




102 Camley Street

Design Report for the Design of Bored Pile Basement Retaining Wall

Report Ref **EA/JM0014 Rev A** **Client – JM Piling**
Date **10/12/2015**

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Preamble

The basis of this report comprised essentially a review of the available documented information from a variety of sources, together with (where appropriate) meetings and discussions with relevant authorities and other interested parties. The information reviewed should not be considered exhaustive and has been accepted in good faith by Geofirma Limited as providing a true description of site conditions and the proposed scheme. However, no liability can be accepted for the detailed accuracy or otherwise of any of the reports or documents prepared by others for the Client or for third parties, or for any associated errors or omissions.

The liability of Geofirma Limited in respect of the information contained in the report will not extend to any third party.

1. Introduction/Scope of Works

This report presents the design calculations for the bored pile retaining wall required to form a single level basement which will form part of a mixed commercial and residential development fronting on to Regents Canal in Camden, London. The two blocks comprising the development will be 9 to 12 storeys and include a house plant and a gym. The site address is 102 Camley Street, Post Code NW1 0NF, with grid reference 529719 183729.

The site currently houses a storage warehouse previously occupied by Marigold Foods.

To the east of the site are various railway lines which form the Network Rail and CTRL services in to St Pancras International. There is a Network Rail substation which is positioned to the northeast corner of the site, whilst to the west of the site is 103 Camley Street which is a mixed use 12 storey student housing and residential development. To the south of the site is Regents Canal and a towpath. To the north of the site is a warehouse.

2. Documentation

The following drawings, reports and specifications have been referred to in this design.

Main Drawing Nos

S100 Rev.T1 – Pile Plan
S110 Rev.T1 – Foundation Plan
S111-115 Rev.P2 – Foundation Plan Sheets 1 to 5
S116 Rev.P1 – Foundation Plan Sheet 6
S120 Rev.T1 – Basement Plan
S130 Rev.T1 – Ground Floor Plan
S131-135 Rev.P2 – Ground Floor Plan Sheets 1 to 5
S136 Rev.P1 – Ground Floor Plan Sheet 6
S200 and S201 Rev.T1 - Building Sections Sheet 1 and 2
S400-402 Rev T1 - Basement Section Sheets 1 to 3
S406 Rev.T1 - Typical Pile Cap Setting Out and Details
S421 and S422 Rev.T1 - Capping Beam Details Sheet 1 and 2
S441 Rev.T1 - External Works Sheet 1
S-1-930 Rev.T1 – Secant/Contiguous Pile Wall Vertical Loading- Vertical Loadings

Ground Investigatons

102 Camley Street, London Geo Environmental Site Investigation REC Ref. 20698P2R1. Dated March 2015.

Additional Geo-Environmental Investigation and Groundwater Monitoring – 102 Camley Street. Memo dated 24th October 2014. Ref.20698/141024/L1

Specifications

102 Camley Street –. Structural Specification Ref 140674/TE. Dated 27 November 2015. Rev.0

Other Documents

Design Loading & Criteria Document 140674/TAE. August 2015. Rev No. 0.

102 Camley Street NR/L2/CIV/003/F001:Approval In Principle. Job Number 234937-00. Issued 31 October 2014.

3. Main Design Requirements from Drawings, Documents and Client

- The wall adjacent to the Network Rail assets (wall A) shall be secant and propped. The other walls (B and C) shall be contiguous and constructed as a temporary cantilever. For practical reasons the eastern corner of wall B shall also be propped.
- For the wall adjacent to the Network Rail Assets (wall A) the pile lateral deflection and vertical settlement to be limited to 4 mm and 14 mm respectively as stated in the Stage E – Design Loading and Criteria Document. No deflection criteria has been set for the other walls.
- Surcharge loadings have been stated on S-1-930 Rev T1. A minimum surcharge of 20 kN/m^2 is to be assumed to be acting behind the wall. The Network Rail substation is to be assumed to apply a load of 40 kN/m^2 behind the north east corner of the basement wall.
- The design life of the basement wall is to be 50 years.
- A minimum of C40 concrete to be used for the floor slab and foundations.
- Concrete used to construct the piles to conform to ACEC class AC-3s and design sulphate class DS-4.

4. Ground Conditions

Information from two ground investigations has been made available by the client. One (BH1) boreholes having a depth of 40 m and 9No window samples (WS101 to 105 and WS301 to WS304) having a maximum depth of 5 m. The findings of this exploratory hole and the previous boreholes are discussed in an interpretative report prepared by REC Ltd report dated March 2015. The ground conditions are also discussed in the Network Rail AIP document dated October 2014.

Based on the above information, the following tabulated ground conditions below have been assumed in the design of the retaining wall:

Assumed Ground Profile	Surface level of Stratum (m OD)
Made Ground	28.30
London Clay	24.00
Lambeth Group	-2.00

Minor seepages were encountered during the drilling of BH101. Groundwater monitoring was undertaken and the highest levels of 2.34 m bgl and 2.6 m bgl were encountered in window sample holes WS201 and WS301 respectively.

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5 Soil Description and Design Parameters

5.1 Made Ground

A layer of Made Ground is assumed to be present at the site. Typically the material is varied and comprises clayey gravelly sand as well as sandy gravelly clay. Included in the soil matrix are concrete, brick, clinker and frequent cobbles as well as organic matter. SPT 'N' values of 6, 1 and 7 where recorded in this material, with a resulting average of 5. Due to the varied nature of the Made Ground and the presence of cohesive material an angle of friction of 26 degrees has been assumed in the retaining wall analysis.

5.2 London Clay

The London Clay was encountered as a firm becoming stiff brown, mottled blue grey thinly laminated clay. At depth this material becomes a very stiff grey thinly laminated clay with frequent selenite and mica crystals. Both undrained triaxials and standard penetration tests were performed in this strata. Both sets of data have been used to develop a profile of undrained shear strength vs level. The SPT'N' values have been converted into undrained shear strength using a correlation factor of 4.5, using the formula:

$Cu = f_i N$ (after Stroud)

The plot of undrained shear strength vs depth is shown on the next page.

For the long term analysis of the retaining wall, effective stress parameters have been assumed. These are c' = 3 kPa and an angle of friction of 24 degrees.

5.3 Lambeth Group

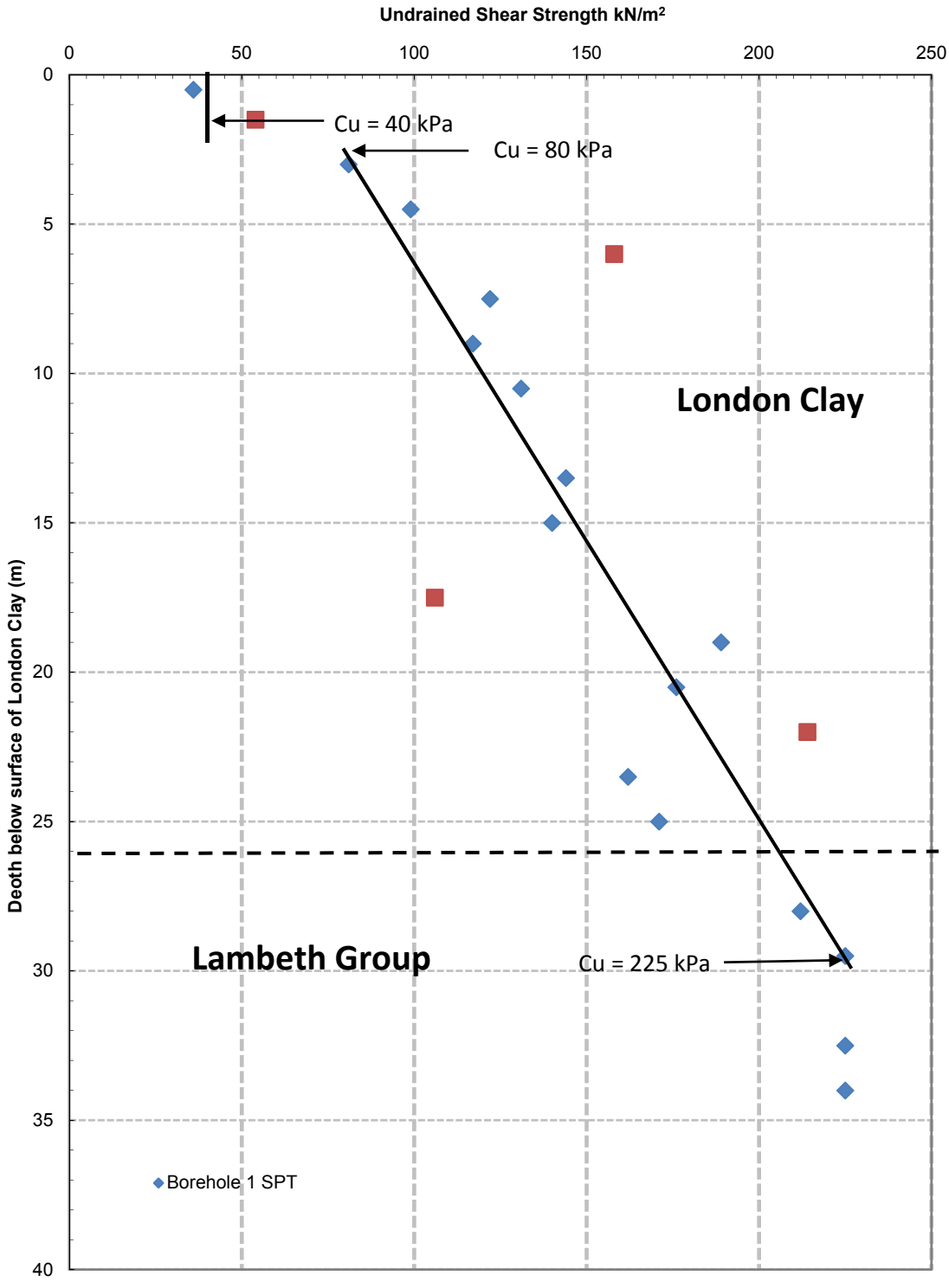
The Lambeth Group is was encountered in BH101 as a blue grey and grey very stiff silty clay.

Both undrained triaxials and standard penetration tests were performed in this strata. Both sets of data have been used to develop a profile of undrained shear strength vs level. The SPT'N' values have been converted into undrained shear strength using a correlation factor of 4.5, using the formula:

$Cu = f_i N$ (after Stroud)

The plot of undrained shear strength vs depth is shown on the next page.

For the long term analysis of the retaining wall, the same parameters as assumed for the London Clay are used.


Undrained Shear Strength kN/m²
0
50
100
150
200
250
0
5
10
15
20
25
30
35
40
Deoth below surface of London Clay (m)
Cu = 40 kPa
Cu = 80 kPa
London Clay
Lambeth Group
Cu = 225 kPa
Borehole 1 SPT

5.4 Stiffness Parameters

Youngs Moduli values have been derived for Made Ground assuming the relationship:

E' = 2000N kN/m2 for ULS analysis (Based on guidance in CIRIA 143)

For the cohesive deposits the Youngs Moduli values used in the ULS analysis has been determined using the expression:

E_u = 500Cu kN/m2 (Cu = undrained shear strength)

The drained Youngs Moduli for the cohesive deposits used in the ULS is derived from the expression:

E' = 0.7 x 500Cu kN/m2 (Cu = undrained shear strength)

For the SLS analysis as stated in C580 it is customary to assume the stiffness is twice that of the stiffness used in the ultimate state analysis.

STRATUM	CHARACTERISTIC SOIL DESIGN PARAMETERS
Made Ground	Bulk Density = 19 kN/m^3 Young's Modulus = 10000 kN/m^2 (20000 kN/m^2 for SLS calcs) C' = 0 Φ' = 26° No strength parameters assumed for pile bearing calculations
London Clay	Bulk Density = 19 kN/m^3 C' = 3 kPa Φ' = 24° Cu = 40 kN/m^2 (from z = 0 to 2 m below surface of London Clay Eu = 20000 kN/m^2 (40000 kN/m^2 for SLS calcs) E' = 14000 kN/m^2 (28000 kN/m^2 for SLS calcs) Cu = 80 + 5.18 z (z = depth below surface of London Clay) Eu = 40000 + 2590 z kN/m^2 (80000 + 5180 z kN/m^2 for SLS calcs) E' = 28000 + 1813 z kN/m^2 (56000 + 3626 z kN/m^2 for SLS calcs)
Lambeth Group Cohesive (Parameters of this stratum not used in this design)	Bulk Density = 19kN/m^3 (Parameters not used in this design)

5.5 Wall and Slab Properties

The piles will be formed from reinforced concrete. The following were used in this computations:

I = πD^4/64s m^4 per m run

D = pile diameter

S = pile centre to centre spacing

E_{steel} = 2.1 x 10^8 kN/m^2

$E_{o\ concrete}$ = 2.8 x 10^7 kN/m^2

6 Construction Methodology and Sequence

6.1 Walls B and C

The wall is designed as a 750 mm diameter bored pile wall with the piles spaced at 900 mm c/c. The basement wall will not be propped during construction. The ground levels, dig levels and surcharge are based on those provided on the drawings and information provided. The modelled sequence is as follows:

- Piles installed from PPL = approx. 27.4 m OD (Note existing ground level appears to vary approx. between 28.3 m and 27.3 m OD from topography information)
- Excavation undertaken to maximum dig level which varies between 22.485 m OD and 23.335 m OD. The maximum design dig level with overdig (0.5 m) has also been checked in this design. In locations where pile caps are in front of the wall, the dig level required to form the pile cap has been assumed in the design.
- Install 0.3 m thick Basement slab on top of 0.225 m thick cellcore layer. Basement slab acts as permanent prop.
- Install level ground slab at approximately 27.45 m OD. Ground floor slab acts as permanent prop.

6.2 Wall A

The wall is designed as a 750 mm diameter bored pile wall with the piles spaced at 1100 mm c/c. The ground levels, dig levels and surcharge are based on those provided on the drawings and information required. The modelled sequence is as follows:

- Piles installed from PPL = approx. 27.4 m OD (Note existing ground level appears to be at approximately 28.3 m OD from topography information)
- Excavation undertaken to just below capping beam of 27.1 m OD approx. A berm will then be formed in front of the wall which will be 2 m at the top and approximately 5 to 6 m at formation level.
- Excavation undertaken to maximum dig level which varies between 22.485 m OD and 23.335 m OD. The maximum design dig level with overdig (0.5 m) has also been checked in this design. In locations where pile caps are in front of the wall, the dig level required to form the pile cap has been assumed in the design.
- Install 0.3 m thick Basement slab on top of 0.225 m thick cellcore layer. Basement slab acts as permanent prop.
- Install level ground slab at approximately 27.45 m OD. Ground floor slab acts as permanent prop.
- Remove the temporary prop.

7 Design Philosophy and Approach

7.1 ULS Design of Retaining Wall Pile

- Soil parameters used are 'moderately conservative' in accordance with EC7.
- Surcharge loads as stipulated in S-1-930 Rev.T1 have been assumed. These are assumed to be the worst case loads. It has been assumed that in the location of the Network Rail sub-station the surcharge loading is 40 kN/m^2,and elsewhere a surcharge loading of 20 kN/m^2 is applied.
- Design Approach 1 Combination 1 and 2 (DA1 C1 and DA1 C2) have been used in the analysis with the appropriate factors, as stated in EC7 and the UK National Annex. An additional SLS analysis has been undertaken to estimate the movement of the wall.
- Both DA1 C1 and DA1 C2 analyses' have been undertaken using the moderately conservative parameters, with the bending moments and shear force outputs from DA1 C1 being multiplied by 1.35. Both sets of outputs are compared and the maximum is designed for. Note that DA1 C2 tends to control the pile toe level. The bending moments obtained from WALLAP runs are multiplied by the pile spacing to convert the values from per linear metre to per pile.
- The force acting on the single temporary prop attached to the capping beam has been derived by selecting the higher of either 1.35 times the DA1 C1 output value,and 1.0 times the DA1 C2 output value.
- A groundwater level of approximately 24 to 25 m OD has been assumed during construction. This level has been assumed for walls B and C because the walls will be contiguous and hence the full water is not likely to build up. The client has stated that if groundwater is encountered dewatering will be undertaken. A groundwater level of 26.3 m OD will be assumed for wall A which will be a secant wall. The permanent groundwater level for the long term will be assumed to be 1 m below the ground surface.
- In the temporary condition, wall A is assumed to be temporarily propped at the capping beam. The temporary prop should only be removed after all the permanent slabs are in place.
- In the permanent case, the wall is assumed to be propped by the basement slab and the basement and ground floor slabs.
- An overdig allowance of 0.5 m has been allowed for in the ULS analysis.
- The area of main steel was calculated using the maximum moments and shear forces from the WALLAP runs. Actual areas of reinforcement and links required were determined using ADC and the attached Geofirma Ltd spreadsheet.

7.1 SLS Check on Retaining Wall Pile Lateral Deflections

- Soil parameters used are 'moderately conservative' in accordance with EC7. Unfactored strength parameters are used in this assessment.

- More realistic surcharges are assumed to act behind the walls in the SLS analysis. Behind walls B and C a surcharge of 10 kN/m^2 is assumed to act. Behind wall A loadings are based on those given in the Arup AIP report (NR/L2/CIV/003/F001). In the section of wall adjacent to the substation a live load of 5 kN/m^2 has been assumed immediately behind the wall and a surcharge of 40 kN/m^2 assumed to act 2.45 m behind the wall. Elsewhere a live load of 5 kN/m^2 is assumed to act immediately behind the wall and 50 kNm^2 which represents the load of a train, is assumed to act 5 m behind the wall.

- A groundwater level of approximately 24 to 25 m OD has been assumed during construction. This level has been assumed for walls B and C because the walls will be contiguous and hence the full water is not likely to build up. The client has stated that if groundwater is encountered dewatering will be undertaken. A groundwater level of 26.3 m OD will be assumed for wall A which will be a secant wall. The permanent groundwater level of 2 m below ground level has been assumed for the SLS case.

- In the temporary condition, wall A is assumed to be temporarily propped at the capping beam. The temporary prop should only be removed after all the permanent slabs are in place.

- In the permanent case, the wall is assumed to be propped by the basement slab and the basement and ground floor slabs.

- No overdig allowance in the SLS analysis.

7.2 Design of Retaining Wall Pile for Bearing Capacity

- The contiguous wall piles were also designed to carry vertical loads using OASYS Pile. A factor of safety of 2.6 in accordance with the LDSA.

- To ensure settlement is controlled the piles have been designed to ensure the ultimate skin friction (USF) is a minimum of 1.2 times the pile safe working load (SWL). This should ensure the pile performance is satisfactory.

- The pile loadings have been provided on the drawing S-1-930 Rev.T1. To determine the load carried by each pile the load per metre has been multiplied by the pile spacing and added to the vertical load due to the point/column loads. The load from each point load is assumed to be carried by 5No piles. The calculated load per pile is tabulated below:

Wall Section	Point Load	Point Load (kN)	Line Load (kN)	Assumed No of Piles beneath point load	Pile Spacing (m)	Calculated Load per pile (kN)	Required Minimum Toe Level (m OD)	Design Pile Toe Level (m OD)
A1-1	1	6100	200	5	1.1	1440	3.4	3.4
A1-2	2	4800	180	5	1.1	1158	6.4	4.9
A1-2/A2	3	5500	180	5	1.1	1298	4.9	4.9
A2	4	5750	135	5	1.1	1298.5	4.9	3.9
A2	5	5800	135	5	1.1	1308.5	4.4	3.9
A2	6	5500	135	5	1.1	1248.5	5.4	3.9
A2	7	6100	135	5	1.1	1368.5	3.9	3.9
A2	8	5900	135	5	1.1	1328.5	4.4	3.9
A2	9	5900	135	5	1.1	1328.5	4.4	3.9
B4	10	3250	180	5	0.9	812	10.4	10.4
B4/C1	11	1950	180	5	0.9	552	14.4	10.4
C1/C2	12	2450	180	5	0.9	652	12.9	10.4
C2	13	2600	180	5	0.9	682	12.4	10.4
C2	14	3350	180	5	0.9	832	10.4	10.4
C4	15	2500	135	5	0.9	621.5	13.4	9.9
C4	16	3150	135	5	0.9	751.5	11.4	9.9
C4	17	3650	135	5	0.9	851.5	9.9	9.9
C5	18	3450	135	5	0.9	811.5	10.4	9.9
C6	19	9200	135	5	0.9	1961.5	-1.6	-1.6

- The pile loadings have been rationalised for practicality reasons on the pile schedule.

7.3 Temporary Propping

The design assumes a single level of props will be used to support the excavation during construction. The single level of props is assumed to be connected to the capping beam of the Wall A (A1 and A2) and the north east corner of wall B bored pile wall (B1).

The propping should be applied to the capping beam as soon as the excavation works proceed to ensure the retaining wall system is stiff and the deflections are limited to those stipulated in this document. The temporary propping should be designed by the Temporary Works specialist in accordance with CIRIA documents C517 and C580. **The temporary propping must NOT be removed until after the basement and ground floor slabs have been placed and have gained the required concrete strength.**

The level of temporary propping is assumed to be at 27.7 m OD. It has been assumed the area of the prop is 0.01 m^2, and the Youngs Modulus is 2 x 10^8 kN/m^2. Based on the WALLAP analysis the temporary props should be designed to carry a minimum unfactored horizontal prop load of 100 kN/m run.

8 Design Summary

The summary of the bending moments and shear forces and schedule requirements:

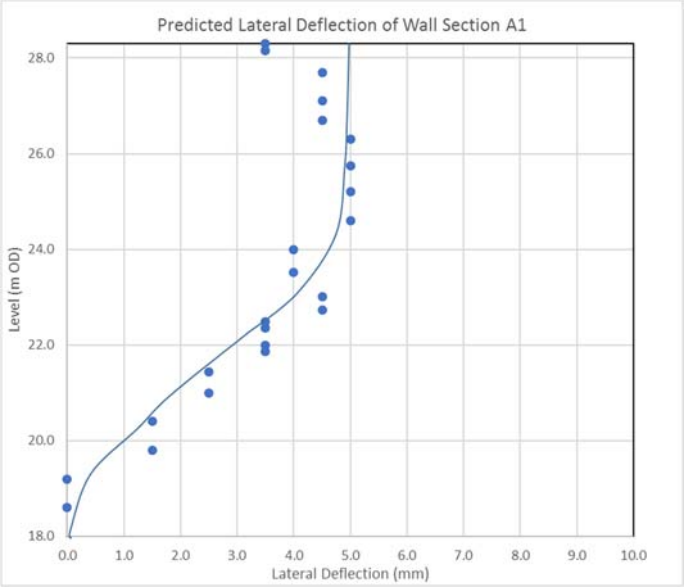
Wall Ref	Construction Method	Pile Dia (mm)	Pile Spacing (mm)	Est PPL (m OD)	Est Top of Capping Beam (m OD)	Est COL (m OD)	Max Bending Moment per pile (kNm)	Max Shear Force per pile (kN)	Toe Level (Comp) (m OD)	Steel Cage	Links Steel	Steel Toe (m OD)
A1-1 (Sub Station	Propped	750	1100	27.4	28.3	TBC	344	252	3.4	8H25	H10 at 200 mm	18
A1-2 (Sub Station)	Propped	750	1100	27.4	27.725/27.58	TBC	344	252	4.9	8H25	H10 at 200 mm	18
A2	Propped	750	1100	27.4	27.725/27.58	TBC	337	185	3.9	7H25	H10 at 200 mm	18
B1	Propped	750	900	27.4	28.3	TBC	364	208	13.5	8H25	H10 at 200 mm	16
B2	Cantilever	750	900	27.4	28.3	TBC	853	244	13.5	8H40	H10 at 200 mm	13.5
B3	Cantilever	750	900	27.4	27.65	TBC	717	216	13.5	10H32	H10 at 200 mm	13.5
B4	Cantilever	750	900	27.4	27.65	TBC	489	226	10.4	6H32	H10 at 200 mm	14
C1	Cantilever	750	900	27.4	27.45	TBC	533	176	10.4	7H32	H10 at 250 mm	15
C2	Cantilever	750	900	27.4	27.45	TBC	379	168	10.4	8H25	H10 at 250 mm	15
C3	Cantilever	750	900	27.4	27.45	TBC	533	176	10.4	7H32	H10 at 250 mm	15.5
C4	Cantilever	750	900	27.4	27.725	TBC	379	168	9.9	8H25	H10 at 250 mm	15
C5	Cantilever	750	900	27.4	27.725	TBC	460	144	9.9	9H25	H10 at 250 mm	15
C6	Cantilever	750	900	27.4	27.725	TBC	379	168	-1.6	8H25	H10 at 250 mm	15
C7	Cantilever	750	900	27.4	27.725	TBC	379	168	10.4	8H25	H10 at 250 mm	15

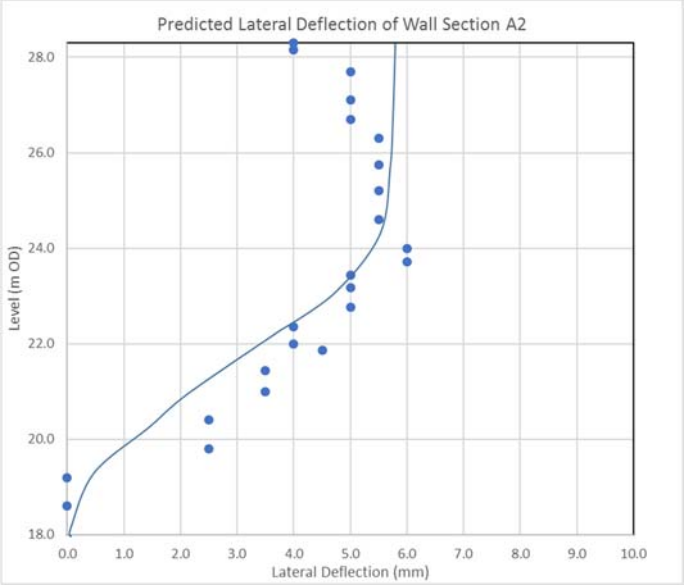
9. Other Issues

9.1 Wall Deflections

Based on guidance given in C580 (2003), it is anticipated the lateral movements in the wall could be up to 0.2 % of the excavated depth for propped embedded retaining walls, and 0.4 % of the excavation depth for cantilevered embedded retaining walls constructed in stiff soils within the UK. The above values are based on case studies and data collected from actual projects within the UK and abroad. Based on this approach, it is anticipated the lateral movements could range in the region of 8 to 25 mm.

Wall movements are critical for wall A due to its close proximity to the Network Rail Assets. Therefore an assessment has been undertaken utilising WALLAP to estimate the wall deflections. It should be noted that WALLAP typically overestimates the wall movement due to the excavation down to the top of the berm. For walls A1 and A2 the deflection computed for the first stage of the excavation to the top of the berm varied between 3 and 4 mm. Half of these values (1.5 and 2 mm respectively) are then subtracted from the WALLAP computed deflections at each stage. The plots of the deflection vs depth of wall A are shown below.





The values above are less than the estimated C580 value of 0.2% of the retained wall height, which is in the range of 8 to 10 mm. Nonetheless both sets of values exceed the maximum lateral deflection criteria of 4 mm stated in the design load and criteria document. There is hence a potentially risk the wall deflections could exceed the specified maximum allowable lateral deflection. To reduce the possibility of excessive lateral deflections the wall must be propped throughout the excavation phase of the project using suitably stiff wailing and propping system designed by the temporary works specialist. Monitoring must be undertaken using Hilti monitoring points placed on the capping beam to determine lateral deflections of the capping beam. Lateral deflections along the depth of the piles may also be monitored using inclinometers or Shape Accel Arrays (SAA). These should be installed in the piles during construction and monitored regularly to enable a wall lateral deflection vs depth profile to be determined. Monitoring must be undertaken on a regular basis (minimum twice a day) during the formation of the berm and a minimum of three times per week during other periods. If the rate of deflection of the wall is observed to increase at any stage, the frequency of the monitoring should be duly increased. Where the deflections are noted to approach pre-defined trigger values, excavation works should be stopped immediately and extra support applied to the wall. It should be noted that the calculated values do not include for the compression of the temporary props.

Walls B and C are to be constructed as cantilevers. Typically based on the CIRIA 580 guidance, the lateral deflection could be up to 0.4% of the retained height which corresponds to a value of up to 20 mm. An assessment has been undertaken using WALLAP which typically overestimates the deflection of cantilever wall by up to twice the real value, therefore lateral deflections are expected to vary between 11 mm and 16 mm.

Settlement has been estimated for the bored pile walls using OASYS Pile and the wall settlements are not anticipated to exceed 5 mm.

9.2 Miscellaneous Issues

In the permanent case, an impermeable structural lining will be connected to the inside of the retaining wall to provide a basement which is fit for purpose and provides a suitable level of watertightness.

During construction the contiguous bored pile retaining wall is solely required to provide a stable excavation during construction and **not** to control the inflow of water into the excavation. Entry of groundwater into the excavation during construction may need to be controlled by dewatering.

The steel reinforcement in the piles shall be 500 N/mm^2 and the concrete shall have a minimum cube strength of 40 N/mm^2. The DS class for the piles shall be is DS-3 and the concrete class AC-3.

IMPORTANT INFORMATION FROM CLIENT

Ebenezer Adenmosun

From: Ebenezer Adenmosun
Sent: 28 October 2015 14:35
To: 'Herbert, Kieran'
Cc: Gilhooley, Patrick
Subject: RE: Camley Street

Hi Kieran,

Hope all is well.

If competently propped the deflections will be the same as those calculated for wall section A1-1. We just need confirmation from the temporary works people.

Regards,

Ebenezer Adenmosun
BEng(Hons) ACGI MSc DIC CEng MICE FGS

Director

Geofirma Ltd
62 - The Hub
The Wenta Business Centre
Colne Way
Watford
Herts
WD24 7ND

Mobile Tel. 07812 044018/07517 290667
Office Tel. 01923 803879
Email ebenezer.adenmosun@geofirmaconsultants.co.uk

From: Herbert, Kieran [mailto:kieranherbert@murphygroup.co.uk]
Sent: 28 October 2015 10:25
To: Ebenezer Adenmosun <ebenezer.adenmosun@geofirmaconsultants.co.uk>
Cc: Gilhooley, Patrick <patrickgilhooley@murphygroup.co.uk>
Subject: Camley Street

Hi Ebenezer,

Myself and Patrick had a meeting yesterday with the guys at Camley street regarding the retaining wall.

The Engineer from Conisbee have had a look through your calcs and picked out section B1 on the wall and made a comment on the deflections . Do the deflections stated in this area (around 20mm I believe) take into account the corner prop? Or will it reduce further?

Regards,

Kieran Herbert

Engineer

J.M.PILING
Celebrating 50 years

J Murphy & Sons Limited, Hiview House, Highgate Road, London NW5 1TN

Telephone: 02037 571 456 | Mobile: 07912 395 823 | Email: kieranherbert@murphygroup.co.uk

Follow us on LinkedIn or visit www.murphygroup.co.uk

Ebenezer Adenmosun

From: Herbert, Kieran <kieranherbert@murphygroup.co.uk>
Sent: 06 October 2015 07:09
To: Ebenezer Adenmosun
Cc: Gilhooley, Patrick
Subject: RE: Camley Street - Wall Design

Sorry Ebenezer,

Typo on my behalf. Should be 27.4 M

Regards,

Kieran Herbert
Engineer

J.M.PILING
Celebrating 50 years

J Murphy & Sons Limited, Hiview House, Highgate Road, London NW5 1TN

Telephone: 02037 571 456 | Mobile: 07912 395 823 | Email: kieranherbert@murphygroup.co.uk

Follow us on LinkedIn or visit www.murphygroup.co.uk

From: Ebenezer Adenmosun [mailto:ebenezer.adenmosun@geofirmaconsultants.co.uk]
Sent: 05 October 2015 22:25
To: Herbert, Kieran
Cc: Gilhooley, Patrick
Subject: RE: Camley Street - Wall Design

Hi Kieran,

Are you sure this is the piling platform level for the bored pile wall. Did you mean 27.4 m OD?

Regards,

Ebenezer Adenmosun
BEng(Hons) ACGI MSc DIC CEng MICE FGS

Director

Geofirma Ltd
62 - The Hub
The Wenta Business Centre
Colne Way
Watford
Herts
WD24 7ND

Ebenezer Adenmosun

From: Herbert, Kieran <kieranherbert@murphygroup.co.uk>
Sent: 01 October 2015 09:45
To: Ebenezer Adenmosun
Cc: Gilhooley, Patrick
Subject: RE: 102 Camley Street - Capping beam RC details.

Hi Ebenezer,

After speaking with SISK they have informed me that they believe the water table to be below the depth of the dig and water shown any higher that this in the SI will only be parched. If they come across excessive water they will carry out De-Watering.

Regards,

Kieran Herbert
Engineer

J.M.PILING
Celebrating 50 years

J Murphy & Sons Limited, Hiview House, Highgate Road, London NW5 1TN

Telephone: 02037 571 456 | Mobile: 07912 395 823 | Email: kieranherbert@murphygroup.co.uk

Follow us on LinkedIn or visit www.murphygroup.co.uk

From: Ebenezer Adenmosun [mailto:ebenezer.adenmosun@geofirmaconsultants.co.uk]
Sent: 30 September 2015 17:55
To: Herbert, Kieran
Cc: Gilhooley, Patrick
Subject: RE: 102 Camley Street - Capping beam RC details.

Kieran,

Please can you ask Sisk whether they intend to undertake dewatering as part of this scheme because there could be water present based on the borehole information and the Arup report.

Regards,

Ebenezer Adenmosun
BEng(Hons) ACGI MSc DIC CEng MICE FGS

Director

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Herts
WD24 7ND

Mobile Tel. 07812 044018/07517 290667
Office Tel. 01923 803879
Email ebenezer.adenmosun@geofirmaconsultants.co.uk

From: Herbert, Kieran [mailto:kieranherbert@murphygroup.co.uk]
Sent: 30 September 2015 16:25
To: Ebenezer Adenmosun <ebenezer.adenmosun@geofirmaconsultants.co.uk>
Cc: Gilhooley, Patrick <patrickgilhooley@murphygroup.co.uk>
Subject: FW: 102 Camley Street - Capping beam RC details.

Another Email Chain regarding propping that may be worth a read through

Regards,

Kieran Herbert
Engineer

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Celebrating 50 years

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From: Jonathan Staley [mailto:JonathanStaley@sisk.co.uk]
Sent: 30 September 2015 16:22
To: Herbert, Kieran
Subject: FW: 102 Camley Street - Capping beam RC details.

Kieran,

See below for your information.

Thanks,

Jon

Jon Staley MEng MICE CEng
Contracts Manager

John Sisk & Son Ltd
1 Curo Park
Frogmore
St Albans
Hertfordshire
AL2 2DD

T: 01727 875551
F: 01727 875642
M: 07833441353

Have you seen our new websites –
www.johnsiskandson.com www.siskgroup.com

From: Keith O Connor [mailto:KeithOConnor@groundconstruction.com]
Sent: 30 September 2015 16:20
To: Jonathan Staley; Grant Mears
Cc: David Bailey; Thomas Scanlon; Michael Greene; Terence Reginold
Subject: RE: 102 Camley Street - Capping beam RC details.

Jon

In terms of berm size, I have gone with a smaller one than the one currently shown on the Arup sketches, the size of which seems very excessive.
I have envisaged a berm 2m wide at the top and approx. 5.3m wide at the base. Where this berm encroaches onto the piles caps we would use sheet piles and propping if necessary to support the excavation.

On return of a formal letter of intent we would be able to confirm the lateral loads, at present we would envisage a lateral load of 125-150kN

Regards
Keith

Keith O Connor
Technical & Temporary Works Director

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Ground Construction Ltd, Ground House, 2-3 Little Burrow, Welwyn Garden City, Hertfordshire, AL7 4SP

From: Jonathan Staley [mailto:JonathanStaley@sisk.co.uk]
Sent: 30 September 2015 13:46
To: Keith O Connor; Grant Mears
Cc: David Bailey; Thomas Scanlon; Michael Greene; Terence Reginold
Subject: RE: 102 Camley Street - Capping beam RC details.

Thanks Keith,

What have you assumed with regards to the berm size prior to propping? The Arup Form 001 shows a giant berm that extends out 5m flat and then down on a 35 degree angle of repose, whilst this is probably excessive we will need to work with the pile designers to make sure the wall deflection works relative to the size of berm you are assuming, prior to prop install.

My concern is making sure we can install the core pile caps working around the berm, we may be in a situation where we need to install something like a temporary sheet piled wall along the berm side of the cap, to support the berm behind.

In answer to your other email we do not need to prop the non-rail elevation, but need to confirm this with the pile designers so that their piled wall design reflects this. I can send them your initial proposal as a guide to work to so that the contig wall is designed to suit.

Currently the piles are being designed for a standard lateral load of 50kN, how quickly could you advise of the loads induced by your props? I would assume that the two core caps will probably be fine but we may need to increase pile rebar and/or diameter size for some of the piles.

Kind regards,

Jon

Jon Staley MEng MICE CEng
Contracts Manager

John Sisk & Son Ltd
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Frogmore
St Albans
Hertfordshire
AL2 2DD

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M: 07833441353

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www.johnsiskandson.com www.siskgroup.com

From: Keith O Connor [mailto:KeithOConnor@groundconstruction.com]
Sent: 30 September 2015 13:17
To: Jonathan Staley; Grant Mears
Cc: David Bailey; Thomas Scanlon; Michael Greene
Subject: RE: 102 Camley Street - Capping beam RC details.

Jon, Grant

Please find attached our preliminary propping layout for propping of the capping beam along the network rail boundary. Note that this has not been checked internal and this is not due to be carried out until we receive a letter of intent.

As such the design is subject to change, both as a result of our own internal checking procedures and external checking procedures.
In addition to this, this propping layout assumes that the bearing piles are capable of resisting the applied lateral loads.
Also I have changed the pile cap layout slightly, at GL B/5 we propose casting the 2No PC3s in own, this way we get 8no piles working against the prop load.
We have assumed that the capping beam can span 9.1m without exceeding the NR deflection limits- please confirm that this is OK.

At present we do not foresee the Mabey system, as sent through on the email below, as the most cost effective solution to the propping of the capping beam. These props weigh from 14t up to 19t will have a weekly hire rate of approx. £3500 per week.
They also clash with the position of a number of the vertical elements and Prop 1.2 looks like it could possible clash with the tower crane mast.

Regards
Keith

Keith O Connor
Technical & Temporary Works Director
GCL
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E-mail: Info@GroundConstruction.com

Ground Construction Ltd, Ground House, 2-3 Little Burrow, Welwyn Garden City, Hertfordshire, AL7 4SP

From: Jonathan Staley [mailto:JonathanStaley@sisk.co.uk]
Sent: 30 September 2015 11:39
To: Grant Mears; Michael Greene
Cc: Keith O Connor; David Bailey; Thomas Scanlon
Subject: RE: 102 Camley Street - Capping beam RC details.

All,

Some work attached that may help from Mabey that our temporary works department have been looking at.

Could you also have a look at this in comparison to your proposals. I think the lateral imposed load of 145 is high, and we are assuming a worst case of 112, but this should be a reasonable sense check to your current work.

Regards,

Jon

Jon Staley MEng MICE CEng
Contracts Manager

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1 Curo Park
Frogmore
St Albans
Hertfordshire
AL2 2DD

BUILDERS SISK CONTRACTORS Established 1839

T: 01727 875551
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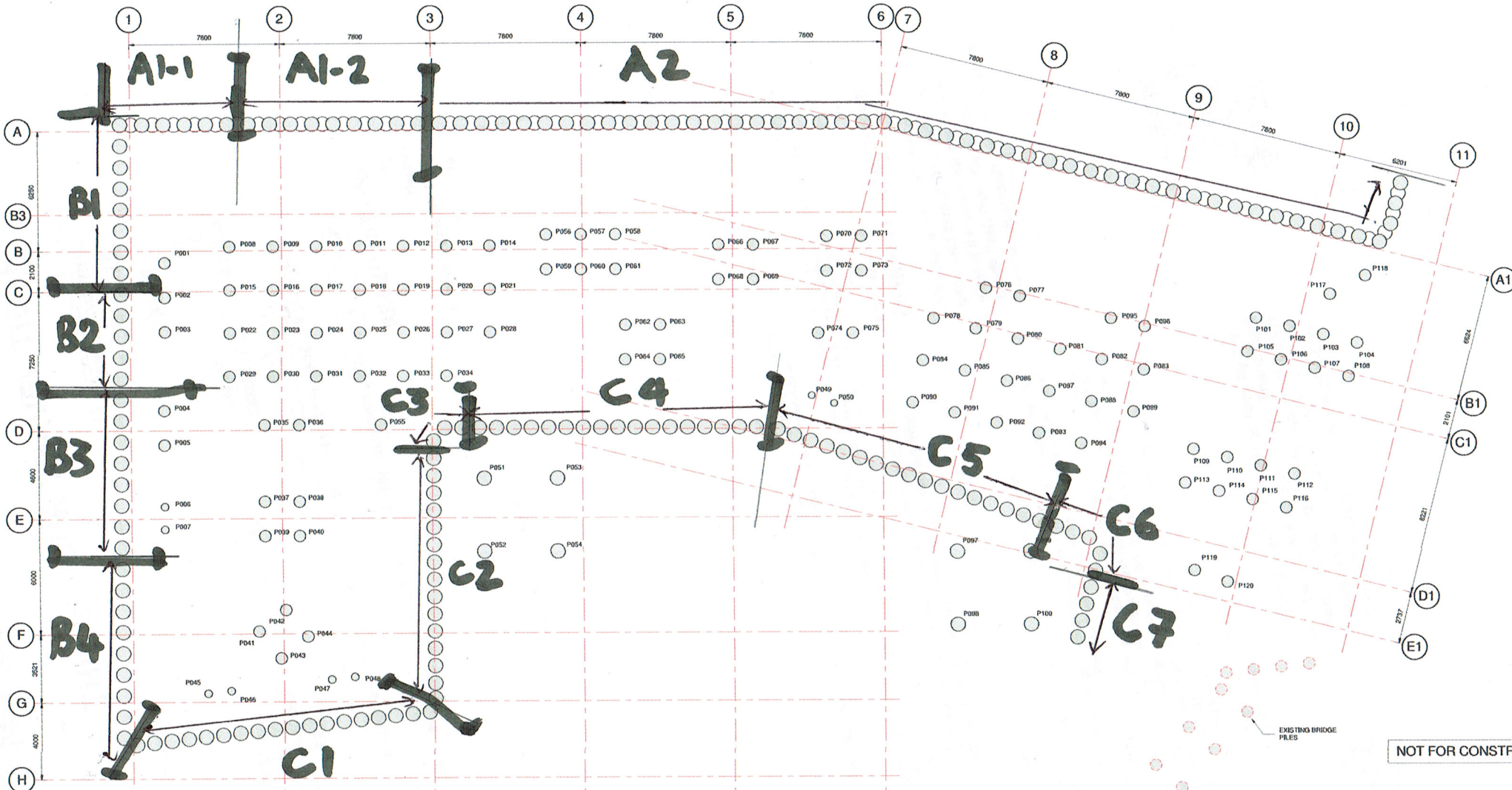
M: 07833441353

From: Grant Mears
Sent: 30 September 2015 11:24
To: Jonathan Staley; Michael Greene
Cc: Keith O Connor; David Bailey; Thomas Scanlon

PILE SCHEDULE WITH WALL LAYOUT



NOT FOR CONSTRUCTION

REFER TO S-1-105 FOR PILE LOADS

Propped - A1-1, A1-2, A2 & B1

Cantilever - B2 to B4, C1 to C7

WALL LAYOUT WITH SECTIONS
103 CAMLEY STREET

Rev. A 10/12/15

E.A

PILING NOTES

1. PILES ARE TO BE DESIGNED BY THE SPECIALIST SUB-CONTRACTOR USING THE INFORMATION PROVIDED ON THIS DRAWING AND IN THE SPECIFICATION.
2. NO PILING SHOULD COMMENCE ON SITE UNTIL THE DESIGN IS REVIEWED BY CONISBEE.
3. THE CONTRACTOR SHOULD ALLOW TO PROBE EACH PILE POSITION TO ENSURE THERE ARE NO OBSTRUCTIONS THAT MAY DELAY THE PILING WORKS OR CAUSE PILING POSITIONS TO BE MOVED. IF NECESSARY, REMOVE OBSTRUCTIONS AND REPLACE THEM WITH SUITABLE BACKFILL.
4. THE CONTRACTOR IS RESPONSIBLE FOR LOCATING ALL SERVICES ON SITE BEFORE SITE WORKS COMMENCE.
5. ACCESS FOR PILING WILL BE CREATED BY THE MAIN CONTRACTOR. THE PILING CONTRACTOR SHOULD VISIT SITE TO TAKE INTO ACCOUNT THE LOCAL CONDITIONS AND RESTRICTIONS.
6. THE CONTRACTOR SHOULD ALLOW FOR PROVIDING A PILING MAT SUITABLE FOR THE GROUND CONDITIONS AND THE RIG PROPOSED TO CARRY OUT THE WORKS.
7. ALL PILING OPERATIONS ARE TO BE IN ACCORDANCE WITH BS 8004 : 1986, AND CONISBEE PILE SPECIFICATION.
8. ALL PILES TO BE MAXIMUM 750mm DIAMETER.
9. PILE REINFORCEMENT SHALL PROJECT A MINIMUM OF 600mm OR 40x BAR DIAMETER ABOVE PILE CUT OFF LEVEL, AND SHALL BE BENT OVER INTO ADJOINING RC STRUCTURE.
10. THE ENGINEER SHALL BE ADVISED IMMEDIATELY OF ANY PILE DISPLACEMENT, ON PLAN, OF GREATER THAN PLUS OR MINUS 75mm
11. ALL PILES ARE TO BE DESIGNED FOR A FACTOR OF SAFETY OF 3.0 TO BS 8004 "CODE OF PRACTICE FOR FOUNDATIONS" UNLESS PILE LOAD TESTS ARE CARRIED OUT, THE SAFETY FACTOR MAY BE REDUCED IN ACCORDANCE WITH THE GUIDANCE IN LDSA FOUNDATIONS No.1, SO LONG AS THE DESIGN AND SITE REQUIREMENTS ARE STRICTLY ADHERED TO.
12. ALL PILES ARE TO BE INTEGRITY TESTED TO ENSURE THEY ARE FREE OF ANY SIGNIFICANT DEFECT.
13. A MINIMUM OF 2 CONCRETE TEST CUBES ARE TO BE TAKEN DAILY FROM EACH CONCRETE MIX IN USE THAT DAY, FOR CRUSHING AT 7 AND 28 DAYS.
14. PILES TO COMPLY WITH RECOMMENDATIONS OF THE SITE INVESTIGATION REPORT.
15. CONCRETE BELOW GROUND TO CONFORM TO ACEC CLASS AC-3S AND DESIGN SULPHATE CLASS DS-4
16. PILES TO BE DESIGNED TO RESIST POTENTIAL UPLIFT FORCES DUE TO HEAVE - SEE SI REPORT.

THIS DRAWING MUST BE READ IN CONJUNCTION WITH THE SPECIFICATION AND ALL OTHER RELEVANT DRAWINGS. DO NOT SCALE FROM THIS DRAWING.

Rev	Date	Description	Drawn	Check
T1	27.11.15	ISSUED FOR TENDER	PW	TAE

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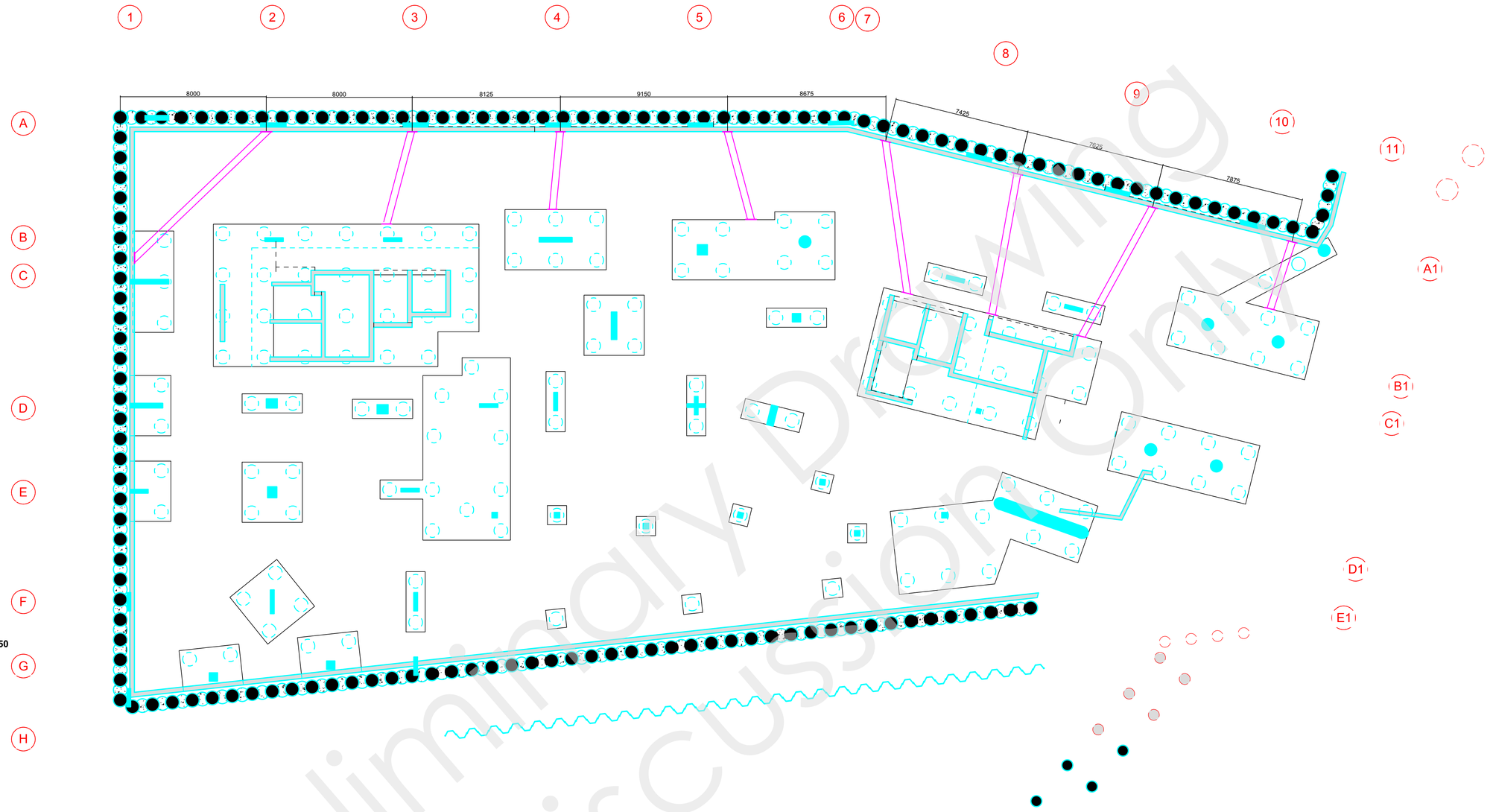
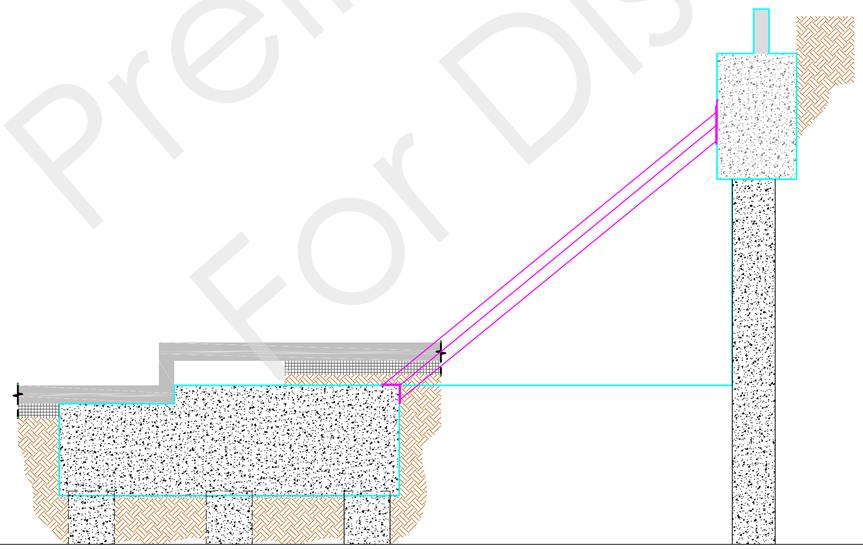
Drawing Status	TENDER
Project	102 CAMLEY STREET (PHASE 1)
Title	PILE PLAN
Date	NOV '15
Scale	1 : 100
Drawn	J.WELSH
Engineer	TAE
Project No	140674
Drawing No	S-1-100
Revision	T1

TEMPORARY PROPPING ARRANGEMENT

Propping General Arangement 1/125



Prop 1 1/50



Notes

Propping layout based on drawings:

- 140674 S110 P3
- 140674 S120 P3
- 140674 S130 P4
- 140674 S402 P3

Props are designed for a load of 112kN/m acting at the capping beam as page A40 of NR/L2/CIV/003/F001

This layout has been prepared as a conceptual design and is subject to change as the design progresses

Piling contractor to confirm that piles can take the lateral loads imposed by raking props

AMENDMENTS

Rev.	Amendment	By	Chkd	Date

G. C. L.,
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TITLE
102 Camley Street
Temporary Basement Propping
Preliminary General Arrangement

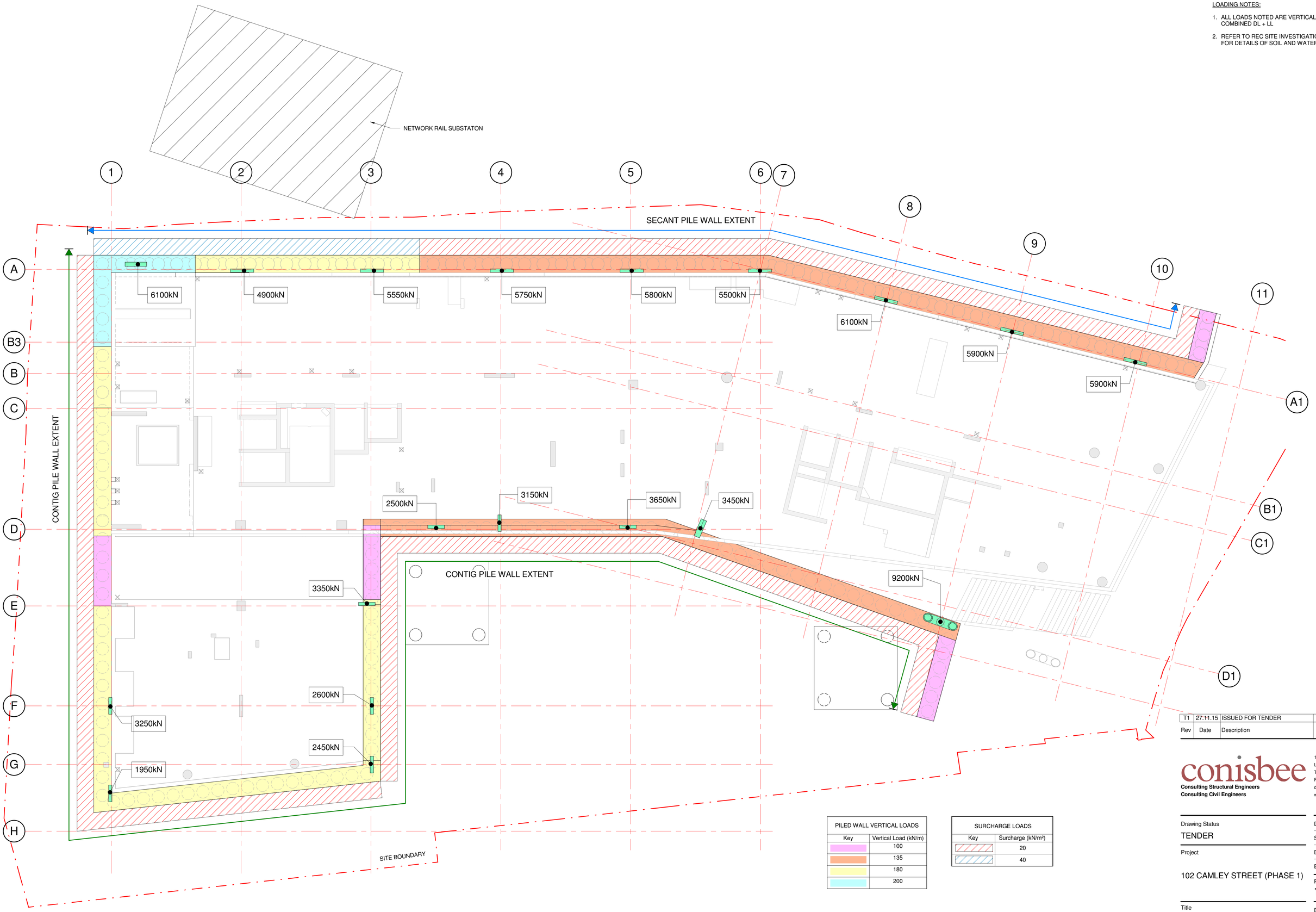
CUSTOMER
GROUND CONSTRUCTION LTD

SCALE: As shown @ A1	DRAWING No
DRAWN BY: K OConnor	DATE: 30/09/15
CAD FILE: GCL Propping Proposal.dwg	

SURCHARGE INFORMATION

LOADING NOTES:

1. ALL LOADS NOTED ARE VERTICAL UNFACTORED COMBINED DL + LL
2. REFER TO REC SITE INVESTIGATION REPORTS FOR DETAILS OF SOIL AND WATER LEVELS.



