	0	No

SURCHARGE LOADS

Surch -arge no.	Elev.	Distance from wall	Length parallel to wall	Width perpend. to wall	Surcharge ----- Near edge	Far edge	Equiv. soil type	Partial factor/ Category
1	30.60	0.50 (L)	10.00	10.00	10.00	=	N/A	1.00 Var
2	29.60	0.50 (L)	10.00	1.00	100.00	=	N/A	1.00 P/U
3	Not defined							
4	25.34	-0.00 (R)	10.00	10.00	60.00	=	N/A	1.00 P/F

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 30.60
2	Apply water pressure profile no.1 (Mod. Conserv.) No analysis at this stage
3	Install strut or anchor no.3 at elevation 31.00
4	Excavate to elevation 25.29 on RIGHT side
5	Fill to elevation 25.34 on RIGHT side with soil type 1
6	Install strut or anchor no.2 at elevation 25.77
7	Install strut or anchor no.1 at elevation 30.45
8	Remove strut or anchor no.3 at elevation 31.00
9	Change EI of wall to 105980 kN.m2/m run Yield moment not defined No adjustments to wall displacements
10	Apply surcharge no.4 at elevation 25.34 No analysis at this stage
11	Change properties of soil type 2 to soil type 4 Ko pressures will not be reset
12	Change properties of soil type 3 to soil type 5 Ko pressures will be reset
13	Apply water pressure profile no.2 (Mod. Conserv.)

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

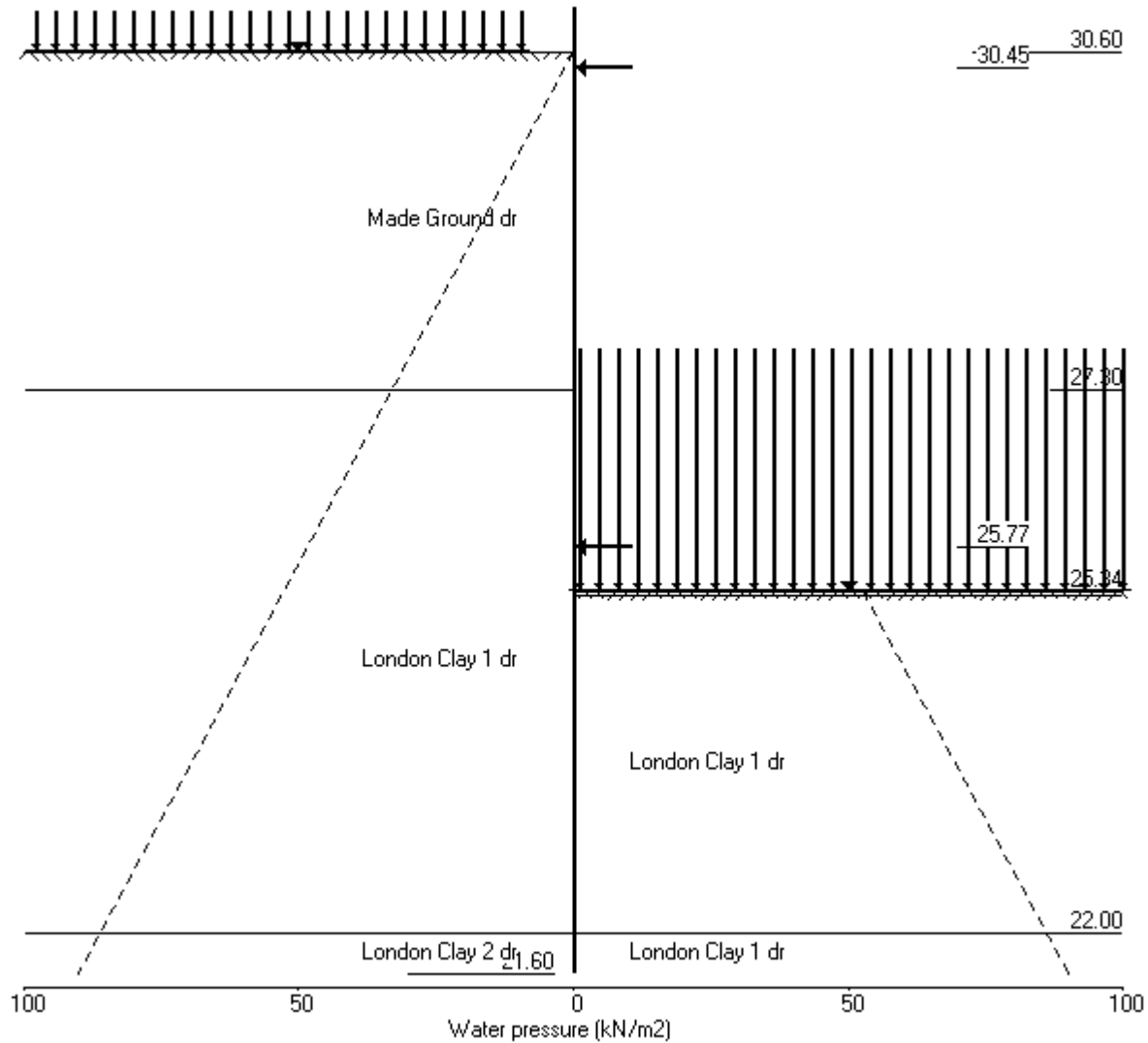
Distance to rigid boundary on Left side = 20.00 m

Distance to rigid boundary on Right side = 20.00 m

OUTPUT OPTIONS

Stage no.	Stage description	Output options		
		Displacement Bending mom. Shear force	Active, Passive pressures	Graph. output
1	Apply surcharge no.1 at elev. 30.60	No	No	No
2	Apply water pressure profile no.1	No	No	No
3	Install strut no.3 at elev. 31.00	No	No	No
4	Excav. to elev. 25.29 on RIGHT side	No	No	No
5	Fill to elev. 25.34 on RIGHT side	No	No	No
6	Install strut no.2 at elev. 25.77	No	No	No
7	Install strut no.1 at elev. 30.45	No	No	No
8	Remove strut no.3 at elev. 31.00	No	No	No
9	Change EI of wall to 105980kN.m2/m run	No	No	No
10	Apply surcharge no.4 at elev. 25.34	No	No	No
11	Change soil type 2 to soil type 4	No	No	No
12	Change soil type 3 to soil type 5	No	No	No
13	Apply water pressure profile no.2	No	No	No
*	Summary output	Yes	-	Yes

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PILEDESIGNS LIMITED	Sheet No.
Program: WALLAP Version 6.06 Revision A51.B69.R54	Job No. 23811
Licensed from GEOSOLVE	Made by : MJC
Data filename/Run ID: 23811_Kentish_Town_Section1_04_SLS	
KENTISH TOWN	Date:26-05-2021
Design Case 1 - 600 dia @ 840	Checked :

Units: kN,m

Stage No. 4 Excavate to elevation 25.29 on RIGHT side

STABILITY ANALYSIS of Fully Embedded Wall according to Strength Factor method

Factor of safety on soil strength

				FoS for toe elev. = 21.60		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
4	30.60 25.29	31.00		3.374	n/a	24.94	0.35	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 20.00 from wall

Right side 20.00 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	31.00	0.00	0.003	-1.32E-03	-44.7	-0.0	44.7	148372
2	30.60	0.00	0.003	-1.29E-03	-44.7	-17.9		148372
3	30.45	1.11	0.004	-1.27E-03	-44.6	-24.6		148372
4	30.15	3.77	0.004	-1.21E-03	-43.9	-37.9		148372
5	29.83	8.85	0.004	-1.11E-03	-41.9	-51.9		148372
6	29.50	13.73	0.005	-9.85E-04	-38.2	-64.9		148372
7	29.00	20.90	0.005	-7.38E-04	-29.5	-82.0		148372
8	28.50	27.85	0.005	-4.42E-04	-17.3	-93.9		148372
9	28.00	34.67	0.006	-1.17E-04	-1.7	-98.8		148372
10	27.65	39.40	0.006	1.13E-04	11.2	-97.2		148372
11	27.30	44.10	0.006	3.35E-04	25.9	-90.8		148372
		16.50	0.006	3.35E-04	25.9	-90.8		
12	26.90	18.50	0.005	5.64E-04	32.9	-79.2		148372
13	26.50	20.50	0.005	7.58E-04	40.7	-64.7		148372
14	26.14	22.32	0.005	8.97E-04	48.4	-48.6		148372
15	25.77	28.59	0.004	9.90E-04	57.7	-27.6		148372
16	25.34	48.31	0.004	1.03E-03	74.3	0.4		148372
17	25.29	50.59	0.004	1.02E-03	76.8	4.1		148372
		-95.33	0.004	1.02E-03	76.8	4.1		
18	25.00	-79.97	0.004	1.00E-03	51.4	22.4		148372
19	24.50	-55.53	0.003	9.01E-04	17.5	38.1		148372
20	24.00	-34.29	0.003	7.70E-04	-4.9	39.9		148372
21	23.50	-16.47	0.002	6.47E-04	-17.6	33.1		148372
22	23.00	-1.54	0.002	5.53E-04	-22.1	22.2		148372
23	22.50	11.42	0.002	4.98E-04	-19.7	10.9		148372
24	22.00	23.37	0.002	4.75E-04	-11.0	2.5		148372
25	21.60	31.43	0.001	4.71E-04	0.0	-0.0		---
At elev. 31.00 Strut force =				44.7 kN/strut =	44.7 kN/m run			

(continued)

Stage No.4 Excavate to elevation 25.29 on RIGHT side

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	31.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	30.60	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	1977
3	30.45	0.00	2.95	1.11	7.86	1.11	1.11a	1977
4	30.15	0.00	10.05	3.77	26.75	3.77	3.77a	1977
5	29.83	3.25	14.91	5.60	39.71	5.60	8.85a	1977
6	29.50	6.50	19.25	7.23	51.25	7.23	13.73a	1977
7	29.00	11.50	25.04	9.40	66.69	9.40	20.90a	1977
8	28.50	16.50	30.23	11.35	80.50	11.35	27.85a	1977
9	28.00	21.50	35.08	13.17	93.41	13.17	34.67a	1977
10	27.65	25.00	38.34	14.40	102.11	14.40	39.40a	1977
11	27.30	28.50	41.53	15.60	110.60	15.60	44.10a	1977
		Total>	70.03	16.50m	285.13	16.50	16.50a	20391
12	26.90	Total>	78.01	18.50m	293.10	18.50	18.50a	20391
13	26.50	Total>	85.93	20.50m	301.02	20.50	20.50a	20391
14	26.14	Total>	93.08	22.32m	308.18	22.32	22.32a	20391
15	25.77	Total>	100.22	24.14m	315.31	28.59	28.59	20391
16	25.34	Total>	108.69	26.30m	323.79	48.31	48.31	20391
17	25.29	Total>	109.67	26.55m	324.77	50.59	50.59	20391
18	25.00	Total>	115.33	28.00m	330.43	63.72	63.72	20391
19	24.50	Total>	125.09	30.50m	340.18	84.40	84.40	20391
20	24.00	Total>	134.83	33.00m	349.93	103.74	103.74	20391
21	23.50	Total>	144.57	35.50m	359.67	121.68	121.68	20391
22	23.00	Total>	154.32	38.00m	369.41	138.46	138.46	20391
23	22.50	Total>	164.06	40.50m	379.16	154.46	154.46	20391
24	22.00	Total>	173.82	43.00m	388.91	170.06	170.06	20391
25	21.60	Total>	180.20	45.00m	404.74	181.21	181.21	21287

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	31.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	30.60	0.00	0.00	0.00	0.00	0.00	0.00	0.0
3	30.45	0.00	0.00	0.00	0.00	0.00	0.00	0.0
4	30.15	0.00	0.00	0.00	0.00	0.00	0.00	0.0
5	29.83	0.00	0.00	0.00	0.00	0.00	0.00	0.0
6	29.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
7	29.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
8	28.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
9	28.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
10	27.65	0.00	0.00	0.00	0.00	0.00	0.00	0.0
11	27.30	0.00	0.00	0.00	0.00	0.00	0.00	0.0
12	26.90	0.00	0.00	0.00	0.00	0.00	0.00	0.0
13	26.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
14	26.14	0.00	0.00	0.00	0.00	0.00	0.00	0.0
15	25.77	0.00	0.00	0.00	0.00	0.00	0.00	0.0
16	25.34	0.00	0.00	0.00	0.00	0.00	0.00	0.0
17	25.29	0.00	0.00	0.00	0.00	0.00	0.00	0.0
		Total>	0.00	0.00	215.10	145.92	145.92	31250
18	25.00	Total>	5.80	1.45m	220.90	143.69	143.69	31250
19	24.50	Total>	15.80	3.95m	230.90	139.93	139.93	31250
20	24.00	Total>	25.81	6.45m	240.91	138.03	138.03	31250

(continued)

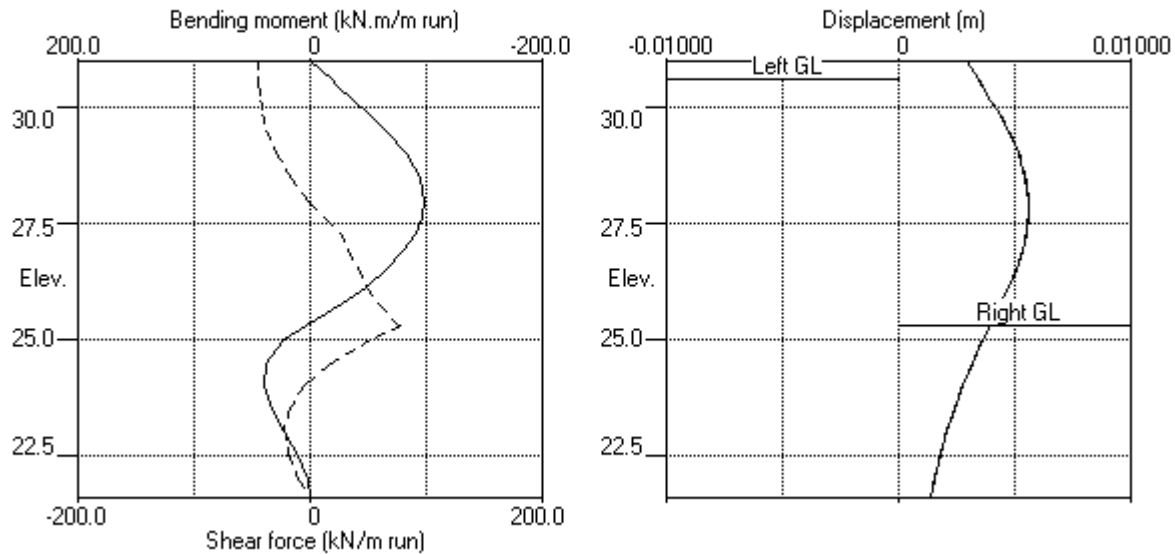
Stage No.4 Excavate to elevation 25.29 on RIGHT side

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
21	23.50	Total>	35.83	8.95m	250.93	138.16	138.16	31250
22	23.00	Total>	45.86	11.45m	260.96	140.00	140.00	31250
23	22.50	Total>	55.92	13.95m	271.01	143.04	143.04	31250
24	22.00	Total>	65.99	16.45m	281.08	146.69	146.69	31250
25	21.60	Total>	74.06	18.45m	289.16	149.77	149.77	31250

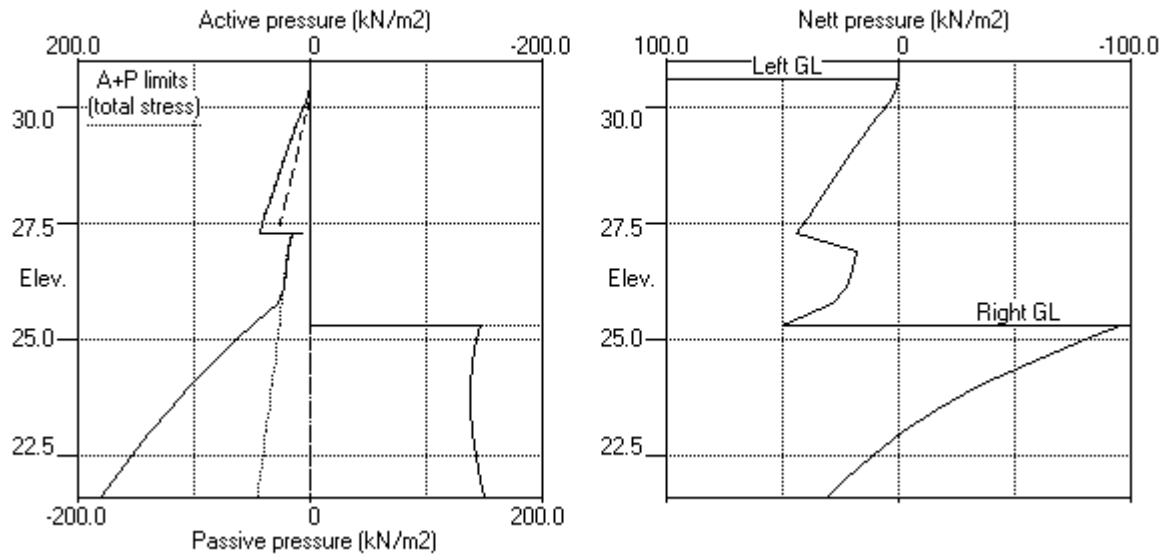
Note: 22.32a Soil pressure at active limit
 123.45p Soil pressure at passive limit

Units: kN,m

Stage No.4 Excav. to elev. 25.29 on RIGHT side



Stage No.4 Excav. to elev. 25.29 on RIGHT side



PILEDESIGNS LIMITED	Sheet No.
Program: WALLAP Version 6.06 Revision A51.B69.R54	Job No. 23811
Licensed from GEOSOLVE	Made by : MJC
Data filename/Run ID: 23811_Kentish_Town_Section1_04_SLS	
KENTISH TOWN	Date:26-05-2021
Design Case 1 - 600 dia @ 840	Checked :

Units: kN,m

Stage No. 5 Fill to elevation 25.34 on RIGHT side with soil type 1

STABILITY ANALYSIS of Fully Embedded Wall according to Strength Factor method

Factor of safety on soil strength

				FoS for toe elev. = 21.60		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
5	30.60 25.34	31.00		3.396	n/a	24.95	0.39	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 20.00 from wall

Right side 20.00 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	31.00	0.00	0.003	-1.32E-03	-44.8	-0.0	44.8	148372
2	30.60	0.00	0.003	-1.29E-03	-44.8	-17.9		148372
3	30.45	1.11	0.004	-1.27E-03	-44.7	-24.6		148372
4	30.15	3.77	0.004	-1.21E-03	-44.0	-37.9		148372
5	29.83	8.85	0.004	-1.11E-03	-41.9	-51.9		148372
6	29.50	13.73	0.005	-9.85E-04	-38.2	-64.9		148372
7	29.00	20.90	0.005	-7.37E-04	-29.6	-82.1		148372
8	28.50	27.85	0.005	-4.40E-04	-17.4	-94.0		148372
9	28.00	34.68	0.006	-1.15E-04	-1.8	-99.0		148372
10	27.65	39.41	0.006	1.16E-04	11.2	-97.4		148372
11	27.30	44.10	0.006	3.38E-04	25.8	-90.9		148372
		16.58	0.006	3.38E-04	25.8	-90.9		
12	26.90	18.61	0.005	5.67E-04	32.9	-79.4		148372
13	26.50	20.65	0.005	7.62E-04	40.7	-64.8		148372
14	26.14	22.50	0.005	9.01E-04	48.6	-48.7		148372
15	25.77	28.81	0.004	9.94E-04	57.9	-27.6		148372
16	25.34	48.58	0.004	1.03E-03	74.6	0.4		148372
17	25.29	50.50	0.004	1.03E-03	77.1	4.2		148372
		-95.70	0.004	1.03E-03	77.1	4.2		
18	25.00	-80.29	0.004	1.00E-03	51.6	22.5		148372
19	24.50	-55.75	0.003	9.05E-04	17.6	38.3		148372
20	24.00	-34.42	0.003	7.73E-04	-5.0	40.1		148372
21	23.50	-16.53	0.002	6.49E-04	-17.7	33.3		148372
22	23.00	-1.54	0.002	5.56E-04	-22.2	22.3		148372
23	22.50	11.47	0.002	4.99E-04	-19.7	11.0		148372
24	22.00	23.46	0.002	4.77E-04	-11.0	2.5		148372
25	21.60	31.58	0.001	4.73E-04	0.0	-0.0		---
At elev. 31.00 Strut force =				44.8 kN/strut =	44.8 kN/m run			

(continued)

Stage No.5 Fill to elevation 25.34 on RIGHT side with soil type 1

Node no.	Y coord	----- LEFT 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
1	31.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	30.60	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	6290
3	30.45	0.00	2.95	1.11	7.86	1.11	1.11a	6290
4	30.15	0.00	10.05	3.77	26.75	3.77	3.77a	6290
5	29.83	3.25	14.91	5.60	39.71	5.60	8.85a	6290
6	29.50	6.50	19.25	7.23	51.25	7.23	13.73a	6290
7	29.00	11.50	25.04	9.40	66.69	9.40	20.90a	2553
8	28.50	16.50	30.23	11.35	80.50	11.35	27.85a	2553
9	28.00	21.50	35.08	13.17	93.41	13.18	34.68a	2553
10	27.65	25.00	38.34	14.40	102.11	14.41	39.41	2553
11	27.30	28.50	41.53	15.60	110.60	15.60	44.10	2553
		Total>	70.03	16.50m	285.13	16.58	16.58	25557
12	26.90	Total>	78.01	18.50m	293.10	18.61	18.61	25557
13	26.50	Total>	85.93	20.50m	301.02	20.65	20.65	25557
14	26.14	Total>	93.08	22.32m	308.18	22.50	22.50	25557
15	25.77	Total>	100.22	24.14m	315.31	28.81	28.81	25557
16	25.34	Total>	108.69	26.30m	323.79	48.58	48.58	25557
17	25.29	Total>	109.67	26.55m	324.77	50.86	50.86	25557
18	25.00	Total>	115.33	28.00m	330.43	64.02	64.02	25557
19	24.50	Total>	125.09	30.50m	340.18	84.74	84.74	25557
20	24.00	Total>	134.83	33.00m	349.93	104.13	104.13	25557
21	23.50	Total>	144.57	35.50m	359.67	122.11	122.11	25557
22	23.00	Total>	154.32	38.00m	369.41	138.92	138.92	25557
23	22.50	Total>	164.06	40.50m	379.16	154.94	154.94	25557
24	22.00	Total>	173.82	43.00m	388.91	170.56	170.56	25557
25	21.60	Total>	180.20	45.00m	404.74	181.75	181.75	26679

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
1	31.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	30.60	0.00	0.00	0.00	0.00	0.00	0.00	0.0
3	30.45	0.00	0.00	0.00	0.00	0.00	0.00	0.0
4	30.15	0.00	0.00	0.00	0.00	0.00	0.00	0.0
5	29.83	0.00	0.00	0.00	0.00	0.00	0.00	0.0
6	29.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
7	29.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
8	28.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
9	28.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
10	27.65	0.00	0.00	0.00	0.00	0.00	0.00	0.0
11	27.30	0.00	0.00	0.00	0.00	0.00	0.00	0.0
12	26.90	0.00	0.00	0.00	0.00	0.00	0.00	0.0
13	26.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
14	26.14	0.00	0.00	0.00	0.00	0.00	0.00	0.0
15	25.77	0.00	0.00	0.00	0.00	0.00	0.00	0.0
16	25.34	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	2561
17	25.29	0.00	0.95	0.36	2.53	0.36	0.36a	2561
		Total>	0.95	0.25m	216.05	146.56	146.56	25630
18	25.00	Total>	6.75	1.70m	221.85	144.31	144.31	25630
19	24.50	Total>	16.75	4.20m	231.85	140.49	140.49	25630

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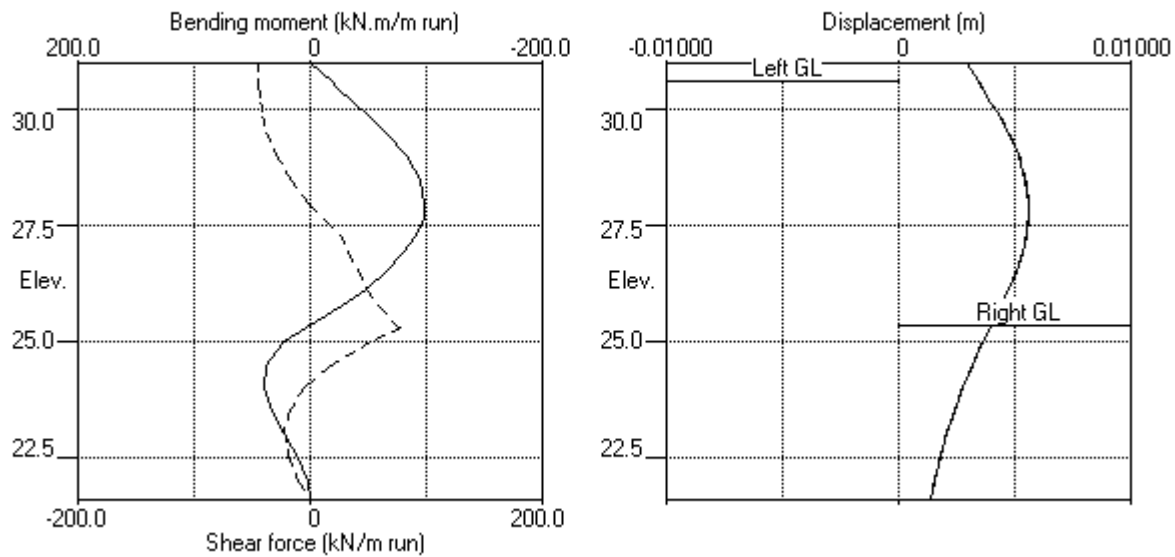
Stage No.5 Fill to elevation 25.34 on RIGHT side with soil type 1

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
20	24.00	Total>	26.76	6.70m	241.86	138.55	138.55	25630
21	23.50	Total>	36.78	9.20m	251.88	138.64	138.64	25630
22	23.00	Total>	46.82	11.70m	261.91	140.46	140.46	25630
23	22.50	Total>	56.87	14.20m	271.97	143.47	143.47	25630
24	22.00	Total>	66.94	16.70m	282.04	147.11	147.11	25630
25	21.60	Total>	75.02	18.70m	290.12	150.17	150.17	25630

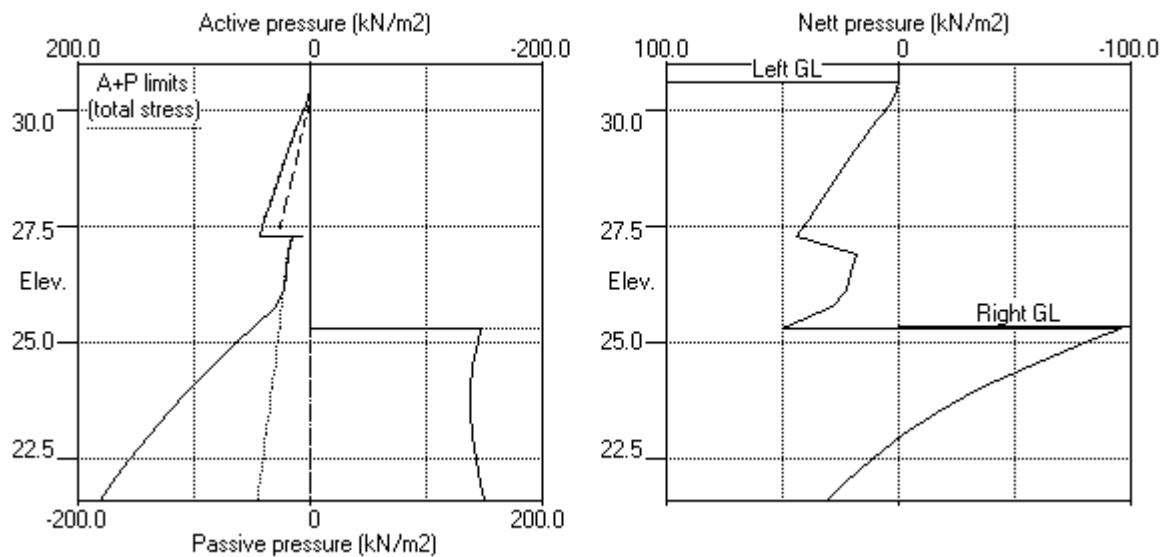
Note: 0.36a Soil pressure at active limit
 123.45p Soil pressure at passive limit

Units: kN,m

Stage No.5 Fill to elev. 25.34 on RIGHT side



Stage No.5 Fill to elev. 25.34 on RIGHT side



PILEDESIGNS LIMITED | Sheet No.
 Program: WALLAP Version 6.06 Revision A51.B69.R54 | Job No. 23811
 Licensed from GEOSOLVE | Made by : MJC
 Data filename/Run ID: 23811_Kentish_Town_Section1_04_SLS |
 KENTISH TOWN | Date:26-05-2021
 Design Case 1 - 600 dia @ 840 | Checked :

Units: kN,m

Stage No. 11 Change properties of soil type 2 to soil type 4
 Ko pressures will not be reset

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

Stage	---	G.L.	---	Strut	FoS for toe	Toe elev. for		
No.	Act.	Pass.	Elev.		elev. = 21.60	FoS = 1.000		
11	30.60	25.34						

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 20.00 from wall
 Right side 20.00 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	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	31.00	0.00	0.003	-1.23E-03	0.0	-0.0		105980
2	30.60	0.00	0.004	-1.23E-03	0.0	-0.0		105980
3	30.45	1.11	0.004	-1.23E-03	0.1	0.0	57.7	105980
		1.11	0.004	-1.23E-03	-57.6	0.0		
4	30.15	3.77	0.004	-1.22E-03	-56.8	-17.2		105980
5	29.83	8.85	0.004	-1.16E-03	-54.8	-35.3		105980
6	29.50	13.73	0.005	-1.06E-03	-51.1	-52.6		105980
7	29.00	20.90	0.005	-8.35E-04	-42.5	-76.1		105980
8	28.50	27.85	0.006	-5.34E-04	-30.3	-94.5		105980
9	28.00	34.67	0.006	-1.78E-04	-14.6	-105.9		105980
10	27.65	39.40	0.006	9.01E-05	-1.7	-108.8		105980
11	27.30	44.10	0.006	3.61E-04	12.9	-106.9		105980
		46.02	0.006	3.61E-04	12.9	-106.9		
12	26.90	50.38	0.006	6.59E-04	32.2	-98.1		105980
13	26.50	54.73	0.005	9.21E-04	53.2	-81.2		105980
14	26.14	58.66	0.005	1.10E-03	73.8	-58.2		105980
15	25.77	62.58	0.004	1.20E-03	95.9	-25.6	45.3	105980
		62.58	0.004	1.20E-03	50.6	-25.6		
16	25.34	67.24	0.004	1.23E-03	78.7	2.0		105980
		44.71	0.004	1.23E-03	78.7	2.0		
17	25.29	44.89	0.004	1.23E-03	80.9	6.0		105980
		-76.30	0.004	1.23E-03	80.9	6.0		
18	25.00	-84.68	0.003	1.20E-03	57.6	25.9		105980
19	24.50	-62.69	0.003	1.07E-03	20.7	43.8		105980
20	24.00	-39.44	0.002	9.10E-04	-4.8	46.3		105980
21	23.50	-19.78	0.002	7.55E-04	-19.6	39.0		105980
22	23.00	-3.21	0.002	6.36E-04	-25.4	26.7		105980
23	22.50	11.20	0.001	5.63E-04	-23.4	13.6		105980
24	22.00	24.48	0.001	5.32E-04	-14.5	3.3		105980
		31.08	0.001	5.32E-04	-14.5	3.3		

Stage No.11 Change properties of soil type 2 to soil type 4
 Ko pressures will not be reset

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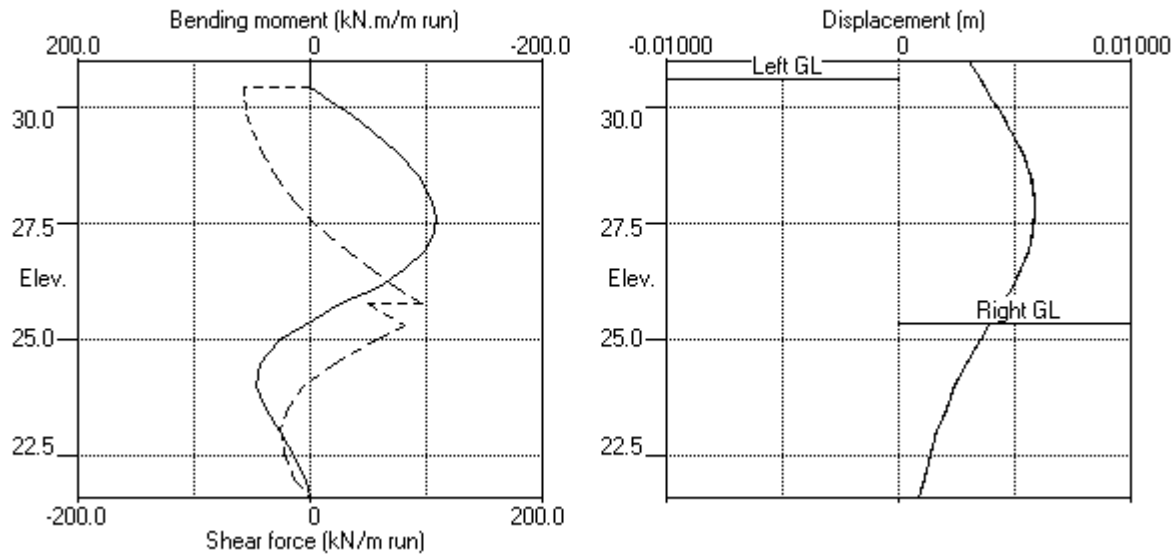
Stage No.11 Change properties of soil type 2 to soil type 4
 Ko pressures will not be reset

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
13	26.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
14	26.14	0.00	0.00	0.00	0.00	0.00	0.00	0.0
15	25.77	0.00	0.00	0.00	0.00	0.00	0.00	0.0
16	25.34	0.00	0.00	0.00	0.00	0.00	0.00	0.0
		0.00	60.00	22.53	159.78	22.53	22.53a	3102
17	25.29	0.00	60.93	22.88	162.26	22.88	22.88a	3102
		0.00	60.93	25.70	144.49	144.08	144.08	16577
18	25.00	0.00	66.74	28.15	158.25	155.58	155.58	16577
19	24.50	7.83	68.80	29.01	163.13	143.27	151.10	16577
20	24.00	15.66	70.62	29.78	167.46	132.74	148.40	16577
21	23.50	23.49	72.13	30.42	171.03	124.13	147.62	16577
22	23.00	31.32	73.29	30.91	173.79	117.20	148.52	16577
23	22.50	39.15	74.14	31.27	175.79	111.51	150.66	16577
24	22.00	46.98	74.71	31.51	177.16	106.46	153.44	16577
25	21.60	53.24	75.03	31.64	177.91	102.56	155.80	16577

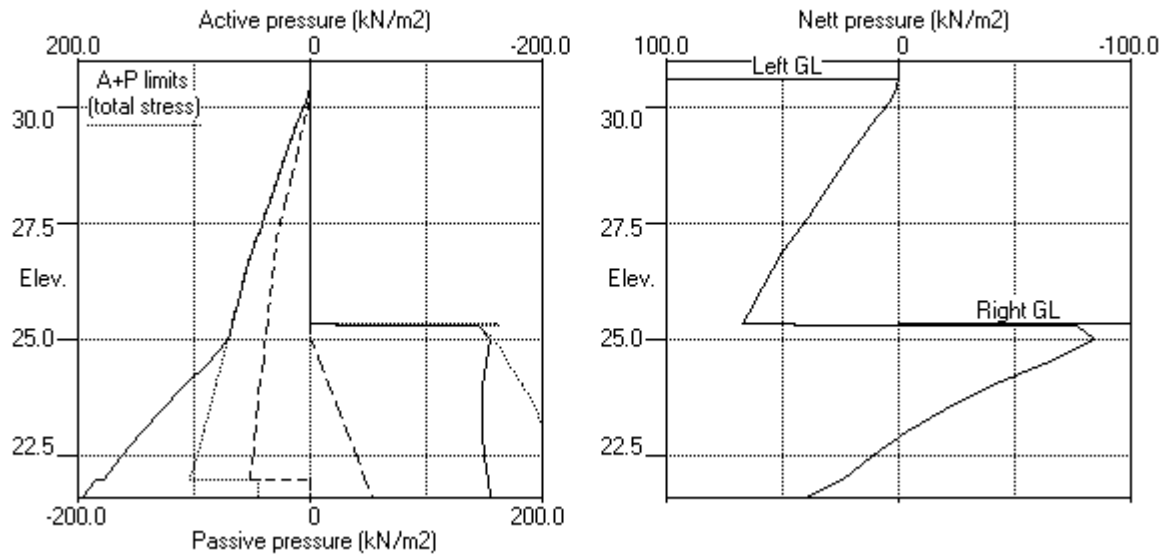
Note: 22.88a Soil pressure at active limit
 123.45p Soil pressure at passive limit

Units: kN,m

Stage No.11 Change soil type 2 to soil type 4



Stage No.11 Change soil type 2 to soil type 4



PILEDDESIGNS LIMITED	Sheet No.
Program: WALLAP Version 6.06 Revision A51.B69.R54	Job No. 23811
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KENTISH TOWN	Date:26-05-2021
Design Case 1 - 600 dia @ 840	Checked :

Units: kN,m

Stage No. 12 Change properties of soil type 3 to soil type 5
Ko pressures will be reset

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

			FoS for toe elev. = 21.60	Toe elev. for FoS = 1.000		
Stage	--- G.L. ---	Strut	Factor	Moment	Toe	Wall
No.	Act. Pass.	Elev.	of	equilib.	elev.	Penetr
			Safety	at elev.		-ation
12	30.60 25.34		More than one strut.	No FoS calc.		Direction of failure

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 20.00 from wall
Right side 20.00 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	31.00	0.00	0.003	-1.23E-03	0.0	-0.0		105980
2	30.60	0.00	0.004	-1.23E-03	0.0	-0.0		105980
3	30.45	1.11	0.004	-1.23E-03	0.1	0.0	57.7	105980
		1.11	0.004	-1.23E-03	-57.6	0.0		
4	30.15	3.77	0.004	-1.22E-03	-56.8	-17.2		105980
5	29.83	8.85	0.004	-1.16E-03	-54.8	-35.3		105980
6	29.50	13.73	0.005	-1.06E-03	-51.1	-52.6		105980
7	29.00	20.90	0.005	-8.35E-04	-42.5	-76.1		105980
8	28.50	27.85	0.006	-5.33E-04	-30.3	-94.5		105980
9	28.00	34.67	0.006	-1.78E-04	-14.6	-105.9		105980
10	27.65	39.40	0.006	9.02E-05	-1.7	-108.8		105980
11	27.30	44.10	0.006	3.62E-04	12.9	-106.9		105980
		46.02	0.006	3.62E-04	12.9	-106.9		
12	26.90	50.39	0.006	6.59E-04	32.2	-98.1		105980
13	26.50	54.73	0.005	9.21E-04	53.2	-81.2		105980
14	26.14	58.67	0.005	1.10E-03	73.9	-58.2		105980
15	25.77	62.59	0.004	1.20E-03	95.9	-25.6	44.5	105980
		62.59	0.004	1.20E-03	51.4	-25.6		
16	25.34	67.25	0.004	1.23E-03	79.5	2.4		105980
		44.72	0.004	1.23E-03	79.5	2.4		
17	25.29	44.90	0.004	1.23E-03	81.8	6.4		105980
		-76.24	0.004	1.23E-03	81.8	6.4		
18	25.00	-84.68	0.003	1.19E-03	58.4	26.6		105980
19	24.50	-62.81	0.003	1.06E-03	21.6	44.9		105980
20	24.00	-39.86	0.002	8.97E-04	-4.1	47.8		105980
21	23.50	-20.70	0.002	7.35E-04	-19.3	40.8		105980
22	23.00	-4.89	0.002	6.07E-04	-25.6	28.6		105980
23	22.50	8.51	0.001	5.25E-04	-24.7	15.1		105980
24	22.00	20.57	0.001	4.89E-04	-17.5	3.8		105980
		40.93	0.001	4.89E-04	-17.5	3.8		

Stage No.12 Change properties of soil type 3 to soil type 5
 Ko pressures will be reset

[illegible]

(continued)

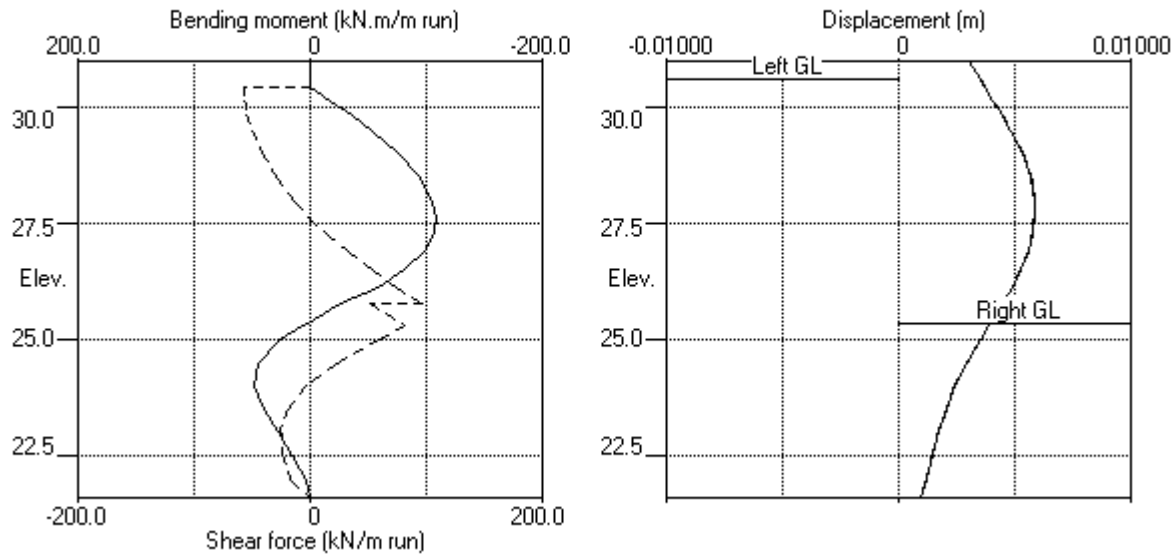
Stage No.12 Change properties of soil type 3 to soil type 5
 Ko pressures will be reset

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
13	26.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
14	26.14	0.00	0.00	0.00	0.00	0.00	0.00	0.0
15	25.77	0.00	0.00	0.00	0.00	0.00	0.00	0.0
16	25.34	0.00	0.00	0.00	0.00	0.00	0.00	0.0
		0.00	60.00	22.53	159.78	22.53	22.53a	18178
17	25.29	0.00	60.93	22.88	162.26	22.88	22.88a	18178
		0.00	60.93	25.70	144.49	144.03	144.03	97772
18	25.00	0.00	66.74	28.15	158.25	155.57	155.57	60309
19	24.50	7.83	68.80	29.01	163.13	143.33	151.16	30268
20	24.00	15.66	70.62	29.78	167.46	132.95	148.61	30268
21	23.50	23.49	72.13	30.42	171.03	124.59	148.08	30268
22	23.00	31.32	73.29	30.91	173.79	118.04	149.36	30268
23	22.50	39.15	74.14	31.27	175.79	112.86	152.01	30268
24	22.00	46.98	74.71	31.51	177.16	108.41	155.39	30268
25	21.60	53.24	75.03	31.64	177.91	105.04	158.28	30268

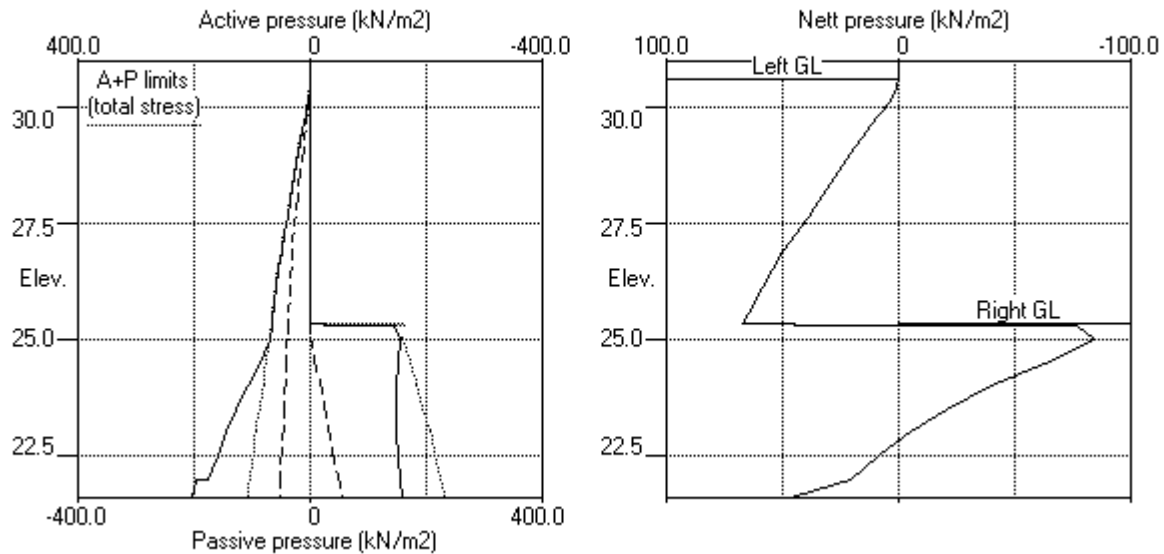
Note: 22.88a Soil pressure at active limit
 123.45p Soil pressure at passive limit

Units: kN,m

Stage No.12 Change soil type 3 to soil type 5



Stage No.12 Change soil type 3 to soil type 5



PILEDESIGNS LIMITED	Sheet No.
Program: WALLAP Version 6.06 Revision A51.B69.R54	Job No. 23811
Licensed from GEOSOLVE	Made by : MJC
Data filename/Run ID: 23811_Kentish_Town_Section1_04_SLS	
KENTISH TOWN	Date:26-05-2021
Design Case 1 - 600 dia @ 840	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

Stage	--- G.L. ---		Strut	FoS for toe		Toe elev. for		Direction
No.	Act.	Pass.	Elev.	Factor	Moment	elev.	FoS	
				of equilib.		FoS = 1.000		
				Safety at elev.		elevation		of failure
1	30.60	30.60	Cant.	Conditions not suitable for FoS calc.				
2	30.60	30.60	Cant.	Conditions not suitable for FoS calc.				
3	30.60	30.60		No analysis at this stage				
4	30.60	25.29	31.00	3.374	n/a	24.94	0.35	L to R
5	30.60	25.34	31.00	3.396	n/a	24.95	0.39	L to R
6	30.60	25.34		No analysis at this stage				
All remaining stages have more than one strut - FoS calculation n/a								

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Program: WALLAP Version 6.06 Revision A51.B69.R54

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Data filename/Run ID: 23811_Kentish_Town_Section1_04_SLS

KENTISH TOWN

Design Case 1 - 600 dia @ 840

| Sheet No.

| Job No. 23811

| Made by : MJC

| Date:26-05-2021

| 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 20.00 from wall

Right side 20.00 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			
		max.	min.	Calculated		Factored		Calculated		Factored	
				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	31.00	0.003	0.000	0	-0	0	-0	0	-45	0	-60
2	30.60	0.004	0.000	0	-18	0	-24	0	-45	0	-60
3	30.45	0.004	0.000	0	-25	0	-33	0	-58	0	-78
4	30.15	0.004	0.000	0	-38	0	-51	0	-57	0	-77
5	29.83	0.004	0.000	0	-52	0	-70	0	-55	0	-74
6	29.50	0.005	0.000	0	-65	0	-88	0	-51	0	-69
7	29.00	0.005	0.000	0	-82	0	-111	0	-42	0	-57
8	28.50	0.006	0.000	0	-95	0	-128	1	-30	1	-41
9	28.00	0.006	0.000	0	-106	0	-143	6	-15	8	-20
10	27.65	0.006	0.000	1	-109	1	-147	11	-2	15	-2
11	27.30	0.006	0.000	5	-107	7	-144	26	0	35	0
12	26.90	0.006	0.000	10	-98	14	-132	48	0	65	0
13	26.50	0.005	0.000	13	-81	17	-110	73	0	99	0
14	26.14	0.005	0.000	13	-58	18	-79	97	-0	131	-1
15	25.77	0.005	0.000	25	-30	34	-40	123	-30	166	-41
16	25.34	0.004	0.000	19	-2	25	-3	80	-4	107	-6
17	25.29	0.004	0.000	19	0	26	0	82	-4	110	-6
18	25.00	0.004	0.000	27	0	36	0	58	-5	79	-6
19	24.50	0.004	0.000	45	0	61	0	22	-5	29	-6
20	24.00	0.004	0.000	48	0	65	0	0	-5	0	-7
21	23.50	0.003	0.000	41	0	55	0	0	-20	0	-26
22	23.00	0.003	0.000	29	0	39	0	0	-26	0	-35
23	22.50	0.003	0.000	15	0	20	0	0	-25	0	-33
24	22.00	0.003	0.000	4	0	5	0	0	-17	0	-24
25	21.60	0.003	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	
1	1	26.14	-1	28.50	2	-1	2	27.30	-1	29.83	2	-1
2	13	26.14	-4	28.50	18	-5	17	27.30	-5	25.00	23	-6
3	No calculation at this stage											
4	40	24.00	-99	28.00	54	-133	77	25.29	-45	31.00	104	-60
5	40	24.00	-99	28.00	54	-134	77	25.29	-45	31.00	104	-60
6	No calculation at this stage											
7	No calculation at this stage											
8	38	24.00	-92	27.65	51	-124	76	25.29	-52	30.45	102	-70
9	No calculation at this stage											
10	No calculation at this stage											
11	46	24.00	-109	27.65	63	-147	96	25.77	-58	30.45	129	-78
12	48	24.00	-109	27.65	65	-147	96	25.77	-58	30.45	129	-78
13	25	25.77	-93	28.00	34	-125	123	25.77	-56	30.45	166	-76

Maximum and minimum displacement at each stage

Stage no.	Displacement				Stage description
	maximum	elev.	minimum	elev.	
	m		m		
1	0.000	31.00	0.000	31.00	Apply surcharge no.1 at elev. 30.60
2	0.001	31.00	0.000	31.00	Apply water pressure profile no.1
3	No calculation at this stage				Install strut no.3 at elev. 31.00
4	0.006	27.65	0.000	31.00	Excav. to elev. 25.29 on RIGHT side
5	0.006	28.00	0.000	31.00	Fill to elev. 25.34 on RIGHT side
6	No calculation at this stage				Install strut no.2 at elev. 25.77
7	No calculation at this stage				Install strut no.1 at elev. 30.45
8	0.005	27.65	0.000	31.00	Remove strut no.3 at elev. 31.00
9	No calculation at this stage				Change EI of wall to 105980kN.m ² /m run
10	No calculation at this stage				Apply surcharge no.4 at elev. 25.34
11	0.006	27.65	0.000	31.00	Change soil type 2 to soil type 4
12	0.006	27.65	0.000	31.00	Change soil type 3 to soil type 5
13	0.005	27.65	0.000	31.00	Apply water pressure profile no.2

Strut forces at each stage (horizontal components)

Stage no.	Strut no. 1			Strut no. 2			Strut no. 3		
	at elev. 30.45			at elev. 25.77			at elev. 31.00		
	--Calculated--	Factored		--Calculated--	Factored		--Calculated--	Factored	
	kN per m run	kN per strut	kN per strut	kN per m run	kN per strut	kN per strut	kN per m run	kN per strut	kN per strut
4	---	---	---	---	---	---	45	45	60
5	---	---	---	---	---	---	45	45	60
8	52	52	70	slack	slack	slack	---	---	---
11	58	58	78	45	45	61	---	---	---
12	58	58	78	44	44	60	---	---	---
13	56	56	76	153	153	206	---	---	---

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KENTISH TOWN

Design Case 1 - 600 dia @ 840

| Sheet No.