PILED WALL VERTICAL LOADS	
Key	Vertical Load (kN/m)
	100
	135
	180
	200

SURCHARGE LOADS	
Key	Surcharge (kN/m²)
	20
	40

Rev	Date	Description	Drawn	Check
T1	27.11.15	ISSUED FOR TENDER	PW	

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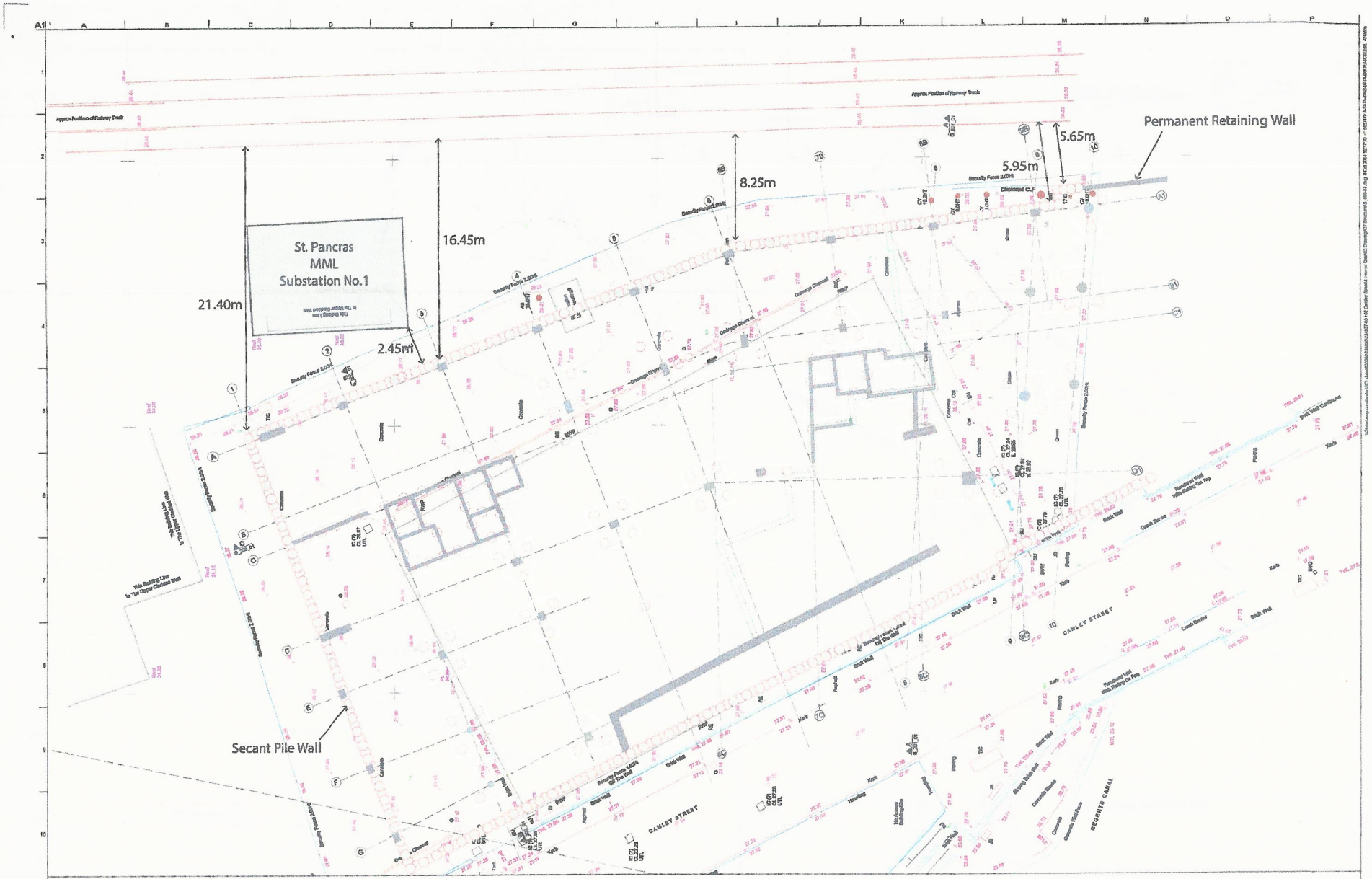
Drawing Status
TENDER

Project
102 CAMLEY STREET (PHASE 1)

Title
SECANT/CONTIG PILE WALL - VERTICAL LOADING

Date NOV '15
Scale 1 : 100
Drawn PW
Engineer TE
Project No **140674**
Drawing No **S-1-930**
Revision **T1**



ARUP

Client: Regent Renewal Ltd

Job Title: 102 Camley Street Development

Site Layout
Distances to Network Rail Assets

Scale at A3: 1:250
Discipline: General
Job No: 234937
Drawing Status: Form 001
Drawing No: G_001_01
Issue: 01

WALLAP ANALYSIS

ULS Analysis

GEOFIRMA LTD | Sheet No.
Program: WALLAP Version 6.05 Revision A45.B58.R49 | Job No. JMP008
Licensed from GEOSOLVE | Made by : EA
Data filename/Run ID: Section A1 Rev A_ULS1 |
Camley Street | Date: 8-12-2015
Section A1 Adjacent to Sub Station | Checked :

Units: kN,m

INPUT DATA

SOIL PROFILE

Stratum no.	Elevation of top of stratum	Soil types Active side	Passive side
1	28.30	8 Made Ground Init	8 Made Ground Init
2	24.00	3 London Cly Top Undr	3 London Cly Top Undr
3	22.00	6 London Cly bt Undr	6 London Cly bt Undr

SOIL PROPERTIES (Unfactored SLS soil strengths)

No.	Soil type -- Description (Datum elev.)	Bulk density kN/m3	Young's Modulus Eh,kN/m2 (dEh/dy)	At rest coeff. Ko (dKo/dy)	Consol state. NC/OC (Nu)	Active limit Ka (Kac)	Passive limit Kp (Kpc)	Cohesion kN/m2 (dc/dy)
1	Made Ground	19.00	10000	0.577	OC (0.250)	0.390 (0.000)	2.561 (0.000)	
2	Gravels	19.00	30000	0.423	OC (0.300)	0.227 (0.000)	6.084 (0.000)	
3	London Cly Top Undr	19.00	20000	1.000	OC (0.490)	1.000 (2.000)	1.000 (2.000)	40.00u
4	London Cly Top dr	19.00	14000	1.000	OC (0.250)	0.422 (1.299)	2.371 (3.080)	3.000d
5	Concrete	24.00	200000	1.000	OC (0.490)	1.000 (2.000)	1.000 (2.000)	30000u
6	London Cl.. (24.00)	19.00	42500 (2589)	1.400	OC (0.490)	1.000 (2.476)	1.000 (2.390)	80.00u (5.180)
7	London Cl.. (24.00)	19.00	28000 (1813)	1.400	OC (0.250)	0.366 (1.423)	3.077 (4.665)	3.000d
8	Made Ground Init	19.00	10000	0.577	OC (0.250)	0.337 (0.000)	3.442 (0.000)	

Additional soil parameters associated with Ka and Kp

No.	Soil type ------- Description	--- parameters for Ka --- Soil friction angle	Wall adhesion coeff.	Back-fill angle	--- parameters for Kp --- Soil friction angle	Wall adhesion coeff.	Back-fill angle
1	Made Ground	26.00	0.000	0.00	26.00	0.000	0.00
2	Gravels	35.00	0.670	0.00	35.00	0.500	0.00
3	London Cly Top Undr	0.00	0.000	0.00	0.00	0.000	0.00
4	London Cly Top dr	24.00	0.000	0.00	24.00	0.000	0.00
5	Concrete	0.00	0.000	0.00	0.00	0.000	0.00
6	London Cly bt Undr	0.00	0.670	0.00	0.00	0.500	0.00
7	London Cly bt dr	24.00	0.670	0.00	24.00	0.500	0.00
8	Made Ground Init	26.00	0.670	0.00	26.00	0.500	0.00

GROUND WATER CONDITIONS

Density of water = 10.00 kN/m3

	Active side	Passive side
Initial water table elevation	26.30	21.86

Automatic water pressure balancing at toe of wall : Yes

Water press. profile no.	Active side Point no.	Elev. m	Piezo elev. m	Water press. kN/m2	Passive side Point no.	Elev. m	Piezo elev. m	Water press. kN/m2	
1	1	27.30	27.30	0.0	1	22.36	22.36	0.0	MC+WC
					2	22.36	27.30	49.4	

WALL PROPERTIES

Type of structure = Fully Embedded Wall
Elevation of toe of wall = 18.00
Maximum finite element length = 0.60 m
Youngs modulus of wall E = 1.9600E+07 kN/m2
Moment of inertia of wall I = 0.017260 m4/m run
E.I = 338296 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	27.70	8.00	0.010000	2.000E+08	10.00	0.00	0	No
2	22.73	1.00	0.300000	1.400E+07	10.00	0.00	0	No
3	28.15	1.00	0.300000	1.400E+07	10.00	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	28.30	0.50(A)	100.00	20.00	40.00	=	N/A	1.10 Var
2	22.36	-0.00(P)	30.00	20.00	50.00	=	N/A	1.00 P/U

Note: A = Active side, P = Passive 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 28.30
	No analysis at this stage
2	Excavate to elevation 27.10 on PASSIVE side
	Toe of berm at elevation 22.48
	Width of top of berm = 2.00
	Width of toe of berm = 6.62
3	Install strut or anchor no.1 at elevation 27.70
4	Excavate to elevation 21.98 on PASSIVE side
5	Install strut or anchor no.2 at elevation 22.73
6	Fill to elevation 23.01 on PASSIVE side with soil type 6
7	Install strut or anchor no.3 at elevation 28.15
8	Remove strut or anchor no.1 at elevation 27.70
9	Change properties of soil type 9 to soil type 1
	No analysis at this stage
	Ko pressures will not be reset
10	Apply water pressure profile no.1 (Mod. Conserv.)
	No analysis at this stage
11	Change properties of soil type 3 to soil type 4
	No analysis at this stage
	Ko pressures will not be reset
12	Change properties of soil type 6 to soil type 7
	No analysis at this stage
	Ko pressures will not be reset
13	Apply surcharge no.2 at elevation 22.36

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 Permanent Variable 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) = 0 m

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

Width of excavation on active side of wall = 20.00 m
Width of excavation on passive side of wall = 20.00 m

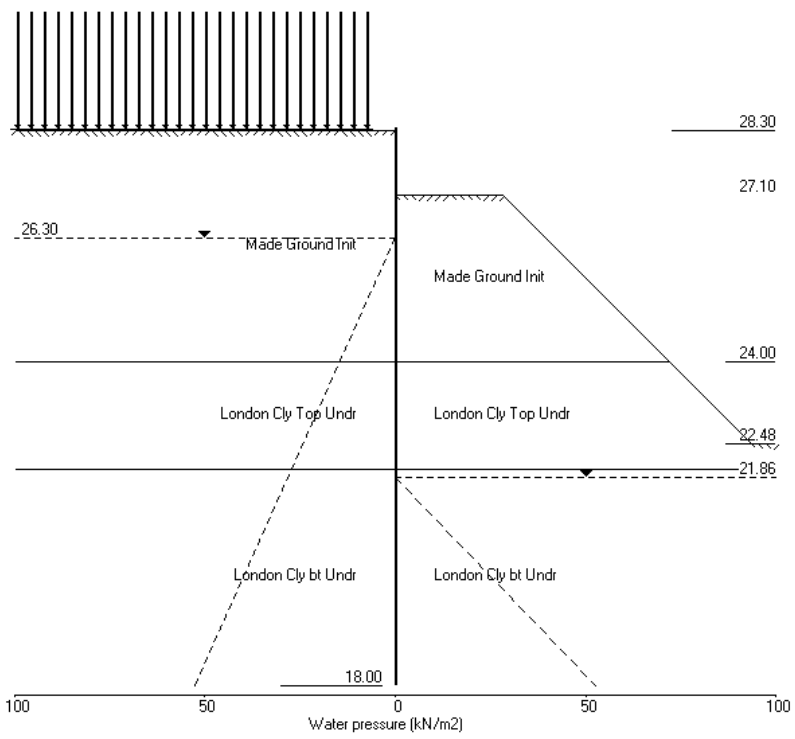
Distance to rigid boundary on active side = 20.00 m
Distance to rigid boundary on passive side = 20.00 m

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. 28.30	No	No	No
2	Excav. to elev. 27.10 on PASSIVE side	No	No	No
3	Install strut no.1 at elev. 27.70	No	No	No
4	Excav. to elev. 21.98 on PASSIVE side	No	No	No
5	Install strut no.2 at elev. 22.73	No	No	No
6	Fill to elev. 23.01 on PASSIVE side	No	No	No
7	Install strut no.3 at elev. 28.15	No	No	No
8	Remove strut no.1 at elev. 27.70	No	No	No
9	Change soil type 9 to soil type 1	No	No	No
10	Apply water pressure profile no.1	No	No	No
11	Change soil type 3 to soil type 4	No	No	No
12	Change soil type 6 to soil type 7	No	No	No
13	Apply surcharge no.2 at elev. 22.36	No	No	No
*	Summary output	Yes	-	Yes

Units: kN,m

Stage No.2 Excav. to elev. 27.10 on PASSIVE side



Units: kN,m

Stage No. 2 Excavate to elevation 27.10 on PASSIVE side
Toe of berm at elevation 22.48
Width of top of berm = 2.00
Width of toe of berm = 6.62

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: Active side 20.00 from wall
Passive 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.

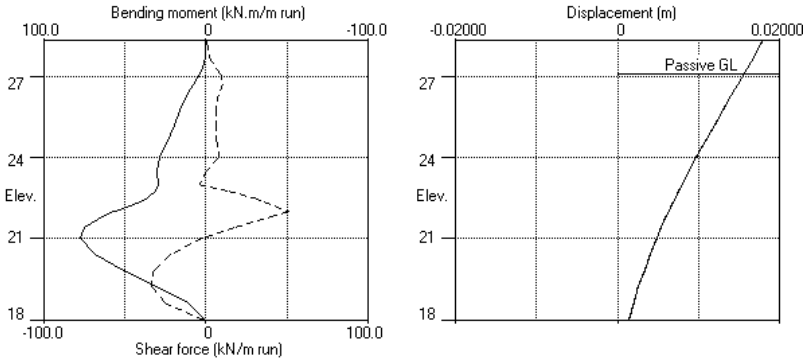
Node no.	Y coord	Nett pressure kN/m2	Wall disp. m	Wall rotation rad.	Shear force kN/m	Bending moment kN.m/m	Strut forces kN/m
1	28.30	0.00	0.018	1.96E-03	0.0	-0.0	
2	28.15	1.11	0.018	1.96E-03	0.1	0.0	
3	27.70	7.46	0.017	1.96E-03	2.0	0.4	
4	27.30	13.06	0.016	1.95E-03	6.1	1.9	
5	27.10	15.42	0.016	1.95E-03	9.0	3.4	
6	26.70	-6.66	0.015	1.95E-03	10.7	7.8	
		-1.44	0.015	1.95E-03	10.7	7.8	
7	26.30	-13.99	0.014	1.93E-03	7.6	12.1	
		1.86	0.014	1.93E-03	7.6	12.1	
8	25.75	-5.98	0.013	1.91E-03	6.5	16.2	
		1.90	0.013	1.91E-03	6.5	16.2	
9	25.20	-3.04	0.012	1.88E-03	6.2	19.8	
		2.63	0.012	1.88E-03	6.2	19.8	
10	24.60	-1.17	0.011	1.84E-03	6.6	23.7	
		3.35	0.011	1.84E-03	6.6	23.7	
11	24.00	2.14	0.010	1.80E-03	8.3	28.7	
		-19.81	0.010	1.80E-03	8.3	28.7	
12	23.51	-11.69	0.009	1.75E-03	0.5	30.4	
13	23.01	-3.97	0.008	1.71E-03	-3.4	29.2	
		62.56	0.008	1.71E-03	-3.4	29.2	
14	22.73	68.42	0.008	1.69E-03	14.6	30.7	
		61.77	0.008	1.69E-03	14.6	30.7	
15	22.48	66.85	0.007	1.66E-03	30.7	36.3	
		40.19	0.007	1.66E-03	30.7	36.3	
16	22.36	42.34	0.007	1.65E-03	35.8	40.5	
		39.98	0.007	1.65E-03	35.8	40.5	
17	22.00	45.98	0.006	1.60E-03	51.3	56.0	
		-67.50	0.006	1.60E-03	51.3	56.0	
18	21.98	-67.15	0.006	1.59E-03	50.3	56.8	
19	21.86	-64.24	0.006	1.57E-03	42.1	62.5	
20	21.43	-52.03	0.005	1.48E-03	17.1	74.8	
21	21.00	-40.16	0.005	1.39E-03	-2.7	77.3	
22	20.40	-24.29	0.004	1.26E-03	-22.1	68.6	
23	19.80	-9.14	0.003	1.15E-03	-32.1	51.1	
24	19.20	5.58	0.003	1.08E-03	-33.2	30.3	
25	18.60	20.28	0.002	1.04E-03	-25.4	11.5	
26	18.00	64.38	0.001	1.03E-03	-0.0	0.0	

(continued)

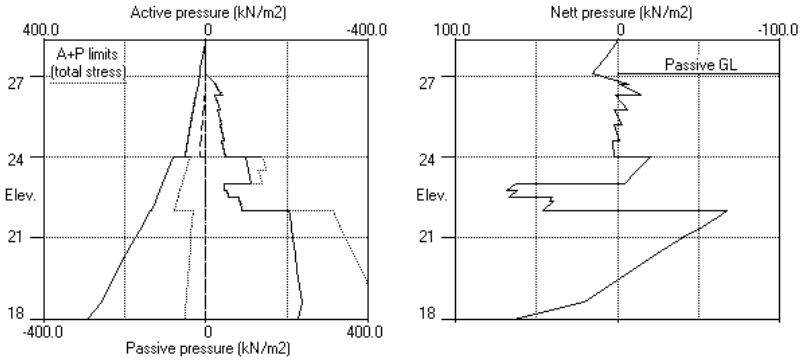
Stage No.2 Excavate to elevation 27.10 on PASSIVE side
Toe of berm at elevation 22.48
Width of top of berm = 2.00
Width of toe of berm = 6.62

Units: kN,m

Stage No.2 Excav. to elev. 27.10 on PASSIVE side



Stage No.2 Excav. to elev. 27.10 on PASSIVE side



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Program: WALLAP Version 6.05 Revision A45.B58.R49 | Job No. JMP008
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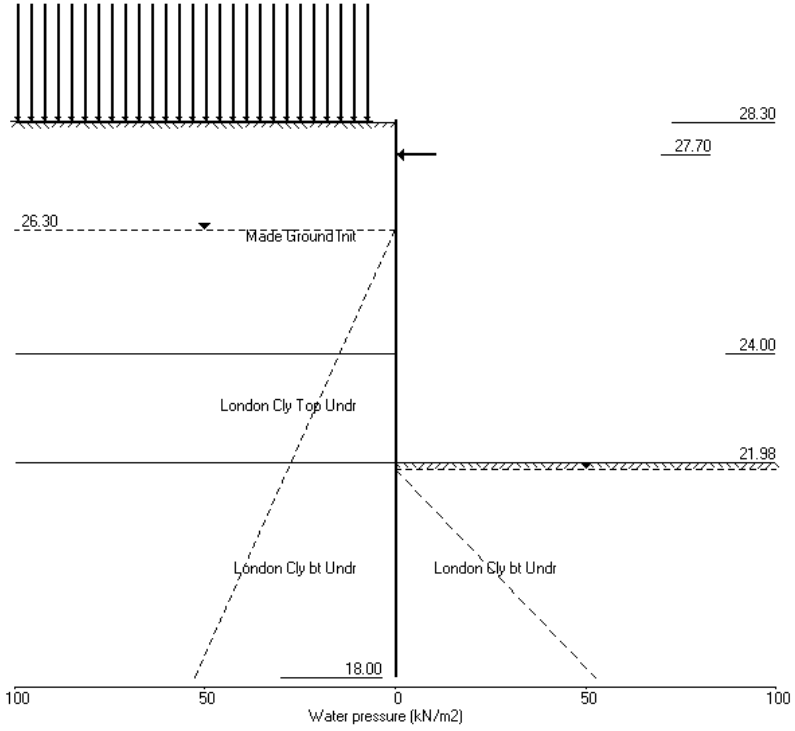
Data filename/Run ID: Section A1 Rev A_ULS1 |
Camley Street | Date: 8-12-2015
Section A1 Adjacent to Sub Station | Checked :

Units: kN,m

Stage No.4 Excav. to elev. 21.98 on PASSIVE side



Units: kN,m

Stage No. 4 Excavate to elevation 21.98 on PASSIVE 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: Active side 20.00 from wall
Passive 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/m2	Wall disp. m	Wall rotation rad.	Shear force kN/m	Bending moment kN.m/m	Strut forces kN/m
1	28.30	0.00	0.021	-8.31E-05	0.0	0.0	
2	28.15	1.11	0.021	-8.31E-05	0.1	0.0	
3	27.70	7.46	0.021	-8.34E-05	2.0	0.4	104.1
		7.46	0.021	-8.34E-05	-102.1	0.4	
4	27.30	13.06	0.021	-6.02E-05	-97.9	-39.7	
5	27.10	15.42	0.021	-3.10E-05	-95.1	-59.0	
6	26.70	19.50	0.021	6.03E-05	-88.1	-95.5	
7	26.30	23.07	0.021	1.92E-04	-79.6	-128.7	
8	25.75	29.82	0.021	4.34E-04	-65.1	-168.7	
9	25.20	36.26	0.020	7.34E-04	-46.9	-199.6	
10	24.60	43.08	0.020	1.10E-03	-23.1	-220.9	
11	24.00	49.77	0.019	1.50E-03	4.8	-226.0	
		52.54	0.019	1.50E-03	4.8	-226.0	
12	23.51	66.00	0.018	1.82E-03	34.1	-217.0	
13	23.01	79.73	0.017	2.12E-03	70.2	-191.8	
14	22.73	87.47	0.017	2.27E-03	93.2	-169.4	
15	22.48	94.57	0.016	2.38E-03	115.9	-143.3	
16	22.36	98.13	0.016	2.43E-03	128.0	-128.1	
17	22.00	108.43	0.015	2.54E-03	165.2	-75.5	
		77.85	0.015	2.54E-03	165.2	-75.5	
18	21.98	78.46	0.015	2.55E-03	166.3	-73.0	
		-128.05	0.015	2.55E-03	166.3	-73.0	
19	21.86	-123.98	0.015	2.57E-03	150.6	-53.2	
20	21.43	-106.83	0.013	2.60E-03	101.0	0.1	
21	21.00	-88.85	0.012	2.58E-03	58.9	33.7	
22	20.40	-63.00	0.011	2.50E-03	13.3	53.2	
23	19.80	-36.64	0.009	2.41E-03	-16.6	49.9	
24	19.20	-9.79	0.008	2.34E-03	-30.5	33.5	
25	18.60	17.85	0.006	2.30E-03	-28.1	13.5	
26	18.00	75.71	0.005	2.28E-03	-0.0	0.0	

At elev. 27.70 Strut force = 832.5 kN/strut = 104.1 kN/m run

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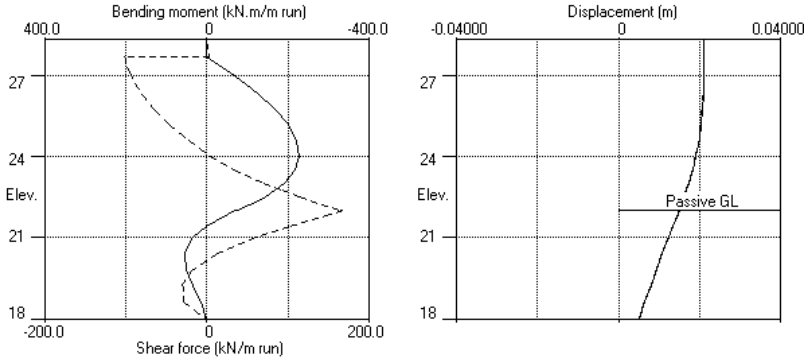
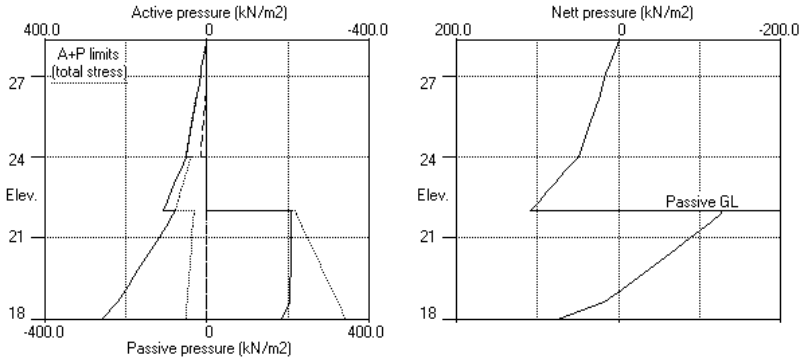
Camley Street | Date: 8-12-2015
Section A1 Adjacent to Sub Station | Checked :

Units: kN,m

Stage No.4 Excav. to elev. 21.98 on PASSIVE side

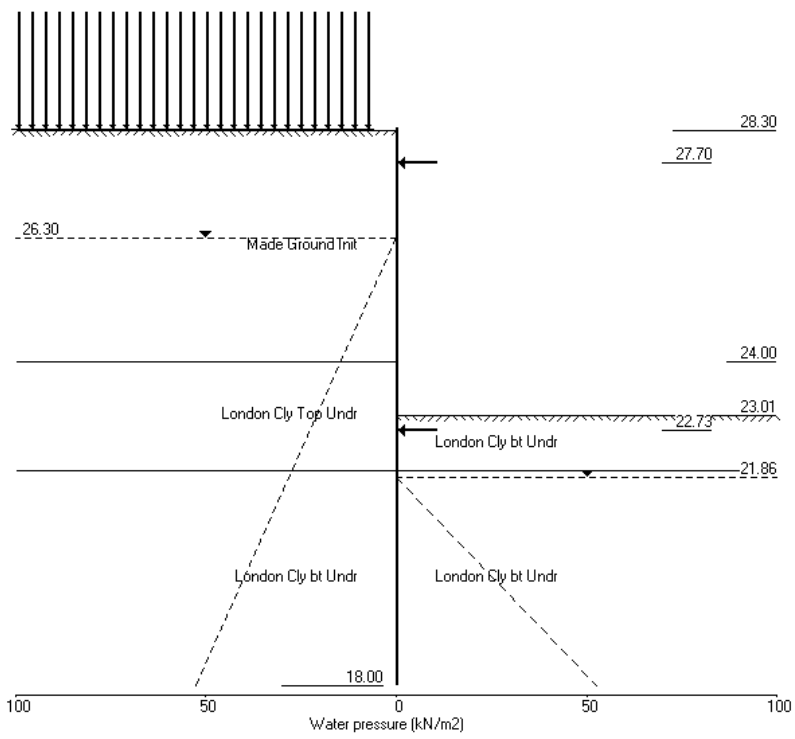


Stage No.4 Excav. to elev. 21.98 on PASSIVE side



Units: kN,m

Stage No.6 Fill to elev. 23.01 on PASSIVE side



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Program: WALLAP Version 6.05 Revision A45.B58.R49 | Job No. JMP008
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Data filename/Run ID: Section A1 Rev A_ULS1 |
Camley Street | Date: 8-12-2015
Section A1 Adjacent to Sub Station | Checked :

Units: kN,m

Stage No. 6 Fill to elevation 23.01 on PASSIVE side with soil type 6

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: Active side 20.00 from wall
Passive 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/m2	Wall disp. m	Wall rotation rad.	Shear force kN/m	Bending moment kN.m/m	Strut forces kN/m
1	28.30	0.00	0.021	6.22E-05	0.0	0.0	
2	28.15	1.11	0.021	6.22E-05	0.1	0.0	
3	27.70	7.47	0.021	6.19E-05	2.0	0.4	103.9
		7.47	0.021	6.19E-05	-101.9	0.4	
4	27.30	13.15	0.021	8.51E-05	-97.8	-39.6	
5	27.10	15.54	0.021	1.14E-04	-94.9	-58.9	
6	26.70	19.70	0.021	2.05E-04	-87.9	-95.4	
7	26.30	23.34	0.021	3.37E-04	-79.3	-128.4	
8	25.75	30.20	0.020	5.78E-04	-64.5	-168.1	
9	25.20	36.74	0.020	8.77E-04	-46.1	-198.8	
10	24.60	43.68	0.019	1.24E-03	-22.0	-219.4	
11	24.00	50.48	0.019	1.64E-03	6.3	-223.8	
		54.40	0.019	1.64E-03	6.3	-223.8	
12	23.51	68.09	0.018	1.96E-03	36.6	-213.8	
13	23.01	82.05	0.017	2.25E-03	73.7	-187.1	
14	22.73	88.53	0.016	2.39E-03	97.2	-163.7	-0.0
15	22.48	94.01	0.015	2.50E-03	120.0	-136.7	
16	22.36	95.52	0.015	2.55E-03	131.8	-121.0	
17	22.00	99.89	0.014	2.65E-03	167.0	-67.3	
		73.09	0.014	2.65E-03	167.0	-67.3	
18	21.98	73.46	0.014	2.65E-03	168.1	-64.8	
		-133.05	0.014	2.65E-03	168.1	-64.8	
19	21.86	-128.65	0.014	2.67E-03	151.8	-44.8	
20	21.43	-110.42	0.013	2.70E-03	100.4	8.6	
21	21.00	-91.41	0.011	2.67E-03	57.0	41.6	
22	20.40	-64.21	0.010	2.58E-03	10.3	59.4	
23	19.80	-36.59	0.008	2.47E-03	-19.9	54.2	
24	19.20	-8.52	0.007	2.40E-03	-33.5	35.7	
25	18.60	20.33	0.005	2.35E-03	-29.9	14.2	
26	18.00	79.41	0.004	2.34E-03	-0.0	0.0	

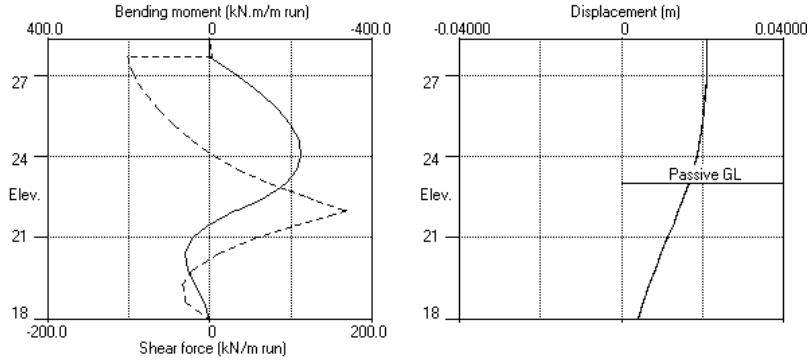
At elev. 27.70 Strut force = 831.3 kN/strut = 103.9 kN/m run
At elev. 22.73 The strut is slack

(continued)

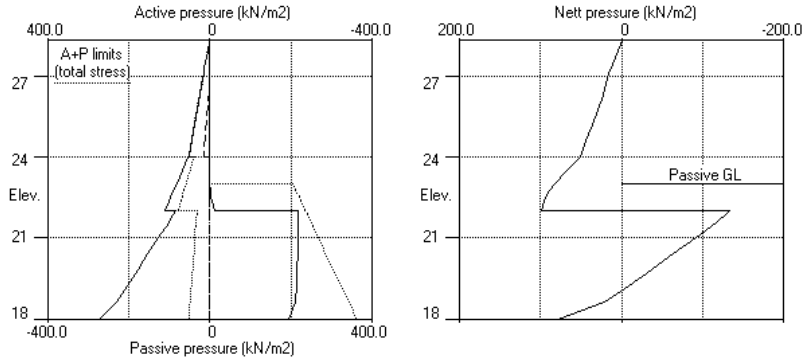
Stage No.6 Fill to elevation 23.01 on PASSIVE side with soil type 6

Units: kN,m

Stage No.6 Fill to elev. 23.01 on PASSIVE side

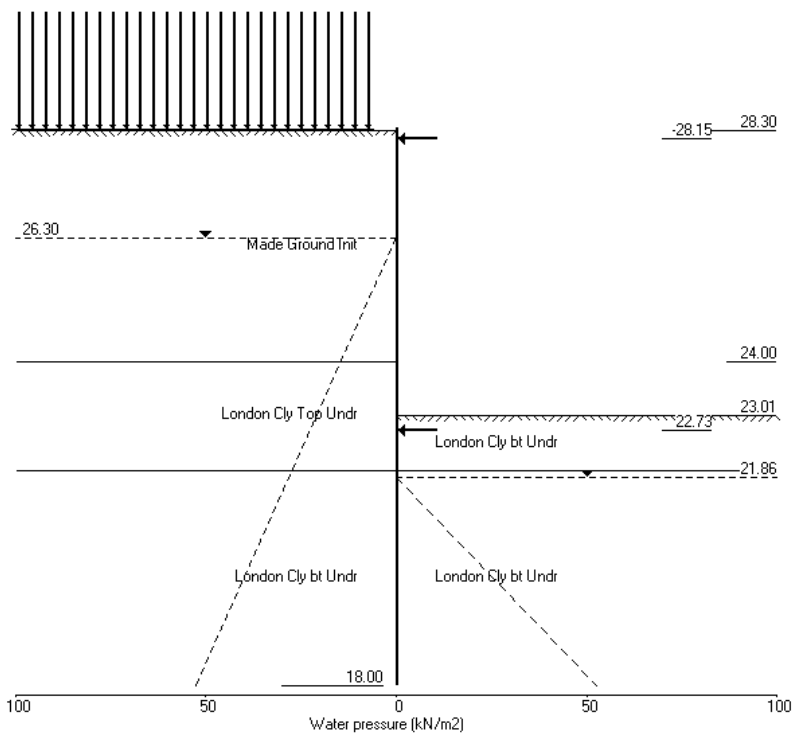


Stage No.6 Fill to elev. 23.01 on PASSIVE side



Units: kN,m

Stage No.8 Remove strut no.1 at elev. 27.70



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Data filename/Run ID: Section A1 Rev A_ULS1 |
Camley Street | Date: 8-12-2015
Section A1 Adjacent to Sub Station | Checked :

Units: kN,m

Stage No. 8 Remove strut or anchor no.1 at elevation 27.70

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: Active side 20.00 from wall
Passive 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/m2	Wall disp. m	Wall rotation rad.	Shear force kN/m	Bending moment kN.m/m	Strut forces kN/m
1	28.30	0.00	0.021	-1.41E-04	0.0	0.0	
2	28.15	1.11	0.021	-1.41E-04	0.1	0.0	93.9
		1.11	0.021	-1.41E-04	-93.9	0.0	
3	27.70	7.46	0.021	-1.13E-04	-91.9	-41.9	
4	27.30	13.06	0.021	-4.30E-05	-87.8	-77.9	
5	27.10	15.42	0.021	8.16E-06	-85.0	-95.2	
6	26.70	19.50	0.021	1.39E-04	-78.0	-127.7	
7	26.30	23.07	0.021	3.08E-04	-69.5	-156.8	
8	25.75	29.82	0.021	5.91E-04	-54.9	-191.2	
9	25.20	36.26	0.021	9.22E-04	-36.8	-216.6	
10	24.60	43.12	0.020	1.32E-03	-12.9	-231.8	
11	24.00	49.99	0.019	1.73E-03	15.0	-230.8	
		53.12	0.019	1.73E-03	15.0	-230.8	
12	23.51	66.98	0.018	2.05E-03	44.7	-216.7	
13	23.01	81.12	0.017	2.35E-03	81.4	-186.1	
		76.22	0.017	2.35E-03	81.4	-186.1	
14	22.73	83.24	0.016	2.49E-03	103.3	-160.8	-0.0
15	22.48	89.21	0.016	2.60E-03	124.8	-132.4	
16	22.36	90.96	0.015	2.64E-03	136.1	-116.1	
17	22.00	96.02	0.014	2.74E-03	169.8	-61.2	
		68.40	0.014	2.74E-03	169.8	-61.2	
18	21.98	68.80	0.014	2.74E-03	170.8	-58.6	
		-137.71	0.014	2.74E-03	170.8	-58.6	
19	21.86	-133.03	0.014	2.76E-03	153.9	-38.4	
20	21.43	-113.89	0.013	2.77E-03	100.8	15.5	
21	21.00	-94.03	0.012	2.73E-03	56.1	48.4	
22	20.40	-65.78	0.010	2.63E-03	8.1	65.2	
23	19.80	-37.23	0.008	2.52E-03	-22.8	58.4	
24	19.20	-8.05	0.007	2.44E-03	-36.3	38.1	
25	18.60	22.72	0.005	2.39E-03	-31.9	15.0	
26	18.00	83.73	0.004	2.38E-03	-0.0	0.0	

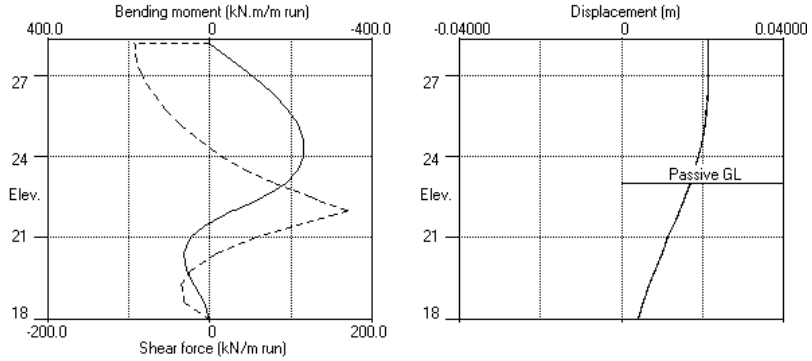
At elev. 28.15 Strut force = 93.9 kN/strut = 93.9 kN/m run
At elev. 22.73 The strut is slack

(continued)

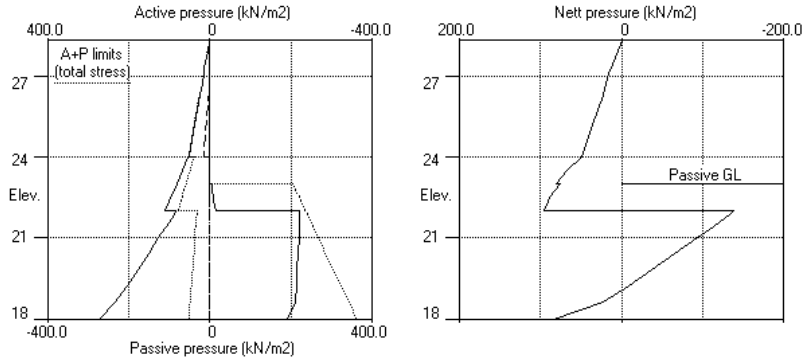
Stage No.8 Remove strut or anchor no.1 at elevation 27.70

Units: kN,m

Stage No.8 Remove strut no.1 at elev. 27.70



Stage No.8 Remove strut no.1 at elev. 27.70



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: Active side 20.00 from wall
Passive side 20.00 from wall

Limit State: ULS DA1 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 max.	Displacement min.	Bending moment Calculated max.	Bending moment Calculated min.	Bending moment Factored max.	Bending moment Factored min.	Shear force Calculated max.	Shear force Calculated min.	Shear force Factored max.	Shear force Factored min.
		m	m	kN.m/m	kN.m/m	kN.m/m	kN.m/m	kN/m	kN/m	kN/m	kN/m
1	28.30	0.021	0.000	0	-0	0	-0	0	0	0	0
2	28.15	0.021	0.000	0	-0	0	-0	0	-94	0	-127
3	27.70	0.021	0.000	0	-42	1	-57	2	-102	3	-138
4	27.30	0.021	0.000	2	-78	3	-105	6	-98	8	-132
5	27.10	0.021	0.000	3	-95	5	-129	9	-95	12	-128
6	26.70	0.021	0.000	8	-128	11	-172	11	-88	14	-119
7	26.30	0.021	0.000	12	-157	16	-212	8	-80	10	-107
8	25.75	0.021	0.000	16	-191	22	-258	6	-65	9	-88
9	25.20	0.021	0.000	20	-217	27	-292	6	-47	8	-63
10	24.60	0.020	0.000	24	-232	32	-313	10	-23	13	-31
11	24.00	0.019	0.000	29	-231	39	-312	45	-0	60	-1
12	23.51	0.018	0.000	30	-217	41	-293	80	0	109	0
13	23.01	0.018	0.000	29	-192	39	-259	123	-3	166	-5
14	22.73	0.017	0.000	31	-169	41	-229	148	-6	199	-8
15	22.48	0.017	0.000	36	-143	49	-193	125	0	169	0
16	22.36	0.016	0.000	40	-128	55	-173	136	0	184	0
17	22.00	0.016	0.000	56	-75	76	-102	170	0	229	0
18	21.98	0.016	0.000	57	-73	77	-99	171	0	231	0
19	21.86	0.015	0.000	63	-53	84	-72	154	0	208	0
20	21.43	0.014	0.000	75	-20	101	-27	101	0	136	0
21	21.00	0.013	0.000	77	-7	104	-10	59	-3	79	-4
22	20.40	0.012	0.000	69	0	93	0	16	-22	21	-30
23	19.80	0.011	0.000	58	0	79	0	6	-32	9	-43
24	19.20	0.010	0.000	38	0	51	0	0	-36	0	-49
25	18.60	0.008	0.000	15	0	20	0	0	-32	0	-43
26	18.00	0.007	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 Calculated max.	elev.	min.	elev.	Bending moment Factored max.	min.	Shear force Calculated max.	elev.	min.	elev.	Shear force Factored max.	min.
	kN.m/m		kN.m/m		kN.m/m		kN/m		kN/m		kN/m	kN/m
1	13	20.40	-25	24.00	18	-33	25	22.00	-9	25.75	34	-12
2	77	21.00	-0	28.30	104	-0	51	22.00	-33	19.20	69	-45
3	No calculation at this stage											
4	53	20.40	-226	24.00	72	-305	166	21.98	-102	27.70	225	-138
5	No calculation at this stage											
6	59	20.40	-224	24.00	80	-302	168	21.98	-102	27.70	227	-138
7	No calculation at this stage											
8	65	20.40	-232	24.60	88	-313	171	21.98	-94	28.15	231	-127
9	No calculation at this stage											
10	No calculation at this stage											
11	No calculation at this stage											
12	No calculation at this stage											
13	9	19.80	-197	24.60	12	-265	148	22.73	-89	28.15	199	-120

Maximum and minimum displacement at each stage

Stage no.	Displacement maximum	elev.	minimum	elev.	Stage description
	m		m		
1	0.006	28.30	0.000	28.30	Apply surcharge no.1 at elev. 28.30
2	0.018	28.30	0.000	28.30	Excav. to elev. 27.10 on PASSIVE side
3	No calculation at this stage				Install strut no.1 at elev. 27.70
4	0.021	27.10	0.000	28.30	Excav. to elev. 21.98 on PASSIVE side
5	No calculation at this stage				Install strut no.2 at elev. 22.73
6	0.021	28.30	0.000	28.30	Fill to elev. 23.01 on PASSIVE side
7	No calculation at this stage				Install strut no.3 at elev. 28.15
8	0.021	27.10	0.000	28.30	Remove strut no.1 at elev. 27.70
9	No calculation at this stage				Change soil type 9 to soil type 1
10	No calculation at this stage				Apply water pressure profile no.1
11	No calculation at this stage				Change soil type 3 to soil type 4
12	No calculation at this stage				Change soil type 6 to soil type 7
13	0.021	27.10	0.000	28.30	Apply surcharge no.2 at elev. 22.36

Strut forces at each stage (horizontal components)

Stage no.	Strut no. 1 at elev. 27.70 Calculated kN per m run	Strut no. 1 Factored kN per strut	Strut no. 2 at elev. 22.73 Calculated kN per m run	Strut no. 2 Factored kN per strut	Strut no. 3 at elev. 28.15 Calculated kN per m run	Strut no. 3 Factored kN per strut
4	104	833	---	---	---	---
6	104	831	slack	slack	---	---
8	---	---	slack	slack	94	94
13	---	---	153	153	89	89

Stage no.	Strut no. 1 Factored kN per strut	Strut no. 2 Factored kN per strut	Strut no. 3 Factored kN per strut
4	1124	---	---
6	1122	slack	---
8	---	slack	127
13	---	207	120

* Indicates that the total force shown is the sum of the force in the strut plus a force applied at the same elevation which may represent temperature load or other forces which are part of the strut load. Force components are listed in the detailed results for individual stages.