| Job No. 23811

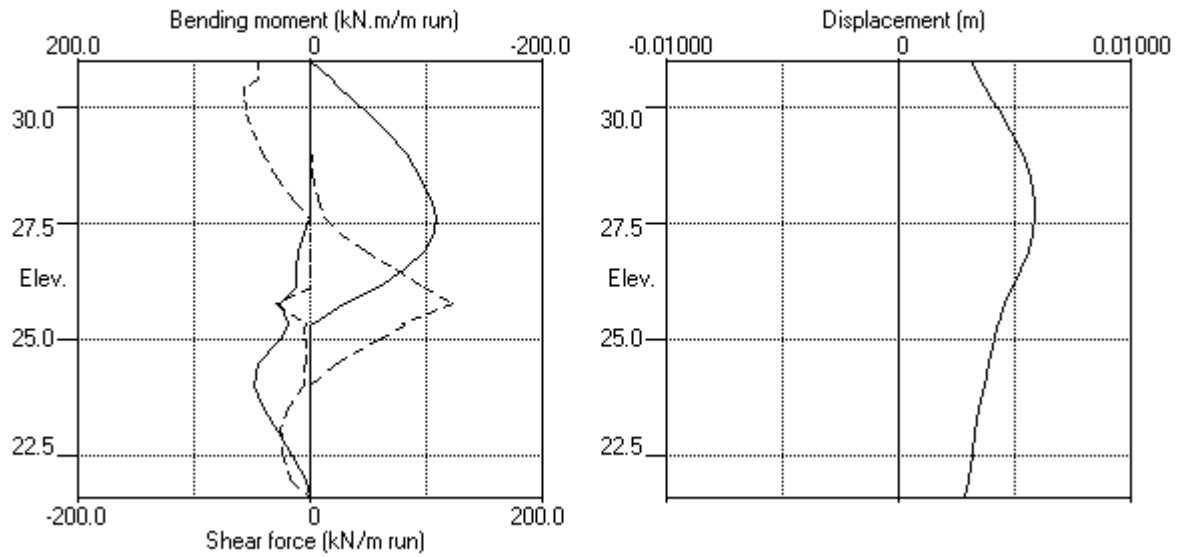
| Made by : MJC

| Date:26-05-2021

| Checked :

Units: kN,m

Bending moment, shear force, displacement envelopes



PILEDESIGNS LIMITED	Sheet No.
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Data filename/Run ID: 23811_Kentish_Town_Section1_04_ULS1	
KENTISH TOWN	Date:26-05-2021
Design Case 1 - 600 dia @ 840	Checked :

Units: kN,m

INPUT DATA

SOIL PROFILE

Stratum no.	Elevation of top of stratum	Soil types	
		Left side	Right side
1	30.60	1 Made Ground dr	1 Made Ground dr
2	27.30	2 London Clay 1 und	2 London Clay 1 und
3	22.00	3 London Clay 2 und	2 London Clay 1 und

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 dr	19.00	10000	0.540	OC (0.250)	0.376 (0.000)	2.663 (0.000)	
2 London Clay 1 und	20.00	72000	1.200	OC (0.490)	1.000 (2.389)	1.000 (2.390)	90.00u
3 London Cl.. (22.00)	20.00	72000 (7904)	1.200	OC (0.490)	1.000 (2.389)	1.000 (2.390)	90.00u (9.880)
4 London Clay 1 dr	20.00	55440	1.200	OC (0.200)	0.422 (1.299)	2.371 (3.080)	0.0d
5 London Cl.. (22.00)	20.00	55440 (6086)	1.200	OC (0.200)	0.422 (1.299)	2.371 (3.080)	0.0d

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 dr	27.00	0.000	0.00	27.00	0.000	
2 London Clay 1 und	0.00	0.500	0.00	0.00	0.500	
3 London Clay 2 und	0.00	0.500	0.00	0.00	0.500	
4 London Clay 1 dr	24.00	0.000	0.00	24.00	0.000	
5 London Clay 2 dr	24.00	0.000	0.00	24.00	0.000	

GROUND WATER CONDITIONS

Density of water = 10.00 kN/m3

	Left side	Right side
Initial water table elevation	25.00	25.00

Automatic water pressure balancing at toe of wall : Yes

Left side				Right side			
Water press.							
profile	Point	Elev.	Piezo	Point	Elev.	Piezo	Water
no.	no.	m	elev. m	no.	m	elev. m	press. kN/m2
1	1	30.15	30.15	1	25.00	25.00	0.0 MC+WC
	2	27.30	30.15	2	25.00	25.00	0.0
2	1	30.60	30.60	1	25.34	25.34	0.0 MC+WC
				2	25.34	30.60	52.6

WALL PROPERTIES

Type of structure = Fully Embedded Wall
Elevation of toe of wall = 21.60
Maximum finite element length = 0.50 m
Youngs modulus of wall E = 1.9600E+07 kN/m2
Moment of inertia of wall I = 7.5700E-03 m4/m run
E.I = 148372 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	30.45	1.00	0.275000	1.400E+07	5.00	0.00	0	No
2	25.77	1.00	0.450000	1.400E+07	5.00	0.00	0	No
3	31.00	1.00	1.000000	30000	1.00	0.00	0	No

SURCHARGE LOADS

Surch -arge no.	Elev.	Distance from wall	Length parallel to wall	Width perpend. to wall	Surcharge ----- Near edge	Surcharge ----- Far edge	Equiv. soil type	Partial factor/ Category
1	30.60	0.50 (L)	10.00	10.00	10.00	=	N/A	1.10 Var
2	29.60	0.50 (L)	10.00	1.00	100.00	=	N/A	1.00 P/U
3	Not defined							
4	25.34	-0.00 (R)	10.00	10.00	60.00	=	N/A	1.00 P/F

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 30.60
2	Apply water pressure profile no.1 (Mod. Conserv.) No analysis at this stage
3	Install strut or anchor no.3 at elevation 31.00
4	Excavate to elevation 24.79 on RIGHT side
5	Fill to elevation 25.34 on RIGHT side with soil type 1
6	Install strut or anchor no.2 at elevation 25.77
7	Install strut or anchor no.1 at elevation 30.45
8	Remove strut or anchor no.3 at elevation 31.00
9	Change EI of wall to 105980 kN.m2/m run Yield moment not defined No adjustments to wall displacements
10	Apply surcharge no.4 at elevation 25.34 No analysis at this stage
11	Change properties of soil type 2 to soil type 4 Ko pressures will not be reset
12	Change properties of soil type 3 to soil type 5 Ko pressures will be reset
13	Apply water pressure profile no.2 (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 = 20.00 m
Distance to rigid boundary on Right side = 20.00 m

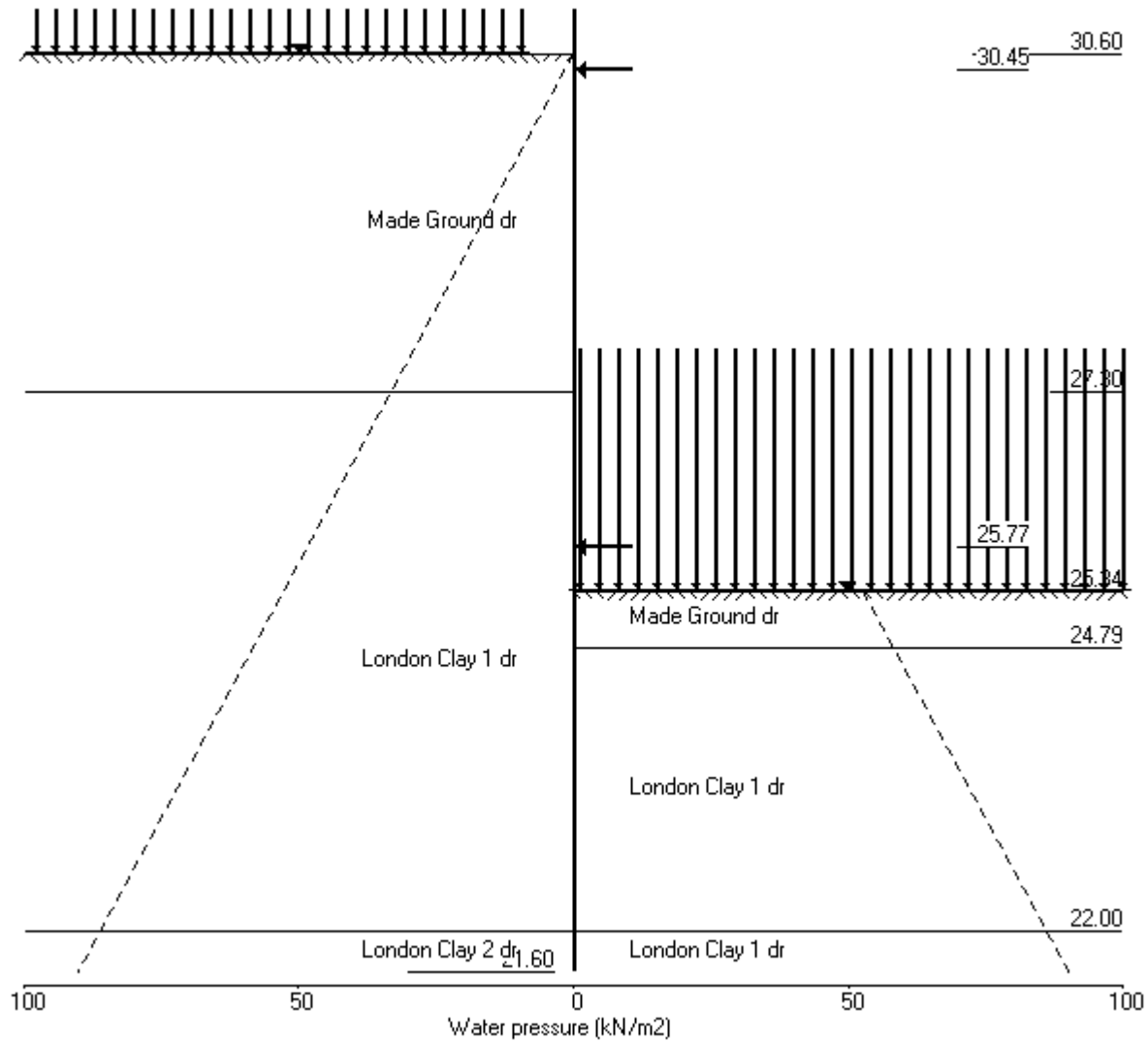
OUTPUT OPTIONS

Stage no.	Stage description	Output options		
		Displacement Bending mom. Shear force	Active, Passive pressures	Graph. output
1	Apply surcharge no.1 at elev. 30.60	No	No	No
2	Apply water pressure profile no.1	No	No	No
3	Install strut no.3 at elev. 31.00	No	No	No
4	Excav. to elev. 24.79 on RIGHT side	No	No	No
5	Fill to elev. 25.34 on RIGHT side	No	No	No
6	Install strut no.2 at elev. 25.77	No	No	No
7	Install strut no.1 at elev. 30.45	No	No	No
8	Remove strut no.3 at elev. 31.00	No	No	No
9	Change EI of wall to 105980kN.m2/m run	No	No	No
10	Apply surcharge no.4 at elev. 25.34	No	No	No
11	Change soil type 2 to soil type 4	No	No	No
12	Change soil type 3 to soil type 5	No	No	No
13	Apply water pressure profile no.2	No	No	No
*	Summary output	Yes	-	Yes

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Units: kN,m

Stage No.13 Apply water pressure profile no.2 (Mod. Conserv.)



PILEDESIGNS LIMITED	Sheet No.
Program: WALLAP Version 6.06 Revision A51.B69.R54	Job No. 23811
Licensed from GEOSOLVE	Made by : MJC
Data filename/Run ID: 23811_Kentish_Town_Section1_04_ULS1	
KENTISH TOWN	Date:26-05-2021
Design Case 1 - 600 dia @ 840	Checked :

Units: kN,m

Stage No. 4 Excavate to elevation 24.79 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 20.00 from wall
 Right side 20.00 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	31.00	0.00	0.003	-1.64E-03	-50.2	0.0	50.2	148372
2	30.60	0.00	0.004	-1.61E-03	-50.2	-20.1		148372
3	30.45	1.11	0.004	-1.58E-03	-50.1	-27.6		148372
4	30.15	3.83	0.004	-1.51E-03	-49.4	-42.5		148372
5	29.83	8.98	0.005	-1.40E-03	-47.3	-58.3		148372
6	29.50	13.91	0.005	-1.26E-03	-43.6	-73.1		148372
7	29.00	21.13	0.006	-9.84E-04	-34.8	-92.9		148372
8	28.50	28.11	0.006	-6.47E-04	-22.5	-107.4		148372
9	28.00	34.94	0.007	-2.72E-04	-6.8	-114.9		148372
10	27.65	39.67	0.007	-1.46E-06	6.3	-115.0		148372
11	27.30	44.37	0.007	2.64E-04	21.0	-110.3		148372
		16.50	0.007	2.64E-04	21.0	-110.3		
12	26.90	18.50	0.006	5.48E-04	28.0	-100.7		148372
13	26.50	20.50	0.006	8.03E-04	35.8	-88.1		148372
14	26.14	22.32	0.006	1.00E-03	43.6	-73.8		148372
15	25.77	24.14	0.005	1.16E-03	52.0	-56.5		148372
16	25.34	28.58	0.005	1.28E-03	63.4	-28.6		148372
17	25.00	46.08	0.004	1.32E-03	76.1	-5.3		148372
18	24.79	54.31	0.004	1.31E-03	86.7	11.7		148372
		-123.50	0.004	1.31E-03	86.7	11.7		
19	24.40	-94.64	0.004	1.25E-03	43.6	36.3		148372
20	24.00	-67.81	0.003	1.14E-03	11.5	46.2		148372
21	23.50	-37.71	0.003	9.95E-04	-14.9	43.4		148372
22	23.00	-11.68	0.002	8.69E-04	-27.2	31.2		148372
23	22.50	11.36	0.002	7.89E-04	-27.3	16.1		148372
24	22.00	32.78	0.001	7.55E-04	-16.3	3.9		148372
25	21.60	48.52	0.001	7.50E-04	0.0	0.0		---
At elev. 31.00 Strut force =				50.2 kN/strut =	50.2 kN/m run			

Node no.	Y coord	LEFT side						
		Water press.	Vertical	Effective Active limit	Effective 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	31.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	30.60	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	2006
3	30.45	0.00	2.96	1.11	7.89	1.11	1.11a	2006
4	30.15	0.00	10.20	3.83	27.15	3.83	3.83a	2006
5	29.83	3.25	15.26	5.73	40.63	5.73	8.98a	2006
6	29.50	6.50	19.73	7.41	52.54	7.41	13.91a	2006

(continued)

Stage No.4 Excavate to elevation 24.79 on RIGHT side

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		
7	29.00	11.50	25.66	9.63	68.32	9.63	21.13a	2006
8	28.50	16.50	30.91	11.61	82.32	11.61	28.11a	2006
9	28.00	21.50	35.80	13.44	95.33	13.44	34.94a	2006
10	27.65	25.00	39.07	14.67	104.05	14.67	39.67a	2006
11	27.30	28.50	42.27	15.87	112.55	15.87	44.37a	2006
		Total>	70.77	16.50m	285.87	16.50	16.50a	20642
12	26.90	Total>	78.74	18.50m	293.84	18.50	18.50a	20642
13	26.50	Total>	86.65	20.50m	301.76	20.50	20.50a	20642
14	26.14	Total>	93.80	22.32m	308.91	22.32	22.32a	20642
15	25.77	Total>	100.92	24.14m	316.03	24.14	24.14a	20642
16	25.34	Total>	109.37	26.30m	324.48	28.58	28.58	20642
17	25.00	Total>	116.00	28.00m	331.11	46.08	46.08	20642
18	24.79	Total>	120.08	29.05m	335.20	56.41	56.41	20642
19	24.40	Total>	127.77	31.02m	342.88	75.53	75.53	20642
20	24.00	Total>	135.44	33.00m	350.56	93.85	93.85	20642
21	23.50	Total>	145.16	35.50m	360.28	115.61	115.61	20642
22	23.00	Total>	154.88	38.00m	370.00	135.85	135.85	20642
23	22.50	Total>	164.60	40.50m	379.72	155.01	155.01	20642
24	22.00	Total>	174.33	43.00m	389.46	173.59	173.59	20642
25	21.60	Total>	180.58	45.00m	405.15	187.31	187.31	21548

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			
1	31.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0	
2	30.60	0.00	0.00	0.00	0.00	0.00	0.00	0.0	
3	30.45	0.00	0.00	0.00	0.00	0.00	0.00	0.0	
4	30.15	0.00	0.00	0.00	0.00	0.00	0.00	0.0	
5	29.83	0.00	0.00	0.00	0.00	0.00	0.00	0.0	
6	29.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0	
7	29.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0	
8	28.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0	
9	28.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0	
10	27.65	0.00	0.00	0.00	0.00	0.00	0.00	0.0	
11	27.30	0.00	0.00	0.00	0.00	0.00	0.00	0.0	
12	26.90	0.00	0.00	0.00	0.00	0.00	0.00	0.0	
13	26.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0	
14	26.14	0.00	0.00	0.00	0.00	0.00	0.00	0.0	
15	25.77	0.00	0.00	0.00	0.00	0.00	0.00	0.0	
16	25.34	0.00	0.00	0.00	0.00	0.00	0.00	0.0	
17	25.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0	
18	24.79	2.10	0.00	0.00	0.00	0.00	2.10	0.0	
		Total>	2.10	2.10w	217.20	179.91	179.91	36635	
19	24.40	Total>	10.00	3.02m	225.10	170.16	170.16	36635	
20	24.00	Total>	17.90	5.00m	233.00	161.67	161.67	36635	
21	23.50	Total>	27.91	7.50m	243.01	153.31	153.31	36635	
22	23.00	Total>	37.93	10.00m	253.03	147.53	147.53	36635	
23	22.50	Total>	47.97	12.50m	263.07	143.65	143.65	36635	
24	22.00	Total>	58.02	15.00m	273.12	140.80	140.80	36635	
25	21.60	Total>	66.09	17.00m	281.18	138.79	138.79	36635	

Run ID. 23811_Kentish_Town_Section1_04_ULS1
KENTISH TOWN
Design Case 1 - 600 dia @ 840

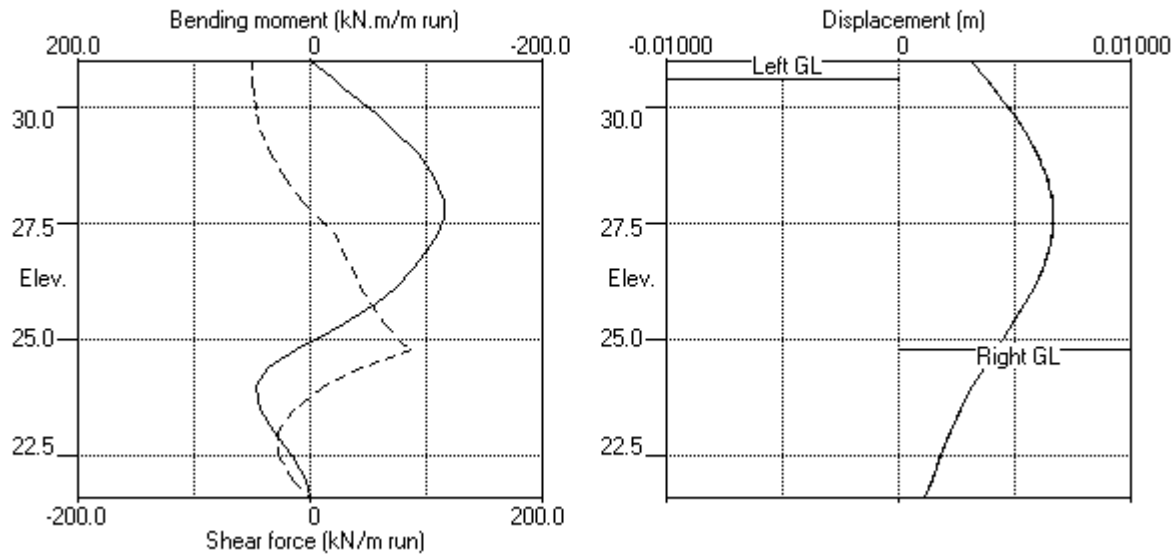
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| Date:26-05-2021
| Checked :

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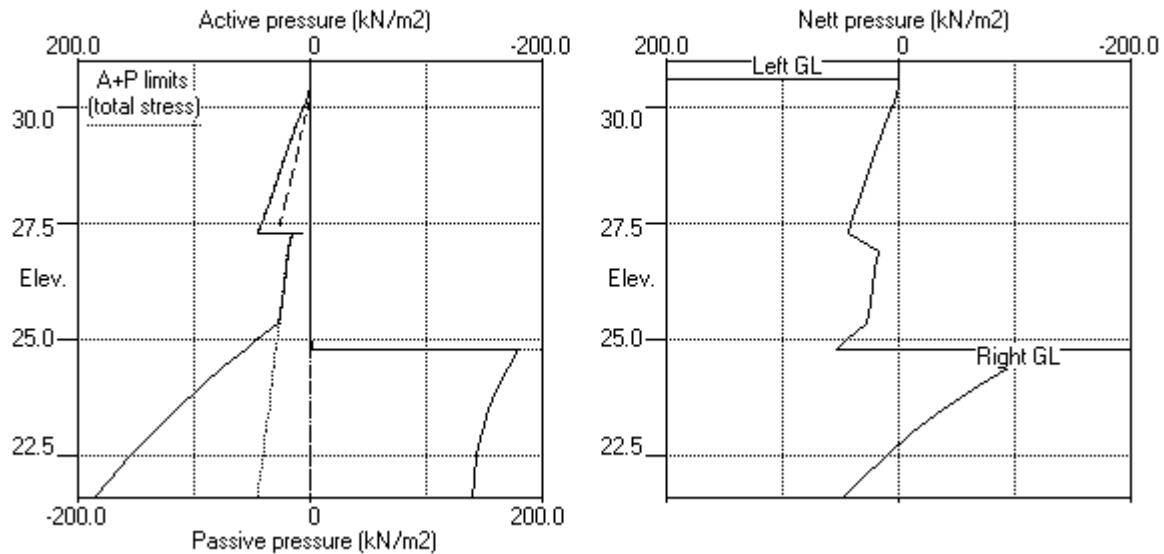
Stage No.4 Excavate to elevation 24.79 on RIGHT side
Note: 24.14a Soil pressure at active limit
 123.45p Soil pressure at passive limit

Units: kN,m

Stage No.4 Excav. to elev. 24.79 on RIGHT side



Stage No.4 Excav. to elev. 24.79 on RIGHT side



PILEDESIGNS LIMITED	Sheet No.
Program: WALLAP Version 6.06 Revision A51.B69.R54	Job No. 23811
Licensed from GEOSOLVE	Made by : MJC
Data filename/Run ID: 23811_Kentish_Town_Section1_04_ULS1	
KENTISH TOWN	Date:26-05-2021
Design Case 1 - 600 dia @ 840	Checked :

Units: kN,m

Stage No. 5 Fill to elevation 25.34 on RIGHT side with soil type 1

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 20.00 from wall
 Right side 20.00 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	31.00	0.00	0.003	-1.63E-03	-50.6	0.0	50.6	148372
2	30.60	0.00	0.004	-1.61E-03	-50.6	-20.2		148372
3	30.45	1.11	0.004	-1.58E-03	-50.5	-27.8		148372
4	30.15	3.83	0.004	-1.51E-03	-49.8	-42.9		148372
5	29.83	8.98	0.005	-1.40E-03	-47.7	-58.8		148372
6	29.50	13.91	0.005	-1.25E-03	-44.0	-73.7		148372
7	29.00	21.13	0.006	-9.77E-04	-35.2	-93.6		148372
8	28.50	28.11	0.006	-6.37E-04	-22.9	-108.4		148372
9	28.00	34.95	0.007	-2.59E-04	-7.1	-116.0		148372
10	27.65	39.70	0.007	1.48E-05	5.9	-116.3		148372
11	27.30	44.42	0.007	2.83E-04	20.6	-111.7		148372
		16.93	0.007	2.83E-04	20.6	-111.7		
12	26.90	19.16	0.006	5.72E-04	27.9	-102.2		148372
13	26.50	21.44	0.006	8.30E-04	36.0	-89.6		148372
14	26.14	23.54	0.006	1.03E-03	44.2	-75.2		148372
15	25.77	25.68	0.005	1.19E-03	53.1	-57.6		148372
16	25.34	30.53	0.005	1.32E-03	65.3	-29.1		148372
17	25.00	45.94	0.004	1.36E-03	78.3	-5.1		148372
18	24.79	52.95	0.004	1.35E-03	88.7	12.4		148372
		-126.58	0.004	1.35E-03	88.7	12.4		
19	24.40	-96.96	0.004	1.28E-03	44.5	37.5		148372
20	24.00	-69.45	0.003	1.17E-03	11.6	47.5		148372
21	23.50	-38.59	0.003	1.02E-03	-15.4	44.6		148372
22	23.00	-11.91	0.002	8.91E-04	-28.0	32.1		148372
23	22.50	11.69	0.002	8.09E-04	-28.1	16.6		148372
24	22.00	33.63	0.001	7.74E-04	-16.7	4.0		148372
25	21.60	49.97	0.001	7.69E-04	0.0	0.0		---
At elev. 31.00 Strut force =			50.6 kN/strut =		50.6 kN/m run			

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	31.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	30.60	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	4317
3	30.45	0.00	2.96	1.11	7.89	1.11	1.11a	4317
4	30.15	0.00	10.20	3.83	27.15	3.83	3.83a	4317
5	29.83	3.25	15.26	5.73	40.63	5.73	8.98a	4317
6	29.50	6.50	19.73	7.41	52.54	7.41	13.91a	4317

(continued)

Stage No.5 Fill to elevation 25.34 on RIGHT side with soil type 1

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	
7	29.00	11.50	25.66	9.63	68.32	9.63	21.13a	4317
8	28.50	16.50	30.91	11.61	82.32	11.61	28.11a	4317
9	28.00	21.50	35.80	13.44	95.33	13.45	34.95	2710
10	27.65	25.00	39.07	14.67	104.05	14.70	39.70	2710
11	27.30	28.50	42.27	15.87	112.55	15.92	44.42	2710
		Total>	70.77	16.50m	285.87	16.93	16.93	26987
12	26.90	Total>	78.74	18.50m	293.84	19.16	19.16	26987
13	26.50	Total>	86.65	20.50m	301.76	21.44	21.44	26987
14	26.14	Total>	93.80	22.32m	308.91	23.54	23.54	26987
15	25.77	Total>	100.92	24.14m	316.03	25.68	25.68	26987
16	25.34	Total>	109.37	26.30m	324.48	30.53	30.53	26987
17	25.00	Total>	116.00	28.00m	331.11	48.37	48.37	26987
18	24.79	Total>	120.08	29.05m	335.20	58.90	58.90	26987
19	24.40	Total>	127.77	31.02m	342.88	78.39	78.39	26987
20	24.00	Total>	135.44	33.00m	350.56	97.05	97.05	26987
21	23.50	Total>	145.16	35.50m	360.28	119.18	119.18	26987
22	23.00	Total>	154.88	38.00m	370.00	139.75	139.75	26987
23	22.50	Total>	164.60	40.50m	379.72	159.19	159.19	26987
24	22.00	Total>	174.33	43.00m	389.46	178.03	178.03	26987
25	21.60	Total>	180.58	45.00m	405.15	192.16	192.16	28172

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	31.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	30.60	0.00	0.00	0.00	0.00	0.00	0.00	0.0
3	30.45	0.00	0.00	0.00	0.00	0.00	0.00	0.0
4	30.15	0.00	0.00	0.00	0.00	0.00	0.00	0.0
5	29.83	0.00	0.00	0.00	0.00	0.00	0.00	0.0
6	29.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
7	29.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
8	28.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
9	28.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
10	27.65	0.00	0.00	0.00	0.00	0.00	0.00	0.0
11	27.30	0.00	0.00	0.00	0.00	0.00	0.00	0.0
12	26.90	0.00	0.00	0.00	0.00	0.00	0.00	0.0
13	26.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
14	26.14	0.00	0.00	0.00	0.00	0.00	0.00	0.0
15	25.77	0.00	0.00	0.00	0.00	0.00	0.00	0.0
16	25.34	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	2710
17	25.00	0.00	6.46	2.43	17.20	2.43	2.43a	2710
18	24.79	3.24	7.21	2.71	19.20	2.71	5.95a	2710
		Total>	10.45	2.75m	225.55	185.48	185.48	26987
19	24.40	Total>	18.35	4.72m	233.45	175.35	175.35	26987
20	24.00	Total>	26.26	6.70m	241.36	166.51	166.51	26987
21	23.50	Total>	36.28	9.20m	251.38	157.77	157.77	26987
22	23.00	Total>	46.32	11.70m	261.42	151.67	151.67	26987
23	22.50	Total>	56.37	14.20m	271.47	147.50	147.50	26987
24	22.00	Total>	66.44	16.70m	281.54	144.40	144.40	26987
25	21.60	Total>	74.52	18.70m	289.62	142.19	142.19	26987

Run ID. 23811_Kentish_Town_Section1_04_ULS1
KENTISH TOWN
Design Case 1 - 600 dia @ 840

| Sheet No.
| Date:26-05-2021
Checked :

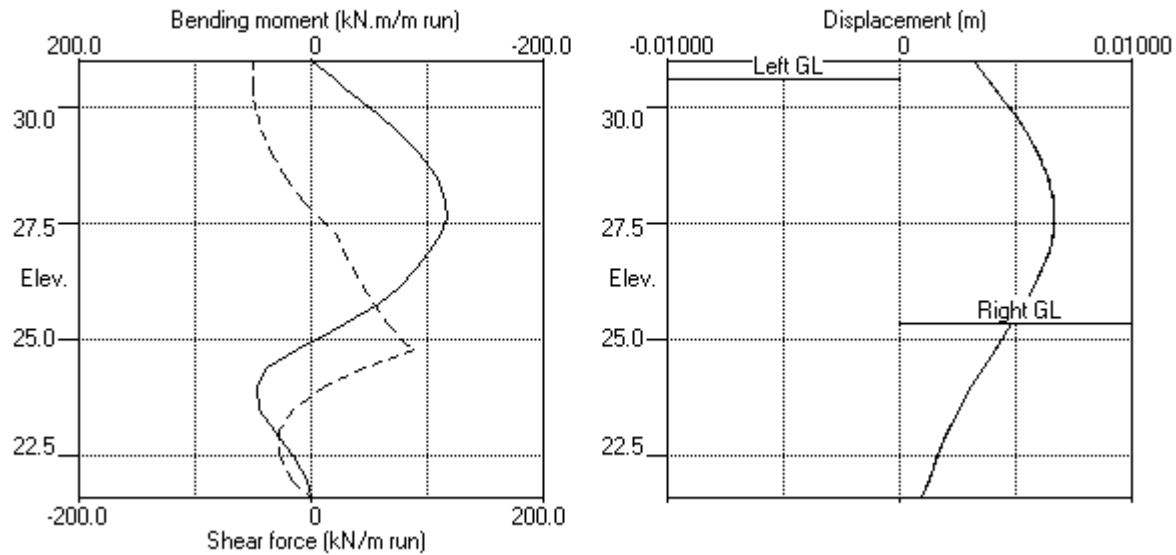
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Stage No.5 Fill to elevation 25.34 on RIGHT side with soil type 1

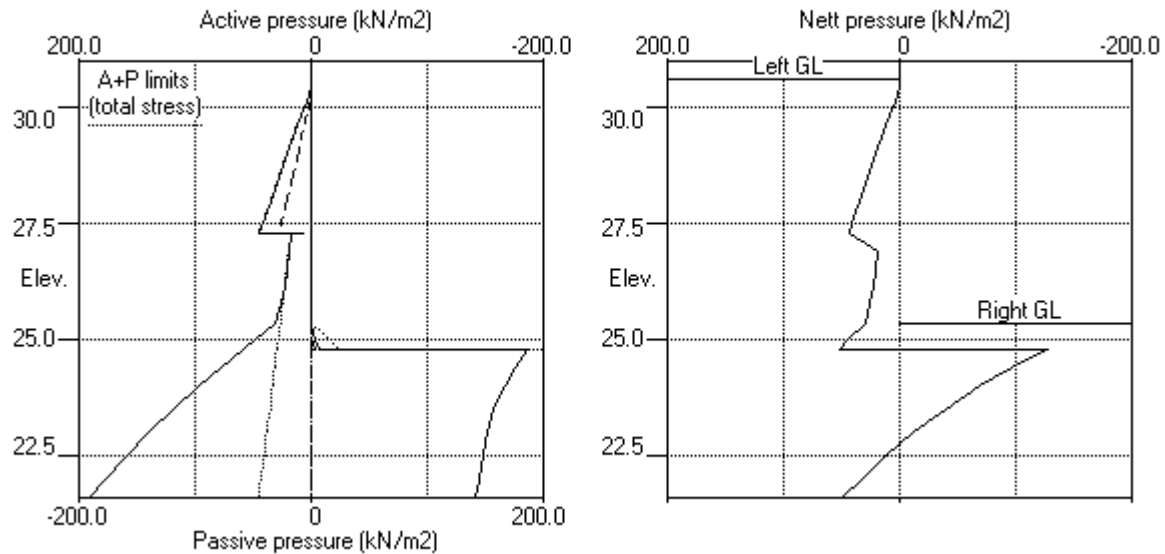
Note: 5.95a Soil pressure at active limit
 123.45p Soil pressure at passive limit

Units: kN,m

Stage No.5 Fill to elev. 25.34 on RIGHT side



Stage No.5 Fill to elev. 25.34 on RIGHT side



(continued)

Stage No.11 Change properties of soil type 2 to soil type 4
 Ko pressures will not be reset

Node no.	Y coord	LEFT side						Coeff. of subgrade reaction
		Water press. kN/m2	Vertical -al kN/m2	Effective Active limit kN/m2	Effective Passive limit kN/m2	Earth pressure kN/m2	Total earth pressure kN/m2	
1	31.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	30.60	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	49983
3	30.45	0.00	2.96	1.11	7.89	1.11	1.11a	2676
4	30.15	0.00	10.20	3.83	27.15	3.83	3.83a	2676
5	29.83	3.25	15.26	5.73	40.63	5.73	8.98a	2676
6	29.50	6.50	19.73	7.41	52.54	7.41	13.91a	2676
7	29.00	11.50	25.66	9.63	68.32	9.63	21.13a	2676
8	28.50	16.50	30.91	11.61	82.32	11.61	28.11a	2676
9	28.00	21.50	35.80	13.44	95.33	13.44	34.94a	2676
10	27.65	25.00	39.07	14.67	104.05	14.67	39.67a	2676
11	27.30	28.50	42.27	15.87	112.55	15.87	44.37a	2676
		28.50	42.27	17.82	100.22	17.82	46.32a	14280
12	26.90	30.24	48.50	20.45	115.01	20.45	50.69a	14280
13	26.50	31.97	54.68	23.06	129.64	23.06	55.03a	14280
14	26.14	33.55	60.25	25.41	142.85	25.41	58.96a	14280
15	25.77	35.13	65.79	27.74	156.00	27.74	62.87a	14280
16	25.34	37.01	72.36	30.52	171.59	30.52	67.53a	14280
17	25.00	38.48	77.51	32.69	183.80	32.69	71.17a	19079
18	24.79	39.40	80.69	34.03	191.33	34.03	73.42a	19079
19	24.40	41.11	86.66	36.54	205.48	39.78	80.89	19079
20	24.00	42.82	92.62	39.06	219.62	57.60	100.42	19079
21	23.50	44.99	100.17	42.24	237.51	78.62	123.61	19079
22	23.00	47.16	107.71	45.42	255.41	97.86	145.03	19079
23	22.50	49.34	115.27	48.61	273.32	115.87	165.21	19079
24	22.00	51.51	122.83	51.80	291.24	133.22	184.72	19079
		Total>	174.33	43.00m	389.46	190.72	190.72	34880
25	21.60	Total>	180.58	45.00m	405.15	206.50	206.50	36412

Node no.	Y coord	RIGHT side						Coeff. of subgrade reaction
		Water press. kN/m2	Vertical -al kN/m2	Effective Active limit kN/m2	Effective Passive limit kN/m2	Earth pressure kN/m2	Total earth pressure kN/m2	
1	31.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	30.60	0.00	0.00	0.00	0.00	0.00	0.00	0.0
3	30.45	0.00	0.00	0.00	0.00	0.00	0.00	0.0
4	30.15	0.00	0.00	0.00	0.00	0.00	0.00	0.0
5	29.83	0.00	0.00	0.00	0.00	0.00	0.00	0.0
6	29.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
7	29.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
8	28.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
9	28.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
10	27.65	0.00	0.00	0.00	0.00	0.00	0.00	0.0
11	27.30	0.00	0.00	0.00	0.00	0.00	0.00	0.0
12	26.90	0.00	0.00	0.00	0.00	0.00	0.00	0.0
13	26.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
14	26.14	0.00	0.00	0.00	0.00	0.00	0.00	0.0
15	25.77	0.00	0.00	0.00	0.00	0.00	0.00	0.0
16	25.34	0.00	0.00	0.00	0.00	0.00	0.00	0.0
		0.00	60.00	22.53	159.78	22.53	22.53a	23187
17	25.00	0.00	66.45	24.95	176.95	24.95	24.95a	3567
18	24.79	3.29	67.13	25.21	178.75	25.21	28.49a	3567
		3.29	67.13	28.31	159.17	158.41	161.69	19079

(continued)

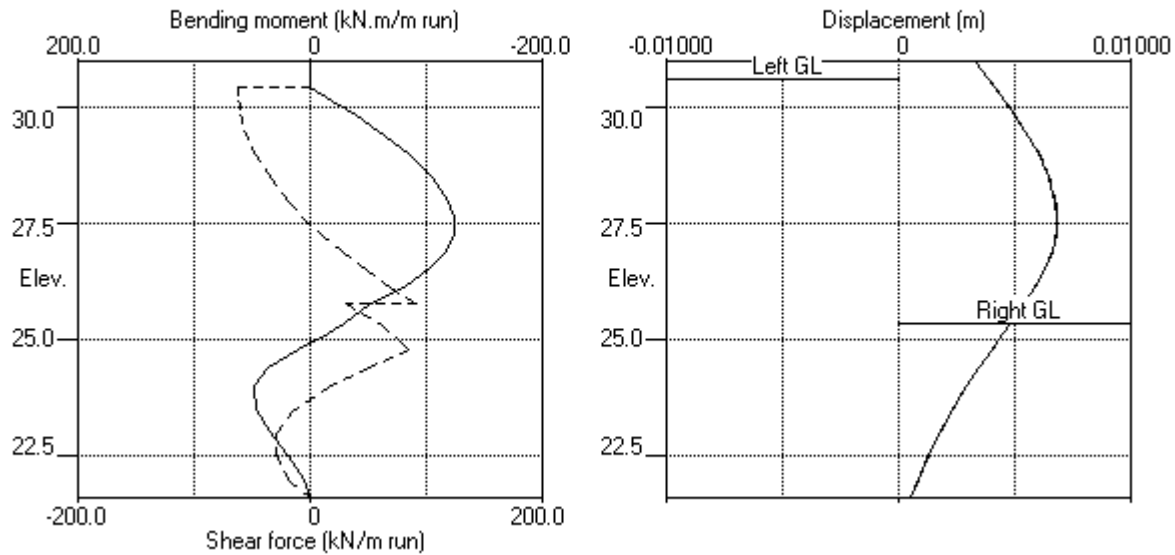
Stage No.11 Change properties of soil type 2 to soil type 4
 Ko pressures will not be reset

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		
19	24.40	9.47	68.70	28.97	162.91	160.97	170.44	19079
20	24.00	15.66	70.12	29.57	166.27	161.94	177.59	19079
21	23.50	23.49	71.63	30.21	169.85	144.53	168.02	19079
22	23.00	31.32	72.79	30.70	172.61	129.56	160.88	19079
23	22.50	39.15	73.64	31.05	174.61	116.49	155.64	19079
24	22.00	46.98	74.21	31.30	175.98	104.47	151.45	19079
25	21.60	53.24	74.53	31.43	176.72	95.11	148.35	19079

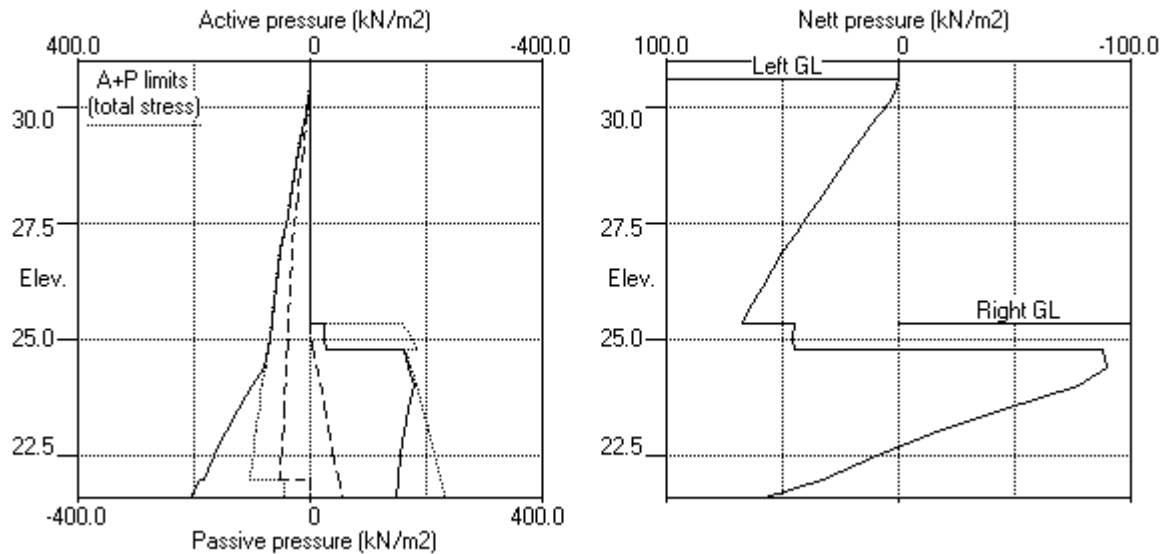
Note: 28.49a Soil pressure at active limit
 123.45p Soil pressure at passive limit

Units: kN,m

Stage No.11 Change soil type 2 to soil type 4



Stage No.11 Change soil type 2 to soil type 4



PILEDDESIGNS LIMITED	Sheet No.
Program: WALLAP Version 6.06 Revision A51.B69.R54	Job No. 23811
Licensed from GEOSOLVE	Made by : MJC
Data filename/Run ID: 23811_Kentish_Town_Section1_04_ULS1	
KENTISH TOWN	Date:26-05-2021
Design Case 1 - 600 dia @ 840	Checked :

Units: kN,m

Stage No. 12 Change properties of soil type 3 to soil type 5
Ko pressures will 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 20.00 from wall

Right side 20.00 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/m ²	Wall disp. m	Wall rotation rad.	Shear force kN/m	Bending moment kN.m/m	Strut forces kN/m	EI of wall kN.m ² /m
1	31.00	0.00	0.003	-1.48E-03	0.0	0.0		105980
2	30.60	0.00	0.004	-1.48E-03	0.0	-0.0		105980
3	30.45	1.11	0.004	-1.48E-03	0.1	0.0	63.3	105980
		1.11	0.004	-1.48E-03	-63.2	0.0		
4	30.15	3.83	0.005	-1.46E-03	-62.5	-18.8		105980
5	29.83	8.98	0.005	-1.40E-03	-60.4	-38.9		105980
6	29.50	13.91	0.005	-1.29E-03	-56.7	-57.9		105980
7	29.00	21.13	0.006	-1.04E-03	-47.9	-84.2		105980
8	28.50	28.11	0.006	-7.16E-04	-35.6	-105.3		105980
9	28.00	34.94	0.007	-3.23E-04	-19.8	-119.3		105980
10	27.65	39.67	0.007	-2.33E-05	-6.8	-124.0		105980
11	27.30	44.37	0.007	2.83E-04	7.9	-123.9		105980
		46.33	0.007	2.83E-04	7.9	-123.9		
12	26.90	50.69	0.007	6.26E-04	27.3	-117.1		105980
13	26.50	55.03	0.006	9.37E-04	48.5	-102.1		105980
14	26.14	58.96	0.006	1.16E-03	69.2	-80.8		105980
15	25.77	62.88	0.005	1.33E-03	91.3	-51.8	59.4	105980
		62.88	0.005	1.33E-03	31.9	-51.8		
16	25.34	67.53	0.005	1.44E-03	60.1	-29.0		105980
		45.00	0.005	1.44E-03	60.1	-29.0		
17	25.00	46.22	0.004	1.48E-03	75.7	-6.1		105980
18	24.79	44.93	0.004	1.47E-03	85.2	10.8		105980
		-88.28	0.004	1.47E-03	85.2	10.8		
19	24.40	-89.64	0.003	1.41E-03	50.1	36.7		105980
20	24.00	-77.35	0.003	1.29E-03	17.1	49.0		105980
21	23.50	-44.79	0.002	1.12E-03	-13.4	47.9		105980
22	23.00	-16.53	0.002	9.77E-04	-28.8	35.6		105980
23	22.50	8.50	0.001	8.79E-04	-30.8	19.1		105980
24	22.00	31.75	0.001	8.36E-04	-20.7	4.8		105980
		45.92	0.001	8.36E-04	-20.7	4.8		
25	21.60	57.60	0.001	8.30E-04	0.0	0.0		---
At elev. 30.45 Strut force =				63.3 kN/strut =		63.3 kN/m run		
At elev. 25.77 Strut force =				59.4 kN/strut =		59.4 kN/m run		

(continued)

Stage No.12 Change properties of soil type 3 to soil type 5
Ko pressures will 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	31.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	30.60	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	44573
3	30.45	0.00	2.96	1.11	7.89	1.11	1.11a	2543
4	30.15	0.00	10.20	3.83	27.15	3.83	3.83a	2543
5	29.83	3.25	15.26	5.73	40.63	5.73	8.98a	2543
6	29.50	6.50	19.73	7.41	52.54	7.41	13.91a	2543
7	29.00	11.50	25.66	9.63	68.32	9.63	21.13a	2543
8	28.50	16.50	30.91	11.61	82.32	11.61	28.11a	2543
9	28.00	21.50	35.80	13.44	95.33	13.44	34.94a	2543
10	27.65	25.00	39.07	14.67	104.05	14.67	39.67a	2543
11	27.30	28.50	42.27	15.87	112.55	15.87	44.37a	2543
		28.50	42.27	17.82	100.22	17.83	46.33a	13564
12	26.90	30.24	48.50	20.45	115.01	20.46	50.69a	13564
13	26.50	31.97	54.68	23.06	129.64	23.06	55.03a	13564
14	26.14	33.55	60.25	25.41	142.85	25.41	58.96a	13564
15	25.77	35.13	65.79	27.74	156.00	27.75	62.88a	13564
16	25.34	37.01	72.36	30.52	171.59	30.52	67.53a	13564
17	25.00	38.48	77.51	32.69	183.80	32.69	71.17a	29683
18	24.79	39.40	80.69	34.03	191.33	34.03	73.42a	29683
19	24.40	41.11	86.66	36.54	205.48	39.74	80.85	29683
20	24.00	42.82	92.62	39.06	219.62	57.51	100.33	29683
21	23.50	44.99	100.17	42.24	237.51	78.43	123.42	29683
22	23.00	47.16	107.71	45.42	255.41	97.53	144.69	29683
23	22.50	49.34	115.27	48.61	273.32	115.34	164.68	29683
24	22.00	51.51	122.83	51.80	291.24	132.45	183.96	29683
		51.51	122.83	51.80	291.24	146.63	198.14	29683
25	21.60	53.24	128.88	54.35	305.60	153.66	206.90	30986

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	31.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	30.60	0.00	0.00	0.00	0.00	0.00	0.00	0.0
3	30.45	0.00	0.00	0.00	0.00	0.00	0.00	0.0
4	30.15	0.00	0.00	0.00	0.00	0.00	0.00	0.0
5	29.83	0.00	0.00	0.00	0.00	0.00	0.00	0.0
6	29.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
7	29.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
8	28.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
9	28.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
10	27.65	0.00	0.00	0.00	0.00	0.00	0.00	0.0
11	27.30	0.00	0.00	0.00	0.00	0.00	0.00	0.0
12	26.90	0.00	0.00	0.00	0.00	0.00	0.00	0.0
13	26.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
14	26.14	0.00	0.00	0.00	0.00	0.00	0.00	0.0
15	25.77	0.00	0.00	0.00	0.00	0.00	0.00	0.0
16	25.34	0.00	0.00	0.00	0.00	0.00	0.00	0.0
		0.00	60.00	22.53	159.78	22.53	22.53a	31640
17	25.00	0.00	66.45	24.95	176.95	24.95	24.95a	5537
18	24.79	3.29	67.13	25.21	178.75	25.21	28.50a	5537
		3.29	67.13	28.31	159.17	158.42	161.71	29683

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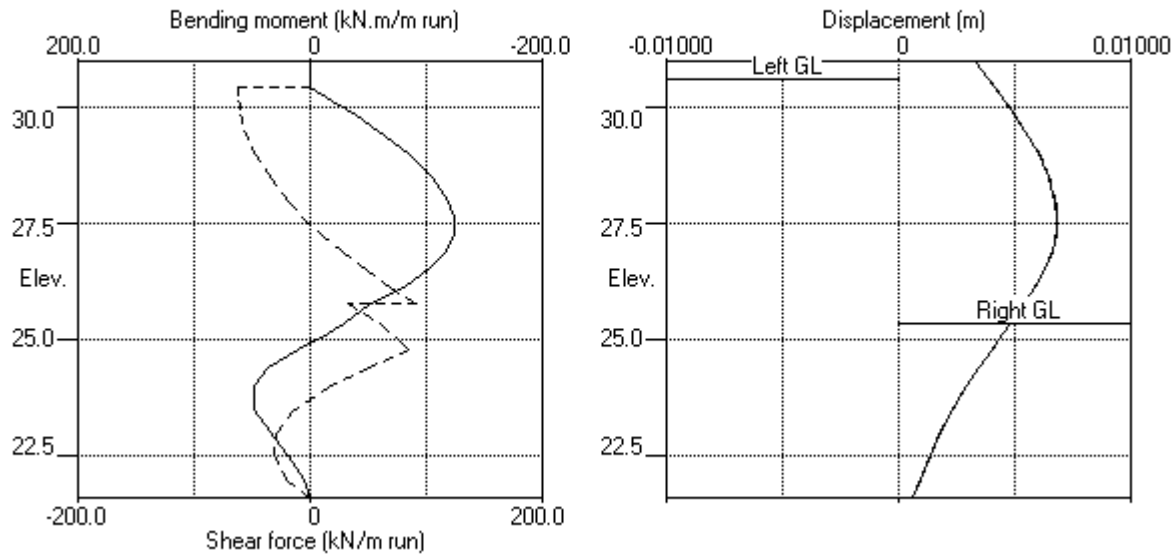
Stage No.12 Change properties of soil type 3 to soil type 5
 Ko pressures will be reset

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		
19	24.40	9.47	68.70	28.97	162.91	161.01	170.48	29683
20	24.00	15.66	70.12	29.57	166.27	162.03	177.68	29683
21	23.50	23.49	71.63	30.21	169.85	144.72	168.21	29683
22	23.00	31.32	72.79	30.70	172.61	129.90	161.22	29683
23	22.50	39.15	73.64	31.05	174.61	117.02	156.17	29683
24	22.00	46.98	74.21	31.30	175.98	105.24	152.21	29683
25	21.60	53.24	74.53	31.43	176.72	96.06	149.31	29683