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Program: WALLAP Version 6.05 Revision A45.B58.R49 | Job No. JMP008
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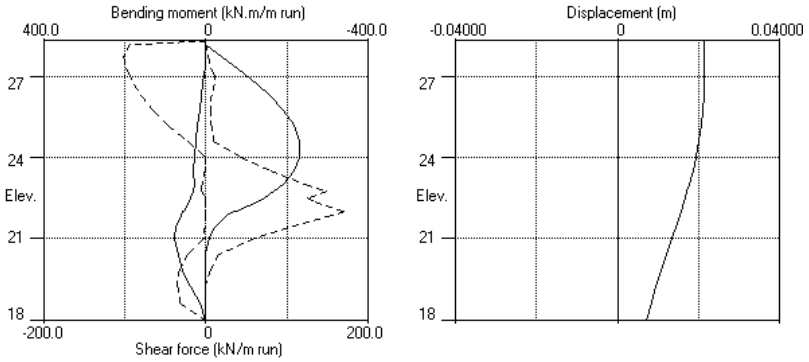
Camley Street | Date: 8-12-2015
Section A1 Adjacent to Sub Station | Checked :

Units: kN,m

Bending moment, shear force, displacement envelopes



GEOFIRMA LTD | Sheet No.
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Data filename/Run ID: Section A1 Rev A_ULS2 |
Camley Street | Date: 8-12-2015
Section A1 Adjacent to Sub Station | Checked :

Units: kN,m

INPUT DATA

SOIL PROFILE

Stratum no.	Elevation of top of stratum	Soil types Active side	Passive side
1	28.30	8 Made Ground Init	8 Made Ground Init
2	24.00	3 London Cly Top Undr	3 London Cly Top Undr
3	22.00	6 London Cly bt Undr	6 London Cly bt Undr

SOIL PROPERTIES (Unfactored SLS soil strengths)

No.	Soil type -- Description (Datum elev.)	Bulk density kN/m3	Young's Modulus Eh,kN/m2 (dEh/dy)	At rest coeff. Ko (dKo/dy)	Consol state. NC/OC (Nu)	Active limit Ka (Kac)	Passive limit Kp (Kpc)	Cohesion kN/m2 (dc/dy)
1	Made Ground	19.00	10000	0.577	OC (0.250)	0.390 (0.000)	2.561 (0.000)	
2	Gravels	19.00	30000	0.423	OC (0.300)	0.227 (0.000)	6.084 (0.000)	
3	London Cly Top Undr	19.00	20000	1.000	OC (0.490)	1.000 (2.000)	1.000 (2.000)	40.00u
4	London Cly Top dr	19.00	14000	1.000	OC (0.250)	0.422 (1.299)	2.371 (3.080)	3.000d
5	Concrete	24.00	200000	1.000	OC (0.490)	1.000 (2.000)	1.000 (2.000)	30000u
6	London Cl.. (24.00)	19.00	42500 (2589)	1.400	OC (0.490)	1.000 (2.476)	1.000 (2.390)	80.00u (5.180)
7	London Cl.. (24.00)	19.00	28000 (1813)	1.400	OC (0.250)	0.366 (1.423)	3.077 (4.665)	3.000d
8	Made Ground Init	19.00	10000	0.577	OC (0.250)	0.337 (0.000)	3.442 (0.000)	

Additional soil parameters associated with Ka and Kp

No.	Soil type ------- Description	--- parameters for Ka --- Soil friction angle	Wall adhesion coeff.	Back-fill angle	--- parameters for Kp --- Soil friction angle	Wall adhesion coeff.	Back-fill angle
1	Made Ground	26.00	0.000	0.00	26.00	0.000	0.00
2	Gravels	35.00	0.670	0.00	35.00	0.500	0.00
3	London Cly Top Undr	0.00	0.000	0.00	0.00	0.000	0.00
4	London Cly Top dr	24.00	0.000	0.00	24.00	0.000	0.00
5	Concrete	0.00	0.000	0.00	0.00	0.000	0.00
6	London Cly bt Undr	0.00	0.670	0.00	0.00	0.500	0.00
7	London Cly bt dr	24.00	0.670	0.00	24.00	0.500	0.00
8	Made Ground Init	26.00	0.670	0.00	26.00	0.500	0.00

GROUND WATER CONDITIONS

Density of water = 10.00 kN/m3

	Active side	Passive side
Initial water table elevation	26.30	21.86

Automatic water pressure balancing at toe of wall : Yes

Water press. profile no.	Active side Point no.	Elev. m	Piezo elev. m	Water press. kN/m2	Passive side Point no.	Elev. m	Piezo elev. m	Water press. kN/m2	
1	1	27.30	27.30	0.0	1	22.36	22.36	0.0	MC+WC
					2	22.36	27.30	49.4	

WALL PROPERTIES

Type of structure = Fully Embedded Wall
Elevation of toe of wall = 18.00
Maximum finite element length = 0.60 m
Youngs modulus of wall E = 1.9600E+07 kN/m2
Moment of inertia of wall I = 0.017260 m4/m run
E.I = 338296 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	27.70	8.00	0.010000	2.000E+08	10.00	0.00	0	No
2	22.73	1.00	0.300000	1.400E+07	10.00	0.00	0	No
3	28.15	1.00	0.300000	1.400E+07	10.00	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	28.30	0.50(A)	100.00	20.00	40.00	=	N/A	1.30 Var
2	22.36	-0.00(P)	30.00	20.00	50.00	=	N/A	1.00 P/U

Note: A = Active side, P = Passive 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 28.30
	No analysis at this stage
2	Excavate to elevation 27.10 on PASSIVE side
	Toe of berm at elevation 22.48
	Width of top of berm = 2.00
	Width of toe of berm = 6.62
3	Install strut or anchor no.1 at elevation 27.70
4	Excavate to elevation 21.98 on PASSIVE side
5	Install strut or anchor no.2 at elevation 22.73
6	Fill to elevation 23.01 on PASSIVE side with soil type 6
7	Install strut or anchor no.3 at elevation 28.15
8	Remove strut or anchor no.1 at elevation 27.70
9	Change properties of soil type 9 to soil type 1
	No analysis at this stage
	Ko pressures will not be reset
10	Apply water pressure profile no.1 (Worst Cred.)
	No analysis at this stage
11	Change properties of soil type 3 to soil type 4
	No analysis at this stage
	Ko pressures will not be reset
12	Change properties of soil type 6 to soil type 7
	No analysis at this stage
	Ko pressures will not be reset
13	Apply surcharge no.2 at elevation 22.36

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 Permanent Variable 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) = 0 m

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

Width of excavation on active side of wall = 20.00 m
Width of excavation on passive side of wall = 20.00 m

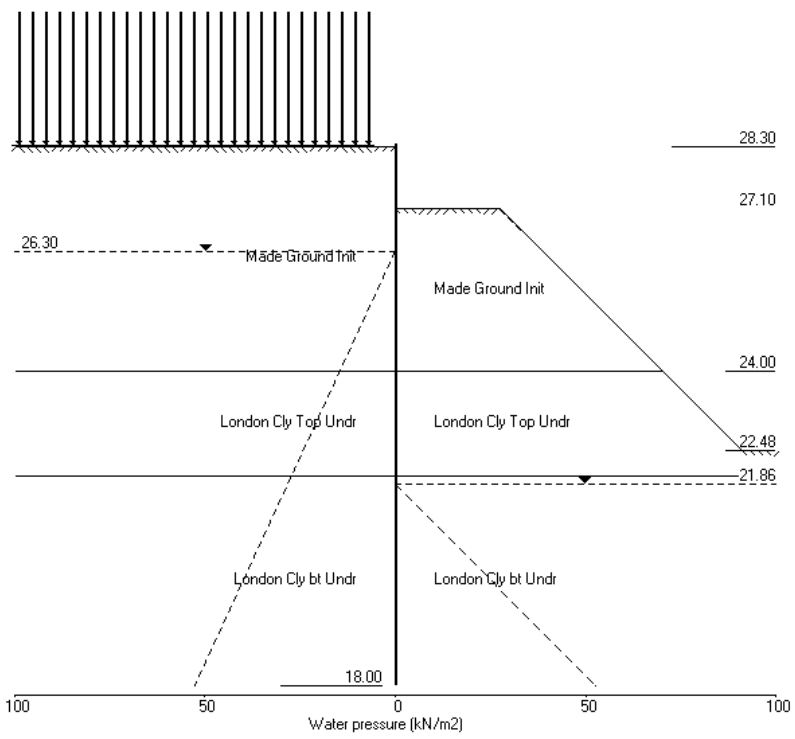
Distance to rigid boundary on active side = 20.00 m
Distance to rigid boundary on passive side = 20.00 m

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. 28.30	No	No	No
2	Excav. to elev. 27.10 on PASSIVE side	No	No	No
3	Install strut no.1 at elev. 27.70	No	No	No
4	Excav. to elev. 21.98 on PASSIVE side	No	No	No
5	Install strut no.2 at elev. 22.73	No	No	No
6	Fill to elev. 23.01 on PASSIVE side	No	No	No
7	Install strut no.3 at elev. 28.15	No	No	No
8	Remove strut no.1 at elev. 27.70	No	No	No
9	Change soil type 9 to soil type 1	No	No	No
10	Apply water pressure profile no.1	No	No	No
11	Change soil type 3 to soil type 4	No	No	No
12	Change soil type 6 to soil type 7	No	No	No
13	Apply surcharge no.2 at elev. 22.36	No	No	No
*	Summary output	Yes	-	Yes

Units: kN,m

Stage No.2 Excav. to elev. 27.10 on PASSIVE side



Units: kN,m

Stage No. 2 Excavate to elevation 27.10 on PASSIVE side
Toe of berm at elevation 22.48
Width of top of berm = 2.00
Width of toe of berm = 6.62

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

Stage No.	--- G.L. --- Act.	Pass.	Strut Elev.	Overall FoS for toe elev. = 18.00 Factor of Safety	Moment equilib. at elev.	Toe FoS = 1.000 Toe elev.	Wall Penetr -ation
2	28.30	27.10	Cant.	1.174	19.27	19.23	7.87

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: Active side 20.00 from wall
Passive 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
1	28.30	0.00	0.041	5.12E-03	0.0	-0.0	
2	28.15	1.39	0.040	5.12E-03	0.1	0.0	
3	27.70	9.89	0.038	5.12E-03	2.6	0.8	
4	27.30	17.39	0.036	5.12E-03	8.1	2.8	
5	27.10	20.50	0.035	5.11E-03	11.9	4.8	
6	26.70	5.57	0.033	5.10E-03	17.1	10.8	
		8.84	0.033	5.10E-03	17.1	10.8	
7	26.30	-3.57	0.031	5.09E-03	18.2	18.0	
		13.41	0.031	5.09E-03	18.2	18.0	
8	25.75	9.41	0.028	5.05E-03	24.4	29.8	
		15.72	0.028	5.05E-03	24.4	29.8	
9	25.20	13.83	0.025	4.99E-03	32.6	45.5	
		18.37	0.025	4.99E-03	32.6	45.5	
10	24.60	17.45	0.022	4.89E-03	43.3	68.3	
		21.06	0.022	4.89E-03	43.3	68.3	
11	24.00	20.82	0.020	4.74E-03	55.9	98.4	
		-47.38	0.020	4.74E-03	55.9	98.4	
12	23.51	-46.70	0.017	4.58E-03	32.6	120.2	
		36.85	0.017	4.58E-03	32.6	120.2	
13	23.01	43.64	0.015	4.39E-03	52.5	141.0	
		43.27	0.015	4.39E-03	52.5	141.0	
14	22.73	46.97	0.014	4.27E-03	64.9	157.1	
		41.50	0.014	4.27E-03	64.9	157.1	
15	22.48	46.96	0.013	4.14E-03	76.0	175.1	
		43.62	0.013	4.14E-03	76.0	175.1	
16	22.36	47.35	0.012	4.08E-03	81.7	184.9	
		44.64	0.012	4.08E-03	81.7	184.9	
17	22.00	55.00	0.011	3.86E-03	99.6	217.3	
		-156.77	0.011	3.86E-03	99.6	217.3	

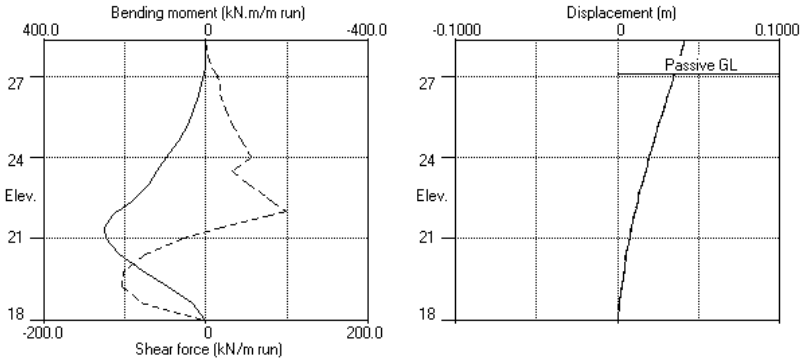
(continued)

Stage No.2 Excavate to elevation 27.10 on PASSIVE side
Toe of berm at elevation 22.48
Width of top of berm = 2.00
Width of toe of berm = 6.62

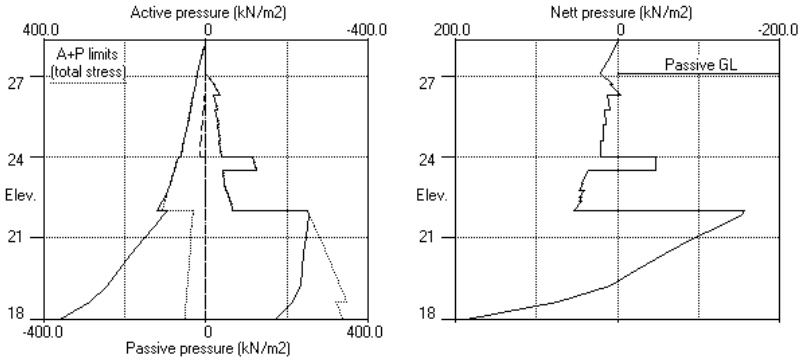
Node no.	Y coord	Nett pressure kN/m2	Wall disp. m	Wall rotation rad.	Shear force kN/m	Bending moment kN.m/m	Strut forces kN/m
18	21.98	-156.31	0.011	3.85E-03	97.2	218.8	
19	21.86	-152.52	0.010	3.77E-03	77.9	229.7	
20	21.43	-124.83	0.009	3.46E-03	18.3	251.5	
21	21.00	-95.62	0.007	3.15E-03	-29.1	247.8	
22	20.40	-57.85	0.006	2.74E-03	-75.1	213.3	
23	19.80	-23.21	0.004	2.41E-03	-99.5	157.9	
24	19.20	9.27	0.003	2.19E-03	-103.6	94.1	
25	18.60	74.18	0.001	2.07E-03	-78.6	33.7	
26	18.00	187.81	0.000	2.04E-03	0.0	0.0	

Units: kN,m

Stage No.2 Excav. to elev. 27.10 on PASSIVE side



Stage No.2 Excav. to elev. 27.10 on PASSIVE side



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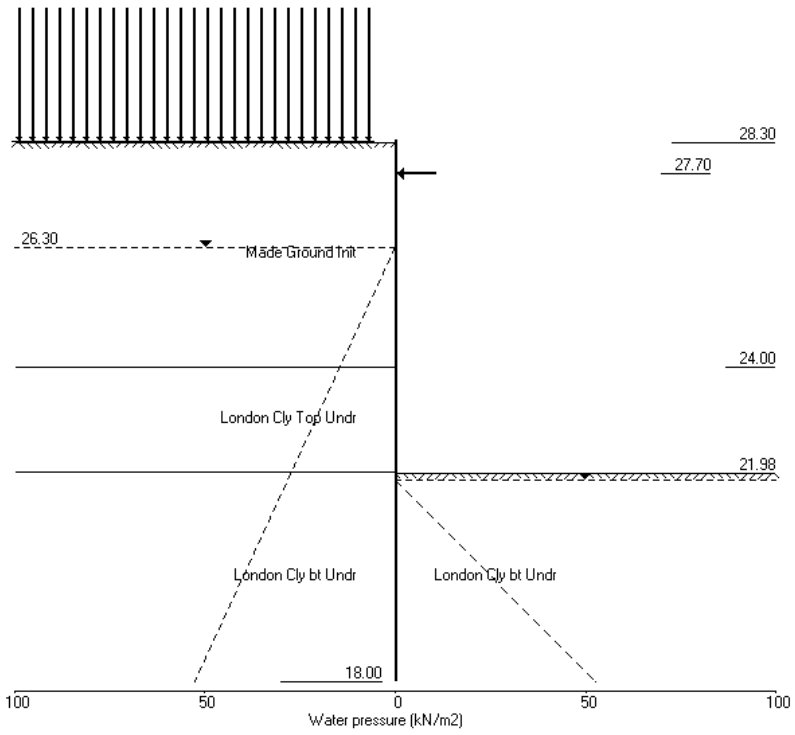
Camley Street | Date: 8-12-2015
Section A1 Adjacent to Sub Station | Checked :

Units: kN,m

Stage No.4 Excav. to elev. 21.98 on PASSIVE side



Units: kN,m

Stage No. 4 Excavate to elevation 21.98 on PASSIVE side

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

Stage No.	--- G.L. --- Act.	Pass.	Strut Elev.	Overall FoS for toe elev. = 18.00 Factor of Safety	Moment equilib. at elev.	Toe elev. for FoS = 1.000 Toe elev.	Wall Penetr -ation
4	28.30	21.98	27.70	1.647	n/a	20.69	1.30

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: Active side 20.00 from wall
Passive 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
1	28.30	0.00	0.044	2.25E-03	0.0	-0.0	
2	28.15	1.39	0.044	2.25E-03	0.1	0.0	
3	27.70	9.89	0.043	2.25E-03	2.6	0.8	120.8
		9.89	0.043	2.25E-03	-118.2	0.8	
4	27.30	17.39	0.042	2.27E-03	-112.7	-45.5	
5	27.10	20.50	0.042	2.31E-03	-108.9	-67.7	
6	26.70	25.82	0.041	2.41E-03	-99.7	-109.5	
7	26.30	30.39	0.040	2.56E-03	-88.4	-147.2	
8	25.75	38.05	0.038	2.84E-03	-69.6	-190.8	
9	25.20	45.27	0.037	3.17E-03	-46.7	-223.0	
10	24.60	52.85	0.035	3.59E-03	-17.3	-242.5	
11	24.00	60.24	0.032	4.02E-03	16.7	-242.5	
		68.71	0.032	4.02E-03	16.7	-242.5	
12	23.51	78.82	0.030	4.36E-03	53.2	-225.5	
13	23.01	88.77	0.028	4.66E-03	94.6	-189.2	
14	22.73	94.24	0.027	4.80E-03	119.8	-159.8	
15	22.48	99.18	0.025	4.91E-03	144.0	-126.5	
16	22.36	101.65	0.025	4.95E-03	156.5	-107.7	
17	22.00	108.71	0.023	5.04E-03	194.4	-44.8	
		31.50	0.023	5.04E-03	194.4	-44.8	
18	21.98	31.58	0.023	5.04E-03	194.9	-41.8	
		-122.81	0.023	5.04E-03	194.9	-41.8	
19	21.86	-125.67	0.022	5.05E-03	179.3	-18.5	
20	21.43	-125.82	0.020	5.03E-03	125.3	51.1	
21	21.00	-110.42	0.018	4.94E-03	74.5	92.9	
22	20.40	-88.93	0.015	4.75E-03	14.7	116.4	
23	19.80	-67.62	0.012	4.55E-03	-32.3	108.1	
24	19.20	-46.35	0.010	4.39E-03	-66.5	75.5	
25	18.60	42.31	0.007	4.29E-03	-67.7	32.9	
26	18.00	183.24	0.004	4.26E-03	-0.0	0.0	

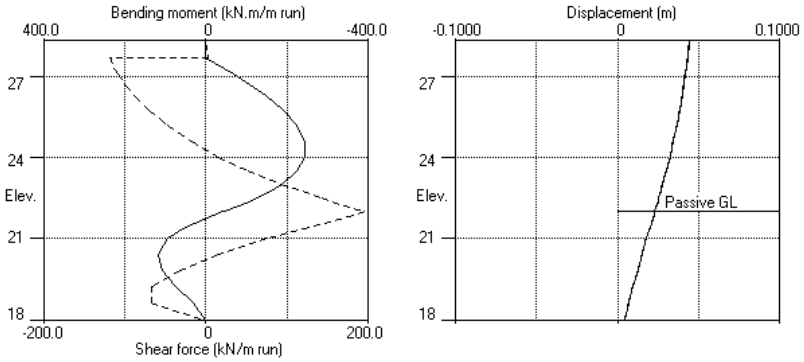
At elev. 27.70 Strut force = 966.7 kN/strut = 120.8 kN/m run

(continued)

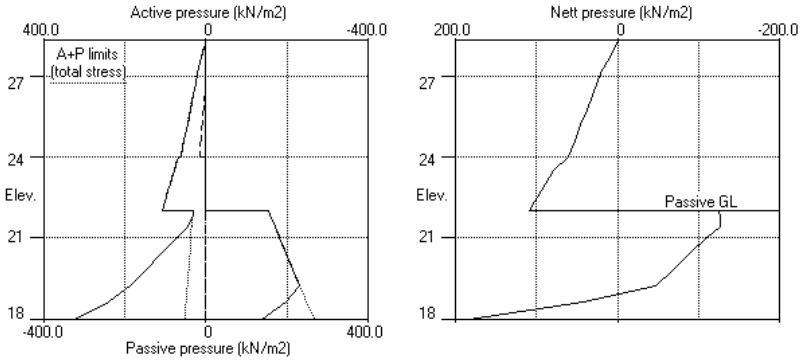
Stage No.4 Excavate to elevation 21.98 on PASSIVE side

Units: kN,m

Stage No.4 Excav. to elev. 21.98 on PASSIVE side



Stage No.4 Excav. to elev. 21.98 on PASSIVE side



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Program: WALLAP Version 6.05 Revision A45.B58.R49 | Job No. JMP008
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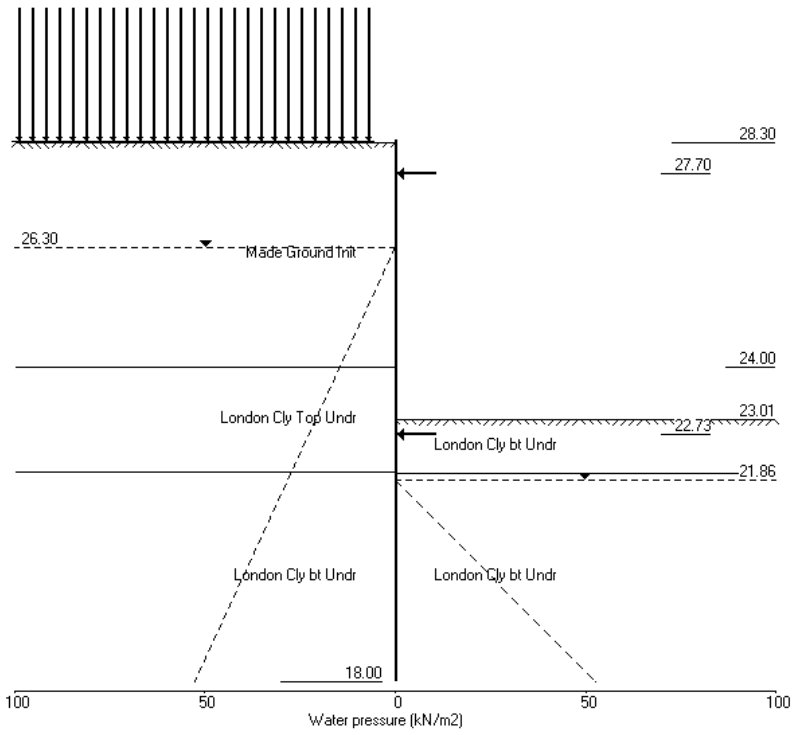
Data filename/Run ID: Section A1 Rev A_ULS2 |
Camley Street | Date: 8-12-2015
Section A1 Adjacent to Sub Station | Checked :

Units: kN,m

Stage No.6 Fill to elev. 23.01 on PASSIVE side



Units: kN,m

Stage No. 6 Fill to elevation 23.01 on PASSIVE side with soil type 6

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

Stage No.	--- G.L. --- Act.	Pass.	Strut Elev.	Overall FoS for toe elev. = 18.00 Factor of Safety	Moment equilib. at elev.	Toe elev. for FoS = 1.000 Toe elev.	Wall Penetr -ation
6	28.30	23.01		More than one strut			

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: Active side 20.00 from wall
Passive 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
1	28.30	0.00	0.044	2.39E-03	0.0	-0.0	
2	28.15	1.39	0.044	2.39E-03	0.1	0.0	
3	27.70	9.90	0.043	2.39E-03	2.6	0.8	120.7
		9.90	0.043	2.39E-03	-118.0	0.8	
4	27.30	17.48	0.042	2.42E-03	-112.6	-45.4	
5	27.10	20.62	0.042	2.45E-03	-108.8	-67.6	
6	26.70	26.01	0.041	2.56E-03	-99.4	-109.3	
7	26.30	30.66	0.039	2.71E-03	-88.1	-146.9	
8	25.75	38.43	0.038	2.98E-03	-69.1	-190.3	
9	25.20	45.75	0.036	3.32E-03	-45.9	-222.2	
10	24.60	53.45	0.034	3.73E-03	-16.2	-241.1	
11	24.00	60.95	0.032	4.16E-03	18.1	-240.3	
		70.57	0.032	4.16E-03	18.1	-240.3	
12	23.51	80.91	0.030	4.49E-03	55.6	-222.4	
13	23.01	91.08	0.027	4.79E-03	98.2	-184.6	
14	22.73	95.30	0.026	4.93E-03	123.8	-154.1	-0.0
15	22.48	98.63	0.025	5.03E-03	148.1	-119.9	
16	22.36	99.04	0.024	5.07E-03	160.4	-100.6	
17	22.00	100.17	0.022	5.14E-03	196.3	-36.6	
		26.74	0.022	5.14E-03	196.3	-36.6	
18	21.98	26.58	0.022	5.15E-03	196.7	-33.6	
		-127.81	0.022	5.15E-03	196.7	-33.6	
19	21.86	-130.34	0.021	5.15E-03	180.5	-10.0	
20	21.43	-129.41	0.019	5.12E-03	124.7	59.6	
21	21.00	-112.98	0.017	5.02E-03	72.6	100.8	
22	20.40	-90.14	0.014	4.82E-03	11.6	122.7	
23	19.80	-67.56	0.011	4.61E-03	-35.7	112.3	
24	19.20	-45.07	0.009	4.44E-03	-69.5	77.7	
25	18.60	44.79	0.006	4.35E-03	-69.5	33.6	
26	18.00	186.94	0.003	4.32E-03	-0.0	0.0	

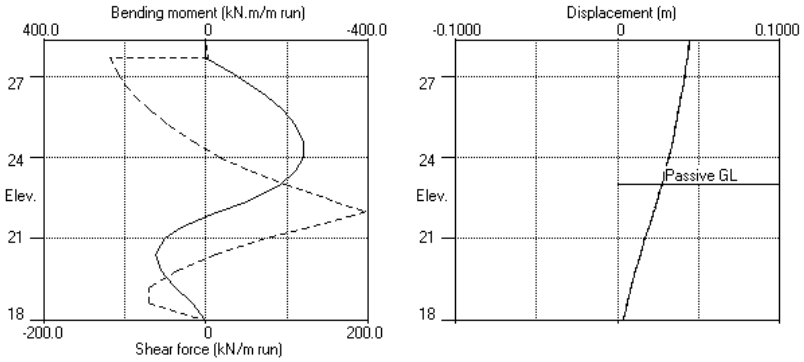
At elev. 27.70 Strut force = 965.5 kN/strut = 120.7 kN/m run
At elev. 22.73 The strut is slack

(continued)

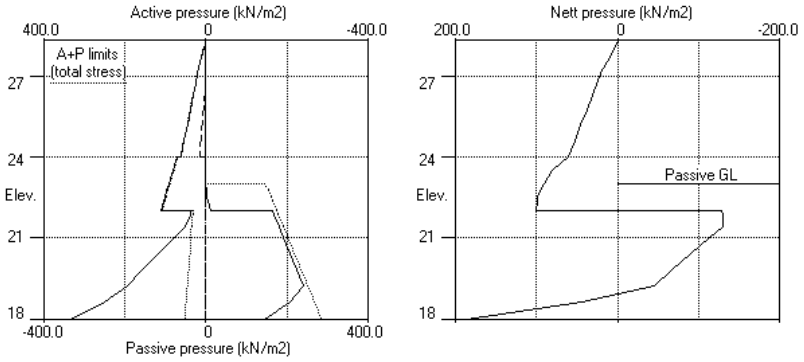
Stage No.6 Fill to elevation 23.01 on PASSIVE side with soil type 6

Units: kN,m

Stage No.6 Fill to elev. 23.01 on PASSIVE side



Stage No.6 Fill to elev. 23.01 on PASSIVE side



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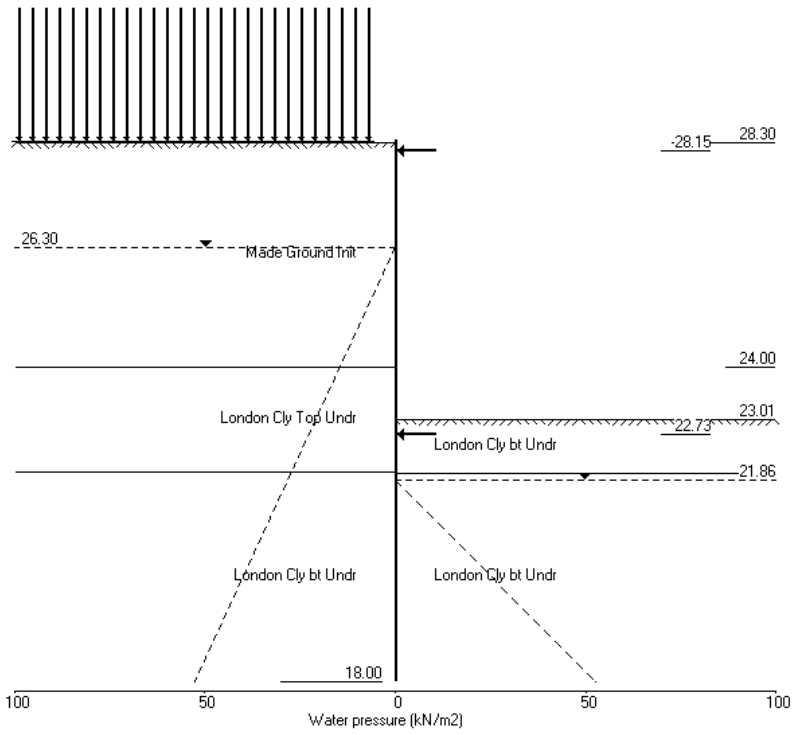
Camley Street | Date: 8-12-2015
Section A1 Adjacent to Sub Station | Checked :

Units: kN,m

Stage No.8 Remove strut no.1 at elev. 27.70



Units: kN,m

Stage No. 8 Remove strut or anchor no.1 at elevation 27.70

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

Stage No.	--- G.L. --- Act.	Pass.	Strut Elev.	Overall FoS for toe elev. = 18.00 Factor of Safety	Moment equilib. at elev.	Toe elev. for FoS = 1.000 Toe elev.	Wall Penetr -ation
8	28.30	23.01		More than one strut			

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: Active side 20.00 from wall
Passive 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
1	28.30	0.00	0.045	2.15E-03	0.0	-0.0	
2	28.15	1.39	0.044	2.15E-03	0.1	0.0	109.2
		1.39	0.044	2.15E-03	-109.1	0.0	
3	27.70	9.89	0.043	2.19E-03	-106.5	-48.3	
4	27.30	17.39	0.042	2.27E-03	-101.1	-90.0	
5	27.10	20.50	0.042	2.33E-03	-97.3	-109.8	
6	26.70	25.82	0.041	2.48E-03	-88.0	-147.0	
7	26.30	30.39	0.040	2.67E-03	-76.8	-180.0	
8	25.75	38.05	0.038	3.00E-03	-58.0	-217.3	
9	25.20	45.27	0.037	3.37E-03	-35.1	-243.1	
10	24.60	52.85	0.035	3.81E-03	-5.6	-255.5	
11	24.00	60.38	0.032	4.26E-03	28.3	-248.6	
		69.07	0.032	4.26E-03	28.3	-248.6	
12	23.51	79.61	0.030	4.61E-03	65.1	-225.7	
13	23.01	89.99	0.028	4.91E-03	107.1	-183.4	
		84.29	0.028	4.91E-03	107.1	-183.4	
14	22.73	89.13	0.026	5.04E-03	131.0	-150.8	-0.0
15	22.48	93.03	0.025	5.14E-03	153.7	-114.9	
16	22.36	93.72	0.024	5.18E-03	165.4	-94.9	
17	22.00	95.65	0.022	5.24E-03	199.5	-29.5	
		21.27	0.022	5.24E-03	199.5	-29.5	
18	21.98	21.14	0.022	5.25E-03	199.8	-26.5	
		-133.24	0.022	5.25E-03	199.8	-26.5	
19	21.86	-135.45	0.022	5.25E-03	183.0	-2.5	
20	21.43	-133.46	0.019	5.21E-03	125.2	67.7	
21	21.00	-116.05	0.017	5.10E-03	71.6	108.7	
22	20.40	-91.98	0.014	4.89E-03	9.1	129.5	
23	19.80	-68.32	0.011	4.67E-03	-38.9	117.3	
24	19.20	-44.55	0.009	4.49E-03	-72.8	80.5	
25	18.60	47.58	0.006	4.39E-03	-71.9	34.5	
26	18.00	192.02	0.003	4.36E-03	-0.0	0.0	

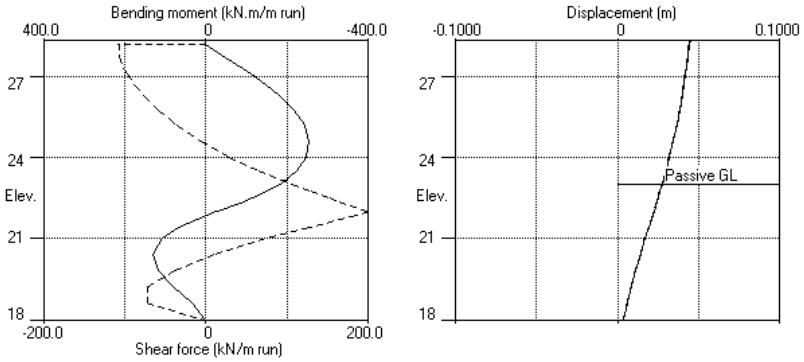
At elev. 28.15 Strut force = 109.2 kN/strut = 109.2 kN/m run
At elev. 22.73 The strut is slack

(continued)

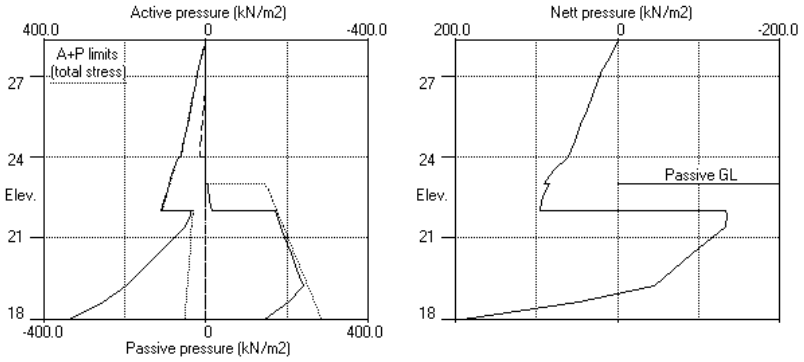
Stage No.8 Remove strut or anchor no.1 at elevation 27.70

Units: kN,m

Stage No.8 Remove strut no.1 at elev. 27.70



Stage No.8 Remove strut no.1 at elev. 27.70



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Camley Street | Date: 8-12-2015
Section A1 Adjacent to Sub Station | 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 Permanent Variable loads = 1.300

STABILITY ANALYSIS of Fully Embedded Wall according to Strength Factor method

Factor of safety on soil strength

Stage No.	G.L. Act.	G.L. Pass.	Strut Elev.	Overall FoS for toe elev. = 18.00 Factor of Safety	Moment equilib. at elev.	Toe elev. for FoS = 1.000 Toe elev.	Wall Penetration
1	28.30	28.30	Cant.	Conditions not suitable for FoS calc.			
2	28.30	27.10	Cant.	1.174	19.27	19.23	7.87
3	28.30	27.10		No analysis at this stage			
4	28.30	21.98	27.70	1.647	n/a	20.69	1.30
5	28.30	21.98		No analysis at this stage			

All remaining stages have more than one strut - FoS calculation n/a

Units: kN,m

Summary of results

BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall

Analysis options

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

Rigid boundaries: Active side 20.00 from wall
Passive side 20.00 from wall

Limit State: ULS DA1 Combination 2

Bending moment, shear force and displacement envelopes

Node no.	Y coord	Displacement maximum	Displacement minimum	Bending moment maximum	Bending moment minimum	Shear force maximum	Shear force minimum
		m	m	kN.m/m	kN.m/m	kN/m	kN/m
1	28.30	0.045	0.000	0.0	-0.0	0.0	0.0
2	28.15	0.044	0.000	0.0	-0.0	0.1	-109.1
3	27.70	0.043	0.000	0.8	-48.3	2.6	-118.2
4	27.30	0.042	0.000	2.8	-90.0	8.1	-112.7
5	27.10	0.042	0.000	4.8	-109.8	11.9	-108.9
6	26.70	0.041	0.000	10.8	-147.0	17.1	-99.7
7	26.30	0.040	0.000	18.0	-180.0	18.2	-88.4
8	25.75	0.038	0.000	29.8	-217.3	24.4	-69.6
9	25.20	0.037	0.000	45.5	-243.1	32.6	-46.7
10	24.60	0.035	0.000	68.3	-255.5	43.3	-17.3
11	24.00	0.032	0.000	98.4	-248.6	76.1	0.0
12	23.51	0.030	0.000	120.2	-225.7	119.0	0.0
13	23.01	0.028	0.000	141.0	-189.2	167.3	0.0
14	22.73	0.027	0.000	157.1	-159.8	193.2	-29.0
15	22.48	0.026	0.000	175.1	-126.5	153.7	-4.8
16	22.36	0.026	0.000	184.9	-107.7	165.4	0.0
17	22.00	0.024	0.000	217.3	-44.8	199.5	0.0
18	21.98	0.024	0.000	218.8	-41.8	199.8	0.0
19	21.86	0.024	0.000	229.7	-18.5	183.0	0.0
20	21.43	0.022	0.000	251.5	0.0	125.3	0.0
21	21.00	0.020	0.000	247.8	0.0	74.5	-29.1
22	20.40	0.018	0.000	213.3	0.0	14.7	-75.1
23	19.80	0.016	0.000	157.9	0.0	0.0	-99.5
24	19.20	0.014	0.000	94.1	0.0	0.0	-103.6
25	18.60	0.012	0.000	34.5	0.0	0.0	-78.6
26	18.00	0.010	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 maximum	elev.	minimum	elev.	Shear force maximum	elev.	minimum	elev.
	kN.m/m		kN.m/m		kN/m		kN/m	
1	23.0	21.00	-16.2	24.60	27.0	22.00	-11.3	19.20
2	251.5	21.43	-0.0	28.30	99.6	22.00	-103.6	19.20
3	No calculation at this stage							
4	116.4	20.40	-242.5	24.00	194.9	21.98	-118.2	27.70
5	No calculation at this stage							
6	122.7	20.40	-241.1	24.60	196.7	21.98	-118.0	27.70
7	No calculation at this stage							
8	129.5	20.40	-255.5	24.60	199.8	21.98	-109.1	28.15
9	No calculation at this stage							
10	No calculation at this stage							
11	No calculation at this stage							
12	No calculation at this stage							
13	66.2	20.40	-170.3	25.20	193.2	22.73	-88.2	28.15

Maximum and minimum displacement at each stage

Stage no.	Displacement maximum	elev.	minimum	elev.	Stage description
	m		m		
1	0.008	28.30	0.000	28.30	Apply surcharge no.1 at elev. 28.30
2	0.041	28.30	0.000	28.30	Excav. to elev. 27.10 on PASSIVE side
3	No calculation at this stage				Install strut no.1 at elev. 27.70
4	0.044	28.30	0.000	28.30	Excav. to elev. 21.98 on PASSIVE side
5	No calculation at this stage				Install strut no.2 at elev. 22.73
6	0.044	28.30	0.000	28.30	Fill to elev. 23.01 on PASSIVE side
7	No calculation at this stage				Install strut no.3 at elev. 28.15
8	0.045	28.30	0.000	28.30	Remove strut no.1 at elev. 27.70
9	No calculation at this stage				Change soil type 9 to soil type 1
10	No calculation at this stage				Apply water pressure profile no.1
11	No calculation at this stage				Change soil type 3 to soil type 4
12	No calculation at this stage				Change soil type 6 to soil type 7
13	0.045	28.30	0.000	28.30	Apply surcharge no.2 at elev. 22.36

Strut forces at each stage (horizontal components)

Stage no.	Strut no. 1 at elev. 27.70 kN/m run	Strut no. 1 kN/strut	Strut no. 2 at elev. 22.73 kN/m run	Strut no. 2 kN/strut	Strut no. 3 at elev. 28.15 kN/m run	Strut no. 3 kN/strut
4	120.83	966.65	---	---	---	---
6	120.68	965.46	slack	slack	---	---
8	---	---	slack	slack	109.19	109.19
13	---	---	222.22	222.22	88.27	88.27

* Indicates that the total force shown is the sum of the force in the strut plus a force applied at the same elevation which may represent temperature load or other forces which are part of the strut load. Force components are listed in the detailed results for individual stages.

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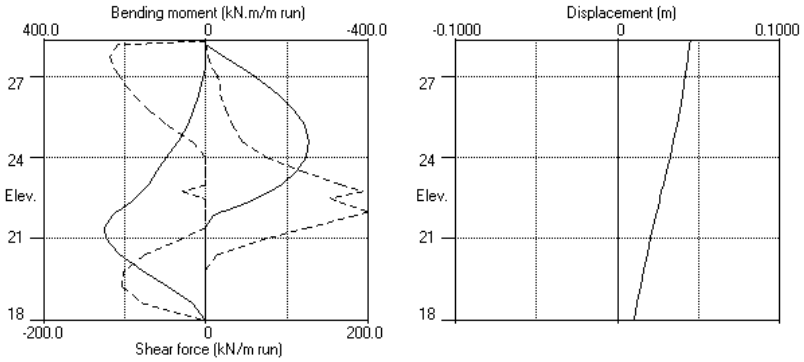
Data filename/Run ID: Section A1 Rev A_ULS2 |
Camley Street | Date: 8-12-2015
Section A1 Adjacent to Sub Station | Checked :

Units: kN,m

Bending moment, shear force, displacement envelopes



Units: kN,m

INPUT DATA

SOIL PROFILE

Stratum no.	Elevation of top of stratum	Soil types Active side	Passive side
1	28.30	8 Made Ground Init	8 Made Ground Init
2	24.00	3 London Cly Top Undr	3 London Cly Top Undr
3	22.00	6 London Cly bt Undr	6 London Cly bt Undr

SOIL PROPERTIES (Unfactored SLS soil strengths)

No.	Soil type -- Description (Datum elev.)	Bulk density kN/m3	Young's Modulus Eh,kN/m2 (dEh/dy)	At rest coeff. Ko (dKo/dy)	Consol state. NC/OC (Nu)	Active limit Ka (Kac)	Passive limit Kp (Kpc)	Cohesion kN/m2 (dc/dy)
1	Made Ground	19.00	10000	0.577	OC (0.250)	0.390 (0.000)	2.561 (0.000)	
2	Gravels	19.00	30000	0.423	OC (0.300)	0.227 (0.000)	6.084 (0.000)	
3	London Cly Top Undr	19.00	20000	1.000	OC (0.490)	1.000 (2.000)	1.000 (2.000)	40.00u
4	London Cly Top dr	19.00	14000	1.000	OC (0.250)	0.422 (1.299)	2.371 (3.080)	3.000d
5	Concrete	24.00	200000	1.000	OC (0.490)	1.000 (2.000)	1.000 (2.000)	30000u
6	London Cl.. (24.00)	19.00	42500 (2589)	1.400	OC (0.490)	1.000 (2.476)	1.000 (2.390)	80.00u (5.180)
7	London Cl.. (24.00)	19.00	28000 (1813)	1.400	OC (0.250)	0.366 (1.423)	3.077 (4.665)	3.000d
8	Made Ground Init	19.00	10000	0.577	OC (0.250)	0.337 (0.000)	3.442 (0.000)	

Additional soil parameters associated with Ka and Kp

No.	Soil type ------- Description	--- parameters for Ka --- Soil friction angle	Wall adhesion coeff.	Back-fill angle	--- parameters for Kp --- Soil friction angle	Wall adhesion coeff.	Back-fill angle
1	Made Ground	26.00	0.000	0.00	26.00	0.000	0.00
2	Gravels	35.00	0.670	0.00	35.00	0.500	0.00
3	London Cly Top Undr	0.00	0.000	0.00	0.00	0.000	0.00
4	London Cly Top dr	24.00	0.000	0.00	24.00	0.000	0.00
5	Concrete	0.00	0.000	0.00	0.00	0.000	0.00
6	London Cly bt Undr	0.00	0.670	0.00	0.00	0.500	0.00
7	London Cly bt dr	24.00	0.670	0.00	24.00	0.500	0.00
8	Made Ground Init	26.00	0.670	0.00	26.00	0.500	0.00

GROUND WATER CONDITIONS

Density of water = 10.00 kN/m3

	Active side	Passive side
Initial water table elevation	26.30	21.86

Automatic water pressure balancing at toe of wall : Yes

Water press. profile no.	Active side Point no.	Elev. m	Piezo elev. m	Water press. kN/m2	Passive side Point no.	Elev. m	Piezo elev. m	Water press. kN/m2	
1	1	27.30	27.30	0.0	1	22.36	22.36	0.0	MC+WC
					2	22.36	27.30	49.4	

WALL PROPERTIES

Type of structure = Fully Embedded Wall
Elevation of toe of wall = 18.00
Maximum finite element length = 0.60 m
Youngs modulus of wall E = 1.9600E+07 kN/m2
Moment of inertia of wall I = 0.017260 m4/m run
E.I = 338296 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	27.70	8.00	0.010000	2.000E+08	10.00	0.00	0	No
2	23.43	1.00	0.300000	1.400E+07	10.00	0.00	0	No
3	28.15	1.00	0.300000	1.400E+07	10.00	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	28.30	0.50(A)	100.00	20.00	20.00	=	N/A	1.10 Var
2	22.36	-0.00(P)	30.00	20.00	50.00	=	N/A	1.00 P/U

Note: A = Active side, P = Passive 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 28.30
	No analysis at this stage
2	Excavate to elevation 27.10 on PASSIVE side
	Toe of berm at elevation 23.19
	Width of top of berm = 2.00
	Width of toe of berm = 5.91
3	Install strut or anchor no.1 at elevation 27.70
4	Excavate to elevation 22.69 on PASSIVE side
5	Install strut or anchor no.2 at elevation 23.43
6	Fill to elevation 23.58 on PASSIVE side with soil type 6
7	Install strut or anchor no.3 at elevation 28.15
8	Remove strut or anchor no.1 at elevation 27.70
9	Change properties of soil type 9 to soil type 1
	No analysis at this stage
	Ko pressures will not be reset
10	Apply water pressure profile no.1 (Mod. Conserv.)
	No analysis at this stage
11	Change properties of soil type 3 to soil type 4
	No analysis at this stage
	Ko pressures will not be reset
12	Change properties of soil type 6 to soil type 7
	No analysis at this stage
	Ko pressures will not be reset
13	Apply surcharge no.2 at elevation 22.36

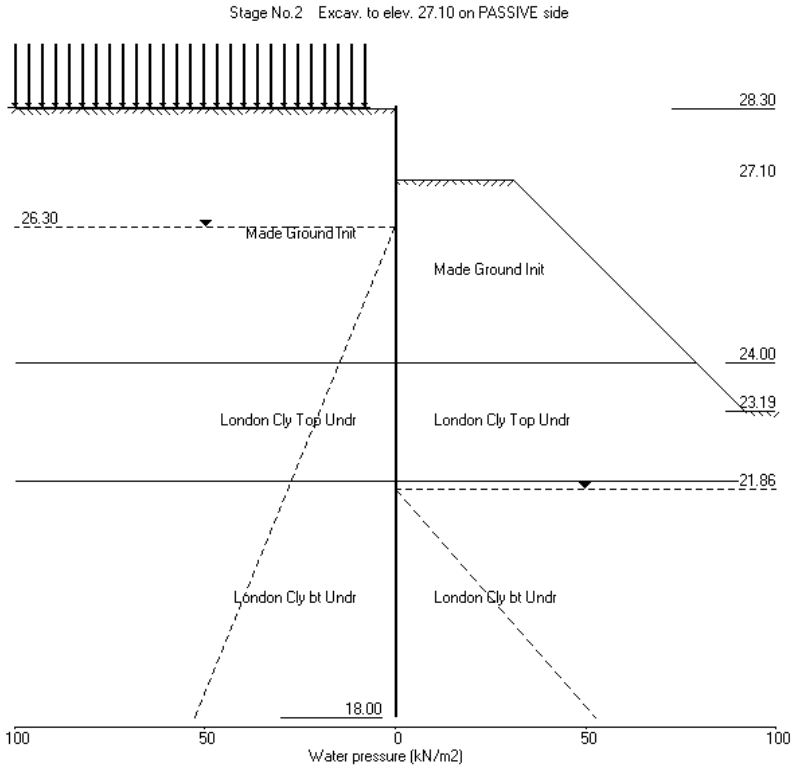
FACTORS OF SAFETY and ANALYSIS OPTIONS

```
   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 Permanent Variable 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) = 0 m

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

      Width of excavation on active  side of wall  = 20.00 m
      Width of excavation on passive side of wall  = 20.00 m

      Distance to rigid boundary on active side  = 20.00 m
      Distance to rigid boundary on passive 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. 28.30	No	No	No
2	Excav. to elev. 27.10 on PASSIVE side	No	No	No
3	Install strut no.1 at elev. 27.70	No	No	No
4	Excav. to elev. 22.69 on PASSIVE side	No	No	No
5	Install strut no.2 at elev. 23.43	No	No	No
6	Fill to elev. 23.58 on PASSIVE side	No	No	No
7	Install strut no.3 at elev. 28.15	No	No	No
8	Remove strut no.1 at elev. 27.70	No	No	No
9	Change soil type 9 to soil type 1	No	No	No
10	Apply water pressure profile no.1	No	No	No
11	Change soil type 3 to soil type 4	No	No	No
12	Change soil type 6 to soil type 7	No	No	No
13	Apply surcharge no.2 at elev. 22.36	No	No	No
*	Summary output	Yes	-	Yes

Units: kN,m



Units: kN,m

Stage No. 2 Excavate to elevation 27.10 on PASSIVE side
Toe of berm at elevation 23.19
Width of top of berm = 2.00
Width of toe of berm = 5.91

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: Active side 20.00 from wall
Passive side 20.00 from wall

Limit State: ULS DA1 Combination 1

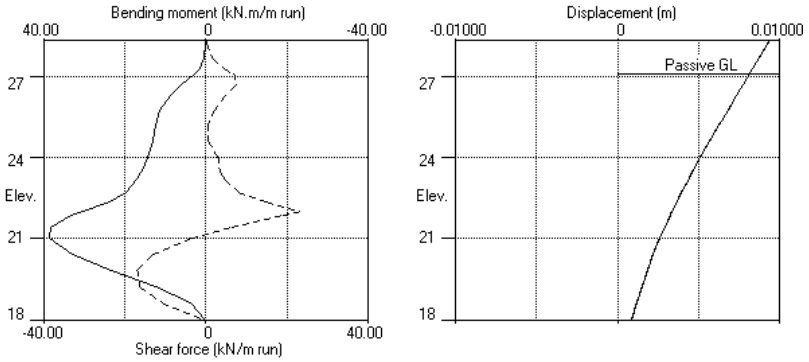
Calculated Bending Moments and Strut Forces are to be multiplied by a factor of 1.35 to obtain values for structural design. See summary for factored values.

Node no.	Y coord	Nett pressure kN/m2	Wall disp. m	Wall rotation rad.	Shear force kN/m	Bending moment kN.m/m	Strut forces kN/m
1	28.30	0.00	0.009	1.02E-03	0.0	-0.0	
2	28.15	1.04	0.009	1.02E-03	0.1	0.0	
3	27.70	5.65	0.009	1.02E-03	1.6	0.3	
4	27.30	9.73	0.008	1.02E-03	4.7	1.6	
5	27.10	11.55	0.008	1.01E-03	6.8	2.7	
6	26.70	-7.50	0.008	1.01E-03	7.6	6.1	
		-6.06	0.008	1.01E-03	7.6	6.1	
7	26.30	-8.14	0.007	1.00E-03	4.8	8.8	
		-3.27	0.007	1.00E-03	4.8	8.8	
8	25.75	-6.43	0.007	9.88E-04	2.1	11.5	
		-3.17	0.007	9.88E-04	2.1	11.5	
9	25.20	-2.90	0.006	9.69E-04	0.4	12.5	
		-0.21	0.006	9.69E-04	0.4	12.5	
10	24.60	0.80	0.006	9.46E-04	0.6	13.1	
		3.02	0.006	9.46E-04	0.6	13.1	
11	24.00	4.37	0.005	9.22E-04	2.8	14.4	
		-1.11	0.005	9.22E-04	2.8	14.4	
12	23.58	2.28	0.005	9.03E-04	3.1	15.4	
13	23.43	3.47	0.005	8.96E-04	3.5	15.9	
14	23.19	5.38	0.004	8.85E-04	4.6	16.9	
15	22.69	9.13	0.004	8.57E-04	8.2	19.9	
		18.94	0.004	8.57E-04	8.2	19.9	
16	22.36	22.94	0.004	8.36E-04	15.1	23.6	
		20.07	0.004	8.36E-04	15.1	23.6	
17	22.00	24.25	0.003	8.07E-04	23.1	30.4	
		-33.70	0.003	8.07E-04	23.1	30.4	
18	21.86	-32.33	0.003	7.94E-04	18.5	33.3	
19	21.43	-25.84	0.003	7.49E-04	6.0	38.3	
20	21.00	-19.51	0.003	7.00E-04	-3.8	38.5	
21	20.40	-10.99	0.002	6.37E-04	-12.9	32.9	
22	19.80	-2.76	0.002	5.87E-04	-17.1	23.2	
23	19.20	5.34	0.002	5.55E-04	-16.3	12.6	
24	18.60	13.52	0.001	5.40E-04	-10.6	3.9	
25	18.00	21.96	0.001	5.37E-04	-0.0	-0.0	

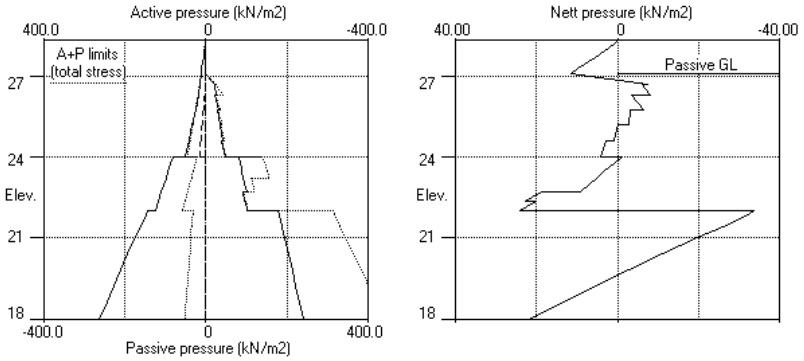
(continued)

Stage No.2 Excavate to elevation 27.10 on PASSIVE side
Toe of berm at elevation 23.19
Width of top of berm = 2.00
Width of toe of berm = 5.91

Stage No.2 Excav. to elev. 27.10 on PASSIVE side



Stage No.2 Excav. to elev. 27.10 on PASSIVE side



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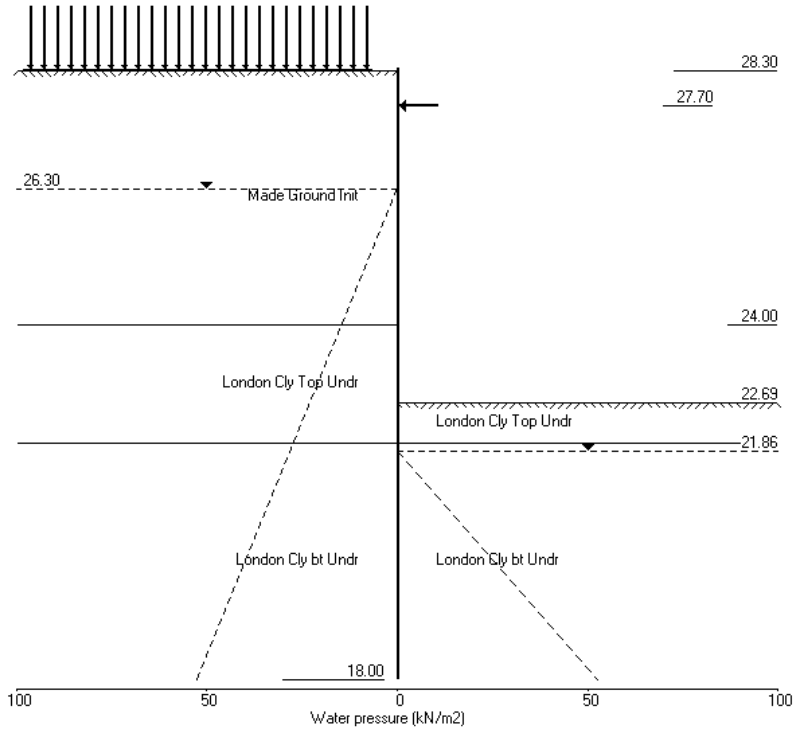
Camley Street | Date:10-12-2015
Section A2 | Checked :
Units: kN,m

Stage No.4 Excav. to elev. 22.69 on PASSIVE side



Units: kN,m

Stage No. 4 Excavate to elevation 22.69 on PASSIVE 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: Active side 20.00 from wall
Passive 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/m2	Wall disp. m	Wall rotation rad.	Shear force kN/m	Bending moment kN.m/m	Strut forces kN/m
1	28.30	0.00	0.012	-8.04E-04	0.0	-0.0	
2	28.15	1.04	0.012	-8.04E-04	0.1	0.0	
3	27.70	5.65	0.012	-8.04E-04	1.6	0.3	91.4
		5.65	0.012	-8.04E-04	-89.8	0.3	
4	27.30	9.73	0.013	-7.84E-04	-86.8	-35.0	
5	27.10	11.55	0.013	-7.58E-04	-84.6	-52.1	
6	26.70	14.87	0.013	-6.77E-04	-79.4	-84.7	
7	26.30	17.93	0.013	-5.59E-04	-72.8	-115.0	
8	25.75	24.22	0.014	-3.43E-04	-61.2	-151.2	
9	25.20	30.36	0.014	-7.33E-05	-46.2	-180.6	
10	24.60	36.95	0.014	2.66E-04	-26.0	-202.1	
11	24.00	43.48	0.013	6.31E-04	-1.9	-210.4	
		55.42	0.013	6.31E-04	-1.9	-210.4	
12	23.58	64.91	0.013	8.87E-04	23.1	-206.2	
13	23.43	68.39	0.013	9.78E-04	33.1	-202.0	
14	23.19	74.15	0.013	1.12E-03	50.6	-191.8	
15	22.69	86.14	0.012	1.37E-03	90.6	-157.0	
		41.19	0.012	1.37E-03	90.6	-157.0	
16	22.36	46.62	0.012	1.51E-03	105.1	-124.8	
		43.75	0.012	1.51E-03	105.1	-124.8	
17	22.00	49.89	0.011	1.62E-03	122.0	-84.0	
		-84.19	0.011	1.62E-03	122.0	-84.0	
18	21.86	-81.78	0.011	1.65E-03	110.4	-67.8	
19	21.43	-71.34	0.010	1.71E-03	77.4	-27.8	
20	21.00	-60.10	0.009	1.73E-03	49.2	-1.1	
21	20.40	-43.49	0.008	1.72E-03	18.1	17.7	
22	19.80	-26.13	0.007	1.68E-03	-2.8	20.8	
23	19.20	-8.12	0.006	1.65E-03	-13.1	14.6	
24	18.60	10.65	0.005	1.63E-03	-12.3	5.4	
25	18.00	30.35	0.004	1.63E-03	-0.0	0.0	

At elev. 27.70 Strut force = 731.4 kN/strut = 91.4 kN/m run

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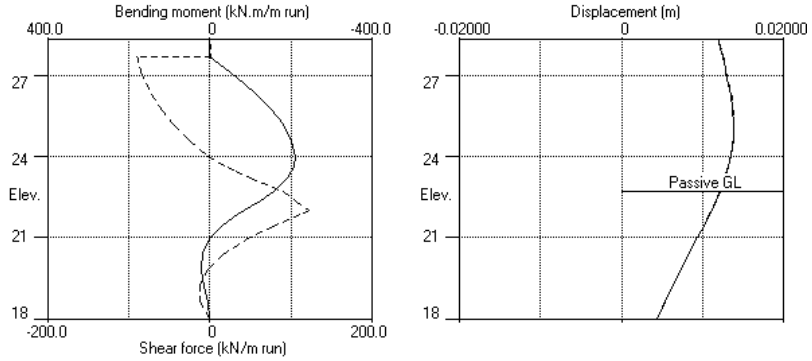
Units: kN,m

Stage No.4 Excav. to elev. 22.69 on PASSIVE side



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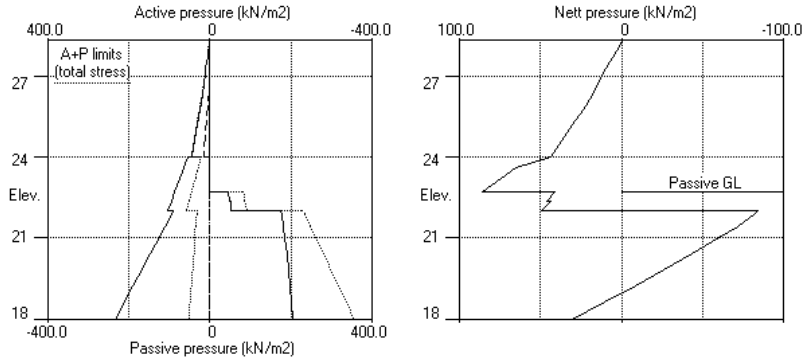
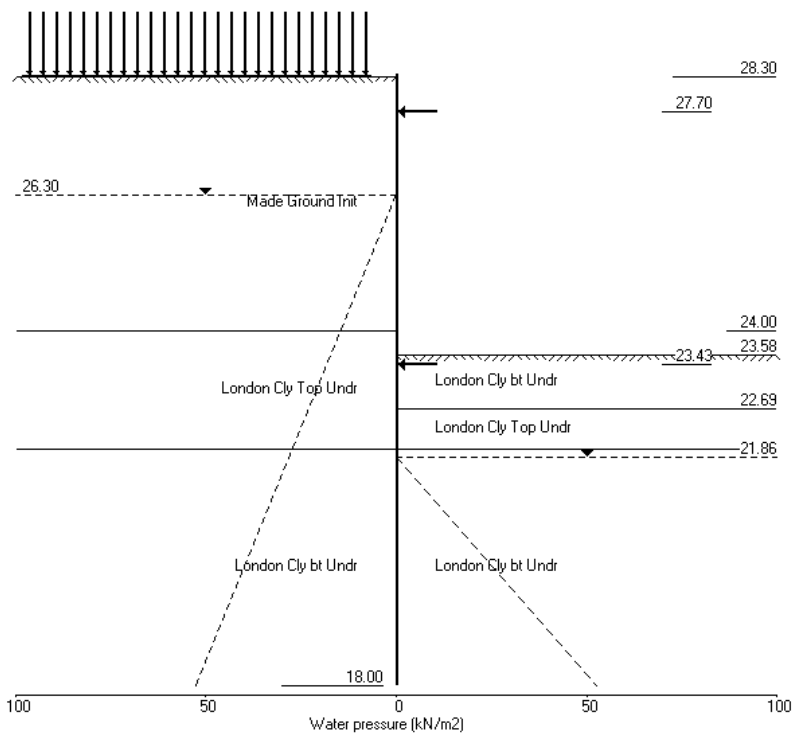


Units: kN,m

Stage No.6 Fill to elev. 23.58 on PASSIVE side



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Units: kN,m

Stage No. 6 Fill to elevation 23.58 on PASSIVE side with soil type 6

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: Active side 20.00 from wall
Passive 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/m2	Wall disp. m	Wall rotation rad.	Shear force kN/m	Bending moment kN.m/m	Strut forces kN/m
1	28.30	0.00	0.012	-6.22E-04	0.0	-0.0	
2	28.15	1.04	0.012	-6.22E-04	0.1	0.0	
3	27.70	5.73	0.012	-6.22E-04	1.6	0.3	89.8
		5.73	0.012	-6.22E-04	-88.2	0.3	
4	27.30	9.90	0.013	-6.02E-04	-85.0	-34.3	
5	27.10	11.75	0.013	-5.76E-04	-82.9	-51.1	
6	26.70	15.16	0.013	-4.97E-04	-77.5	-83.0	
7	26.30	18.31	0.013	-3.82E-04	-70.8	-112.4	
8	25.75	24.72	0.013	-1.70E-04	-59.0	-147.5	
9	25.20	30.97	0.013	9.18E-05	-43.6	-175.6	
10	24.60	37.67	0.013	4.20E-04	-23.1	-195.5	
11	24.00	44.31	0.013	7.73E-04	1.5	-201.9	
		57.61	0.013	7.73E-04	1.5	-201.9	
12	23.58	67.27	0.012	1.01E-03	27.5	-196.1	
13	23.43	70.07	0.012	1.10E-03	37.8	-191.2	-0.0
14	23.19	74.69	0.012	1.23E-03	55.5	-179.8	
15	22.69	79.52	0.011	1.47E-03	94.0	-143.0	
		30.60	0.011	1.47E-03	94.0	-143.0	
16	22.36	36.23	0.011	1.59E-03	105.1	-110.3	
		33.36	0.011	1.59E-03	105.1	-110.3	
17	22.00	39.67	0.010	1.69E-03	118.2	-70.2	
		-85.90	0.010	1.69E-03	118.2	-70.2	
18	21.86	-83.24	0.010	1.72E-03	106.4	-54.5	
19	21.43	-72.08	0.009	1.76E-03	73.0	-16.5	
20	21.00	-60.19	0.008	1.77E-03	44.5	8.3	
21	20.40	-42.82	0.007	1.74E-03	13.6	24.3	
22	19.80	-24.82	0.006	1.69E-03	-6.7	24.9	
23	19.20	-6.23	0.005	1.66E-03	-16.0	16.5	
24	18.60	13.08	0.004	1.64E-03	-13.9	5.9	
25	18.00	33.31	0.003	1.63E-03	-0.0	0.0	

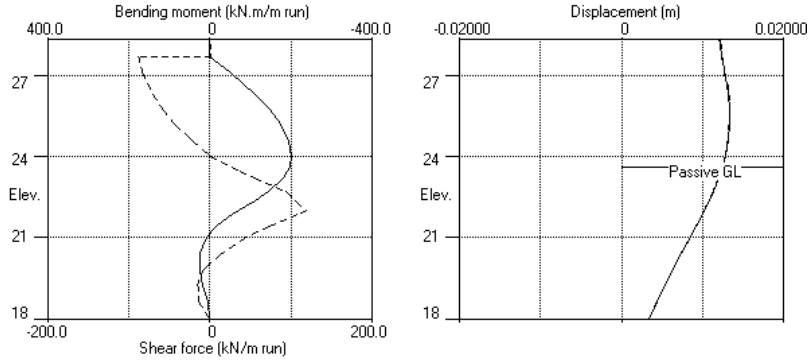
At elev. 27.70 Strut force = 718.0 kN/strut = 89.8 kN/m run
At elev. 23.43 The strut is slack

(continued)

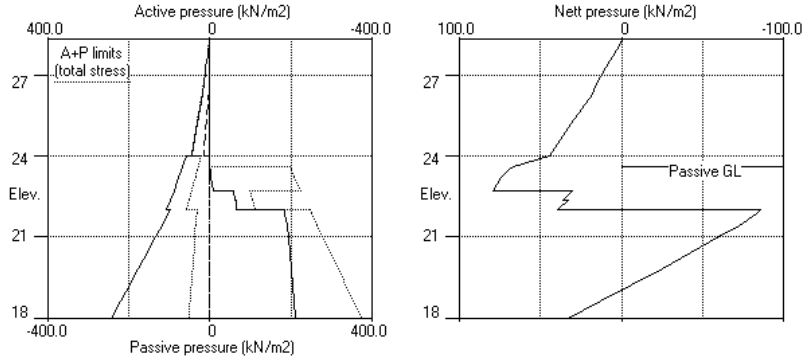
Stage No.6 Fill to elevation 23.58 on PASSIVE side with soil type 6

Units: kN,m

Stage No.6 Fill to elev. 23.58 on PASSIVE side

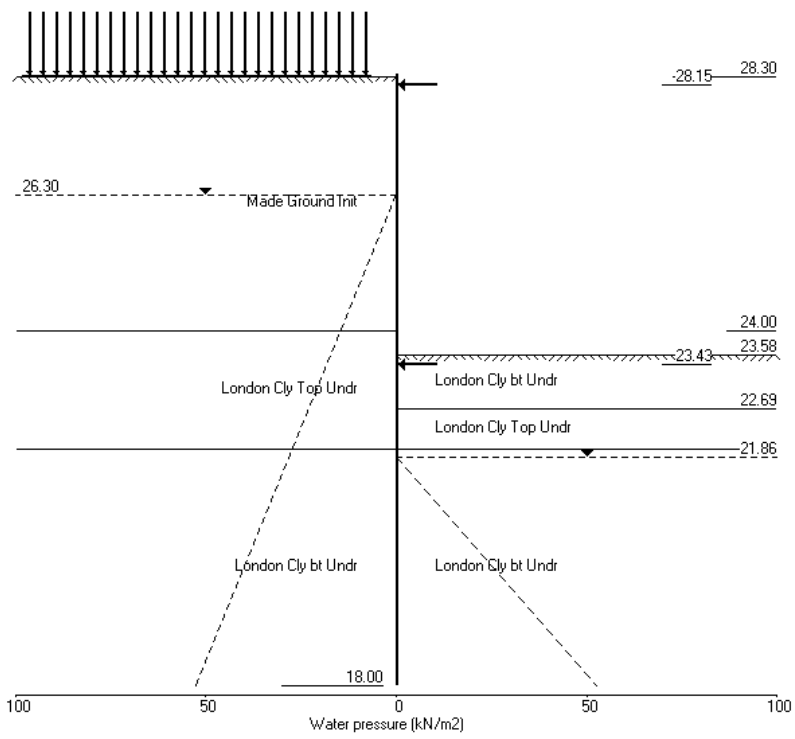


Stage No.6 Fill to elev. 23.58 on PASSIVE side



Units: kN,m

Stage No.8 Remove strut no.1 at elev. 27.70



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Section A2 | Checked :

Units: kN,m

Stage No. 8 Remove strut or anchor no.1 at elevation 27.70

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: Active side 20.00 from wall
Passive 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/m2	Wall disp. m	Wall rotation rad.	Shear force kN/m	Bending moment kN.m/m	Strut forces kN/m
1	28.30	0.00	0.012	-7.90E-04	0.0	-0.0	
2	28.15	1.04	0.012	-7.90E-04	0.1	0.0	80.6
		1.04	0.012	-7.90E-04	-80.6	0.0	
3	27.70	5.65	0.013	-7.66E-04	-79.1	-36.0	
4	27.30	9.73	0.013	-7.05E-04	-76.0	-67.0	
5	27.10	11.55	0.013	-6.61E-04	-73.9	-82.0	
6	26.70	14.87	0.013	-5.48E-04	-68.6	-110.2	
7	26.30	17.93	0.013	-4.02E-04	-62.0	-136.2	
8	25.75	24.22	0.014	-1.56E-04	-50.4	-166.5	
9	25.20	30.47	0.014	1.33E-04	-35.4	-189.9	
10	24.60	37.22	0.013	4.83E-04	-15.1	-205.0	
11	24.00	43.91	0.013	8.48E-04	9.3	-206.7	
		56.57	0.013	8.48E-04	9.3	-206.7	
12	23.58	66.35	0.013	1.09E-03	34.8	-197.8	
		62.16	0.013	1.09E-03	34.8	-197.8	
13	23.43	65.16	0.012	1.18E-03	44.3	-191.8	-0.0
14	23.19	70.13	0.012	1.31E-03	60.9	-179.0	
15	22.69	75.67	0.011	1.55E-03	97.3	-140.1	
		28.55	0.011	1.55E-03	97.3	-140.1	
16	22.36	34.46	0.011	1.67E-03	107.7	-106.3	
		31.58	0.011	1.67E-03	107.7	-106.3	
17	22.00	38.19	0.010	1.76E-03	120.3	-65.5	
		-89.44	0.010	1.76E-03	120.3	-65.5	
18	21.86	-86.55	0.010	1.78E-03	108.0	-49.5	
19	21.43	-74.72	0.009	1.82E-03	73.3	-11.0	
20	21.00	-62.20	0.008	1.82E-03	43.9	13.6	
21	20.40	-44.05	0.007	1.78E-03	12.0	28.9	
22	19.80	-25.35	0.006	1.73E-03	-8.8	28.2	
23	19.20	-5.97	0.005	1.69E-03	-18.2	18.5	
24	18.60	14.95	0.004	1.67E-03	-15.5	6.5	
25	18.00	36.82	0.003	1.66E-03	0.0	0.0	

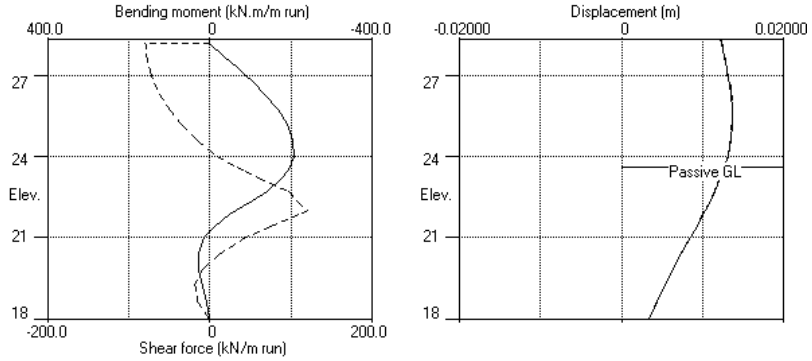
At elev. 28.15 Strut force = 80.6 kN/strut = 80.6 kN/m run
At elev. 23.43 The strut is slack

(continued)

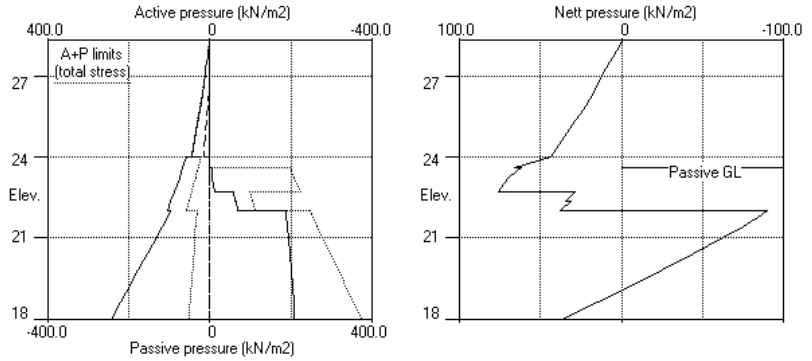
Stage No.8 Remove strut or anchor no.1 at elevation 27.70

Units: kN,m

Stage No.8 Remove strut no.1 at elev. 27.70



Stage No.8 Remove strut no.1 at elev. 27.70



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: Active side 20.00 from wall
Passive side 20.00 from wall

Limit State: ULS DA1 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 max. m	Displacement min. m	Bending moment Calculated max. kN.m/m	Bending moment Calculated min. kN.m/m	Bending moment Factored max. kN.m/m	Bending moment Factored min. kN.m/m	Shear force Calculated max. kN/m	Shear force Calculated min. kN/m	Shear force Factored max. kN/m	Shear force Factored min. kN/m
1	28.30	0.012	0.000	0	-0	0	-0	0	0	0	0
2	28.15	0.012	0.000	0	-0	0	-0	0	-92	0	-124
3	27.70	0.013	0.000	0	-41	0	-55	2	-90	2	-122
4	27.30	0.013	0.000	2	-77	2	-103	5	-87	6	-118
5	27.10	0.013	0.000	3	-94	4	-127	7	-85	9	-115
6	26.70	0.014	0.000	6	-126	8	-171	8	-79	10	-107
7	26.30	0.014	0.000	9	-156	12	-211	5	-73	6	-98
8	25.75	0.014	0.000	12	-190	16	-256	2	-61	3	-83
9	25.20	0.014	0.000	13	-214	17	-289	0	-46	1	-62
10	24.60	0.014	0.000	13	-227	18	-306	1	-26	1	-35
11	24.00	0.014	0.000	14	-223	19	-301	23	-2	30	-3
12	23.58	0.013	0.000	15	-207	21	-280	53	0	71	0
13	23.43	0.013	0.000	16	-202	22	-273	64	0	86	0
14	23.19	0.013	0.000	17	-192	23	-259	61	0	82	0
15	22.69	0.012	0.000	20	-163	27	-220	97	0	131	0
16	22.36	0.012	0.000	24	-134	32	-180	108	0	145	0
17	22.00	0.011	0.000	30	-99	41	-134	122	0	165	0
18	21.86	0.011	0.000	33	-86	45	-116	110	0	149	0
19	21.43	0.010	0.000	38	-51	52	-69	77	0	105	0
20	21.00	0.009	0.000	39	-24	52	-32	57	-4	77	-5
21	20.40	0.008	0.000	33	0	44	0	34	-13	46	-17
22	19.80	0.007	0.000	28	0	38	0	12	-17	16	-23
23	19.20	0.006	0.000	18	0	25	0	0	-18	0	-25
24	18.60	0.005	0.000	7	0	9	0	0	-16	0	-21
25	18.00	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 Calculated max. kN.m/m	elev.	Bending moment Calculated min. kN.m/m	elev.	Bending moment Factored max. kN.m/m	Bending moment Factored min. kN.m/m	Shear force Calculated max. kN/m	elev.	Shear force Calculated min. kN/m	elev.	Shear force Factored max. kN/m	Shear force Factored min. kN/m
1	11	21.00	-14	24.00	14	-19	16	22.00	-6	19.20	21	-8
2	39	21.00	-0	28.30	52	-0	23	22.00	-17	19.80	31	-23
3	No calculation at this stage											
4	21	19.80	-210	24.00	28	-284	122	22.00	-90	27.70	165	-121
5	No calculation at this stage											
6	25	19.80	-202	24.00	34	-273	118	22.00	-88	27.70	160	-119
7	No calculation at this stage											
8	29	20.40	-207	24.00	39	-279	120	22.00	-81	28.15	162	-109
9	No calculation at this stage											
10	No calculation at this stage											
11	No calculation at this stage											
12	No calculation at this stage											
13	15	19.20	-227	24.60	21	-306	96	22.36	-92	28.15	130	-124

Maximum and minimum displacement at each stage

Stage no.	maximum m	elev.	minimum m	elev.	Stage description
1	0.003	28.30	0.000	28.30	Apply surcharge no.1 at elev. 28.30
2	0.009	28.30	0.000	28.30	Excav. to elev. 27.10 on PASSIVE side
3	No calculation at this stage				Install strut no.1 at elev. 27.70
4	0.014	25.20	0.000	28.30	Excav. to elev. 22.69 on PASSIVE side
5	No calculation at this stage				Install strut no.2 at elev. 23.43
6	0.013	25.20	0.000	28.30	Fill to elev. 23.58 on PASSIVE side
7	No calculation at this stage				Install strut no.3 at elev. 28.15
8	0.014	25.20	0.000	28.30	Remove strut no.1 at elev. 27.70
9	No calculation at this stage				Change soil type 9 to soil type 1
10	No calculation at this stage				Apply water pressure profile no.1
11	No calculation at this stage				Change soil type 3 to soil type 4
12	No calculation at this stage				Change soil type 6 to soil type 7
13	0.014	25.20	0.000	28.30	Apply surcharge no.2 at elev. 22.36

Strut forces at each stage (horizontal components)

Stage no.	Strut no. 1 at elev. 27.70 Calculated kN per m run	Strut no. 1 Factored kN per strut	Strut no. 2 at elev. 23.43 Calculated kN per m run	Strut no. 2 Factored kN per strut	Strut no. 3 at elev. 28.15 Calculated kN per m run	Strut no. 3 Factored kN per strut
4	91	731	987	---	---	---	---	---	---
6	90	718	969	slack	slack	slack	---	---	---
8	---	---	---	slack	slack	slack	81	81	109
13	---	---	---	44	44	60	92	92	124

* Indicates that the total force shown is the sum of the force in the strut plus a force applied at the same elevation which may represent temperature load or other forces which are part of the strut load.
Force components are listed in the detailed results for individual stages.

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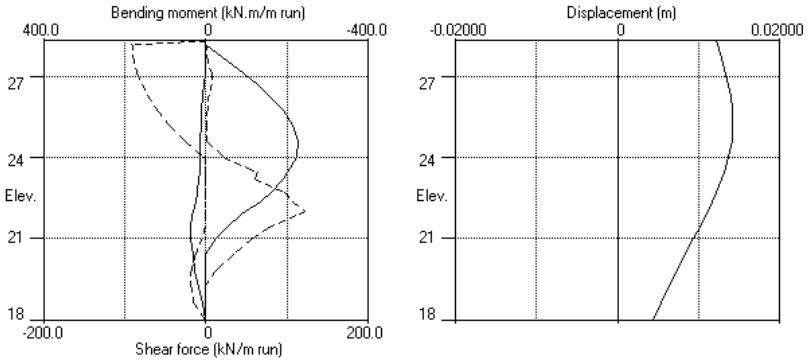
Camley Street | Date:10-12-2015
Section A2 | Checked :

Units: kN,m

Bending moment, shear force, displacement envelopes



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Data filename/Run ID: Section A2 Rev A2_ULS2 |
Camley Street | Date:10-12-2015
Section A2 | Checked :

Units: kN,m

INPUT DATA

SOIL PROFILE

Stratum no.	Elevation of top of stratum	Soil types Active side	Passive side
1	28.30	8 Made Ground Init	8 Made Ground Init
2	24.00	3 London Cly Top Undr	3 London Cly Top Undr
3	22.00	6 London Cly bt Undr	6 London Cly bt Undr

SOIL PROPERTIES (Unfactored SLS soil strengths)

No.	Soil type -- Description (Datum elev.)	Bulk density kN/m3	Young's Modulus Eh,kN/m2 (dEh/dy)	At rest coeff. Ko (dKo/dy)	Consol state. NC/OC (Nu)	Active limit Ka (Kac)	Passive limit Kp (Kpc)	Cohesion kN/m2 (dc/dy)
1	Made Ground	19.00	10000	0.577	OC (0.250)	0.390 (0.000)	2.561 (0.000)	
2	Gravels	19.00	30000	0.423	OC (0.300)	0.227 (0.000)	6.084 (0.000)	
3	London Cly Top Undr	19.00	20000	1.000	OC (0.490)	1.000 (2.000)	1.000 (2.000)	40.00u
4	London Cly Top dr	19.00	14000	1.000	OC (0.250)	0.422 (1.299)	2.371 (3.080)	3.000d
5	Concrete	24.00	200000	1.000	OC (0.490)	1.000 (2.000)	1.000 (2.000)	30000u
6	London Cl.. (24.00)	19.00	42500 (2589)	1.400	OC (0.490)	1.000 (2.476)	1.000 (2.390)	80.00u (5.180)
7	London Cl.. (24.00)	19.00	28000 (1813)	1.400	OC (0.250)	0.366 (1.423)	3.077 (4.665)	3.000d
8	Made Ground Init	19.00	10000	0.577	OC (0.250)	0.337 (0.000)	3.442 (0.000)	

Additional soil parameters associated with Ka and Kp

No.	Soil type ------- Description	--- parameters for Ka --- Soil friction angle	Wall adhesion coeff.	Back-fill angle	--- parameters for Kp --- Soil friction angle	Wall adhesion coeff.	Back-fill angle
1	Made Ground	26.00	0.000	0.00	26.00	0.000	0.00
2	Gravels	35.00	0.670	0.00	35.00	0.500	0.00
3	London Cly Top Undr	0.00	0.000	0.00	0.00	0.000	0.00
4	London Cly Top dr	24.00	0.000	0.00	24.00	0.000	0.00
5	Concrete	0.00	0.000	0.00	0.00	0.000	0.00
6	London Cly bt Undr	0.00	0.670	0.00	0.00	0.500	0.00
7	London Cly bt dr	24.00	0.670	0.00	24.00	0.500	0.00
8	Made Ground Init	26.00	0.670	0.00	26.00	0.500	0.00

GROUND WATER CONDITIONS

Density of water = 10.00 kN/m3

	Active side	Passive side
Initial water table elevation	26.30	21.86

Automatic water pressure balancing at toe of wall : Yes

Water press. profile no.	Active side Point no.	Elev. m	Piezo elev. m	Water press. kN/m2	Passive side Point no.	Elev. m	Piezo elev. m	Water press. kN/m2	
1	1	27.30	27.30	0.0	1	22.36	22.36	0.0	MC+WC
					2	22.36	27.30	49.4	

WALL PROPERTIES

Type of structure = Fully Embedded Wall
Elevation of toe of wall = 18.00
Maximum finite element length = 0.60 m
Youngs modulus of wall E = 1.9600E+07 kN/m2
Moment of inertia of wall I = 0.017260 m4/m run
E.I = 338296 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	27.70	8.00	0.010000	2.000E+08	10.00	0.00	0	No
2	23.43	1.00	0.300000	1.400E+07	10.00	0.00	0	No
3	28.15	1.00	0.300000	1.400E+07	10.00	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	28.30	0.50(A)	100.00	20.00	20.00	=	N/A	1.30 Var
2	22.36	-0.00(P)	30.00	20.00	50.00	=	N/A	1.00 P/U

Note: A = Active side, P = Passive 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 28.30
	No analysis at this stage
2	Excavate to elevation 27.10 on PASSIVE side
	Toe of berm at elevation 23.19
	Width of top of berm = 2.00
	Width of toe of berm = 5.91
3	Install strut or anchor no.1 at elevation 27.70
4	Excavate to elevation 22.69 on PASSIVE side
5	Install strut or anchor no.2 at elevation 23.43
6	Fill to elevation 23.58 on PASSIVE side with soil type 6
7	Install strut or anchor no.3 at elevation 28.15
8	Remove strut or anchor no.1 at elevation 27.70
9	Change properties of soil type 9 to soil type 1
	No analysis at this stage
	Ko pressures will not be reset
10	Apply water pressure profile no.1 (Worst Cred.)
	No analysis at this stage
11	Change properties of soil type 3 to soil type 4
	No analysis at this stage
	Ko pressures will not be reset
12	Change properties of soil type 6 to soil type 7
	No analysis at this stage
	Ko pressures will not be reset
13	Apply surcharge no.2 at elevation 22.36

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 Permanent Variable 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) = 0 m

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

Width of excavation on active side of wall = 20.00 m
Width of excavation on passive side of wall = 20.00 m

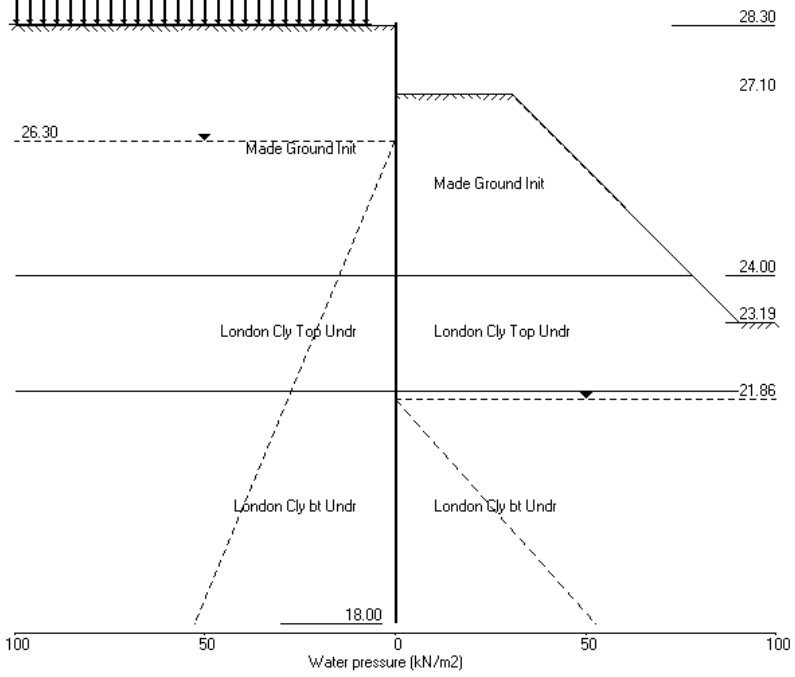
Distance to rigid boundary on active side = 20.00 m
Distance to rigid boundary on passive side = 20.00 m

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. 28.30	No	No	No
2	Excav. to elev. 27.10 on PASSIVE side	No	No	No
3	Install strut no.1 at elev. 27.70	No	No	No
4	Excav. to elev. 22.69 on PASSIVE side	No	No	No
5	Install strut no.2 at elev. 23.43	No	No	No
6	Fill to elev. 23.58 on PASSIVE side	No	No	No
7	Install strut no.3 at elev. 28.15	No	No	No
8	Remove strut no.1 at elev. 27.70	No	No	No
9	Change soil type 9 to soil type 1	No	No	No
10	Apply water pressure profile no.1	No	No	No
11	Change soil type 3 to soil type 4	No	No	No
12	Change soil type 6 to soil type 7	No	No	No
13	Apply surcharge no.2 at elev. 22.36	No	No	No
*	Summary output	Yes	-	Yes

Units: kN,m

Stage No.2 Excav. to elev. 27.10 on PASSIVE side



Units: kN,m

Stage No. 2 Excavate to elevation 27.10 on PASSIVE side
Toe of berm at elevation 23.19
Width of top of berm = 2.00
Width of toe of berm = 5.91

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

Stage No.	G.L. Act.	G.L. Pass.	Strut Elev.	Overall FoS for toe elev. = 18.00 Factor of Safety	Moment equilib. at elev.	Toe elev. for FoS = 1.000 Toe elev.	Wall Penetr-ation
2	28.30	27.10	Cant.	1.450	19.27	21.00	6.10

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: Active side 20.00 from wall
Passive 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
1	28.30	0.00	0.020	2.48E-03	0.0	-0.0	
2	28.15	1.28	0.020	2.48E-03	0.1	0.0	
3	27.70	7.28	0.019	2.48E-03	2.0	0.4	
4	27.30	12.59	0.018	2.48E-03	6.0	1.9	
5	27.10	14.92	0.017	2.48E-03	8.8	3.4	
6	26.70	-1.10	0.016	2.48E-03	11.5	7.7	
		2.17	0.016	2.48E-03	11.5	7.7	
7	26.30	-10.96	0.015	2.46E-03	9.8	12.2	
		6.02	0.015	2.46E-03	9.8	12.2	
8	25.75	1.36	0.014	2.44E-03	11.8	18.2	
		7.67	0.014	2.44E-03	11.8	18.2	
9	25.20	5.35	0.013	2.40E-03	15.4	25.7	
		9.89	0.013	2.40E-03	15.4	25.7	
10	24.60	8.64	0.011	2.35E-03	20.9	36.6	
		12.26	0.011	2.35E-03	20.9	36.6	
11	24.00	11.78	0.010	2.27E-03	28.1	51.3	
		-41.68	0.010	2.27E-03	28.1	51.3	
12	23.58	-33.00	0.009	2.20E-03	12.6	59.4	
13	23.43	-29.96	0.008	2.18E-03	7.9	60.9	
		3.95	0.008	2.18E-03	7.9	60.9	
14	23.19	8.27	0.008	2.13E-03	9.4	63.0	
		25.97	0.008	2.13E-03	9.4	63.0	
15	22.69	35.85	0.007	2.03E-03	24.9	71.2	
		31.63	0.007	2.03E-03	24.9	71.2	
16	22.36	37.80	0.006	1.96E-03	36.3	81.2	
		34.48	0.006	1.96E-03	36.3	81.2	
17	22.00	40.90	0.006	1.86E-03	49.9	96.5	
		-79.65	0.006	1.86E-03	49.9	96.5	

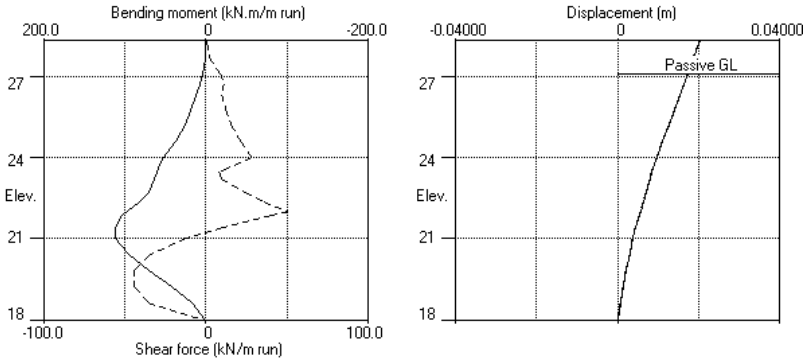
(continued)

Stage No.2 Excavate to elevation 27.10 on PASSIVE side
Toe of berm at elevation 23.19
Width of top of berm = 2.00
Width of toe of berm = 5.91

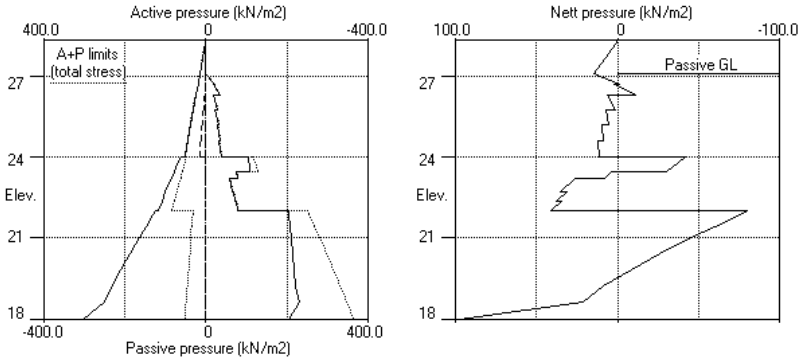
Node no.	Y coord	Nett pressure kN/m2	Wall disp. m	Wall rotation rad.	Shear force kN/m	Bending moment kN.m/m	Strut forces kN/m
18	21.86	-75.31	0.005	1.82E-03	39.0	102.7	
19	21.43	-60.01	0.005	1.68E-03	10.0	112.6	
20	21.00	-45.39	0.004	1.54E-03	-12.7	111.4	
21	20.40	-26.22	0.003	1.36E-03	-34.2	95.7	
22	19.80	-8.33	0.002	1.21E-03	-44.6	70.6	
23	19.20	8.73	0.002	1.11E-03	-44.4	42.4	
24	18.60	21.01	0.001	1.06E-03	-35.5	17.4	
25	18.00	97.37	0.000	1.04E-03	-0.0	0.0	

Units: kN,m

Stage No.2 Excav. to elev. 27.10 on PASSIVE side



Stage No.2 Excav. to elev. 27.10 on PASSIVE side



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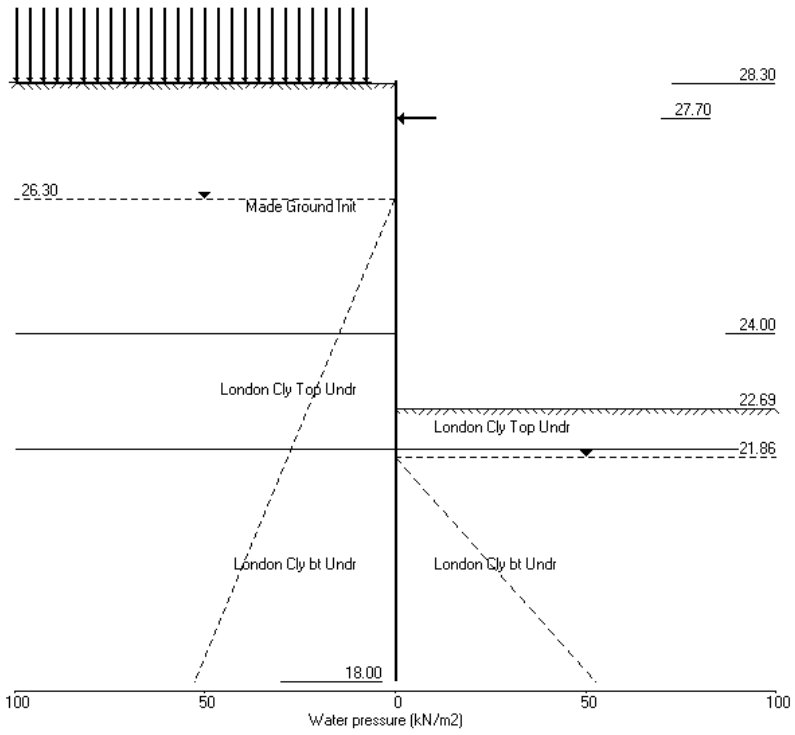
Camley Street | Date:10-12-2015
Section A2 | Checked :

Units: kN,m

Stage No.4 Excav. to elev. 22.69 on PASSIVE side



Units: kN,m

Stage No. 4 Excavate to elevation 22.69 on PASSIVE side

STABILITY ANALYSIS of Fully Embedded Wall according to Strength Factor method

Factor of safety on soil strength

Stage No.	--- G.L. --- Act.	Pass.	Strut Elev.	Overall FoS for toe elev. = 18.00 Factor of Safety	Moment equilib. at elev.	Toe elev. for FoS = 1.000 Toe elev.	Wall Penetration
4	28.30	22.69	27.70	2.112	n/a	21.27	1.42

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: Active side 20.00 from wall
Passive side 20.00 from wall

Limit State: ULS DA1 Combination 2

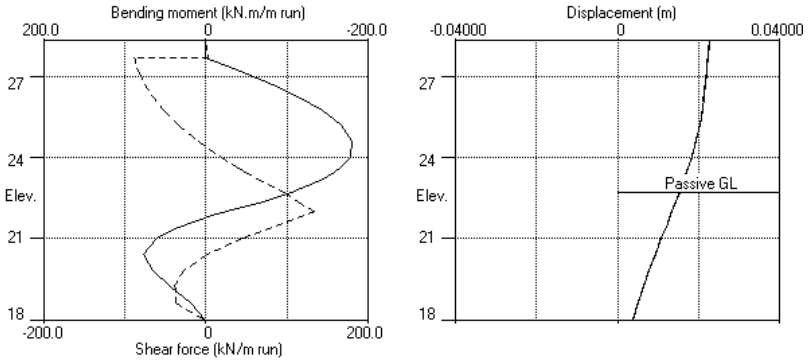
Node no.	Y coord	Nett pressure kN/m2	Wall disp. m	Wall rotation rad.	Shear force kN/m	Bending moment kN.m/m	Strut forces kN/m
1	28.30	0.00	0.023	6.31E-04	0.0	-0.0	
2	28.15	1.28	0.023	6.31E-04	0.1	0.0	
3	27.70	7.28	0.022	6.30E-04	2.0	0.4	90.6
		7.28	0.022	6.30E-04	-88.6	0.4	
4	27.30	12.59	0.022	6.50E-04	-84.6	-34.3	
5	27.10	14.92	0.022	6.76E-04	-81.9	-51.0	
6	26.70	19.14	0.022	7.55E-04	-75.1	-82.4	
7	26.30	22.99	0.021	8.69E-04	-66.6	-110.7	
8	25.75	29.99	0.021	1.07E-03	-52.1	-143.6	
9	25.20	36.77	0.020	1.32E-03	-33.7	-167.3	
10	24.60	44.03	0.019	1.63E-03	-9.5	-180.5	
11	24.00	51.18	0.018	1.95E-03	19.1	-177.9	
		46.63	0.018	1.95E-03	19.1	-177.9	
12	23.58	54.81	0.017	2.16E-03	40.1	-165.9	
13	23.43	57.76	0.017	2.23E-03	48.6	-159.3	
14	23.19	62.55	0.016	2.34E-03	63.3	-145.6	
15	22.69	75.78	0.015	2.53E-03	97.9	-104.8	
		40.58	0.015	2.53E-03	97.9	-104.8	
16	22.36	51.16	0.014	2.61E-03	113.1	-70.2	
17	22.00	62.94	0.013	2.66E-03	133.6	-26.0	
		-97.38	0.013	2.66E-03	133.6	-26.0	
18	21.86	-95.25	0.013	2.67E-03	120.1	-8.3	
19	21.43	-88.52	0.012	2.66E-03	80.6	34.3	
20	21.00	-81.68	0.011	2.60E-03	44.0	60.5	
21	20.40	-61.25	0.009	2.47E-03	1.1	76.3	
22	19.80	-33.91	0.008	2.35E-03	-27.4	66.1	
23	19.20	-6.55	0.006	2.25E-03	-39.6	43.6	
24	18.60	16.77	0.005	2.19E-03	-36.5	18.8	
25	18.00	104.87	0.004	2.18E-03	-0.0	-0.0	

At elev. 27.70 Strut force = 725.0 kN/strut = 90.6 kN/m run

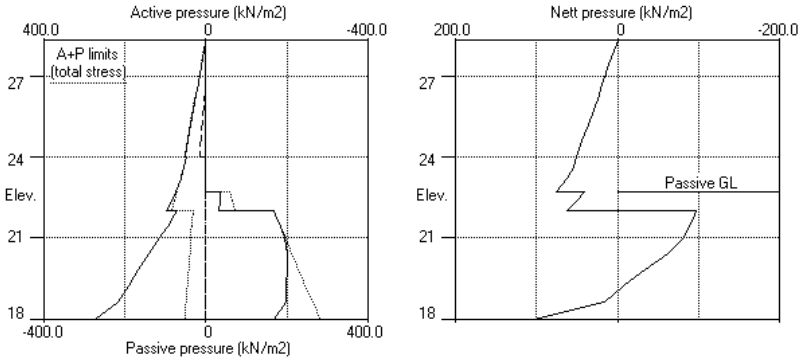
(continued)

Stage No.4 Excavate to elevation 22.69 on PASSIVE side

Stage No.4 Excav. to elev. 22.69 on PASSIVE side



Stage No.4 Excav. to elev. 22.69 on PASSIVE side



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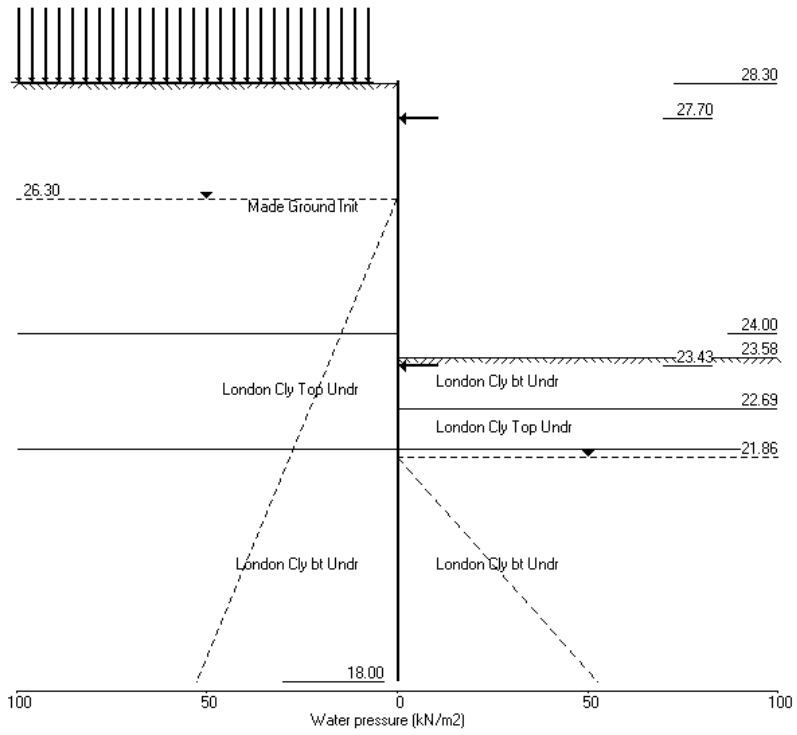
Units: kN,m

Stage No.6 Fill to elev. 23.58 on PASSIVE side



Units: kN,m

Stage No. 6 Fill to elevation 23.58 on PASSIVE side with soil type 6

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

Stage No.	--- G.L. --- Act.	Pass.	Strut Elev.	Overall FoS for toe elev. = 18.00 Factor of Safety	Moment equilib. at elev.	Toe elev. for FoS = 1.000 Toe elev.	Wall Penetr -ation
6	28.30	23.58		More than one strut			

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: Active side 20.00 from wall
Passive side 20.00 from wall
Limit State: ULS DA1 Combination 2

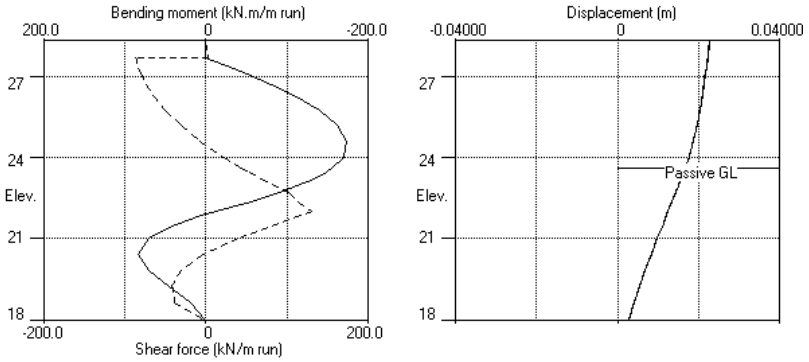
Node no.	Y coord	Nett pressure kN/m2	Wall disp. m	Wall rotation rad.	Shear force kN/m	Bending moment kN.m/m	Strut forces kN/m
1	28.30	0.00	0.023	8.13E-04	0.0	-0.0	
2	28.15	1.28	0.023	8.13E-04	0.1	0.0	
3	27.70	7.36	0.022	8.13E-04	2.0	0.4	89.0
		7.36	0.022	8.13E-04	-86.9	0.4	
4	27.30	12.76	0.022	8.32E-04	-82.9	-33.6	
5	27.10	15.13	0.022	8.57E-04	-80.1	-50.0	
6	26.70	19.44	0.021	9.34E-04	-73.2	-80.7	
7	26.30	23.37	0.021	1.04E-03	-64.6	-108.2	
8	25.75	30.48	0.020	1.24E-03	-49.8	-139.9	
9	25.20	37.38	0.020	1.49E-03	-31.2	-162.3	
10	24.60	44.74	0.019	1.79E-03	-6.5	-173.9	
11	24.00	52.01	0.018	2.09E-03	22.5	-169.3	
		48.82	0.018	2.09E-03	22.5	-169.3	
12	23.58	57.18	0.017	2.29E-03	44.5	-155.8	
13	23.43	59.43	0.016	2.36E-03	53.2	-148.5	-0.0
14	23.19	63.09	0.016	2.46E-03	68.3	-133.6	
15	22.69	69.16	0.014	2.63E-03	101.3	-90.9	
		29.99	0.014	2.63E-03	101.3	-90.9	
16	22.36	40.77	0.013	2.70E-03	113.0	-55.7	
17	22.00	52.73	0.013	2.73E-03	129.8	-12.2	
		-99.10	0.013	2.73E-03	129.8	-12.2	
18	21.86	-96.70	0.012	2.74E-03	116.1	5.0	
19	21.43	-89.25	0.011	2.70E-03	76.1	45.7	
20	21.00	-81.78	0.010	2.63E-03	39.4	69.9	
21	20.40	-60.59	0.008	2.49E-03	-3.3	82.9	
22	19.80	-32.59	0.007	2.36E-03	-31.3	70.1	
23	19.20	-4.66	0.005	2.26E-03	-42.5	45.5	
24	18.60	19.20	0.004	2.20E-03	-38.1	19.3	
25	18.00	107.83	0.003	2.18E-03	-0.0	-0.0	

At elev. 27.70 Strut force = 711.6 kN/strut = 89.0 kN/m run
At elev. 23.43 The strut is slack

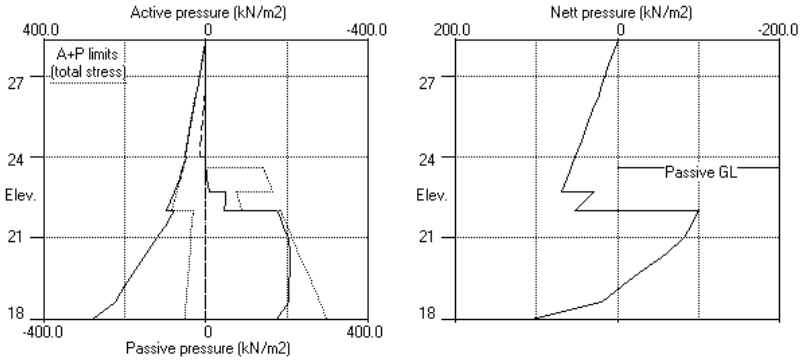
(continued)

Stage No.6 Fill to elevation 23.58 on PASSIVE side with soil type 6

Stage No.6 Fill to elev. 23.58 on PASSIVE side



Stage No.6 Fill to elev. 23.58 on PASSIVE side



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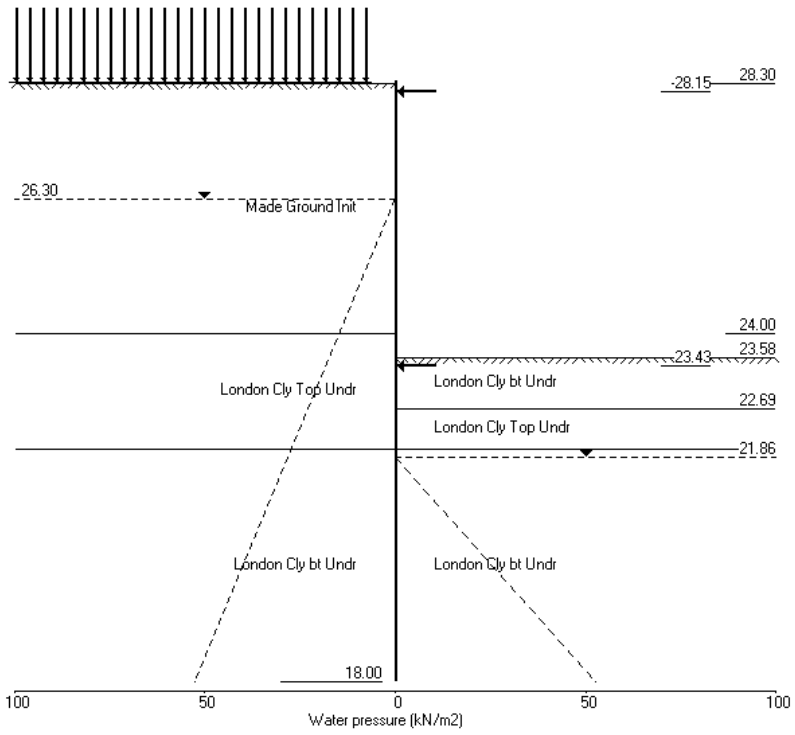
Units: kN,m

Stage No.8 Remove strut no.1 at elev. 27.70



Units: kN,m

Stage No. 8 Remove strut or anchor no.1 at elevation 27.70

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

Stage No.	--- G.L. --- Act.	Pass.	Strut Elev.	Overall FoS for toe elev. = 18.00 Factor of Safety	Moment equilib. at elev.	Toe elev. for FoS = 1.000 Toe elev.	Wall Penetr -ation
8	28.30	23.58		More than one strut			

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: Active side 20.00 from wall
Passive 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
1	28.30	0.00	0.023	6.46E-04	0.0	-0.0	
2	28.15	1.28	0.023	6.46E-04	0.1	0.0	79.9
		1.28	0.023	6.46E-04	-79.8	0.0	
3	27.70	7.28	0.023	6.70E-04	-77.9	-35.6	
4	27.30	12.59	0.022	7.30E-04	-73.9	-66.0	
5	27.10	14.92	0.022	7.73E-04	-71.2	-80.5	
6	26.70	19.14	0.022	8.84E-04	-64.4	-107.7	
7	26.30	22.99	0.021	1.02E-03	-55.9	-131.7	
8	25.75	29.99	0.021	1.26E-03	-41.4	-158.7	
9	25.20	36.89	0.020	1.53E-03	-23.0	-176.5	
10	24.60	44.29	0.019	1.85E-03	1.4	-183.3	
11	24.00	51.61	0.018	2.17E-03	30.2	-174.1	
		47.79	0.018	2.17E-03	30.2	-174.1	
12	23.58	56.26	0.017	2.37E-03	51.7	-157.4	
		52.12	0.017	2.37E-03	51.7	-157.4	
13	23.43	54.57	0.016	2.44E-03	59.7	-149.1	-0.0
14	23.19	58.58	0.016	2.54E-03	73.6	-132.8	
15	22.69	65.35	0.015	2.70E-03	104.6	-87.9	
		27.96	0.015	2.70E-03	104.6	-87.9	
16	22.36	39.02	0.014	2.77E-03	115.6	-51.8	
17	22.00	51.26	0.013	2.80E-03	131.9	-7.5	
		-102.61	0.013	2.80E-03	131.9	-7.5	
18	21.86	-99.99	0.012	2.80E-03	117.7	10.0	
19	21.43	-91.86	0.011	2.76E-03	76.5	51.1	
20	21.00	-83.77	0.010	2.68E-03	38.7	75.2	
21	20.40	-61.80	0.008	2.54E-03	-5.0	87.4	
22	19.80	-33.12	0.007	2.40E-03	-33.5	73.4	
23	19.20	-4.39	0.005	2.29E-03	-44.7	47.5	
24	18.60	21.06	0.004	2.23E-03	-39.7	19.9	
25	18.00	111.30	0.003	2.21E-03	0.0	-0.0	

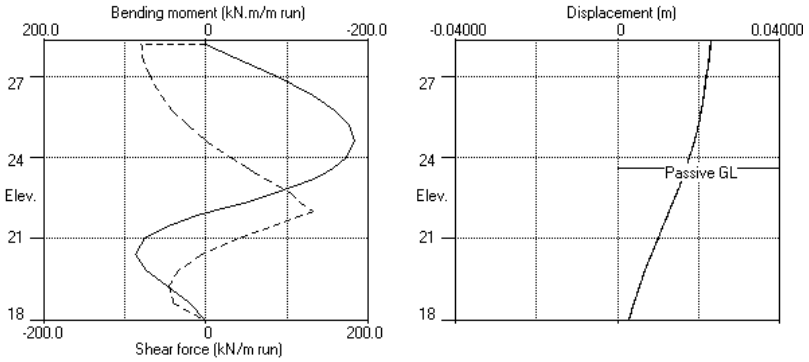
At elev. 28.15 Strut force = 79.9 kN/strut = 79.9 kN/m run
At elev. 23.43 The strut is slack

(continued)

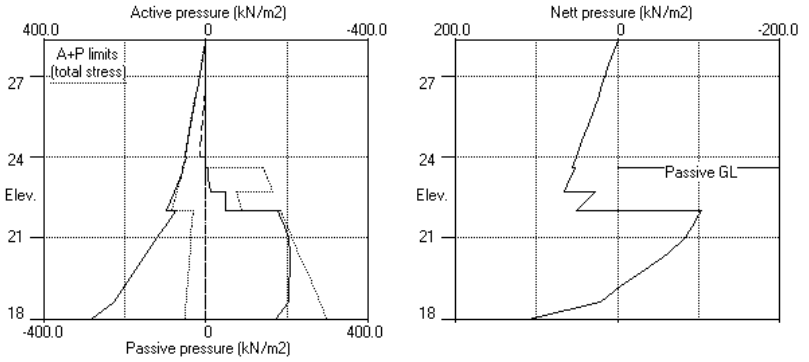
Stage No.8 Remove strut or anchor no.1 at elevation 27.70

Units: kN,m

Stage No.8 Remove strut no.1 at elev. 27.70



Stage No.8 Remove strut no.1 at elev. 27.70



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Section A2 | 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 Permanent Variable loads = 1.300

STABILITY ANALYSIS of Fully Embedded Wall according to Strength Factor method

Factor of safety on soil strength

Stage No.	G.L. Act.	G.L. Pass.	Strut Elev.	Overall FoS for toe elev. = 18.00 Factor of Safety	Moment equilib. at elev.	Toe elev. for FoS = 1.000 Toe elev.	Wall Penetration
1	28.30	28.30	Cant.	Conditions not suitable for FoS calc.			
2	28.30	27.10	Cant.	1.450	19.27	21.00	6.10
3	28.30	27.10		No analysis at this stage			
4	28.30	22.69	27.70	2.112	n/a	21.27	1.42
5	28.30	22.69		No analysis at this stage			

All remaining stages have more than one strut - FoS calculation n/a

Units: kN,m

Summary of results

BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall

Analysis options

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

Rigid boundaries: Active side 20.00 from wall
Passive side 20.00 from wall

Limit State: ULS DA1 Combination 2

Bending moment, shear force and displacement envelopes

Node no.	Y coord	Displacement maximum	Displacement minimum	Bending moment maximum	Bending moment minimum	Shear force maximum	Shear force minimum
		m	m	kN.m/m	kN.m/m	kN/m	kN/m
1	28.30	0.023	0.000	0.0	-0.0	0.0	0.0
2	28.15	0.023	0.000	0.0	-0.0	0.1	-79.8
3	27.70	0.023	0.000	0.4	-35.6	2.0	-88.6
4	27.30	0.022	0.000	1.9	-66.0	6.0	-84.6
5	27.10	0.022	0.000	3.4	-80.5	8.8	-81.9
6	26.70	0.022	0.000	7.7	-107.7	11.5	-75.1
7	26.30	0.022	0.000	12.2	-131.7	9.8	-66.6
8	25.75	0.021	0.000	18.2	-158.7	11.8	-52.1
9	25.20	0.020	0.000	25.7	-176.5	15.4	-33.7
10	24.60	0.019	0.000	36.6	-183.3	25.1	-9.5
11	24.00	0.018	0.000	51.3	-177.9	60.3	0.0
12	23.58	0.018	0.000	59.4	-165.9	88.5	0.0
13	23.43	0.017	0.000	60.9	-159.3	98.1	-7.9
14	23.19	0.017	0.000	63.0	-145.6	73.6	0.0
15	22.69	0.016	0.000	71.2	-104.8	104.6	0.0
16	22.36	0.015	0.000	81.2	-70.2	115.6	0.0
17	22.00	0.014	0.000	96.5	-26.0	133.6	0.0
18	21.86	0.014	0.000	102.7	-13.2	120.1	0.0
19	21.43	0.013	0.000	112.6	0.0	80.6	0.0
20	21.00	0.012	0.000	111.4	0.0	44.0	-12.7
21	20.40	0.011	0.000	95.7	0.0	6.8	-34.2
22	19.80	0.009	0.000	73.4	0.0	0.0	-44.6
23	19.20	0.008	0.000	47.5	0.0	0.0	-44.7
24	18.60	0.007	0.000	19.9	0.0	0.0	-39.7
25	18.00	0.006	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 maximum	elev.	minimum	elev.	Shear force maximum	elev.	minimum	elev.
	kN.m/m		kN.m/m		kN/m		kN/m	
1	12.0	21.00	-14.2	24.00	17.1	22.00	-6.3	19.20
2	112.6	21.43	-0.0	28.30	49.9	22.00	-44.6	19.80
3	No calculation at this stage							
4	76.3	20.40	-180.5	24.60	133.6	22.00	-88.6	27.70
5	No calculation at this stage							
6	82.9	20.40	-173.9	24.60	129.8	22.00	-86.9	27.70
7	No calculation at this stage							
8	87.4	20.40	-183.3	24.60	131.9	22.00	-79.8	28.15
9	No calculation at this stage							
10	No calculation at this stage							
11	No calculation at this stage							
12	No calculation at this stage							
13	30.9	20.40	-148.8	25.20	98.1	23.43	-73.5	28.15

Maximum and minimum displacement at each stage

Stage no.	Displacement maximum	elev.	minimum	elev.	Stage description
	m		m		
1	0.003	28.30	0.000	28.30	Apply surcharge no.1 at elev. 28.30
2	0.020	28.30	0.000	28.30	Excav. to elev. 27.10 on PASSIVE side
3	No calculation at this stage				Install strut no.1 at elev. 27.70
4	0.023	28.30	0.000	28.30	Excav. to elev. 22.69 on PASSIVE side
5	No calculation at this stage				Install strut no.2 at elev. 23.43
6	0.023	28.30	0.000	28.30	Fill to elev. 23.58 on PASSIVE side
7	No calculation at this stage				Install strut no.3 at elev. 28.15
8	0.023	28.30	0.000	28.30	Remove strut no.1 at elev. 27.70
9	No calculation at this stage				Change soil type 9 to soil type 1
10	No calculation at this stage				Apply water pressure profile no.1
11	No calculation at this stage				Change soil type 3 to soil type 4
12	No calculation at this stage				Change soil type 6 to soil type 7
13	0.023	28.30	0.000	28.30	Apply surcharge no.2 at elev. 22.36

Strut forces at each stage (horizontal components)

Stage no.	Strut no. 1 at elev. 27.70 kN/m run	Strut no. 1 kN/strut	Strut no. 2 at elev. 23.43 kN/m run	Strut no. 2 kN/strut	Strut no. 3 at elev. 28.15 kN/m run	Strut no. 3 kN/strut
4	90.62	724.97	---	---	---	---
6	88.96	711.64	slack	slack	---	---
8	---	---	slack	slack	79.92	79.92
13	---	---	105.99	105.99	73.60	73.60

* Indicates that the total force shown is the sum of the force in the strut plus a force applied at the same elevation which may represent temperature load or other forces which are part of the strut load. Force components are listed in the detailed results for individual stages.

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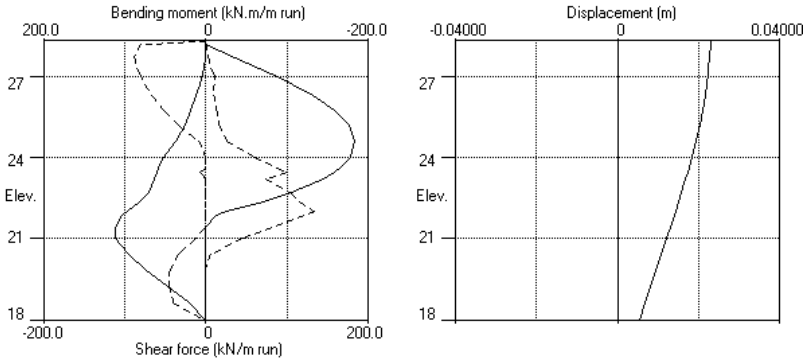
Section A2 | Checked :

Units: kN,m

Bending moment, shear force, displacement envelopes



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Data filename/Run ID: Section B1 Rev A_ULS1 |
Camley Street | Date: 8-12-2015
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Units: kN,m

INPUT DATA

SOIL PROFILE

Stratum no.	Elevation of top of stratum	Soil types Active side	Passive side
1	28.30	8 Made Ground Init	8 Made Ground Init
2	24.00	3 London Cly Top Undr	3 London Cly Top Undr
3	22.00	6 London Cly bt Undr	6 London Cly bt Undr

SOIL PROPERTIES (Unfactored SLS soil strengths)

No.	Soil type -- Description (Datum elev.)	Bulk density kN/m3	Young's Modulus Eh,kN/m2 (dEh/dy)	At rest coeff. Ko (dKo/dy)	Consol state. NC/OC (Nu)	Active limit Ka (Kac)	Passive limit Kp (Kpc)	Cohesion kN/m2 (dc/dy)
1	Made Ground	19.00	10000	0.577	OC (0.250)	0.390 (0.000)	2.561 (0.000)	
2	Gravels	19.00	30000	0.423	OC (0.300)	0.227 (0.000)	6.084 (0.000)	
3	London Cly Top Undr	19.00	20000	1.000	OC (0.490)	1.000 (2.000)	1.000 (2.000)	40.00u
4	London Cly Top dr	19.00	14000	1.000	OC (0.250)	0.422 (1.299)	2.371 (3.080)	3.000d
5	Concrete	24.00	200000	1.000	OC (0.490)	1.000 (2.000)	1.000 (2.000)	30000u
6	London Cl.. (24.00)	19.00	42500 (2589)	1.400	OC (0.490)	1.000 (2.476)	1.000 (2.390)	80.00u (5.180)
7	London Cl.. (24.00)	19.00	28000 (1813)	1.400	OC (0.250)	0.366 (1.423)	3.077 (4.665)	3.000d
8	Made Ground Init	19.00	10000	0.577	OC (0.250)	0.337 (0.000)	3.442 (0.000)	

Additional soil parameters associated with Ka and Kp

No.	Soil type ------- Description	--- parameters for Ka --- Soil friction angle	Wall adhesion coeff.	Back-fill angle	--- parameters for Kp --- Soil friction angle	Wall adhesion coeff.	Back-fill angle
1	Made Ground	26.00	0.000	0.00	26.00	0.000	0.00
2	Gravels	35.00	0.670	0.00	35.00	0.500	0.00
3	London Cly Top Undr	0.00	0.000	0.00	0.00	0.000	0.00
4	London Cly Top dr	24.00	0.000	0.00	24.00	0.000	0.00
5	Concrete	0.00	0.000	0.00	0.00	0.000	0.00
6	London Cly bt Undr	0.00	0.670	0.00	0.00	0.500	0.00
7	London Cly bt dr	24.00	0.670	0.00	24.00	0.500	0.00
8	Made Ground Init	26.00	0.670	0.00	26.00	0.500	0.00

GROUND WATER CONDITIONS

Density of water = 10.00 kN/m3

	Active side	Passive side
Initial water table elevation	26.30	21.21

Automatic water pressure balancing at toe of wall : Yes

Water press. profile no.	Point no.	Active side Elev. m	Piezo elev. m	Water press. kN/m2	Point no.	Passive side Elev. m	Piezo elev. m	Water press. kN/m2	
1	1	27.30	27.30	0.0	1	22.36	22.36	0.0	MC+WC
					2	22.36	27.30	49.4	

WALL PROPERTIES

Type of structure = Fully Embedded Wall
Elevation of toe of wall = 18.00
Maximum finite element length = 0.60 m
Youngs modulus of wall E = 1.9600E+07 kN/m2
Moment of inertia of wall I = 0.017260 m4/m run
E.I = 338296 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	27.70	8.00	0.010000	2.000E+08	10.00	0.00	0	No
2	22.73	1.00	0.300000	1.400E+07	10.00	0.00	0	No
3	28.15	1.00	0.300000	1.400E+07	10.00	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	28.30	0.50(A)	100.00	20.00	20.00	=	N/A	1.10 Var
2	22.36	-0.00(P)	30.00	20.00	50.00	=	N/A	1.00 P/U

Note: A = Active side, P = Passive 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 28.30
	No analysis at this stage
2	Excavate to elevation 27.10 on PASSIVE side
	Toe of berm at elevation 22.48
	Width of top of berm = 2.00
	Width of toe of berm = 6.62
3	Install strut or anchor no.1 at elevation 27.70
4	Excavate to elevation 21.21 on PASSIVE side
5	Install strut or anchor no.2 at elevation 22.73
6	Fill to elevation 23.01 on PASSIVE side with soil type 6
7	Install strut or anchor no.3 at elevation 28.15
8	Remove strut or anchor no.1 at elevation 27.70
9	Change properties of soil type 9 to soil type 1
	No analysis at this stage
	Ko pressures will not be reset
10	Apply water pressure profile no.1 (Mod. Conserv.)
	No analysis at this stage
11	Change properties of soil type 3 to soil type 4
	No analysis at this stage
	Ko pressures will not be reset
12	Change properties of soil type 6 to soil type 7
	No analysis at this stage
	Ko pressures will not be reset
13	Apply surcharge no.2 at elevation 22.36

FACTORS OF SAFETY and ANALYSIS OPTIONS

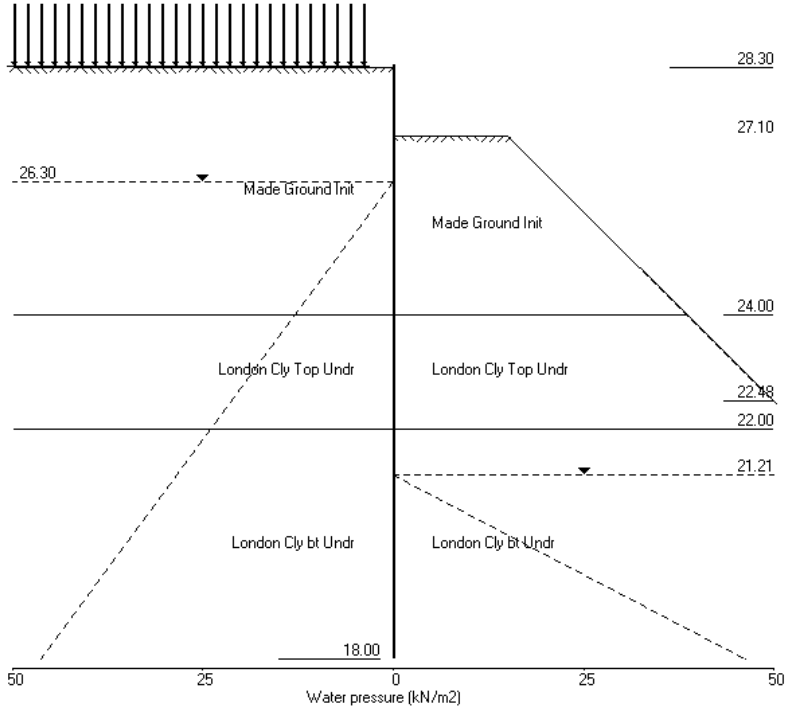
```
   Limit State options: ULS DA1 Combination 1
      Water pressures : Moderately Conservative
      Partial factor on   C'         = 1.000
      Partial factor on Phi'         = 1.000
      Partial factor on   Cu         = 1.000
      Partial factor on Soil Modulus = 1.000
      Partial factor on Permanent Unfavourable loads = 1.000
      Partial factor on Permanent Favourable loads   = 1.000
      Partial factor on Permanent Variable 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) = 0 m