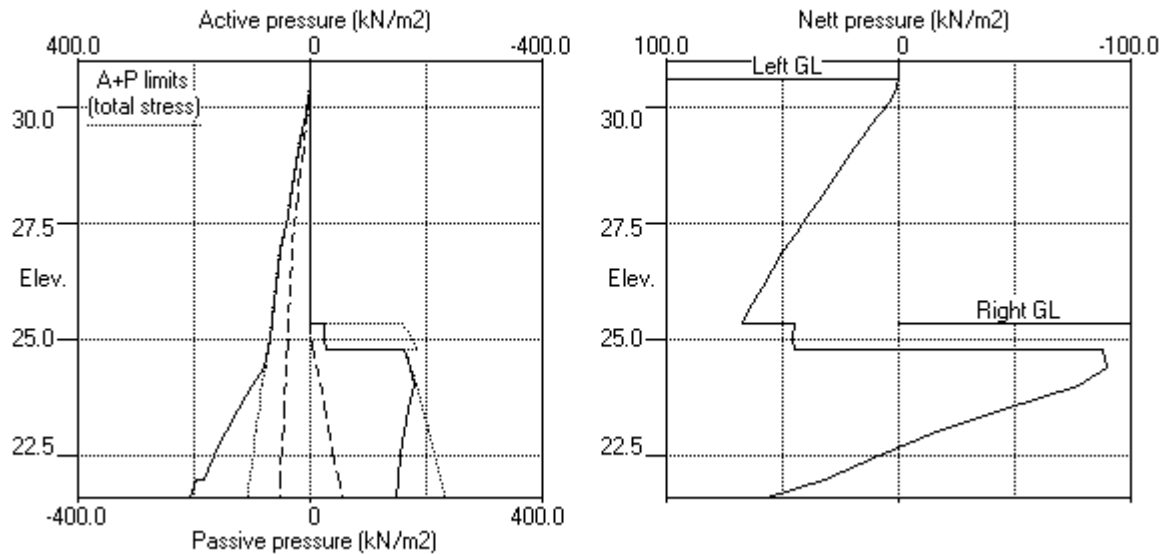
Note: 28.50a Soil pressure at active limit
 123.45p Soil pressure at passive limit

Units: kN,m

Stage No.12 Change soil type 3 to soil type 5



Stage No.12 Change soil type 3 to soil type 5



PILEDESIGNS LIMITED	Sheet No.
Program: WALLAP Version 6.06 Revision A51.B69.R54	Job No. 23811
Licensed from GEOSOLVE	Made by : MJC
Data filename/Run ID: 23811_Kentish_Town_Section1_04_ULS1	
KENTISH TOWN	Date:26-05-2021
Design Case 1 - 600 dia @ 840	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 20.00 from wall
 Right side 20.00 from wall

Limit State: ULS DAI 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	31.00	0.003	0.000	0	-0	0	-0	0	-51	0	-68
2	30.60	0.004	0.000	0	-20	0	-27	0	-51	0	-68
3	30.45	0.004	0.000	0	-28	0	-38	0	-63	0	-85
4	30.15	0.005	0.000	0	-43	0	-58	0	-62	0	-84
5	29.83	0.005	0.000	0	-59	0	-79	0	-60	0	-82
6	29.50	0.005	0.000	0	-74	0	-99	0	-57	0	-77
7	29.00	0.006	0.000	0	-94	0	-126	0	-48	0	-65
8	28.50	0.006	0.000	0	-108	0	-146	1	-36	1	-48
9	28.00	0.007	0.000	0	-119	0	-161	6	-20	8	-27
10	27.65	0.007	0.000	1	-124	1	-167	11	-7	15	-9
11	27.30	0.007	0.000	6	-124	8	-167	21	0	29	0
12	26.90	0.007	0.000	11	-117	14	-158	44	0	60	0
13	26.50	0.006	0.000	13	-102	17	-138	70	0	94	0
14	26.14	0.006	0.000	13	-81	18	-109	94	-0	127	-1
15	25.77	0.006	0.000	13	-60	17	-80	120	-27	162	-36
16	25.34	0.005	0.000	11	-32	15	-43	65	-4	88	-6
17	25.00	0.005	0.000	9	-8	12	-11	78	-5	106	-6
18	24.79	0.005	0.000	12	0	17	0	89	-5	120	-7
19	24.40	0.005	0.000	38	0	51	0	50	-5	68	-6
20	24.00	0.004	0.000	49	0	66	0	17	-4	23	-5
21	23.50	0.004	0.000	48	0	65	0	0	-15	0	-21
22	23.00	0.004	0.000	36	0	48	0	0	-29	0	-39
23	22.50	0.003	0.000	19	0	26	0	0	-31	0	-42
24	22.00	0.003	0.000	5	0	6	0	0	-21	0	-28
25	21.60	0.003	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	
1	2	26.14	-1	28.50	2	-1	2	27.30	-1	29.83	3	-1
2	13	26.14	-4	28.50	18	-5	17	27.30	-5	24.79	23	-7
3	No calculation at this stage											
4	46	24.00	-115	27.65	62	-155	87	24.79	-50	31.00	117	-68
5	48	24.00	-116	27.65	64	-157	89	24.79	-51	31.00	120	-68
6	No calculation at this stage											
7	No calculation at this stage											
8	45	24.00	-110	27.65	61	-148	88	24.79	-58	30.45	119	-79
9	No calculation at this stage											
10	No calculation at this stage											
11	48	24.00	-124	27.65	65	-167	91	25.77	-63	30.45	123	-85
12	49	24.00	-124	27.65	66	-167	91	25.77	-63	30.45	123	-85
13	14	23.50	-106	27.65	19	-143	120	25.77	-61	30.45	162	-83

Maximum and minimum displacement at each stage

Stage no.	Displacement				Stage description
	maximum	elev.	minimum	elev.	
	m		m		
1	0.000	31.00	0.000	31.00	Apply surcharge no.1 at elev. 30.60
2	0.001	31.00	0.000	31.00	Apply water pressure profile no.1
3	No calculation at this stage				Install strut no.3 at elev. 31.00
4	0.007	27.65	0.000	31.00	Excav. to elev. 24.79 on RIGHT side
5	0.007	27.65	0.000	31.00	Fill to elev. 25.34 on RIGHT side
6	No calculation at this stage				Install strut no.2 at elev. 25.77
7	No calculation at this stage				Install strut no.1 at elev. 30.45
8	0.006	27.65	0.000	31.00	Remove strut no.3 at elev. 31.00
9	No calculation at this stage				Change EI of wall to 105980kN.m ² /m run
10	No calculation at this stage				Apply surcharge no.4 at elev. 25.34
11	0.007	27.65	0.000	31.00	Change soil type 2 to soil type 4
12	0.007	27.65	0.000	31.00	Change soil type 3 to soil type 5
13	0.006	27.65	0.000	31.00	Apply water pressure profile no.2

Strut forces at each stage (horizontal components)

Stage no.	Strut no. 1			Strut no. 2			Strut no. 3		
	at elev. 30.45			at elev. 25.77			at elev. 31.00		
	--Calculated--	Factored		--Calculated--	Factored		--Calculated--	Factored	
	kN per m run	kN per strut	kN per strut	kN per m run	kN per strut	kN per strut	kN per m run	kN per strut	kN per strut
4	---	---	---	---	---	---	50	50	68
5	---	---	---	---	---	---	51	51	68
8	59	59	79	slack	slack	slack	---	---	---
11	63	63	85	60	60	81	---	---	---
12	63	63	85	59	59	80	---	---	---
13	61	61	83	147	147	198	---	---	---

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Data filename/Run ID: 23811_Kentish_Town_Section1_04_ULS1

KENTISH TOWN

Design Case 1 - 600 dia @ 840

| Sheet No.

| Job No. 23811

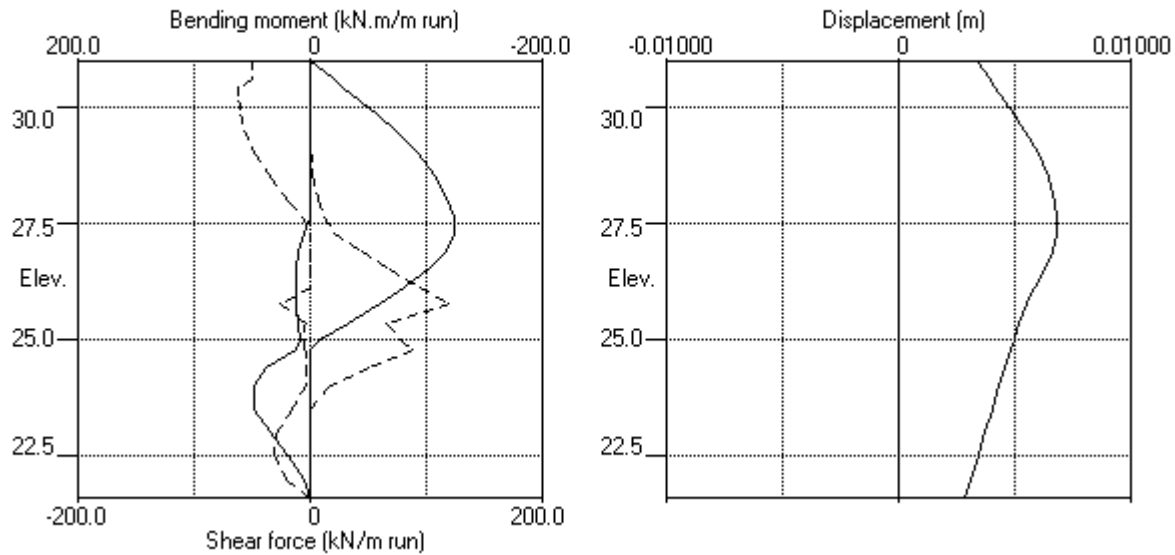
| Made by : MJC

| Date:26-05-2021

| Checked :

Units: kN,m

Bending moment, shear force, displacement envelopes



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 Data filename/Run ID: 23811_Kentish_Town_Section1_04_ULS2 |
 KENTISH TOWN | Date:26-05-2021
 Design Case 1 - 600 dia @ 840 | Checked :

Units: kN,m

INPUT DATA

SOIL PROFILE

Stratum no.	Elevation of top of stratum	Soil types	
		Left side	Right side
1	30.60	1 Made Ground dr	1 Made Ground dr
2	27.30	2 London Clay 1 und	2 London Clay 1 und
3	22.00	3 London Clay 2 und	2 London Clay 1 und

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 dr	19.00	10000	0.540	OC (0.250)	0.376 (0.000)	2.663 (0.000)	
2 London Clay 1 und	20.00	72000	1.200	OC (0.490)	1.000 (2.389)	1.000 (2.390)	90.00u
3 London Cl.. (22.00)	20.00	72000 (7904)	1.200	OC (0.490)	1.000 (2.389)	1.000 (2.390)	90.00u (9.880)
4 London Clay 1 dr	20.00	55440	1.200	OC (0.200)	0.422 (1.299)	2.371 (3.080)	0.0d
5 London Cl.. (22.00)	20.00	55440 (6086)	1.200	OC (0.200)	0.422 (1.299)	2.371 (3.080)	0.0d

Additional soil parameters associated with Ka and Kp

Soil type	--- parameters for Ka ---			--- parameters for Kp ---		
	Soil friction	Wall adhesion	Back-fill	Soil friction	Wall adhesion	Back-fill
No. Description	angle	coeff.	angle	angle	coeff.	angle
1 Made Ground dr	27.00	0.000	0.00	27.00	0.000	0.00
2 London Clay 1 und	0.00	0.500	0.00	0.00	0.500	0.00
3 London Clay 2 und	0.00	0.500	0.00	0.00	0.500	0.00
4 London Clay 1 dr	24.00	0.000	0.00	24.00	0.000	0.00
5 London Clay 2 dr	24.00	0.000	0.00	24.00	0.000	0.00

GROUND WATER CONDITIONS

Density of water = 10.00 kN/m3

	Left side	Right side
Initial water table elevation	25.00	25.00

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	Water press. kN/m2	
1	1	30.15	30.15	0.0	1	25.00	25.00	0.0 MC+WC	
	2	27.30	30.15	28.5	2	25.00	25.00	0.0	
2	1	30.60	30.60	0.0	1	25.34	25.34	0.0 MC+WC	
					2	25.34	30.60	52.6	

WALL PROPERTIES

Type of structure = Fully Embedded Wall
 Elevation of toe of wall = 21.60
 Maximum finite element length = 0.50 m
 Youngs modulus of wall E = 1.9600E+07 kN/m2
 Moment of inertia of wall I = 7.5700E-03 m4/m run
 E.I = 148372 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	30.45	1.00	0.275000	1.400E+07	5.00	0.00	0	No
2	25.77	1.00	0.450000	1.400E+07	5.00	0.00	0	No
3	31.00	1.00	1.000000	30000	1.00	0.00	0	No

SURCHARGE LOADS

Surch -arge no.	Elev.	Distance from wall	Length parallel to wall	Width perpend. to wall	Surcharge ----- Near edge	Surcharge ----- Far edge	Equiv. soil type	Partial factor/ Category
1	30.60	0.50 (L)	10.00	10.00	10.00	=	N/A	1.30 Var
2	29.60	0.50 (L)	10.00	1.00	100.00	=	N/A	1.00 P/U
3	Not defined							
4	25.34	-0.00 (R)	10.00	10.00	60.00	=	N/A	1.00 P/F

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 30.60
2	Apply water pressure profile no.1 (Worst Cred.) No analysis at this stage
3	Install strut or anchor no.3 at elevation 31.00
4	Excavate to elevation 24.79 on RIGHT side
5	Fill to elevation 25.34 on RIGHT side with soil type 1
6	Install strut or anchor no.2 at elevation 25.77
7	Install strut or anchor no.1 at elevation 30.45
8	Remove strut or anchor no.3 at elevation 31.00
9	Change EI of wall to 105980 kN.m2/m run Yield moment not defined No adjustments to wall displacements
10	Apply surcharge no.4 at elevation 25.34 No analysis at this stage
11	Change properties of soil type 2 to soil type 4 Ko pressures will not be reset
12	Change properties of soil type 3 to soil type 5 Ko pressures will be reset
13	Apply water pressure profile no.2 (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 = 20.00 m
Distance to rigid boundary on Right side = 20.00 m

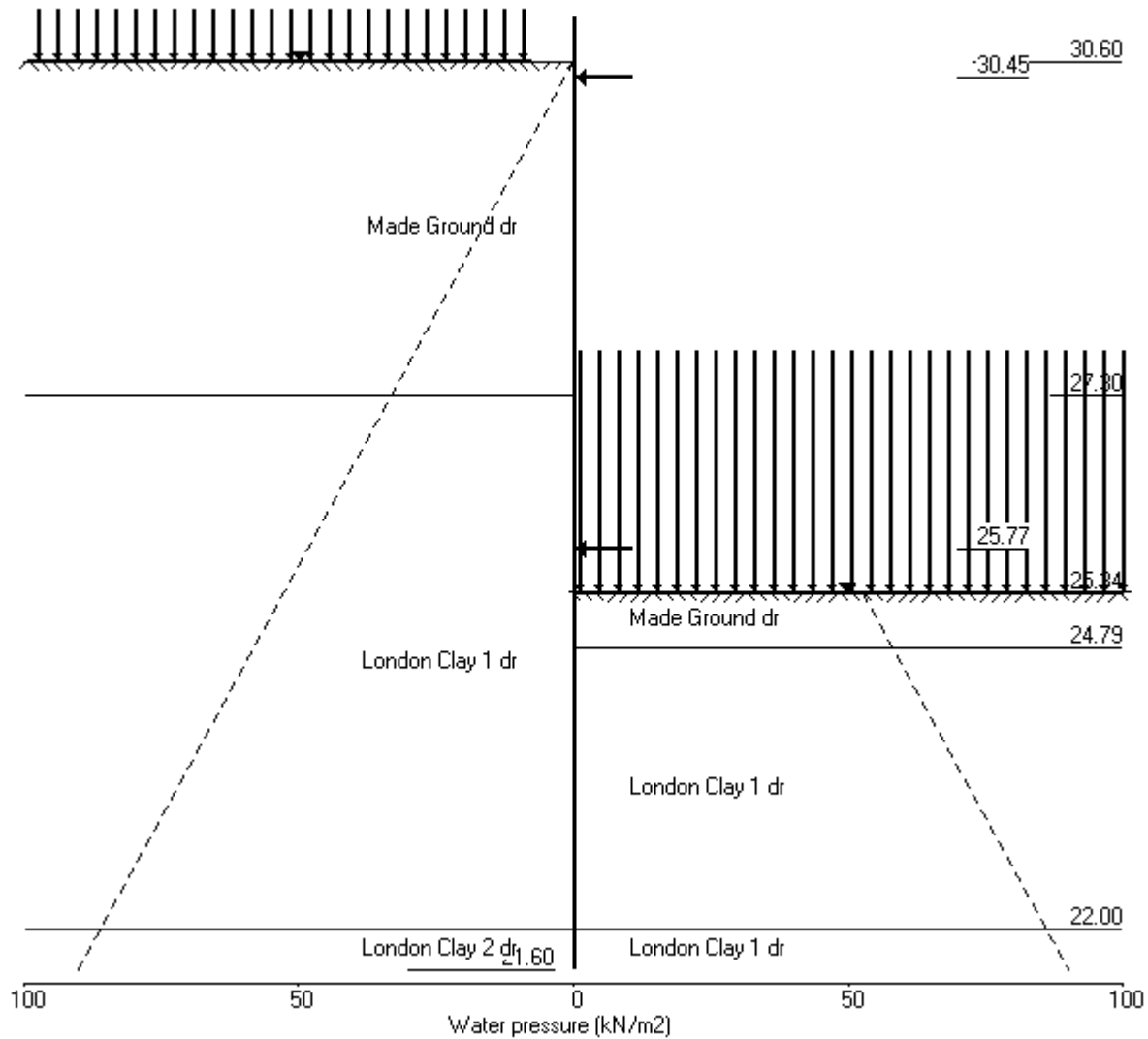
OUTPUT OPTIONS

Stage no.	Stage description	Output options		
		Displacement Bending mom. Shear force	Active, Passive pressures	Graph. output
1	Apply surcharge no.1 at elev. 30.60	No	No	No
2	Apply water pressure profile no.1	No	No	No
3	Install strut no.3 at elev. 31.00	No	No	No
4	Excav. to elev. 24.79 on RIGHT side	No	No	No
5	Fill to elev. 25.34 on RIGHT side	No	No	No
6	Install strut no.2 at elev. 25.77	No	No	No
7	Install strut no.1 at elev. 30.45	No	No	No
8	Remove strut no.3 at elev. 31.00	No	No	No
9	Change EI of wall to 105980kN.m2/m run	No	No	No
10	Apply surcharge no.4 at elev. 25.34	No	No	No
11	Change soil type 2 to soil type 4	No	No	No
12	Change soil type 3 to soil type 5	No	No	No
13	Apply water pressure profile no.2	No	No	No
*	Summary output	Yes	-	Yes

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Units: kN,m

Stage No.13 Apply water pressure profile no.2 (Worst Cred.)



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 Data filename/Run ID: 23811_Kentish_Town_Section1_04_ULS2 |
 KENTISH TOWN | Date:26-05-2021
 Design Case 1 - 600 dia @ 840 | Checked :

Units: kN,m

Stage No. 4 Excavate to elevation 24.79 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. = 21.60					
			-----		-----			
Stage	--- G.L. ---	Strut	Factor	Moment	Toe	Wall	Direction	
No.	Act. Pass.	Elev.	of	equilib.	elev.	Penetr	of	
			Safety	at elev.		-ation	failure	
4	30.60	24.79	31.00	2.146	n/a	24.21	0.58	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 20.00 from wall

Right side 20.00 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	31.00	0.00	0.003	-1.74E-03	-55.0	0.0	55.0	148372
2	30.60	0.00	0.004	-1.71E-03	-55.0	-22.0		148372
3	30.45	1.35	0.004	-1.69E-03	-54.9	-30.2		148372
4	30.15	4.74	0.005	-1.61E-03	-54.0	-46.6		148372
5	29.83	10.46	0.005	-1.49E-03	-51.5	-63.8		148372
6	29.50	15.85	0.006	-1.33E-03	-47.2	-79.9		148372
7	29.00	23.65	0.006	-1.02E-03	-37.4	-101.2		148372
8	28.50	31.09	0.007	-6.62E-04	-23.7	-116.5		148372
9	28.00	38.33	0.007	-2.57E-04	-6.3	-124.2		148372
10	27.65	43.32	0.007	3.56E-05	8.0	-124.0		148372
11	27.30	48.26	0.007	3.21E-04	24.0	-118.4		148372
		16.50	0.007	3.21E-04	24.0	-118.4		
12	26.90	18.50	0.007	6.26E-04	31.0	-107.6		148372
13	26.50	20.50	0.007	8.97E-04	38.8	-93.9		148372
14	26.14	22.32	0.006	1.10E-03	46.6	-78.5		148372
15	25.77	24.14	0.006	1.27E-03	55.0	-60.1		148372
16	25.34	26.30	0.005	1.41E-03	65.9	-34.0		148372
17	25.00	41.08	0.005	1.46E-03	77.4	-8.0		148372
18	24.79	49.95	0.004	1.46E-03	87.0	9.1		148372
		-103.69	0.004	1.46E-03	87.0	9.1		
19	24.40	-91.25	0.004	1.40E-03	48.5	35.4		148372
20	24.00	-79.61	0.003	1.29E-03	14.7	47.4		148372
21	23.50	-44.75	0.003	1.13E-03	-16.4	49.9		148372
22	23.00	-14.23	0.002	9.85E-04	-31.1	36.1		148372
23	22.50	12.75	0.002	8.93E-04	-31.5	18.7		148372
24	22.00	37.80	0.001	8.53E-04	-18.9	4.5		148372
25	21.60	56.48	0.001	8.47E-04	0.0	0.0		---
At elev. 31.00 Strut force =			55.0 kN/strut =		55.0 kN/m run			

(continued)

Stage No.4 Excavate to elevation 24.79 on RIGHT side

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	31.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	30.60	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	2016
3	30.45	0.00	2.98	1.35	6.60	1.35	1.35a	2016
4	30.15	0.00	10.50	4.74	23.22	4.74	4.74a	2016
5	29.83	3.25	15.94	7.21	35.28	7.21	10.46a	2016
6	29.50	6.50	20.70	9.35	45.80	9.35	15.85a	2016
7	29.00	11.50	26.88	12.15	59.49	12.15	23.65a	2016
8	28.50	16.50	32.28	14.59	71.42	14.59	31.09a	2016
9	28.00	21.50	37.23	16.83	82.39	16.83	38.33a	2016
10	27.65	25.00	40.53	18.32	89.69	18.32	43.32a	2016
11	27.30	28.50	43.73	19.76	96.77	19.76	48.26a	2016
		Total>	72.23	16.50m	225.88	16.50	16.50a	20735
12	26.90	Total>	80.20	18.50m	233.85	18.50	18.50a	20735
13	26.50	Total>	88.09	20.50m	241.75	20.50	20.50a	20735
14	26.14	Total>	95.22	22.32m	248.87	22.32	22.32a	20735
15	25.77	Total>	102.31	24.14m	255.97	24.14	24.14a	20735
16	25.34	Total>	110.73	26.30m	264.39	26.30	26.30a	20735
17	25.00	Total>	117.32	28.00m	270.98	41.08	41.08	20735
18	24.79	Total>	121.39	29.05m	275.05	52.05	52.05	20735
19	24.40	Total>	129.03	31.02m	282.69	72.39	72.39	20735
20	24.00	Total>	136.67	33.00m	290.33	91.94	91.94	20735
21	23.50	Total>	146.33	35.50m	300.00	115.17	115.17	20735
22	23.00	Total>	156.00	38.00m	309.67	136.70	136.70	20735
23	22.50	Total>	165.67	40.50m	319.34	156.98	156.98	20735
24	22.00	Total>	175.36	43.00m	329.02	176.58	176.58	20735
25	21.60	Total>	181.28	45.00m	341.70	191.22	191.22	21646

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	31.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	30.60	0.00	0.00	0.00	0.00	0.00	0.00	0.0
3	30.45	0.00	0.00	0.00	0.00	0.00	0.00	0.0
4	30.15	0.00	0.00	0.00	0.00	0.00	0.00	0.0
5	29.83	0.00	0.00	0.00	0.00	0.00	0.00	0.0
6	29.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
7	29.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
8	28.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
9	28.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
10	27.65	0.00	0.00	0.00	0.00	0.00	0.00	0.0
11	27.30	0.00	0.00	0.00	0.00	0.00	0.00	0.0
12	26.90	0.00	0.00	0.00	0.00	0.00	0.00	0.0
13	26.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
14	26.14	0.00	0.00	0.00	0.00	0.00	0.00	0.0
15	25.77	0.00	0.00	0.00	0.00	0.00	0.00	0.0
16	25.34	0.00	0.00	0.00	0.00	0.00	0.00	0.0
17	25.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
18	24.79	2.10	0.00	0.00	0.00	0.00	2.10	0.0
		Total>	2.10	2.10w	155.74	155.74	155.74p	38409
19	24.40	Total>	10.00	3.02m	163.64	163.64	163.64p	38409
20	24.00	Total>	17.90	5.00m	171.54	171.54	171.54p	38409

(continued)

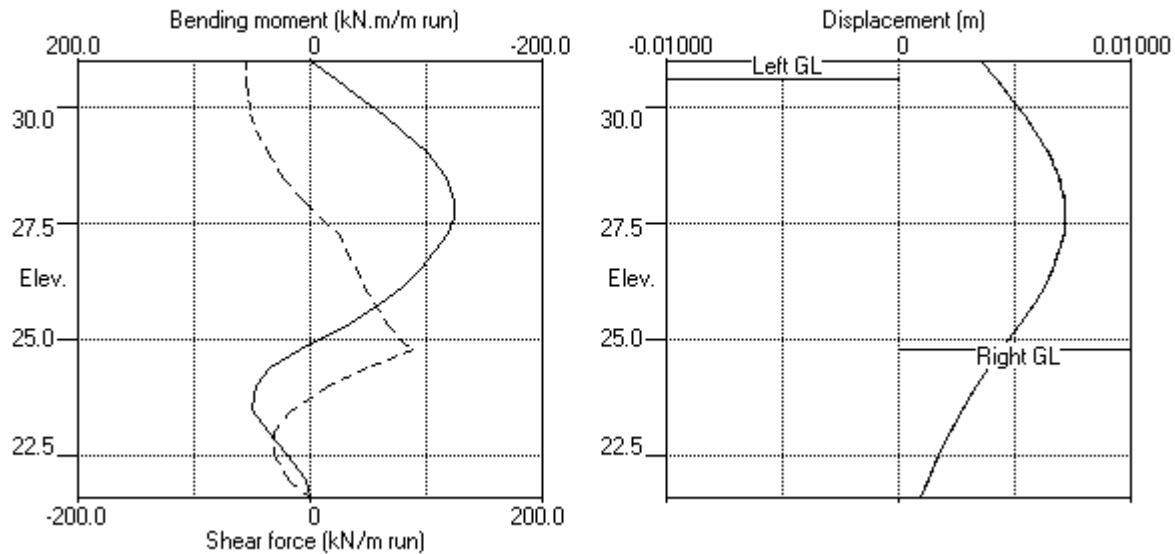
Stage No.4 Excavate to elevation 24.79 on RIGHT side

Node no.	Y coord	----- RIGHT side -----						
		----- Effective stresses -----					Total earth pressure	Coeff. of subgrade reaction
		Water	Vertic	Active	Passive	Earth		
		press. kN/m2	-al kN/m2	limit kN/m2	limit kN/m2	pressure kN/m2		
21	23.50	Total>	27.91	7.50m	181.55	159.92	159.92	38409
22	23.00	Total>	37.93	10.00m	191.57	150.93	150.93	38409
23	22.50	Total>	47.97	12.50m	201.61	144.23	144.23	38409
24	22.00	Total>	58.02	15.00m	211.67	138.78	138.78	38409
25	21.60	Total>	66.09	17.00m	219.73	134.74	134.74	38409

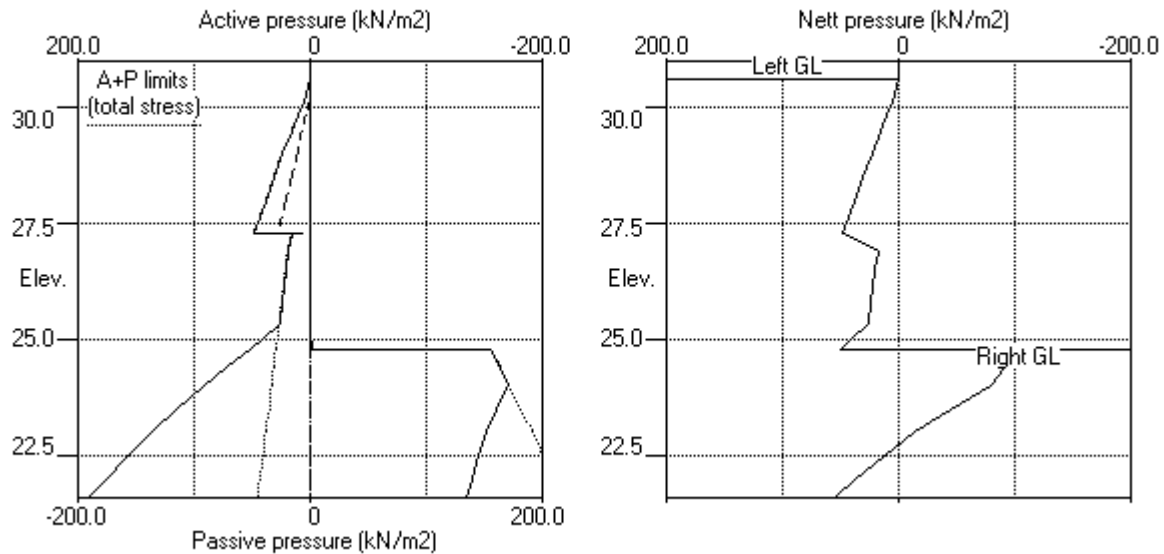
Note: 26.30a Soil pressure at active limit
 171.54p Soil pressure at passive limit

Units: kN,m

Stage No.4 Excav. to elev. 24.79 on RIGHT side



Stage No.4 Excav. to elev. 24.79 on RIGHT side



PILEDESIGNS LIMITED	Sheet No.
Program: WALLAP Version 6.06 Revision A51.B69.R54	Job No. 23811
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Data filename/Run ID: 23811_Kentish_Town_Section1_04_ULS2	
KENTISH TOWN	Date:26-05-2021
Design Case 1 - 600 dia @ 840	Checked :

Units: kN,m

Stage No. 5 Fill to elevation 25.34 on RIGHT side with soil type 1

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. = 21.60		FoS = 1.000			
			-----		-----			
Stage	--- G.L. ---	Strut	Factor	Moment	Toe	Wall	Direction	
No.	Act.	Pass.	of	of equilib.	elev.	Penetr	of	
			Safety	at elev.		-ation	failure	
5	30.60	25.34	31.00	2.271	n/a	24.28	1.06	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 20.00 from wall

Right side 20.00 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	31.00	0.00	0.003	-1.74E-03	-55.4	0.0	55.4	148372
2	30.60	0.00	0.004	-1.71E-03	-55.4	-22.1		148372
3	30.45	1.35	0.004	-1.68E-03	-55.3	-30.4		148372
4	30.15	4.74	0.005	-1.60E-03	-54.4	-46.9		148372
5	29.83	10.46	0.005	-1.48E-03	-51.9	-64.2		148372
6	29.50	15.85	0.006	-1.32E-03	-47.6	-80.4		148372
7	29.00	23.65	0.006	-1.02E-03	-37.7	-101.9		148372
8	28.50	31.09	0.007	-6.52E-04	-24.0	-117.5		148372
9	28.00	38.34	0.007	-2.43E-04	-6.7	-125.4		148372
10	27.65	43.35	0.007	5.23E-05	7.6	-125.3		148372
11	27.30	48.31	0.007	3.41E-04	23.6	-119.9		148372
		16.96	0.007	3.41E-04	23.6	-119.9		
12	26.90	19.20	0.007	6.50E-04	30.9	-109.2		148372
13	26.50	21.47	0.007	9.25E-04	39.0	-95.4		148372
14	26.14	23.58	0.006	1.14E-03	47.2	-79.8		148372
15	25.77	25.72	0.006	1.31E-03	56.2	-61.2		148372
16	25.34	28.30	0.005	1.45E-03	67.9	-34.5		148372
17	25.00	40.48	0.005	1.50E-03	79.5	-7.7		148372
18	24.79	48.08	0.004	1.49E-03	88.8	9.9		148372
		-106.69	0.004	1.49E-03	88.8	9.9		
19	24.40	-93.51	0.004	1.43E-03	49.3	36.6		148372
20	24.00	-81.19	0.003	1.32E-03	14.8	48.8		148372
21	23.50	-45.60	0.003	1.15E-03	-16.9	51.1		148372
22	23.00	-14.44	0.002	1.00E-03	-31.9	36.9		148372
23	22.50	13.08	0.002	9.12E-04	-32.2	19.2		148372
24	22.00	38.64	0.001	8.72E-04	-19.3	4.6		148372
25	21.60	57.92	0.001	8.66E-04	0.0	0.0		---
At elev. 31.00 Strut force =			55.4 kN/strut =		55.4 kN/m run			

(continued)

Stage No.5 Fill to elevation 25.34 on RIGHT side with soil type 1

Node no.	Y coord	LEFT 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
1	31.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	30.60	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	4484
3	30.45	0.00	2.98	1.35	6.60	1.35	1.35a	4484
4	30.15	0.00	10.50	4.74	23.22	4.74	4.74a	4484
5	29.83	3.25	15.94	7.21	35.28	7.21	10.46a	4484
6	29.50	6.50	20.70	9.35	45.80	9.35	15.85a	4484
7	29.00	11.50	26.88	12.15	59.49	12.15	23.65a	4484
8	28.50	16.50	32.28	14.59	71.42	14.59	31.09a	4484
9	28.00	21.50	37.23	16.83	82.39	16.84	38.34	2692
10	27.65	25.00	40.53	18.32	89.69	18.35	43.35	2692
11	27.30	28.50	43.73	19.76	96.77	19.81	48.31	2692
		Total>	72.23	16.50m	225.88	16.96	16.96	26822
12	26.90	Total>	80.20	18.50m	233.85	19.20	19.20	26822
13	26.50	Total>	88.09	20.50m	241.75	21.47	21.47	26822
14	26.14	Total>	95.22	22.32m	248.87	23.58	23.58	26822
15	25.77	Total>	102.31	24.14m	255.97	25.72	25.72	26822
16	25.34	Total>	110.73	26.30m	264.39	28.30	28.30	26822
17	25.00	Total>	117.32	28.00m	270.98	43.40	43.40	26822
18	24.79	Total>	121.39	29.05m	275.05	54.58	54.58	26822
19	24.40	Total>	129.03	31.02m	282.69	75.28	75.28	26822
20	24.00	Total>	136.67	33.00m	290.33	95.16	95.16	26822
21	23.50	Total>	146.33	35.50m	300.00	118.76	118.76	26822
22	23.00	Total>	156.00	38.00m	309.67	140.61	140.61	26822
23	22.50	Total>	165.67	40.50m	319.34	161.17	161.17	26822
24	22.00	Total>	175.36	43.00m	329.02	181.02	181.02	26822
25	21.60	Total>	181.28	45.00m	341.70	196.07	196.07	28000

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
1	31.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	30.60	0.00	0.00	0.00	0.00	0.00	0.00	0.0
3	30.45	0.00	0.00	0.00	0.00	0.00	0.00	0.0
4	30.15	0.00	0.00	0.00	0.00	0.00	0.00	0.0
5	29.83	0.00	0.00	0.00	0.00	0.00	0.00	0.0
6	29.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
7	29.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
8	28.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
9	28.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
10	27.65	0.00	0.00	0.00	0.00	0.00	0.00	0.0
11	27.30	0.00	0.00	0.00	0.00	0.00	0.00	0.0
12	26.90	0.00	0.00	0.00	0.00	0.00	0.00	0.0
13	26.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
14	26.14	0.00	0.00	0.00	0.00	0.00	0.00	0.0
15	25.77	0.00	0.00	0.00	0.00	0.00	0.00	0.0
16	25.34	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	2692
17	25.00	0.00	6.46	2.92	14.29	2.92	2.92a	2692
18	24.79	3.24	7.21	3.26	15.95	3.26	6.50a	2692
		Total>	10.45	2.75m	164.09	161.27	161.27	26822
19	24.40	Total>	18.35	4.72m	172.00	168.79	168.79	26822

(continued)

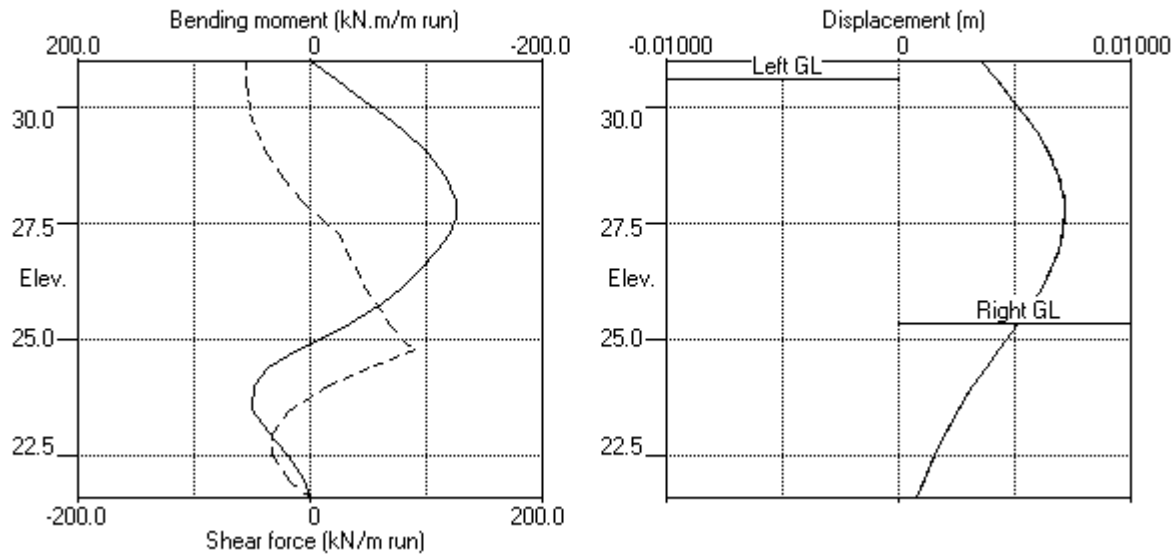
Stage No.5 Fill to elevation 25.34 on RIGHT side with soil type 1

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
20	24.00	Total>	26.26	6.70m	179.90	176.36	176.36	26822
21	23.50	Total>	36.28	9.20m	189.93	164.36	164.36	26822
22	23.00	Total>	46.32	11.70m	199.96	155.06	155.06	26822
23	22.50	Total>	56.37	14.20m	210.01	148.08	148.08	26822
24	22.00	Total>	66.44	16.70m	220.09	142.38	142.38	26822
25	21.60	Total>	74.52	18.70m	228.17	138.15	138.15	26822

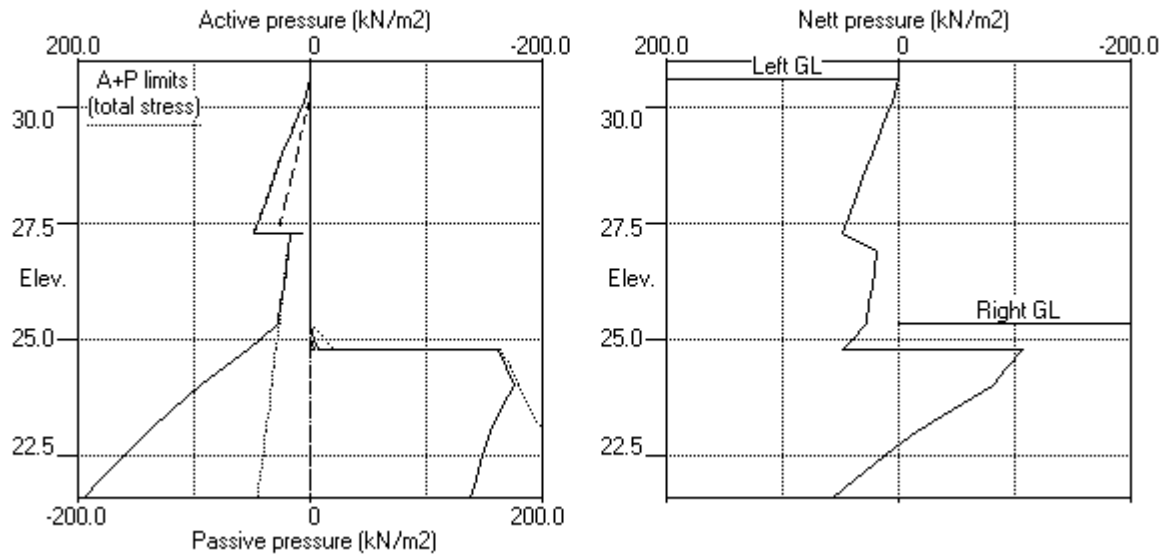
Note: 6.50a Soil pressure at active limit
 123.45p Soil pressure at passive limit

Units: kN,m

Stage No.5 Fill to elev. 25.34 on RIGHT side



Stage No.5 Fill to elev. 25.34 on RIGHT side



PILEDESIGNS LIMITED	Sheet No.
Program: WALLAP Version 6.06 Revision A51.B69.R54	Job No. 23811
Licensed from GEOSOLVE	Made by : MJC
Data filename/Run ID: 23811_Kentish_Town_Section1_04_ULS2	
KENTISH TOWN	Date:26-05-2021
Design Case 1 - 600 dia @ 840	Checked :

Units: kN,m

Stage No. 11 Change properties of soil type 2 to soil type 4
 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. = 21.60		FoS = 1.000	
Stage	--- G.L. ---	Strut	Factor	Moment	Toe	Wall
No.	Act. Pass.	Elev.	of	equilib.	elev.	Penetr
			Safety	at elev.		-ation
11	30.60 25.34		More than one strut.	No	FoS calc.	failure

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 20.00 from wall
 Right side 20.00 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	31.00	0.00	0.004	-1.52E-03	0.0	0.0		105980
2	30.60	0.00	0.004	-1.52E-03	0.0	-0.0		105980
3	30.45	1.35	0.005	-1.52E-03	0.1	0.0	67.5	105980
		1.35	0.005	-1.52E-03	-67.4	0.0		
4	30.15	4.74	0.005	-1.50E-03	-66.5	-20.1		105980
5	29.83	10.46	0.005	-1.43E-03	-64.0	-41.3		105980
6	29.50	15.85	0.006	-1.31E-03	-59.7	-61.5		105980
7	29.00	23.65	0.007	-1.05E-03	-49.9	-89.1		105980
8	28.50	31.09	0.007	-7.13E-04	-36.2	-110.7		105980
9	28.00	38.33	0.007	-3.06E-04	-18.8	-124.6		105980
10	27.65	43.32	0.007	2.14E-06	-4.5	-128.8		105980
11	27.30	48.26	0.007	3.15E-04	11.5	-127.6		105980
		50.26	0.007	3.15E-04	11.5	-127.6		
12	26.90	55.09	0.007	6.60E-04	32.6	-119.0		105980
13	26.50	59.89	0.007	9.68E-04	55.6	-101.6		105980
14	26.14	64.23	0.006	1.18E-03	78.1	-77.4		105980
15	25.77	68.55	0.006	1.32E-03	102.3	-44.8	88.3	105980
		68.55	0.006	1.32E-03	13.9	-44.8		
16	25.34	73.69	0.005	1.42E-03	44.7	-32.3		105980
		46.57	0.005	1.42E-03	44.7	-32.3		
17	25.00	47.68	0.005	1.47E-03	60.7	-12.6		105980
18	24.79	46.56	0.004	1.48E-03	70.6	1.2		105980
		-58.02	0.004	1.48E-03	70.6	1.2		
19	24.40	-62.71	0.004	1.46E-03	46.8	24.1		105980
20	24.00	-62.20	0.003	1.38E-03	22.1	37.4		105980
21	23.50	-49.02	0.003	1.25E-03	-5.7	44.9		105980
22	23.00	-27.08	0.002	1.12E-03	-24.7	35.4		105980
23	22.50	4.73	0.001	1.03E-03	-30.3	19.6		105980
24	22.00	34.61	0.001	9.89E-04	-20.5	5.1		105980
		38.88	0.001	9.89E-04	-20.5	5.1		

(continued)

Stage No.11 Change properties of soil type 2 to soil type 4
 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 ---
25	21.60	63.46	0.001	9.82E-04	0.0	0.0		
At elev.	30.45	Strut	force =	67.5 kN/strut =		67.5 kN/m	run	
At elev.	25.77	Strut	force =	88.3 kN/strut =		88.3 kN/m	run	

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	31.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	30.60	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	49054
3	30.45	0.00	2.98	1.35	6.60	1.35	1.35a	2503
4	30.15	0.00	10.50	4.74	23.22	4.74	4.74a	2503
5	29.83	3.25	15.94	7.21	35.28	7.21	10.46a	2503
6	29.50	6.50	20.70	9.35	45.80	9.35	15.85a	2503
7	29.00	11.50	26.88	12.15	59.49	12.15	23.65a	2503
8	28.50	16.50	32.28	14.59	71.42	14.59	31.09a	2503
9	28.00	21.50	37.23	16.83	82.39	16.83	38.33a	2503
10	27.65	25.00	40.53	18.32	89.69	18.32	43.32a	2503
11	27.30	28.50	43.73	19.76	96.77	19.76	48.26a	2503
		28.50	43.73	21.76	87.90	21.76	50.26a	13347
12	26.90	30.24	49.96	24.86	100.42	24.86	55.09a	13347
13	26.50	31.97	56.12	27.92	112.80	27.92	59.89a	13347
14	26.14	33.55	61.67	30.68	123.95	30.68	64.23a	13347
15	25.77	35.13	67.18	33.43	135.04	33.43	68.55a	13347
16	25.34	37.01	73.72	36.68	148.18	36.68	73.69a	13347
17	25.00	38.48	78.84	39.22	158.46	39.22	77.71a	13347
18	24.79	39.40	82.00	40.79	164.81	40.79	80.19a	13347
19	24.40	41.11	87.92	43.74	176.72	43.74	84.85a	13347
20	24.00	42.82	93.85	46.69	188.62	51.58	94.40	13347
21	23.50	44.99	101.34	50.42	203.69	73.45	118.44	13347
22	23.00	47.16	108.84	54.15	218.75	94.38	141.54	34086
23	22.50	49.34	116.34	57.88	233.83	114.73	164.06	34086
24	22.00	51.51	123.85	61.62	248.93	134.37	185.88	34086
		Total>	175.36	43.00m	329.02	190.15	190.15	60697
25	21.60	Total>	181.28	45.00m	341.70	208.57	208.57	63362

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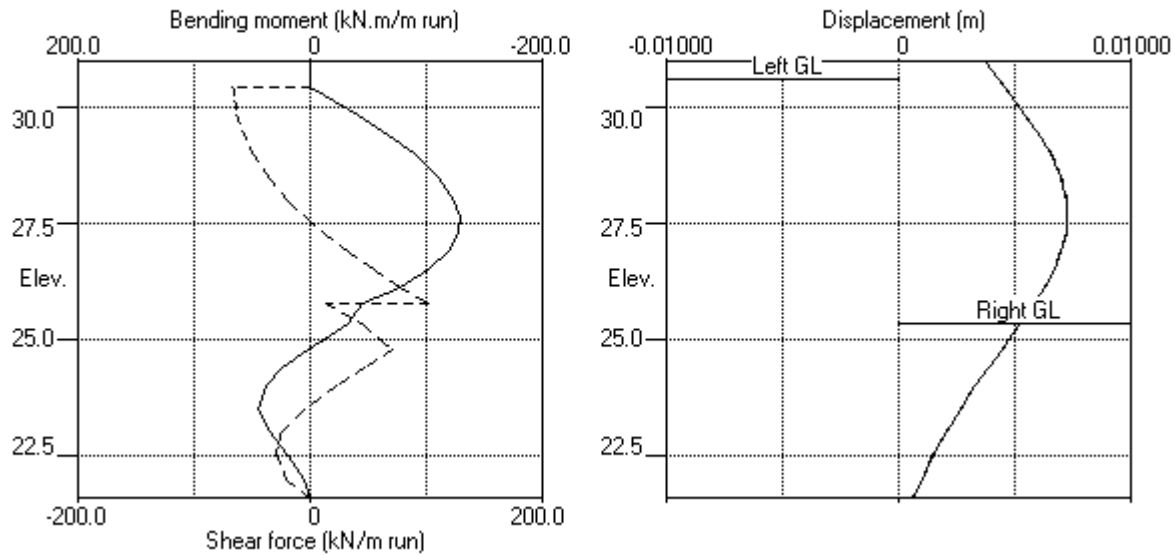
Stage No.11 Change properties of soil type 2 to soil type 4
 Ko pressures will not be reset

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
13	26.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
14	26.14	0.00	0.00	0.00	0.00	0.00	0.00	0.0
15	25.77	0.00	0.00	0.00	0.00	0.00	0.00	0.0
16	25.34	0.00	0.00	0.00	0.00	0.00	0.00	0.0
		0.00	60.00	27.12	132.76	27.12	27.12a	4427
17	25.00	0.00	66.45	30.03	147.03	30.03	30.03a	4427
18	24.79	3.29	67.13	30.34	148.53	30.34	33.62a	4427
		3.29	67.13	33.40	134.92	134.92	138.21p	23712
19	24.40	9.47	68.70	34.18	138.09	138.09	147.56p	23712
20	24.00	15.66	70.12	34.89	140.94	140.94	156.60p	23712
21	23.50	23.49	71.63	35.64	143.97	143.97	167.46p	23712
22	23.00	31.32	72.79	36.22	146.31	137.30	168.62	34086
23	22.50	39.15	73.64	36.64	148.01	120.19	159.33	34086
24	22.00	46.98	74.21	36.92	149.17	104.29	151.27	34086
25	21.60	53.24	74.53	37.08	149.80	91.87	145.12	34086

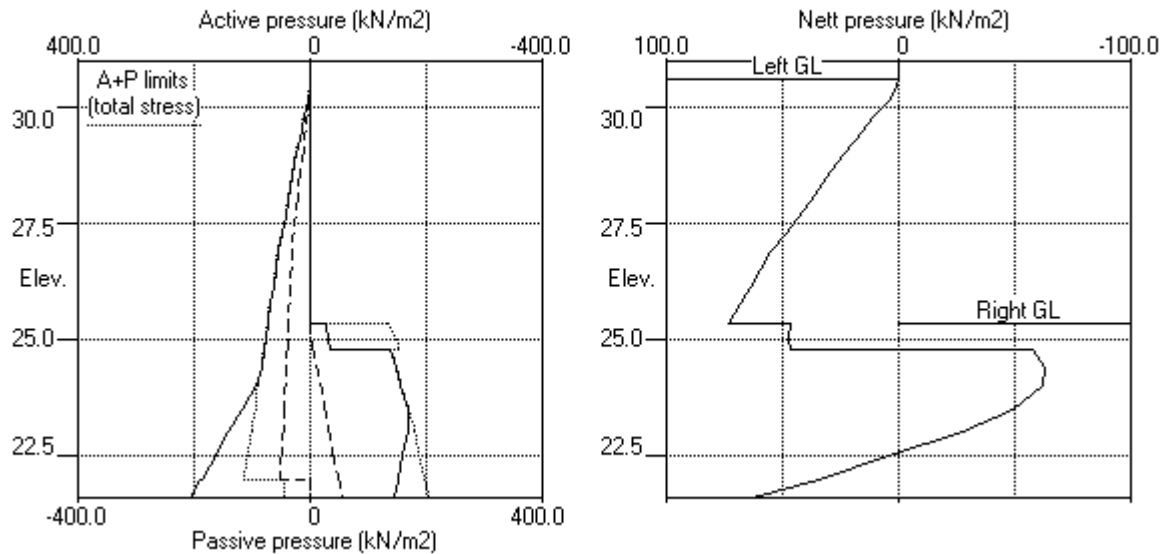
Note: 33.62a Soil pressure at active limit
 167.46p Soil pressure at passive limit

Units: kN,m

Stage No.11 Change soil type 2 to soil type 4



Stage No.11 Change soil type 2 to soil type 4



PILEDESIGNS LIMITED	Sheet No.
Program: WALLAP Version 6.06 Revision A51.B69.R54	Job No. 23811
Licensed from GEOSOLVE	Made by : MJC
Data filename/Run ID: 23811_Kentish_Town_Section1_04_ULS2	
KENTISH TOWN	Date:26-05-2021
Design Case 1 - 600 dia @ 840	Checked :