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

      Width of excavation on active  side of wall  = 20.00 m
      Width of excavation on passive side of wall  = 20.00 m

      Distance to rigid boundary on active side  = 20.00 m
      Distance to rigid boundary on passive 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. 28.30	No	No	No
2	Excav. to elev. 27.10 on PASSIVE side	No	No	No
3	Install strut no.1 at elev. 27.70	No	No	No
4	Excav. to elev. 21.21 on PASSIVE side	No	No	No
5	Install strut no.2 at elev. 22.73	No	No	No
6	Fill to elev. 23.01 on PASSIVE side	No	No	No
7	Install strut no.3 at elev. 28.15	No	No	No
8	Remove strut no.1 at elev. 27.70	No	No	No
9	Change soil type 9 to soil type 1	No	No	No
10	Apply water pressure profile no.1	No	No	No
11	Change soil type 3 to soil type 4	No	No	No
12	Change soil type 6 to soil type 7	No	No	No
13	Apply surcharge no.2 at elev. 22.36	No	No	No
*	Summary output	Yes	-	Yes

Units: kN,m

Stage No.2 Excav. to elev. 27.10 on PASSIVE side



Units: kN,m

Stage No. 2 Excavate to elevation 27.10 on PASSIVE side
Toe of berm at elevation 22.48
Width of top of berm = 2.00
Width of toe of berm = 6.62

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: Active side 20.00 from wall
Passive 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.

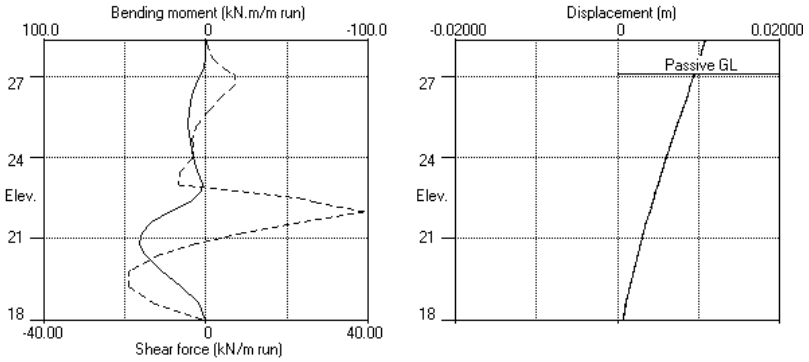
Node no.	Y coord	Nett pressure kN/m2	Wall disp. m	Wall rotation rad.	Shear force kN/m	Bending moment kN.m/m	Strut forces kN/m
1	28.30	0.00	0.011	1.14E-03	0.0	-0.0	
2	28.15	1.04	0.011	1.14E-03	0.1	0.0	
3	27.70	5.65	0.010	1.14E-03	1.6	0.3	
4	27.30	9.73	0.010	1.14E-03	4.7	1.6	
5	27.10	11.55	0.010	1.14E-03	6.8	2.7	
6	26.70	-9.29	0.009	1.13E-03	7.2	6.1	
		-6.07	0.009	1.13E-03	7.2	6.1	
7	26.30	-9.88	0.009	1.12E-03	4.0	8.7	
		-3.28	0.009	1.12E-03	4.0	8.7	
8	25.75	-8.89	0.008	1.11E-03	0.7	10.6	
		-3.98	0.008	1.11E-03	0.7	10.6	
9	25.20	-6.35	0.007	1.09E-03	-2.1	11.1	
		-2.09	0.007	1.09E-03	-2.1	11.1	
10	24.60	-2.67	0.007	1.07E-03	-3.6	9.8	
		1.02	0.007	1.07E-03	-3.6	9.8	
11	24.00	0.90	0.006	1.06E-03	-3.0	8.2	
		-8.25	0.006	1.06E-03	-3.0	8.2	
12	23.51	-3.74	0.006	1.05E-03	-6.0	5.7	
13	23.01	0.64	0.005	1.04E-03	-6.7	2.3	
		55.30	0.005	1.04E-03	-6.7	2.3	
14	22.73	60.28	0.005	1.04E-03	9.2	2.6	
		53.62	0.005	1.04E-03	9.2	2.6	
15	22.48	57.94	0.004	1.04E-03	23.1	6.6	
		31.28	0.004	1.04E-03	23.1	6.6	
16	22.36	33.06	0.004	1.03E-03	27.1	9.7	
		30.70	0.004	1.03E-03	27.1	9.7	
17	22.00	35.69	0.004	1.02E-03	39.1	21.6	
		-43.48	0.004	1.02E-03	39.1	21.6	
18	21.61	-38.16	0.004	9.88E-04	23.0	33.6	
19	21.21	-32.84	0.003	9.46E-04	8.9	39.6	
20	20.81	-25.12	0.003	8.98E-04	-2.8	40.6	
21	20.40	-17.51	0.002	8.51E-04	-11.4	37.4	
22	19.80	-6.41	0.002	7.93E-04	-18.6	27.6	
23	19.20	4.64	0.002	7.55E-04	-19.1	15.4	
24	18.60	15.86	0.001	7.37E-04	-13.0	4.8	
25	18.00	27.46	0.001	7.33E-04	-0.0	0.0	

(continued)

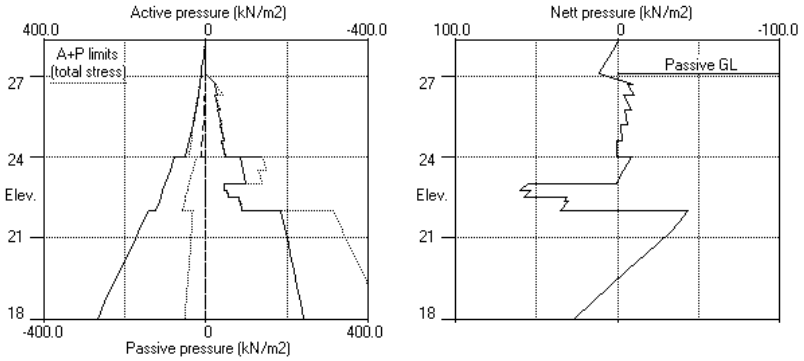
Stage No.2 Excavate to elevation 27.10 on PASSIVE side
Toe of berm at elevation 22.48
Width of top of berm = 2.00
Width of toe of berm = 6.62

Units: kN,m

Stage No.2 Excav. to elev. 27.10 on PASSIVE side



Stage No.2 Excav. to elev. 27.10 on PASSIVE side



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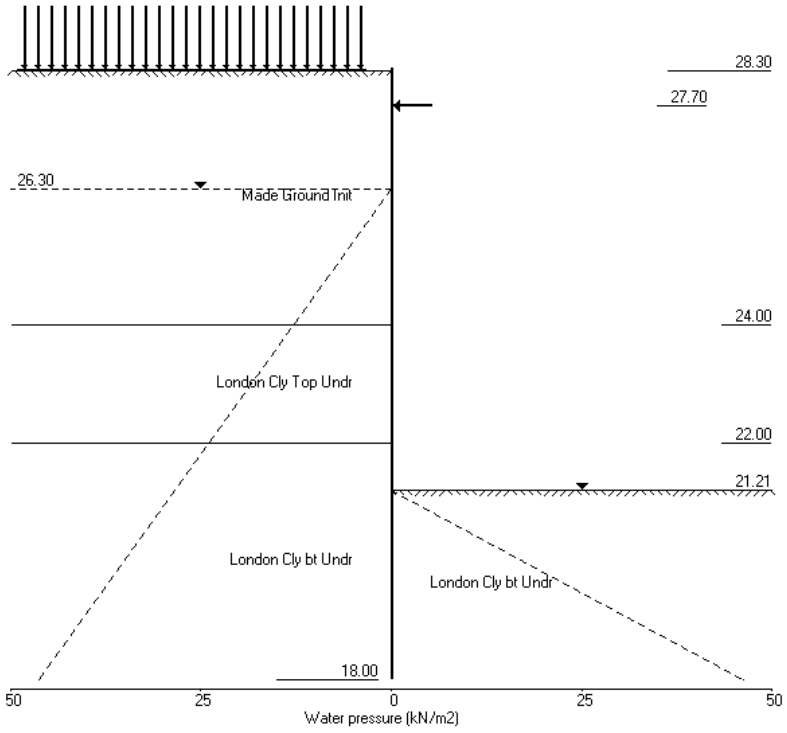
Stage No.4 Excav. to elev. 21.21 on PASSIVE side



Units: kN,m

Stage No. 4 Excavate to elevation 21.21 on PASSIVE 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: Active side 20.00 from wall
Passive 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/m2	Wall disp. m	Wall rotation rad.	Shear force kN/m	Bending moment kN.m/m	Strut forces kN/m
1	28.30	0.00	0.014	-1.41E-03	0.0	-0.0	
2	28.15	1.04	0.014	-1.41E-03	0.1	0.0	
3	27.70	5.65	0.015	-1.41E-03	1.6	0.3	112.6
		5.65	0.015	-1.41E-03	-111.0	0.3	
4	27.30	9.73	0.015	-1.38E-03	-107.9	-43.4	
5	27.10	11.55	0.016	-1.35E-03	-105.8	-64.8	
6	26.70	14.87	0.016	-1.25E-03	-100.5	-105.8	
7	26.30	17.93	0.017	-1.10E-03	-93.9	-144.5	
8	25.75	23.94	0.017	-8.34E-04	-82.4	-192.7	
9	25.20	29.80	0.017	-4.88E-04	-67.7	-233.2	
10	24.60	36.09	0.018	-4.45E-05	-47.9	-267.7	
11	24.00	42.31	0.017	4.49E-04	-24.4	-289.2	
		42.22	0.017	4.49E-04	-24.4	-289.2	
12	23.51	53.40	0.017	8.77E-04	-0.7	-295.8	
13	23.01	65.13	0.017	1.30E-03	28.6	-289.3	
14	22.73	71.89	0.016	1.53E-03	47.5	-278.9	
15	22.48	78.18	0.016	1.73E-03	66.2	-264.7	
16	22.36	81.38	0.016	1.83E-03	76.2	-255.8	
17	22.00	90.76	0.015	2.08E-03	107.2	-223.0	
		63.03	0.015	2.08E-03	107.2	-223.0	
18	21.61	77.52	0.014	2.32E-03	134.9	-175.6	
19	21.21	92.85	0.013	2.49E-03	168.6	-116.0	
		-132.34	0.013	2.49E-03	168.6	-116.0	
20	20.81	-114.80	0.012	2.59E-03	118.5	-58.6	
21	20.40	-95.70	0.011	2.64E-03	75.9	-19.9	
22	19.80	-65.30	0.009	2.65E-03	27.6	8.5	
23	19.20	-32.97	0.008	2.63E-03	-1.9	13.5	
24	18.60	1.09	0.006	2.61E-03	-11.4	6.5	
25	18.00	36.98	0.005	2.60E-03	-0.0	0.0	

At elev. 27.70 Strut force = 900.6 kN/strut = 112.6 kN/m run

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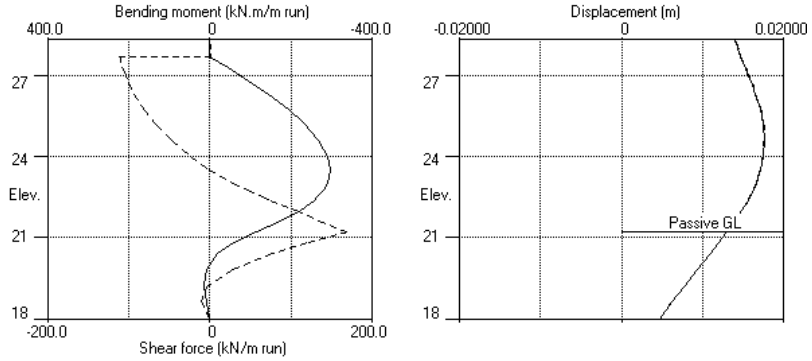
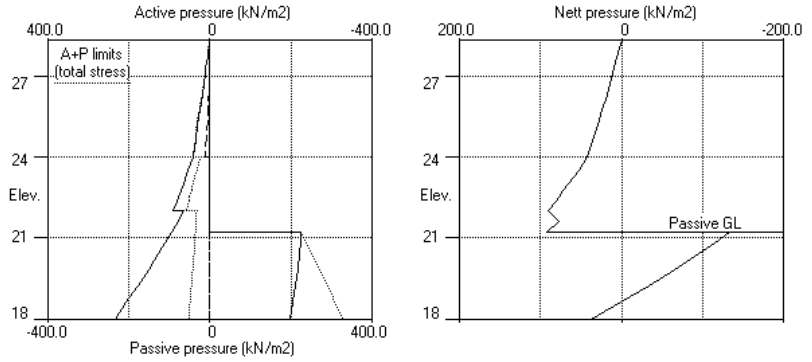
Stage No.4 Excav. to elev. 21.21 on PASSIVE side

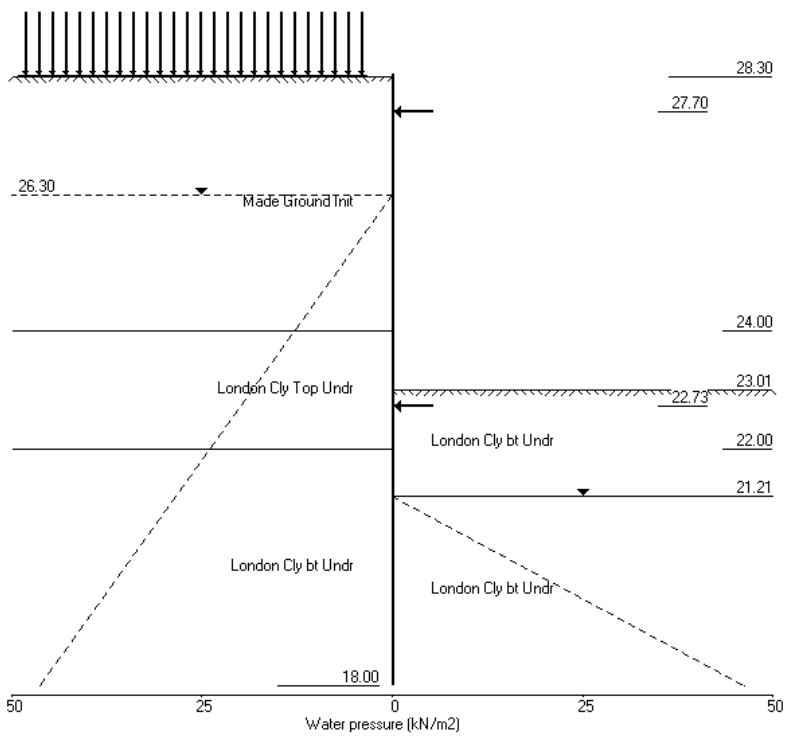


Stage No.4 Excav. to elev. 21.21 on PASSIVE side



Units: kN,m

Stage No.6 Fill to elev. 23.01 on PASSIVE side



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Units: kN,m

Stage No. 6 Fill to elevation 23.01 on PASSIVE side with soil type 6

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: Active side 20.00 from wall
Passive side 20.00 from wall

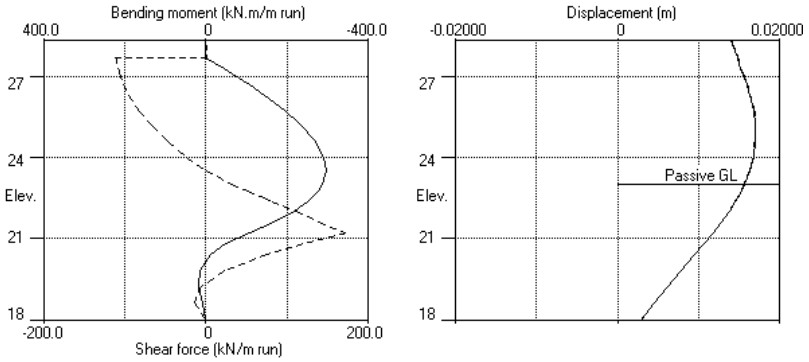
Limit State: ULS DA1 Combination 1

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.

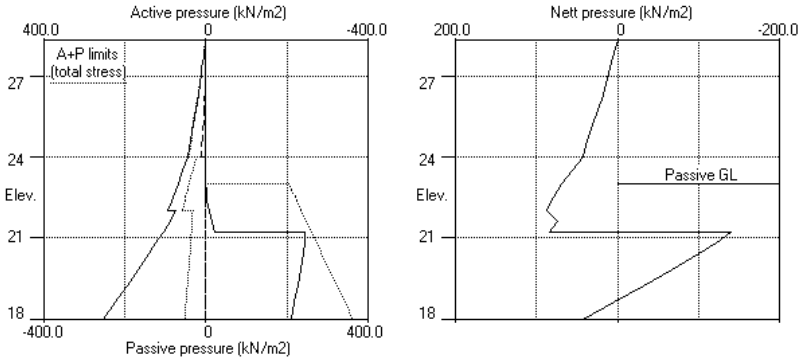
Node no.	Y coord	Nett pressure kN/m2	Wall disp. m	Wall rotation rad.	Shear force kN/m	Bending moment kN.m/m	Strut forces kN/m
1	28.30	0.00	0.014	-1.21E-03	0.0	-0.0	
2	28.15	1.04	0.014	-1.21E-03	0.1	0.0	
3	27.70	5.65	0.015	-1.21E-03	1.6	0.3	113.5
		5.65	0.015	-1.21E-03	-111.9	0.3	
4	27.30	9.79	0.015	-1.18E-03	-108.8	-43.8	
5	27.10	11.67	0.015	-1.15E-03	-106.7	-65.4	
6	26.70	15.10	0.016	-1.05E-03	-101.3	-106.7	
7	26.30	18.28	0.016	-9.04E-04	-94.7	-145.7	
8	25.75	24.45	0.017	-6.28E-04	-82.9	-194.2	
9	25.20	30.47	0.017	-2.79E-04	-67.8	-235.0	
10	24.60	36.94	0.017	1.68E-04	-47.6	-269.4	
11	24.00	43.34	0.017	6.64E-04	-23.5	-290.6	
		44.95	0.017	6.64E-04	-23.5	-290.6	
12	23.51	56.52	0.016	1.09E-03	1.6	-296.4	
13	23.01	68.66	0.016	1.52E-03	32.6	-288.4	
14	22.73	74.27	0.015	1.75E-03	52.3	-276.8	-0.0
15	22.48	79.51	0.015	1.95E-03	71.5	-261.3	
16	22.36	82.18	0.015	2.04E-03	81.6	-251.8	
17	22.00	87.18	0.014	2.29E-03	112.1	-217.3	
		65.44	0.014	2.29E-03	112.1	-217.3	
18	21.61	74.63	0.013	2.51E-03	139.7	-167.9	
19	21.21	84.66	0.012	2.68E-03	171.2	-106.9	
		-140.53	0.012	2.68E-03	171.2	-106.9	
20	20.81	-121.07	0.011	2.77E-03	118.2	-49.1	
21	20.40	-100.08	0.010	2.80E-03	73.4	-11.1	
22	19.80	-66.96	0.008	2.80E-03	23.3	15.1	
23	19.20	-31.94	0.006	2.77E-03	-6.3	17.2	
24	18.60	4.82	0.004	2.75E-03	-14.5	7.7	
25	18.00	43.46	0.003	2.74E-03	-0.0	-0.0	

At elev. 27.70 Strut force = 908.1 kN/strut = 113.5 kN/m run
At elev. 22.73 The strut is slack

Stage No.6 Fill to elev. 23.01 on PASSIVE side



Stage No.6 Fill to elev. 23.01 on PASSIVE side



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Camley Street | Date: 8-12-2015
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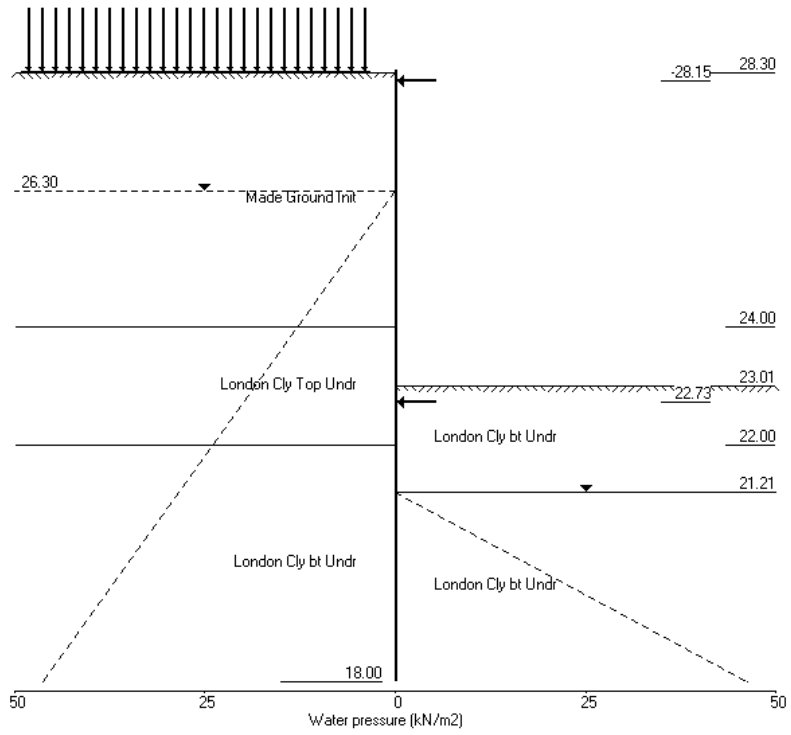
Units: kN,m

Stage No.8 Remove strut no.1 at elev. 27.70



Units: kN,m

Stage No. 8 Remove strut or anchor no.1 at elevation 27.70

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: Active side 20.00 from wall
Passive 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/m2	Wall disp. m	Wall rotation rad.	Shear force kN/m	Bending moment kN.m/m	Strut forces kN/m
1	28.30	0.00	0.014	-1.43E-03	0.0	-0.0	
2	28.15	1.04	0.014	-1.43E-03	0.1	0.0	102.5
		1.04	0.014	-1.43E-03	-102.5	0.0	
3	27.70	5.65	0.015	-1.40E-03	-101.0	-45.8	
4	27.30	9.73	0.016	-1.32E-03	-97.9	-85.6	
5	27.10	11.55	0.016	-1.27E-03	-95.8	-105.0	
6	26.70	14.87	0.016	-1.12E-03	-90.5	-142.0	
7	26.30	17.93	0.017	-9.35E-04	-83.9	-176.6	
8	25.75	23.94	0.017	-6.14E-04	-72.4	-219.3	
9	25.20	29.82	0.017	-2.29E-04	-57.6	-254.3	
10	24.60	36.34	0.017	2.47E-04	-37.8	-282.7	
11	24.00	42.82	0.017	7.62E-04	-14.0	-298.1	
		43.56	0.017	7.62E-04	-14.0	-298.1	
12	23.51	55.32	0.017	1.19E-03	10.4	-299.4	
13	23.01	67.64	0.016	1.62E-03	40.9	-287.2	
		62.32	0.016	1.62E-03	40.9	-287.2	
14	22.73	68.51	0.015	1.85E-03	58.9	-273.5	-0.0
15	22.48	74.29	0.015	2.05E-03	76.7	-256.6	
16	22.36	77.23	0.015	2.14E-03	86.2	-246.5	
17	22.00	82.97	0.014	2.38E-03	115.0	-210.6	
		60.34	0.014	2.38E-03	115.0	-210.6	
18	21.61	70.47	0.013	2.60E-03	140.9	-160.5	
19	21.21	81.37	0.012	2.75E-03	170.8	-99.4	
		-143.82	0.012	2.75E-03	170.8	-99.4	
20	20.81	-123.53	0.011	2.84E-03	116.7	-41.9	
21	20.40	-101.79	0.010	2.86E-03	71.1	-4.8	
22	19.80	-67.65	0.008	2.85E-03	20.3	19.7	
23	19.20	-31.42	0.006	2.82E-03	-9.5	19.8	
24	18.60	7.42	0.004	2.79E-03	-16.7	8.6	
25	18.00	48.16	0.003	2.78E-03	0.0	-0.0	

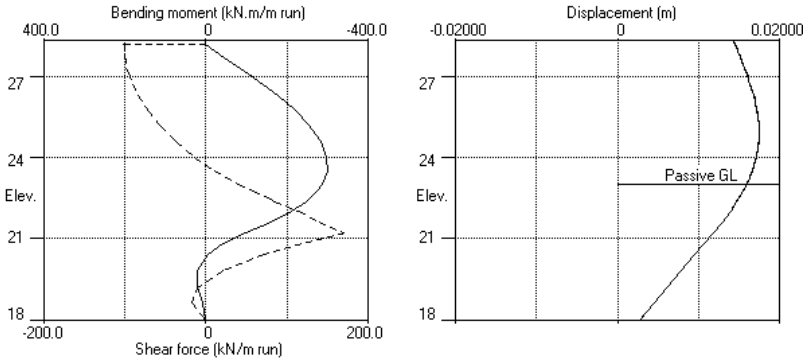
At elev. 28.15 Strut force = 102.5 kN/strut = 102.5 kN/m run
At elev. 22.73 The strut is slack

(continued)

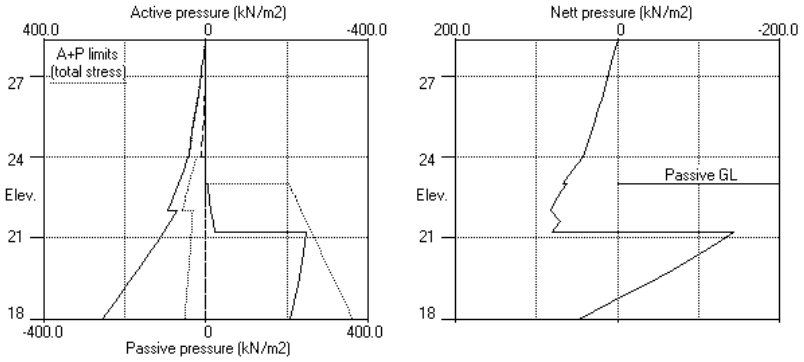
Stage No.8 Remove strut or anchor no.1 at elevation 27.70

Units: kN,m

Stage No.8 Remove strut no.1 at elev. 27.70



Stage No.8 Remove strut no.1 at elev. 27.70



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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: Active side 20.00 from wall
Passive side 20.00 from wall

Limit State: ULS DA1 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 max. m	Displacement min. m	Bending moment Calculated max. kN.m/m	Bending moment Calculated min. kN.m/m	Bending moment Factored max. kN.m/m	Bending moment Factored min. kN.m/m	Shear force Calculated max. kN/m	Shear force Calculated min. kN/m	Shear force Factored max. kN/m	Shear force Factored min. kN/m
1	28.30	0.014	0.000	0	-0	0	-0	0	0	0	0
2	28.15	0.014	0.000	0	-0	0	-0	0	-102	0	-138
3	27.70	0.015	0.000	0	-46	0	-62	2	-112	2	-151
4	27.30	0.016	0.000	2	-86	2	-116	5	-109	6	-147
5	27.10	0.016	0.000	3	-105	4	-142	7	-107	9	-144
6	26.70	0.016	0.000	6	-142	8	-192	7	-101	10	-137
7	26.30	0.017	0.000	9	-177	12	-238	4	-95	5	-128
8	25.75	0.017	0.000	11	-219	14	-296	1	-83	1	-112
9	25.20	0.018	0.000	11	-254	15	-343	0	-68	0	-92
10	24.60	0.018	0.000	10	-283	13	-382	0	-48	0	-65
11	24.00	0.018	0.000	8	-298	11	-402	15	-24	20	-33
12	23.51	0.017	0.000	6	-299	8	-404	46	-6	62	-8
13	23.01	0.017	0.000	2	-289	3	-391	83	-7	112	-9
14	22.73	0.016	0.000	3	-279	3	-377	104	0	140	0
15	22.48	0.016	0.000	7	-265	9	-357	77	0	104	0
16	22.36	0.016	0.000	10	-256	13	-345	86	0	116	0
17	22.00	0.015	0.000	22	-223	29	-301	115	0	155	0
18	21.61	0.015	0.000	34	-176	45	-237	141	0	190	0
19	21.21	0.014	0.000	40	-116	54	-157	171	0	231	0
20	20.81	0.013	0.000	41	-67	55	-90	119	-3	160	-4
21	20.40	0.012	0.000	37	-44	51	-59	76	-11	102	-15
22	19.80	0.011	0.000	28	-20	37	-27	34	-19	46	-25
23	19.20	0.009	0.000	20	-6	27	-8	20	-19	26	-26
24	18.60	0.008	0.000	9	-0	12	-0	8	-17	11	-23
25	18.00	0.007	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	Bending moment				Shear force					
	Calculated				Factored		Calculated				Factored	
no.	max. kN.m/m	elev.	min. kN.m/m	elev.	max. kN.m/m	min. kN.m/m	max. kN/m	elev.	min. kN/m	elev.	max. kN/m	min. kN/m
1	11	20.81	-14	24.00	15	-19	16	22.00	-6	19.20	21	-8
2	41	20.81	-0	28.30	55	-0	39	22.00	-19	19.20	53	-26
3	No calculation at this stage											
4	13	19.20	-296	23.51	18	-399	169	21.21	-111	27.70	228	-150
5	No calculation at this stage											
6	17	19.20	-296	23.51	23	-400	171	21.21	-112	27.70	231	-151
7	No calculation at this stage											
8	20	19.20	-299	23.51	27	-404	171	21.21	-102	28.15	231	-138
9	No calculation at this stage											
10	No calculation at this stage											
11	No calculation at this stage											
12	No calculation at this stage											
13	0	28.15	-254	24.00	0	-343	104	22.73	-100	28.15	140	-135

Maximum and minimum displacement at each stage

Stage no.	Displacement maximum m	elev.	minimum m	elev.	Stage description
1	0.003	28.30	0.000	28.30	Apply surcharge no.1 at elev. 28.30
2	0.011	28.30	0.000	28.30	Excav. to elev. 27.10 on PASSIVE side
3	No calculation at this stage				Install strut no.1 at elev. 27.70
4	0.018	24.60	0.000	28.30	Excav. to elev. 21.21 on PASSIVE side
5	No calculation at this stage				Install strut no.2 at elev. 22.73
6	0.017	24.60	0.000	28.30	Fill to elev. 23.01 on PASSIVE side
7	No calculation at this stage				Install strut no.3 at elev. 28.15
8	0.017	25.20	0.000	28.30	Remove strut no.1 at elev. 27.70
9	No calculation at this stage				Change soil type 9 to soil type 1
10	No calculation at this stage				Apply water pressure profile no.1
11	No calculation at this stage				Change soil type 3 to soil type 4
12	No calculation at this stage				Change soil type 6 to soil type 7
13	0.018	24.60	0.000	28.30	Apply surcharge no.2 at elev. 22.36

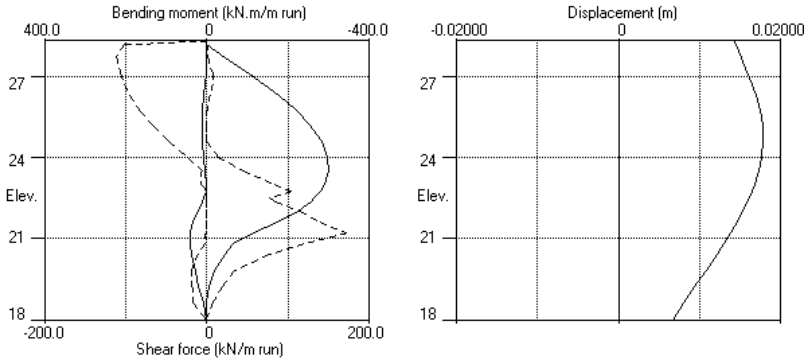
Strut forces at each stage (horizontal components)

Stage no.	Strut no. 1 at elev. 27.70			Strut no. 2 at elev. 22.73			Strut no. 3 at elev. 28.15		
	Calculated m run kN per	Factored strut kN per	Factored strut kN per	Calculated m run kN per	Factored strut kN per	Factored strut kN per	Calculated m run kN per	Factored strut kN per	Factored strut kN per
4	113	901	1216	---	---	---	---	---	---
6	114	908	1226	slack	slack	slack	---	---	---
8	---	---	---	slack	slack	slack	103	103	138
13	---	---	---	84	84	113	100	100	135

* Indicates that the total force shown is the sum of the force in the strut plus a force applied at the same elevation which may represent temperature load or other forces which are part of the strut load. Force components are listed in the detailed results for individual stages.

Units: kN,m

Bending moment, shear force, displacement envelopes



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Units: kN,m

INPUT DATA

SOIL PROFILE

Stratum no.	Elevation of top of stratum	Soil types Active side	Passive side
1	28.30	8 Made Ground Init	8 Made Ground Init
2	24.00	3 London Cly Top Undr	3 London Cly Top Undr
3	22.00	6 London Cly bt Undr	6 London Cly bt Undr

SOIL PROPERTIES (Unfactored SLS soil strengths)

No.	Soil type -- Description (Datum elev.)	Bulk density kN/m3	Young's Modulus Eh,kN/m2 (dEh/dy)	At rest coeff. Ko (dKo/dy)	Consol state. NC/OC (Nu)	Active limit Ka (Kac)	Passive limit Kp (Kpc)	Cohesion kN/m2 (dc/dy)
1	Made Ground	19.00	10000	0.577	OC (0.250)	0.390 (0.000)	2.561 (0.000)	
2	Gravels	19.00	30000	0.423	OC (0.300)	0.227 (0.000)	6.084 (0.000)	
3	London Cly Top Undr	19.00	20000	1.000	OC (0.490)	1.000 (2.000)	1.000 (2.000)	40.00u
4	London Cly Top dr	19.00	14000	1.000	OC (0.250)	0.422 (1.299)	2.371 (3.080)	3.000d
5	Concrete	24.00	200000	1.000	OC (0.490)	1.000 (2.000)	1.000 (2.000)	30000u
6	London Cl.. (24.00)	19.00	42500 (2589)	1.400	OC (0.490)	1.000 (2.476)	1.000 (2.390)	80.00u (5.180)
7	London Cl.. (24.00)	19.00	28000 (1813)	1.400	OC (0.250)	0.366 (1.423)	3.077 (4.665)	3.000d
8	Made Ground Init	19.00	10000	0.577	OC (0.250)	0.337 (0.000)	3.442 (0.000)	

Additional soil parameters associated with Ka and Kp

No.	Soil type ------- Description	--- parameters for Ka --- Soil friction angle	Wall adhesion coeff.	Back-fill angle	--- parameters for Kp --- Soil friction angle	Wall adhesion coeff.	Back-fill angle
1	Made Ground	26.00	0.000	0.00	26.00	0.000	0.00
2	Gravels	35.00	0.670	0.00	35.00	0.500	0.00
3	London Cly Top Undr	0.00	0.000	0.00	0.00	0.000	0.00
4	London Cly Top dr	24.00	0.000	0.00	24.00	0.000	0.00
5	Concrete	0.00	0.000	0.00	0.00	0.000	0.00
6	London Cly bt Undr	0.00	0.670	0.00	0.00	0.500	0.00
7	London Cly bt dr	24.00	0.670	0.00	24.00	0.500	0.00
8	Made Ground Init	26.00	0.670	0.00	26.00	0.500	0.00

GROUND WATER CONDITIONS

Density of water = 10.00 kN/m3

	Active side	Passive side
Initial water table elevation	26.30	21.21

Automatic water pressure balancing at toe of wall : Yes

Water press. profile no.	Point no.	Active side Elev. m	Piezo elev. m	Water press. kN/m2	Point no.	Passive side Elev. m	Piezo elev. m	Water press. kN/m2	
1	1	27.30	27.30	0.0	1	22.36	22.36	0.0	MC+WC
					2	22.36	27.30	49.4	

WALL PROPERTIES

Type of structure = Fully Embedded Wall
Elevation of toe of wall = 18.00
Maximum finite element length = 0.60 m
Youngs modulus of wall E = 1.9600E+07 kN/m2
Moment of inertia of wall I = 0.017260 m4/m run
E.I = 338296 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	27.70	8.00	0.010000	2.000E+08	10.00	0.00	0	No
2	22.73	1.00	0.300000	1.400E+07	10.00	0.00	0	No
3	28.15	1.00	0.300000	1.400E+07	10.00	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	28.30	0.50(A)	100.00	20.00	20.00	=	N/A	1.30 Var
2	22.36	-0.00(P)	30.00	20.00	50.00	=	N/A	1.00 P/U

Note: A = Active side, P = Passive 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 28.30
	No analysis at this stage
2	Excavate to elevation 27.10 on PASSIVE side
	Toe of berm at elevation 22.48
	Width of top of berm = 2.00
	Width of toe of berm = 6.62
3	Install strut or anchor no.1 at elevation 27.70
4	Excavate to elevation 21.21 on PASSIVE side
5	Install strut or anchor no.2 at elevation 22.73
6	Fill to elevation 23.01 on PASSIVE side with soil type 6
7	Install strut or anchor no.3 at elevation 28.15
8	Remove strut or anchor no.1 at elevation 27.70
9	Change properties of soil type 9 to soil type 1
	No analysis at this stage
	Ko pressures will not be reset
10	Apply water pressure profile no.1 (Worst Cred.)
	No analysis at this stage
11	Change properties of soil type 3 to soil type 4
	No analysis at this stage
	Ko pressures will not be reset
12	Change properties of soil type 6 to soil type 7
	No analysis at this stage
	Ko pressures will not be reset
13	Apply surcharge no.2 at elevation 22.36

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 Permanent Variable 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) = 0 m

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

Width of excavation on active side of wall = 20.00 m
Width of excavation on passive side of wall = 20.00 m

Distance to rigid boundary on active side = 20.00 m
Distance to rigid boundary on passive 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. 28.30	No	No	No
2	Excav. to elev. 27.10 on PASSIVE side	No	No	No
3	Install strut no.1 at elev. 27.70	No	No	No
4	Excav. to elev. 21.21 on PASSIVE side	No	No	No
5	Install strut no.2 at elev. 22.73	No	No	No
6	Fill to elev. 23.01 on PASSIVE side	No	No	No
7	Install strut no.3 at elev. 28.15	No	No	No
8	Remove strut no.1 at elev. 27.70	No	No	No
9	Change soil type 9 to soil type 1	No	No	No
10	Apply water pressure profile no.1	No	No	No
11	Change soil type 3 to soil type 4	No	No	No
12	Change soil type 6 to soil type 7	No	No	No
13	Apply surcharge no.2 at elev. 22.36	No	No	No
*	Summary output	Yes	-	Yes

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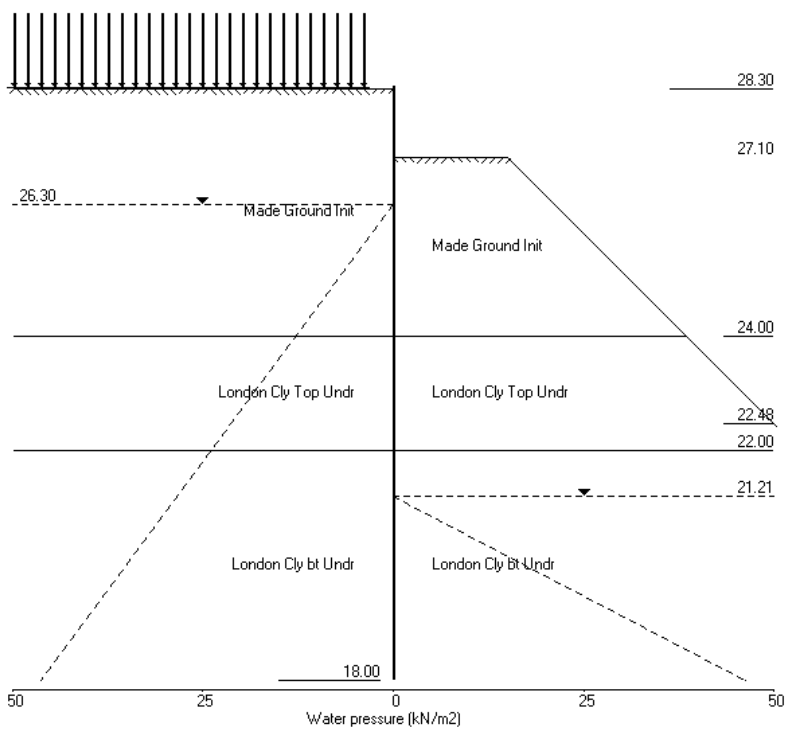
Units: kN,m

Stage No.2 Excav. to elev. 27.10 on PASSIVE side



Units: kN,m

Stage No. 2 Excavate to elevation 27.10 on PASSIVE side
Toe of berm at elevation 22.48
Width of top of berm = 2.00
Width of toe of berm = 6.62

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

Stage No.	G.L. Act.	G.L. Pass.	Strut Elev.	Overall FoS for toe elev. = 18.00 Factor of Safety	Moment equilib. at elev.	Toe elev. for FoS = 1.000 Toe elev.	Wall Penetration
2	28.30	27.10	Cant.	1.400	19.26	20.57	6.53

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: Active side 20.00 from wall
Passive side 20.00 from wall
Limit State: ULS DA1 Combination 2

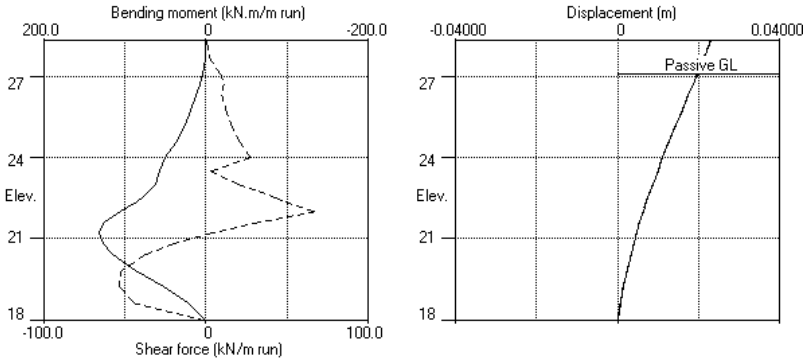
Node no.	Y coord	Nett pressure kN/m2	Wall disp. m	Wall rotation rad.	Shear force kN/m	Bending moment kN.m/m	Strut forces kN/m
1	28.30	0.00	0.023	2.81E-03	0.0	-0.0	
2	28.15	1.28	0.023	2.81E-03	0.1	0.0	
3	27.70	7.28	0.021	2.81E-03	2.0	0.4	
4	27.30	12.59	0.020	2.80E-03	6.0	1.9	
5	27.10	14.92	0.020	2.80E-03	8.8	3.4	
6	26.70	-1.10	0.019	2.80E-03	11.5	7.8	
		2.16	0.019	2.80E-03	11.5	7.8	
7	26.30	-10.97	0.017	2.78E-03	9.8	12.2	
		6.02	0.017	2.78E-03	9.8	12.2	
8	25.75	1.10	0.016	2.76E-03	11.7	18.2	
		7.41	0.016	2.76E-03	11.7	18.2	
9	25.20	4.84	0.014	2.72E-03	15.1	25.6	
		9.37	0.014	2.72E-03	15.1	25.6	
10	24.60	7.85	0.013	2.67E-03	20.2	36.2	
		11.46	0.013	2.67E-03	20.2	36.2	
11	24.00	10.71	0.011	2.59E-03	26.9	50.4	
		-54.01	0.011	2.59E-03	26.9	50.4	
12	23.51	-42.35	0.010	2.51E-03	3.0	57.1	
		29.39	0.010	2.51E-03	3.0	57.1	
13	23.01	41.15	0.009	2.43E-03	20.5	62.4	
		40.77	0.009	2.43E-03	20.5	62.4	
14	22.73	47.18	0.008	2.37E-03	32.6	69.6	
		41.70	0.008	2.37E-03	32.6	69.6	
15	22.48	47.26	0.007	2.32E-03	43.7	79.1	
		43.93	0.007	2.32E-03	43.7	79.1	
16	22.36	46.62	0.007	2.29E-03	49.4	84.9	
		43.91	0.007	2.29E-03	49.4	84.9	
17	22.00	51.42	0.006	2.19E-03	66.5	105.6	
		-94.36	0.006	2.19E-03	66.5	105.6	

(continued)

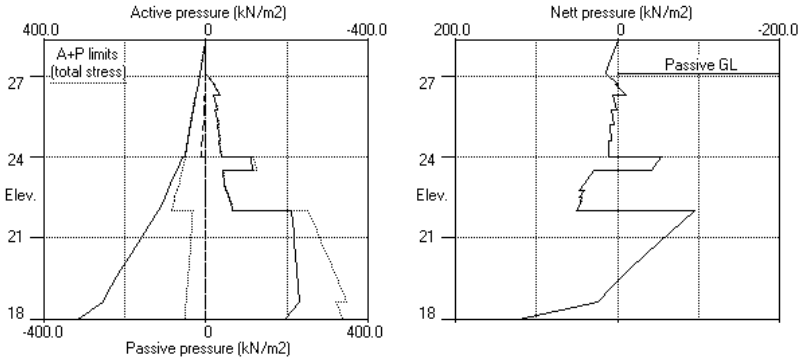
Stage No.2 Excavate to elevation 27.10 on PASSIVE side
Toe of berm at elevation 22.48
Width of top of berm = 2.00
Width of toe of berm = 6.62

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
18	21.61	-79.86	0.005	2.05E-03	32.1	124.5	
19	21.21	-65.89	0.005	1.90E-03	3.3	131.0	
20	20.81	-49.94	0.004	1.75E-03	-20.1	127.0	
21	20.40	-34.76	0.003	1.60E-03	-37.3	114.8	
22	19.80	-13.50	0.002	1.42E-03	-51.7	86.3	
23	19.20	6.71	0.002	1.30E-03	-53.8	52.9	
24	18.60	24.95	0.001	1.23E-03	-44.3	22.0	
25	18.00	122.67	0.000	1.22E-03	-0.0	0.0	

Stage No.2 Excav. to elev. 27.10 on PASSIVE side



Stage No.2 Excav. to elev. 27.10 on PASSIVE side



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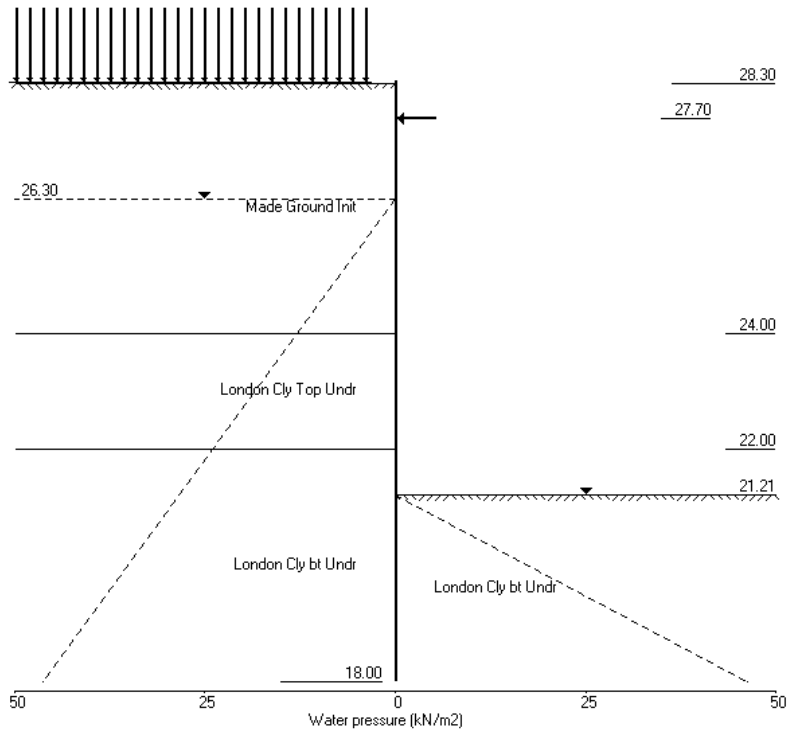
Units: kN,m

Stage No.4 Excav. to elev. 21.21 on PASSIVE side



Units: kN,m

Stage No. 4 Excavate to elevation 21.21 on PASSIVE side

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

Stage No.	--- G.L. --- Act.	Pass.	Strut Elev.	Overall FoS for toe elev. = 18.00 Factor of Safety	Moment equilib. at elev.	Toe elev. for FoS = 1.000 Toe elev.	Wall Penetr -ation
4	28.30	21.21	27.70	1.684	n/a	20.15	1.06

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: Active side 20.00 from wall
Passive side 20.00 from wall
Limit State: ULS DA1 Combination 2

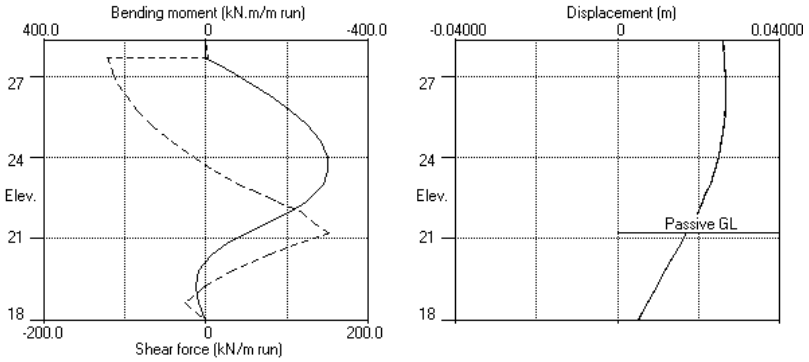
Node no.	Y coord	Nett pressure kN/m2	Wall disp. m	Wall rotation rad.	Shear force kN/m	Bending moment kN.m/m	Strut forces kN/m
1	28.30	0.00	0.026	-3.43E-04	0.0	-0.0	
2	28.15	1.28	0.026	-3.43E-04	0.1	0.0	
3	27.70	7.28	0.026	-3.43E-04	2.0	0.4	123.3
		7.28	0.026	-3.43E-04	-121.3	0.4	
4	27.30	12.59	0.026	-3.15E-04	-117.3	-47.4	
5	27.10	14.92	0.026	-2.80E-04	-114.5	-70.6	
6	26.70	19.14	0.027	-1.71E-04	-107.7	-115.0	
7	26.30	22.99	0.027	-1.07E-05	-99.3	-156.5	
8	25.75	29.74	0.027	2.84E-04	-84.8	-207.3	
9	25.20	36.27	0.026	6.55E-04	-66.7	-249.1	
10	24.60	43.25	0.026	1.12E-03	-42.8	-282.2	
11	24.00	50.14	0.025	1.64E-03	-14.8	-299.7	
		46.63	0.025	1.64E-03	-14.8	-299.7	
12	23.51	56.38	0.024	2.08E-03	10.7	-301.3	
13	23.01	66.06	0.023	2.51E-03	41.0	-289.0	
14	22.73	71.41	0.022	2.74E-03	59.9	-275.2	
15	22.48	76.26	0.021	2.94E-03	78.4	-257.9	
16	22.36	78.68	0.021	3.03E-03	88.1	-247.5	
17	22.00	85.63	0.020	3.27E-03	117.6	-210.7	
		31.50	0.020	3.27E-03	117.6	-210.7	
18	21.61	40.22	0.019	3.49E-03	131.8	-159.4	
19	21.21	59.71	0.017	3.64E-03	151.5	-104.2	
		-101.53	0.017	3.64E-03	151.5	-104.2	
20	20.81	-92.13	0.016	3.74E-03	112.3	-51.4	
21	20.40	-82.19	0.014	3.78E-03	77.0	-13.7	
22	19.80	-66.72	0.012	3.77E-03	32.4	17.0	
23	19.20	-50.52	0.010	3.74E-03	-2.8	23.7	
24	18.60	-23.23	0.007	3.70E-03	-24.9	19.0	
25	18.00	106.37	0.005	3.68E-03	-0.0	0.0	

At elev. 27.70 Strut force = 986.4 kN/strut = 123.3 kN/m run

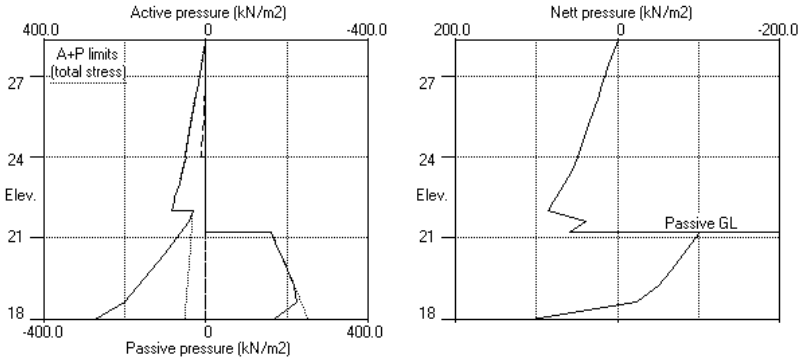
(continued)

Stage No.4 Excavate to elevation 21.21 on PASSIVE side

Stage No.4 Excav. to elev. 21.21 on PASSIVE side



Stage No.4 Excav. to elev. 21.21 on PASSIVE side



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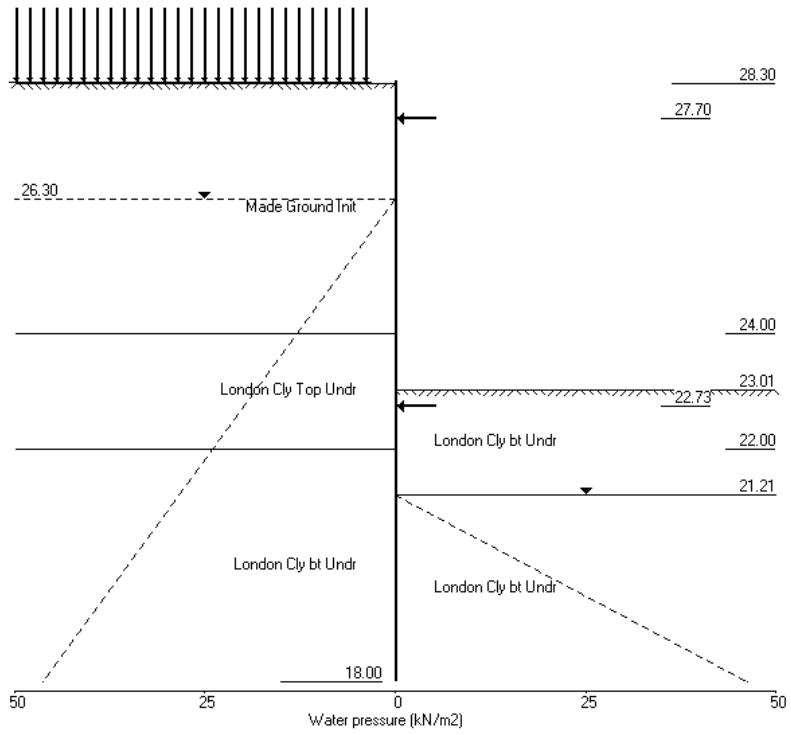
Stage No.6 Fill to elev. 23.01 on PASSIVE side



Units: kN,m

Stage No. 6 Fill to elevation 23.01 on PASSIVE side with soil type 6

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

Stage No.	--- G.L. --- Act.	Pass.	Strut Elev.	Overall FoS for toe elev. = 18.00 Factor of Safety	Moment equilib. at elev.	Toe elev. for FoS = 1.000 Toe elev.	Wall Penetr -ation
6	28.30	23.01		More than one strut			

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: Active side 20.00 from wall
Passive side 20.00 from wall
Limit State: ULS DA1 Combination 2

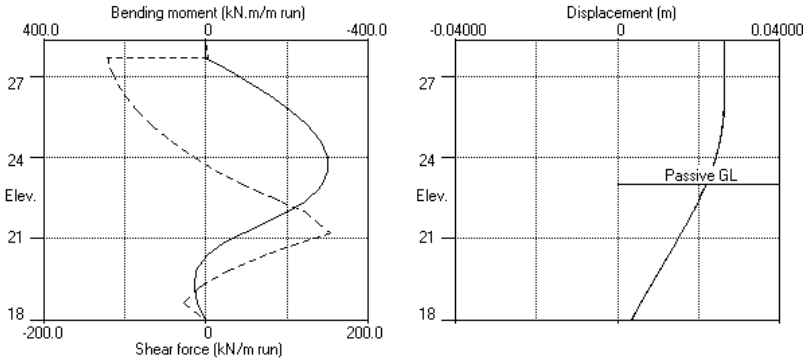
Node no.	Y coord	Nett pressure kN/m2	Wall disp. m	Wall rotation rad.	Shear force kN/m	Bending moment kN.m/m	Strut forces kN/m
1	28.30	0.00	0.026	-1.41E-04	0.0	-0.0	
2	28.15	1.28	0.026	-1.41E-04	0.1	0.0	
3	27.70	7.28	0.026	-1.41E-04	2.0	0.4	124.2
		7.28	0.026	-1.41E-04	-122.2	0.4	
4	27.30	12.66	0.026	-1.13E-04	-118.2	-47.8	
5	27.10	15.04	0.026	-7.83E-05	-115.4	-71.1	
6	26.70	19.38	0.026	3.22E-05	-108.6	-115.9	
7	26.30	23.34	0.026	1.93E-04	-100.0	-157.7	
8	25.75	30.25	0.026	4.91E-04	-85.3	-208.8	
9	25.20	36.95	0.026	8.65E-04	-66.8	-250.9	
10	24.60	44.11	0.025	1.33E-03	-42.5	-283.9	
11	24.00	51.17	0.024	1.85E-03	-13.9	-301.1	
		49.36	0.024	1.85E-03	-13.9	-301.1	
12	23.51	59.51	0.023	2.29E-03	13.0	-302.0	
13	23.01	69.59	0.022	2.73E-03	45.0	-288.0	
14	22.73	73.79	0.021	2.95E-03	64.7	-273.0	-0.0
15	22.48	77.58	0.020	3.15E-03	83.6	-254.5	
16	22.36	79.48	0.020	3.24E-03	93.5	-243.5	
17	22.00	82.04	0.019	3.48E-03	122.5	-204.9	
		33.91	0.019	3.48E-03	122.5	-204.9	
18	21.61	37.34	0.017	3.69E-03	136.6	-151.8	
19	21.21	51.51	0.016	3.83E-03	154.1	-95.1	
		-109.72	0.016	3.83E-03	154.1	-95.1	
20	20.81	-98.40	0.014	3.91E-03	112.0	-41.9	
21	20.40	-86.58	0.013	3.94E-03	74.5	-4.8	
22	19.80	-68.38	0.010	3.93E-03	28.1	23.6	
23	19.20	-49.49	0.008	3.88E-03	-7.3	27.4	
24	18.60	-19.50	0.006	3.84E-03	-28.0	20.2	
25	18.00	112.86	0.003	3.82E-03	-0.0	0.0	

At elev. 27.70 Strut force = 993.8 kN/strut = 124.2 kN/m run
At elev. 22.73 The strut is slack

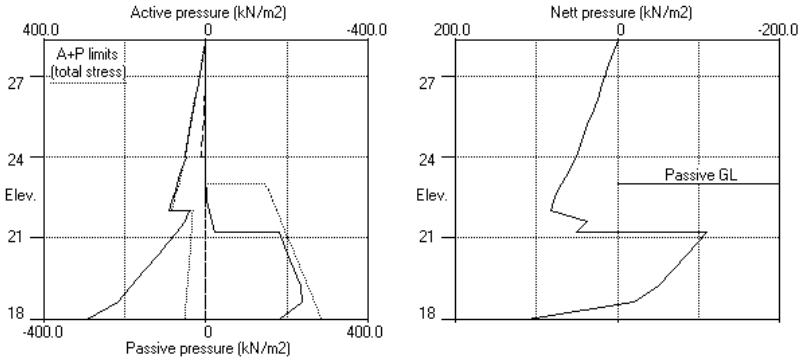
(continued)

Stage No.6 Fill to elevation 23.01 on PASSIVE side with soil type 6

Stage No.6 Fill to elev. 23.01 on PASSIVE side



Stage No.6 Fill to elev. 23.01 on PASSIVE side



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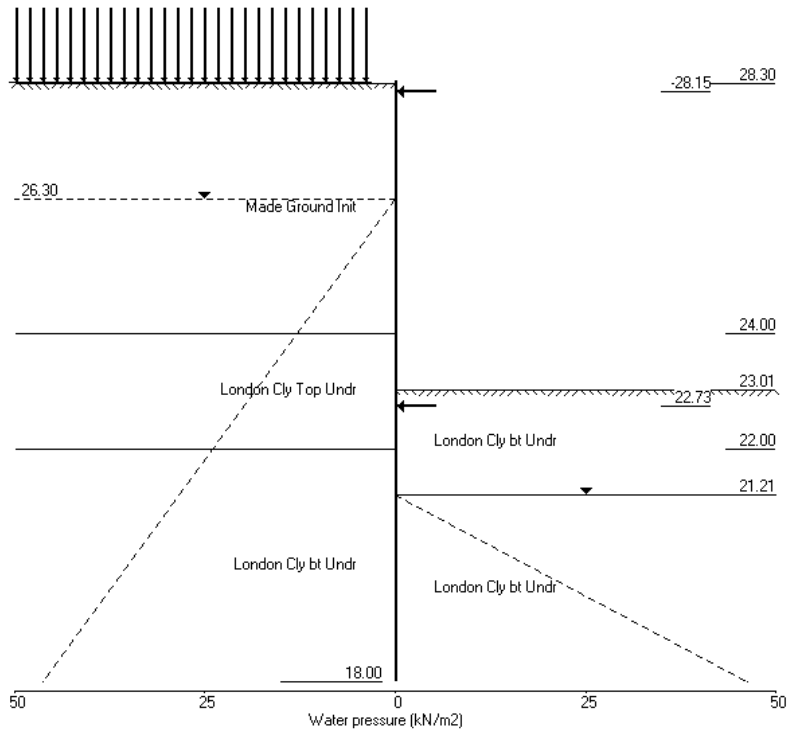
Units: kN,m

Stage No.8 Remove strut no.1 at elev. 27.70



Units: kN,m

Stage No. 8 Remove strut or anchor no.1 at elevation 27.70

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

Stage No.	--- G.L. --- Act.	Pass.	Strut Elev.	Overall FoS for toe elev. = 18.00 Factor of Safety	Moment equilib. at elev.	Toe elev. for FoS = 1.000 Toe elev.	Wall Penetr -ation
8	28.30	23.01		More than one strut			

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: Active side 20.00 from wall
Passive 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
1	28.30	0.00	0.026	-3.84E-04	0.0	-0.0	
2	28.15	1.28	0.027	-3.84E-04	0.1	0.0	112.3
		1.28	0.027	-3.84E-04	-112.2	0.0	
3	27.70	7.28	0.027	-3.51E-04	-110.3	-50.1	
4	27.30	12.59	0.027	-2.66E-04	-106.3	-93.5	
5	27.10	14.92	0.027	-2.04E-04	-103.5	-114.5	
6	26.70	19.14	0.027	-4.57E-05	-96.7	-154.5	
7	26.30	22.99	0.027	1.58E-04	-88.3	-191.6	
8	25.75	29.74	0.027	5.06E-04	-73.8	-236.3	
9	25.20	36.27	0.026	9.20E-04	-55.6	-272.1	
10	24.60	43.45	0.026	1.42E-03	-31.7	-298.5	
11	24.00	50.60	0.025	1.96E-03	-3.5	-309.4	
		47.83	0.025	1.96E-03	-3.5	-309.4	
12	23.51	58.19	0.024	2.41E-03	22.7	-305.3	
13	23.01	68.48	0.022	2.84E-03	54.1	-286.8	
		62.65	0.022	2.84E-03	54.1	-286.8	
14	22.73	67.48	0.021	3.07E-03	72.0	-269.5	-0.0
15	22.48	71.87	0.021	3.26E-03	89.4	-249.4	
16	22.36	74.05	0.020	3.35E-03	98.5	-237.7	
17	22.00	77.43	0.019	3.58E-03	125.8	-197.7	
		28.32	0.019	3.58E-03	125.8	-197.7	
18	21.61	32.77	0.017	3.78E-03	137.8	-143.7	
19	21.21	47.90	0.016	3.92E-03	153.8	-86.8	
		-113.34	0.016	3.92E-03	153.8	-86.8	
20	20.81	-101.10	0.014	3.99E-03	110.4	-34.1	
21	20.40	-88.45	0.013	4.01E-03	72.0	2.1	
22	19.80	-69.15	0.010	3.98E-03	24.7	28.6	
23	19.20	-48.94	0.008	3.93E-03	-10.7	30.3	
24	18.60	-16.65	0.006	3.88E-03	-30.4	21.1	
25	18.00	118.04	0.003	3.86E-03	0.0	0.0	

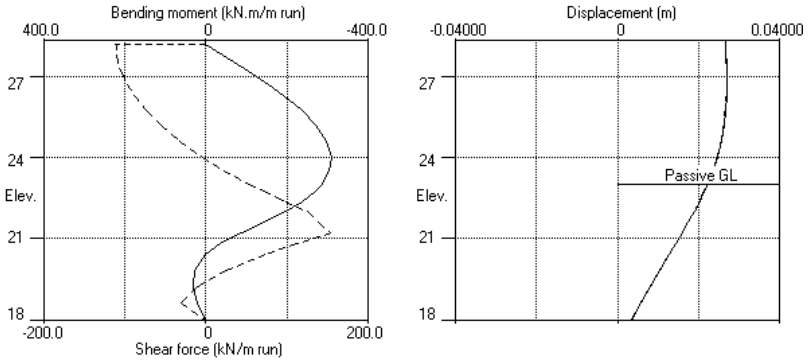
At elev. 28.15 Strut force = 112.3 kN/strut = 112.3 kN/m run
At elev. 22.73 The strut is slack

(continued)

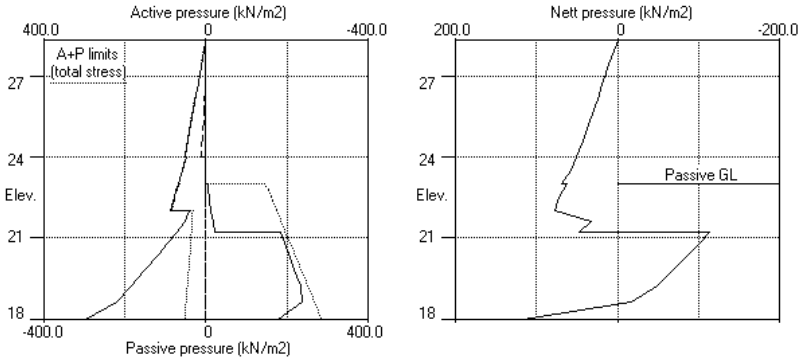
Stage No.8 Remove strut or anchor no.1 at elevation 27.70

Units: kN,m

Stage No.8 Remove strut no.1 at elev. 27.70



Stage No.8 Remove strut no.1 at elev. 27.70



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Camley Street | Date: 8-12-2015
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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 Permanent Variable loads = 1.300

STABILITY ANALYSIS of Fully Embedded Wall according to Strength Factor method

Factor of safety on soil strength

Stage No.	G.L. Act.	G.L. Pass.	Strut Elev.	Overall FoS for toe elev. = 18.00 Factor of Safety	Moment equilib. at elev.	Toe elev. for FoS = 1.000 Toe elev.	Wall Penetration
1	28.30	28.30	Cant.	Conditions not suitable for FoS calc.			
2	28.30	27.10	Cant.	1.400	19.26	20.57	6.53
3	28.30	27.10		No analysis at this stage			
4	28.30	21.21	27.70	1.684	n/a	20.15	1.06
5	28.30	21.21		No analysis at this stage			

All remaining stages have more than one strut - FoS calculation n/a

Units: kN,m

Summary of results

BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall

Analysis options

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

Rigid boundaries: Active side 20.00 from wall
Passive side 20.00 from wall

Limit State: ULS DA1 Combination 2

Bending moment, shear force and displacement envelopes

Node no.	Y coord	Displacement maximum m	Displacement minimum m	Bending moment maximum kN.m/m	Bending moment minimum kN.m/m	Shear force maximum kN/m	Shear force minimum kN/m
1	28.30	0.026	0.000	0.0	-0.0	0.0	0.0
2	28.15	0.027	0.000	0.0	-0.0	0.1	-112.2
3	27.70	0.027	0.000	0.4	-50.1	2.0	-122.2
4	27.30	0.027	0.000	1.9	-93.5	6.0	-118.2
5	27.10	0.027	0.000	3.4	-114.5	8.8	-115.4
6	26.70	0.027	0.000	7.8	-154.5	11.5	-108.6
7	26.30	0.027	0.000	12.2	-191.6	9.8	-100.0
8	25.75	0.027	0.000	18.2	-236.3	11.7	-85.3
9	25.20	0.026	0.000	25.6	-272.1	15.1	-66.8
10	24.60	0.026	0.000	36.2	-298.5	20.2	-42.8
11	24.00	0.025	0.000	50.4	-309.4	35.2	-14.8
12	23.51	0.024	0.000	57.1	-305.3	69.1	0.0
13	23.01	0.023	0.000	62.4	-289.0	107.4	0.0
14	22.73	0.022	0.000	69.6	-275.2	127.7	0.0
15	22.48	0.022	0.000	79.1	-257.9	89.4	0.0
16	22.36	0.021	0.000	84.9	-247.5	98.5	0.0
17	22.00	0.021	0.000	105.6	-210.7	125.8	0.0
18	21.61	0.020	0.000	124.5	-159.4	137.8	0.0
19	21.21	0.019	0.000	131.0	-104.2	154.1	0.0
20	20.81	0.017	0.000	127.0	-51.4	112.3	-20.1
21	20.40	0.016	0.000	114.8	-13.7	77.0	-37.3
22	19.80	0.015	0.000	86.3	0.0	32.4	-51.7
23	19.20	0.013	0.000	52.9	0.0	0.0	-53.8
24	18.60	0.011	0.000	22.0	0.0	0.0	-44.3
25	18.00	0.010	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 maximum kN.m/m	elev.	Bending moment minimum kN.m/m	elev.	Shear force maximum kN/m	elev.	Shear force minimum kN/m	elev.
1	12.9	20.81	-14.1	24.00	17.2	22.00	-6.7	19.20
2	131.0	21.21	-0.0	28.30	66.5	22.00	-53.8	19.20
3	No calculation at this stage							
4	23.7	19.20	-301.3	23.51	151.5	21.21	-121.3	27.70
5	No calculation at this stage							
6	27.4	19.20	-302.0	23.51	154.1	21.21	-122.2	27.70
7	No calculation at this stage							
8	30.3	19.20	-309.4	24.00	153.8	21.21	-112.2	28.15
9	No calculation at this stage							
10	No calculation at this stage							
11	No calculation at this stage							
12	No calculation at this stage							
13	12.1	18.60	-235.5	24.60	127.7	22.73	-100.0	28.15

Maximum and minimum displacement at each stage

Stage no.	Displacement maximum m	elev.	Displacement minimum m	elev.	Stage description
1	0.003	28.30	0.000	28.30	Apply surcharge no.1 at elev. 28.30
2	0.023	28.30	0.000	28.30	Excav. to elev. 27.10 on PASSIVE side
3	No calculation at this stage				Install strut no.1 at elev. 27.70
4	0.027	26.30	0.000	28.30	Excav. to elev. 21.21 on PASSIVE side
5	No calculation at this stage				Install strut no.2 at elev. 22.73
6	0.026	26.70	0.000	28.30	Fill to elev. 23.01 on PASSIVE side
7	No calculation at this stage				Install strut no.3 at elev. 28.15
8	0.027	26.70	0.000	28.30	Remove strut no.1 at elev. 27.70
9	No calculation at this stage				Change soil type 9 to soil type 1
10	No calculation at this stage				Apply water pressure profile no.1
11	No calculation at this stage				Change soil type 3 to soil type 4
12	No calculation at this stage				Change soil type 6 to soil type 7
13	0.027	26.70	0.000	28.30	Apply surcharge no.2 at elev. 22.36

Strut forces at each stage (horizontal components)

Stage no.	Strut no. 1 at elev. 27.70 kN/m run	Strut no. 1 at elev. 27.70 kN/strut	Strut no. 2 at elev. 22.73 kN/m run	Strut no. 2 at elev. 22.73 kN/strut	Strut no. 3 at elev. 28.15 kN/m run	Strut no. 3 at elev. 28.15 kN/strut
4	123.30	986.36	---	---	---	---
6	124.23	993.83	slack	slack	---	---
8	---	---	slack	slack	112.28	112.28
13	---	---	109.99	109.99	100.06	100.06

* Indicates that the total force shown is the sum of the force in the strut plus a force applied at the same elevation which may represent temperature load or other forces which are part of the strut load. Force components are listed in the detailed results for individual stages.

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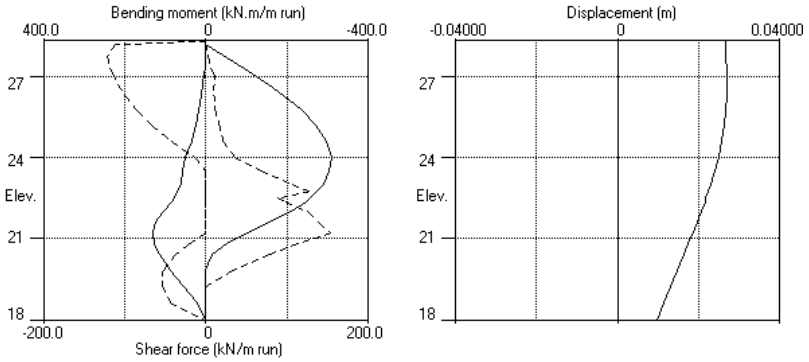
Bending moment, shear force, displacement envelopes



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Section B2 | Checked :

Units: kN,m

INPUT DATA

SOIL PROFILE

Stratum no.	Elevation of top of stratum	Soil types Active side	Passive side
1	28.30	8 Made Ground	8 Made Ground
2	24.00	3 London Cly Top Undr	3 London Cly Top Undr
3	22.00	6 London Cly bt Undr	6 London Cly bt Undr

SOIL PROPERTIES (Unfactored SLS soil strengths)

No.	Soil type -- Description (Datum elev.)	Bulk density kN/m3	Young's Modulus Eh,kN/m2 (dEh/dy)	At rest coeff. Ko (dKo/dy)	Consol state. NC/OC (Nu)	Active limit Ka (Kac)	Passive limit Kp (Kpc)	Cohesion kN/m2 (dc/dy)
1	Made Ground	19.00	10000	0.577	OC (0.250)	0.390 (0.000)	2.561 (0.000)	
2	Gravels	19.00	30000	0.423	OC (0.300)	0.227 (0.000)	6.084 (0.000)	
3	London Cly Top Undr	19.00	20000	1.000	OC (0.490)	1.000 (2.000)	1.000 (2.000)	40.00u
4	London Cly Top dr	19.00	14000	1.000	OC (0.250)	0.422 (1.299)	2.371 (3.080)	3.000d
5	Concrete	24.00	200000	1.000	OC (0.490)	1.000 (2.000)	1.000 (2.000)	30000u
6	London Cl.. (24.00)	19.00	42500 (2589)	1.400	OC (0.490)	1.000 (2.476)	1.000 (2.390)	80.00u (5.180)
7	London Cl.. (24.00)	19.00	28000 (1813)	1.400	OC (0.250)	0.366 (1.423)	3.077 (4.665)	3.000d
8	Made Ground	19.00	10000	0.577	OC (0.250)	0.337 (0.000)	3.442 (0.000)	

Additional soil parameters associated with Ka and Kp

No.	Soil type Description	--- parameters for Ka --- Soil friction angle	Wall adhesion coeff.	Back-fill angle	--- parameters for Kp --- Soil friction angle	Wall adhesion coeff.	Back-fill angle
1	Made Ground	26.00	0.000	0.00	26.00	0.000	0.00
2	Gravels	35.00	0.670	0.00	35.00	0.500	0.00
3	London Cly Top Undr	0.00	0.000	0.00	0.00	0.000	0.00
4	London Cly Top dr	24.00	0.000	0.00	24.00	0.000	0.00
5	Concrete	0.00	0.000	0.00	0.00	0.000	0.00
6	London Cly bt Undr	0.00	0.670	0.00	0.00	0.500	0.00
7	London Cly bt dr	24.00	0.670	0.00	24.00	0.500	0.00
8	Made Ground	26.00	0.670	0.00	26.00	0.500	0.00

GROUND WATER CONDITIONS

Density of water = 10.00 kN/m3

	Active side	Passive side
Initial water table elevation	25.70	21.21

Automatic water pressure balancing at toe of wall : Yes

Water press. profile no.	Active side Point no.	Elev. m	Piezo elev. m	Water press. kN/m2	Passive side Point no.	Elev. m	Piezo elev. m	Water press. kN/m2	
1	1	27.30	27.30	0.0	1	22.36	22.36	0.0	MC+WC
					2	22.36	27.30	49.4	

WALL PROPERTIES

Type of structure = Fully Embedded Wall
Elevation of toe of wall = 13.50
Maximum finite element length = 0.80 m
Youngs modulus of wall E = 1.4000E+07 kN/m2
Moment of inertia of wall I = 0.017260 m4/m run
E.I = 241640 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	26.60	5.00	0.010000	2.000E+08	10.00	0.00	0	No
2	22.73	1.00	0.300000	1.400E+07	10.00	0.00	0	No
3	28.15	1.00	0.300000	1.400E+07	10.00	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	28.30	0.50(A)	100.00	20.00	20.00	=	N/A	1.10 Var
2	22.36	-0.00(P)	30.00	20.00	50.00	=	N/A	1.00 P/U

Note: A = Active side, P = Passive 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 28.30
	No analysis at this stage
2	Excavate to elevation 21.21 on PASSIVE side
3	Install strut or anchor no.2 at elevation 22.73
4	Fill to elevation 23.01 on PASSIVE side with soil type 6
5	Install strut or anchor no.3 at elevation 28.15
6	Change properties of soil type 8 to soil type 1
	No analysis at this stage
	Ko pressures will not be reset
7	Apply water pressure profile no.1 (Mod. Conserv.)
	No analysis at this stage
8	Change properties of soil type 3 to soil type 4
	No analysis at this stage
	Ko pressures will not be reset
9	Change properties of soil type 6 to soil type 7
	No analysis at this stage
	Ko pressures will not be reset
10	Apply surcharge no.2 at elevation 22.36

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 Permanent Variable 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) = 0 m

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

   Width of excavation on active side of wall = 20.00 m
   Width of excavation on passive side of wall = 20.00 m

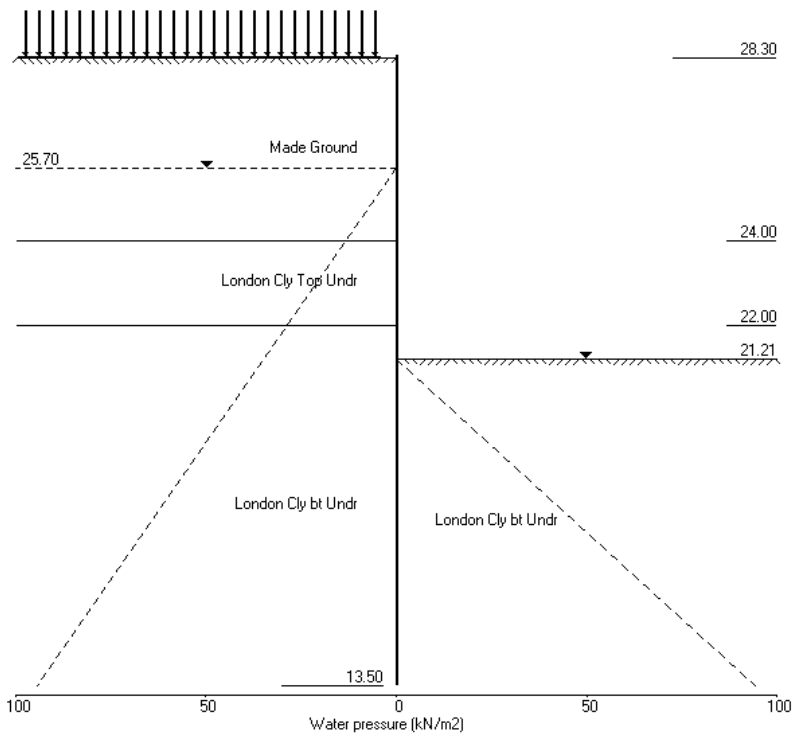
   Distance to rigid boundary on active side = 20.00 m
   Distance to rigid boundary on passive side = 20.00 m

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. 28.30	No	No	No
2	Excav. to elev. 21.21 on PASSIVE side	No	No	No
3	Install strut no.2 at elev. 22.73	No	No	No
4	Fill to elev. 23.01 on PASSIVE side	No	No	No
5	Install strut no.3 at elev. 28.15	No	No	No
6	Change soil type 8 to soil type 1	No	No	No
7	Apply water pressure profile no.1	No	No	No
8	Change soil type 3 to soil type 4	No	No	No
9	Change soil type 6 to soil type 7	No	No	No
10	Apply surcharge no.2 at elev. 22.36	No	No	No
*	Summary output	Yes	-	Yes

Units: kN,m

Stage No.2 Excav. to elev. 21.21 on PASSIVE side



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Units: kN,m

Stage No. 2 Excavate to elevation 21.21 on PASSIVE 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: Active side 20.00 from wall
Passive side 20.00 from wall

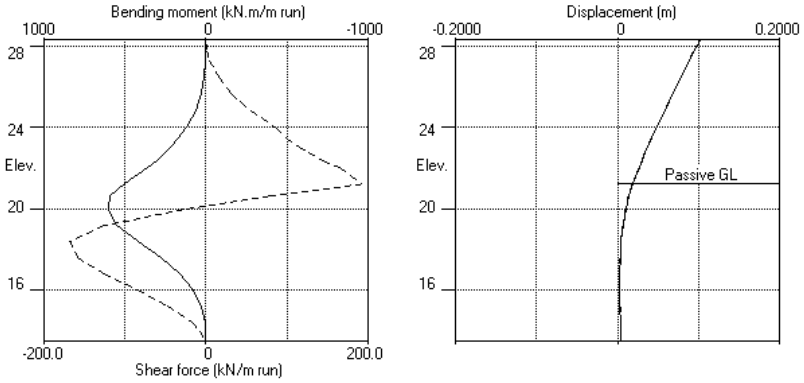
Limit State: ULS DA1 Combination 1

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.