Units: kN,m

Stage No. 12 Change properties of soil type 3 to soil type 5
Ko pressures will 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. = 21.60		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
12	30.60 25.34		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 20.00 from wall
Right side 20.00 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	31.00	0.00	0.004	-1.52E-03	0.0	0.0		105980
2	30.60	0.00	0.004	-1.52E-03	0.0	-0.0		105980
3	30.45	1.35	0.005	-1.52E-03	0.1	0.0	67.5	105980
		1.35	0.005	-1.52E-03	-67.4	0.0		
4	30.15	4.74	0.005	-1.50E-03	-66.5	-20.1		105980
5	29.83	10.46	0.005	-1.43E-03	-64.0	-41.3		105980
6	29.50	15.86	0.006	-1.31E-03	-59.7	-61.5		105980
7	29.00	23.65	0.007	-1.05E-03	-49.8	-89.1		105980
8	28.50	31.09	0.007	-7.13E-04	-36.2	-110.7		105980
9	28.00	38.33	0.007	-3.05E-04	-18.8	-124.6		105980
10	27.65	43.32	0.007	2.18E-06	-4.5	-128.7		105980
11	27.30	48.27	0.007	3.15E-04	11.5	-127.6		105980
		50.27	0.007	3.15E-04	11.5	-127.6		
12	26.90	55.11	0.007	6.60E-04	32.6	-119.0		105980
13	26.50	59.90	0.007	9.67E-04	55.6	-101.5		105980
14	26.14	64.24	0.006	1.18E-03	78.2	-77.4		105980
15	25.77	68.56	0.006	1.32E-03	102.3	-44.7	88.1	105980
		68.56	0.006	1.32E-03	14.2	-44.7		
16	25.34	73.69	0.005	1.42E-03	45.0	-32.1		105980
		46.57	0.005	1.42E-03	45.0	-32.1		
17	25.00	47.67	0.005	1.47E-03	61.0	-12.3		105980
18	24.79	46.56	0.004	1.48E-03	70.9	1.5		105980
		-58.02	0.004	1.48E-03	70.9	1.5		
19	24.40	-62.71	0.004	1.45E-03	47.1	24.6		105980
20	24.00	-62.34	0.003	1.38E-03	22.4	38.0		105980
21	23.50	-49.27	0.003	1.24E-03	-5.5	45.6		105980
22	23.00	-27.88	0.002	1.11E-03	-24.8	36.1		105980
23	22.50	3.52	0.002	1.01E-03	-30.9	20.2		105980
24	22.00	32.93	0.001	9.72E-04	-21.8	5.2		105980
		47.17	0.001	9.72E-04	-21.8	5.2		

(continued)

Stage No.12 Change properties of soil type 3 to soil type 5

Ko pressures will 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
25	21.60	61.84	0.001	9.64E-04	0.0	0.0		---
At elev.	30.45	Strut force =		67.5 kN/strut =		67.5 kN/m	run	
At elev.	25.77	Strut force =		88.1 kN/strut =		88.1 kN/m	run	

Node no.	Y coord	LEFT side						
		Effective stresses					Total earth pressure	Coeff. of subgrade reaction
		Water press. kN/m ²	Vertic -al kN/m ²	Active limit kN/m ²	Passive limit kN/m ²	Earth pressure kN/m ²		
1	31.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	30.60	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	49007
3	30.45	0.00	2.98	1.35	6.60	1.35	1.35a	2711
4	30.15	0.00	10.50	4.74	23.22	4.74	4.74a	2711
5	29.83	3.25	15.94	7.21	35.28	7.21	10.46a	2711
6	29.50	6.50	20.70	9.35	45.80	9.36	15.86a	2711
7	29.00	11.50	26.88	12.15	59.49	12.15	23.65a	2711
8	28.50	16.50	32.28	14.59	71.42	14.59	31.09a	2711
9	28.00	21.50	37.23	16.83	82.39	16.83	38.33a	2711
10	27.65	25.00	40.53	18.32	89.69	18.32	43.32a	2711
11	27.30	28.50	43.73	19.76	96.77	19.77	48.27a	2711
		28.50	43.73	21.76	87.90	21.77	50.27	14468
12	26.90	30.24	49.96	24.86	100.42	24.87	55.11	14468
13	26.50	31.97	56.12	27.92	112.80	27.93	59.90	14468
14	26.14	33.55	61.67	30.68	123.95	30.69	64.24	14468
15	25.77	35.13	67.18	33.43	135.04	33.43	68.56a	14468
16	25.34	37.01	73.72	36.68	148.18	36.68	73.69a	28264
17	25.00	38.48	78.84	39.22	158.46	39.22	77.71a	28264
18	24.79	39.40	82.00	40.79	164.81	40.79	80.19a	28264
19	24.40	41.11	87.92	43.74	176.72	43.74	84.85a	28264
20	24.00	42.82	93.85	46.69	188.62	51.44	94.26	28264
21	23.50	44.99	101.34	50.42	203.69	73.20	118.19	28264
22	23.00	47.16	108.84	54.15	218.75	93.97	141.14	28264
23	22.50	49.34	116.34	57.88	233.83	114.12	163.46	28264
24	22.00	51.51	123.85	61.62	248.93	133.53	185.04	28264
		51.51	123.85	61.62	248.93	147.78	199.28	28264
25	21.60	53.24	129.87	64.61	261.02	154.75	208.00	29505

[illegible]

(continued)

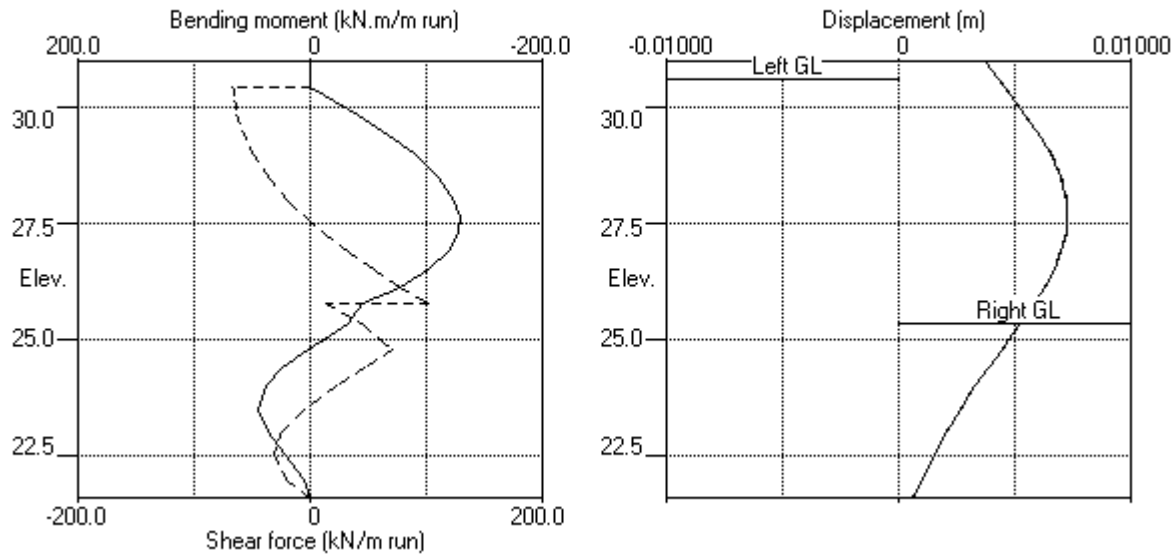
Stage No.12 Change properties of soil type 3 to soil type 5
 Ko pressures will be reset

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
13	26.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
14	26.14	0.00	0.00	0.00	0.00	0.00	0.00	0.0
15	25.77	0.00	0.00	0.00	0.00	0.00	0.00	0.0
16	25.34	0.00	0.00	0.00	0.00	0.00	0.00	0.0
		0.00	60.00	27.12	132.76	27.12	27.12a	5273
17	25.00	0.00	66.45	30.03	147.03	30.04	30.04a	5273
18	24.79	3.29	67.13	30.34	148.53	30.34	33.63	5273
		3.29	67.13	33.40	134.92	134.92	138.21p	28264
19	24.40	9.47	68.70	34.18	138.09	138.09	147.56p	28264
20	24.00	15.66	70.12	34.89	140.94	140.94	156.60p	28264
21	23.50	23.49	71.63	35.64	143.97	143.97	167.46p	28264
22	23.00	31.32	72.79	36.22	146.31	137.70	169.02	28264
23	22.50	39.15	73.64	36.64	148.01	120.79	159.94	28264
24	22.00	46.98	74.21	36.92	149.17	105.13	152.11	28264
25	21.60	53.24	74.53	37.08	149.80	92.92	146.16	28264

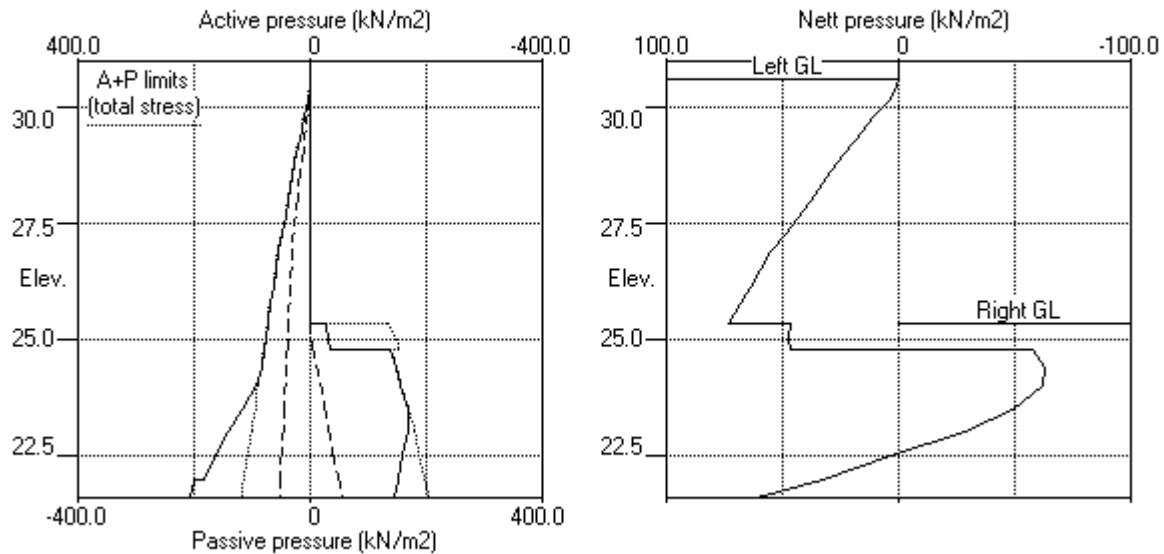
Note: 30.04a Soil pressure at active limit
 167.46p Soil pressure at passive limit

Units: kN,m

Stage No.12 Change soil type 3 to soil type 5



Stage No.12 Change soil type 3 to soil type 5



PILEDESIGNS LIMITED	Sheet No.
Program: WALLAP Version 6.06 Revision A51.B69.R54	Job No. 23811
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Data filename/Run ID: 23811_Kentish_Town_Section1_04_ULS2	
KENTISH TOWN	Date:26-05-2021
Design Case 1 - 600 dia @ 840	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. = 21.60		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	30.60	30.60	Cant.	Conditions not suitable for FoS calc.				
2	30.60	30.60	Cant.	Conditions not suitable for FoS calc.				
3	30.60	30.60		No analysis at this stage				
4	30.60	24.79	31.00	2.146	n/a	24.21	0.58	L to R
5	30.60	25.34	31.00	2.271	n/a	24.28	1.06	L to R
6	30.60	25.34		No analysis at this stage				
All remaining stages have more than one strut - FoS calculation n/a								

PILEDESIGNS LIMITED	Sheet No.
Program: WALLAP Version 6.06 Revision A51.B69.R54	Job No. 23811
Licensed from GEOSOLVE	Made by : MJC
Data filename/Run ID: 23811_Kentish_Town_Section1_04_ULS2	
KENTISH TOWN	Date:26-05-2021
Design Case 1 - 600 dia @ 840	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 20.00 from wall
 Right side 20.00 from wall

Limit State: ULS DA1 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	31.00	0.004	0.000	0.0	-0.0	0.0	-55.4
2	30.60	0.004	0.000	0.0	-22.1	0.0	-55.4
3	30.45	0.005	0.000	0.0	-30.4	0.2	-67.4
4	30.15	0.005	0.000	0.0	-46.9	0.0	-66.5
5	29.83	0.005	0.000	0.0	-64.2	0.0	-64.0
6	29.50	0.006	0.000	0.0	-80.4	0.0	-59.7
7	29.00	0.007	0.000	0.0	-101.9	0.0	-49.9
8	28.50	0.007	0.000	0.0	-117.5	1.6	-36.2
9	28.00	0.007	0.000	0.0	-125.4	6.8	-18.8
10	27.65	0.007	0.000	2.2	-128.8	11.8	-4.5
11	27.30	0.007	0.000	7.4	-127.6	26.0	0.0
12	26.90	0.007	0.000	12.5	-119.0	51.2	0.0
13	26.50	0.007	0.000	14.6	-101.6	78.6	0.0
14	26.14	0.006	0.000	14.8	-81.0	105.0	-1.1
15	25.77	0.006	0.000	15.5	-63.3	132.6	-41.0
16	25.34	0.006	0.000	11.9	-37.3	67.9	-6.6
17	25.00	0.005	0.000	10.0	-12.6	79.5	-5.5
18	24.79	0.005	0.000	9.9	0.0	88.8	-5.4
19	24.40	0.005	0.000	36.6	0.0	49.9	-5.0
20	24.00	0.005	0.000	48.8	0.0	22.4	-4.4
21	23.50	0.005	0.000	51.1	0.0	0.0	-16.9
22	23.00	0.004	0.000	36.9	0.0	0.0	-31.9
23	22.50	0.004	0.000	20.2	0.0	0.0	-32.2
24	22.00	0.004	0.000	5.2	0.0	0.0	-21.8
25	21.60	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 kN.m/m	elev.	minimum kN.m/m	elev.	maximum kN/m	elev.	minimum kN/m	elev.
1	2.1	26.14	-0.6	29.00	2.4	27.30	-0.7	24.79
2	14.8	26.14	-3.0	29.00	17.8	27.30	-5.5	25.00
3	No calculation at this stage							
4	49.9	23.50	-124.2	28.00	87.0	24.79	-55.0	31.00
5	51.1	23.50	-125.4	28.00	88.8	24.79	-55.4	31.00
6	No calculation at this stage							
7	No calculation at this stage							
8	49.1	23.50	-118.0	27.65	88.3	24.79	-63.9	30.45
9	No calculation at this stage							
10	No calculation at this stage							
11	44.9	23.50	-128.8	27.65	102.3	25.77	-67.4	30.45
12	45.6	23.50	-128.7	27.65	102.3	25.77	-67.4	30.45
13	15.5	25.77	-108.1	28.00	132.6	25.77	-64.6	30.45

Maximum and minimum displacement at each stage

Stage no.	Displacement				Stage description
	maximum m	elev.	minimum m	elev.	
1	0.000	31.00	0.000	31.00	Apply surcharge no.1 at elev. 30.60
2	0.002	31.00	0.000	31.00	Apply water pressure profile no.1
3	No calculation at this stage				Install strut no.3 at elev. 31.00
4	0.007	27.65	0.000	31.00	Excav. to elev. 24.79 on RIGHT side
5	0.007	27.65	0.000	31.00	Fill to elev. 25.34 on RIGHT side
6	No calculation at this stage				Install strut no.2 at elev. 25.77
7	No calculation at this stage				Install strut no.1 at elev. 30.45
8	0.007	27.65	0.000	31.00	Remove strut no.3 at elev. 31.00
9	No calculation at this stage				Change EI of wall to 105980kN.m ² /m run
10	No calculation at this stage				Apply surcharge no.4 at elev. 25.34
11	0.007	27.65	0.000	31.00	Change soil type 2 to soil type 4
12	0.007	27.65	0.000	31.00	Change soil type 3 to soil type 5
13	0.007	27.65	0.000	31.00	Apply water pressure profile no.2

Strut forces at each stage (horizontal components)

Stage no.	Strut no. 1		Strut no. 2		Strut no. 3	
	at elev. 30.45 kN/m run	kN/strut	at elev. 25.77 kN/m run	kN/strut	at elev. 31.00 kN/m run	kN/strut
4	---	---	---	---	54.99	54.99
5	---	---	---	---	55.37	55.37
8	64.02	64.02	slack	slack	---	---
11	67.49	67.49	88.34	88.34	---	---
12	67.48	67.48	88.09	88.09	---	---
13	64.79	64.79	173.61	173.61	---	---

PILEDESIGNS LIMITED

Program: WALLAP Version 6.06 Revision A51.B69.R54

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Data filename/Run ID: 23811_Kentish_Town_Section1_04_ULS2

KENTISH TOWN

Design Case 1 - 600 dia @ 840

| Sheet No.

| Job No. 23811

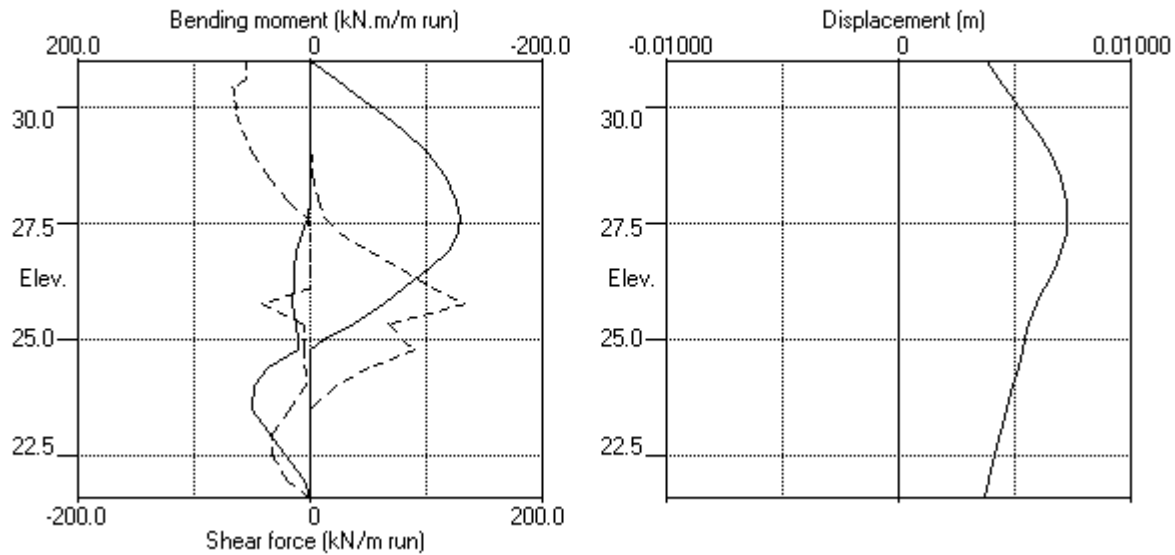
| Made by : MJC

| Date:26-05-2021

| Checked :

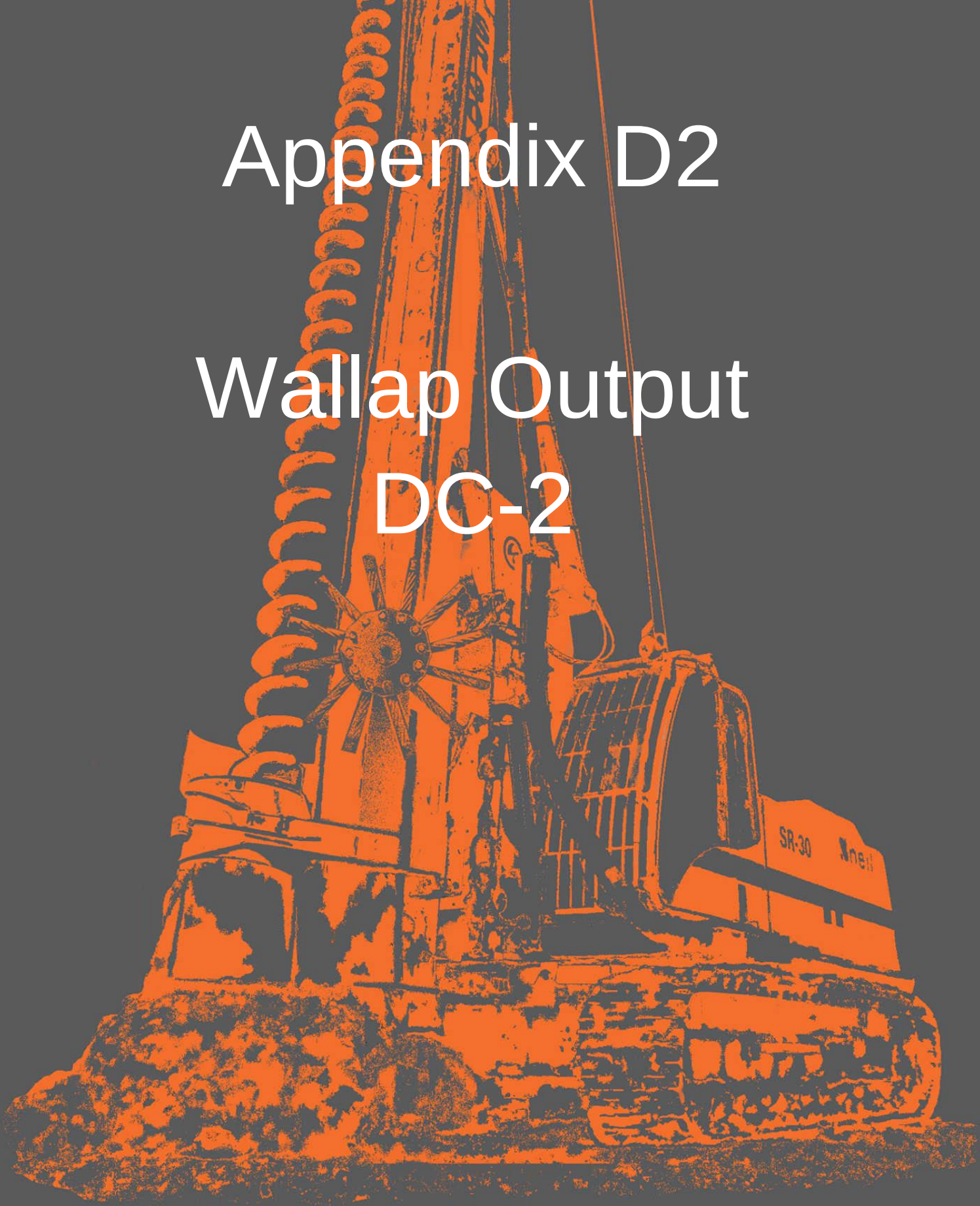
Units: kN,m

Bending moment, shear force, displacement envelopes



Appendix D2

Wallap Output DC-2



PILEDESIGNS LIMITED	Sheet No.
Program: WALLAP Version 6.06 Revision A51.B69.R54	Job No. 23811
Licensed from GEOSOLVE	Made by : MJC
Data filename/Run ID: 23811_Kentish_Town_Section2_04_SLS	
KENTISH TOWN	Date:26-05-2021
Design Case 2 - 600 dia @ 840	Checked :

Units: kN,m

INPUT DATA

SOIL PROFILE

Stratum no.	Elevation of top of stratum	Soil types	
		Left side	Right side
1	30.60	1 Made Ground dr	1 Made Ground dr
2	27.30	2 London Clay 1 und	2 London Clay 1 und
3	22.00	3 London Clay 2 und	2 London Clay 1 und

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 dr	19.00	10000	0.540	OC (0.250)	0.376 (0.000)	2.663 (0.000)	
2 London Clay 1 und	20.00	72000	1.200	OC (0.490)	1.000 (2.389)	1.000 (2.390)	90.00u
3 London Cl.. (22.00)	20.00	72000 (7904)	1.200	OC (0.490)	1.000 (2.389)	1.000 (2.390)	90.00u (9.880)
4 London Clay 1 dr	20.00	55440	1.200	OC (0.200)	0.422 (1.299)	2.371 (3.080)	0.0d
5 London Cl.. (22.00)	20.00	55440 (6086)	1.200	OC (0.200)	0.422 (1.299)	2.371 (3.080)	0.0d

Additional soil parameters associated with Ka and Kp

--- parameters for Ka ---			--- parameters for Kp ---		
Soil	Wall	Back-	Soil	Wall	Back-
friction angle	adhesion coeff.	fill angle	friction angle	adhesion coeff.	fill angle
1 Made Ground dr	27.00	0.000	0.00	27.00	0.000
2 London Clay 1 und	0.00	0.500	0.00	0.00	0.500
3 London Clay 2 und	0.00	0.500	0.00	0.00	0.500
4 London Clay 1 dr	24.00	0.000	0.00	24.00	0.000
5 London Clay 2 dr	24.00	0.000	0.00	24.00	0.000

GROUND WATER CONDITIONS

Density of water = 10.00 kN/m3

	Left side	Right side
Initial water table elevation	25.00	25.00

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
	1	30.15	30.15	0.0	1	25.00	25.00
	2	27.30	30.15	28.5	2	25.00	25.00
	1	30.60	30.60	0.0	1	25.34	25.34
	2				2	25.34	30.60

WALL PROPERTIES

Type of structure = Fully Embedded Wall
Elevation of toe of wall = 21.60
Maximum finite element length = 0.50 m
Youngs modulus of wall E = 1.9600E+07 kN/m2
Moment of inertia of wall I = 7.5700E-03 m4/m run
E.I = 148372 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	30.45	1.00	0.275000	1.400E+07	5.00	0.00	0	No
2	25.77	1.00	0.450000	1.400E+07	5.00	0.00	0	No
3	31.00	1.00	1.000000	30000	1.00	0.00	0	No

SURCHARGE LOADS

Surch -arge no.	Distance from wall	Length parallel to wall	Width perpend. to wall	Surcharge ----- Near edge	Far edge	Equiv. soil type	Partial factor/ Category
1	30.60	0.50 (L)	10.00	10.00	=	N/A	1.00 Var
2	29.60	1.00 (L)	10.00	100.00	=	N/A	1.00 P/U
3	Not defined						
4	25.34	-0.00 (R)	10.00	60.00	=	N/A	1.00 P/F

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 30.60
2	Apply surcharge no.2 at elevation 29.60
	No analysis at this stage
3	Apply water pressure profile no.1 (Mod. Conserv.)
	No analysis at this stage
4	Install strut or anchor no.3 at elevation 31.00
5	Excavate to elevation 25.29 on RIGHT side
6	Fill to elevation 25.34 on RIGHT side with soil type 1
7	Install strut or anchor no.2 at elevation 25.77
8	Install strut or anchor no.1 at elevation 30.45
9	Remove strut or anchor no.3 at elevation 31.00
10	Change EI of wall to 105980 kN.m2/m run
	Yield moment not defined
	No adjustments to wall displacements
11	Apply surcharge no.4 at elevation 25.34
	No analysis at this stage
12	Change properties of soil type 2 to soil type 4
	Ko pressures will not be reset
13	Change properties of soil type 3 to soil type 5
	Ko pressures will be reset
14	Apply water pressure profile no.2 (Mod. Conserv.)

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 = 20.00 m

Distance to rigid boundary on Right side = 20.00 m

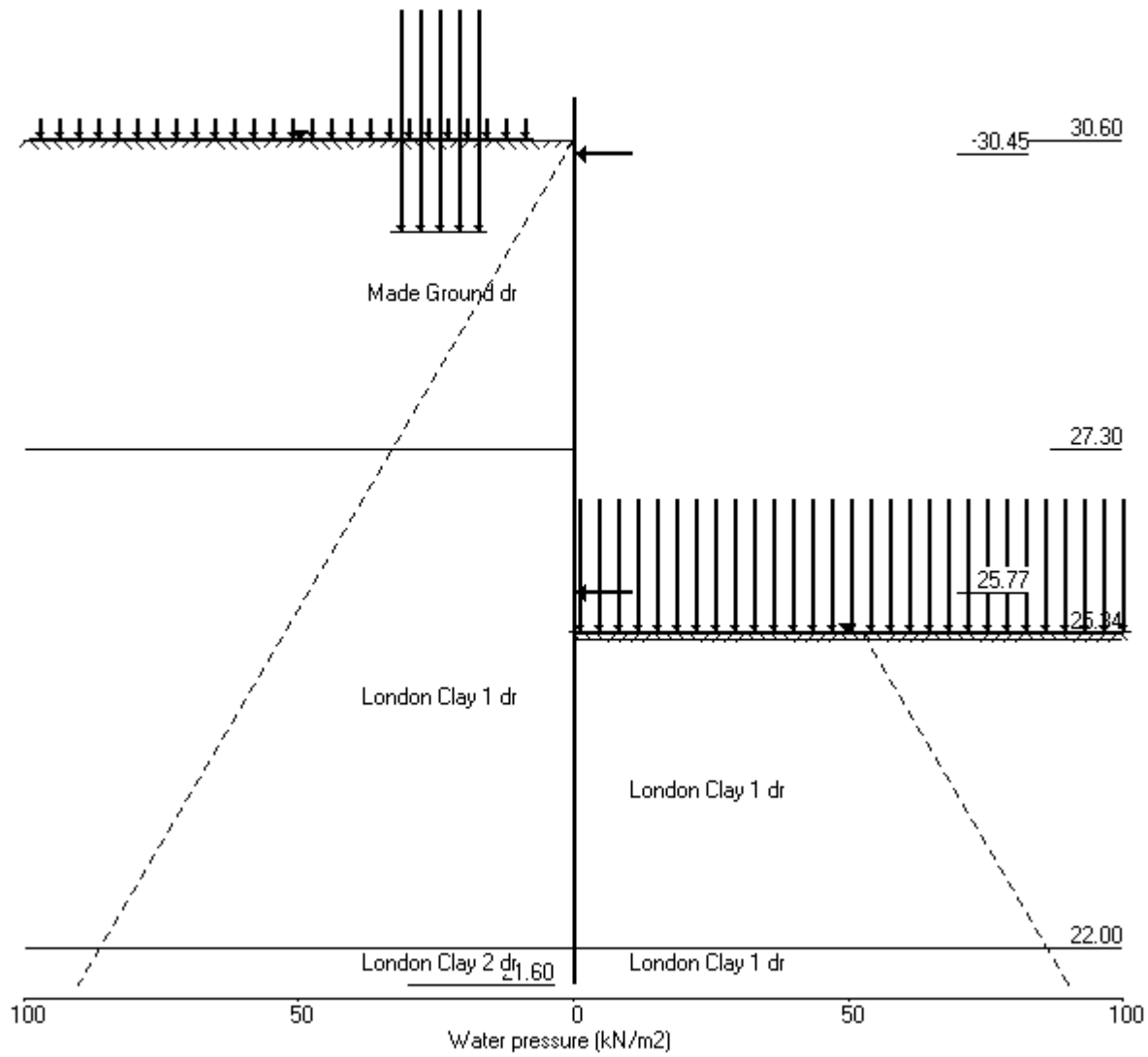
OUTPUT OPTIONS

Stage no.	Stage description	Output options		
		Displacement Bending mom. Shear force	Active, Passive pressures	Graph. output
1	Apply surcharge no.1 at elev. 30.60	No	No	No
2	Apply surcharge no.2 at elev. 29.60	No	No	No
3	Apply water pressure profile no.1	No	No	No
4	Install strut no.3 at elev. 31.00	No	No	No
5	Excav. to elev. 25.29 on RIGHT side	No	No	No
6	Fill to elev. 25.34 on RIGHT side	No	No	No
7	Install strut no.2 at elev. 25.77	No	No	No
8	Install strut no.1 at elev. 30.45	No	No	No
9	Remove strut no.3 at elev. 31.00	No	No	No
10	Change EI of wall to 105980kN.m2/m run	No	No	No
11	Apply surcharge no.4 at elev. 25.34	No	No	No
12	Change soil type 2 to soil type 4	No	No	No
13	Change soil type 3 to soil type 5	No	No	No
14	Apply water pressure profile no.2	No	No	No
*	Summary output	Yes	-	Yes

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Units: kN,m

Stage No.14 Apply water pressure profile no.2 (Mod. Conserv.)



PILEDESIGNS LIMITED	Sheet No.
Program: WALLAP Version 6.06 Revision A51.B69.R54	Job No. 23811
Licensed from GEOSOLVE	Made by : MJC
Data filename/Run ID: 23811_Kentish_Town_Section2_04_SLS	
KENTISH TOWN	Date:26-05-2021
Design Case 2 - 600 dia @ 840	Checked :

Units: kN,m

Stage No. 5 Excavate to elevation 25.29 on RIGHT side

STABILITY ANALYSIS of Fully Embedded Wall according to Strength Factor method

Factor of safety on soil strength

				FoS for toe elev. = 21.60		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
5	30.60 25.29	31.00		2.889	n/a	24.91	0.38	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 20.00 from wall
Right side 20.00 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	31.00	0.00	0.004	-1.39E-03	-50.5	-0.0	50.5	148372
2	30.60	0.00	0.004	-1.37E-03	-50.5	-20.2		148372
3	30.45	1.11	0.005	-1.34E-03	-50.4	-27.7		148372
4	30.15	3.77	0.005	-1.27E-03	-49.7	-42.8		148372
5	29.88	8.08	0.005	-1.18E-03	-48.0	-56.2		148372
6	29.60	12.25	0.006	-1.06E-03	-45.2	-69.1		148372
7	29.30	16.97	0.006	-9.15E-04	-40.9	-82.0		148372
8	29.00	22.88	0.006	-7.38E-04	-34.9	-93.4		148372
9	28.50	33.91	0.007	-3.99E-04	-20.7	-107.5		148372
10	28.00	43.57	0.007	-2.74E-05	-1.3	-113.3		148372
11	27.65	49.24	0.007	2.37E-04	14.9	-111.0		148372
12	27.30	54.27	0.006	4.89E-04	33.0	-102.6		148372
		16.50	0.006	4.89E-04	33.0	-102.6		
13	26.90	18.50	0.006	7.46E-04	40.0	-88.2		148372
14	26.50	20.50	0.006	9.60E-04	47.8	-70.8		148372
15	26.14	22.32	0.005	1.11E-03	55.6	-52.2		148372
16	25.77	34.42	0.005	1.21E-03	65.9	-28.3		148372
17	25.34	54.57	0.005	1.24E-03	85.2	3.6		148372
18	25.29	56.90	0.004	1.24E-03	88.0	8.0		148372
		-110.67	0.004	1.24E-03	88.0	8.0		
19	25.00	-92.76	0.004	1.20E-03	58.5	28.8		148372
20	24.50	-64.23	0.004	1.08E-03	19.2	46.4		148372
21	24.00	-39.51	0.003	9.22E-04	-6.7	47.9		148372
22	23.50	-18.80	0.003	7.75E-04	-21.3	39.5		148372
23	23.00	-1.46	0.002	6.64E-04	-26.3	26.4		148372
24	22.50	13.64	0.002	5.98E-04	-23.3	13.0		148372
25	22.00	27.62	0.002	5.70E-04	-13.0	3.0		148372
26	21.60	37.26	0.001	5.66E-04	0.0	0.0		---
At elev. 31.00 Strut force =				50.5 kN/strut =	50.5 kN/m run			

(continued)

Stage No.5 Excavate to elevation 25.29 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	31.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0	
2	30.60	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	2002	
3	30.45	0.00	2.95	1.11	7.86	1.11	1.11a	2002	
4	30.15	0.00	10.05	3.77	26.75	3.77	3.77a	2002	
5	29.88	2.75	14.19	5.33	37.80	5.33	8.08a	2002	
6	29.60	5.50	17.97	6.75	47.86	6.75	12.25a	2002	
7	29.30	8.50	22.56	8.47	60.07	8.47	16.97a	2002	
8	29.00	11.50	30.31	11.38	80.72	11.38	22.88a	2002	
9	28.50	16.50	46.36	17.41	123.46	17.41	33.91a	2002	
10	28.00	21.50	58.77	22.07	156.51	22.07	43.57a	2002	
11	27.65	25.00	64.56	24.24	171.93	24.24	49.24a	2002	
12	27.30	28.50	68.64	25.77	182.78	25.77	54.27a	2002	
13	26.90	Total>	97.14	16.50m	312.23	16.50	16.50a	20610	
		Total>	104.86	18.50m	319.95	18.50	18.50a	20610	
14	26.50	Total>	111.75	20.50m	326.85	20.50	20.50a	20610	
15	26.14	Total>	117.65	22.32m	332.74	22.32	22.32a	20610	
16	25.77	Total>	123.38	24.14m	338.47	34.42	34.42	20610	
17	25.34	Total>	130.13	26.30m	345.23	54.57	54.57	20610	
18	25.29	Total>	130.91	26.55m	346.01	56.90	56.90	20610	
19	25.00	Total>	135.45	28.00m	350.55	70.32	70.32	20610	
20	24.50	Total>	143.36	30.50m	358.46	91.44	91.44	20610	
21	24.00	Total>	151.41	33.00m	366.51	111.10	111.10	20610	
22	23.50	Total>	159.62	35.50m	374.72	129.26	129.26	20610	
23	23.00	Total>	167.99	38.00m	383.09	146.18	146.18	20610	
24	22.50	Total>	176.52	40.50m	391.61	162.31	162.31	20610	
25	22.00	Total>	185.18	43.00m	400.27	178.09	178.09	20610	
26	21.60	Total>	192.20	45.00m	416.74	189.37	189.37	21515	

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	31.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	30.60	0.00	0.00	0.00	0.00	0.00	0.00	0.0
3	30.45	0.00	0.00	0.00	0.00	0.00	0.00	0.0
4	30.15	0.00	0.00	0.00	0.00	0.00	0.00	0.0
5	29.88	0.00	0.00	0.00	0.00	0.00	0.00	0.0
6	29.60	0.00	0.00	0.00	0.00	0.00	0.00	0.0
7	29.30	0.00	0.00	0.00	0.00	0.00	0.00	0.0
8	29.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
9	28.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
10	28.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
11	27.65	0.00	0.00	0.00	0.00	0.00	0.00	0.0
12	27.30	0.00	0.00	0.00	0.00	0.00	0.00	0.0
13	26.90	0.00	0.00	0.00	0.00	0.00	0.00	0.0
14	26.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
15	26.14	0.00	0.00	0.00	0.00	0.00	0.00	0.0
16	25.77	0.00	0.00	0.00	0.00	0.00	0.00	0.0
17	25.34	0.00	0.00	0.00	0.00	0.00	0.00	0.0
18	25.29	0.00	0.00	0.00	0.00	0.00	0.00	0.0
		Total>	0.00	0.00	215.10	167.57	167.57	33086
19	25.00	Total>	5.80	1.45m	220.90	163.08	163.08	33086

(continued)

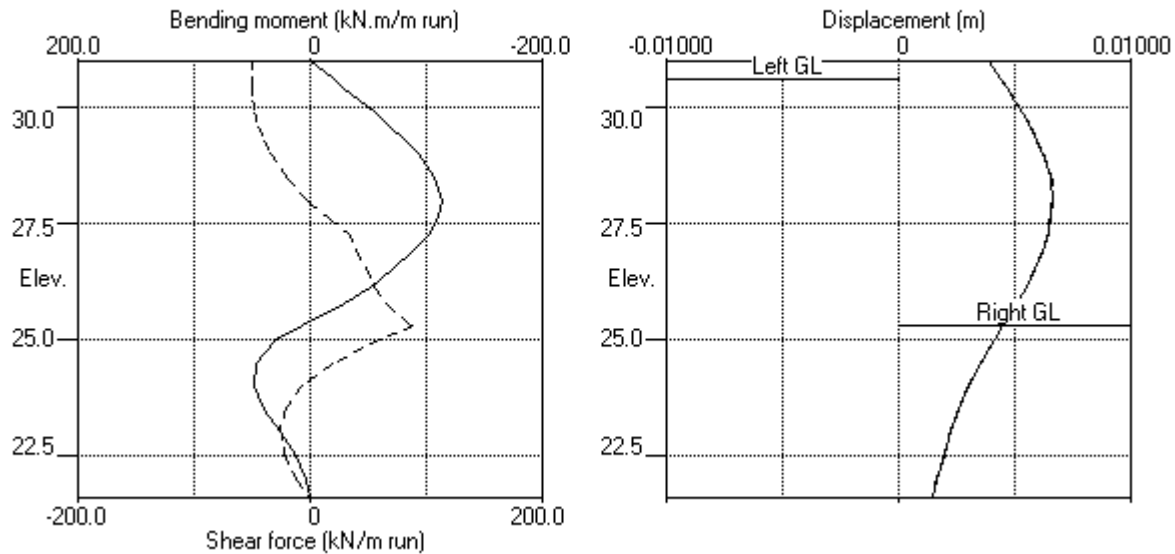
Stage No.5 Excavate to elevation 25.29 on RIGHT side

Node no.	Y coord	----- RIGHT side -----						Total earth pressure	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			
20	24.50	Total>	15.80	3.95m	230.90	155.67	155.67	33086	
21	24.00	Total>	25.81	6.45m	240.91	150.61	150.61	33086	
22	23.50	Total>	35.83	8.95m	250.93	148.06	148.06	33086	
23	23.00	Total>	45.86	11.45m	260.96	147.64	147.64	33086	
24	22.50	Total>	55.92	13.95m	271.01	148.67	148.67	33086	
25	22.00	Total>	65.99	16.45m	281.08	150.47	150.47	33086	
26	21.60	Total>	74.06	18.45m	289.16	152.11	152.11	33086	

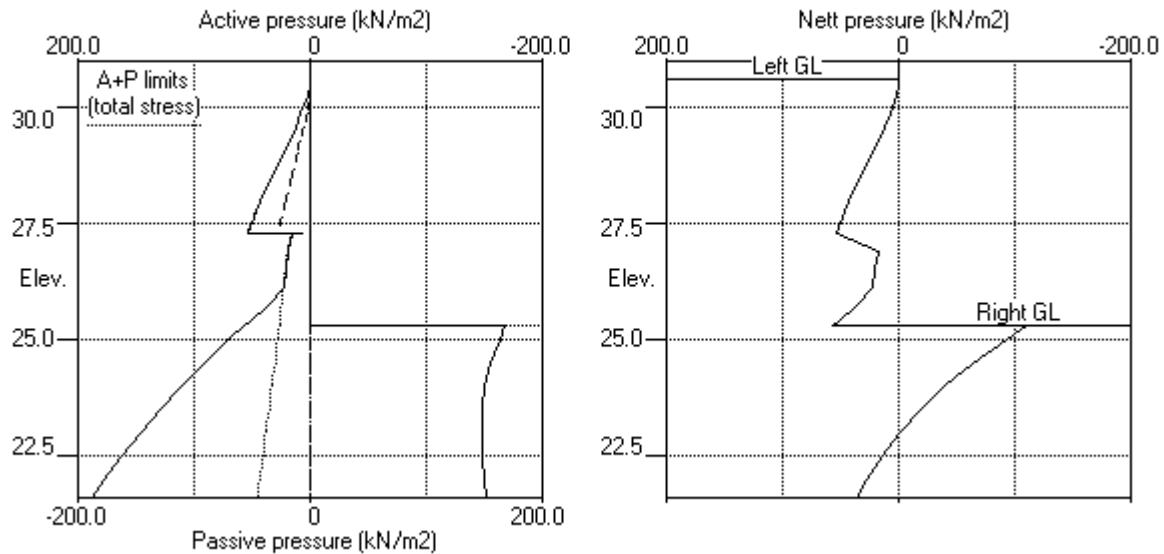
Note: 22.32a Soil pressure at active limit
 123.45p Soil pressure at passive limit

Units: kN,m

Stage No.5 Excav. to elev. 25.29 on RIGHT side



Stage No.5 Excav. to elev. 25.29 on RIGHT side



PILEDESIGNS LIMITED	Sheet No.
Program: WALLAP Version 6.06 Revision A51.B69.R54	Job No. 23811
Licensed from GEOSOLVE	Made by : MJC
Data filename/Run ID: 23811_Kentish_Town_Section2_04_SLS	
KENTISH TOWN	Date:26-05-2021
Design Case 2 - 600 dia @ 840	Checked :

Units: kN,m

Stage No. 6 Fill to elevation 25.34 on RIGHT side with soil type 1

STABILITY ANALYSIS of Fully Embedded Wall according to Strength Factor method

Factor of safety on soil strength

				FoS for toe elev. = 21.60		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	30.60 25.34	31.00		2.905	n/a	24.91	0.43	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 20.00 from wall

Right side 20.00 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	31.00	0.00	0.004	-1.39E-03	-50.5	-0.0	50.5	148372
2	30.60	0.00	0.004	-1.37E-03	-50.5	-20.2		148372
3	30.45	1.11	0.005	-1.34E-03	-50.4	-27.8		148372
4	30.15	3.77	0.005	-1.27E-03	-49.7	-42.8		148372
5	29.88	8.08	0.005	-1.18E-03	-48.1	-56.3		148372
6	29.60	12.25	0.006	-1.06E-03	-45.3	-69.1		148372
7	29.30	16.97	0.006	-9.14E-04	-40.9	-82.1		148372
8	29.00	22.88	0.006	-7.36E-04	-34.9	-93.5		148372
9	28.50	33.91	0.007	-3.98E-04	-20.7	-107.7		148372
10	28.00	43.57	0.007	-2.55E-05	-1.4	-113.4		148372
11	27.65	49.25	0.007	2.39E-04	14.9	-111.1		148372
12	27.30	54.28	0.006	4.91E-04	33.0	-102.8		148372
		16.58	0.006	4.91E-04	33.0	-102.8		
13	26.90	18.61	0.006	7.49E-04	40.0	-88.4		148372
14	26.50	20.65	0.006	9.64E-04	47.9	-71.0		148372
15	26.14	22.50	0.005	1.11E-03	55.7	-52.3		148372
16	25.77	34.63	0.005	1.21E-03	66.1	-28.4		148372
17	25.34	54.83	0.005	1.25E-03	85.5	3.7		148372
18	25.29	56.81	0.004	1.24E-03	88.3	8.0		148372
		-111.05	0.004	1.24E-03	88.3	8.0		
19	25.00	-93.08	0.004	1.21E-03	58.7	28.9		148372
20	24.50	-64.45	0.004	1.08E-03	19.3	46.5		148372
21	24.00	-39.64	0.003	9.25E-04	-6.7	48.0		148372
22	23.50	-18.87	0.003	7.78E-04	-21.3	39.6		148372
23	23.00	-1.46	0.002	6.66E-04	-26.4	26.5		148372
24	22.50	13.68	0.002	5.99E-04	-23.4	13.1		148372
25	22.00	27.71	0.002	5.72E-04	-13.0	3.0		148372
26	21.60	37.41	0.001	5.68E-04	0.0	0.0		---
At elev. 31.00 Strut force =				50.5 kN/strut =	50.5 kN/m run			

(continued)

Stage No.6 Fill to elevation 25.34 on RIGHT side with soil type 1

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	31.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	30.60	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	6290
3	30.45	0.00	2.95	1.11	7.86	1.11	1.11a	6290
4	30.15	0.00	10.05	3.77	26.75	3.77	3.77a	6290
5	29.88	2.75	14.19	5.33	37.80	5.33	8.08a	6290
6	29.60	5.50	17.97	6.75	47.86	6.75	12.25a	6290
7	29.30	8.50	22.56	8.47	60.07	8.47	16.97a	6290
8	29.00	11.50	30.31	11.38	80.72	11.38	22.88a	2553
9	28.50	16.50	46.36	17.41	123.46	17.41	33.91a	2553
10	28.00	21.50	58.77	22.07	156.51	22.07	43.57a	2553
11	27.65	25.00	64.56	24.24	171.93	24.25	49.25	2553
12	27.30	28.50	68.64	25.77	182.78	25.78	54.28	2553
		Total>	97.14	16.50m	312.23	16.58	16.58	25557
13	26.90	Total>	104.86	18.50m	319.95	18.61	18.61	25557
14	26.50	Total>	111.75	20.50m	326.85	20.65	20.65	25557
15	26.14	Total>	117.65	22.32m	332.74	22.50	22.50	25557
16	25.77	Total>	123.38	24.14m	338.47	34.63	34.63	25557
17	25.34	Total>	130.13	26.30m	345.23	54.83	54.83	25557
18	25.29	Total>	130.91	26.55m	346.01	57.17	57.17	25557
19	25.00	Total>	135.45	28.00m	350.55	70.62	70.62	25557
20	24.50	Total>	143.36	30.50m	358.46	91.79	91.79	25557
21	24.00	Total>	151.41	33.00m	366.51	111.49	111.49	25557
22	23.50	Total>	159.62	35.50m	374.72	129.68	129.68	25557
23	23.00	Total>	167.99	38.00m	383.09	146.63	146.63	25557
24	22.50	Total>	176.52	40.50m	391.61	162.79	162.79	25557
25	22.00	Total>	185.18	43.00m	400.27	178.60	178.60	25557
26	21.60	Total>	192.20	45.00m	416.74	189.92	189.92	26679

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	31.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	30.60	0.00	0.00	0.00	0.00	0.00	0.00	0.0
3	30.45	0.00	0.00	0.00	0.00	0.00	0.00	0.0
4	30.15	0.00	0.00	0.00	0.00	0.00	0.00	0.0
5	29.88	0.00	0.00	0.00	0.00	0.00	0.00	0.0
6	29.60	0.00	0.00	0.00	0.00	0.00	0.00	0.0
7	29.30	0.00	0.00	0.00	0.00	0.00	0.00	0.0
8	29.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
9	28.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
10	28.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
11	27.65	0.00	0.00	0.00	0.00	0.00	0.00	0.0
12	27.30	0.00	0.00	0.00	0.00	0.00	0.00	0.0
13	26.90	0.00	0.00	0.00	0.00	0.00	0.00	0.0
14	26.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
15	26.14	0.00	0.00	0.00	0.00	0.00	0.00	0.0
16	25.77	0.00	0.00	0.00	0.00	0.00	0.00	0.0
17	25.34	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	2561
18	25.29	0.00	0.95	0.36	2.53	0.36	0.36a	2561
		Total>	0.95	0.25m	216.05	168.21	168.21	25630

(continued)

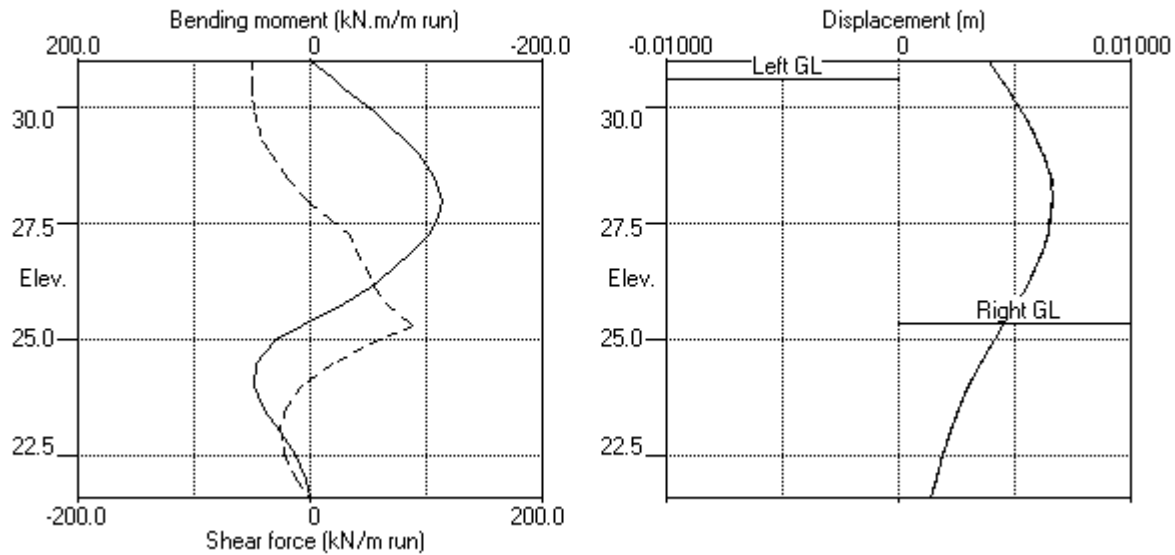
Stage No.6 Fill to elevation 25.34 on RIGHT side with soil type 1

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		
19	25.00	Total>	6.75	1.70m	221.85	163.69	163.69	25630
20	24.50	Total>	16.75	4.20m	231.85	156.24	156.24	25630
21	24.00	Total>	26.76	6.70m	241.86	151.13	151.13	25630
22	23.50	Total>	36.78	9.20m	251.88	148.55	148.55	25630
23	23.00	Total>	46.82	11.70m	261.91	148.10	148.10	25630
24	22.50	Total>	56.87	14.20m	271.97	149.11	149.11	25630
25	22.00	Total>	66.94	16.70m	282.04	150.89	150.89	25630
26	21.60	Total>	75.02	18.70m	290.12	152.50	152.50	25630

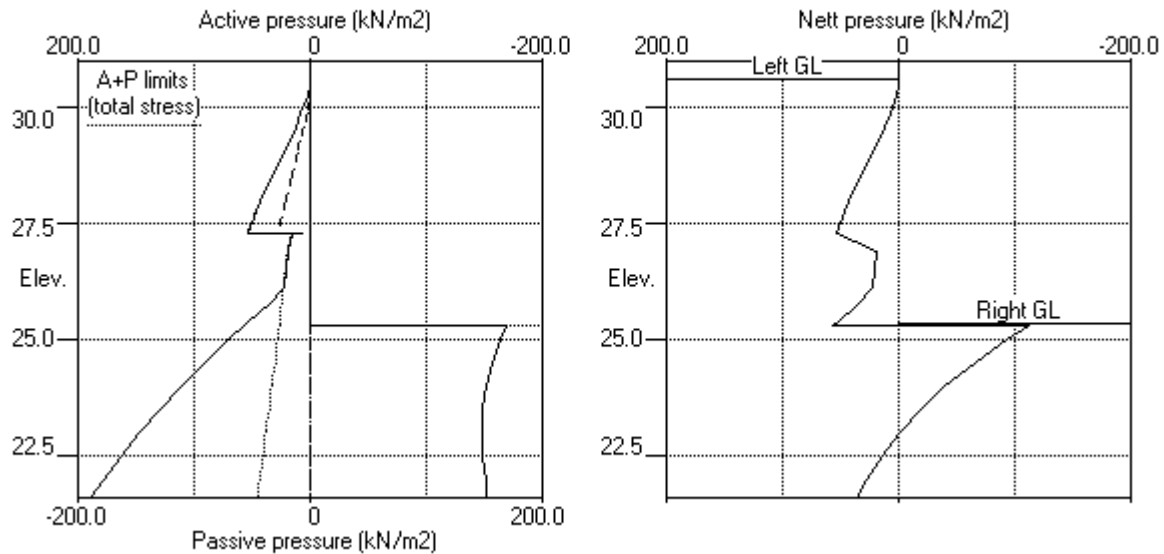
Note: 0.36a Soil pressure at active limit
 123.45p Soil pressure at passive limit

Units: kN,m

Stage No.6 Fill to elev. 25.34 on RIGHT side



Stage No.6 Fill to elev. 25.34 on RIGHT side



PILEDESIGNS LIMITED | Sheet No.
 Program: WALLAP Version 6.06 Revision A51.B69.R54 | Job No. 23811
 Licensed from GEOSOLVE | Made by : MJC
 Data filename/Run ID: 23811_Kentish_Town_Section2_04_SLS |
 KENTISH TOWN | Date:26-05-2021
 Design Case 2 - 600 dia @ 840 | Checked :

Units: kN,m

Stage No. 12 Change properties of soil type 2 to soil type 4
 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. = 21.60	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.			
12	30.60	25.34		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 20.00 from wall
 Right side 20.00 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	31.00	0.00	0.004	-1.32E-03	0.0	-0.0		105980
2	30.60	0.00	0.005	-1.32E-03	0.0	-0.0		105980
3	30.45	1.11	0.005	-1.32E-03	0.1	0.0	65.4	105980
		1.11	0.005	-1.32E-03	-65.4	0.0		
4	30.15	3.77	0.005	-1.29E-03	-64.6	-19.5		105980
5	29.88	8.08	0.005	-1.24E-03	-63.0	-37.1		105980
6	29.60	12.25	0.006	-1.15E-03	-60.2	-54.0		105980
7	29.30	16.97	0.006	-1.02E-03	-55.8	-71.5		105980
8	29.00	22.88	0.006	-8.56E-04	-49.8	-87.3		105980
9	28.50	33.91	0.007	-5.09E-04	-35.6	-109.0		105980
10	28.00	43.57	0.007	-9.84E-05	-16.3	-122.2		105980
11	27.65	49.24	0.007	2.11E-04	-0.0	-125.1		105980
12	27.30	54.27	0.007	5.23E-04	18.1	-122.0		105980
		57.45	0.007	5.23E-04	18.1	-122.0		
13	26.90	61.71	0.006	8.61E-04	41.9	-110.2		105980
14	26.50	65.62	0.006	1.15E-03	67.4	-88.6		105980
15	26.14	69.02	0.006	1.34E-03	91.8	-59.8		105980
16	25.77	72.35	0.005	1.44E-03	117.5	-19.9	70.5	105980
		72.35	0.005	1.44E-03	47.0	-19.9		
17	25.34	76.28	0.004	1.44E-03	79.2	7.0		105980
		53.75	0.004	1.44E-03	79.2	7.0		
18	25.29	53.85	0.004	1.44E-03	81.9	11.0		105980
		-67.75	0.004	1.44E-03	81.9	11.0		
19	25.00	-77.71	0.004	1.39E-03	60.8	31.5		105980
20	24.50	-71.87	0.003	1.25E-03	23.4	51.0		105980
21	24.00	-45.15	0.003	1.06E-03	-5.8	53.6		105980
22	23.50	-22.56	0.002	8.87E-04	-22.8	45.0		105980
23	23.00	-3.48	0.002	7.51E-04	-29.3	30.7		105980
24	22.50	13.16	0.001	6.68E-04	-26.9	15.6		105980

Stage No.12 Change properties of soil type 2 to soil type 4
 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
25	22.00	28.58	0.001	6.33E-04	-16.4	3.8		105980
		35.15	0.001	6.33E-04	-16.4	3.8		
26	21.60	46.96	0.001	6.27E-04	0.0	0.0		---
At elev. 30.45 Strut force =				65.4 kN/strut =		65.4 kN/m run		
At elev. 25.77 Strut force =				70.5 kN/strut =		70.5 kN/m run		

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	Active limit kN/m2	Passive limit kN/m2	Earth pressure kN/m2		
		-----	Effective	stresses	-----			
1	31.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	30.60	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	50767
3	30.45	0.00	2.95	1.11	7.86	1.11	1.11a	2718
4	30.15	0.00	10.05	3.77	26.75	3.77	3.77a	2718
5	29.88	2.75	14.19	5.33	37.80	5.33	8.08a	2718
6	29.60	5.50	17.97	6.75	47.86	6.75	12.25a	2718
7	29.30	8.50	22.56	8.47	60.07	8.47	16.97a	2718
8	29.00	11.50	30.31	11.38	80.72	11.38	22.88a	2718
9	28.50	16.50	46.36	17.41	123.46	17.41	33.91a	2718
10	28.00	21.50	58.77	22.07	156.51	22.07	43.57a	2718
11	27.65	25.00	64.56	24.24	171.93	24.24	49.24a	2718
12	27.30	28.50	68.64	25.77	182.78	25.77	54.27a	2718
		28.50	68.64	28.95	162.75	28.95	57.45a	14508
13	26.90	30.24	74.62	31.47	176.94	31.47	61.71a	14508
14	26.50	31.97	79.78	33.65	189.18	33.65	65.62a	14508
15	26.14	33.55	84.10	35.47	199.41	35.47	69.02a	14508
16	25.77	35.13	88.25	37.22	209.25	37.22	72.35a	14508
17	25.34	37.01	93.12	39.27	220.81	39.27	76.28a	14508
18	25.29	37.22	93.69	39.51	222.15	39.51	76.74a	17006
19	25.00	38.48	96.97	40.89	229.93	40.89	79.38a	17006
20	24.50	40.65	102.71	43.31	243.54	54.51	95.17	17006
21	24.00	42.82	108.59	45.79	257.48	73.24	116.06	17006
22	23.50	44.99	114.63	48.34	271.81	90.20	135.19	17006
23	23.00	47.16	120.83	50.96	286.51	105.69	152.85	17006
24	22.50	49.34	111.84	47.17	265.20	120.25	169.58	17006
25	22.00	51.51	133.67	56.37	316.97	134.37	185.88	17006
		Total>	185.18	43.00m	400.27	192.44	192.44	31328
26	21.60	Total>	192.20	45.00m	416.74	205.13	205.13	32704

[illegible]

(continued)

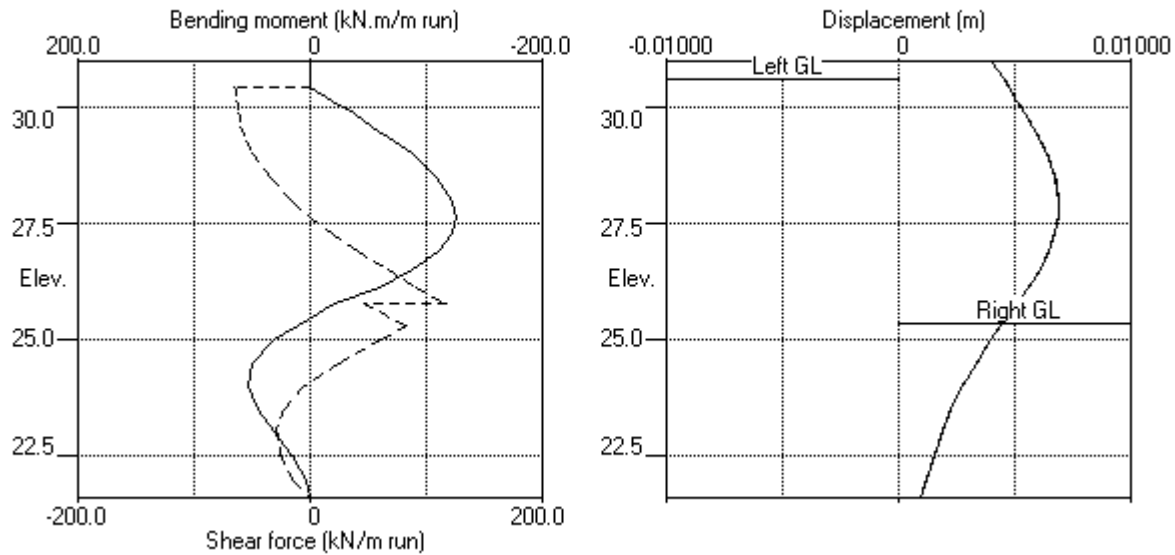
Stage No.12 Change properties of soil type 2 to soil type 4
 Ko pressures will not be reset

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
10	28.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
11	27.65	0.00	0.00	0.00	0.00	0.00	0.00	0.0
12	27.30	0.00	0.00	0.00	0.00	0.00	0.00	0.0
13	26.90	0.00	0.00	0.00	0.00	0.00	0.00	0.0
14	26.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
15	26.14	0.00	0.00	0.00	0.00	0.00	0.00	0.0
16	25.77	0.00	0.00	0.00	0.00	0.00	0.00	0.0
17	25.34	0.00	0.00	0.00	0.00	0.00	0.00	0.0
18	25.29	0.00	60.00	22.53	159.78	22.53	22.53a	11321
		0.00	60.93	22.88	162.26	22.88	22.88a	3182
19	25.00	0.00	60.93	25.70	144.49	144.48	144.48p	17006
		0.00	66.74	28.15	158.25	157.09	157.09	17006
20	24.50	7.83	68.80	29.01	163.13	159.20	167.03	17006
21	24.00	15.66	70.62	29.78	167.46	145.55	161.21	17006
22	23.50	23.49	72.13	30.42	171.03	134.26	157.75	17006
23	23.00	31.32	73.29	30.91	173.79	125.01	156.33	17006
24	22.50	39.15	74.14	31.27	175.79	117.27	156.42	17006
25	22.00	46.98	74.71	31.51	177.16	110.32	157.29	17006
26	21.60	53.24	75.03	31.64	177.91	104.93	158.17	17006

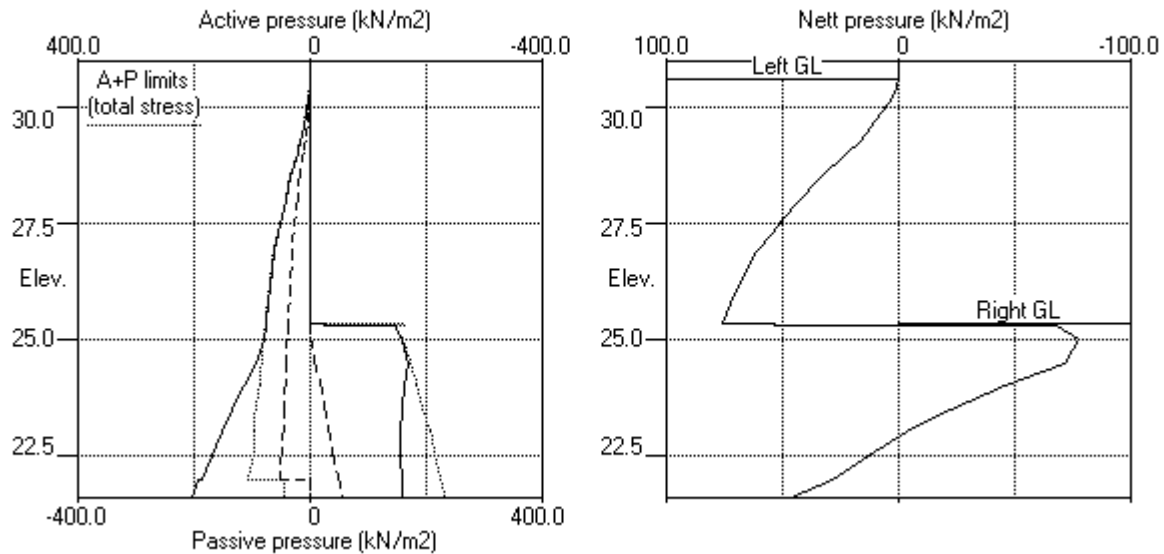
Note: 22.88a Soil pressure at active limit
 144.48p Soil pressure at passive limit

Units: kN,m

Stage No.12 Change soil type 2 to soil type 4



Stage No.12 Change soil type 2 to soil type 4



PILEDESIGNS LIMITED
 Program: WALLAP Version 6.06 Revision A51.B69.R54
 Data filename/Run ID: 23811_Kentish_Town_Section2_04_SLS
 KENTISH TOWN
 Design Case 2 - 600 dia @ 840

| Sheet No.
 | Job No. 23811
 | Made by : MJC
 | Date:26-05-2021
 | Checked :

Units: kN,m

Stage No. 13 Change properties of soil type 3 to soil type 5
 Ko pressures will be reset

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

				FoS for toe elev. = 21.60	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	
13	30.60 25.34			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 20.00 from wall
 Right side 20.00 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	31.00	0.00	0.004	-1.32E-03	0.0	-0.0		105980
2	30.60	0.00	0.005	-1.32E-03	0.0	-0.0		105980
3	30.45	1.11	0.005	-1.32E-03	0.1	0.0	65.4	105980
		1.11	0.005	-1.32E-03	-65.4	0.0		
4	30.15	3.77	0.005	-1.29E-03	-64.6	-19.5		105980
5	29.88	8.08	0.005	-1.24E-03	-63.0	-37.1		105980
6	29.60	12.25	0.006	-1.15E-03	-60.2	-54.0		105980
7	29.30	16.97	0.006	-1.02E-03	-55.8	-71.5		105980
8	29.00	22.88	0.006	-8.56E-04	-49.8	-87.3		105980
9	28.50	33.91	0.007	-5.09E-04	-35.6	-109.0		105980
10	28.00	43.57	0.007	-9.82E-05	-16.3	-122.2		105980
11	27.65	49.25	0.007	2.11E-04	-0.0	-125.1		105980
12	27.30	54.28	0.007	5.23E-04	18.1	-122.0		105980
		57.46	0.007	5.23E-04	18.1	-122.0		
13	26.90	61.72	0.006	8.62E-04	41.9	-110.2		105980
14	26.50	65.63	0.006	1.15E-03	67.4	-88.6		105980
15	26.14	69.03	0.006	1.34E-03	91.9	-59.8		105980
16	25.77	72.36	0.005	1.44E-03	117.6	-19.9	69.3	105980
		72.36	0.005	1.44E-03	48.2	-19.9		
17	25.34	76.29	0.004	1.44E-03	80.4	7.5		105980
		53.76	0.004	1.44E-03	80.4	7.5		
18	25.29	53.87	0.004	1.44E-03	83.1	11.6		105980
		-67.66	0.004	1.44E-03	83.1	11.6		
19	25.00	-77.71	0.004	1.39E-03	62.0	32.5		105980
20	24.50	-72.05	0.003	1.24E-03	24.6	52.6		105980
21	24.00	-45.74	0.003	1.04E-03	-4.8	55.8		105980
22	23.50	-23.87	0.002	8.58E-04	-22.2	47.6		105980
23	23.00	-5.87	0.002	7.09E-04	-29.7	33.4		105980
24	22.50	9.32	0.002	6.14E-04	-28.8	17.8		105980

(continued)

Stage No.13 Change properties of soil type 3 to soil type 5
 Ko pressures will 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
25	22.00	23.01	0.001	5.72E-04	-20.7	4.5		105980
		49.04	0.001	5.72E-04	-20.7	4.5		
26	21.60	54.61	0.001	5.65E-04	0.0	0.0		---
At elev. 30.45		Strut force =		65.4 kN/strut =		65.4 kN/m run		
At elev. 25.77		Strut force =		69.3 kN/strut =		69.3 kN/m run		

Node no.		Y coord	LEFT side					
			Effective stresses				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/m3
1	31.00		0.00	0.00	0.00	0.00	0.00	0.0
2	30.60		0.00	0.00	0.00	0.00	0.00	0.0
			0.00	0.00	0.00	0.00	0.00	39683
3	30.45		0.00	2.95	1.11	7.86	1.11a	5392
4	30.15		0.00	10.05	3.77	26.75	3.77a	2872
5	29.88		2.75	14.19	5.33	37.80	5.33	8.08a
6	29.60		5.50	17.97	6.75	47.86	6.75	12.25a
7	29.30		8.50	22.56	8.47	60.07	8.47	16.97a
8	29.00		11.50	30.31	11.38	80.72	11.38	22.88a
9	28.50		16.50	46.36	17.41	123.46	17.41	33.91a
10	28.00		21.50	58.77	22.07	156.51	22.07	43.57a
11	27.65		25.00	64.56	24.24	171.93	24.25	49.25a
12	27.30		28.50	68.64	25.77	182.78	25.78	54.28a
			28.50	68.64	28.95	162.75	28.96	57.46
13	26.90		30.24	74.62	31.47	176.94	31.48	61.72
14	26.50		31.97	79.78	33.65	189.18	33.66	65.63
15	26.14		33.55	84.10	35.47	199.41	35.48	69.03
16	25.77		35.13	88.25	37.22	209.25	37.23	72.36
17	25.34		37.01	93.12	39.27	220.81	39.29	76.29
18	25.29		37.22	93.69	39.51	222.15	39.52	76.75
19	25.00		38.48	96.97	40.89	229.93	40.90	79.38a
20	24.50		40.65	102.71	43.31	243.54	54.42	95.08
21	24.00		42.82	108.59	45.79	257.48	72.94	115.77
22	23.50		44.99	114.63	48.34	271.81	89.54	134.53
23	23.00		47.16	120.83	50.96	286.51	104.49	151.66
24	22.50		49.34	111.84	47.17	265.20	118.33	167.66
25	22.00		51.51	133.67	56.37	316.97	131.58	183.09
			51.51	133.67	56.37	316.97	157.62	209.12
26	21.60		53.24	138.96	58.60	329.50	163.07	216.31

Node no.		Y coord	RIGHT side					
			Effective stresses				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/m3
1	31.00		0.00	0.00	0.00	0.00	0.00	0.0
2	30.60		0.00	0.00	0.00	0.00	0.00	0.0
3	30.45		0.00	0.00	0.00	0.00	0.00	0.0
4	30.15		0.00	0.00	0.00	0.00	0.00	0.0
5	29.88		0.00	0.00	0.00	0.00	0.00	0.0
6	29.60		0.00	0.00	0.00	0.00	0.00	0.0
7	29.30		0.00	0.00	0.00	0.00	0.00	0.0
8	29.00		0.00	0.00	0.00	0.00	0.00	0.0
9	28.50		0.00	0.00	0.00	0.00	0.00	0.0

(continued)

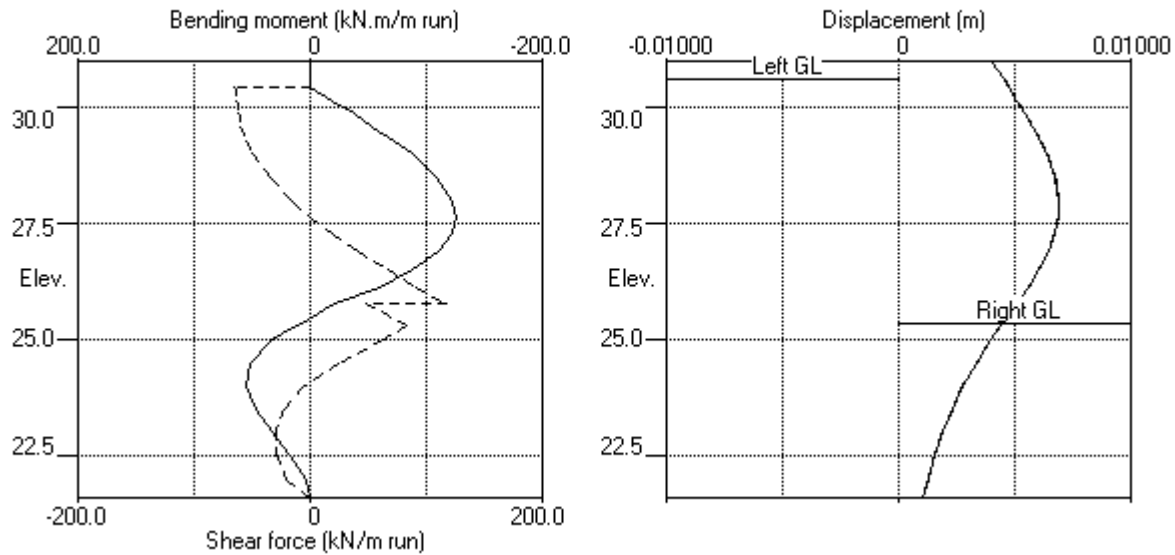
Stage No.13 Change properties of soil type 3 to soil type 5
 Ko pressures will be reset

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
10	28.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
11	27.65	0.00	0.00	0.00	0.00	0.00	0.00	0.0
12	27.30	0.00	0.00	0.00	0.00	0.00	0.00	0.0
13	26.90	0.00	0.00	0.00	0.00	0.00	0.00	0.0
14	26.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
15	26.14	0.00	0.00	0.00	0.00	0.00	0.00	0.0
16	25.77	0.00	0.00	0.00	0.00	0.00	0.00	0.0
17	25.34	0.00	0.00	0.00	0.00	0.00	0.00	0.0
18	25.29	0.00	60.00	22.53	159.78	22.53	22.53a	18065
		0.00	60.93	22.88	162.26	22.88	22.88a	18065
		0.00	60.93	25.70	144.49	144.41	144.41	97163
19	25.00	0.00	66.74	28.15	158.25	157.08	157.08	60327
20	24.50	7.83	68.80	29.01	163.13	159.29	167.12	30277
21	24.00	15.66	70.62	29.78	167.46	145.85	161.51	30277
22	23.50	23.49	72.13	30.42	171.03	134.91	158.40	30277
23	23.00	31.32	73.29	30.91	173.79	126.20	157.52	30277
24	22.50	39.15	74.14	31.27	175.79	119.19	158.34	30277
25	22.00	46.98	74.71	31.51	177.16	113.11	160.08	30277
26	21.60	53.24	75.03	31.64	177.91	108.46	161.70	30277

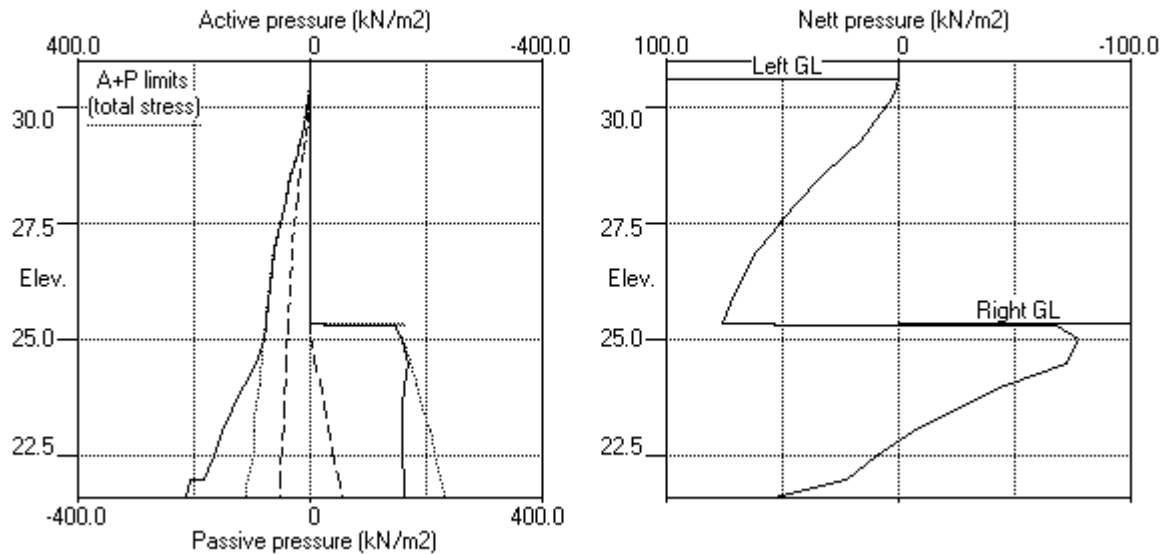
Note: 22.88a Soil pressure at active limit
 123.45p Soil pressure at passive limit

Units: kN,m

Stage No.13 Change soil type 3 to soil type 5



Stage No.13 Change soil type 3 to soil type 5



PILEDESIGNS LIMITED	Sheet No.
Program: WALLAP Version 6.06 Revision A51.B69.R54	Job No. 23811
Licensed from GEOSOLVE	Made by : MJC
Data filename/Run ID: 23811_Kentish_Town_Section2_04_SLS	
KENTISH TOWN	Date:26-05-2021
Design Case 2 - 600 dia @ 840	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

Stage	--- G.L. ---		Strut	FoS for toe		Toe elev. for		Direction
No.	Act.	Pass.	Elev.	Factor	Moment	elev.	FoS	
				of equilib.		FoS = 1.000		
				Safety at elev.				
1	30.60	30.60	Cant.	Conditions not suitable for FoS calc.				
2	30.60	30.60		No analysis at this stage				
3	30.60	30.60	Cant.	Conditions not suitable for FoS calc.				
4	30.60	30.60		No analysis at this stage				
5	30.60	25.29	31.00	2.889	n/a	24.91	0.38	L to R
6	30.60	25.34	31.00	2.905	n/a	24.91	0.43	L to R
7	30.60	25.34		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: 23811_Kentish_Town_Section2_04_SLS

KENTISH TOWN

Design Case 2 - 600 dia @ 840

| Sheet No.

| Job No. 23811

| Made by : MJC

| Date:26-05-2021

| 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 20.00 from wall

Right side 20.00 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			
		max.	min.	Calculated		Factored		Calculated		Factored	
				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	31.00	0.004	0.000	0	-0	0	-0	0	-51	0	-68
2	30.60	0.005	0.000	0	-20	0	-27	0	-51	0	-68
3	30.45	0.005	0.000	0	-28	0	-37	0	-65	0	-88
4	30.15	0.005	0.000	0	-43	0	-58	0	-65	0	-87
5	29.88	0.005	0.000	0	-56	0	-76	0	-63	0	-85
6	29.60	0.006	0.000	0	-69	0	-93	0	-60	0	-81
7	29.30	0.006	0.000	0	-82	0	-111	0	-56	0	-75
8	29.00	0.006	0.000	0	-93	0	-126	0	-50	0	-67
9	28.50	0.007	0.000	0	-109	0	-147	0	-36	0	-48
10	28.00	0.007	0.000	0	-122	0	-165	6	-16	8	-22
11	27.65	0.007	0.000	0	-125	0	-169	15	-0	20	-0
12	27.30	0.007	0.000	3	-122	4	-165	33	0	45	0
13	26.90	0.006	0.000	9	-110	12	-149	61	0	82	0
14	26.50	0.006	0.000	12	-89	16	-120	91	0	122	0
15	26.14	0.006	0.000	13	-60	18	-81	119	0	160	0
16	25.77	0.005	0.000	41	-31	56	-41	148	-45	200	-61
17	25.34	0.005	0.000	29	0	39	0	85	-9	115	-12
18	25.29	0.005	0.000	29	0	39	0	88	-8	119	-10
19	25.00	0.005	0.000	32	0	44	0	62	-4	84	-6
20	24.50	0.004	0.000	53	0	71	0	25	-4	33	-6
21	24.00	0.004	0.000	56	0	75	0	0	-7	0	-9
22	23.50	0.004	0.000	48	0	64	0	0	-23	0	-31
23	23.00	0.004	0.000	33	0	45	0	0	-30	0	-40
24	22.50	0.004	0.000	18	0	24	0	0	-29	0	-39
25	22.00	0.004	0.000	5	0	6	0	0	-21	0	-28
26	21.60	0.003	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	kN/m	
1	1 26.14	-1 28.50		2 -1			2 27.30	-1 29.60		3 -1		
2	No calculation at this stage											
3	13 26.14	-7 28.50		18 -9			20 27.30	-5 29.30		28 -7		
4	No calculation at this stage											
5	48 24.00	-113 28.00		65 -153			88 25.29	-50 31.00		119 -68		
6	48 24.00	-113 28.00		65 -153			88 25.29	-51 31.00		119 -68		
7	No calculation at this stage											
8	No calculation at this stage											
9	46 24.00	-105 27.65		61 -141			87 25.29	-58 30.45		117 -79		
10	No calculation at this stage											
11	No calculation at this stage											
12	54 24.00	-125 27.65		72 -169			118 25.77	-65 30.45		159 -88		
13	56 24.00	-125 27.65		75 -169			118 25.77	-65 30.45		159 -88		
14	41 25.77	-105 28.00		56 -142			148 25.77	-62 30.45		200 -84		

Maximum and minimum displacement at each stage

Stage no.	Displacement				Stage description
	maximum elev.	minimum elev.			
	m	m			
1	0.000 31.00	0.000 31.00			Apply surcharge no.1 at elev. 30.60
2	No calculation at this stage				Apply surcharge no.2 at elev. 29.60
3	0.002 31.00	0.000 31.00			Apply water pressure profile no.1
4	No calculation at this stage				Install strut no.3 at elev. 31.00
5	0.007 28.00	0.000 31.00			Excav. to elev. 25.29 on RIGHT side
6	0.007 28.00	0.000 31.00			Fill to elev. 25.34 on RIGHT side
7	No calculation at this stage				Install strut no.2 at elev. 25.77
8	No calculation at this stage				Install strut no.1 at elev. 30.45
9	0.006 28.00	0.000 31.00			Remove strut no.3 at elev. 31.00
10	No calculation at this stage				Change EI of wall to 105980kN.m2/m run
11	No calculation at this stage				Apply surcharge no.4 at elev. 25.34
12	0.007 28.00	0.000 31.00			Change soil type 2 to soil type 4
13	0.007 28.00	0.000 31.00			Change soil type 3 to soil type 5
14	0.006 28.00	0.000 31.00			Apply water pressure profile no.2

Strut forces at each stage (horizontal components)

Stage no.	Strut no. 1			Strut no. 2			Strut no. 3		
	at elev. 30.45			at elev. 25.77			at elev. 31.00		
	--Calculated--	Factored		--Calculated--	Factored		--Calculated--	Factored	
	kN per m run	kN per strut	kN per strut	kN per m run	kN per strut	kN per strut	kN per m run	kN per strut	kN per strut
5	---	---	---	---	---	---	50	50	68
6	---	---	---	---	---	---	51	51	68
9	58	58	79	slack	slack	slack	---	---	---
12	65	65	88	71	71	95	---	---	---
13	65	65	88	69	69	94	---	---	---
14	63	63	84	193	193	260	---	---	---

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KENTISH TOWN

Design Case 2 - 600 dia @ 840

| Sheet No.

| Job No. 23811

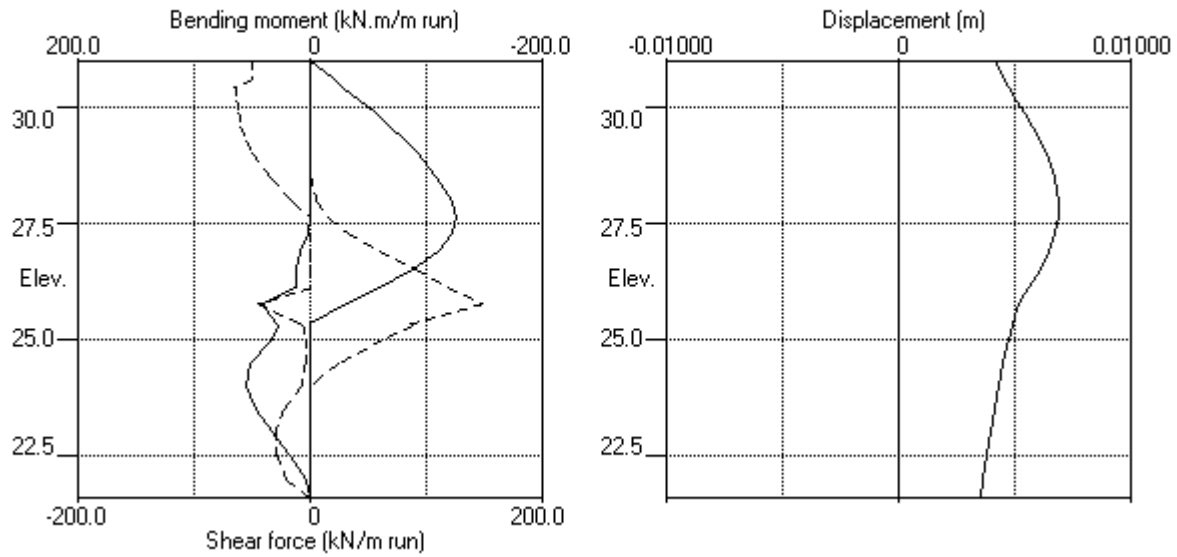
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| Date:26-05-2021

| Checked :

Units: kN,m

Bending moment, shear force, displacement envelopes



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Data filename/Run ID: 23811_Kentish_Town_Section2_04_ULS1	
KENTISH TOWN	Date:26-05-2021
Design Case 2 - 600 dia @ 840	Checked :

Units: kN,m

INPUT DATA

SOIL PROFILE

Stratum no.	Elevation of top of stratum	Left side	Soil types	Right side
1	30.60	1 Made Ground dr		1 Made Ground dr
2	27.30	2 London Clay 1 und		2 London Clay 1 und
3	22.00	3 London Clay 2 und		2 London Clay 1 und

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 dr	19.00	10000	0.540	OC (0.250)	0.376 (0.000)	2.663 (0.000)	
2 London Clay 1 und	20.00	72000	1.200	OC (0.490)	1.000 (2.389)	1.000 (2.390)	90.00u
3 London Cl.. (22.00)	20.00	72000 (7904)	1.200	OC (0.490)	1.000 (2.389)	1.000 (2.390)	90.00u (9.880)
4 London Clay 1 dr	20.00	55440	1.200	OC (0.200)	0.422 (1.299)	2.371 (3.080)	0.0d
5 London Cl.. (22.00)	20.00	55440 (6086)	1.200	OC (0.200)	0.422 (1.299)	2.371 (3.080)	0.0d

Additional soil parameters associated with Ka and Kp

----- Soil type -----	Soil friction	Wall adhesion	Back- fill	--- parameters for Ka ---	Soil friction	Wall adhesion	Back- fill	--- parameters for Kp ---
No. Description	angle	coeff.	angle	angle	angle	coeff.	angle	angle
1 Made Ground dr	27.00	0.000	0.00		27.00	0.000	0.00	
2 London Clay 1 und	0.00	0.500	0.00		0.00	0.500	0.00	
3 London Clay 2 und	0.00	0.500	0.00		0.00	0.500	0.00	
4 London Clay 1 dr	24.00	0.000	0.00		24.00	0.000	0.00	
5 London Clay 2 dr	24.00	0.000	0.00		24.00	0.000	0.00	

GROUND WATER CONDITIONS

Density of water = 10.00 kN/m3

	Left side	Right side
Initial water table elevation	25.00	25.00

Automatic water pressure balancing at toe of wall : Yes

Water press.	Left side				Right side			
profile no.	Point no.	Elev. m	Piezo elev. m	Water press. kN/m2	Point no.	Elev. m	Piezo elev. m	Water press. kN/m2
	1	30.15	30.15	0.0	1	25.00	25.00	0.0 MC+WC
	2	27.30	30.15	28.5	2	25.00	25.00	0.0
	1	30.60	30.60	0.0	1	25.34	25.34	0.0 MC+WC
					2	25.34	30.60	52.6

WALL PROPERTIES

Type of structure = Fully Embedded Wall

Elevation of toe of wall = 21.60

Maximum finite element length = 0.50 m

Youngs modulus of wall E = 1.9600E+07 kN/m2

Moment of inertia of wall I = 7.5700E-03 m4/m run

E.I = 148372 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	30.45	1.00	0.275000	1.400E+07	5.00	0.00	0	No
2	25.77	1.00	0.450000	1.400E+07	5.00	0.00	0	No
3	31.00	1.00	1.000000	30000	1.00	0.00	0	No

SURCHARGE LOADS

Surch -arge no.	Elev.	Distance from wall	Length parallel to wall	Width perpend. to wall	Surcharge ----- Near edge	Surcharge ----- Far edge	Equiv. soil type	Partial factor/ Category
1	30.60	0.50 (L)	10.00	10.00	10.00	=	N/A	1.10 Var
2	29.60	1.00 (L)	10.00	1.00	100.00	=	N/A	1.00 P/U
3	Not defined							
4	25.34	-0.00 (R)	10.00	10.00	60.00	=	N/A	1.00 P/F

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 30.60
2	Apply surcharge no.2 at elevation 29.60
	No analysis at this stage
3	Apply water pressure profile no.1 (Mod. Conserv.)
	No analysis at this stage
4	Install strut or anchor no.3 at elevation 31.00
5	Excavate to elevation 24.79 on RIGHT side
6	Fill to elevation 25.34 on RIGHT side with soil type 1
7	Install strut or anchor no.2 at elevation 25.77
8	Install strut or anchor no.1 at elevation 30.45
9	Remove strut or anchor no.3 at elevation 31.00
10	Change EI of wall to 105980 kN.m2/m run
	Yield moment not defined
	No adjustments to wall displacements
11	Apply surcharge no.4 at elevation 25.34
	No analysis at this stage
12	Change properties of soil type 2 to soil type 4
	Ko pressures will not be reset
13	Change properties of soil type 3 to soil type 5
	Ko pressures will be reset
14	Apply water pressure profile no.2 (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 = 20.00 m
Distance to rigid boundary on Right side = 20.00 m

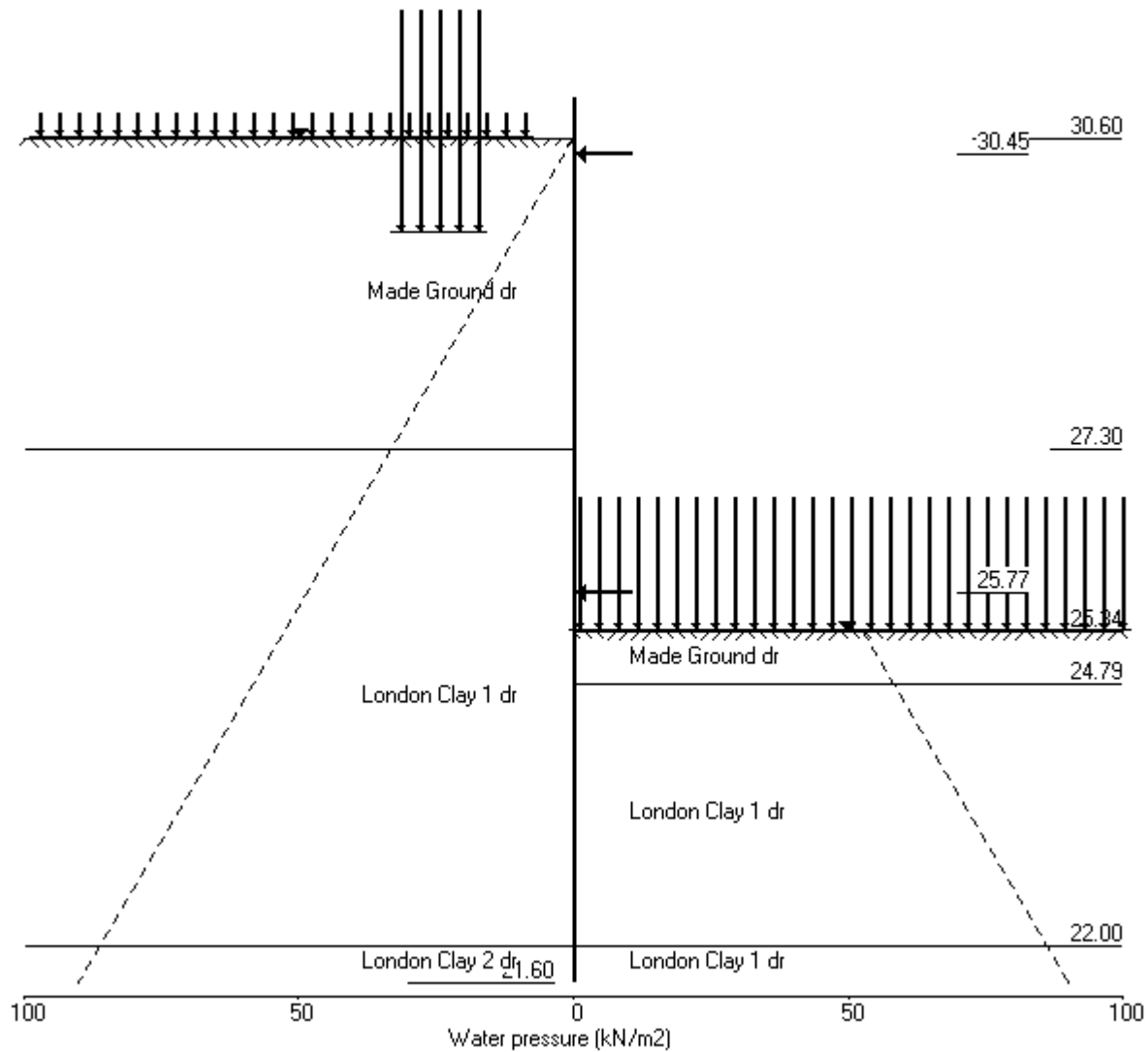
OUTPUT OPTIONS

Stage no.	Stage description	Output options		
		Displacement Bending mom. Shear force	Active, Passive pressures	Graph. output
1	Apply surcharge no.1 at elev. 30.60	No	No	No
2	Apply surcharge no.2 at elev. 29.60	No	No	No
3	Apply water pressure profile no.1	No	No	No
4	Install strut no.3 at elev. 31.00	No	No	No
5	Excav. to elev. 24.79 on RIGHT side	No	No	No
6	Fill to elev. 25.34 on RIGHT side	No	No	No
7	Install strut no.2 at elev. 25.77	No	No	No
8	Install strut no.1 at elev. 30.45	No	No	No
9	Remove strut no.3 at elev. 31.00	No	No	No
10	Change EI of wall to 105980kN.m2/m run	No	No	No
11	Apply surcharge no.4 at elev. 25.34	No	No	No
12	Change soil type 2 to soil type 4	No	No	No
13	Change soil type 3 to soil type 5	No	No	No
14	Apply water pressure profile no.2	No	No	No
*	Summary output	Yes	-	Yes

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Units: kN,m

Stage No.14 Apply water pressure profile no.2 (Mod. Conserv.)