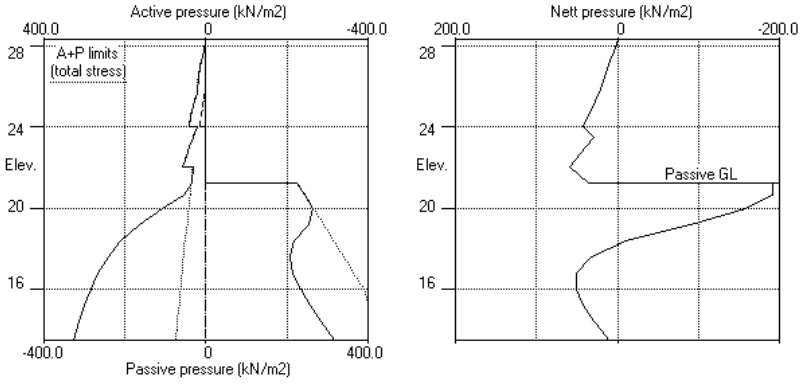
Node no.	Y coord	Nett pressure kN/m2	Wall disp. m	Wall rotation rad.	Shear force kN/m	Bending moment kN.m/m	Strut forces kN/m
1	28.30	0.00	0.101	1.23E-02	0.0	-0.0	
2	28.15	1.04	0.099	1.23E-02	0.1	0.0	
3	27.73	5.37	0.094	1.23E-02	1.4	0.3	
4	27.30	9.73	0.089	1.23E-02	4.6	1.6	
5	26.50	16.42	0.079	1.23E-02	15.1	9.1	
6	25.70	22.26	0.069	1.22E-02	30.6	27.0	
7	25.25	27.70	0.063	1.22E-02	41.8	43.2	
8	24.80	33.07	0.058	1.21E-02	55.5	65.0	
9	24.00	42.53	0.048	1.18E-02	85.7	121.0	
		21.50	0.048	1.18E-02	85.7	121.0	
10	23.51	30.08	0.043	1.15E-02	98.5	166.4	
11	23.01	39.71	0.037	1.11E-02	115.8	219.2	
12	22.73	45.04	0.034	1.08E-02	127.4	252.6	
13	22.36	52.29	0.030	1.04E-02	145.7	303.7	
14	22.00	59.22	0.026	9.92E-03	165.8	359.6	
		31.50	0.026	9.92E-03	165.8	359.6	
15	21.21	35.45	0.019	8.52E-03	192.2	500.5	
		-190.29	0.019	8.52E-03	192.2	500.5	
16	20.61	-191.50	0.014	7.15E-03	76.7	590.8	
17	20.00	-157.33	0.010	5.66E-03	-28.8	601.8	
18	19.20	-89.49	0.007	3.76E-03	-127.5	546.9	
19	18.40	-10.22	0.004	2.16E-03	-167.4	416.4	
20	17.60	33.39	0.003	1.01E-03	-158.2	279.3	
21	16.80	50.77	0.003	2.82E-04	-124.5	163.6	
22	16.00	51.21	0.002	-1.20E-04	-83.7	80.3	
23	15.20	42.17	0.003	-3.03E-04	-46.4	29.9	
24	14.40	28.64	0.003	-3.63E-04	-18.0	6.3	
25	13.95	20.12	0.003	-3.70E-04	-7.1	1.1	
26	13.50	11.27	0.003	-3.71E-04	-0.0	-0.0	

Units: kN,m

Stage No.2 Excav. to elev. 21.21 on PASSIVE side

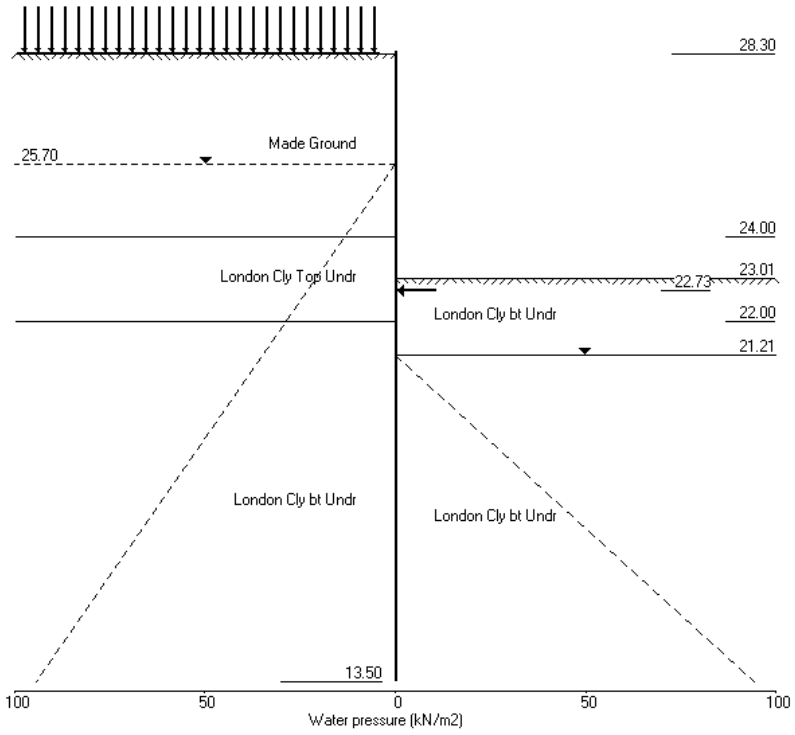


Stage No.2 Excav. to elev. 21.21 on PASSIVE side



Units: kN,m

Stage No.4 Fill to elev. 23.01 on PASSIVE side



Units: kN,m

Stage No. 4 Fill to elevation 23.01 on PASSIVE side with soil type 6

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: Active side 20.00 from wall
Passive 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/m2	Wall disp. m	Wall rotation rad.	Shear force kN/m	Bending moment kN.m/m	Strut forces kN/m
1	28.30	0.00	0.101	1.26E-02	0.0	-0.0	
2	28.15	1.04	0.099	1.26E-02	0.1	0.0	
3	27.73	5.37	0.094	1.26E-02	1.4	0.3	
4	27.30	9.84	0.089	1.26E-02	4.7	1.6	
5	26.50	16.78	0.078	1.26E-02	15.3	9.2	
6	25.70	22.86	0.068	1.25E-02	31.2	27.4	
7	25.25	28.43	0.063	1.25E-02	42.7	43.9	
8	24.80	33.94	0.057	1.24E-02	56.8	66.2	
9	24.00	43.64	0.047	1.21E-02	87.8	123.4	
		24.50	0.047	1.21E-02	87.8	123.4	
10	23.51	33.47	0.041	1.18E-02	102.1	170.2	
11	23.01	43.49	0.036	1.14E-02	121.2	225.2	
12	22.73	47.65	0.033	1.11E-02	133.7	260.2	-0.0
13	22.36	53.29	0.028	1.06E-02	152.6	313.8	
14	22.00	56.47	0.025	1.01E-02	172.4	372.0	
		34.97	0.025	1.01E-02	172.4	372.0	
15	21.21	27.79	0.017	8.71E-03	197.2	517.7	
		-197.95	0.017	8.71E-03	197.2	517.7	
16	20.61	-196.93	0.012	7.30E-03	77.7	609.6	
17	20.00	-160.86	0.008	5.76E-03	-30.5	620.2	
18	19.20	-91.06	0.005	3.80E-03	-131.3	562.8	
19	18.40	-10.43	0.002	2.16E-03	-171.9	428.8	
20	17.60	34.03	0.001	9.81E-04	-162.4	288.1	
21	16.80	51.85	0.000	2.24E-04	-128.1	169.2	
22	16.00	52.43	0.000	-1.93E-04	-86.4	83.4	
23	15.20	43.35	0.001	-3.83E-04	-48.0	31.2	
24	14.40	29.66	0.001	-4.46E-04	-18.8	6.7	
25	13.95	21.02	0.001	-4.53E-04	-7.4	1.2	
26	13.50	12.04	0.001	-4.54E-04	-0.0	-0.0	

At elev. 22.73 The strut is slack

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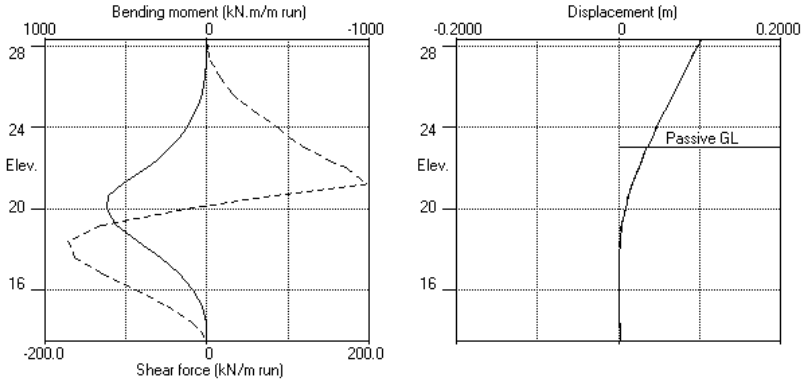
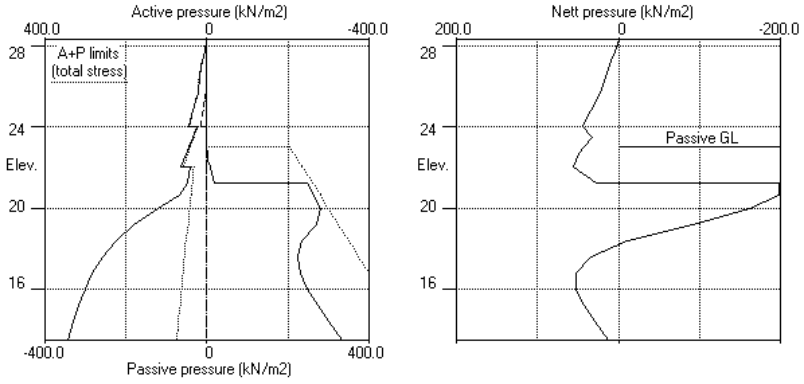
Units: kN,m

Stage No.4 Fill to elev. 23.01 on PASSIVE side



Stage No.4 Fill to elev. 23.01 on PASSIVE side



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: Active side 20.00 from wall
Passive side 20.00 from wall

Limit State: ULS DA1 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 max. m	Displacement min. m	Bending moment Calculated max. kN.m/m	Bending moment Calculated min. kN.m/m	Bending moment Factored max. kN.m/m	Bending moment Factored min. kN.m/m	Shear force Calculated max. kN/m	Shear force Calculated min. kN/m	Shear force Factored max. kN/m	Shear force Factored min. kN/m
1	28.30	0.101	0.000	0	-0	0	-0	0	0	0	0
2	28.15	0.099	0.000	0	-0	0	-0	0	-5	0	-7
3	27.73	0.094	0.000	0	-2	0	-3	1	-4	2	-5
4	27.30	0.089	0.000	2	-3	2	-4	5	-3	6	-4
5	26.50	0.079	0.000	9	-5	12	-6	15	-5	21	-6
6	25.70	0.069	0.000	27	-9	37	-12	38	-5	51	-6
7	25.25	0.064	0.000	44	-11	59	-14	55	-4	75	-6
8	24.80	0.058	0.000	73	-12	98	-17	76	-3	102	-4
9	24.00	0.049	0.000	150	-13	202	-18	119	0	160	0
10	23.51	0.043	0.000	216	-11	292	-15	149	0	201	0
11	23.01	0.037	0.000	298	-8	402	-11	183	0	246	0
12	22.73	0.034	0.000	351	-5	473	-7	200	0	271	0
13	22.36	0.031	0.000	364	-0	491	-1	153	0	206	0
14	22.00	0.027	0.000	382	0	516	0	172	0	233	0
15	21.21	0.020	0.000	518	0	699	0	197	0	266	0
16	20.61	0.016	0.000	610	0	823	0	78	0	105	0
17	20.00	0.012	0.000	620	0	837	0	0	-30	0	-41
18	19.20	0.008	0.000	563	0	760	0	0	-131	0	-177
19	18.40	0.005	0.000	429	0	579	0	0	-172	0	-232
20	17.60	0.003	0.000	288	0	389	0	0	-162	0	-219
21	16.80	0.003	0.000	198	0	267	0	0	-128	0	-173
22	16.00	0.002	0.000	122	0	164	0	0	-86	0	-117
23	15.20	0.003	0.000	61	0	82	0	0	-65	0	-88
24	14.40	0.003	0.000	18	0	25	0	0	-39	0	-52
25	13.95	0.003	0.000	5	0	6	0	0	-20	0	-27
26	13.50	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 Calculated max. kN.m/m	elev.	Bending moment Calculated min. kN.m/m	elev.	Bending moment Factored max. kN.m/m	Bending moment Factored min. kN.m/m	Shear force Calculated max. kN/m	elev.	Shear force Calculated min. kN/m	elev.	Shear force Factored max. kN/m	Shear force Factored min. kN/m
1	21	20.00	-13	24.00	28	-18	19	22.00	-5	17.60	25	-7
2	602	20.00	-0	28.30	812	-0	192	21.21	-167	18.40	259	-226
3	No calculation at this stage											
4	620	20.00	-0	28.30	837	-0	197	21.21	-172	18.40	266	-232
5	No calculation at this stage											
6	No calculation at this stage											
7	No calculation at this stage											
8	No calculation at this stage											
9	No calculation at this stage											
10	460	20.61	-3	27.30	621	-4	200	22.73	-101	17.60	271	-136

Maximum and minimum displacement at each stage

Stage no.	Displacement maximum m	elev.	Displacement minimum m	elev.	Stage description
1	0.002	28.30	0.000	28.30	Apply surcharge no.1 at elev. 28.30
2	0.101	28.30	0.000	28.30	Excav. to elev. 21.21 on PASSIVE side
3	No calculation at this stage				Install strut no.2 at elev. 22.73
4	0.101	28.30	0.000	28.30	Fill to elev. 23.01 on PASSIVE side
5	No calculation at this stage				Install strut no.3 at elev. 28.15
6	No calculation at this stage				Change soil type 8 to soil type 1
7	No calculation at this stage				Apply water pressure profile no.1
8	No calculation at this stage				Change soil type 3 to soil type 4
9	No calculation at this stage				Change soil type 6 to soil type 7
10	0.101	28.30	0.000	28.30	Apply surcharge no.2 at elev. 22.36

Strut forces at each stage (horizontal components)

Stage no.	Strut no. 2 at elev. 22.73 --Calculated-- kN per m run	Strut no. 2 at elev. 22.73 Factored kN per strut	Strut no. 3 at elev. 28.15 --Calculated-- kN per m run	Strut no. 3 at elev. 28.15 Factored kN per strut
4	slack	slack	---	---
10	178	240	5	7

* Indicates that the total force shown is the sum of the force in the strut plus a force applied at the same elevation which may represent temperature load or other forces which are part of the strut load. Force components are listed in the detailed results for individual stages.

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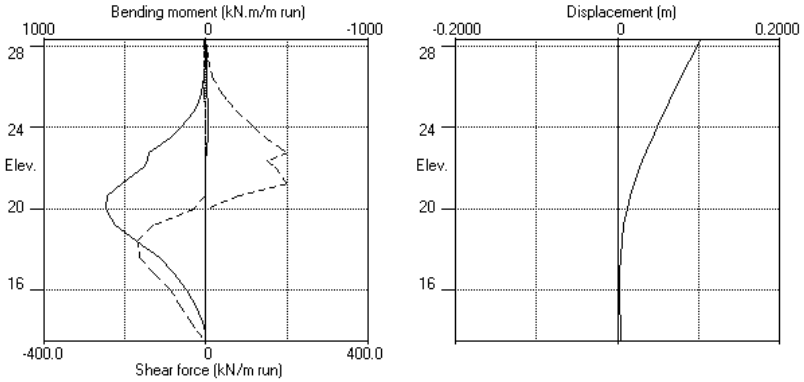
Bending moment, shear force, displacement envelopes



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Units: kN,m

INPUT DATA

SOIL PROFILE

Stratum no.	Elevation of top of stratum	Soil types Active side	Passive side
1	28.30	8 Made Ground	8 Made Ground
2	24.00	3 London Cly Top Undr	3 London Cly Top Undr
3	22.00	6 London Cly bt Undr	6 London Cly bt Undr

SOIL PROPERTIES (Unfactored SLS soil strengths)

No.	Soil type -- Description (Datum elev.)	Bulk density kN/m3	Young's Modulus Eh,kN/m2 (dEh/dy)	At rest coeff. Ko (dKo/dy)	Consol state. NC/OC (Nu)	Active limit Ka (Kac)	Passive limit Kp (Kpc)	Cohesion kN/m2 (dc/dy)
1	Made Ground	19.00	10000	0.577	OC (0.250)	0.390 (0.000)	2.561 (0.000)	
2	Gravels	19.00	30000	0.423	OC (0.300)	0.227 (0.000)	6.084 (0.000)	
3	London Cly Top Undr	19.00	20000	1.000	OC (0.490)	1.000 (2.000)	1.000 (2.000)	40.00u
4	London Cly Top dr	19.00	14000	1.000	OC (0.250)	0.422 (1.299)	2.371 (3.080)	3.000d
5	Concrete	24.00	200000	1.000	OC (0.490)	1.000 (2.000)	1.000 (2.000)	30000u
6	London Cl.. (24.00)	19.00	42500 (2589)	1.400	OC (0.490)	1.000 (2.476)	1.000 (2.390)	80.00u (5.180)
7	London Cl.. (24.00)	19.00	28000 (1813)	1.400	OC (0.250)	0.366 (1.423)	3.077 (4.665)	3.000d
8	Made Ground	19.00	10000	0.577	OC (0.250)	0.337 (0.000)	3.442 (0.000)	

Additional soil parameters associated with Ka and Kp

No.	Soil type ------- Description	--- parameters for Ka --- Soil friction angle	Wall adhesion coeff.	Back-fill angle	--- parameters for Kp --- Soil friction angle	Wall adhesion coeff.	Back-fill angle
1	Made Ground	26.00	0.000	0.00	26.00	0.000	0.00
2	Gravels	35.00	0.670	0.00	35.00	0.500	0.00
3	London Cly Top Undr	0.00	0.000	0.00	0.00	0.000	0.00
4	London Cly Top dr	24.00	0.000	0.00	24.00	0.000	0.00
5	Concrete	0.00	0.000	0.00	0.00	0.000	0.00
6	London Cly bt Undr	0.00	0.670	0.00	0.00	0.500	0.00
7	London Cly bt dr	24.00	0.670	0.00	24.00	0.500	0.00
8	Made Ground	26.00	0.670	0.00	26.00	0.500	0.00

GROUND WATER CONDITIONS

Density of water = 10.00 kN/m3

	Active side	Passive side
Initial water table elevation	25.70	21.21

Automatic water pressure balancing at toe of wall : Yes

Water press. profile no.	Point no.	Active side Elev. m	Piezo elev. m	Water press. kN/m2	Point no.	Passive side Elev. m	Piezo elev. m	Water press. kN/m2	
1	1	27.30	27.30	0.0	1	22.36	22.36	0.0	MC+WC
					2	22.36	27.30	49.4	

WALL PROPERTIES

Type of structure = Fully Embedded Wall
Elevation of toe of wall = 13.50
Maximum finite element length = 0.80 m
Youngs modulus of wall E = 1.4000E+07 kN/m2
Moment of inertia of wall I = 0.017260 m4/m run
E.I = 241640 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	26.60	5.00	0.010000	2.000E+08	10.00	0.00	0	No
2	22.73	1.00	0.300000	1.400E+07	10.00	0.00	0	No
3	28.15	1.00	0.300000	1.400E+07	10.00	0.00	0	No

SURCHARGE LOADS

Surcharge no.	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	28.30	0.50(A)	100.00	20.00	=	N/A	1.30 Var
2	22.36	-0.00(P)	30.00	20.00	50.00 =	N/A	1.00 P/U

Note: A = Active side, P = Passive 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 28.30
	No analysis at this stage
2	Excavate to elevation 21.21 on PASSIVE side
3	Install strut or anchor no.2 at elevation 22.73
4	Fill to elevation 23.01 on PASSIVE side with soil type 6
5	Install strut or anchor no.3 at elevation 28.15
6	Change properties of soil type 8 to soil type 1
	No analysis at this stage
	Ko pressures will not be reset
7	Apply water pressure profile no.1 (Worst Cred.)
	No analysis at this stage
8	Change properties of soil type 3 to soil type 4
	No analysis at this stage
	Ko pressures will not be reset
9	Change properties of soil type 6 to soil type 7
	No analysis at this stage
	Ko pressures will not be reset
10	Apply surcharge no.2 at elevation 22.36

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 Permanent Variable 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) = 0 m

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

Width of excavation on active side of wall = 20.00 m
Width of excavation on passive side of wall = 20.00 m

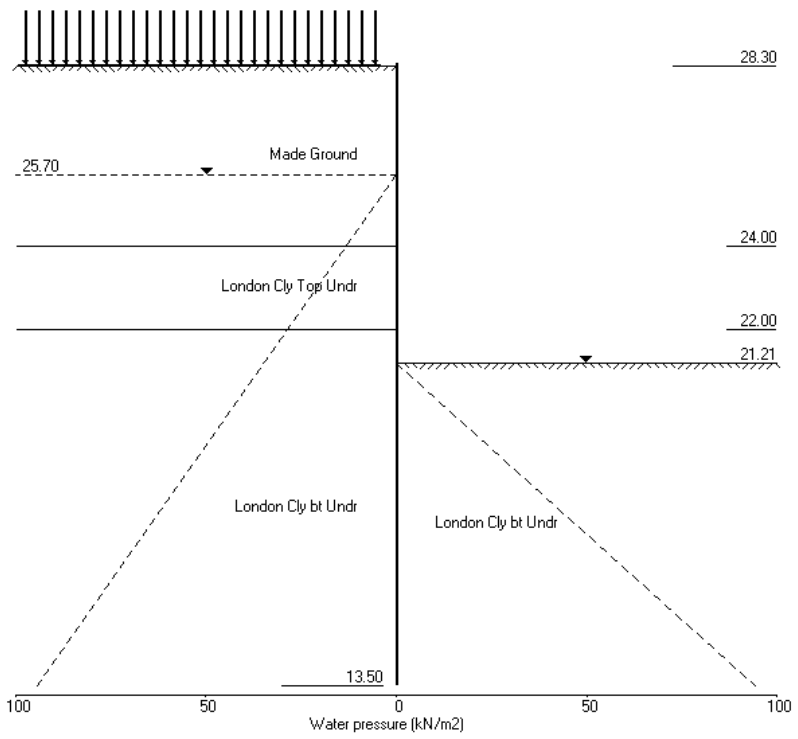
Distance to rigid boundary on active side = 20.00 m
Distance to rigid boundary on passive side = 20.00 m

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. 28.30	No	No	No
2	Excav. to elev. 21.21 on PASSIVE side	No	No	No
3	Install strut no.2 at elev. 22.73	No	No	No
4	Fill to elev. 23.01 on PASSIVE side	No	No	No
5	Install strut no.3 at elev. 28.15	No	No	No
6	Change soil type 8 to soil type 1	No	No	No
7	Apply water pressure profile no.1	No	No	No
8	Change soil type 3 to soil type 4	No	No	No
9	Change soil type 6 to soil type 7	No	No	No
10	Apply surcharge no.2 at elev. 22.36	No	No	No
*	Summary output	Yes	-	Yes

Units: kN,m

Stage No.2 Excav. to elev. 21.21 on PASSIVE side



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Stage No. 2 Excavate to elevation 21.21 on PASSIVE side

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

Stage No.	--- G.L. --- Act.	Pass.	Strut Elev.	Overall FoS for toe elev. = 13.50 Factor of Safety	Moment equilib. at elev.	Toe elev. for FoS = 1.000 Toe elev.	Wall Penetr -ation
2	28.30	21.21	Cant.	1.219	15.01	14.89	6.32

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: Active side 20.00 from wall
Passive side 20.00 from wall
Limit State: ULS DA1 Combination 2

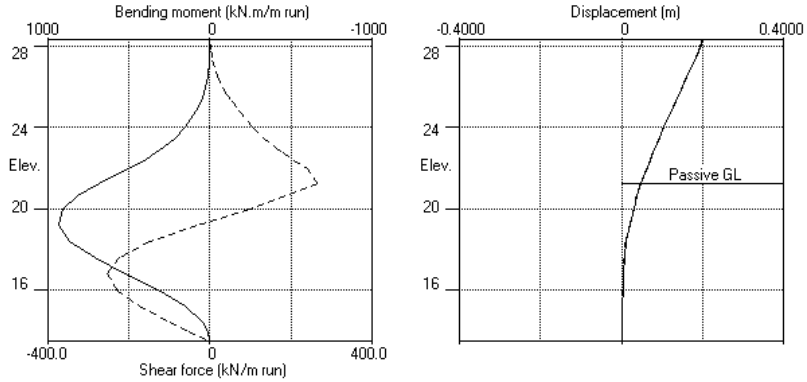
Node no.	Y coord	Nett pressure kN/m2	Wall disp. m	Wall rotation rad.	Shear force kN/m	Bending moment kN.m/m	Strut forces kN/m
1	28.30	0.00	0.201	2.26E-02	0.0	-0.0	
2	28.15	1.28	0.198	2.26E-02	0.1	0.0	
3	27.73	6.92	0.188	2.26E-02	1.8	0.3	
4	27.30	12.59	0.179	2.26E-02	6.0	1.9	
5	26.50	21.10	0.161	2.26E-02	19.5	12.0	
6	25.70	28.37	0.143	2.25E-02	39.3	35.1	
7	25.25	34.29	0.132	2.24E-02	53.3	55.8	
8	24.80	40.12	0.122	2.23E-02	70.1	83.4	
9	24.00	50.34	0.105	2.19E-02	106.3	153.4	
		46.63	0.105	2.19E-02	106.3	153.4	
10	23.51	56.38	0.094	2.15E-02	131.8	212.1	
11	23.01	66.06	0.083	2.10E-02	162.1	284.5	
12	22.73	71.41	0.078	2.07E-02	181.0	331.7	
13	22.36	78.68	0.070	2.01E-02	209.1	404.7	
14	22.00	85.63	0.063	1.94E-02	238.7	485.2	
		31.50	0.063	1.94E-02	238.7	485.2	
15	21.21	35.45	0.048	1.75E-02	265.1	683.7	
		-125.79	0.048	1.75E-02	265.1	683.7	
16	20.61	-139.61	0.038	1.56E-02	184.9	820.1	
17	20.00	-153.44	0.029	1.35E-02	96.2	905.4	
18	19.20	-171.76	0.020	1.04E-02	-33.9	931.1	
19	18.40	-118.15	0.012	7.50E-03	-149.9	869.1	
20	17.60	-67.94	0.007	4.89E-03	-224.3	711.0	
21	16.80	-1.93	0.004	2.85E-03	-252.2	522.4	
22	16.00	57.26	0.003	1.45E-03	-230.1	320.1	
23	15.20	87.23	0.002	6.70E-04	-172.3	154.4	
24	14.40	101.89	0.001	3.41E-04	-96.7	44.6	
25	13.95	107.48	0.001	2.89E-04	-49.5	11.4	
26	13.50	112.73	0.001	2.78E-04	-0.0	-0.0	

(continued)

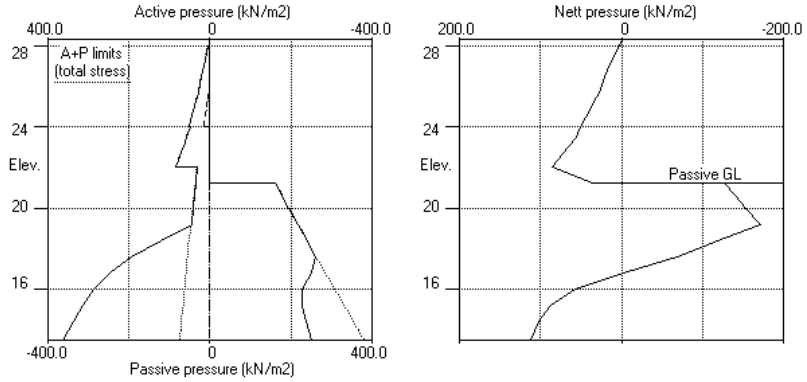
Stage No.2 Excavate to elevation 21.21 on PASSIVE side

Units: kN,m

Stage No.2 Excav. to elev. 21.21 on PASSIVE side

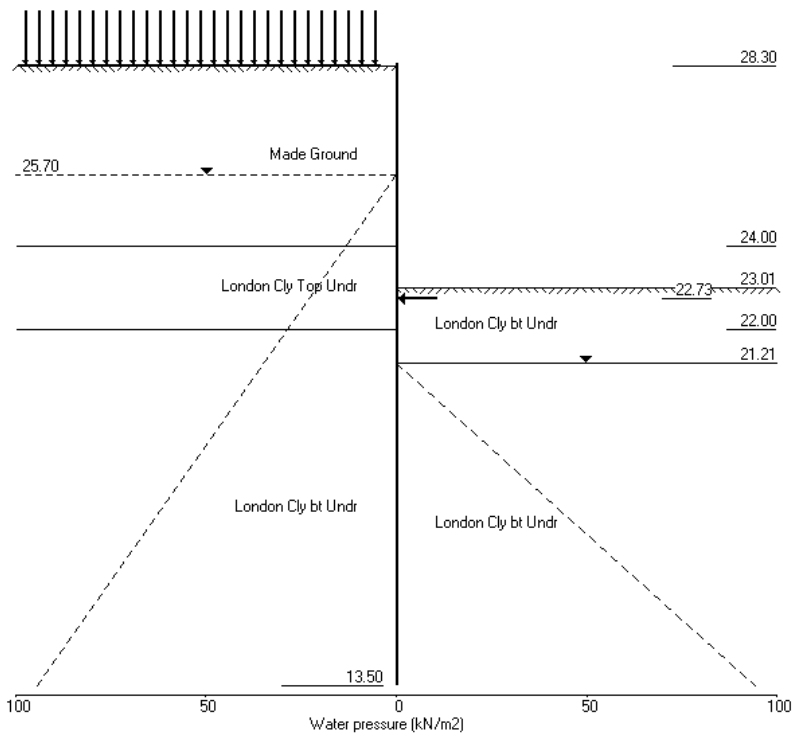


Stage No.2 Excav. to elev. 21.21 on PASSIVE side



Units: kN,m

Stage No.4 Fill to elev. 23.01 on PASSIVE side



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Units: kN,m

Stage No. 4 Fill to elevation 23.01 on PASSIVE side with soil type 6

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

Stage No.	--- G.L. --- Act.	Pass.	Strut Elev.	Overall FoS for toe elev. = 13.50 Factor of Safety	Moment equilib. at elev.	Toe elev. for FoS = 1.000 Toe elev.	Wall Penetr -ation
4	28.30	23.01	22.73	Conditions not suitable for 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: Active side 20.00 from wall
Passive 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
1	28.30	0.00	0.202	2.29E-02	0.0	-0.0	
2	28.15	1.28	0.198	2.29E-02	0.1	0.0	
3	27.73	6.92	0.188	2.29E-02	1.8	0.3	
4	27.30	12.70	0.179	2.29E-02	6.0	1.9	
5	26.50	21.45	0.160	2.29E-02	19.7	12.1	
6	25.70	28.97	0.142	2.28E-02	39.8	35.4	
7	25.25	35.02	0.132	2.27E-02	54.2	56.4	
8	24.80	40.99	0.121	2.26E-02	71.3	84.6	
9	24.00	51.45	0.104	2.22E-02	108.3	155.8	
		49.63	0.104	2.22E-02	108.3	155.8	
10	23.51	59.78	0.093	2.18E-02	135.4	215.9	
11	23.01	69.84	0.082	2.13E-02	167.5	290.5	
12	22.73	74.01	0.076	2.09E-02	187.3	339.3	-0.0
13	22.36	79.67	0.068	2.04E-02	216.1	414.8	
14	22.00	82.88	0.061	1.97E-02	245.3	497.6	
		34.97	0.061	1.97E-02	245.3	497.6	
15	21.21	27.79	0.046	1.77E-02	270.1	700.9	
		-133.45	0.046	1.77E-02	270.1	700.9	
16	20.61	-145.04	0.036	1.58E-02	185.9	838.9	
17	20.00	-156.98	0.027	1.36E-02	94.5	923.8	
18	19.20	-173.33	0.017	1.05E-02	-37.6	947.1	
19	18.40	-118.36	0.010	7.50E-03	-154.3	881.5	
20	17.60	-67.29	0.005	4.85E-03	-228.6	719.8	
21	16.80	-0.85	0.002	2.79E-03	-255.8	528.0	
22	16.00	58.49	0.001	1.38E-03	-232.8	323.2	
23	15.20	88.42	-0.000	5.90E-04	-174.0	155.7	
24	14.40	102.91	-0.000	2.58E-04	-97.5	44.9	
25	13.95	108.39	-0.000	2.05E-04	-49.9	11.5	
26	13.50	113.50	-0.001	1.95E-04	-0.0	-0.0	

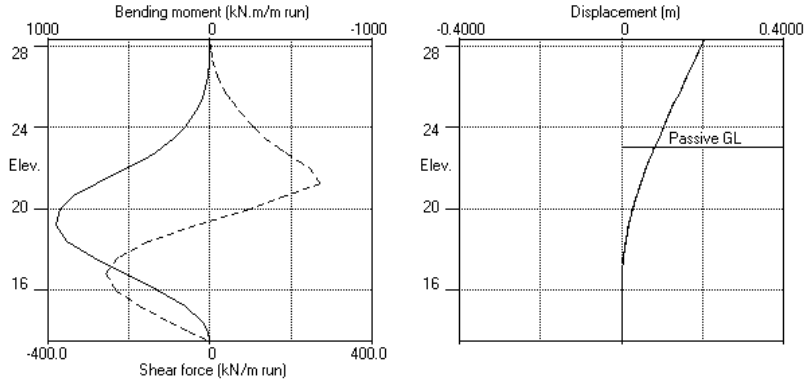
At elev. 22.73 The strut is slack

(continued)

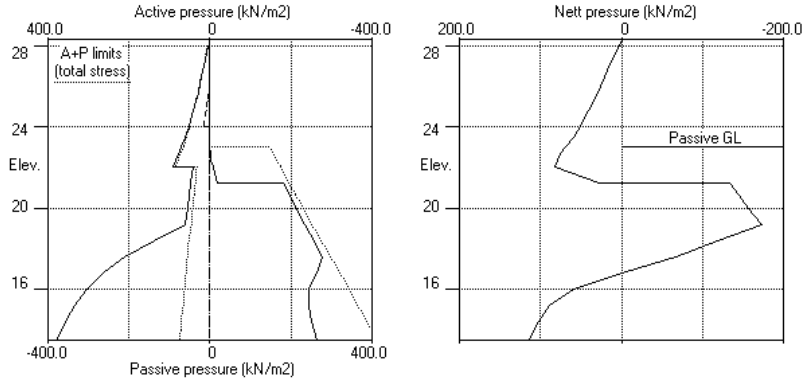
Stage No.4 Fill to elevation 23.01 on PASSIVE side with soil type 6

Units: kN,m

Stage No.4 Fill to elev. 23.01 on PASSIVE side



Stage No.4 Fill to elev. 23.01 on PASSIVE side



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 Permanent Variable loads = 1.300

STABILITY ANALYSIS of Fully Embedded Wall according to Strength Factor method

Factor of safety on soil strength

Stage No.	G.L. Act.	G.L. Pass.	Strut Elev.	Overall FoS for toe elev. = 13.50 Factor of Safety	Moment equilib. at elev.	Toe elev. for FoS = 1.000 Toe elev.	Wall Penetr -ation
1	28.30	28.30	Cant.	Conditions not suitable for FoS calc.			
2	28.30	21.21	Cant.	1.219	15.01	14.89	6.32
3	28.30	21.21		No analysis at this stage			
4	28.30	23.01	22.73	Conditions not suitable for FoS calc.			
5	28.30	23.01		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: Section B2 Rev A_ULS2 |
Camley Street | Date: 8-12-2015
Section B2 | 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: Active side 20.00 from wall
Passive side 20.00 from wall

Limit State: ULS DA1 Combination 2

Bending moment, shear force and displacement envelopes

Node no.	Y coord	Displacement maximum m	Displacement minimum m	Bending moment maximum kN.m/m	Bending moment minimum kN.m/m	Shear force maximum kN/m	Shear force minimum kN/m
1	28.30	0.202	0.000	0.0	-0.0	0.0	0.0
2	28.15	0.198	0.000	0.0	-0.0	0.5	-0.3
3	27.73	0.188	0.000	0.9	-0.5	5.3	-1.9
4	27.30	0.179	0.000	4.7	-1.6	13.0	-3.0
5	26.50	0.161	0.000	23.6	-4.2	34.6	-4.4
6	25.70	0.143	0.000	63.1	-8.0	65.5	-4.9
7	25.25	0.132	0.000	97.3	-10.2	86.7	-4.4
8	24.80	0.122	0.000	141.6	-11.9	110.5	-3.1
9	24.00	0.105	0.000	249.1	-12.8	159.1	0.0
10	23.51	0.094	0.000	336.1	-11.3	193.1	0.0
11	23.01	0.083	0.000	441.0	-7.8	231.3	0.0
12	22.73	0.078	0.000	507.5	-4.8	252.4	0.0
13	22.36	0.071	0.000	521.7	0.0	216.1	0.0
14	22.00	0.065	0.000	542.1	0.0	245.3	0.0
15	21.21	0.052	0.000	700.9	0.0	270.1	0.0
16	20.61	0.043	0.000	838.9	0.0	185.9	0.0
17	20.00	0.035	0.000	923.8	0.0	96.2	-0.9
18	19.20	0.026	0.000	947.1	0.0	0.0	-37.6
19	18.40	0.019	0.000	881.5	0.0	0.0	-154.3
20	17.60	0.013	0.000	719.8	0.0	0.0	-228.6
21	16.80	0.009	0.000	528.0	0.0	0.0	-255.8
22	16.00	0.005	0.000	323.2	0.0	0.0	-232.8
23	15.20	0.003	-0.000	160.9	0.0	0.0	-174.0
24	14.40	0.001	-0.000	58.6	0.0	0.0	-100.4
25	13.95	0.001	-0.000	20.5	0.0	0.0	-65.2
26	13.50	0.001	-0.001	0.0	-0.0	0.0	-0.0

Maximum and minimum bending moment and shear force at each stage

Stage no.	Bending moment maximum kN.m/m	Bending moment elev.	Bending moment minimum kN.m/m	Bending moment elev.	Shear force maximum kN/m	Shear force elev.	Shear force minimum kN/m	Shear force elev.
1	23.0	20.00	-12.8	24.00	20.2	22.00	-5.8	18.40
2	931.1	19.20	-0.0	28.30	265.1	21.21	-252.2	16.80
3	No calculation at this stage							
4	947.1	19.20	-0.0	28.30	270.1	21.21	-255.8	16.80
5	No calculation at this stage							
6	No calculation at this stage							
7	No calculation at this stage							
8	No calculation at this stage							
9	No calculation at this stage							
10	649.0	20.00	-0.0	28.30	252.4	22.73	-158.4	16.00

Summary of results (continued)

Maximum and minimum displacement at each stage

Stage no.	Displacement maximum m	elev.	minimum m	elev.	Stage description
1	0.003	28.30	0.000	28.30	Apply surcharge no.1 at elev. 28.30
2	0.201	28.30	0.000	28.30	Excav. to elev. 21.21 on PASSIVE side
3	No calculation at this stage				Install strut no.2 at elev. 22.73
4	0.202	28.30	-0.001	13.50	Fill to elev. 23.01 on PASSIVE side
5	No calculation at this stage				Install strut no.3 at elev. 28.15
6	No calculation at this stage				Change soil type 8 to soil type 1
7	No calculation at this stage				Apply water pressure profile no.1
8	No calculation at this stage				Change soil type 3 to soil type 4
9	No calculation at this stage				Change soil type 6 to soil type 7
10	0.197	28.30	-0.001	13.50	Apply surcharge no.2 at elev. 22.36

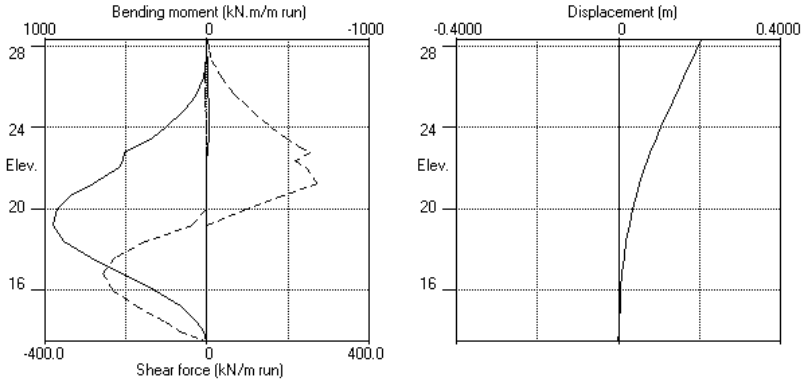
Strut forces at each stage (horizontal components)

Stage no.	Strut no. 2 at elev. 22.73 kN/m run	Strut no. 2 at elev. 22.73 kN/strut	Strut no. 3 at elev. 28.15 kN/m run	Strut no. 3 at elev. 28.15 kN/strut
4	slack	slack	---	---
10	229.43	229.43	slack	slack

* Indicates that the total force shown is the sum of the force in the strut plus a force applied at the same elevation which may represent temperature load or other forces which are part of the strut load. Force components are listed in the detailed results for individual stages.

Units: kN,m

Bending moment, shear force, displacement envelopes



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Data filename/Run ID: Section B3 Rev A_ULS1 |
Camley Street | Date: 8-12-2015
Section B3 | Checked :

Units: kN,m

INPUT DATA

SOIL PROFILE

Stratum no.	Elevation of top of stratum	Soil types Active side	Passive side
1	27.65	1 Made Ground	1 Made Ground
2	24.00	3 London Cly Top Undr	3 London Cly Top Undr
3	22.00	6 London Cly bt Undr	6 London Cly bt Undr

SOIL PROPERTIES (Unfactored SLS soil strengths)

No.	Soil type -- Description (Datum elev.)	Bulk density kN/m3	Young's Modulus Eh,kN/m2 (dEh/dy)	At rest coeff. Ko (dKo/dy)	Consol state. NC/OC (Nu)	Active limit Ka (Kac)	Passive limit Kp (Kpc)	Cohesion kN/m2 (dc/dy)
1	Made Ground	19.00	10000	0.577	OC (0.250)	0.390 (0.000)	2.561 (0.000)	
2	Gravels	19.00	30000	0.423	OC (0.300)	0.227 (0.000)	6.084 (0.000)	
3	London Cly Top Undr	19.00	20000	1.000	OC (0.490)	1.000 (2.000)	1.000 (2.000)	40.00u
4	London Cly Top dr	19.00	14000	1.000	OC (0.250)	0.422 (1.299)	2.371 (3.080)	3.000d
5	Concrete	24.00	200000	1.000	OC (0.490)	1.000 (2.000)	1.000 (2.000)	30000u
6	London Cl.. (24.00)	19.00	42500 (2589)	1.400	OC (0.490)	1.000 (2.476)	1.000 (2.390)	80.00u (5.180)
7	London Cl.. (24.00)	19.00	28000 (1813)	1.400	OC (0.250)	0.366 (1.423)	3.077 (4.665)	3.000d

Additional soil parameters associated with Ka and Kp

No.	Soil type ------- Description	--- parameters for Ka --- Soil friction angle	Wall adhesion coeff.	Back-fill angle	--- parameters for Kp --- Soil friction angle	Wall adhesion coeff.	Back-fill angle
1	Made Ground	26.00	0.000	0.00	26.00	0.000	0.00
2	Gravels	35.00	0.670	0.00	35.00	0.500	0.00
3	London Cly Top Undr	0.00	0.000	0.00	0.00	0.000	0.00
4	London Cly Top dr	24.00	0.000	0.00	24.00	0.000	0.00
5	Concrete	0.00	0.000	0.00	0.00	0.000	0.00
6	London Cly bt Undr	0.00	0.670	0.00	0.00	0.500	0.00
7	London Cly bt dr	24.00	0.670	0.00	24.00	0.500	0.00

GROUND WATER CONDITIONS

Density of water = 10.00 kN/m3

	Active side	Passive side
Initial water table elevation	24.65	21.08

Automatic water pressure balancing at toe of wall : Yes

Water press. profile no.	Point no.	Active side Elev. m	Piezo elev. m	Water press. kN/m2	Point no.	Passive side Elev. m	Piezo elev. m	Water press. kN/m2	
1	1	27.30	27.30	0.0	1	22.36	22.36	0.0	MC+WC
					2	22.36	27.30	49.4	

WALL PROPERTIES

Type of structure = Fully Embedded Wall
Elevation of toe of wall = 13.50
Maximum finite element length = 0.80 m
Youngs modulus of wall E = 1.4000E+07 kN/m2
Moment of inertia of wall I = 0.017260 m4/m run
E.I = 241640 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	26.60	5.00	0.010000	2.000E+08	10.00	0.00	0	No
2	22.73	1.00	0.300000	1.400E+07	10.00	0.00	0	No
3	27.50	1.00	0.300000	1.400E+07	10.00	0.00	0	No

SURCHARGE LOADS

Surcharge 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	27.65	0.50(A)	100.00	20.00	20.00	=		N/A	1.10 Var
2	22.36	-0.00(P)	30.00	20.00	50.00	=		N/A	1.00 P/U
3	27.65	0.50(A)	100.00	20.00	7.00	=		N/A	1.00 P/U
4	28.00	0.50(A)	100.00	20.00	20.00	=		N/A	1.10 Var

Note: A = Active side, P = Passive 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.3 at elevation 27.65
	No analysis at this stage
2	Apply surcharge no.1 at elevation 27.65
	No analysis at this stage
3	Excavate to elevation 21.21 on PASSIVE side
4	Install strut or anchor no.2 at elevation 22.73
5	Fill to elevation 23.01 on PASSIVE side with soil type 6
6	Install strut or anchor no.3 at elevation 27.50
7	Remove surcharge no.3 at elevation 27.65
	No analysis at this stage
8	Remove surcharge no.1 at elevation 27.65
	No analysis at this stage
9	Fill to elevation 28.00 on ACTIVE side with soil type 1
10	Apply surcharge no.4 at elevation 28.00
	No analysis at this stage
11	Apply water pressure profile no.1 (Mod. Conserv.)
	No analysis at this stage
12	Change properties of soil type 3 to soil type 4
	No analysis at this stage
	Ko pressures will not be reset
13	Change properties of soil type 6 to soil type 7
	No analysis at this stage
	Ko pressures will not be reset
14	Apply surcharge no.2 at elevation 22.36

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 Permanent Variable 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) = 0 m

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

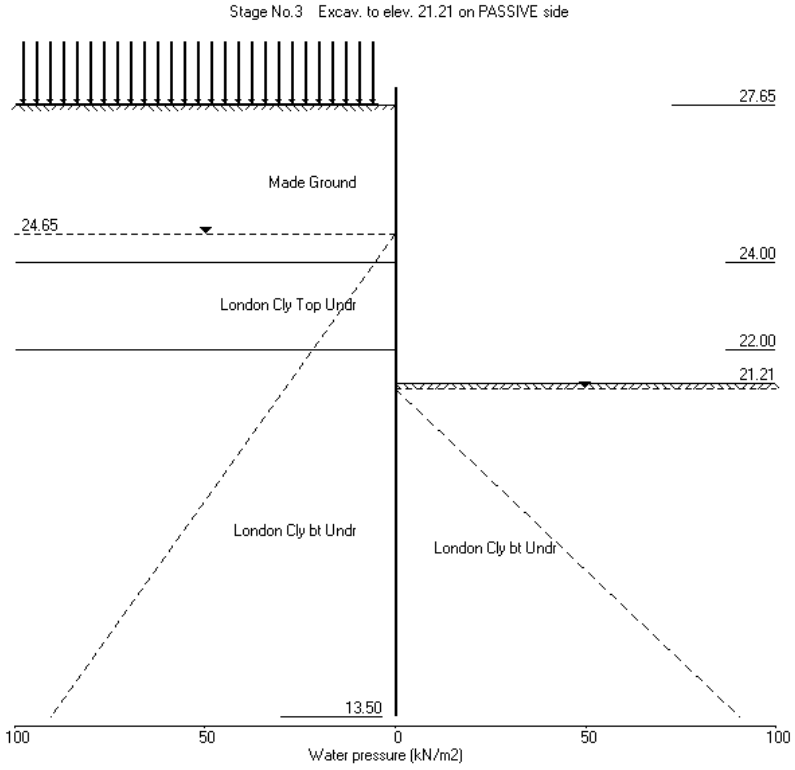
Width of excavation on active side of wall = 20.00 m
Width of excavation on passive side of wall = 20.00 m

Distance to rigid boundary on active side = 20.00 m
Distance to rigid boundary on passive 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.3 at elev. 27.65	No	No	No
2	Apply surcharge no.1 at elev. 27.65	No	No	No
3	Excav. to elev. 21.21 on PASSIVE side	No	No	No
4	Install strut no.2 at elev. 22.73	No	No	No
5	Fill to elev. 23.01 on PASSIVE side	No	No	No
6	Install strut no.3 at elev. 27.50	No	No	No
7	Remove surcharge no.3 at elev. 27.65	No	No	No
8	Remove surcharge no.1 at elev. 27.65	No	No	No
9	Fill to elev. 28.00 on ACTIVE side	No	No	No
10	Apply surcharge no.4 at elev. 28.00	No	No	No
11	Apply water pressure profile no.1	No	No	No
12	Change soil type 3 to soil type 4	No	No	No
13	Change soil type 6 to soil type 7	No	No	No
14	Apply surcharge no.2 at elev. 22.36	No	No	No
*	Summary output	Yes	-	Yes

Units: kN,m



Units: kN,m

Stage No. 3 Excavate to elevation 21.21 on PASSIVE 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: Active side 20.00 from wall
Passive 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/m2	Wall disp. m	Wall rotation rad.	Shear force kN/m	Bending moment kN.m/m	Strut forces kN/m
1	28.00	0.00	0.075	9.56E-03	0.0	-0.0	
2	27.65	0.00	0.072	9.56E-03	0.0	0.0	
3	27.50	1.23	0.070	9.56E-03	0.1	0.0	
4	27.30	3.61	0.069	9.56E-03	0.6	0.1	
5	26.85	9.99	0.064	9.56E-03	3.6	0.9	
6	26.40	15.37	0.060	9.56E-03	9.3	3.7	
7	25.60	23.14	0.052	9.52E-03	24.7	16.9	
8	25.13	27.26	0.048	9.47E-03	36.7	31.5	
9	24.65	31.20	0.043	9.39E-03	50.6	52.1	
10	24.00	39.63	0.037	9.20E-03	73.6	92.2	
		18.25	0.037	9.20E-03	73.6	92.2	
11	23.51	23.23	0.033	8.97E-03	83.9	131.0	
12	23.01	33.06	0.028	8.66E-03	97.8	175.8	
13	22.73	38.48	0.026	8.44E-03	107.7	204.0	
14	22.36	45.83	0.023	8.09E-03	123.5	247.3	
15	22.00	52.84	0.020	7.69E-03	141.2	294.8	
		28.25	0.020	7.69E-03	141.2	294.8	
16	21.21	32.20	0.014	6.52E-03	165.1	415.5	
		-193.54	0.014	6.52E-03	165.1	415.5	
17	21.08	-194.42	0.014	6.30E-03	140.9	435.0	
18	20.54	-166.76	0.011	5.27E-03	42.9	482.6	
19	20.00	-138.83	0.008	4.18E-03	-40.0	490.1	
20	19.20	-51.40	0.005	2.69E-03	-116.1	413.8	
21	18.40	3.58	0.004	1.50E-03	-135.2	304.6	
22	17.60	32.18	0.003	6.70E-04	-120.9	197.6	
23	16.80	41.97	0.002	1.59E-04	-91.3	111.3	
24	16.00	39.64	0.002	-1.10E-04	-58.6	51.8	
25	15.20	30.78	0.003	-2.25E-04	-30.4	17.7	
26	14.40	19.00	0.003	-2.60E-04	-10.5	3.2	
27	13.95	11.76	0.003	-2.63E-04	-3.6	0.4	
28	13.50	4.27	0.003	-2.63E-04	0.0	-0.0	

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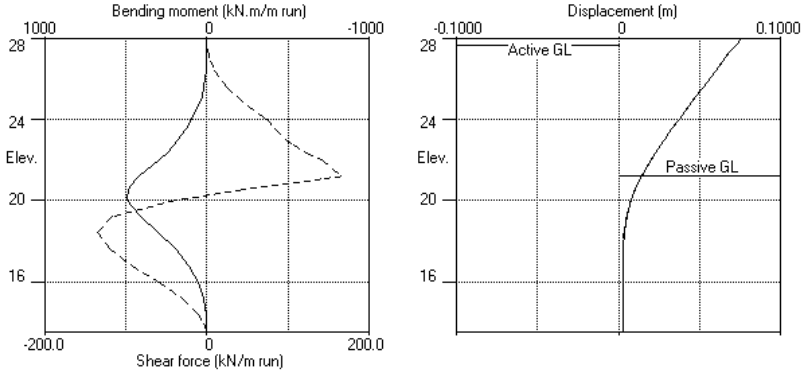
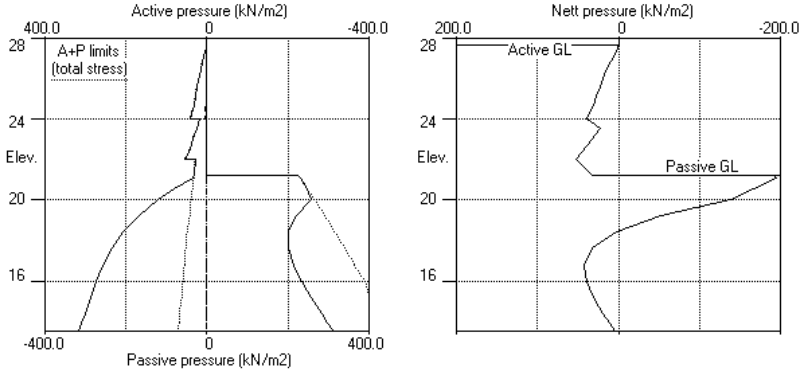
Camley Street | Date: 8-12-2015
Section B3 | Checked :