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KENTISH TOWN	Date:26-05-2021
Design Case 2 - 600 dia @ 840	Checked :

Units: kN,m

Stage No. 5 Excavate to elevation 24.79 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 20.00 from wall
 Right side 20.00 from wall

Limit State: ULS DAL 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	31.00	0.00	0.004	-1.74E-03	-56.4	0.0	56.4	148372
2	30.60	0.00	0.005	-1.71E-03	-56.4	-22.6		148372
3	30.45	1.11	0.005	-1.69E-03	-56.3	-31.0		148372
4	30.15	3.83	0.006	-1.61E-03	-55.6	-47.8		148372
5	29.88	8.20	0.006	-1.50E-03	-53.9	-62.9		148372
6	29.60	12.42	0.006	-1.37E-03	-51.1	-77.3		148372
7	29.30	17.18	0.007	-1.20E-03	-46.6	-92.0		148372
8	29.00	23.11	0.007	-1.00E-03	-40.6	-105.1		148372
9	28.50	34.17	0.008	-6.24E-04	-26.3	-122.1		148372
10	28.00	43.84	0.008	-1.99E-04	-6.8	-130.6		148372
11	27.65	49.52	0.008	1.08E-04	9.6	-130.1		148372
12	27.30	54.55	0.008	4.07E-04	27.8	-123.7		148372
		16.50	0.008	4.07E-04	27.8	-123.7		
13	26.90	18.50	0.007	7.24E-04	34.8	-111.4		148372
14	26.50	20.50	0.007	1.00E-03	42.6	-96.1		148372
15	26.14	22.32	0.007	1.21E-03	50.4	-79.3		148372
16	25.77	24.14	0.006	1.38E-03	58.8	-59.6		148372
17	25.34	33.01	0.006	1.51E-03	71.2	-28.6		148372
18	25.00	50.99	0.005	1.55E-03	85.5	-2.4		148372
19	24.79	59.53	0.005	1.54E-03	97.1	16.7		148372
		-140.55	0.005	1.54E-03	97.1	16.7		
20	24.40	-107.45	0.004	1.46E-03	48.1	44.0		148372
21	24.00	-76.77	0.004	1.33E-03	11.7	54.6		148372
22	23.50	-42.41	0.003	1.15E-03	-18.1	50.8		148372
23	23.00	-12.74	0.002	1.00E-03	-31.9	36.4		148372
24	22.50	13.52	0.002	9.13E-04	-31.7	18.7		148372
25	22.00	37.99	0.001	8.74E-04	-18.8	4.5		148372
26	21.60	56.10	0.001	8.68E-04	0.0	-0.0		---
At elev. 31.00 Strut force =					56.4 kN/strut =	56.4 kN/m run		

LEFT side								
Node no.	Y coord	Effective stresses					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	31.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	30.60	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	2020
3	30.45	0.00	2.96	1.11	7.89	1.11	1.11a	2020
4	30.15	0.00	10.20	3.83	27.15	3.83	3.83a	2020
5	29.88	2.75	14.51	5.45	38.64	5.45	8.20a	2020

(continued)

Stage No.5 Excavate to elevation 24.79 on RIGHT side

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		
6	29.60	5.50	18.42	6.92	49.05	6.92	12.42a	2020
7	29.30	8.50	23.10	8.68	61.52	8.68	17.18a	2020
8	29.00	11.50	30.93	11.61	82.36	11.61	23.11a	2020
9	28.50	16.50	47.04	17.67	125.28	17.67	34.17a	2020
10	28.00	21.50	59.49	22.34	158.42	22.34	43.84a	2020
11	27.65	25.00	65.29	24.52	173.87	24.52	49.52a	2020
12	27.30	28.50	69.37	26.05	184.73	26.05	54.55a	2020
		Total>	97.87	16.50m	312.98	16.50	16.50a	20768
13	26.90	Total>	105.59	18.50m	320.70	18.50	18.50a	20768
14	26.50	Total>	112.48	20.50m	327.59	20.50	20.50a	20768
15	26.14	Total>	118.36	22.32m	333.48	22.32	22.32a	20768
16	25.77	Total>	124.07	24.14m	339.19	24.14	24.14a	20768
17	25.34	Total>	130.81	26.30m	345.93	33.01	33.01	20768
18	25.00	Total>	136.11	28.00m	351.23	50.99	50.99	20768
19	24.79	Total>	139.41	29.05m	354.53	61.63	61.63	20768
20	24.40	Total>	145.67	31.02m	360.79	81.31	81.31	20768
21	24.00	Total>	152.03	33.00m	367.15	100.15	100.15	20768
22	23.50	Total>	160.21	35.50m	375.33	122.43	122.43	20768
23	23.00	Total>	168.56	38.00m	383.68	143.12	143.12	20768
24	22.50	Total>	177.05	40.50m	392.18	162.67	162.67	20768
25	22.00	Total>	185.69	43.00m	400.82	181.68	181.68	20768
26	21.60	Total>	192.70	45.00m	417.27	195.73	195.73	21680

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		
1	31.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	30.60	0.00	0.00	0.00	0.00	0.00	0.00	0.0
3	30.45	0.00	0.00	0.00	0.00	0.00	0.00	0.0
4	30.15	0.00	0.00	0.00	0.00	0.00	0.00	0.0
5	29.88	0.00	0.00	0.00	0.00	0.00	0.00	0.0
6	29.60	0.00	0.00	0.00	0.00	0.00	0.00	0.0
7	29.30	0.00	0.00	0.00	0.00	0.00	0.00	0.0
8	29.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
9	28.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
10	28.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
11	27.65	0.00	0.00	0.00	0.00	0.00	0.00	0.0
12	27.30	0.00	0.00	0.00	0.00	0.00	0.00	0.0
13	26.90	0.00	0.00	0.00	0.00	0.00	0.00	0.0
14	26.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
15	26.14	0.00	0.00	0.00	0.00	0.00	0.00	0.0
16	25.77	0.00	0.00	0.00	0.00	0.00	0.00	0.0
17	25.34	0.00	0.00	0.00	0.00	0.00	0.00	0.0
18	25.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
19	24.79	2.10	0.00	0.00	0.00	0.00	2.10	0.0
		Total>	2.10	2.10w	217.20	202.18	202.18	38338
20	24.40	Total>	10.00	3.02m	225.10	188.77	188.77	38338
21	24.00	Total>	17.90	5.00m	233.00	176.92	176.92	38338
22	23.50	Total>	27.91	7.50m	243.01	164.84	164.84	38338
23	23.00	Total>	37.93	10.00m	253.03	155.86	155.86	38338
24	22.50	Total>	47.97	12.50m	263.07	149.15	149.15	38338
25	22.00	Total>	58.02	15.00m	273.12	143.69	143.69	38338

Run ID. 23811_Kentish_Town_Section2_04_ULS1
 KENTISH TOWN
 Design Case 2 - 600 dia @ 840

| Sheet No.
 | Date:26-05-2021
 | Checked :

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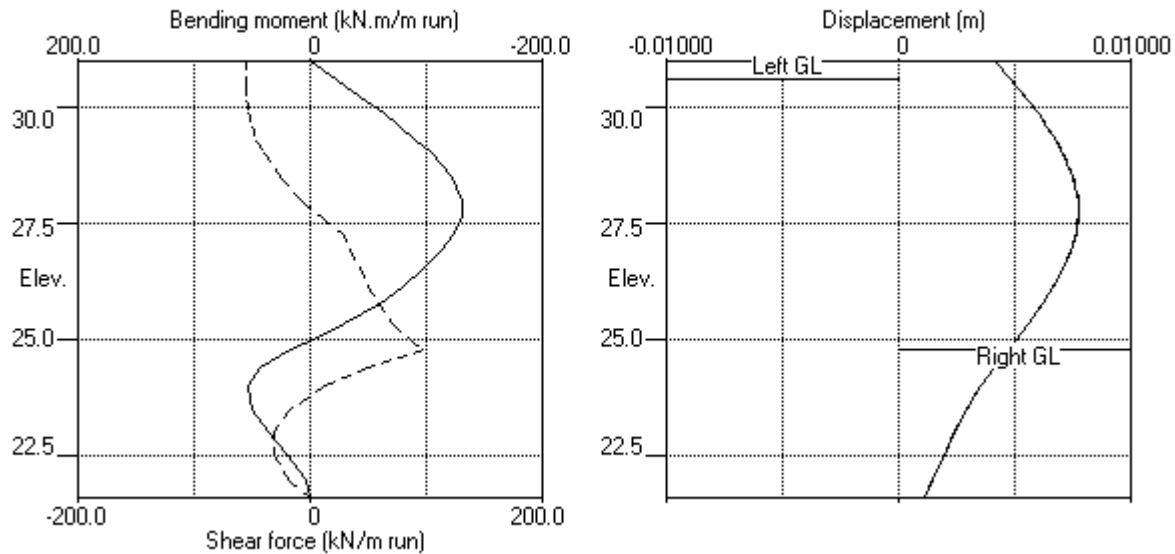
Stage No.5 Excavate to elevation 24.79 on RIGHT side

Node no.	Y coord	----- RIGHT side -----						
		----- Effective stresses -----						
		Water press. kN/m2	Vertic -al kN/m2	Active limit kN/m2	Passive limit kN/m2	Earth pressure kN/m2	Total earth pressure kN/m2	Coeff. of subgrade reaction kN/m3
26	21.60	Total>	66.09	17.00m	281.18	139.63	139.63	38338

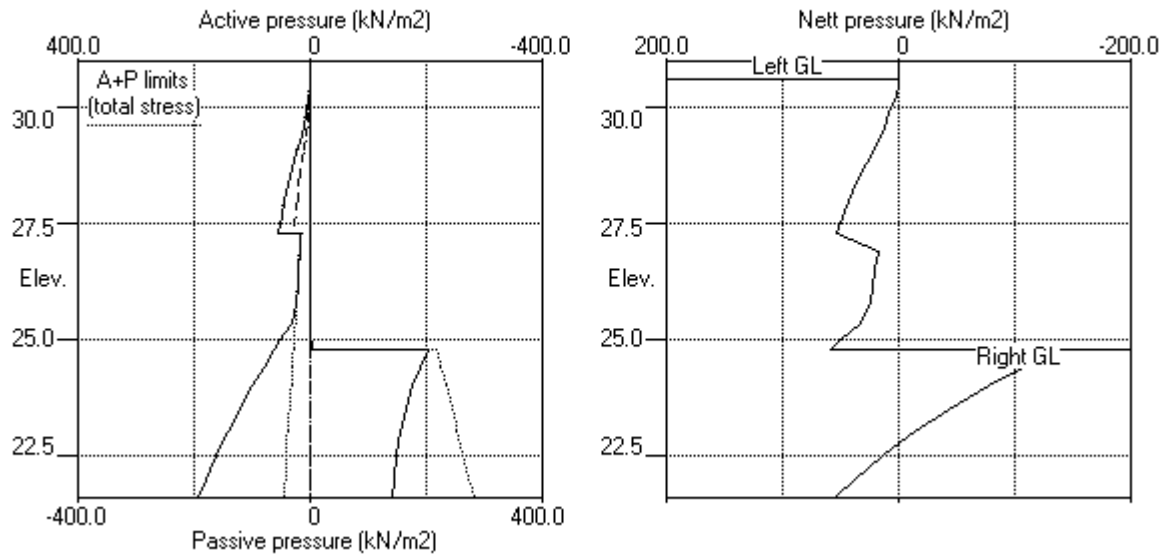
Note: 24.14a Soil pressure at active limit
 123.45p Soil pressure at passive limit

Units: kN,m

Stage No.5 Excav. to elev. 24.79 on RIGHT side



Stage No.5 Excav. to elev. 24.79 on RIGHT side



PILEDESIGNS LIMITED	Sheet No.
Program: WALLAP Version 6.06 Revision A51.B69.R54	Job No. 23811
Licensed from GEOSOLVE	Made by : MJC
Data filename/Run ID: 23811_Kentish_Town_Section2_04_ULS1	
KENTISH TOWN	Date:26-05-2021
Design Case 2 - 600 dia @ 840	Checked :

Units: kN,m

Stage No. 6 Fill to elevation 25.34 on RIGHT side with soil type 1

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 20.00 from wall
 Right side 20.00 from wall

Limit State: ULS DAL 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	31.00	0.00	0.004	-1.74E-03	-56.8	0.0	56.8	148372
2	30.60	0.00	0.005	-1.71E-03	-56.8	-22.7		148372
3	30.45	1.11	0.005	-1.68E-03	-56.7	-31.2		148372
4	30.15	3.83	0.006	-1.60E-03	-55.9	-48.1		148372
5	29.88	8.20	0.006	-1.50E-03	-54.3	-63.3		148372
6	29.60	12.42	0.006	-1.37E-03	-51.5	-77.9		148372
7	29.30	17.18	0.007	-1.20E-03	-47.0	-92.7		148372
8	29.00	23.11	0.007	-1.00E-03	-41.0	-105.9		148372
9	28.50	34.17	0.008	-6.15E-04	-26.7	-123.0		148372
10	28.00	43.85	0.008	-1.85E-04	-7.1	-131.7		148372
11	27.65	49.54	0.008	1.24E-04	9.2	-131.4		148372
12	27.30	54.59	0.008	4.27E-04	27.4	-125.1		148372
		16.93	0.008	4.27E-04	27.4	-125.1		
13	26.90	19.16	0.007	7.47E-04	34.6	-112.9		148372
14	26.50	21.44	0.007	1.03E-03	42.8	-97.6		148372
15	26.14	23.54	0.007	1.25E-03	50.9	-80.7		148372
16	25.77	25.68	0.006	1.42E-03	59.9	-60.7		148372
17	25.34	34.96	0.005	1.55E-03	73.0	-29.1		148372
18	25.00	50.84	0.005	1.59E-03	87.6	-2.2		148372
19	24.79	58.17	0.005	1.57E-03	99.0	17.4		148372
		-143.63	0.005	1.57E-03	99.0	17.4		
20	24.40	-109.78	0.004	1.49E-03	49.0	45.2		148372
21	24.00	-78.41	0.003	1.36E-03	11.8	56.0		148372
22	23.50	-43.29	0.003	1.17E-03	-18.6	52.0		148372
23	23.00	-12.98	0.002	1.02E-03	-32.7	37.2		148372
24	22.50	13.85	0.002	9.33E-04	-32.4	19.2		148372
25	22.00	38.83	0.001	8.93E-04	-19.3	4.6		148372
26	21.60	57.55	0.001	8.87E-04	0.0	-0.0		---
At elev. 31.00 Strut force =					56.8 kN/strut =	56.8 kN/m run		

Node no.	Y coord	LEFT side						
		Water press.	Vertic -al	Effective Active limit	Effective 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	31.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	30.60	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	4306
3	30.45	0.00	2.96	1.11	7.89	1.11	1.11a	4306
4	30.15	0.00	10.20	3.83	27.15	3.83	3.83a	4306
5	29.88	2.75	14.51	5.45	38.64	5.45	8.20a	4306

(continued)

Stage No.6 Fill to elevation 25.34 on RIGHT side with soil type 1

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		
6	29.60	5.50	18.42	6.92	49.05	6.92	12.42a	4306
7	29.30	8.50	23.10	8.68	61.52	8.68	17.18a	4306
8	29.00	11.50	30.93	11.61	82.36	11.61	23.11a	4306
9	28.50	16.50	47.04	17.67	125.28	17.67	34.17a	4306
10	28.00	21.50	59.49	22.34	158.42	22.35	43.85	2710
11	27.65	25.00	65.29	24.52	173.87	24.54	49.54	2710
12	27.30	28.50	69.37	26.05	184.73	26.09	54.59	2710
		Total>	97.87	16.50m	312.98	16.93	16.93	26987
13	26.90	Total>	105.59	18.50m	320.70	19.16	19.16	26987
14	26.50	Total>	112.48	20.50m	327.59	21.44	21.44	26987
15	26.14	Total>	118.36	22.32m	333.48	23.54	23.54	26987
16	25.77	Total>	124.07	24.14m	339.19	25.68	25.68	26987
17	25.34	Total>	130.81	26.30m	345.93	34.96	34.96	26987
18	25.00	Total>	136.11	28.00m	351.23	53.27	53.27	26987
19	24.79	Total>	139.41	29.05m	354.53	64.12	64.12	26987
20	24.40	Total>	145.67	31.02m	360.79	84.18	84.18	26987
21	24.00	Total>	152.03	33.00m	367.15	103.35	103.35	26987
22	23.50	Total>	160.21	35.50m	375.33	126.01	126.01	26987
23	23.00	Total>	168.56	38.00m	383.68	147.01	147.01	26987
24	22.50	Total>	177.05	40.50m	392.18	166.85	166.85	26987
25	22.00	Total>	185.69	43.00m	400.82	186.12	186.12	26987
26	21.60	Total>	192.70	45.00m	417.27	200.58	200.58	28172

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	31.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0	
2	30.60	0.00	0.00	0.00	0.00	0.00	0.00	0.0	
3	30.45	0.00	0.00	0.00	0.00	0.00	0.00	0.0	
4	30.15	0.00	0.00	0.00	0.00	0.00	0.00	0.0	
5	29.88	0.00	0.00	0.00	0.00	0.00	0.00	0.0	
6	29.60	0.00	0.00	0.00	0.00	0.00	0.00	0.0	
7	29.30	0.00	0.00	0.00	0.00	0.00	0.00	0.0	
8	29.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0	
9	28.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0	
10	28.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0	
11	27.65	0.00	0.00	0.00	0.00	0.00	0.00	0.0	
12	27.30	0.00	0.00	0.00	0.00	0.00	0.00	0.0	
13	26.90	0.00	0.00	0.00	0.00	0.00	0.00	0.0	
14	26.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0	
15	26.14	0.00	0.00	0.00	0.00	0.00	0.00	0.0	
16	25.77	0.00	0.00	0.00	0.00	0.00	0.00	0.0	
17	25.34	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	2710	
18	25.00	0.00	6.46	2.43	17.20	2.43	2.43a	2710	
19	24.79	3.24	7.21	2.71	19.20	2.71	5.95a	2710	
		Total>	10.45	2.75m	225.55	207.74	207.74	26987	
20	24.40	Total>	18.35	4.72m	233.45	193.95	193.95	26987	
21	24.00	Total>	26.26	6.70m	241.36	181.76	181.76	26987	
22	23.50	Total>	36.28	9.20m	251.38	169.30	169.30	26987	
23	23.00	Total>	46.32	11.70m	261.42	159.99	159.99	26987	
24	22.50	Total>	56.37	14.20m	271.47	153.01	153.01	26987	

Run ID. 23811_Kentish_Town_Section2_04_ULS1
KENTISH TOWN
Design Case 2 - 600 dia @ 840

| Sheet No.
| Date:26-05-2021
| Checked :

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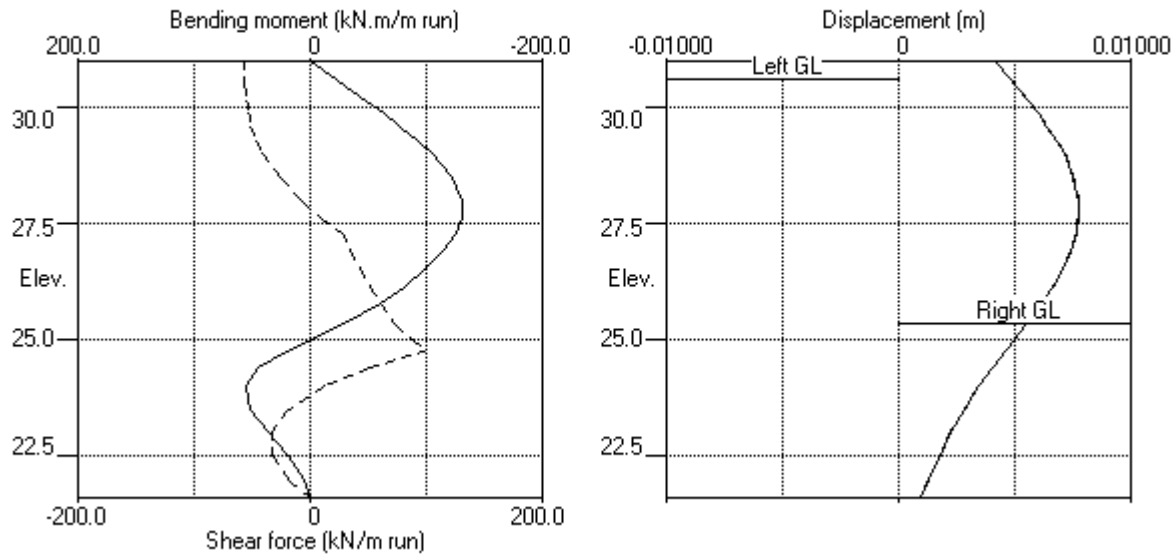
Stage No.6 Fill to elevation 25.34 on RIGHT side with soil type 1

Node no.	Y coord	----- Water press. kN/m2	----- Vertic -al kN/m2	Effective stresses Active limit kN/m2	Passive limit kN/m2	Earth pressure kN/m2	Total earth pressure kN/m2	Coeff. of subgrade reaction kN/m3
25	22.00	Total>	66.44	16.70m	281.54	147.29	147.29	26987
26	21.60	Total>	74.52	18.70m	289.62	143.03	143.03	26987

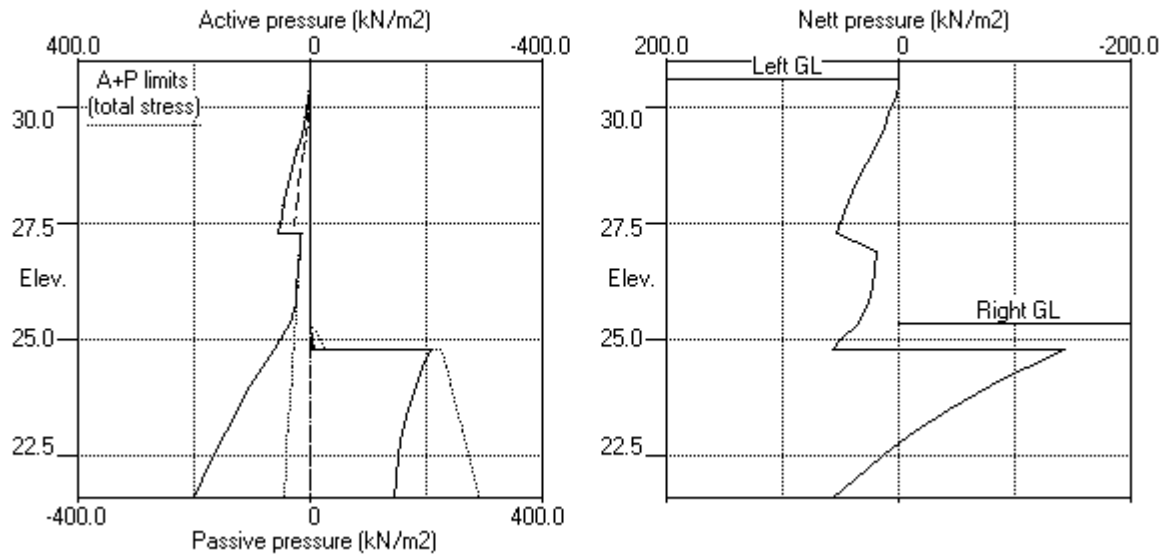
Note: 5.95a Soil pressure at active limit
123.45p Soil pressure at passive limit

Units: kN,m

Stage No.6 Fill to elev. 25.34 on RIGHT side



Stage No.6 Fill to elev. 25.34 on RIGHT side



PILEDESIGNS LIMITED	Sheet No.
Program: WALLAP Version 6.06 Revision A51.B69.R54	Job No. 23811
Licensed from GEOSOLVE	Made by : MJC
Data filename/Run ID: 23811_Kentish_Town_Section2_04_ULS1	
KENTISH TOWN	Date:26-05-2021
Design Case 2 - 600 dia @ 840	Checked :

Units: kN,m

Stage No. 12 Change properties of soil type 2 to soil type 4
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 20.00 from wall
Right side 20.00 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	31.00	0.00	0.004	-1.57E-03	0.0	0.0		105980
2	30.60	0.00	0.005	-1.57E-03	0.0	-0.0		105980
3	30.45	1.11	0.005	-1.57E-03	0.1	0.0	71.0	105980
		1.11	0.005	-1.57E-03	-70.9	0.0		
4	30.15	3.83	0.006	-1.55E-03	-70.2	-21.1		105980
5	29.88	8.20	0.006	-1.49E-03	-68.5	-40.2		105980
6	29.60	12.42	0.006	-1.40E-03	-65.7	-58.7		105980
7	29.30	17.18	0.007	-1.25E-03	-61.2	-77.8		105980
8	29.00	23.11	0.007	-1.07E-03	-55.2	-95.2		105980
9	28.50	34.17	0.008	-7.03E-04	-40.9	-119.5		105980
10	28.00	43.84	0.008	-2.57E-04	-21.4	-135.3		105980
11	27.65	49.52	0.008	8.12E-05	-5.0	-140.0		105980
12	27.30	54.55	0.008	4.26E-04	13.2	-138.6		105980
		57.75	0.008	4.26E-04	13.2	-138.6		
13	26.90	62.01	0.008	8.06E-04	37.1	-128.8		105980
14	26.50	65.92	0.007	1.14E-03	62.7	-109.0		105980
15	26.14	69.32	0.007	1.38E-03	87.3	-81.9		105980
16	25.77	72.64	0.006	1.52E-03	113.1	-45.6	90.4	105980
		72.64	0.006	1.52E-03	22.8	-45.6		
17	25.34	76.57	0.006	1.62E-03	55.1	-25.8		105980
		54.04	0.006	1.62E-03	55.1	-25.8		
18	25.00	54.70	0.005	1.65E-03	73.5	-4.2		105980
19	24.79	53.08	0.005	1.64E-03	84.9	12.4		105980
		-80.88	0.005	1.64E-03	84.9	12.4		
20	24.40	-87.07	0.004	1.58E-03	51.7	38.6		105980
21	24.00	-75.80	0.003	1.46E-03	19.5	51.6		105980
22	23.50	-52.42	0.003	1.28E-03	-12.5	51.2		105980
23	23.00	-19.68	0.002	1.13E-03	-30.6	38.4		105980
24	22.50	9.63	0.002	1.03E-03	-33.1	20.6		105980
25	22.00	37.09	0.001	9.89E-04	-21.4	5.2		105980
		42.45	0.001	9.89E-04	-21.4	5.2		
26	21.60	64.47	0.001	9.81E-04	0.0	-0.0		---
At elev. 30.45 Strut force =				71.0 kN/strut =		71.0 kN/m run		
At elev. 25.77 Strut force =				90.4 kN/strut =		90.4 kN/m run		

(continued)

Stage No.12 Change properties of soil type 2 to soil type 4
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	31.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	30.60	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	49952
3	30.45	0.00	2.96	1.11	7.89	1.11	1.11a	2654
4	30.15	0.00	10.20	3.83	27.15	3.83	3.83a	2654
5	29.88	2.75	14.51	5.45	38.64	5.45	8.20a	2654
6	29.60	5.50	18.42	6.92	49.05	6.92	12.42a	2654
7	29.30	8.50	23.10	8.68	61.52	8.68	17.18a	2654
8	29.00	11.50	30.93	11.61	82.36	11.61	23.11a	2654
9	28.50	16.50	47.04	17.67	125.28	17.67	34.17a	2654
10	28.00	21.50	59.49	22.34	158.42	22.34	43.84a	2654
11	27.65	25.00	65.29	24.52	173.87	24.52	49.52a	2654
12	27.30	28.50	69.37	26.05	184.73	26.05	54.55a	2654
		28.50	69.37	29.25	164.49	29.25	57.75a	14164
13	26.90	30.24	75.35	31.78	178.67	31.78	62.01a	14164
14	26.50	31.97	80.50	33.95	190.89	33.95	65.92a	14164
15	26.14	33.55	84.81	35.77	201.10	35.77	69.32a	14164
16	25.77	35.13	88.95	37.51	210.91	37.51	72.64a	14164
17	25.34	37.01	93.80	39.56	222.42	39.56	76.57a	14164
18	25.00	38.48	97.63	41.17	231.50	41.17	79.66a	14164
19	24.79	39.40	100.02	42.18	237.15	42.18	81.57a	14164
20	24.40	41.11	104.56	44.10	247.94	44.10	85.21a	23071
21	24.00	42.82	109.20	46.05	258.94	62.08	104.90	23071
22	23.50	44.99	115.22	48.59	273.20	83.78	128.78	23071
23	23.00	47.16	121.39	51.19	287.84	103.74	150.91	23071
24	22.50	49.34	127.10	53.60	301.37	122.49	171.82	23071
25	22.00	51.51	134.19	56.59	318.18	140.62	192.12	23071
		Total>	185.69	43.00m	400.82	197.48	197.48	41742
26	21.60	Total>	192.70	45.00m	417.27	214.07	214.07	43575

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	31.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	30.60	0.00	0.00	0.00	0.00	0.00	0.00	0.0
3	30.45	0.00	0.00	0.00	0.00	0.00	0.00	0.0
4	30.15	0.00	0.00	0.00	0.00	0.00	0.00	0.0
5	29.88	0.00	0.00	0.00	0.00	0.00	0.00	0.0
6	29.60	0.00	0.00	0.00	0.00	0.00	0.00	0.0
7	29.30	0.00	0.00	0.00	0.00	0.00	0.00	0.0
8	29.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
9	28.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
10	28.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
11	27.65	0.00	0.00	0.00	0.00	0.00	0.00	0.0
12	27.30	0.00	0.00	0.00	0.00	0.00	0.00	0.0
13	26.90	0.00	0.00	0.00	0.00	0.00	0.00	0.0
14	26.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
15	26.14	0.00	0.00	0.00	0.00	0.00	0.00	0.0
16	25.77	0.00	0.00	0.00	0.00	0.00	0.00	0.0
17	25.34	0.00	0.00	0.00	0.00	0.00	0.00	0.0
		0.00	60.00	22.53	159.78	22.53	22.53a	9977

(continued)

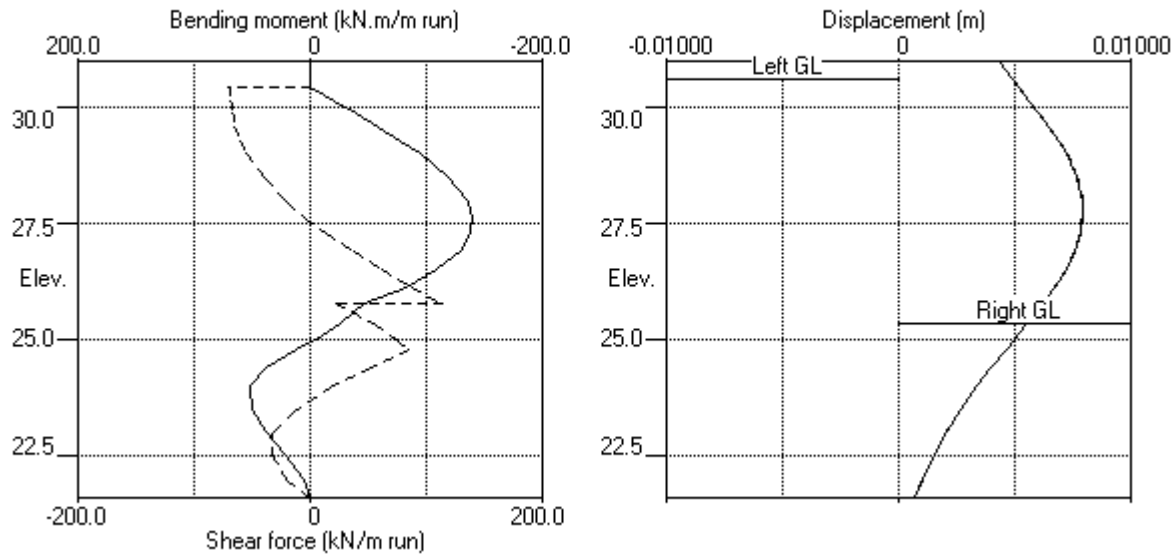
Stage No.12 Change properties of soil type 2 to soil type 4
 Ko pressures will not be reset

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
18	25.00	0.00	66.45	24.95	176.95	24.95	24.95a	9977
19	24.79	3.29	67.13	25.21	178.75	25.21	28.49a	9977
		3.29	67.13	28.31	159.17	159.17	162.45p	53592
20	24.40	9.47	68.70	28.97	162.91	162.80	172.27	23071
21	24.00	15.66	70.12	29.57	166.27	165.04	180.70	23071
22	23.50	23.49	71.63	30.21	169.85	157.71	181.20	23071
23	23.00	31.32	72.79	30.70	172.61	139.27	170.59	23071
24	22.50	39.15	73.64	31.05	174.61	123.04	162.19	23071
25	22.00	46.98	74.21	31.30	175.98	108.05	155.03	23071
26	21.60	53.24	74.53	31.43	176.72	96.36	149.60	23071

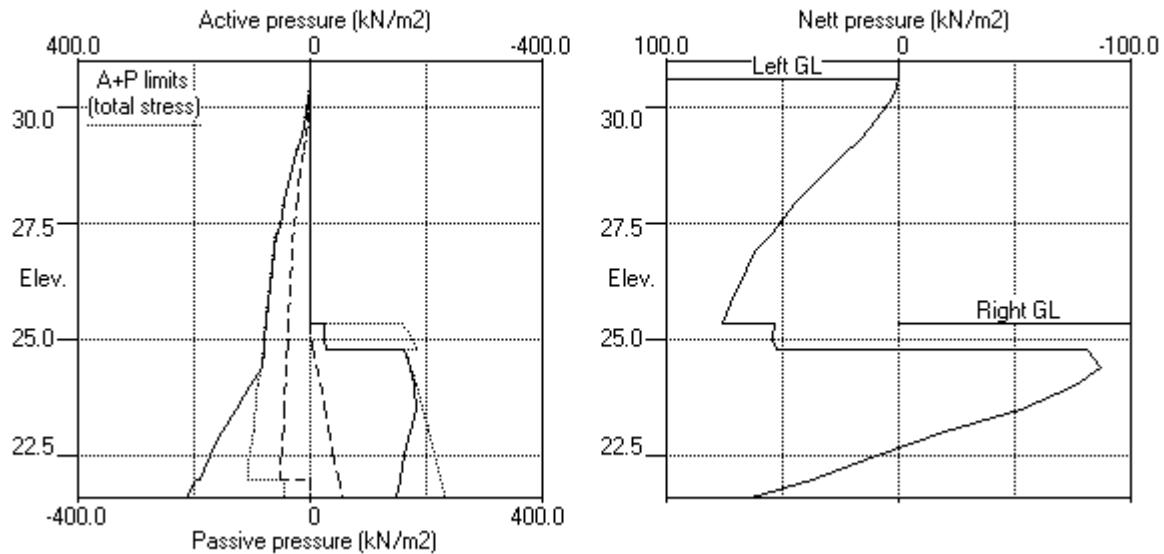
Note: 28.49a Soil pressure at active limit
 162.45p Soil pressure at passive limit

Units: kN,m

Stage No.12 Change soil type 2 to soil type 4



Stage No.12 Change soil type 2 to soil type 4



PILEDESIGNS LIMITED	Sheet No.
Program: WALLAP Version 6.06 Revision A51.B69.R54	Job No. 23811
Licensed from GEOSOLVE	Made by : MJC
Data filename/Run ID: 23811_Kentish_Town_Section2_04_ULS1	
KENTISH TOWN	Date:26-05-2021
Design Case 2 - 600 dia @ 840	Checked :

Units: kN,m

Stage No. 13 Change properties of soil type 3 to soil type 5
Ko pressures will 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 20.00 from wall
Right side 20.00 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	31.00	0.00	0.004	-1.57E-03	0.0	0.0		105980
2	30.60	0.00	0.005	-1.57E-03	0.0	-0.0		105980
3	30.45	1.11	0.005	-1.57E-03	0.1	0.0	71.0	105980
		1.11	0.005	-1.57E-03	-70.9	0.0		
4	30.15	3.83	0.006	-1.55E-03	-70.2	-21.1		105980
5	29.88	8.20	0.006	-1.49E-03	-68.5	-40.2		105980
6	29.60	12.42	0.006	-1.40E-03	-65.7	-58.7		105980
7	29.30	17.18	0.007	-1.25E-03	-61.2	-77.8		105980
8	29.00	23.11	0.007	-1.07E-03	-55.2	-95.2		105980
9	28.50	34.17	0.008	-7.03E-04	-40.9	-119.5		105980
10	28.00	43.84	0.008	-2.57E-04	-21.4	-135.3		105980
11	27.65	49.52	0.008	8.13E-05	-5.0	-140.0		105980
12	27.30	54.55	0.008	4.26E-04	13.2	-138.6		105980
		57.76	0.008	4.26E-04	13.2	-138.6		
13	26.90	62.02	0.008	8.06E-04	37.1	-128.8		105980
14	26.50	65.93	0.007	1.14E-03	62.7	-109.0		105980
15	26.14	69.32	0.007	1.38E-03	87.3	-81.9		105980
16	25.77	72.65	0.006	1.52E-03	113.1	-45.6	89.6	105980
		72.65	0.006	1.52E-03	23.5	-45.6		
17	25.34	76.57	0.006	1.61E-03	55.8	-25.4		105980
		54.04	0.006	1.61E-03	55.8	-25.4		
18	25.00	54.70	0.005	1.64E-03	74.3	-3.6		105980
19	24.79	53.07	0.005	1.64E-03	85.6	13.2		105980
		-80.88	0.005	1.64E-03	85.6	13.2		
20	24.40	-87.15	0.004	1.57E-03	52.4	39.6		105980
21	24.00	-76.20	0.003	1.45E-03	20.2	52.9		105980
22	23.50	-53.27	0.003	1.27E-03	-12.2	52.8		105980
23	23.00	-21.20	0.002	1.11E-03	-30.8	40.0		105980
24	22.50	7.23	0.002	1.00E-03	-34.3	21.9		105980
25	22.00	33.62	0.001	9.51E-04	-24.1	5.6		105980
		54.03	0.001	9.51E-04	-24.1	5.6		
26	21.60	66.52	0.001	9.43E-04	0.0	-0.0		---
At elev. 30.45 Strut force =				71.0 kN/strut =	71.0 kN/m run			
At elev. 25.77 Strut force =				89.6 kN/strut =	89.6 kN/m run			

(continued)

Stage No.13 Change properties of soil type 3 to soil type 5
Ko pressures will 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	31.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	30.60	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	44099
3	30.45	0.00	2.96	1.11	7.89	1.11	1.11a	2555
4	30.15	0.00	10.20	3.83	27.15	3.83	3.83a	2555
5	29.88	2.75	14.51	5.45	38.64	5.45	8.20a	2555
6	29.60	5.50	18.42	6.92	49.05	6.92	12.42a	2555
7	29.30	8.50	23.10	8.68	61.52	8.68	17.18a	2555
8	29.00	11.50	30.93	11.61	82.36	11.61	23.11a	2555
9	28.50	16.50	47.04	17.67	125.28	17.67	34.17a	2555
10	28.00	21.50	59.49	22.34	158.42	22.34	43.84a	2555
11	27.65	25.00	65.29	24.52	173.87	24.52	49.52a	2555
12	27.30	28.50	69.37	26.05	184.73	26.05	54.55a	2555
		28.50	69.37	29.25	164.49	29.26	57.76	13629
13	26.90	30.24	75.35	31.78	178.67	31.79	62.02	13629
14	26.50	31.97	80.50	33.95	190.89	33.96	65.93	13629
15	26.14	33.55	84.81	35.77	201.10	35.77	69.32	13629
16	25.77	35.13	88.95	37.51	210.91	37.52	72.65	13629
17	25.34	37.01	93.80	39.56	222.42	39.56	76.57	13629
18	25.00	38.48	97.63	41.17	231.50	41.17	79.66a	29946
19	24.79	39.40	100.02	42.18	237.15	42.18	81.57a	29946
20	24.40	41.11	104.56	44.10	247.94	44.10	85.21a	29946
21	24.00	42.82	109.20	46.05	258.94	61.88	104.70	29946
22	23.50	44.99	115.22	48.59	273.20	83.36	128.35	29946
23	23.00	47.16	121.39	51.19	287.84	102.99	150.15	29946
24	22.50	49.34	127.10	53.60	301.37	121.28	170.62	29946
25	22.00	51.51	134.19	56.59	318.18	138.88	190.38	29946
		51.51	134.19	56.59	318.18	159.29	210.79	29946
26	21.60	53.24	139.45	58.81	330.67	165.06	218.30	31261

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	31.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	30.60	0.00	0.00	0.00	0.00	0.00	0.00	0.0
3	30.45	0.00	0.00	0.00	0.00	0.00	0.00	0.0
4	30.15	0.00	0.00	0.00	0.00	0.00	0.00	0.0
5	29.88	0.00	0.00	0.00	0.00	0.00	0.00	0.0
6	29.60	0.00	0.00	0.00	0.00	0.00	0.00	0.0
7	29.30	0.00	0.00	0.00	0.00	0.00	0.00	0.0
8	29.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
9	28.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
10	28.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
11	27.65	0.00	0.00	0.00	0.00	0.00	0.00	0.0
12	27.30	0.00	0.00	0.00	0.00	0.00	0.00	0.0
13	26.90	0.00	0.00	0.00	0.00	0.00	0.00	0.0
14	26.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
15	26.14	0.00	0.00	0.00	0.00	0.00	0.00	0.0
16	25.77	0.00	0.00	0.00	0.00	0.00	0.00	0.0
17	25.34	0.00	0.00	0.00	0.00	0.00	0.00	0.0
		0.00	60.00	22.53	159.78	22.53	22.53a	28862

(continued)

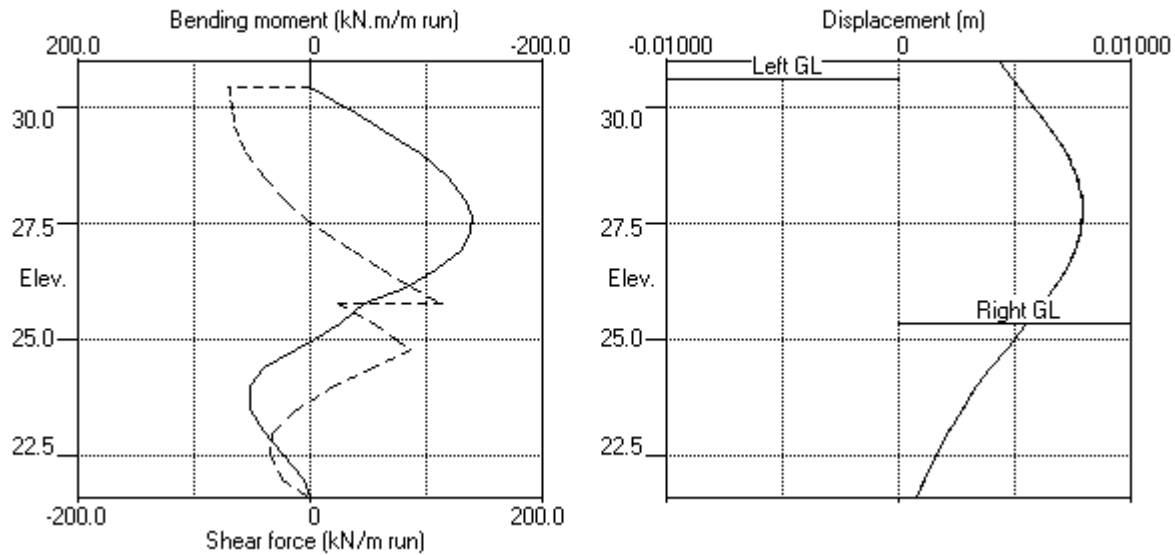
Stage No.13 Change properties of soil type 3 to soil type 5
 Ko pressures will be reset

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		
18	25.00	0.00	66.45	24.95	176.95	24.95	24.95a	5585
19	24.79	3.29	67.13	25.21	178.75	25.21	28.50a	5585
		3.29	67.13	28.31	159.17	159.17	162.45p	29946
20	24.40	9.47	68.70	28.97	162.91	162.89	172.36	29946
21	24.00	15.66	70.12	29.57	166.27	165.24	180.90	29946
22	23.50	23.49	71.63	30.21	169.85	158.13	181.62	29946
23	23.00	31.32	72.79	30.70	172.61	140.03	171.35	29946
24	22.50	39.15	73.64	31.05	174.61	124.24	163.39	29946
25	22.00	46.98	74.21	31.30	175.98	109.79	156.76	29946
26	21.60	53.24	74.53	31.43	176.72	98.54	151.79	29946

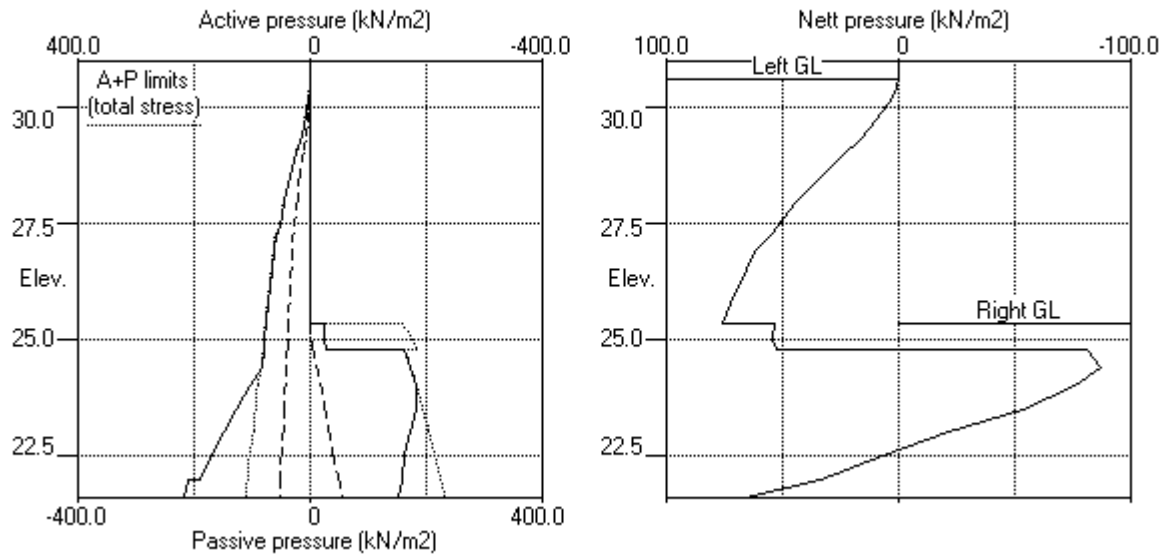
Note: 28.50a Soil pressure at active limit
 162.45p Soil pressure at passive limit

Units: kN,m

Stage No.13 Change soil type 3 to soil type 5



Stage No.13 Change soil type 3 to soil type 5



PILEDESIGNS LIMITED	Sheet No.
Program: WALLAP Version 6.06 Revision A51.B69.R54	Job No. 23811
Licensed from GEOSOLVE	Made by : MJC
Data filename/Run ID: 23811_Kentish_Town_Section2_04_ULS1	
KENTISH TOWN	Date:26-05-2021
Design Case 2 - 600 dia @ 840	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 20.00 from wall
 Right side 20.00 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	31.00	0.004	0.000	0	-0	0	-0	0	-57	0	-77
2	30.60	0.005	0.000	0	-23	0	-31	0	-57	0	-77
3	30.45	0.005	0.000	0	-31	0	-42	0	-71	0	-96
4	30.15	0.006	0.000	0	-48	0	-65	0	-70	0	-95
5	29.88	0.006	0.000	0	-63	0	-85	0	-68	0	-92
6	29.60	0.006	0.000	0	-78	0	-105	0	-66	0	-89
7	29.30	0.007	0.000	0	-93	0	-125	0	-61	0	-83
8	29.00	0.007	0.000	0	-106	0	-143	0	-55	0	-74
9	28.50	0.008	0.000	0	-123	0	-166	0	-41	0	-55
10	28.00	0.008	0.000	0	-135	0	-183	6	-21	8	-29
11	27.65	0.008	0.000	0	-140	0	-189	13	-5	17	-7
12	27.30	0.008	0.000	3	-139	4	-187	28	0	38	0
13	26.90	0.008	0.000	9	-129	12	-174	56	0	76	0
14	26.50	0.007	0.000	12	-109	17	-147	86	0	117	0
15	26.14	0.007	0.000	13	-82	18	-111	115	0	155	0
16	25.77	0.006	0.000	17	-63	23	-85	144	-42	195	-57
17	25.34	0.006	0.000	12	-32	16	-43	73	-6	99	-8
18	25.00	0.006	0.000	11	-5	15	-7	88	-4	118	-6
19	24.79	0.006	0.000	17	0	23	0	99	-4	134	-6
20	24.40	0.005	0.000	45	0	61	0	52	-5	71	-6
21	24.00	0.005	0.000	56	0	76	0	20	-4	27	-6
22	23.50	0.005	0.000	53	0	71	0	0	-19	0	-25
23	23.00	0.004	0.000	40	0	54	0	0	-33	0	-44
24	22.50	0.004	0.000	22	0	30	0	0	-34	0	-46
25	22.00	0.004	0.000	6	0	8	0	0	-24	0	-33
26	21.60	0.004	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	kN/m	
1	2 26.14	-1 28.50		2 -1			2 27.30	-1 29.60		3 -1		
2	No calculation at this stage											
3	13 26.14	-7 28.50		18 -9			21 27.30	-5 29.30		28 -7		
4	No calculation at this stage											
5	55 24.00	-131 28.00		74 -176			97 24.79	-56 31.00		131 -76		
6	56 24.00	-132 28.00		76 -178			99 24.79	-57 31.00		134 -77		
7	No calculation at this stage											
8	No calculation at this stage											
9	53 24.00	-124 27.65		72 -167			99 24.79	-66 30.45		133 -89		
10	No calculation at this stage											
11	No calculation at this stage											
12	52 24.00	-140 27.65		70 -189			113 25.77	-71 30.45		153 -96		
13	53 24.00	-140 27.65		71 -189			113 25.77	-71 30.45		153 -96		
14	17 25.77	-118 27.65		23 -159			144 25.77	-68 30.45		195 -91		

Maximum and minimum displacement at each stage

Stage no.	Displacement				Stage description
	maximum elev.	minimum elev.			
	m	m			
1	0.000 31.00	0.000 31.00			Apply surcharge no.1 at elev. 30.60
2	No calculation at this stage				Apply surcharge no.2 at elev. 29.60
3	0.002 31.00	0.000 31.00			Apply water pressure profile no.1
4	No calculation at this stage				Install strut no.3 at elev. 31.00
5	0.008 27.65	0.000 31.00			Excav. to elev. 24.79 on RIGHT side
6	0.008 27.65	0.000 31.00			Fill to elev. 25.34 on RIGHT side
7	No calculation at this stage				Install strut no.2 at elev. 25.77
8	No calculation at this stage				Install strut no.1 at elev. 30.45
9	0.008 27.65	0.000 31.00			Remove strut no.3 at elev. 31.00
10	No calculation at this stage				Change EI of wall to 105980kN.m2/m run
11	No calculation at this stage				Apply surcharge no.4 at elev. 25.34
12	0.008 27.65	0.000 31.00			Change soil type 2 to soil type 4
13	0.008 27.65	0.000 31.00			Change soil type 3 to soil type 5
14	0.007 27.65	0.000 31.00			Apply water pressure profile no.2

Strut forces at each stage (horizontal components)

Stage no.	Strut no. 1			Strut no. 2			Strut no. 3		
	at elev. 30.45			at elev. 25.77			at elev. 31.00		
	--Calculated--	Factored		--Calculated--	Factored		--Calculated--	Factored	
	kN per m run	kN per strut	kN per strut	kN per m run	kN per strut	kN per strut	kN per m run	kN per strut	kN per strut
5	---	---	---	---	---	---	56	56	76
6	---	---	---	---	---	---	57	57	77
9	66	66	89	slack	slack	slack	---	---	---
12	71	71	96	90	90	122	---	---	---
13	71	71	96	90	90	121	---	---	---
14	68	68	92	187	187	252	---	---	---

PILEDESIGNS LIMITED

Program: WALLAP Version 6.06 Revision A51.B69.R54

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Data filename/Run ID: 23811_Kentish_Town_Section2_04_ULS1

KENTISH TOWN

Design Case 2 - 600 dia @ 840

| Sheet No.

| Job No. 23811

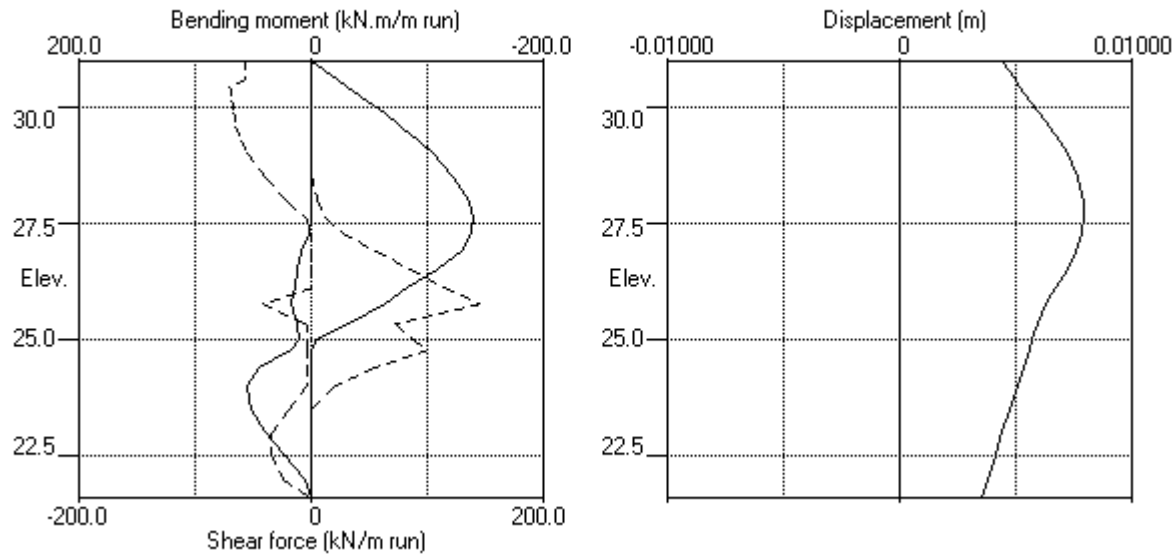
| Made by : MJC

| Date:26-05-2021

| Checked :

Units: kN,m

Bending moment, shear force, displacement envelopes



PILEDESIGNS LIMITED	Sheet No.
Program: WALLAP Version 6.06 Revision A51.B69.R54	Job No. 23811
Licensed from GEOSOLVE	Made by : MJC
Data filename/Run ID: 23811_Kentish_Town_Section2_04_ULS2	
KENTISH TOWN	Date:26-05-2021
Design Case 2 - 600 dia @ 840	Checked :

Units: kN,m

INPUT DATA

SOIL PROFILE

Stratum no.	Elevation of top of stratum	Soil types	
		Left side	Right side
1	30.60	1 Made Ground dr	1 Made Ground dr
2	27.30	2 London Clay 1 und	2 London Clay 1 und
3	22.00	3 London Clay 2 und	2 London Clay 1 und

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 dr	19.00	10000	0.540	OC (0.250)	0.376 (0.000)	2.663 (0.000)	
2 London Clay 1 und	20.00	72000	1.200	OC (0.490)	1.000 (2.389)	1.000 (2.390)	90.00u
3 London Cl.. (22.00)	20.00	72000 (7904)	1.200	OC (0.490)	1.000 (2.389)	1.000 (2.390)	90.00u (9.880)
4 London Clay 1 dr	20.00	55440	1.200	OC (0.200)	0.422 (1.299)	2.371 (3.080)	0.0d
5 London Cl.. (22.00)	20.00	55440 (6086)	1.200	OC (0.200)	0.422 (1.299)	2.371 (3.080)	0.0d

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 dr	27.00	0.000	0.00	27.00	0.000
2 London Clay 1 und	0.00	0.500	0.00	0.00	0.500
3 London Clay 2 und	0.00	0.500	0.00	0.00	0.500
4 London Clay 1 dr	24.00	0.000	0.00	24.00	0.000
5 London Clay 2 dr	24.00	0.000	0.00	24.00	0.000

GROUND WATER CONDITIONS

Density of water = 10.00 kN/m3

	Left side	Right side
Initial water table elevation	25.00	25.00

Automatic water pressure balancing at toe of wall : Yes

Left side				Right side			
Water press.							
profile	Point	Elev.	Piezo	Point	Elev.	Piezo	Water
no.	no.	m	elev. m	no.	m	elev. m	press. kN/m2
1	1	30.15	30.15	1	25.00	25.00	0.0 MC+WC
	2	27.30	30.15	2	25.00	25.00	0.0
2	1	30.60	30.60	1	25.34	25.34	0.0 MC+WC
				2	25.34	30.60	52.6

WALL PROPERTIES

Type of structure = Fully Embedded Wall
Elevation of toe of wall = 21.60
Maximum finite element length = 0.50 m
Youngs modulus of wall E = 1.9600E+07 kN/m2
Moment of inertia of wall I = 7.5700E-03 m4/m run
E.I = 148372 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	30.45	1.00	0.275000	1.400E+07	5.00	0.00	0	No
2	25.77	1.00	0.450000	1.400E+07	5.00	0.00	0	No
3	31.00	1.00	1.000000	30000	1.00	0.00	0	No

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	30.60	0.50 (L)	10.00	10.00	10.00	=	N/A	1.30 Var
2	29.60	1.00 (L)	10.00	1.00	100.00	=	N/A	1.00 P/U
3	Not defined							
4	25.34	-0.00 (R)	10.00	10.00	60.00	=	N/A	1.00 P/F

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 30.60
2	Apply surcharge no.2 at elevation 29.60
	No analysis at this stage
3	Apply water pressure profile no.1 (Worst Cred.)
	No analysis at this stage
4	Install strut or anchor no.3 at elevation 31.00
5	Excavate to elevation 24.79 on RIGHT side
6	Fill to elevation 25.34 on RIGHT side with soil type 1
7	Install strut or anchor no.2 at elevation 25.77
8	Install strut or anchor no.1 at elevation 30.45
9	Remove strut or anchor no.3 at elevation 31.00
10	Change EI of wall to 105980 kN.m2/m run
	Yield moment not defined
	No adjustments to wall displacements
11	Apply surcharge no.4 at elevation 25.34
	No analysis at this stage
12	Change properties of soil type 2 to soil type 4
	Ko pressures will not be reset
13	Change properties of soil type 3 to soil type 5
	Ko pressures will be reset
14	Apply water pressure profile no.2 (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 = 20.00 m

Distance to rigid boundary on Right side = 20.00 m

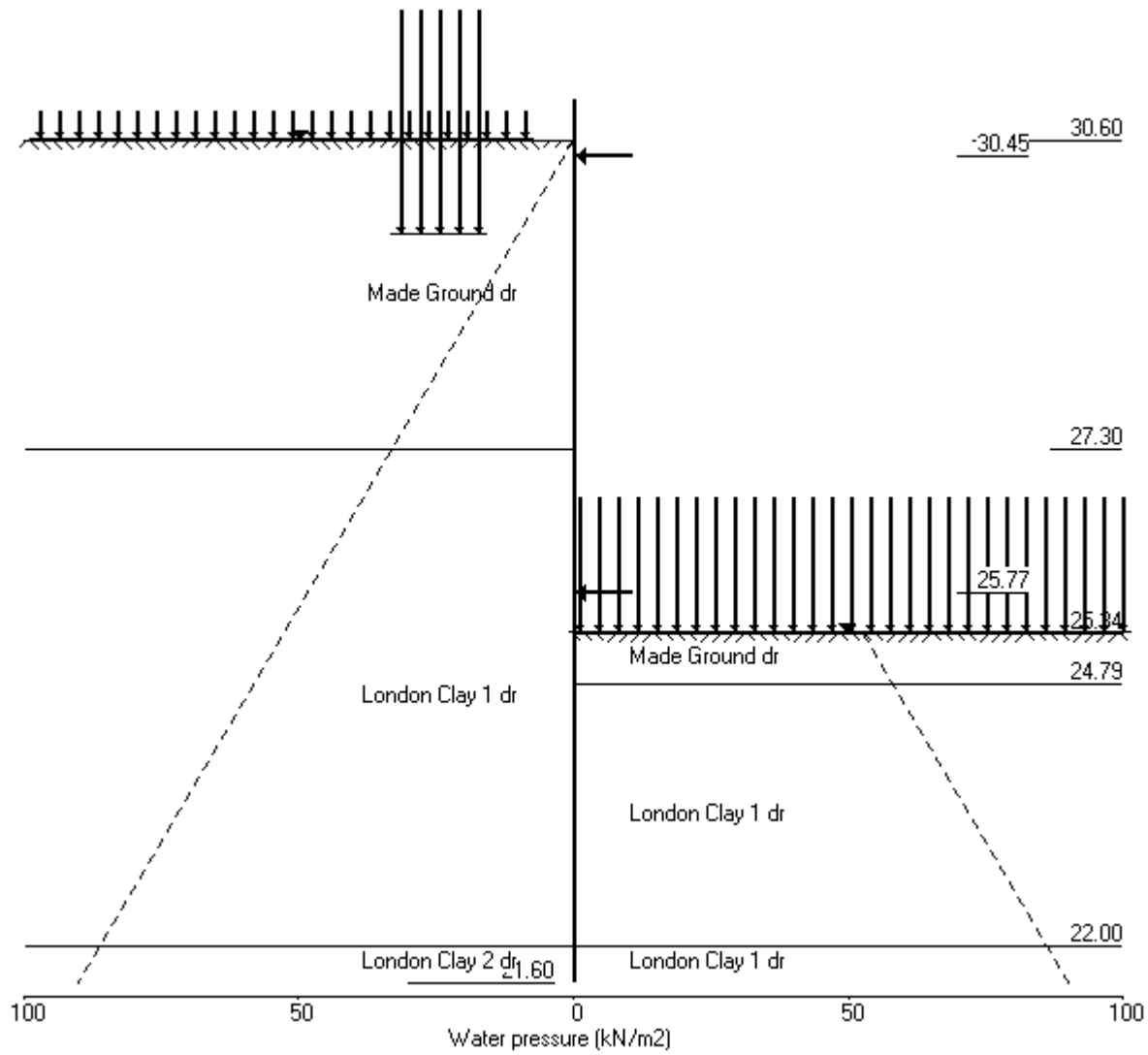
OUTPUT OPTIONS

Stage no.	Stage description	Output options		
		Displacement Bending mom. Shear force	Active, Passive pressures	Graph. output
1	Apply surcharge no.1 at elev. 30.60	No	No	No
2	Apply surcharge no.2 at elev. 29.60	No	No	No
3	Apply water pressure profile no.1	No	No	No
4	Install strut no.3 at elev. 31.00	No	No	No
5	Excav. to elev. 24.79 on RIGHT side	No	No	No
6	Fill to elev. 25.34 on RIGHT side	No	No	No
7	Install strut no.2 at elev. 25.77	No	No	No
8	Install strut no.1 at elev. 30.45	No	No	No
9	Remove strut no.3 at elev. 31.00	No	No	No
10	Change EI of wall to 105980kN.m2/m run	No	No	No
11	Apply surcharge no.4 at elev. 25.34	No	No	No
12	Change soil type 2 to soil type 4	No	No	No
13	Change soil type 3 to soil type 5	No	No	No
14	Apply water pressure profile no.2	No	No	No
*	Summary output	Yes	-	Yes

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Units: kN,m

Stage No.14 Apply water pressure profile no.2 (Worst Cred.)



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Data filename/Run ID: 23811_Kentish_Town_Section2_04_ULS2	
KENTISH TOWN	Date:26-05-2021
Design Case 2 - 600 dia @ 840	Checked :

Units: kN,m

Stage No. 5 Excavate to elevation 24.79 on RIGHT side

STABILITY ANALYSIS of Fully Embedded Wall according to Strength Factor method

Factor of safety on soil strength

			Overall				Direction of failure
			FoS for toe elev. =	21.60	Toe elev. for FoS =	1.000	
Stage No.	--- G.L. Act.	--- Pass.	Strut Elev.	Factor of Safety	Moment of equilib. at elev.	Toe elev.	Wall Penetr-ation
5	30.60	24.79	31.00	1.888	n/a	24.16	0.63
							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 20.00 from wall

Right side 20.00 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	31.00	0.00	0.005	-1.93E-03	-63.2	0.0	63.2	148372
2	30.60	0.00	0.005	-1.89E-03	-63.2	-25.3		148372
3	30.45	1.35	0.006	-1.86E-03	-63.1	-34.7		148372
4	30.15	4.74	0.006	-1.77E-03	-62.2	-53.5		148372
5	29.88	9.59	0.007	-1.66E-03	-60.2	-70.3		148372
6	29.60	14.23	0.007	-1.51E-03	-56.9	-86.5		148372
7	29.30	19.43	0.008	-1.32E-03	-51.9	-102.8		148372
8	29.00	26.03	0.008	-1.10E-03	-45.1	-117.4		148372
9	28.50	38.38	0.008	-6.76E-04	-29.0	-136.2		148372
10	28.00	49.03	0.009	-2.01E-04	-7.1	-145.5		148372
11	27.65	55.17	0.009	1.40E-04	11.1	-144.8		148372
12	27.30	60.51	0.009	4.73E-04	31.4	-137.4		148372
		16.50	0.009	4.73E-04	31.4	-137.4		
13	26.90	18.50	0.008	8.25E-04	38.4	-123.7		148372
14	26.50	20.50	0.008	1.13E-03	46.2	-107.0		148372
15	26.14	22.32	0.007	1.37E-03	54.0	-89.0		148372
16	25.77	24.14	0.007	1.56E-03	62.4	-68.0		148372
17	25.34	26.30	0.006	1.72E-03	73.3	-38.8		148372
18	25.00	38.74	0.006	1.78E-03	84.4	-10.1		148372
19	24.79	48.34	0.005	1.78E-03	93.5	8.5		148372
		-105.30	0.005	1.78E-03	93.5	8.5		
20	24.40	-91.40	0.005	1.72E-03	54.7	37.1		148372
21	24.00	-78.24	0.004	1.60E-03	21.2	51.5		148372
22	23.50	-60.81	0.003	1.42E-03	-13.6	57.0		148372
23	23.00	-22.22	0.002	1.25E-03	-34.3	42.5		148372
24	22.50	12.24	0.002	1.14E-03	-36.8	22.5		148372
25	22.00	44.46	0.001	1.09E-03	-22.7	5.5		148372
26	21.60	68.85	0.001	1.08E-03	0.0	0.0		---
At elev. 31.00 Strut force =			63.2 kN/strut =		63.2 kN/m run			

(continued)

Stage No.5 Excavate to elevation 24.79 on RIGHT side

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	31.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	30.60	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	2027
3	30.45	0.00	2.98	1.35	6.60	1.35	1.35a	2027
4	30.15	0.00	10.50	4.74	23.22	4.74	4.74a	2027
5	29.88	2.75	15.14	6.84	33.51	6.84	9.59a	2027
6	29.60	5.50	19.31	8.73	42.73	8.73	14.23a	2027
7	29.30	8.50	24.20	10.93	53.54	10.93	19.43a	2027
8	29.00	11.50	32.16	14.53	71.15	14.53	26.03a	2027
9	28.50	16.50	48.41	21.88	107.12	21.88	38.38a	2027
10	28.00	21.50	60.93	27.53	134.81	27.53	49.03a	2027
11	27.65	25.00	66.75	30.17	147.70	30.17	55.17a	2027
12	27.30	28.50	70.84	32.01	156.74	32.01	60.51a	2027
		Total>	99.34	16.50m	252.99	16.50	16.50a	20827
13	26.90	Total>	107.05	18.50m	260.71	18.50	18.50a	20827
14	26.50	Total>	113.92	20.50m	267.58	20.50	20.50a	20827
15	26.14	Total>	119.78	22.32m	273.44	22.32	22.32a	20827
16	25.77	Total>	125.47	24.14m	279.13	24.14	24.14a	20827
17	25.34	Total>	132.17	26.30m	285.83	26.30	26.30a	20827
18	25.00	Total>	137.44	28.00m	291.10	38.74	38.74	20827
19	24.79	Total>	140.72	29.05m	294.38	50.44	50.44	20827
20	24.40	Total>	123.33	31.02m	276.99	72.24	72.24	20827
21	24.00	Total>	153.25	33.00m	306.92	93.31	93.31	20827
22	23.50	Total>	161.39	35.50m	315.05	118.45	118.45	20827
23	23.00	Total>	169.68	38.00m	323.35	141.81	141.81	20827
24	22.50	Total>	178.13	40.50m	331.80	163.83	163.83	20827
25	22.00	Total>	186.72	43.00m	340.39	185.17	185.17	20827
26	21.60	Total>	193.68	45.00m	354.10	201.24	201.24	21741

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		
1	31.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	30.60	0.00	0.00	0.00	0.00	0.00	0.00	0.0
3	30.45	0.00	0.00	0.00	0.00	0.00	0.00	0.0
4	30.15	0.00	0.00	0.00	0.00	0.00	0.00	0.0
5	29.88	0.00	0.00	0.00	0.00	0.00	0.00	0.0
6	29.60	0.00	0.00	0.00	0.00	0.00	0.00	0.0
7	29.30	0.00	0.00	0.00	0.00	0.00	0.00	0.0
8	29.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
9	28.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
10	28.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
11	27.65	0.00	0.00	0.00	0.00	0.00	0.00	0.0
12	27.30	0.00	0.00	0.00	0.00	0.00	0.00	0.0
13	26.90	0.00	0.00	0.00	0.00	0.00	0.00	0.0
14	26.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
15	26.14	0.00	0.00	0.00	0.00	0.00	0.00	0.0
16	25.77	0.00	0.00	0.00	0.00	0.00	0.00	0.0
17	25.34	0.00	0.00	0.00	0.00	0.00	0.00	0.0
18	25.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
19	24.79	2.10	0.00	0.00	0.00	0.00	2.10	0.0
		Total>	2.10	2.10w	155.74	155.74	155.74p	40323

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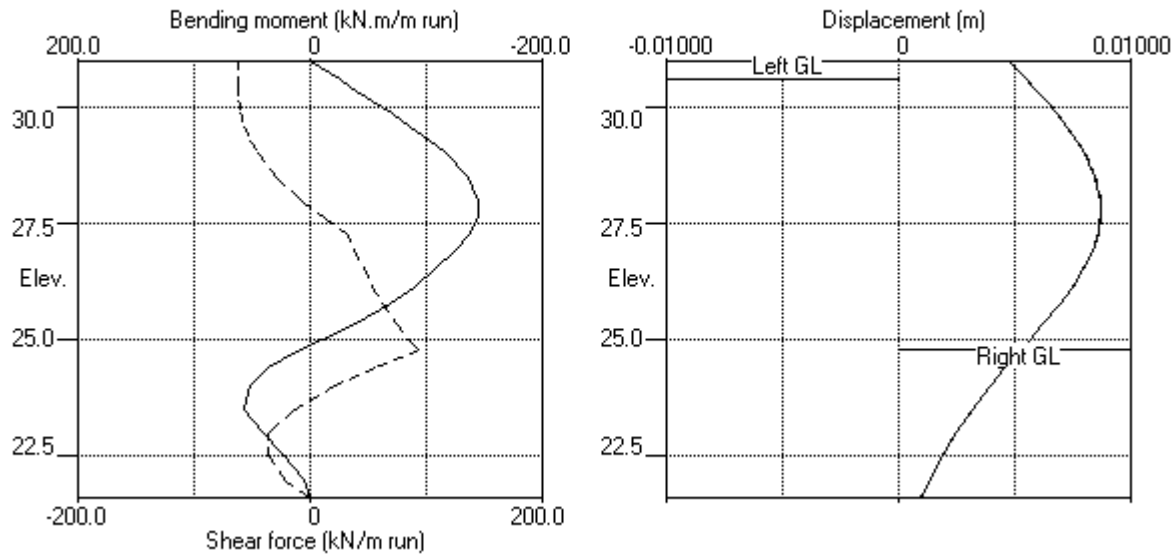
Stage No.5 Excavate to elevation 24.79 on RIGHT side

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
20	24.40	Total>	10.00	3.02m	163.64	163.64	163.64p	40323
21	24.00	Total>	17.90	5.00m	171.54	171.54	171.54p	40323
22	23.50	Total>	27.91	7.50m	181.55	179.26	179.26	40323
23	23.00	Total>	37.93	10.00m	191.57	164.03	164.03	40323
24	22.50	Total>	47.97	12.50m	201.61	151.59	151.59	40323
25	22.00	Total>	58.02	15.00m	211.67	140.70	140.70	40323
26	21.60	Total>	66.09	17.00m	219.73	132.39	132.39	40323

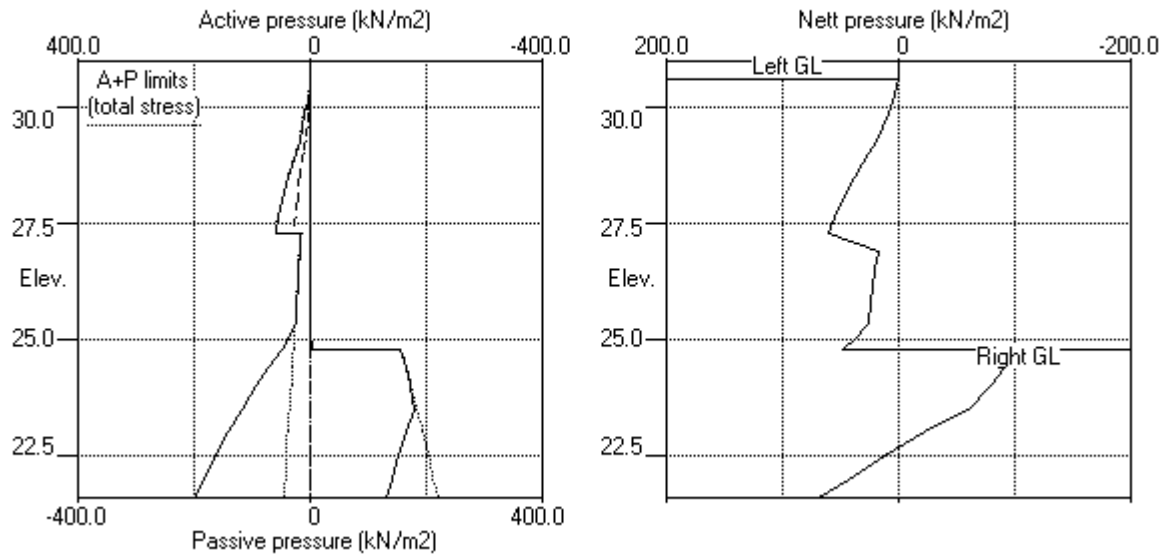
Note: 26.30a Soil pressure at active limit
 171.54p Soil pressure at passive limit

Units: kN,m

Stage No.5 Excav. to elev. 24.79 on RIGHT side



Stage No.5 Excav. to elev. 24.79 on RIGHT side



PILEDESIGNS LIMITED	Sheet No.
Program: WALLAP Version 6.06 Revision A51.B69.R54	Job No. 23811
Licensed from GEOSOLVE	Made by : MJC
Data filename/Run ID: 23811_Kentish_Town_Section2_04_ULS2	
KENTISH TOWN	Date:26-05-2021
Design Case 2 - 600 dia @ 840	Checked :

Units: kN,m

Stage No. 6 Fill to elevation 25.34 on RIGHT side with soil type 1

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. = 21.60		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	
6	30.60	25.34	31.00	1.977	n/a	24.23	1.11	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 20.00 from wall

Right side 20.00 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	31.00	0.00	0.005	-1.92E-03	-63.6	0.0	63.6	148372
2	30.60	0.00	0.006	-1.89E-03	-63.6	-25.4		148372
3	30.45	1.35	0.006	-1.86E-03	-63.5	-35.0		148372
4	30.15	4.74	0.006	-1.77E-03	-62.6	-53.8		148372
5	29.88	9.59	0.007	-1.65E-03	-60.6	-70.8		148372
6	29.60	14.23	0.007	-1.51E-03	-57.3	-87.0		148372
7	29.30	19.43	0.008	-1.32E-03	-52.3	-103.5		148372
8	29.00	26.03	0.008	-1.09E-03	-45.4	-118.2		148372
9	28.50	38.38	0.008	-6.66E-04	-29.3	-137.2		148372
10	28.00	49.05	0.009	-1.88E-04	-7.5	-146.6		148372
11	27.65	55.20	0.009	1.57E-04	10.8	-146.1		148372
12	27.30	60.56	0.009	4.93E-04	31.0	-138.8		148372
		16.96	0.009	4.93E-04	31.0	-138.8		
13	26.90	19.20	0.008	8.49E-04	38.3	-125.2		148372
14	26.50	21.47	0.008	1.16E-03	46.4	-108.5		148372
15	26.14	23.58	0.007	1.40E-03	54.6	-90.4		148372
16	25.77	25.72	0.007	1.60E-03	63.5	-69.0		148372
17	25.34	28.30	0.006	1.76E-03	75.2	-39.2		148372
18	25.00	38.14	0.006	1.81E-03	86.5	-9.8		148372
19	24.79	46.47	0.005	1.81E-03	95.4	9.2		148372
		-108.30	0.005	1.81E-03	95.4	9.2		
20	24.40	-93.66	0.004	1.75E-03	55.5	38.3		148372
21	24.00	-79.82	0.004	1.63E-03	21.3	52.9		148372
22	23.50	-61.65	0.003	1.44E-03	-14.1	58.2		148372
23	23.00	-22.43	0.002	1.27E-03	-35.1	43.4		148372
24	22.50	12.58	0.002	1.16E-03	-37.6	22.9		148372
25	22.00	45.31	0.001	1.11E-03	-23.1	5.7		148372
26	21.60	70.29	0.001	1.10E-03	0.0	0.0		---
At elev. 31.00 Strut force =			63.6 kN/strut =		63.6 kN/m run			

(continued)

Stage No.6 Fill to elevation 25.34 on RIGHT side with soil type 1

Node no.	Y coord	LEFT 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
1	31.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	30.60	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	4461
3	30.45	0.00	2.98	1.35	6.60	1.35	1.35a	4461
4	30.15	0.00	10.50	4.74	23.22	4.74	4.74a	4461
5	29.88	2.75	15.14	6.84	33.51	6.84	9.59a	4461
6	29.60	5.50	19.31	8.73	42.73	8.73	14.23a	4461
7	29.30	8.50	24.20	10.93	53.54	10.93	19.43a	4461
8	29.00	11.50	32.16	14.53	71.15	14.53	26.03a	4461
9	28.50	16.50	48.41	21.88	107.12	21.88	38.38a	4461
10	28.00	21.50	60.93	27.53	134.81	27.55	49.05	2692
11	27.65	25.00	66.75	30.17	147.70	30.20	55.20	2692
12	27.30	28.50	70.84	32.01	156.74	32.06	60.56	2692
		Total>	99.34	16.50m	252.99	16.96	16.96	26822
13	26.90	Total>	107.05	18.50m	260.71	19.20	19.20	26822
14	26.50	Total>	113.92	20.50m	267.58	21.47	21.47	26822
15	26.14	Total>	119.78	22.32m	273.44	23.58	23.58	26822
16	25.77	Total>	125.47	24.14m	279.13	25.72	25.72	26822
17	25.34	Total>	132.17	26.30m	285.83	28.30	28.30	26822
18	25.00	Total>	137.44	28.00m	291.10	41.06	41.06	26822
19	24.79	Total>	140.72	29.05m	294.38	52.97	52.97	26822
20	24.40	Total>	123.33	31.02m	276.99	75.14	75.14	26822
21	24.00	Total>	153.25	33.00m	306.92	96.53	96.53	26822
22	23.50	Total>	161.39	35.50m	315.05	122.05	122.05	26822
23	23.00	Total>	169.68	38.00m	323.35	145.72	145.72	26822
24	22.50	Total>	178.13	40.50m	331.80	168.02	168.02	26822
25	22.00	Total>	186.72	43.00m	340.39	189.61	189.61	26822
26	21.60	Total>	193.68	45.00m	354.10	206.09	206.09	28000

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
1	31.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	30.60	0.00	0.00	0.00	0.00	0.00	0.00	0.0
3	30.45	0.00	0.00	0.00	0.00	0.00	0.00	0.0
4	30.15	0.00	0.00	0.00	0.00	0.00	0.00	0.0
5	29.88	0.00	0.00	0.00	0.00	0.00	0.00	0.0
6	29.60	0.00	0.00	0.00	0.00	0.00	0.00	0.0
7	29.30	0.00	0.00	0.00	0.00	0.00	0.00	0.0
8	29.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
9	28.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
10	28.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
11	27.65	0.00	0.00	0.00	0.00	0.00	0.00	0.0
12	27.30	0.00	0.00	0.00	0.00	0.00	0.00	0.0
13	26.90	0.00	0.00	0.00	0.00	0.00	0.00	0.0
14	26.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
15	26.14	0.00	0.00	0.00	0.00	0.00	0.00	0.0
16	25.77	0.00	0.00	0.00	0.00	0.00	0.00	0.0
17	25.34	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	2692
18	25.00	0.00	6.46	2.92	14.29	2.92	2.92a	2692
19	24.79	3.24	7.21	3.26	15.95	3.26	6.50a	2692
		Total>	10.45	2.75m	164.09	161.27	161.27	26822

(continued)

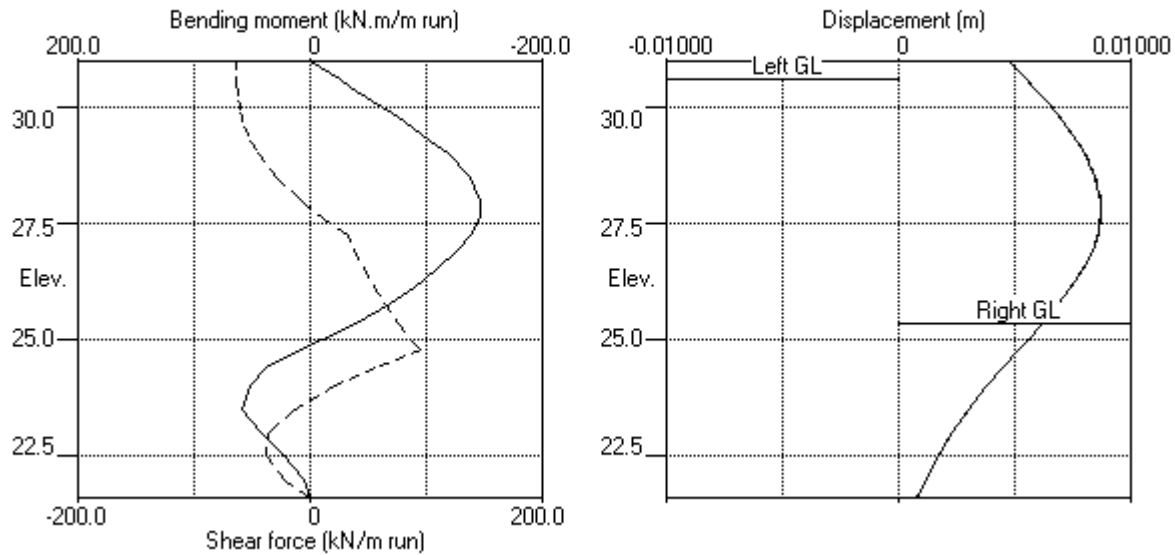
Stage No.6 Fill to elevation 25.34 on RIGHT side with soil type 1

Node no.	Y coord	----- RIGHT side -----						Total earth pressure	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			
20	24.40	Total>	18.35	4.72m	172.00	168.79	168.79	26822	
21	24.00	Total>	26.26	6.70m	179.90	176.36	176.36	26822	
22	23.50	Total>	36.28	9.20m	189.93	183.70	183.70	26822	
23	23.00	Total>	46.32	11.70m	199.96	168.16	168.16	26822	
24	22.50	Total>	56.37	14.20m	210.01	155.44	155.44	26822	
25	22.00	Total>	66.44	16.70m	220.09	144.30	144.30	26822	
26	21.60	Total>	74.52	18.70m	228.17	135.80	135.80	26822	

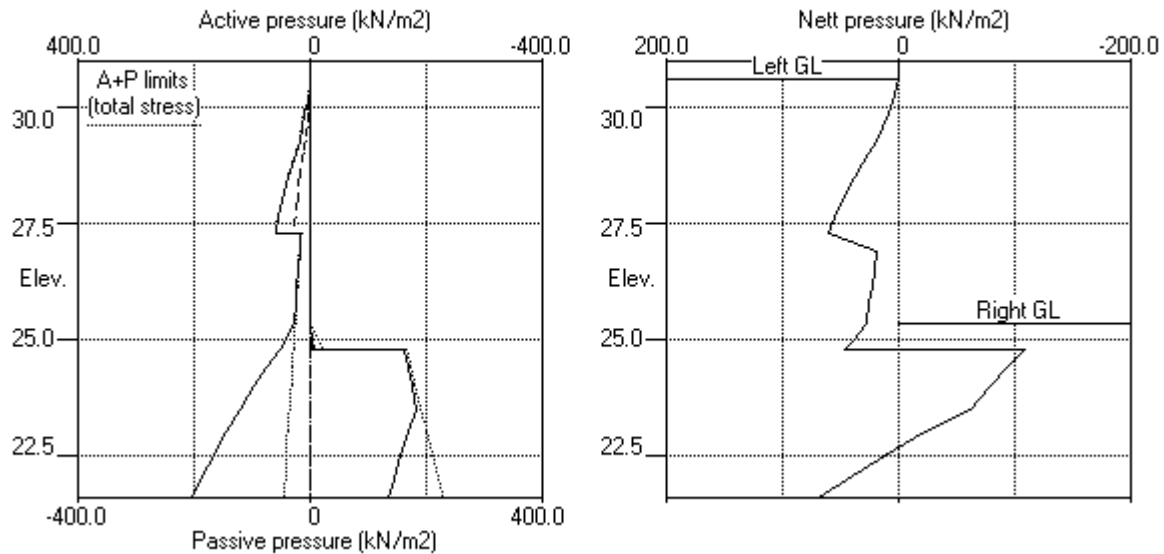
Note: 6.50a Soil pressure at active limit
 123.45p Soil pressure at passive limit

Units: kN,m

Stage No.6 Fill to elev. 25.34 on RIGHT side



Stage No.6 Fill to elev. 25.34 on RIGHT side



PILEDESIGNS LIMITED	Sheet No.
Program: WALLAP Version 6.06 Revision A51.B69.R54	Job No. 23811
Licensed from GEOSOLVE	Made by : MJC
Data filename/Run ID: 23811_Kentish_Town_Section2_04_ULS2	
KENTISH TOWN	Date:26-05-2021
Design Case 2 - 600 dia @ 840	Checked :

Units: kN,m

Stage No. 12 Change properties of soil type 2 to soil type 4
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. = 21.60		FoS = 1.000	
Stage	--- G.L. ---	Strut	Factor	Moment	Toe	Wall
No.	Act. Pass.	Elev.	of	equilib.	elev.	Penetr
			Safety	at elev.		-ation
12	30.60 25.34		More than one strut.	No	FoS calc.	failure

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 20.00 from wall
Right side 20.00 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	31.00	0.00	0.005	-1.67E-03	0.0	0.0		105980
2	30.60	0.00	0.006	-1.67E-03	0.0	-0.0		105980
3	30.45	1.35	0.006	-1.67E-03	0.1	0.0	77.5	105980
		1.35	0.006	-1.67E-03	-77.4	0.0		
4	30.15	4.74	0.006	-1.65E-03	-76.5	-23.0		105980
5	29.88	9.59	0.007	-1.58E-03	-74.5	-43.8		105980
6	29.60	14.27	0.007	-1.48E-03	-71.2	-63.9		105980
7	29.30	19.51	0.008	-1.33E-03	-66.2	-84.5		105980
8	29.00	26.11	0.008	-1.13E-03	-59.3	-103.4		105980
9	28.50	38.41	0.009	-7.36E-04	-43.2	-129.3		105980
10	28.00	49.03	0.009	-2.60E-04	-21.3	-145.7		105980
11	27.65	55.17	0.009	9.94E-05	-3.1	-150.1		105980
12	27.30	60.51	0.009	4.63E-04	17.1	-147.6		105980
		63.74	0.009	4.63E-04	17.1	-147.6		
13	26.90	68.45	0.008	8.59E-04	43.6	-135.8		105980
14	26.50	72.74	0.008	1.20E-03	71.8	-113.0		105980
15	26.14	76.45	0.008	1.44E-03	98.9	-82.1		105980
16	25.77	80.07	0.007	1.57E-03	127.4	-41.1	126.4	105980
		80.07	0.007	1.57E-03	1.0	-41.1		
17	25.34	84.35	0.006	1.65E-03	36.6	-33.2		105980
		57.24	0.006	1.65E-03	36.6	-33.2		
18	25.00	57.69	0.006	1.70E-03	56.2	-15.4		105980
19	24.79	56.18	0.005	1.72E-03	68.1	-2.4		105980
		-48.40	0.005	1.72E-03	68.1	-2.4		
20	24.40	-53.80	0.005	1.71E-03	47.9	20.1		105980
21	24.00	-58.84	0.004	1.65E-03	25.7	34.4		105980
22	23.50	-47.43	0.003	1.54E-03	-0.9	44.3		105980
23	23.00	-33.51	0.002	1.41E-03	-21.1	36.8		105980
24	22.50	-3.90	0.002	1.32E-03	-30.5	21.8		105980
25	22.00	35.57	0.001	1.27E-03	-22.6	6.0		105980
		37.61	0.001	1.27E-03	-22.6	6.0		

(continued)

Stage No.12 Change properties of soil type 2 to soil type 4

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 ---
26	21.60	75.18	0.001	1.26E-03	0.0	0.0		
At elev. 30.45	Strut	force =		77.5 kN/strut =		77.5 kN/m	run	
At elev. 25.77	Strut	force =		126.4 kN/strut =		126.4 kN/m	run	

Node no.	Y coord	LEFT side						Total earth pressure	Coeff. of subgrade reaction
		Effective stresses							
		Water press. kN/m2	Vertic -al kN/m2	Active limit kN/m2	Passive limit kN/m2	Earth pressure kN/m2			
1	31.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0	
2	30.60	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	49114	
3	30.45	0.00	2.98	1.35	6.60	1.35	1.35a	2037	
4	30.15	0.00	10.50	4.74	23.22	4.74	4.74a	2037	
5	29.88	2.75	15.14	6.84	33.51	6.84	9.59a	2037	
6	29.60	5.50	19.31	8.73	42.73	8.77	14.27	2037	
7	29.30	8.50	24.20	10.93	53.54	11.01	19.51	2037	
8	29.00	11.50	32.16	14.53	71.15	14.61	26.11	2037	
9	28.50	16.50	48.41	21.88	107.12	21.91	38.41	2037	
10	28.00	21.50	60.93	27.53	134.81	27.53	49.03a	2037	
11	27.65	25.00	66.75	30.17	147.70	30.17	55.17a	2037	
12	27.30	28.50	70.84	32.01	156.74	32.01	60.51a	2037	
		28.50	70.84	35.24	142.38	35.24	63.74a	10836	
13	26.90	30.24	76.81	38.22	154.39	38.22	68.45a	10836	
14	26.50	31.97	81.95	40.77	164.71	40.77	72.74a	10836	
15	26.14	33.55	86.23	42.90	173.32	42.90	76.45a	10836	
16	25.77	35.13	90.34	44.95	181.58	44.95	80.07a	10836	
17	25.34	37.01	95.16	47.34	191.27	47.34	84.35a	10836	
18	25.00	38.48	98.96	49.23	198.90	49.23	87.72a	10836	
19	24.79	39.40	101.32	50.41	203.65	50.41	89.80a	10836	
20	24.40	41.11	105.83	52.65	212.71	52.65	93.76a	10836	
21	24.00	42.82	110.43	54.94	221.95	54.94	97.76a	10836	
22	23.50	44.99	116.39	57.91	233.94	75.04	120.03	10836	
23	23.00	47.16	122.51	60.95	246.25	96.96	144.12	10836	
24	22.50	49.34	128.79	64.08	258.86	117.62	166.96	12917	
25	22.00	51.51	135.21	67.27	271.76	140.11	191.61	65436	
		Total>	186.72	43.00m	340.39	193.65	193.65	114535	
26	21.60	Total>	193.68	45.00m	354.10	218.12	218.12	119565	

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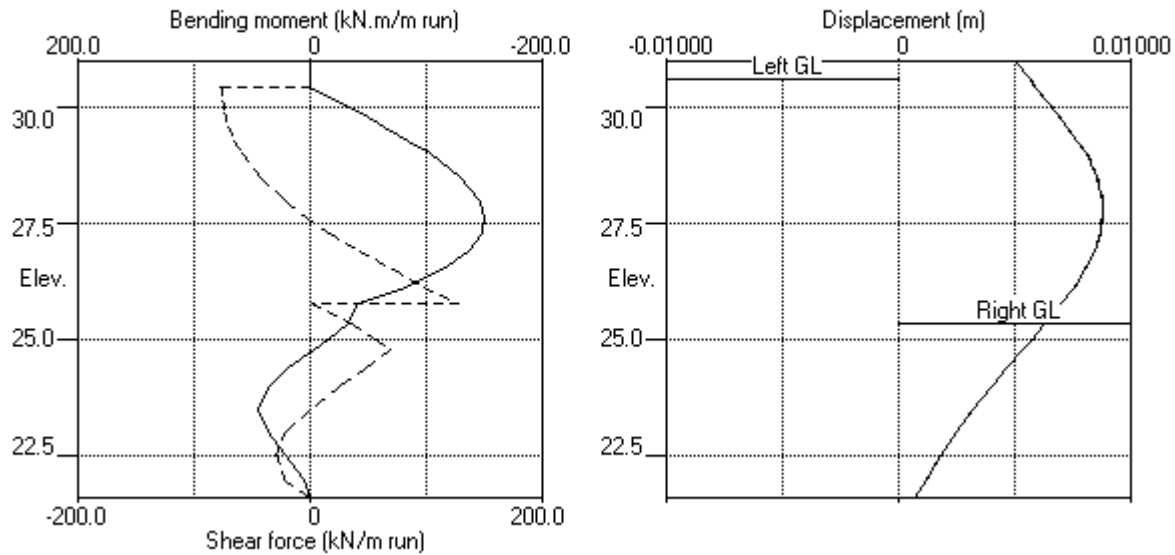
Stage No.12 Change properties of soil type 2 to soil type 4
 Ko pressures will not be reset

Node no.	Y coord	----- RIGHT side -----						Total earth pressure kN/m2	Coeff. of subgrade reaction kN/m3
		Water	Vertic	Effective	Passive	Earth			
		press.	-al	Active	limit	pressure			
		kN/m2	kN/m2	limit kN/m2	kN/m2	kN/m2			
12	27.30	0.00	0.00	0.00	0.00	0.00	0.00	0.0	
13	26.90	0.00	0.00	0.00	0.00	0.00	0.00	0.0	
14	26.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0	
15	26.14	0.00	0.00	0.00	0.00	0.00	0.00	0.0	
16	25.77	0.00	0.00	0.00	0.00	0.00	0.00	0.0	
17	25.34	0.00	0.00	0.00	0.00	0.00	0.00	0.0	
18	25.00	0.00	60.00	27.12	132.76	27.12	27.12a	3328	
		0.00	66.45	30.03	147.03	30.03	30.03a	3328	
19	24.79	3.29	67.13	30.34	148.53	30.34	33.62a	3328	
		3.29	67.13	33.40	134.92	134.92	138.21p	17794	
20	24.40	9.47	68.70	34.18	138.09	138.09	147.56p	17794	
21	24.00	15.66	70.12	34.89	140.94	140.94	156.60p	17794	
22	23.50	23.49	71.63	35.64	143.97	143.97	167.46p	17794	
23	23.00	31.32	72.79	36.22	146.31	146.31	177.63p	17794	
24	22.50	39.15	73.64	36.64	148.01	131.71	170.86	17794	
25	22.00	46.98	74.21	36.92	149.17	109.06	156.04	65436	
26	21.60	53.24	74.53	37.08	149.80	89.70	142.94	65436	

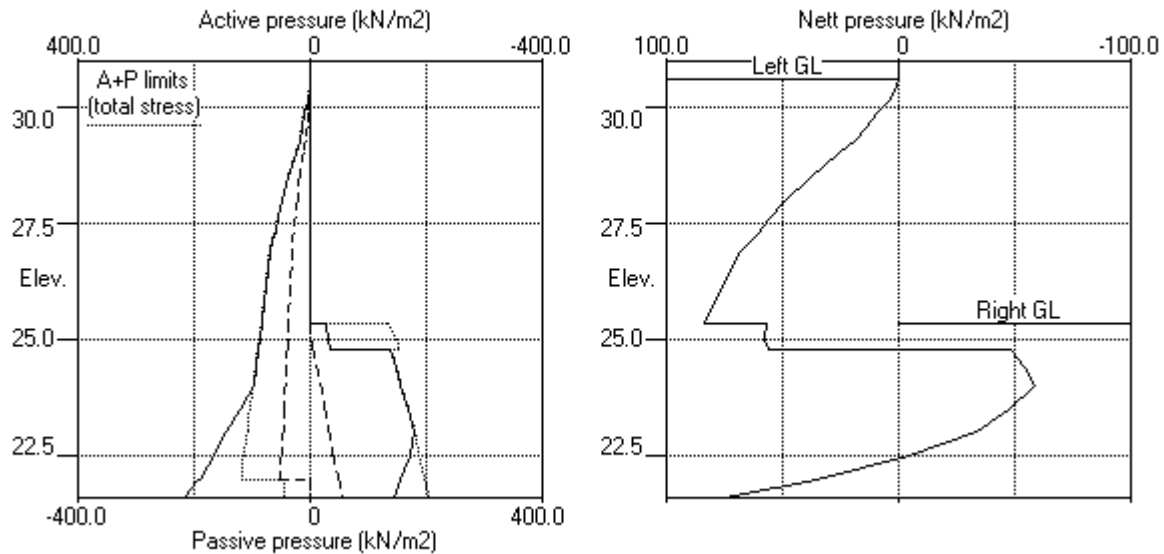
Note: 33.62a Soil pressure at active limit
 177.63p Soil pressure at passive limit

Units: kN,m

Stage No.12 Change soil type 2 to soil type 4



Stage No.12 Change soil type 2 to soil type 4



PILEDESIGNS LIMITED	Sheet No.
Program: WALLAP Version 6.06 Revision A51.B69.R54	Job No. 23811
Licensed from GEOSOLVE	Made by : MJC
Data filename/Run ID: 23811_Kentish_Town_Section2_04_ULS2	
KENTISH TOWN	Date:26-05-2021
Design Case 2 - 600 dia @ 840	Checked :

Units: kN,m

Stage No. 13 Change properties of soil type 3 to soil type 5
Ko pressures will 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. = 21.60		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
13	30.60 25.34		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 20.00 from wall
Right side 20.00 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	31.00	0.00	0.005	-1.67E-03	0.0	0.0		105980
2	30.60	0.00	0.006	-1.67E-03	0.0	-0.0		105980
3	30.45	1.35	0.006	-1.67E-03	0.1	0.0	77.5	105980
		1.35	0.006	-1.67E-03	-77.4	0.0		
4	30.15	4.75	0.006	-1.64E-03	-76.4	-23.0		105980
5	29.88	9.60	0.007	-1.58E-03	-74.5	-43.8		105980
6	29.60	14.28	0.007	-1.48E-03	-71.2	-63.8		105980
7	29.30	19.52	0.008	-1.33E-03	-66.1	-84.5		105980
8	29.00	26.12	0.008	-1.13E-03	-59.3	-103.4		105980
9	28.50	38.42	0.009	-7.35E-04	-43.1	-129.2		105980
10	28.00	49.04	0.009	-2.59E-04	-21.3	-145.6		105980
11	27.65	55.18	0.009	9.94E-05	-3.0	-149.9		105980
12	27.30	60.52	0.009	4.62E-04	17.2	-147.5		105980
		63.80	0.009	4.62E-04	17.2	-147.5		
13	26.90	68.50	0.008	8.58E-04	43.7	-135.6		105980
14	26.50	72.78	0.008	1.20E-03	71.9	-112.7		105980
15	26.14	76.48	0.008	1.43E-03	99.1	-81.8		105980
16	25.77	80.08	0.007	1.56E-03	127.5	-40.8	126.0	105980
		80.08	0.007	1.56E-03	1.5	-40.8		
17	25.34	84.35	0.006	1.65E-03	37.1	-32.6		105980
		57.23	0.006	1.65E-03	37.1	-32.6		
18	25.00	57.66	0.006	1.70E-03	56.6	-14.7		105980
19	24.79	56.15	0.005	1.71E-03	68.6	-1.6		105980
		-48.40	0.005	1.71E-03	68.6	-1.6		
20	24.40	-53.80	0.005	1.70E-03	48.4	21.1		105980
21	24.00	-58.84	0.004	1.63E-03	26.2	35.5		105980
22	23.50	-48.13	0.003	1.51E-03	-0.6	45.8		105980
23	23.00	-34.57	0.003	1.38E-03	-21.3	38.3		105980
24	22.50	-6.92	0.002	1.28E-03	-31.6	23.1		105980
25	22.00	31.51	0.001	1.23E-03	-25.5	6.4		105980
		53.66	0.001	1.23E-03	-25.5	6.4		

(continued)

Stage No.13 Change properties of soil type 3 to soil type 5
Ko pressures will 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
26	21.60	73.79	0.001	1.22E-03	0.0	0.0		---
At elev. 30.45		Strut force =		77.5 kN/strut =		77.5 kN/m	run	
At elev. 25.77		Strut force =		126.0 kN/strut =		126.0 kN/m	run	

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	31.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	30.60	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	49822
3	30.45	0.00	2.98	1.35	6.60	1.35	1.35a	2756
4	30.15	0.00	10.50	4.74	23.22	4.75	4.75a	2756
5	29.88	2.75	15.14	6.84	33.51	6.85	9.60a	2756
6	29.60	5.50	19.31	8.73	42.73	8.78	14.28	2756
7	29.30	8.50	24.20	10.93	53.54	11.02	19.52	2756
8	29.00	11.50	32.16	14.53	71.15	14.62	26.12	2756
9	28.50	16.50	48.41	21.88	107.12	21.92	38.42	2756
10	28.00	21.50	60.93	27.53	134.81	27.54	49.04	2756
11	27.65	25.00	66.75	30.17	147.70	30.18	55.18	2756
12	27.30	28.50	70.84	32.01	156.74	32.02	60.52	2756
		28.50	70.84	35.24	142.38	35.30	63.80	14710
13	26.90	30.24	76.81	38.22	154.39	38.26	68.50	14710
14	26.50	31.97	81.95	40.77	164.71	40.81	72.78	14710
15	26.14	33.55	86.23	42.90	173.32	42.93	76.48	14710
16	25.77	35.13	90.34	44.95	181.58	44.95	80.08a	14710
17	25.34	37.01	95.16	47.34	191.27	47.34	84.35a	26769
18	25.00	38.48	98.96	49.23	198.90	49.23	87.72a	26769
19	24.79	39.40	101.32	50.41	203.65	50.41	89.80a	26769
20	24.40	41.11	105.83	52.65	212.71	52.65	93.76a	26769
21	24.00	42.82	110.43	54.94	221.95	54.94	97.76a	26769
22	23.50	44.99	116.39	57.91	233.94	74.33	119.33	26769
23	23.00	47.16	122.51	60.95	246.25	95.90	143.06	26769
24	22.50	49.34	128.79	64.08	258.86	116.11	165.45	26769
25	22.00	51.51	135.21	67.27	271.76	138.08	189.59	26769
		51.51	135.21	67.27	271.76	160.22	211.73	26769
26	21.60	53.24	140.44	69.87	282.27	165.95	219.19	27945

[illegible]

(continued)

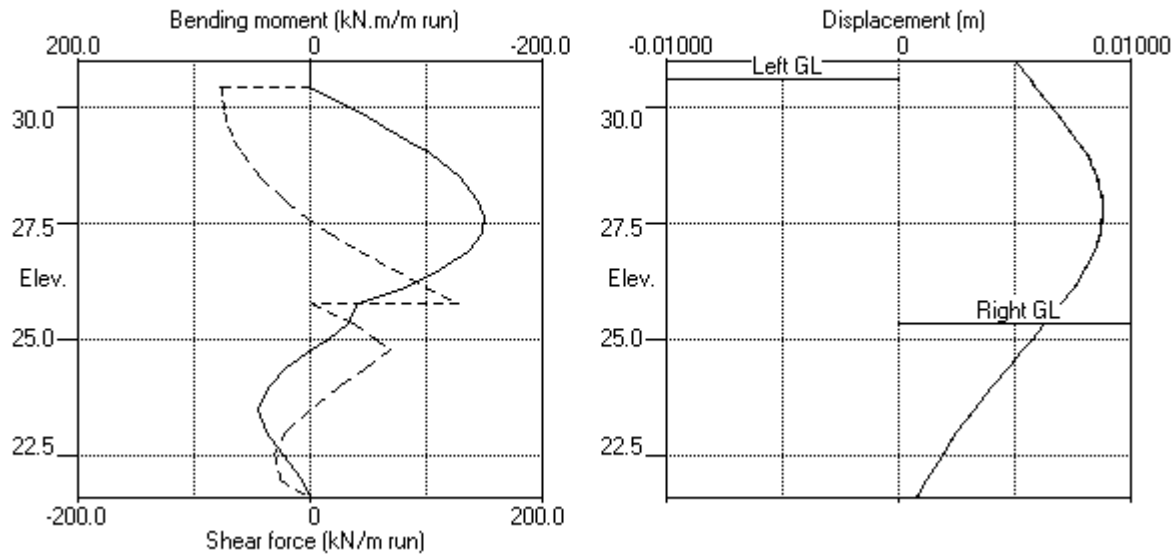
Stage No.13 Change properties of soil type 3 to soil type 5
 Ko pressures will be reset

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	27.30	0.00	0.00	0.00	0.00	0.00	0.00	0.0
13	26.90	0.00	0.00	0.00	0.00	0.00	0.00	0.0
14	26.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
15	26.14	0.00	0.00	0.00	0.00	0.00	0.00	0.0
16	25.77	0.00	0.00	0.00	0.00	0.00	0.00	0.0
17	25.34	0.00	0.00	0.00	0.00	0.00	0.00	0.0
		0.00	60.00	27.12	132.76	27.13	27.13	4995
18	25.00	0.00	66.45	30.03	147.03	30.05	30.05	4995
19	24.79	3.29	67.13	30.34	148.53	30.37	33.65	4995
		3.29	67.13	33.40	134.92	134.92	138.21p	26769
20	24.40	9.47	68.70	34.18	138.09	138.09	147.56p	26769
21	24.00	15.66	70.12	34.89	140.94	140.94	156.60p	26769
22	23.50	23.49	71.63	35.64	143.97	143.97	167.46p	26769
23	23.00	31.32	72.79	36.22	146.31	146.31	177.63p	26769
24	22.50	39.15	73.64	36.64	148.01	133.22	172.37	26769
25	22.00	46.98	74.21	36.92	149.17	111.09	158.07	26769
26	21.60	53.24	74.53	37.08	149.80	92.17	145.41	26769

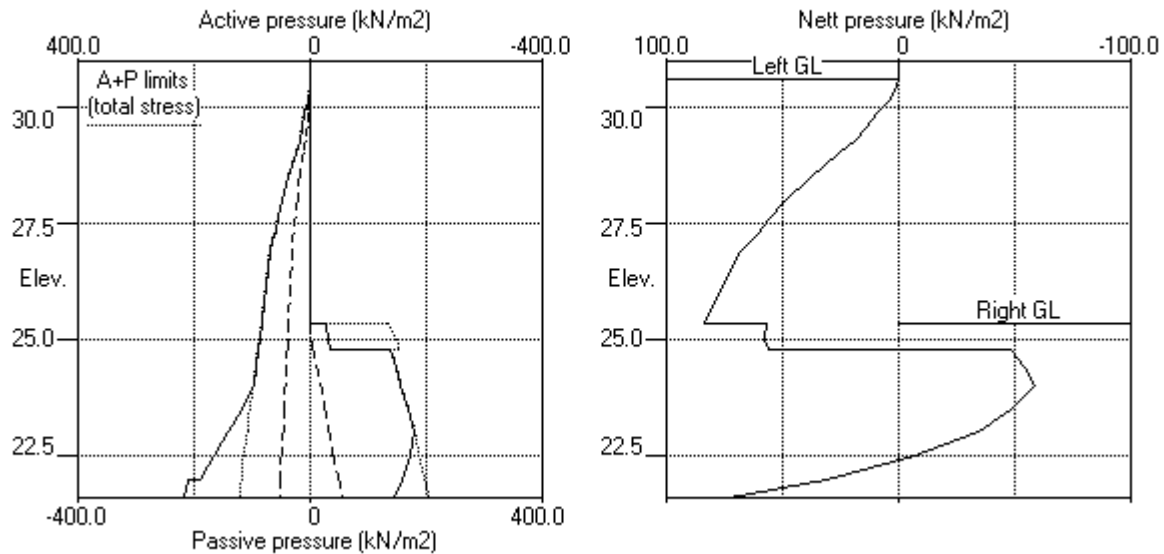
Note: 97.76a Soil pressure at active limit
 177.63p Soil pressure at passive limit

Units: kN,m

Stage No.13 Change soil type 3 to soil type 5



Stage No.13 Change soil type 3 to soil type 5



Units: kN, m

			Overall					
			FoS for toe		Toe elev. for			
			elev. = 21.60		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	30.60	30.60	Cant.	Conditions not suitable for FoS calc.				
2	30.60	30.60		No analysis at this stage				
3	30.60	30.60	Cant.	Conditions not suitable for FoS calc.				
4	30.60	30.60		No analysis at this stage				
5	30.60	24.79	31.00	1.888	n/a	24.16	0.63	L to R
6	30.60	25.34	31.00	1.977	n/a	24.23	1.11	L to R
7	30.60	25.34		No analysis at this stage				
All remaining stages have more than one strut - FoS calculation n/a								

PILEDESIGNS LIMITED	Sheet No.
Program: WALLAP Version 6.06 Revision A51.B69.R54	Job No. 23811
Licensed from GEOSOLVE	Made by : MJC
Data filename/Run ID: 23811_Kentish_Town_Section2_04_ULS2	
KENTISH TOWN	Date:26-05-2021
Design Case 2 - 600 dia @ 840	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 20.00 from wall
 Right side 20.00 from wall

Limit State: ULS DA1 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	31.00	0.005	0.000	0.0	0.0	0.0	-63.6
2	30.60	0.006	0.000	0.0	-25.4	0.0	-63.6
3	30.45	0.006	0.000	0.0	-35.0	0.2	-77.4
4	30.15	0.006	0.000	0.0	-53.8	0.0	-76.5
5	29.88	0.007	0.000	0.0	-70.8	0.0	-74.5
6	29.60	0.007	0.000	0.0	-87.0	0.0	-71.2
7	29.30	0.008	0.000	0.0	-103.5	0.0	-66.2
8	29.00	0.008	0.000	0.0	-118.2	0.0	-59.3
9	28.50	0.009	0.000	0.0	-137.2	0.5	-43.2
10	28.00	0.009	0.000	0.0	-146.6	8.1	-21.3
11	27.65	0.009	0.000	0.3	-150.1	15.0	-3.1
12	27.30	0.009	0.000	6.9	-147.6	33.5	0.0
13	26.90	0.008	0.000	13.7	-135.8	64.6	0.0
14	26.50	0.008	0.000	16.8	-113.0	97.6	0.0
15	26.14	0.008	0.000	17.6	-91.7	128.9	-0.1
16	25.77	0.007	0.000	28.1	-71.5	160.8	-59.5
17	25.34	0.007	0.000	15.0	-42.4	75.2	-20.4
18	25.00	0.007	0.000	13.0	-15.4	86.5	-11.0
19	24.79	0.006	0.000	11.8	-2.4	95.4	-5.9
20	24.40	0.006	0.000	38.3	0.0	56.2	-5.8
21	24.00	0.006	0.000	52.9	0.0	26.2	-5.3
22	23.50	0.006	0.000	58.2	0.0	2.3	-14.1
23	23.00	0.005	0.000	43.4	0.0	0.0	-35.1
24	22.50	0.005	0.000	23.1	0.0	0.0	-37.6
25	22.00	0.005	0.000	6.4	0.0	0.0	-25.5
26	21.60	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 kN.m/m	elev.	minimum kN.m/m	elev.	maximum kN/m	elev.	minimum kN/m	elev.
1	2.1	26.14	-0.6	29.00	2.4	27.30	-0.7	24.79
2	No calculation at this stage							
3	17.6	26.14	-5.7	28.50	22.9	27.30	-5.9	24.79
4	No calculation at this stage							
5	57.0	23.50	-145.5	28.00	93.5	24.79	-63.2	31.00
6	58.2	23.50	-146.6	28.00	95.4	24.79	-63.6	31.00
7	No calculation at this stage							
8	No calculation at this stage							
9	55.9	23.50	-137.8	27.65	94.8	24.79	-73.4	30.45
10	No calculation at this stage							
11	No calculation at this stage							
12	44.3	23.50	-150.1	27.65	127.4	25.77	-77.4	30.45
13	45.8	23.50	-149.9	27.65	127.5	25.77	-77.4	30.45
14	28.1	25.77	-125.6	28.00	160.8	25.77	-73.3	30.45

Maximum and minimum displacement at each stage

Stage no.	Displacement				Stage description
	maximum m	elev.	minimum m	elev.	
1	0.000	31.00	0.000	31.00	Apply surcharge no.1 at elev. 30.60
2	No calculation at this stage				Apply surcharge no.2 at elev. 29.60
3	0.003	31.00	0.000	31.00	Apply water pressure profile no.1
4	No calculation at this stage				Install strut no.3 at elev. 31.00
5	0.009	27.65	0.000	31.00	Excav. to elev. 24.79 on RIGHT side
6	0.009	27.65	0.000	31.00	Fill to elev. 25.34 on RIGHT side
7	No calculation at this stage				Install strut no.2 at elev. 25.77
8	No calculation at this stage				Install strut no.1 at elev. 30.45
9	0.008	27.65	0.000	31.00	Remove strut no.3 at elev. 31.00
10	No calculation at this stage				Change EI of wall to 105980kN.m ² /m run
11	No calculation at this stage				Apply surcharge no.4 at elev. 25.34
12	0.009	27.65	0.000	31.00	Change soil type 2 to soil type 4
13	0.009	27.65	0.000	31.00	Change soil type 3 to soil type 5
14	0.008	27.65	0.000	31.00	Apply water pressure profile no.2

Strut forces at each stage (horizontal components)

Stage no.	Strut no. 1		Strut no. 2		Strut no. 3	
	at elev. 30.45		at elev. 25.77		at elev. 31.00	
	kN/m run	kN/strut	kN/m run	kN/strut	kN/m run	kN/strut
5	---	---	---	---	63.19	63.19
6	---	---	---	---	63.57	63.57
9	73.51	73.51	slack	slack	---	---
12	77.51	77.51	126.37	126.37	---	---
13	77.46	77.46	126.00	126.00	---	---
14	73.47	73.47	220.34	220.34	---	---

PILEDESIGNS LIMITED

Program: WALLAP Version 6.06 Revision A51.B69.R54

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Data filename/Run ID: 23811_Kentish_Town_Section2_04_ULS2

KENTISH TOWN

Design Case 2 - 600 dia @ 840

| Sheet No.

| Job No. 23811

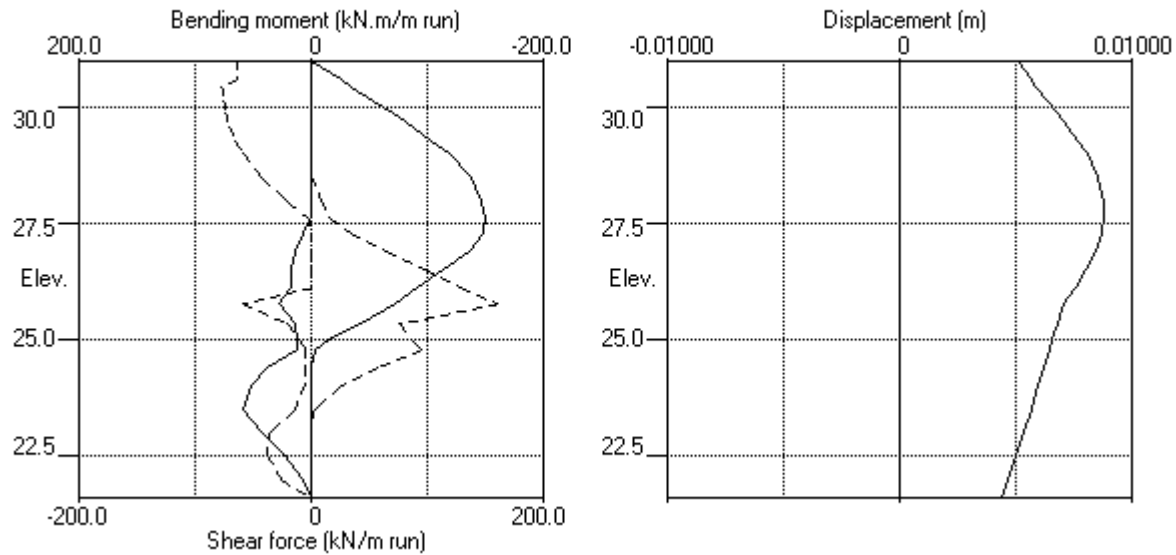
| Made by : MJC

| Date:26-05-2021

| Checked :

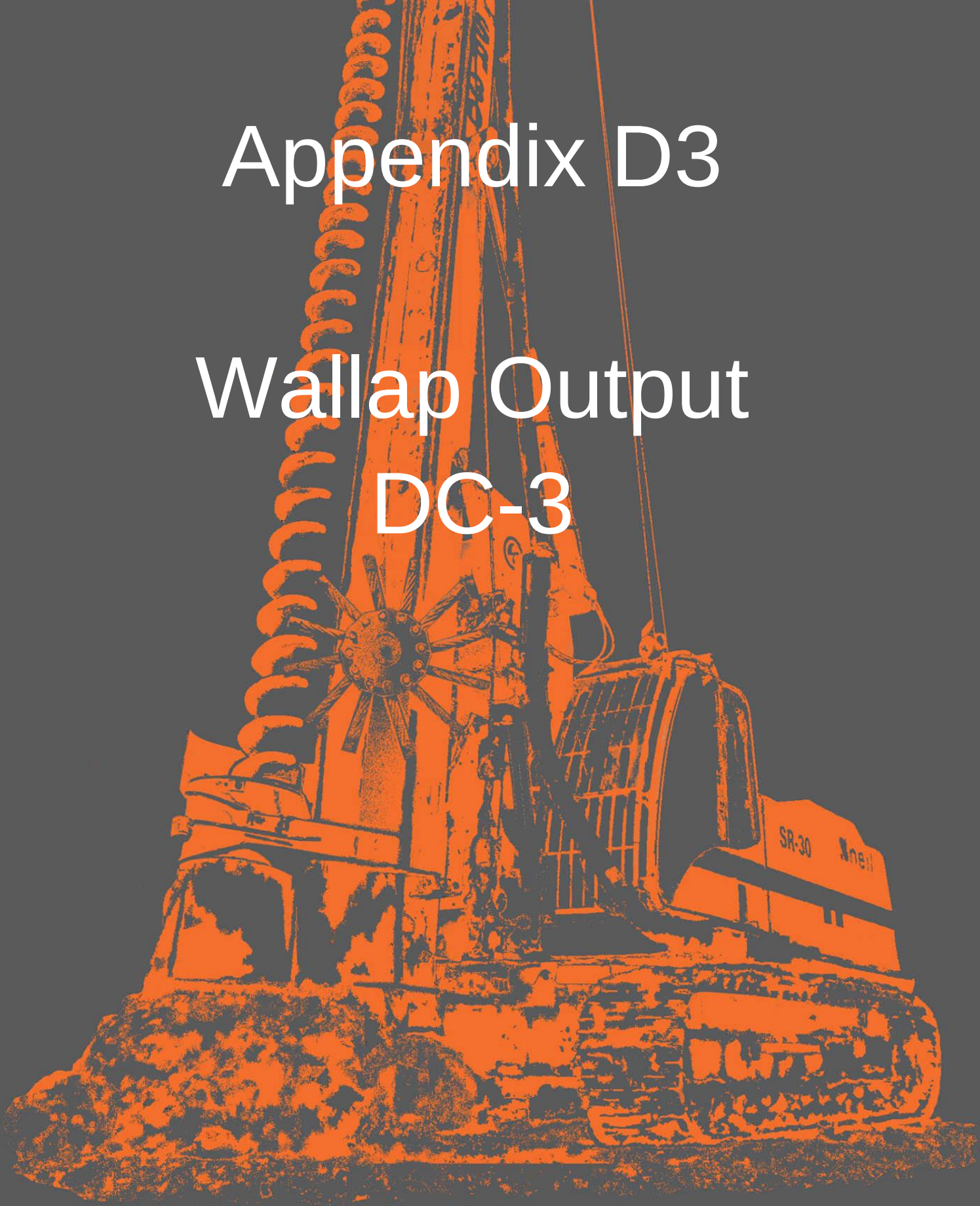
Units: kN,m

Bending moment, shear force, displacement envelopes



Appendix D3

Wallap Output DC-3



PILEDESIGNS LIMITED	Sheet No.
Program: WALLAP Version 6.06 Revision A51.B69.R54	Job No. 23811
Licensed from GEOSOLVE	Made by : MJC
Data filename/Run ID: 23811_Kentish_Town_Section3_03_SLS	
KENTISH TOWN	Date:26-05-2021
Design Case 3 - 600 dia @ 840	Checked :

Units: kN,m

INPUT DATA

SOIL PROFILE

Stratum no.	Elevation of top of stratum	Soil types	
		Left side	Right side
1	30.60	1 Made Ground dr	1 Made Ground dr
2	27.30	2 London Clay 1 und	2 London Clay 1 und
3	22.00	3 London Clay 2 und	2 London Clay 1 und

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 dr	19.00	10000	0.540	OC (0.250)	0.376 (0.000)	2.663 (0.000)	
2 London Clay 1 und	20.00	72000	1.200	OC (0.490)	1.000 (2.389)	1.000 (2.390)	90.00u
3 London Cl.. (22.00)	20.00	72000 (7904)	1.200	OC (0.490)	1.000 (2.389)	1.000 (2.390)	90.00u (9.880)
4 London Clay 1 dr	20.00	55440	1.200	OC (0.200)	0.422 (1.299)	2.371 (3.080)	0.0d
5 London Cl.. (22.00)	20.00	55440 (6086)	1.200	OC (0.200)	0.422 (1.299)	2.371 (3.080)	0.0d

Additional soil parameters associated with Ka and Kp

--- parameters for Ka ---			--- parameters for Kp ---		
Soil	Wall	Back-	Soil	Wall	Back-
friction angle	adhesion coeff.	fill angle	friction angle	adhesion coeff.	fill angle
1 Made Ground dr	27.00	0.000	0.00	27.00	0.000
2 London Clay 1 und	0.00	0.500	0.00	0.00	0.500
3 London Clay 2 und	0.00	0.500	0.00	0.00	0.500
4 London Clay 1 dr	24.00	0.000	0.00	24.00	0.000
5 London Clay 2 dr	24.00	0.000	0.00	24.00	0.000

GROUND WATER CONDITIONS

Density of water = 10.00 kN/m3

	Left side	Right side
Initial water table elevation	25.00	25.00

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
	1	30.15	30.15	0.0	1	25.00	25.00
	2	27.30	30.15	28.5	2	25.00	25.00
	1	30.60	30.60	0.0	1	25.34	25.34
					2	25.34	30.60

WALL PROPERTIES

Type of structure = Fully Embedded Wall
Elevation of toe of wall = 21.60
Maximum finite element length = 0.50 m
Youngs modulus of wall E = 1.9600E+07 kN/m2
Moment of inertia of wall I = 7.5700E-03 m4/m run
E.I = 148372 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	30.45	1.00	0.275000	1.400E+07	5.00	0.00	0	No
2	25.77	1.00	0.450000	1.400E+07	5.00	0.00	0	No
3	31.00	1.00	1.000000	30000	1.00	0.00	0	No

SURCHARGE LOADS

Surch -arge no.	Elev.	Distance from wall	Length parallel to wall	Width perpend. to wall	Surcharge ----- Near edge	Far edge	Equiv. soil type	Partial factor/ Category
1	31.25	0.50 (L)	10.00	10.00	10.00	=	N/A	1.00 Var
2	29.80	0.75 (L)	10.00	1.00	120.00	=	N/A	1.00 P/U
3	Not defined							
4	25.34	-0.00 (R)	10.00	10.00	60.00	=	N/A	1.00 P/F

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 water pressure profile no.1 (Mod. Conserv.) No analysis at this stage
2	Install strut or anchor no.3 at elevation 31.00
3	Fill to elevation 31.25 on LEFT side with soil type 1
4	Apply surcharge no.1 at elevation 31.25 No analysis at this stage
5	Excavate to elevation 25.29 on RIGHT side
6	Fill to elevation 25.34 on RIGHT side with soil type 1
7	Install strut or anchor no.2 at elevation 25.77
8	Install strut or anchor no.1 at elevation 30.45
9	Remove strut or anchor no.3 at elevation 31.00
10	Change EI of wall to 105980 kN.m2/m run Yield moment not defined No adjustments to wall displacements
11	Apply surcharge no.4 at elevation 25.34 No analysis at this stage
12	Change properties of soil type 2 to soil type 4 Ko pressures will not be reset
13	Change properties of soil type 3 to soil type 5 Ko pressures will be reset
14	Apply water pressure profile no.2 (Mod. Conserv.)

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 = 20.00 m

Distance to rigid boundary on Right side = 20.00 m

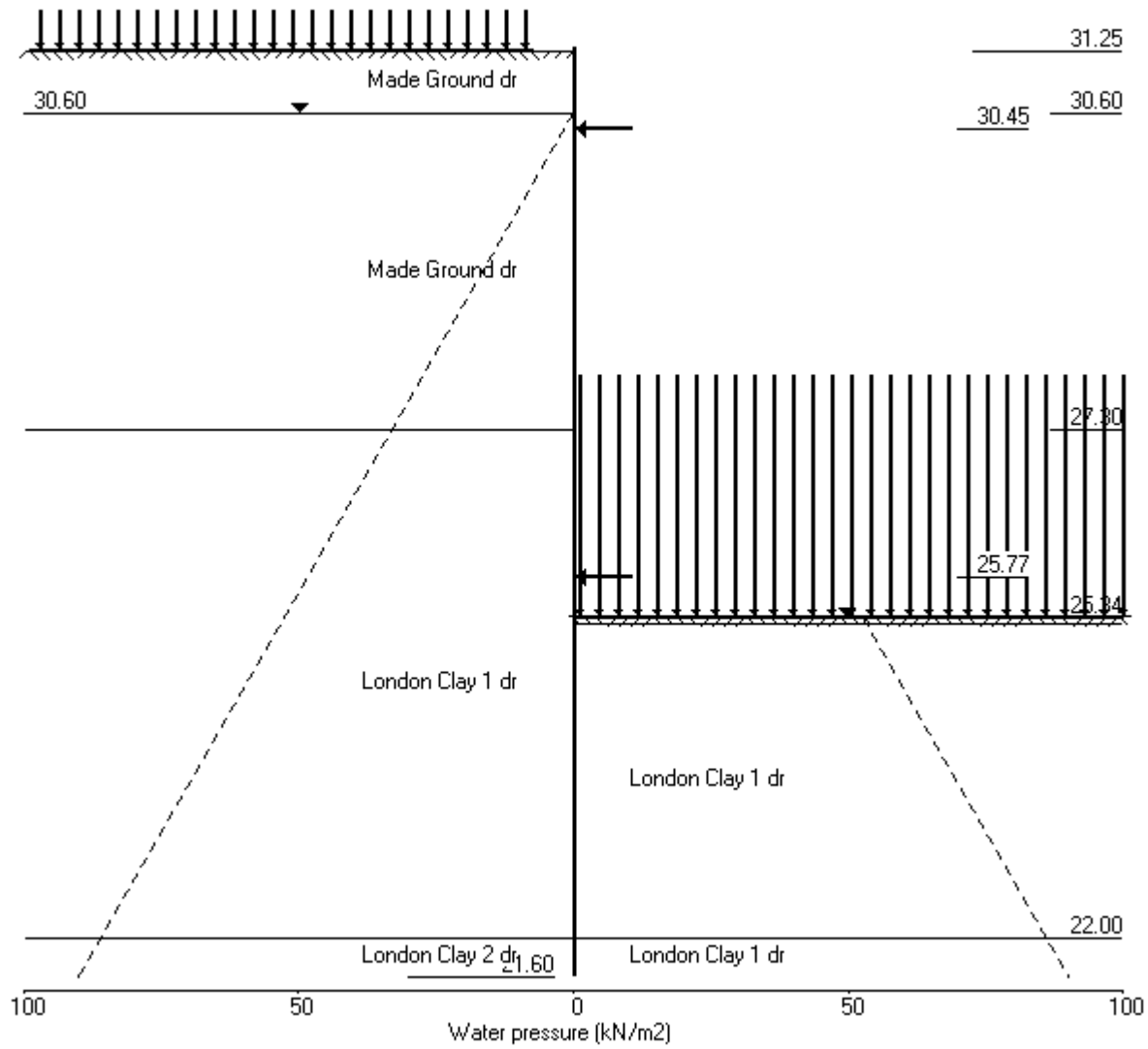
OUTPUT OPTIONS

Stage no.	Stage description	Output options		
		Displacement Bending mom. Shear force	Active, Passive pressures	Graph. output
1	Apply water pressure profile no.1	No	No	No
2	Install strut no.3 at elev. 31.00	No	No	No
3	Fill to elev. 31.25 on LEFT side	No	No	No
4	Apply surcharge no.1 at elev. 31.25	No	No	No
5	Excav. to elev. 25.29 on RIGHT side	No	No	No
6	Fill to elev. 25.34 on RIGHT side	No	No	No
7	Install strut no.2 at elev. 25.77	No	No	No
8	Install strut no.1 at elev. 30.45	No	No	No
9	Remove strut no.3 at elev. 31.00	No	No	No
10	Change EI of wall to 105980kN.m2/m run	No	No	No
11	Apply surcharge no.4 at elev. 25.34	No	No	No
12	Change soil type 2 to soil type 4	No	No	No
13	Change soil type 3 to soil type 5	No	No	No
14	Apply water pressure profile no.2	No	No	No
*	Summary output	Yes	-	Yes

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Units: kN,m

Stage No.14 Apply water pressure profile no.2 (Mod. Conserv.)



PILEDESIGNS LIMITED	Sheet No.
Program: WALLAP Version 6.06 Revision A51.B69.R54	Job No. 23811
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Data filename/Run ID: 23811_Kentish_Town_Section3_03_SLS	
KENTISH TOWN	Date:26-05-2021
Design Case 3 - 600 dia @ 840	Checked :

Units: kN,m

Stage No. 3 Fill to elevation 31.25 on LEFT side with soil type 1

STABILITY ANALYSIS of Fully Embedded Wall according to Strength Factor method

Factor of safety on soil strength

				FoS for toe elev. = 21.60		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
3	31.25 30.60	31.00	30.531	n/a		30.39	0.21	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 20.00 from wall

Right side 20.00 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	31.25	0.00	0.001	6.82E-05	0.0	-0.0		148372
2	31.00	1.78	0.001	6.82E-05	0.2	0.0	7.2	148372
		1.78	0.001	6.82E-05	-7.0	0.0		
3	30.60	4.64	0.001	7.16E-05	-5.7	-2.6		148372
4	30.45	0.77	0.001	7.46E-05	-5.3	-3.4		148372
5	30.15	-0.06	0.001	8.30E-05	-5.2	-5.0		148372
6	29.83	1.08	0.001	9.57E-05	-5.1	-6.6		148372
7	29.50	2.40	0.001	1.11E-04	-4.5	-8.2		148372
8	29.00	6.20	0.001	1.42E-04	-2.3	-10.0		148372
9	28.50	10.06	0.001	1.76E-04	1.7	-10.2		148372
10	28.00	14.00	0.001	2.07E-04	7.7	-8.0		148372
11	27.65	16.79	0.001	2.21E-04	13.1	-4.3		148372
12	27.30	19.60	0.001	2.25E-04	19.5	1.3		148372
		-22.73	0.001	2.25E-04	19.5	1.3		
13	26.90	-17.52	0.001	2.13E-04	11.4	7.3		148372
14	26.50	-12.79	0.001	1.89E-04	5.4	10.5		148372
15	26.14	-9.07	0.001	1.62E-04	1.4	11.6		148372
16	25.77	-5.97	0.000	1.34E-04	-1.3	11.5		148372
17	25.34	-3.05	0.000	1.02E-04	-3.3	10.4		148372
18	25.29	-2.76	0.000	9.87E-05	-3.4	10.2		148372
19	25.00	-1.29	0.000	7.98E-05	-4.0	9.1		148372
20	24.50	0.26	0.000	5.28E-05	-4.3	6.9		148372
21	24.00	1.17	0.000	3.30E-05	-3.9	4.8		148372
22	23.50	1.63	0.000	1.98E-05	-3.2	3.0		148372
23	23.00	1.78	0.000	1.20E-05	-2.4	1.6		148372
24	22.50	1.76	0.000	8.27E-06	-1.5	0.6		148372
25	22.00	1.67	0.000	7.01E-06	-0.6	0.1		148372
26	21.60	1.36	0.000	6.86E-06	0.0	-0.0		---
At elev. 31.00 Strut force =				7.2 kN/strut =		7.2 kN/m run		

(continued)

Stage No.3 Fill to elevation 31.25 on LEFT side with soil type 1

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	31.25	0.00	0.00	0.00	0.00	0.00	0.00	1716
2	31.00	0.00	4.75	1.78	12.65	1.78	1.78a	1716
3	30.60	0.00	12.35	4.64	32.89	4.64	4.64a	1716
4	30.45	0.00	15.20	5.71	40.48	5.71	5.71a	1716
5	30.15	0.00	20.90	7.85	55.66	7.85	7.85a	1716
6	29.83	3.25	23.82	8.95	63.44	8.95	12.20a	1716
7	29.50	6.50	26.75	10.05	71.23	10.22	16.72	1716
8	29.00	11.50	31.25	11.74	83.22	13.91	25.41	1716
9	28.50	16.50	35.75	13.43	95.20	17.64	34.14	1716
10	28.00	21.50	40.25	15.11	107.18	21.41	42.91	1716
11	27.65	25.00	43.40	16.30	115.57	24.06	49.06	1716
12	27.30	28.50	46.55	17.48	123.96	26.72	55.22	1716
		Total>	75.05	19.75m	290.15	70.43	70.43	18187
13	26.90	Total>	83.05	21.75m	298.15	82.67	82.67	18187
14	26.50	Total>	91.05	23.75m	306.15	94.67	94.67	18187
15	26.14	Total>	98.32	25.57m	313.42	105.28	105.28	18187
16	25.77	Total>	105.59	27.39m	320.69	115.58	115.58	18187
17	25.34	Total>	114.25	29.55m	329.35	127.47	127.47	18187
18	25.29	Total>	115.25	29.80m	330.35	128.82	128.82	18187
19	25.00	Total>	121.05	31.25m	336.15	136.54	136.54	18187
20	24.50	Total>	131.05	33.75m	346.15	148.31	148.31	18187
21	24.00	Total>	141.05	36.25m	356.15	159.77	159.77	18187
22	23.50	Total>	151.05	38.75m	366.15	171.00	171.00	18187
23	23.00	Total>	161.05	41.25m	376.15	182.07	182.07	18187
24	22.50	Total>	171.05	43.75m	386.15	193.06	193.06	18187
25	22.00	Total>	181.05	46.25m	396.15	204.01	204.01	18187
26	21.60	Total>	189.05	48.25m	413.59	212.55	212.55	18986

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	31.25	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	31.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
3	30.60	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	1756
4	30.45	0.00	2.85	1.07	7.59	4.94	4.94	1756
5	30.15	0.00	8.55	3.21	22.77	7.91	7.91	1756
6	29.83	0.00	14.72	5.53	39.21	11.12	11.12	1756
7	29.50	0.00	20.90	7.85	55.66	14.32	14.32	1756
8	29.00	0.00	30.40	11.42	80.95	19.22	19.22	1756
9	28.50	0.00	39.90	14.98	106.25	24.08	24.08	1756
10	28.00	0.00	49.40	18.55	131.55	28.91	28.91	1756
11	27.65	0.00	56.05	21.05	149.26	32.27	32.27	1756
12	27.30	0.00	62.70	23.55	166.97	35.63	35.63	1756
		Total>	62.70	16.50m	277.80	93.16	93.16	18510
13	26.90	Total>	70.70	18.50m	285.80	100.19	100.19	18510
14	26.50	Total>	78.70	20.50m	293.80	107.46	107.46	18510
15	26.14	Total>	85.97	22.32m	301.07	114.35	114.35	18510
16	25.77	Total>	93.24	24.14m	308.34	121.55	121.55	18510
17	25.34	Total>	101.90	26.30m	317.00	130.52	130.52	18510
18	25.29	Total>	102.90	26.55m	318.00	131.58	131.58	18510
19	25.00	Total>	108.70	28.00m	323.80	137.83	137.83	18510

(continued)

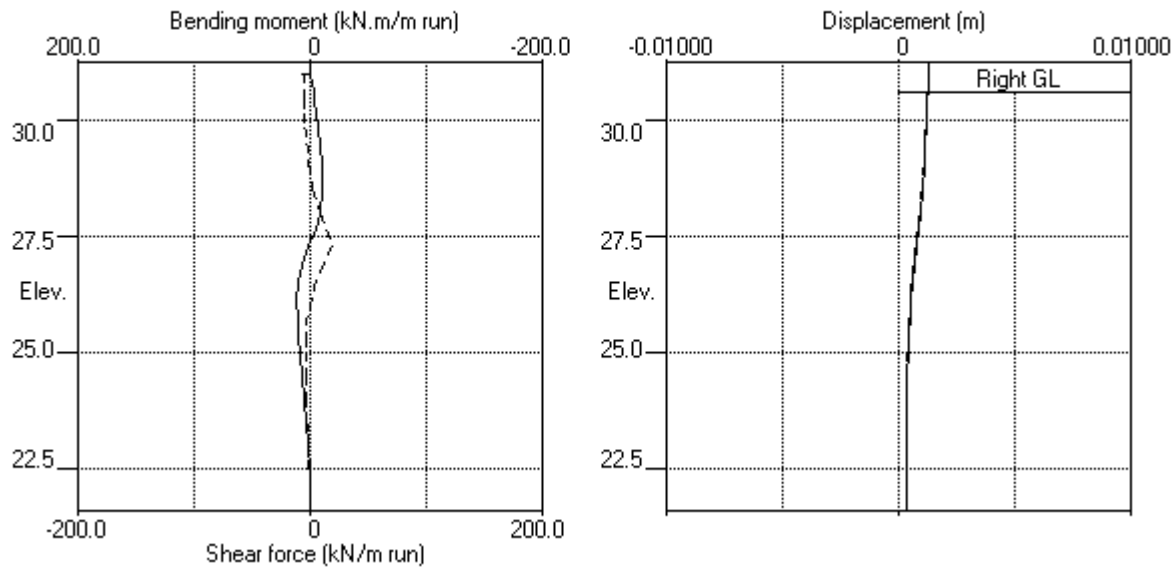
Stage No.3 Fill to elevation 31.25 on LEFT side with soil type 1

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		
20	24.50	Total>	118.70	30.50m	333.80	148.05	148.05	18510
21	24.00	Total>	128.70	33.00m	343.80	158.60	158.60	18510
22	23.50	Total>	138.70	35.50m	353.80	169.36	169.36	18510
23	23.00	Total>	148.70	38.00m	363.80	180.29	180.29	18510
24	22.50	Total>	158.70	40.50m	373.80	191.30	191.30	18510
25	22.00	Total>	168.70	43.00m	383.80	202.34	202.34	18510
26	21.60	Total>	176.70	45.00m	391.80	211.18	211.18	18510

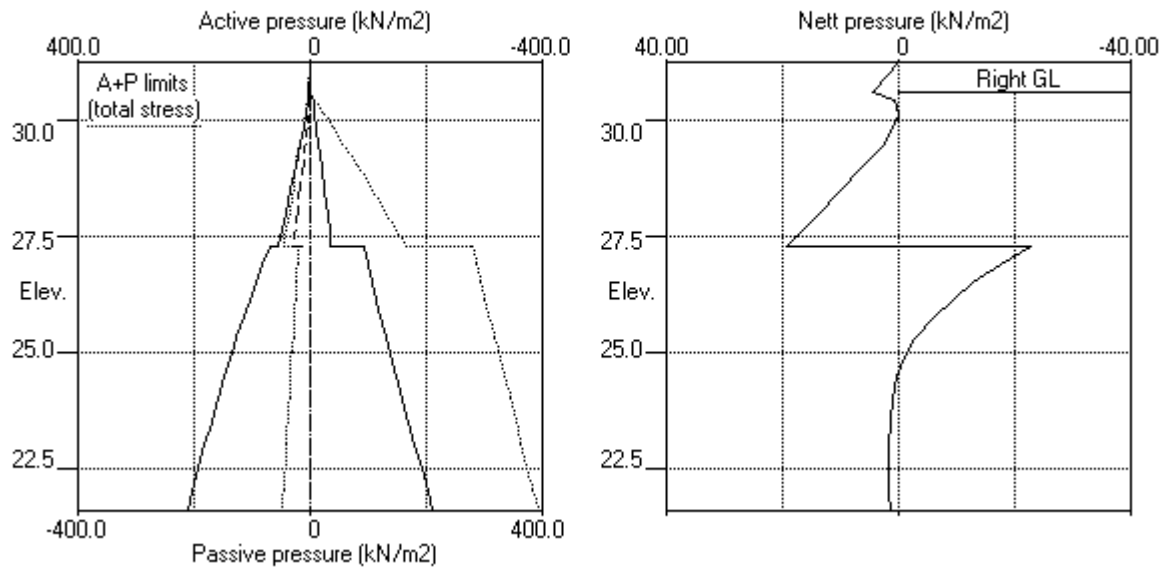
Note: 12.20a Soil pressure at active limit
 123.45p Soil pressure at passive limit

Units: kN,m

Stage No.3 Fill to elev. 31.25 on LEFT side



Stage No.3 Fill to elev. 31.25 on LEFT side



PILEDESIGNS LIMITED	Sheet No.
Program: WALLAP Version 6.06 Revision A51.B69.R54	Job No. 23811
Licensed from GEOSOLVE	Made by : MJC
Data filename/Run ID: 23811_Kentish_Town_Section3_03_SLS	
KENTISH TOWN	Date:26-05-2021
Design Case 3 - 600 dia @ 840	Checked :

Units: kN,m

Stage No. 5 Excavate to elevation 25.29 on RIGHT side

STABILITY ANALYSIS of Fully Embedded Wall according to Strength Factor method

Factor of safety on soil strength

				FoS for toe elev. = 21.60		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
5	31.25 25.29	31.00		3.007	n/a	24.88	0.41	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 20.00 from wall

Right side 20.00 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	31.25	0.00	0.003	-1.61E-03	0.0	-0.0		148372
2	31.00	1.94	0.003	-1.61E-03	0.2	0.0	58.3	148372
		1.94	0.003	-1.61E-03	-58.1	0.0		
3	30.60	5.67	0.004	-1.58E-03	-56.5	-22.9		148372
4	30.45	7.05	0.004	-1.56E-03	-55.6	-31.3		148372
5	30.15	9.67	0.004	-1.48E-03	-53.1	-47.7		148372
6	29.83	14.37	0.005	-1.35E-03	-49.2	-64.3		148372
7	29.50	18.95	0.005	-1.20E-03	-43.8	-79.4		148372
8	29.00	25.85	0.006	-9.00E-04	-32.6	-98.7		148372
9	28.50	32.64	0.006	-5.46E-04	-17.9	-111.4		148372
10	28.00	39.37	0.006	-1.62E-04	0.1	-116.1		148372
11	27.65	44.05	0.006	1.08E-04	14.7	-113.6		148372
12	27.30	48.71	0.006	3.66E-04	30.9	-105.6		148372
		19.75	0.006	3.66E-04	30.9	-105.6		
13	26.90	21.75	0.006	6.32E-04	39.2	-91.8		148372
14	26.50	23.75	0.006	8.56E-04	48.3	-74.4		148372
15	26.14	25.57	0.005	1.01E-03	57.3	-55.4		148372
16	25.77	29.85	0.005	1.12E-03	67.3	-30.8		148372
17	25.34	50.73	0.004	1.16E-03	84.8	1.4		148372
18	25.29	53.15	0.004	1.16E-03	87.4	5.7		148372
		-109.23	0.004	1.16E-03	87.4	5.7		
19	25.00	-91.55	0.004	1.13E-03	58.3	26.5		148372
20	24.50	-63.40	0.004	1.01E-03	19.5	44.2		148372
21	24.00	-38.98	0.003	8.60E-04	-6.1	46.0		148372
22	23.50	-18.56	0.003	7.19E-04	-20.5	38.0		148372
23	23.00	-1.52	0.002	6.12E-04	-25.5	25.5		148372
24	22.50	13.22	0.002	5.47E-04	-22.5	12.5		148372
25	22.00	26.77	0.002	5.22E-04	-12.5	2.9		148372
26	21.60	35.96	0.002	5.18E-04	0.0	0.0		---
At elev. 31.00		Strut force =		58.3 kN/strut =		58.3 kN/m run		

(continued)

Stage No.5 Excavate to elevation 25.29 on RIGHT side

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	31.25	0.00	0.00	0.00	0.00	0.00	0.00	1996	
2	31.00	0.00	5.15	1.94	13.73	1.94	1.94a	1996	
3	30.60	0.00	15.09	5.67	40.19	5.67	5.67a	1996	
4	30.45	0.00	18.77	7.05	49.97	7.05	7.05a	1996	
5	30.15	0.00	25.75	9.67	68.56	9.67	9.67a	1996	
6	29.83	3.25	29.60	11.12	78.83	11.12	14.37a	1996	
7	29.50	6.50	33.15	12.45	88.27	12.45	18.95a	1996	
8	29.00	11.50	38.21	14.35	101.76	14.35	25.85a	1996	
9	28.50	16.50	42.99	16.14	114.48	16.14	32.64a	1996	
10	28.00	21.50	47.58	17.87	126.71	17.87	39.37a	1996	
11	27.65	25.00	50.72	19.05	135.06	19.05	44.05a	1996	
12	27.30	28.50	53.81	20.21	143.30	20.21	48.71a	1996	
		Total>	82.31	19.75m	297.41	19.75	19.75a	20555	
13	26.90	Total>	90.20	21.75m	305.30	21.75	21.75a	20555	
14	26.50	Total>	98.06	23.75m	313.15	23.75	23.75a	20555	
15	26.14	Total>	105.18	25.57m	320.27	25.57	25.57a	20555	
16	25.77	Total>	112.28	27.39m	327.38	29.85	29.85	20555	
17	25.34	Total>	120.73	29.55m	335.83	50.73	50.73	20555	
18	25.29	Total>	121.71	29.80m	336.80	53.15	53.15	20555	
19	25.00	Total>	127.36	31.25m	342.46	67.05	67.05	20555	
20	24.50	Total>	137.10	33.75m	352.20	88.97	88.97	20555	
21	24.00	Total>	146.85	36.25m	361.94	109.37	109.37	20555	
22	23.50	Total>	156.59	38.75m	371.69	128.19	128.19	20555	
23	23.00	Total>	166.34	41.25m	381.44	145.67	145.67	20555	
24	22.50	Total>	176.10	43.75m	391.19	162.24	162.24	20555	
25	22.00	Total>	185.86	46.25m	400.96	178.37	178.37	20555	
26	21.60	Total>	193.68	48.25m	418.22	189.80	189.80	21457	

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	31.25	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	31.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
3	30.60	0.00	0.00	0.00	0.00	0.00	0.00	0.0
4	30.45	0.00	0.00	0.00	0.00	0.00	0.00	0.0
5	30.15	0.00	0.00	0.00	0.00	0.00	0.00	0.0
6	29.83	0.00	0.00	0.00	0.00	0.00	0.00	0.0
7	29.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
8	29.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
9	28.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
10	28.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
11	27.65	0.00	0.00	0.00	0.00	0.00	0.00	0.0
12	27.30	0.00	0.00	0.00	0.00	0.00	0.00	0.0
13	26.90	0.00	0.00	0.00	0.00	0.00	0.00	0.0
14	26.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
15	26.14	0.00	0.00	0.00	0.00	0.00	0.00	0.0
16	25.77	0.00	0.00	0.00	0.00	0.00	0.00	0.0
17	25.34	0.00	0.00	0.00	0.00	0.00	0.00	0.0
18	25.29	0.00	0.00	0.00	0.00	0.00	0.00	0.0
		Total>	0.00	0.00	215.10	162.37	162.37	32549
19	25.00	Total>	5.80	1.45m	220.90	158.60	158.60	32549
20	24.50	Total>	15.80	3.95m	230.90	152.37	152.37	32549

(continued)

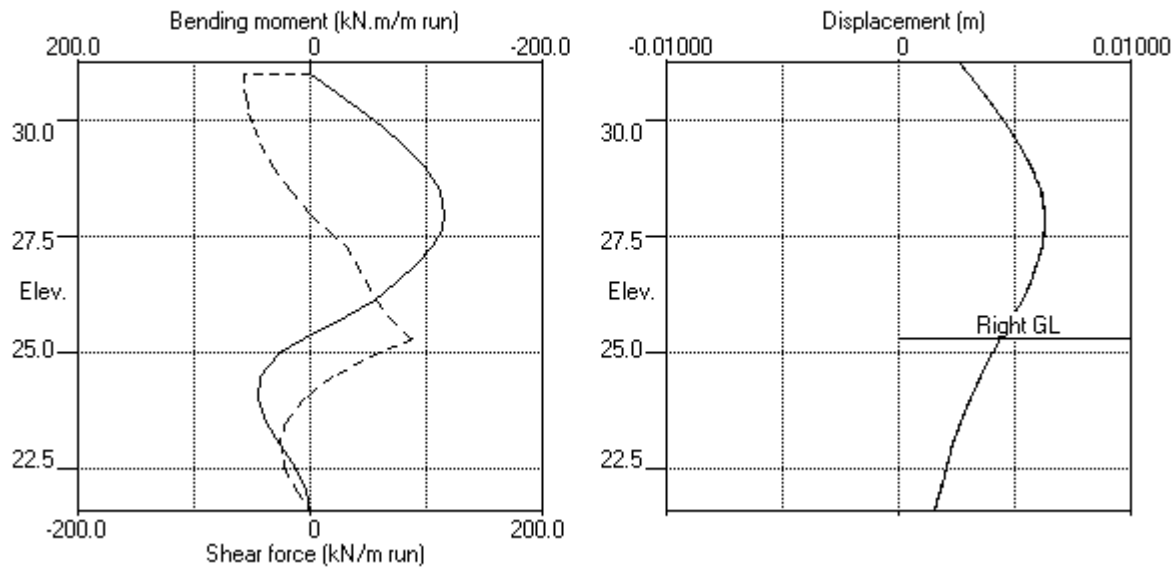
Stage No.5 Excavate to elevation 25.29 on RIGHT side

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
21	24.00	Total>	25.81	6.45m	240.91	148.36	148.36	32549
22	23.50	Total>	35.83	8.95m	250.93	146.75	146.75	32549
23	23.00	Total>	45.86	11.45m	260.96	147.18	147.18	32549
24	22.50	Total>	55.92	13.95m	271.01	149.02	149.02	32549
25	22.00	Total>	65.99	16.45m	281.08	151.59	151.59	32549
26	21.60	Total>	74.06	18.45m	289.16	153.84	153.84	32549

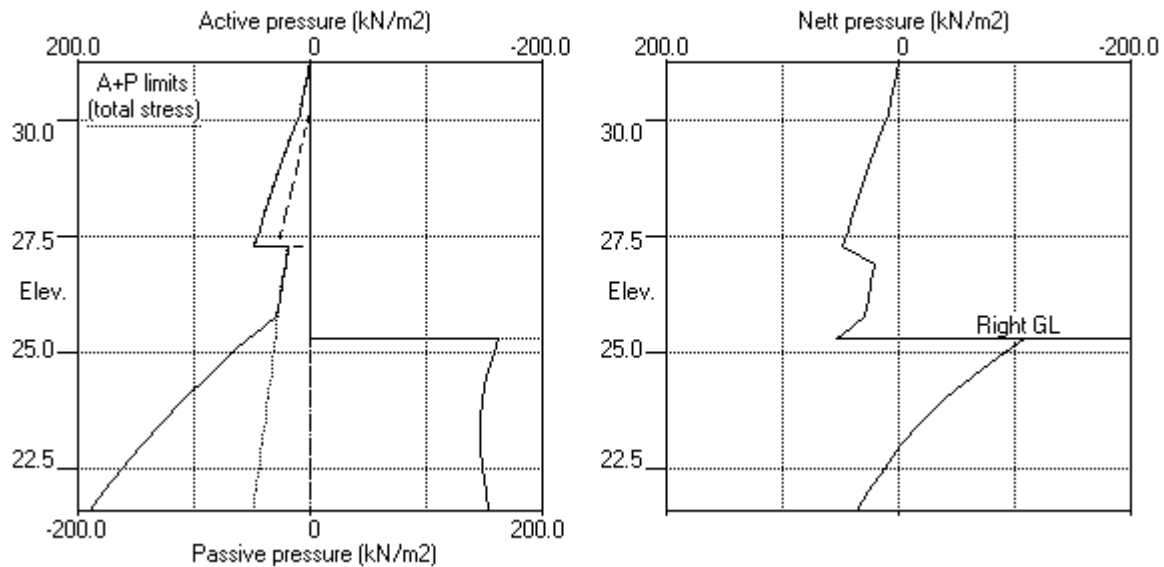
Note: 25.57a Soil pressure at active limit
 123.45p Soil pressure at passive limit

Units: kN,m

Stage No.5 Excav. to elev. 25.29 on RIGHT side



Stage No.5 Excav. to elev. 25.29 on RIGHT side



PILEDESIGNS LIMITED	Sheet No.
Program: WALLAP Version 6.06 Revision A51.B69.R54	Job No. 23811
Licensed from GEOSOLVE	Made by : MJC
Data filename/Run ID: 23811_Kentish_Town_Section3_03_SLS	
KENTISH TOWN	Date:26-05-2021
Design Case 3 - 600 dia @ 840	Checked :

Units: kN,m

Stage No. 6 Fill to elevation 25.34 on RIGHT side with soil type 1

STABILITY ANALYSIS of Fully Embedded Wall according to Strength Factor method

Factor of safety on soil strength

				FoS for toe elev. = 21.60		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	31.25 25.34	31.00		3.024	n/a	24.89	0.45	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 20.00 from wall

Right side 20.00 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	31.25	0.00	0.003	-1.61E-03	0.0	-0.0		148372
2	31.00	1.94	0.003	-1.61E-03	0.2	0.0	58.3	148372
		1.94	0.003	-1.61E-03	-58.1	0.0		
3	30.60	5.67	0.004	-1.58E-03	-56.6	-23.0		148372
4	30.45	7.05	0.004	-1.55E-03	-55.6	-31.4		148372
5	30.15	9.67	0.004	-1.47E-03	-53.1	-47.7		148372
6	29.83	14.37	0.005	-1.35E-03	-49.2	-64.3		148372
7	29.50	18.95	0.005	-1.19E-03	-43.8	-79.5		148372
8	29.00	25.85	0.006	-8.98E-04	-32.6	-98.7		148372
9	28.50	32.65	0.006	-5.44E-04	-18.0	-111.6		148372
10	28.00	39.37	0.006	-1.60E-04	0.0	-116.2		148372
11	27.65	44.05	0.006	1.10E-04	14.6	-113.7		148372
12	27.30	48.72	0.006	3.69E-04	30.9	-105.8		148372
		19.83	0.006	3.69E-04	30.9	-105.8		
13	26.90	21.86	0.006	6.35E-04	39.2	-92.0		148372
14	26.50	23.90	0.006	8.60E-04	48.4	-74.6		148372
15	26.14	25.75	0.005	1.01E-03	57.4	-55.5		148372
16	25.77	30.07	0.005	1.12E-03	67.5	-30.9		148372
17	25.34	50.99	0.004	1.16E-03	85.1	1.5		148372
18	25.29	53.06	0.004	1.16E-03	87.7	5.8		148372
		-109.60	0.004	1.16E-03	87.7	5.8		
19	25.00	-91.86	0.004	1.13E-03	58.5	26.6		148372
20	24.50	-63.61	0.004	1.01E-03	19.6	44.3		148372
21	24.00	-39.12	0.003	8.63E-04	-6.1	46.1		148372
22	23.50	-18.62	0.003	7.21E-04	-20.5	38.2		148372
23	23.00	-1.52	0.002	6.14E-04	-25.6	25.6		148372
24	22.50	13.27	0.002	5.49E-04	-22.6	12.6		148372
25	22.00	26.86	0.002	5.23E-04	-12.6	2.9		148372
26	21.60	36.11	0.002	5.19E-04	0.0	0.0		---
At elev. 31.00 Strut force =				58.3 kN/strut =	58.3 kN/m run			

(continued)

Stage No.6 Fill to elevation 25.34 on RIGHT side with soil type 1

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	31.25	0.00	0.00	0.00	0.00	0.00	0.00	4859
2	31.00	0.00	5.15	1.94	13.73	1.94	1.94a	4859
3	30.60	0.00	15.09	5.67	40.19	5.67	5.67a	4859
4	30.45	0.00	18.77	7.05	49.97	7.05	7.05a	4859
5	30.15	0.00	25.75	9.67	68.56	9.67	9.67a	4859
6	29.83	3.25	29.60	11.12	78.83	11.12	14.37a	4859
7	29.50	6.50	33.15	12.45	88.27	12.45	18.95a	4859
8	29.00	11.50	38.21	14.35	101.76	14.35	25.85a	2553
9	28.50	16.50	42.99	16.14	114.48	16.15	32.65a	2553
10	28.00	21.50	47.58	17.87	126.71	17.87	39.37a	2553
11	27.65	25.00	50.72	19.05	135.06	19.05	44.05	2553
12	27.30	28.50	53.81	20.21	143.30	20.22	48.72	2553
		Total>	82.31	19.75m	297.41	19.83	19.83	25557
13	26.90	Total>	90.20	21.75m	305.30	21.86	21.86	25557
14	26.50	Total>	98.06	23.75m	313.15	23.90	23.90	25557
15	26.14	Total>	105.18	25.57m	320.27	25.75	25.75	25557
16	25.77	Total>	112.28	27.39m	327.38	30.07	30.07	25557
17	25.34	Total>	120.73	29.55m	335.83	50.99	50.99	25557
18	25.29	Total>	121.71	29.80m	336.80	53.41	53.41	25557
19	25.00	Total>	127.36	31.25m	342.46	67.35	67.35	25557
20	24.50	Total>	137.10	33.75m	352.20	89.32	89.32	25557
21	24.00	Total>	146.85	36.25m	361.94	109.76	109.76	25557
22	23.50	Total>	156.59	38.75m	371.69	128.61	128.61	25557
23	23.00	Total>	166.34	41.25m	381.44	146.12	146.12	25557
24	22.50	Total>	176.10	43.75m	391.19	162.72	162.72	25557
25	22.00	Total>	185.86	46.25m	400.96	178.87	178.87	25557
26	21.60	Total>	193.68	48.25m	418.22	190.34	190.34	26679

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	31.25	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	31.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
3	30.60	0.00	0.00	0.00	0.00	0.00	0.00	0.0
4	30.45	0.00	0.00	0.00	0.00	0.00	0.00	0.0
5	30.15	0.00	0.00	0.00	0.00	0.00	0.00	0.0
6	29.83	0.00	0.00	0.00	0.00	0.00	0.00	0.0
7	29.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
8	29.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
9	28.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
10	28.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
11	27.65	0.00	0.00	0.00	0.00	0.00	0.00	0.0
12	27.30	0.00	0.00	0.00	0.00	0.00	0.00	0.0
13	26.90	0.00	0.00	0.00	0.00	0.00	0.00	0.0
14	26.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
15	26.14	0.00	0.00	0.00	0.00	0.00	0.00	0.0
16	25.77	0.00	0.00	0.00	0.00	0.00	0.00	0.0
17	25.34	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	2561
18	25.29	0.00	0.95	0.36	2.53	0.36	0.36a	2561
		Total>	0.95	0.25m	216.05	163.01	163.01	25630
19	25.00	Total>	6.75	1.70m	221.85	159.21	159.21	25630

(continued)

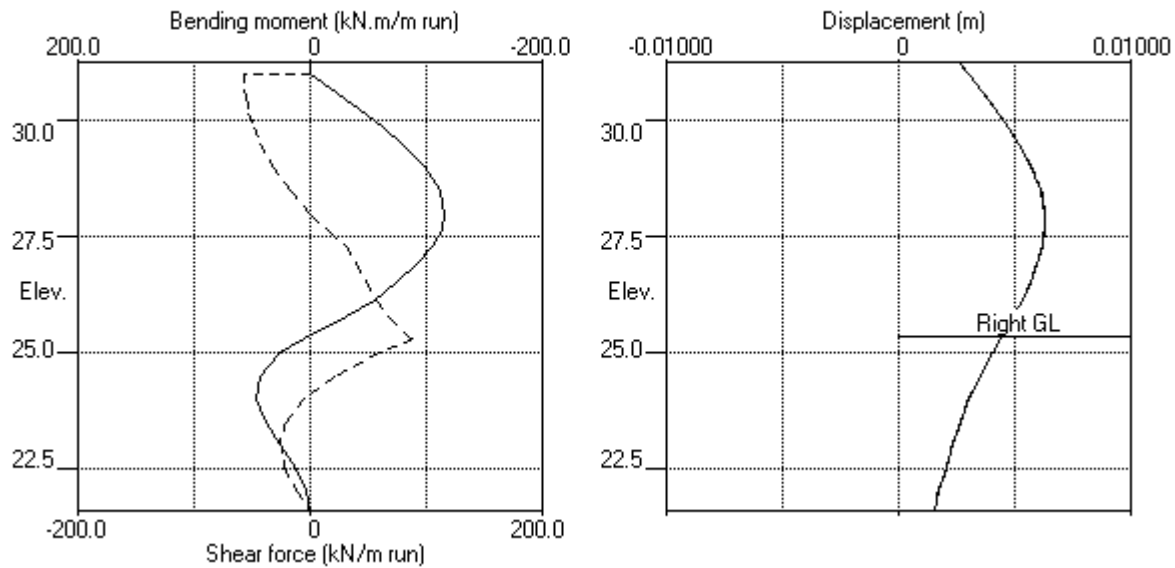
Stage No.6 Fill to elevation 25.34 on RIGHT side with soil type 1

Node no.	Y coord	----- RIGHT side -----						Total earth pressure	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			
20	24.50	Total>	16.75	4.20m	231.85	152.93	152.93	25630	
21	24.00	Total>	26.76	6.70m	241.86	148.88	148.88	25630	
22	23.50	Total>	36.78	9.20m	251.88	147.23	147.23	25630	
23	23.00	Total>	46.82	11.70m	261.91	147.64	147.64	25630	
24	22.50	Total>	56.87	14.20m	271.97	149.46	149.46	25630	
25	22.00	Total>	66.94	16.70m	282.04	152.01	152.01	25630	
26	21.60	Total>	75.02	18.70m	290.12	154.23	154.23	25630	

Note: 0.36a Soil pressure at active limit
 123.45p Soil pressure at passive limit

Units: kN,m

Stage No.6 Fill to elev. 25.34 on RIGHT side



Stage No.6 Fill to elev. 25.34 on RIGHT side