Units: kN,m

Stage No.3 Excav. to elev. 21.21 on PASSIVE side

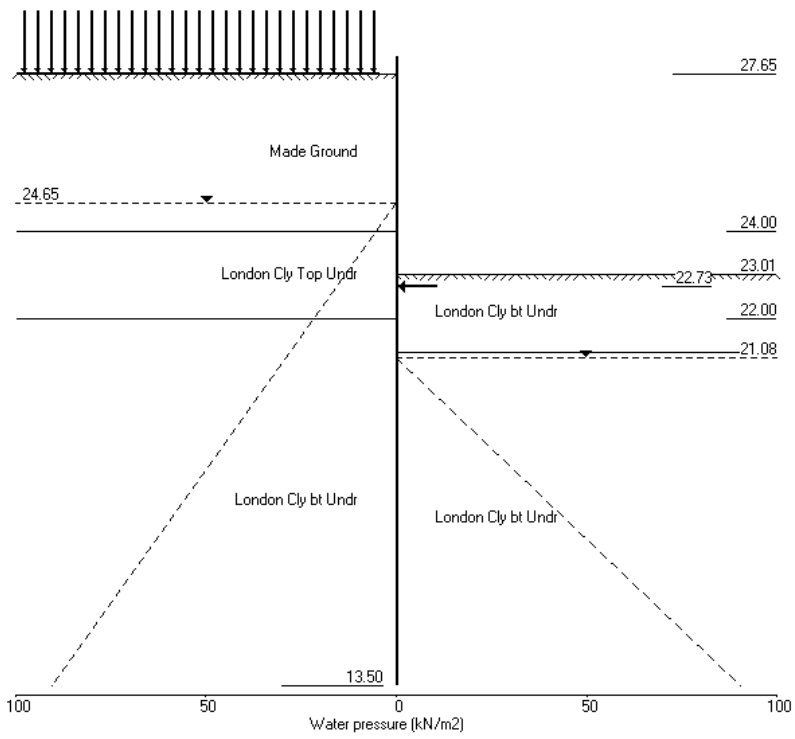


Stage No.3 Excav. to elev. 21.21 on PASSIVE side



Units: kN,m

Stage No.5 Fill to elev. 23.01 on PASSIVE side



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Camley Street | Date: 8-12-2015
Section B3 | Checked :

Units: kN,m

Stage No. 5 Fill to elevation 23.01 on PASSIVE side with soil type 6

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: Active side 20.00 from wall
Passive 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/m2	Wall disp. m	Wall rotation rad.	Shear force kN/m	Bending moment kN.m/m	Strut forces kN/m
1	28.00	0.00	0.075	9.87E-03	0.0	-0.0	
2	27.65	0.00	0.072	9.87E-03	0.0	0.0	
3	27.50	1.28	0.070	9.87E-03	0.1	0.0	
4	27.30	3.72	0.068	9.87E-03	0.6	0.1	
5	26.85	10.24	0.064	9.87E-03	3.7	0.9	
6	26.40	15.75	0.060	9.86E-03	9.6	3.8	
7	25.60	23.77	0.052	9.83E-03	25.4	17.3	
8	25.13	28.04	0.047	9.78E-03	37.7	32.2	
9	24.65	32.12	0.042	9.70E-03	52.0	53.5	
10	24.00	40.74	0.036	9.50E-03	75.7	94.6	
		21.25	0.036	9.50E-03	75.7	94.6	
11	23.51	26.62	0.032	9.26E-03	87.5	134.9	
12	23.01	36.83	0.027	8.94E-03	103.2	181.8	
13	22.73	41.08	0.025	8.71E-03	113.9	211.6	-0.0
14	22.36	46.82	0.021	8.35E-03	130.4	257.4	
15	22.00	50.09	0.018	7.93E-03	147.9	307.2	
		31.71	0.018	7.93E-03	147.9	307.2	
16	21.21	24.53	0.013	6.72E-03	170.1	432.6	
		-201.20	0.013	6.72E-03	170.1	432.6	
17	21.08	-201.60	0.012	6.49E-03	144.9	452.7	
18	20.54	-171.98	0.009	5.42E-03	43.6	501.4	
19	20.00	-142.37	0.006	4.29E-03	-41.7	508.5	
20	19.20	-52.97	0.003	2.73E-03	-119.8	429.7	
21	18.40	3.38	0.001	1.50E-03	-139.7	317.0	
22	17.60	32.82	0.001	6.34E-04	-125.2	206.5	
23	16.80	43.05	0.000	9.94E-05	-94.8	116.9	
24	16.00	40.87	0.000	-1.84E-04	-61.3	54.9	
25	15.20	31.97	0.001	-3.07E-04	-32.1	19.0	
26	14.40	20.02	0.001	-3.44E-04	-11.3	3.6	
27	13.95	12.67	0.001	-3.48E-04	-4.0	0.5	
28	13.50	5.04	0.001	-3.48E-04	0.0	-0.0	

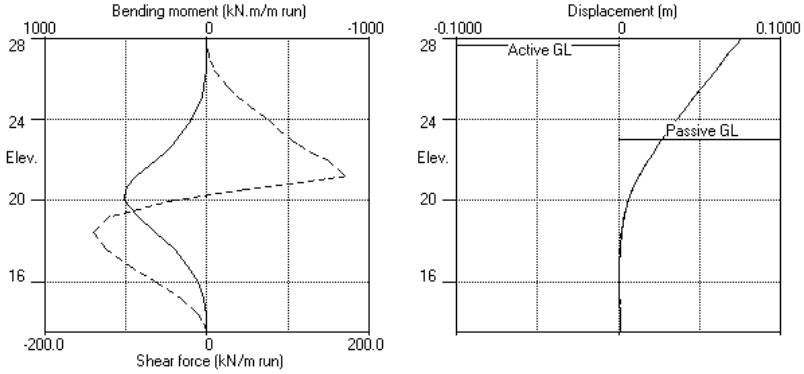
At elev. 22.73 The strut is slack

(continued)

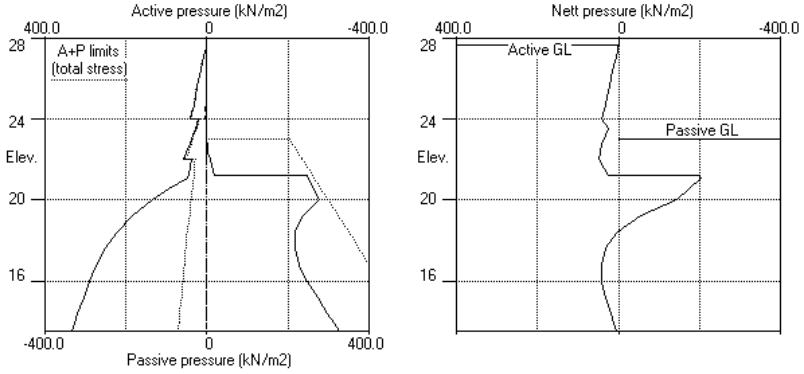
Stage No.5 Fill to elevation 23.01 on PASSIVE side with soil type 6

Units: kN,m

Stage No.5 Fill to elev. 23.01 on PASSIVE side

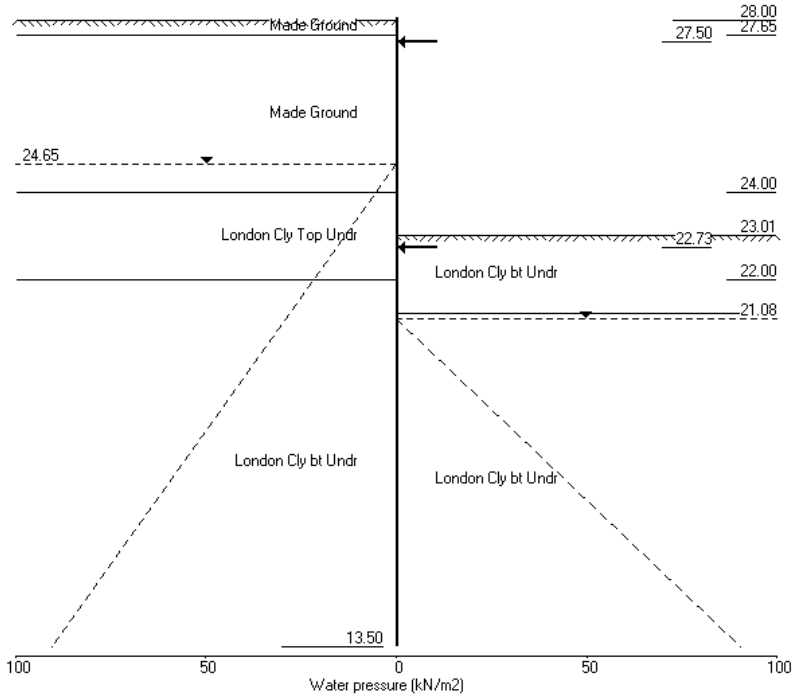


Stage No.5 Fill to elev. 23.01 on PASSIVE side



Units: kN,m

Stage No.9 Fill to elev. 28.00 on ACTIVE side



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Camley Street | Date: 8-12-2015
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Units: kN,m

Stage No. 9 Fill to elevation 28.00 on ACTIVE 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: Active side 20.00 from wall
Passive 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/m2	Wall disp. m	Wall rotation rad.	Shear force kN/m	Bending moment kN.m/m	Strut forces kN/m
1	28.00	0.00	0.072	9.75E-03	0.0	-0.0	
2	27.65	5.76	0.069	9.75E-03	1.0	0.0	
3	27.50	6.91	0.068	9.75E-03	2.0	0.3	-0.0
4	27.30	8.56	0.066	9.75E-03	3.5	0.8	
5	26.85	12.42	0.061	9.75E-03	8.2	3.4	
6	26.40	16.12	0.057	9.74E-03	14.6	8.5	
7	25.60	22.44	0.049	9.68E-03	30.1	26.0	
8	25.13	26.10	0.044	9.61E-03	41.6	42.9	
9	24.65	29.73	0.040	9.50E-03	54.9	65.8	
10	24.00	37.85	0.034	9.27E-03	76.8	108.3	
		20.00	0.034	9.27E-03	76.8	108.3	
11	23.51	22.47	0.029	9.01E-03	87.3	148.8	
12	23.01	26.08	0.025	8.65E-03	99.4	194.6	
13	22.73	29.89	0.023	8.42E-03	107.0	223.0	-0.0
14	22.36	35.05	0.019	8.04E-03	119.2	265.3	
15	22.00	39.98	0.017	7.61E-03	132.7	310.4	
		30.26	0.017	7.61E-03	132.7	310.4	
16	21.21	31.31	0.011	6.41E-03	157.0	424.4	
		-187.99	0.011	6.41E-03	157.0	424.4	
17	21.08	-190.69	0.010	6.18E-03	133.4	443.0	
18	20.54	-163.51	0.007	5.14E-03	37.3	487.0	
19	20.00	-136.13	0.005	4.04E-03	-44.0	492.0	
20	19.20	-49.48	0.002	2.54E-03	-118.2	413.4	
21	18.40	4.83	0.001	1.36E-03	-136.1	303.1	
22	17.60	32.92	-0.000	5.35E-04	-121.0	195.9	
23	16.80	42.34	-0.000	2.93E-05	-90.9	109.7	
24	16.00	39.74	-0.000	-2.36E-04	-58.0	50.6	
25	15.20	30.68	-0.000	-3.48E-04	-29.9	17.0	
26	14.40	18.68	0.000	-3.81E-04	-10.1	3.0	
27	13.95	11.32	0.000	-3.84E-04	-3.4	0.4	
28	13.50	3.68	0.001	-3.84E-04	0.0	-0.0	

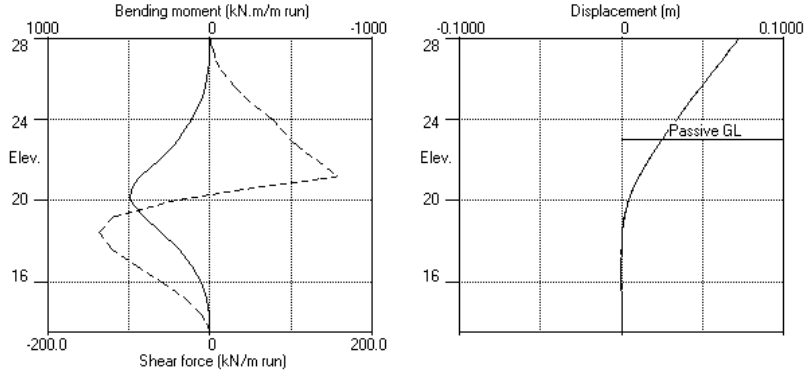
At elev. 27.50 The strut is slack
At elev. 22.73 The strut is slack

(continued)

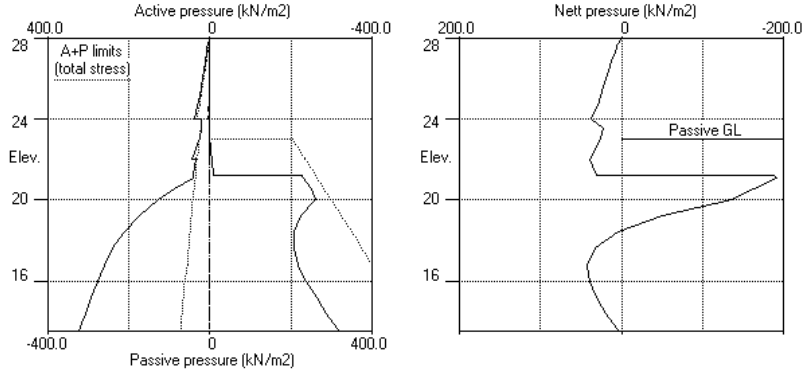
Stage No.9 Fill to elevation 28.00 on ACTIVE side with soil type 1

Units: kN,m

Stage No.9 Fill to elev. 28.00 on ACTIVE side



Stage No.9 Fill to elev. 28.00 on ACTIVE side



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: Active side 20.00 from wall
Passive side 20.00 from wall

Limit State: ULS DA1 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 max.	Displacement min.	Bending moment Calculated max.	Bending moment Calculated min.	Bending moment Factored max.	Bending moment Factored min.	Shear force Calculated max.	Shear force Calculated min.	Shear force Factored max.	Shear force Factored min.
	m	m	m	kN.m/m	kN.m/m	kN.m/m	kN.m/m	kN/m	kN/m	kN/m	kN/m
1	28.00	0.075	0.000	0	-0	0	-0	0	0	0	0
2	27.65	0.072	0.000	0	-0	0	-0	1	0	1	0
3	27.50	0.070	0.000	0	-0	0	-0	2	-15	3	-20
4	27.30	0.069	0.000	1	-3	1	-4	4	-13	5	-18
5	26.85	0.064	0.000	3	-7	5	-10	8	-8	11	-11
6	26.40	0.060	0.000	8	-9	11	-12	15	-1	20	-2
7	25.60	0.053	0.000	26	-2	35	-3	30	-1	41	-2
8	25.13	0.048	0.000	43	-3	58	-4	43	-1	58	-2
9	24.65	0.044	0.000	66	-3	89	-4	65	-1	88	-1
10	24.00	0.038	0.000	108	-4	146	-5	100	0	135	0
11	23.51	0.033	0.000	151	-3	204	-4	129	0	174	0
12	23.01	0.029	0.000	223	-2	301	-3	161	0	218	0
13	22.73	0.026	0.000	269	-1	364	-1	177	0	238	0
14	22.36	0.023	0.000	285	0	384	0	130	0	176	0
15	22.00	0.021	0.000	310	0	419	0	148	0	200	0
16	21.21	0.015	0.000	433	0	584	0	170	0	230	0
17	21.08	0.014	0.000	453	0	611	0	145	0	196	0
18	20.54	0.011	-0.000	501	0	677	0	44	0	59	0
19	20.00	0.009	-0.000	509	0	687	0	0	-44	0	-59
20	19.20	0.005	-0.000	430	0	580	0	0	-120	0	-162
21	18.40	0.004	-0.000	317	0	428	0	0	-140	0	-189
22	17.60	0.003	-0.000	216	0	292	0	0	-125	0	-169
23	16.80	0.002	-0.000	150	0	203	0	0	-95	0	-128
24	16.00	0.002	-0.000	93	0	125	0	0	-65	0	-88
25	15.20	0.003	-0.000	47	-0	64	-0	0	-49	0	-67
26	14.40	0.003	-0.000	14	-0	19	-0	0	-30	0	-40
27	13.95	0.003	-0.000	4	-0	5	-0	0	-16	0	-22
28	13.50	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 Calculated max.	elev.	Bending moment Calculated min.	elev.	Bending moment Factored max.	Bending moment Factored min.	Shear force Calculated max.	elev.	Shear force Calculated min.	elev.	Shear force Factored max.	Shear force Factored min.
	kN.m/m		kN.m/m		kN.m/m		kN/m		kN/m		kN/m	kN/m
1	10	20.54	-4	24.00	13	-5	8	22.00	-3	18.40	11	-4
2	No calculation at this stage											
3	490	20.00	-0	27.65	662	-0	165	21.21	-135	18.40	223	-183
4	No calculation at this stage											
5	509	20.00	-0	27.65	687	-0	170	21.21	-140	18.40	230	-189
6	No calculation at this stage											
7	No calculation at this stage											
8	No calculation at this stage											
9	492	20.00	-0	28.00	664	-0	157	21.21	-136	18.40	212	-184
10	No calculation at this stage											
11	No calculation at this stage											
12	No calculation at this stage											
13	No calculation at this stage											
14	374	20.00	-9	26.40	505	-12	177	22.73	-81	17.60	238	-109

Maximum and minimum displacement at each stage

Stage no.	Displacement maximum m	elev.	Displacement minimum m	elev.	Stage description
1	0.001	28.00	-0.000	19.20	Apply surcharge no.3 at elev. 27.65
2	No calculation at this stage				Apply surcharge no.1 at elev. 27.65
3	0.075	28.00	0.000	28.00	Excav. to elev. 21.21 on PASSIVE side
4	No calculation at this stage				Install strut no.2 at elev. 22.73
5	0.075	28.00	0.000	28.00	Fill to elev. 23.01 on PASSIVE side
6	No calculation at this stage				Install strut no.3 at elev. 27.50
7	No calculation at this stage				Remove surcharge no.3 at elev. 27.65
8	No calculation at this stage				Remove surcharge no.1 at elev. 27.65
9	0.072	28.00	-0.000	16.80	Fill to elev. 28.00 on ACTIVE side
10	No calculation at this stage				Apply surcharge no.4 at elev. 28.00
11	No calculation at this stage				Apply water pressure profile no.1
12	No calculation at this stage				Change soil type 3 to soil type 4
13	No calculation at this stage				Change soil type 6 to soil type 7
14	0.075	28.00	-0.000	13.50	Apply surcharge no.2 at elev. 22.36

Strut forces at each stage (horizontal components)

Stage no.	Strut no. 2 at elev. 22.73 Calculated kN per m run	Strut no. 2 at elev. 22.73 Factored kN per strut	Strut no. 3 at elev. 27.50 Calculated kN per m run	Strut no. 3 at elev. 27.50 Factored kN per strut
5	slack	slack	---	---
9	slack	slack	slack	slack
14	147	147	16	21

* Indicates that the total force shown is the sum of the force in the strut plus a force applied at the same elevation which may represent temperature load or other forces which are part of the strut load. Force components are listed in the detailed results for individual stages.

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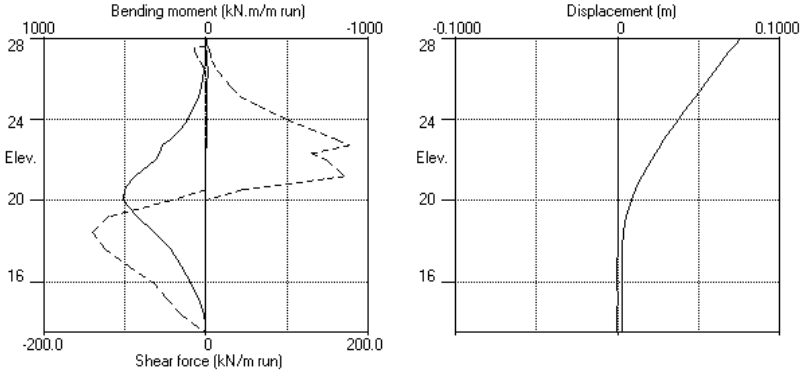
Camley Street | Date: 8-12-2015
Section B3 | Checked :

Units: kN,m

Bending moment, shear force, displacement envelopes



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Camley Street | Date: 8-12-2015
Section B3 | Checked :

Units: kN,m

INPUT DATA

SOIL PROFILE

Stratum no.	Elevation of top of stratum	Soil types Active side	Passive side
1	27.65	1 Made Ground	1 Made Ground
2	24.00	3 London Cly Top Undr	3 London Cly Top Undr
3	22.00	6 London Cly bt Undr	6 London Cly bt Undr

SOIL PROPERTIES (Unfactored SLS soil strengths)

No.	Soil type -- Description (Datum elev.)	Bulk density kN/m3	Young's Modulus Eh,kN/m2 (dEh/dy)	At rest coeff. Ko (dKo/dy)	Consol state. NC/OC (Nu)	Active limit Ka (Kac)	Passive limit Kp (Kpc)	Cohesion kN/m2 (dc/dy)
1	Made Ground	19.00	10000	0.577	OC (0.250)	0.390 (0.000)	2.561 (0.000)	
2	Gravels	19.00	30000	0.423	OC (0.300)	0.227 (0.000)	6.084 (0.000)	
3	London Cly Top Undr	19.00	20000	1.000	OC (0.490)	1.000 (2.000)	1.000 (2.000)	40.00u
4	London Cly Top dr	19.00	14000	1.000	OC (0.250)	0.422 (1.299)	2.371 (3.080)	3.000d
5	Concrete	24.00	200000	1.000	OC (0.490)	1.000 (2.000)	1.000 (2.000)	30000u
6	London Cl.. (24.00)	19.00	42500 (2589)	1.400	OC (0.490)	1.000 (2.476)	1.000 (2.390)	80.00u (5.180)
7	London Cl.. (24.00)	19.00	28000 (1813)	1.400	OC (0.250)	0.366 (1.423)	3.077 (4.665)	3.000d

Additional soil parameters associated with Ka and Kp

No.	Soil type ------- Description	--- parameters for Ka --- Soil friction angle	Wall adhesion coeff.	Back-fill angle	--- parameters for Kp --- Soil friction angle	Wall adhesion coeff.	Back-fill angle
1	Made Ground	26.00	0.000	0.00	26.00	0.000	0.00
2	Gravels	35.00	0.670	0.00	35.00	0.500	0.00
3	London Cly Top Undr	0.00	0.000	0.00	0.00	0.000	0.00
4	London Cly Top dr	24.00	0.000	0.00	24.00	0.000	0.00
5	Concrete	0.00	0.000	0.00	0.00	0.000	0.00
6	London Cly bt Undr	0.00	0.670	0.00	0.00	0.500	0.00
7	London Cly bt dr	24.00	0.670	0.00	24.00	0.500	0.00

GROUND WATER CONDITIONS

Density of water = 10.00 kN/m3

	Active side	Passive side
Initial water table elevation	24.65	21.08

Automatic water pressure balancing at toe of wall : Yes

Water press. profile no.	Point no.	Active side Elev. m	Piezo elev. m	Water press. kN/m2	Point no.	Passive side Elev. m	Piezo elev. m	Water press. kN/m2	
1	1	27.30	27.30	0.0	1	22.36	22.36	0.0	MC+WC
					2	22.36	27.30	49.4	

WALL PROPERTIES

Type of structure = Fully Embedded Wall
Elevation of toe of wall = 13.50
Maximum finite element length = 0.80 m
Youngs modulus of wall E = 1.4000E+07 kN/m2
Moment of inertia of wall I = 0.017260 m4/m run
E.I = 241640 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	26.60	5.00	0.010000	2.000E+08	10.00	0.00	0	No
2	22.73	1.00	0.300000	1.400E+07	10.00	0.00	0	No
3	27.50	1.00	0.300000	1.400E+07	10.00	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	27.65	0.50(A)	100.00	20.00	20.00	=	N/A	1.30 Var
2	22.36	-0.00(P)	30.00	20.00	50.00	=	N/A	1.00 P/U
3	27.65	0.50(A)	100.00	20.00	7.00	=	N/A	1.00 P/U
4	28.00	0.50(A)	100.00	20.00	20.00	=	N/A	1.30 Var

Note: A = Active side, P = Passive 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.3 at elevation 27.65
	No analysis at this stage
2	Apply surcharge no.1 at elevation 27.65
	No analysis at this stage
3	Excavate to elevation 21.21 on PASSIVE side
4	Install strut or anchor no.2 at elevation 22.73
5	Fill to elevation 23.01 on PASSIVE side with soil type 6
6	Install strut or anchor no.3 at elevation 27.50
7	Remove surcharge no.3 at elevation 27.65
	No analysis at this stage
8	Remove surcharge no.1 at elevation 27.65
	No analysis at this stage
9	Fill to elevation 28.00 on ACTIVE side with soil type 1
10	Apply surcharge no.4 at elevation 28.00
	No analysis at this stage
11	Apply water pressure profile no.1 (Worst Cred.)
	No analysis at this stage
12	Change properties of soil type 3 to soil type 4
	No analysis at this stage
	Ko pressures will not be reset
13	Change properties of soil type 6 to soil type 7
	No analysis at this stage
	Ko pressures will not be reset
14	Apply surcharge no.2 at elevation 22.36

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 Permanent Variable 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) = 0 m

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

Width of excavation on active side of wall = 20.00 m
Width of excavation on passive side of wall = 20.00 m

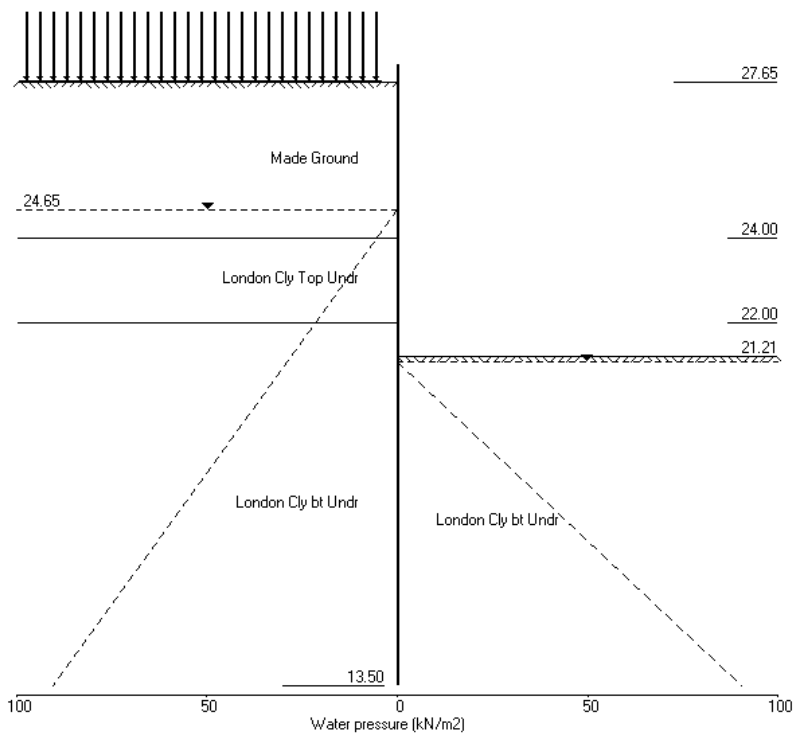
Distance to rigid boundary on active side = 20.00 m
Distance to rigid boundary on passive side = 20.00 m

OUTPUT OPTIONS

Stage no.	Stage description	Output options: Displacement Bending mom. Shear force	Active, Passive pressures	Graph. output
1	Apply surcharge no.3 at elev. 27.65	No	No	No
2	Apply surcharge no.1 at elev. 27.65	No	No	No
3	Excav. to elev. 21.21 on PASSIVE side	No	No	No
4	Install strut no.2 at elev. 22.73	No	No	No
5	Fill to elev. 23.01 on PASSIVE side	No	No	No
6	Install strut no.3 at elev. 27.50	No	No	No
7	Remove surcharge no.3 at elev. 27.65	No	No	No
8	Remove surcharge no.1 at elev. 27.65	No	No	No
9	Fill to elev. 28.00 on ACTIVE side	No	No	No
10	Apply surcharge no.4 at elev. 28.00	No	No	No
11	Apply water pressure profile no.1	No	No	No
12	Change soil type 3 to soil type 4	No	No	No
13	Change soil type 6 to soil type 7	No	No	No
14	Apply surcharge no.2 at elev. 22.36	No	No	No
*	Summary output	Yes	-	Yes

Units: kN,m

Stage No.3 Excav. to elev. 21.21 on PASSIVE side



Units: kN,m

Stage No. 3 Excavate to elevation 21.21 on PASSIVE side

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

Stage No.	--- G.L. --- Act.	Pass.	Strut Elev.	Overall FoS for toe elev. = 13.50 Factor of Safety	Moment equilib. at elev.	Toe elev. for FoS = 1.000 Toe elev.	Wall Penetr -ation
3	27.65	21.21	Cant.	1.323	14.93	15.43	5.78

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: Active side 20.00 from wall
Passive side 20.00 from wall
Limit State: ULS DA1 Combination 2

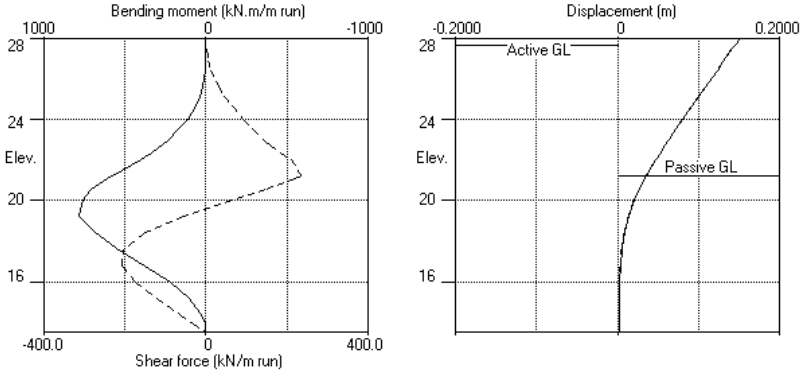
Node no.	Y coord	Nett pressure kN/m2	Wall disp. m	Wall rotation rad.	Shear force kN/m	Bending moment kN.m/m	Strut forces kN/m
1	28.00	0.00	0.151	1.77E-02	0.0	0.0	
2	27.65	0.00	0.145	1.77E-02	0.0	-0.0	
3	27.50	1.49	0.142	1.77E-02	0.1	0.0	
4	27.30	4.49	0.139	1.77E-02	0.7	0.1	
5	26.85	12.61	0.131	1.77E-02	4.6	1.2	
6	26.40	19.38	0.123	1.77E-02	11.8	4.7	
7	25.60	28.98	0.108	1.77E-02	31.1	21.3	
8	25.13	34.00	0.100	1.76E-02	46.1	39.5	
9	24.65	38.78	0.092	1.75E-02	63.3	65.4	
10	24.00	47.89	0.080	1.73E-02	91.5	115.4	
		39.43	0.080	1.73E-02	91.5	115.4	
11	23.51	49.46	0.072	1.70E-02	113.5	165.9	
12	23.01	59.35	0.063	1.66E-02	140.4	228.6	
13	22.73	64.80	0.059	1.63E-02	157.5	269.5	
14	22.36	72.17	0.053	1.58E-02	183.2	333.3	
15	22.00	79.21	0.047	1.53E-02	210.4	404.1	
		28.25	0.047	1.53E-02	210.4	404.1	
16	21.21	32.20	0.036	1.37E-02	234.3	579.4	
		-129.04	0.036	1.37E-02	234.3	579.4	
17	21.08	-131.90	0.034	1.34E-02	218.0	607.7	
18	20.54	-144.29	0.027	1.19E-02	143.1	705.9	
19	20.00	-156.69	0.021	1.03E-02	61.5	761.6	
20	19.20	-141.37	0.014	7.76E-03	-57.8	779.4	
21	18.40	-87.69	0.008	5.33E-03	-149.4	687.5	
22	17.60	-42.08	0.005	3.28E-03	-201.3	553.3	
23	16.80	26.13	0.003	1.73E-03	-207.7	378.9	
24	16.00	59.80	0.002	7.44E-04	-173.3	221.2	
25	15.20	71.55	0.002	2.09E-04	-120.8	101.8	
26	14.40	72.12	0.002	-5.47E-06	-63.3	28.1	
27	13.95	70.44	0.002	-3.80E-05	-31.2	6.9	
28	13.50	68.36	0.002	-4.45E-05	0.0	-0.0	

(continued)

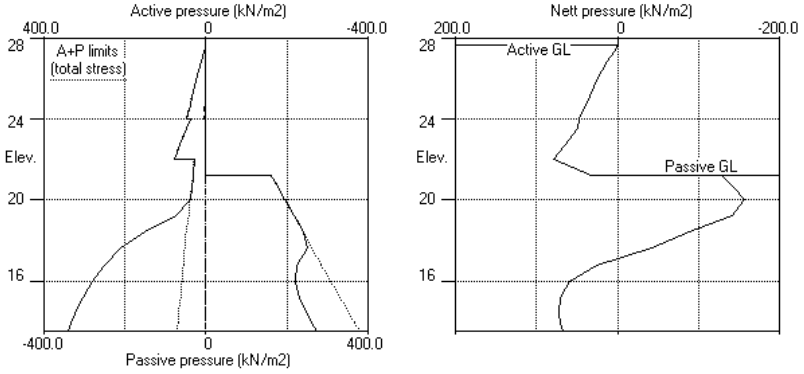
Stage No.3 Excavate to elevation 21.21 on PASSIVE side

Units: kN,m

Stage No.3 Excav. to elev. 21.21 on PASSIVE side



Stage No.3 Excav. to elev. 21.21 on PASSIVE side



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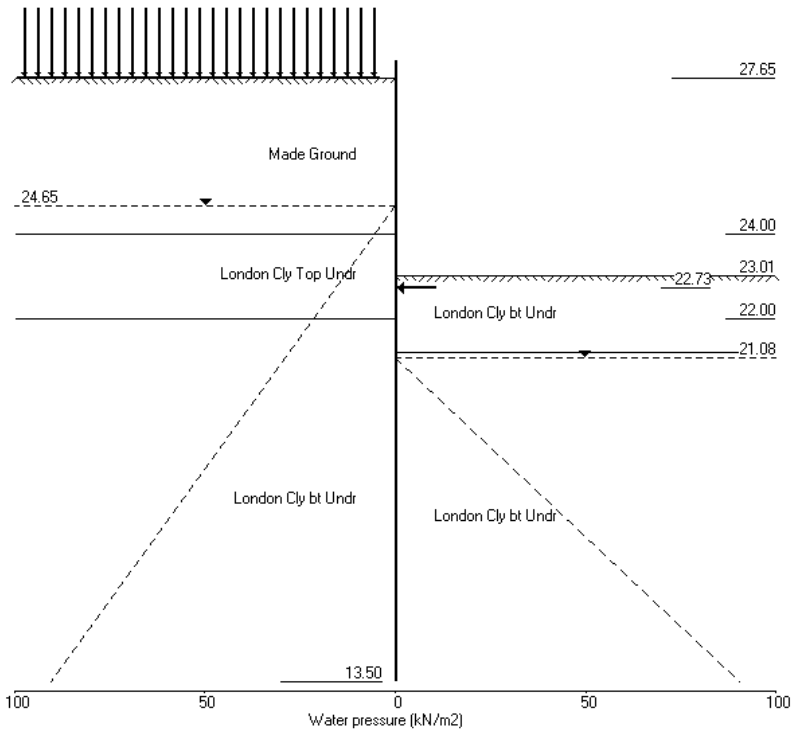
Units: kN,m

Stage No.5 Fill to elev. 23.01 on PASSIVE side



Units: kN,m

Stage No. 5 Fill to elevation 23.01 on PASSIVE side with soil type 6

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

Stage No.	--- G.L. --- Act.	Pass.	Strut Elev.	Overall FoS for toe elev. = 13.50 Factor of Safety	Moment equilib. at elev.	Toe elev. for FoS = 1.000 Toe elev.	Wall Penetr -ation
5	27.65	23.01	22.73	Conditions not suitable for 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: Active side 20.00 from wall
Passive side 20.00 from wall
Limit State: ULS DA1 Combination 2

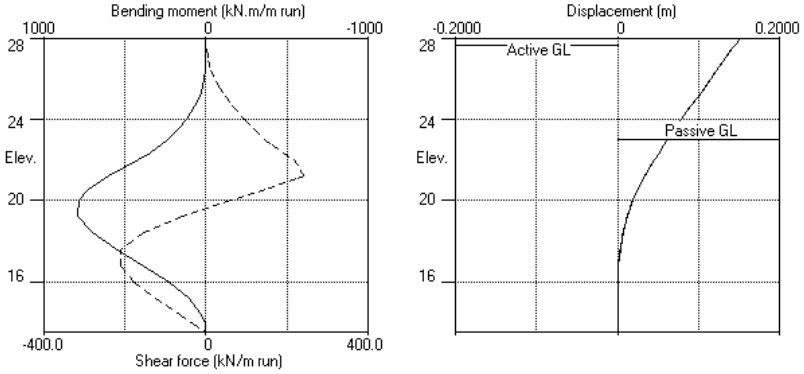
Node no.	Y coord	Nett pressure kN/m2	Wall disp. m	Wall rotation rad.	Shear force kN/m	Bending moment kN.m/m	Strut forces kN/m
1	28.00	0.00	0.151	1.81E-02	0.0	0.0	
2	27.65	0.00	0.145	1.81E-02	0.0	-0.0	
3	27.50	1.54	0.142	1.81E-02	0.1	0.0	
4	27.30	4.60	0.138	1.81E-02	0.7	0.1	
5	26.85	12.86	0.130	1.81E-02	4.7	1.2	
6	26.40	19.76	0.122	1.80E-02	12.0	4.8	
7	25.60	29.61	0.108	1.80E-02	31.7	21.7	
8	25.13	34.77	0.099	1.79E-02	47.0	40.3	
9	24.65	39.70	0.091	1.78E-02	64.7	66.8	
10	24.00	49.00	0.079	1.76E-02	93.6	117.9	
		42.43	0.079	1.76E-02	93.6	117.9	
11	23.51	52.86	0.070	1.73E-02	117.1	169.8	
12	23.01	63.12	0.062	1.69E-02	145.8	234.6	
13	22.73	67.40	0.057	1.66E-02	163.8	277.1	-0.0
14	22.36	73.17	0.051	1.61E-02	190.1	343.4	
15	22.00	76.46	0.045	1.55E-02	217.1	416.4	
		31.71	0.045	1.55E-02	217.1	416.4	
16	21.21	24.53	0.034	1.39E-02	239.3	596.6	
		-136.71	0.034	1.39E-02	239.3	596.6	
17	21.08	-139.08	0.032	1.36E-02	222.1	625.4	
18	20.54	-149.51	0.025	1.21E-02	143.8	724.7	
19	20.00	-160.23	0.019	1.04E-02	59.8	780.1	
20	19.20	-142.94	0.012	7.80E-03	-61.5	795.3	
21	18.40	-87.90	0.006	5.33E-03	-153.8	700.0	
22	17.60	-41.44	0.003	3.24E-03	-205.6	562.2	
23	16.80	27.21	0.001	1.67E-03	-211.3	384.5	
24	16.00	61.03	0.000	6.69E-04	-176.0	224.3	
25	15.20	72.74	-0.000	1.27E-04	-122.5	103.1	
26	14.40	73.15	-0.000	-8.99E-05	-64.1	28.4	
27	13.95	71.34	-0.000	-1.22E-04	-31.6	7.0	
28	13.50	69.13	-0.000	-1.29E-04	0.0	-0.0	

At elev. 22.73 The strut is slack

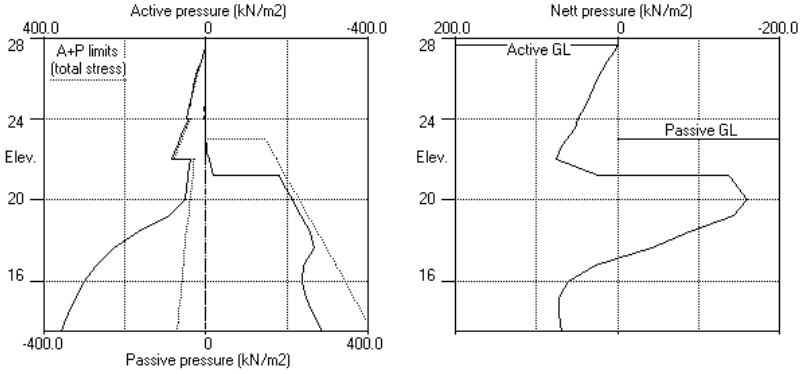
(continued)

Stage No.5 Fill to elevation 23.01 on PASSIVE side with soil type 6

Stage No.5 Fill to elev. 23.01 on PASSIVE side



Stage No.5 Fill to elev. 23.01 on PASSIVE side



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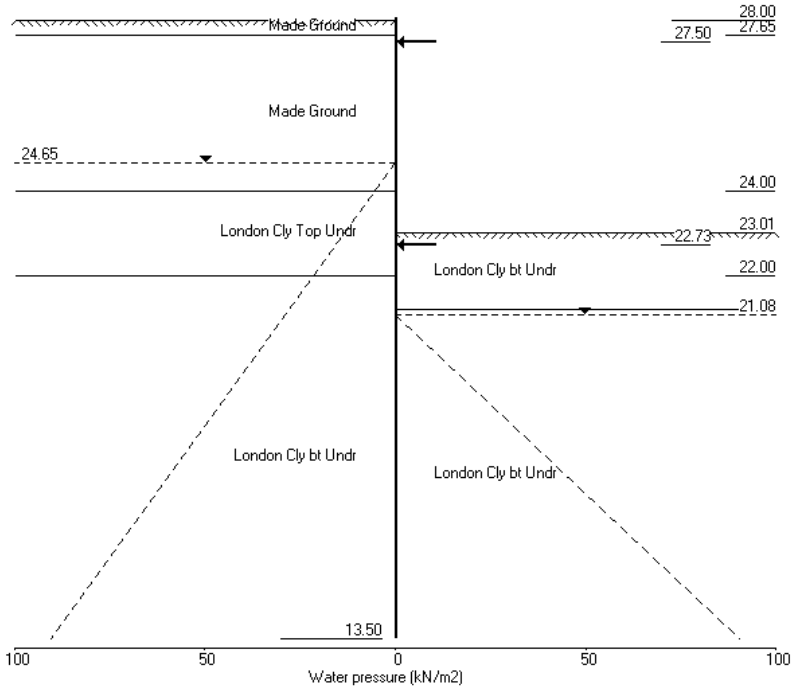
Units: kN,m

Stage No.9 Fill to elev. 28.00 on ACTIVE side



Units: kN,m

Stage No. 9 Fill to elevation 28.00 on ACTIVE side with soil type 1

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

Stage No.	--- G.L. --- Act.	Pass.	Strut Elev.	Overall FoS for toe elev. = 13.50 Factor of Safety	Moment equilib. at elev.	Toe elev. for FoS = 1.000 Toe elev.	Wall Penetr -ation
9	28.00	23.01		More than one strut			

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: Active side 20.00 from wall
Passive 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
1	28.00	0.00	0.147	1.79E-02	0.0	0.0	
2	27.65	6.98	0.141	1.79E-02	1.2	0.0	
3	27.50	8.36	0.138	1.79E-02	2.4	0.3	-0.0
4	27.30	10.49	0.135	1.79E-02	4.3	1.0	
5	26.85	15.69	0.127	1.78E-02	10.1	4.2	
6	26.40	20.49	0.119	1.78E-02	18.3	10.5	
7	25.60	28.31	0.104	1.78E-02	37.8	32.5	
8	25.13	32.75	0.096	1.77E-02	52.3	53.8	
9	24.65	37.10	0.088	1.75E-02	68.9	82.5	
10	24.00	45.76	0.076	1.72E-02	95.8	135.7	
		32.21	0.076	1.72E-02	95.8	135.7	
11	23.51	41.44	0.068	1.69E-02	114.1	187.5	
12	23.01	50.59	0.059	1.65E-02	136.8	249.4	
13	22.73	54.27	0.055	1.62E-02	151.3	288.9	-0.0
14	22.36	59.25	0.049	1.57E-02	172.5	349.6	
15	22.00	64.01	0.043	1.51E-02	194.7	415.4	
		32.74	0.043	1.51E-02	194.7	415.4	
16	21.21	33.05	0.032	1.35E-02	220.7	579.2	
		-118.25	0.032	1.35E-02	220.7	579.2	
17	21.08	-121.31	0.030	1.32E-02	205.7	605.9	
18	20.54	-134.46	0.024	1.17E-02	136.4	699.0	
19	20.00	-147.34	0.018	1.01E-02	59.9	752.6	
20	19.20	-140.66	0.010	7.60E-03	-55.3	771.3	
21	18.40	-87.93	0.005	5.19E-03	-146.7	681.7	
22	17.60	-42.78	0.002	3.15E-03	-199.0	549.6	
23	16.80	25.31	0.000	1.62E-03	-206.0	376.8	
24	16.00	59.07	-0.001	6.35E-04	-172.2	220.2	
25	15.20	71.01	-0.001	1.02E-04	-120.2	101.4	
26	14.40	71.78	-0.001	-1.11E-04	-63.1	28.0	
27	13.95	70.20	-0.001	-1.43E-04	-31.1	6.9	
28	13.50	68.21	-0.001	-1.50E-04	0.0	-0.0	

At elev. 27.50 The strut is slack
At elev. 22.73 The strut is slack

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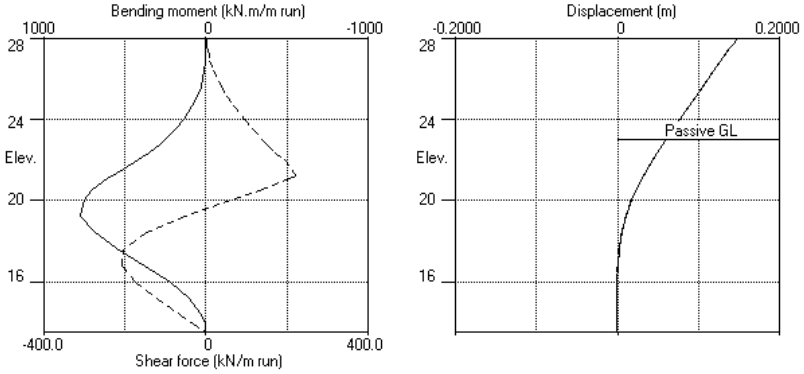
(continued)

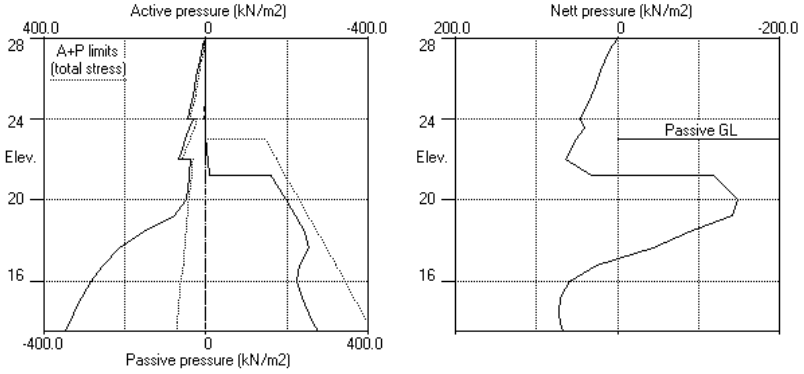
Stage No.9 Fill to elevation 28.00 on ACTIVE side with soil type 1

Units: kN,m

Stage No.9 Fill to elev. 28.00 on ACTIVE side



Stage No.9 Fill to elev. 28.00 on ACTIVE side



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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 Permanent Variable loads = 1.300

STABILITY ANALYSIS of Fully Embedded Wall according to Strength Factor method

Factor of safety on soil strength

Stage No.	G.L. Act.	G.L. Pass.	Strut Elev.	Overall FoS for toe elev. = 13.50: Factor of Safety	Moment equilib. at elev.	Toe elev. for FoS = 1.000: Toe elev.	Wall Penetration
1	27.65	27.65	Cant.	Conditions not suitable for FoS calc.			
2	27.65	27.65		No analysis at this stage			
3	27.65	21.21	Cant.	1.323	14.93	15.43	5.78
4	27.65	21.21		No analysis at this stage			
5	27.65	23.01	22.73	Conditions not suitable for FoS calc.			
6	27.65	23.01		No analysis at this stage			

All remaining stages have more than one strut - FoS calculation n/a

Units: kN,m

Summary of results

BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall

Analysis options

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

Rigid boundaries: Active side 20.00 from wall
Passive side 20.00 from wall

Limit State: ULS DA1 Combination 2

Bending moment, shear force and displacement envelopes

Node no.	Y coord	Displacement maximum	Displacement minimum	Bending moment maximum	Bending moment minimum	Shear force maximum	Shear force minimum
		m	m	kN.m/m	kN.m/m	kN/m	kN/m
1	28.00	0.151	0.000	0.0	0.0	0.0	0.0
2	27.65	0.145	0.000	0.1	-0.0	1.2	0.0
3	27.50	0.142	0.000	0.3	-0.0	2.4	-0.1
4	27.30	0.139	0.000	1.0	-0.0	4.3	-0.4
5	26.85	0.131	0.000	4.2	-0.3	11.0	-0.9
6	26.40	0.123	0.000	11.4	-0.8	22.2	-1.2
7	25.60	0.108	0.000	40.0	-1.9	51.1	-1.4
8	25.13	0.100	0.000	69.4	-2.5	73.4	-1.2
9	24.65	0.092	0.000	110.3	-3.1	99.3	-1.0
10	24.00	0.080	0.000	187.8	-3.4	140.2	0.0
11	23.51	0.072	0.000	265.1	-3.0	172.6	0.0
12	23.01	0.063	0.000	359.3	-1.7	208.7	0.0
13	22.73	0.059	0.000	419.4	-0.6	226.6	0.0
14	22.36	0.054	0.000	433.8	0.0	190.1	0.0
15	22.00	0.049	0.000	452.8	0.0	217.1	0.0
16	21.21	0.038	0.000	596.6	0.0	239.3	0.0
17	21.08	0.037	0.000	625.4	0.0	222.1	0.0
18	20.54	0.031	-0.000	724.7	0.0	143.8	0.0
19	20.00	0.025	-0.000	780.1	0.0	61.5	-1.5
20	19.20	0.018	-0.000	795.3	0.0	0.0	-61.5
21	18.40	0.012	-0.000	700.0	0.0	0.0	-153.8
22	17.60	0.008	-0.000	562.2	0.0	0.0	-205.6
23	16.80	0.005	-0.000	384.5	0.0	0.0	-211.3
24	16.00	0.003	-0.001	224.3	0.0	0.0	-176.0
25	15.20	0.002	-0.001	117.3	-0.3	0.0	-122.5
26	14.40	0.002	-0.001	42.5	-0.2	0.1	-72.6
27	13.95	0.002	-0.001	15.3	-0.1	0.1	-47.4
28	13.50	0.002	-0.002	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 maximum	elev.	minimum	elev.	Shear force maximum	elev.	minimum	elev.
	kN.m/m		kN.m/m		kN/m		kN/m	
1	9.9	20.54	-3.4	24.00	8.0	22.00	-3.2	18.40
2	No calculation at this stage							
3	779.4	19.20	-0.0	27.65	234.3	21.21	-207.7	16.80
4	No calculation at this stage							
5	795.3	19.20	-0.0	27.65	239.3	21.21	-211.3	16.80
6	No calculation at this stage							
7	No calculation at this stage							
8	No calculation at this stage							
9	771.3	19.20	-0.0	13.50	220.7	21.21	-206.0	16.80
10	No calculation at this stage							
11	No calculation at this stage							
12	No calculation at this stage							
13	No calculation at this stage							
14	556.1	19.20	-0.0	13.50	226.6	22.73	-129.9	16.80

Maximum and minimum displacement at each stage

Stage no.	Displacement maximum	elev.	minimum	elev.	Stage description
	m		m		
1	0.001	28.00	-0.000	19.20	Apply surcharge no.3 at elev. 27.65
2	No calculation at this stage				Apply surcharge no.1 at elev. 27.65
3	0.151	28.00	0.000	28.00	Excav. to elev. 21.21 on PASSIVE side
4	No calculation at this stage				Install strut no.2 at elev. 22.73
5	0.151	28.00	-0.000	15.20	Fill to elev. 23.01 on PASSIVE side
6	No calculation at this stage				Install strut no.3 at elev. 27.50
7	No calculation at this stage				Remove surcharge no.3 at elev. 27.65
8	No calculation at this stage				Remove surcharge no.1 at elev. 27.65
9	0.147	28.00	-0.001	15.20	Fill to elev. 28.00 on ACTIVE side
10	No calculation at this stage				Apply surcharge no.4 at elev. 28.00
11	No calculation at this stage				Apply water pressure profile no.1
12	No calculation at this stage				Change soil type 3 to soil type 4
13	No calculation at this stage				Change soil type 6 to soil type 7
14	0.149	28.00	-0.002	13.50	Apply surcharge no.2 at elev. 22.36

Strut forces at each stage (horizontal components)

Stage no.	Strut no. 2 at elev. 22.73 kN/m run	Strut no. 2 at elev. 22.73 kN/strut	Strut no. 3 at elev. 27.50 kN/m run	Strut no. 3 at elev. 27.50 kN/strut
5	slack	slack	---	---
9	slack	slack	slack	slack
14	200.06	200.06	slack	slack

* Indicates that the total force shown is the sum of the force in the strut plus a force applied at the same elevation which may represent temperature load or other forces which are part of the strut load. Force components are listed in the detailed results for individual stages.

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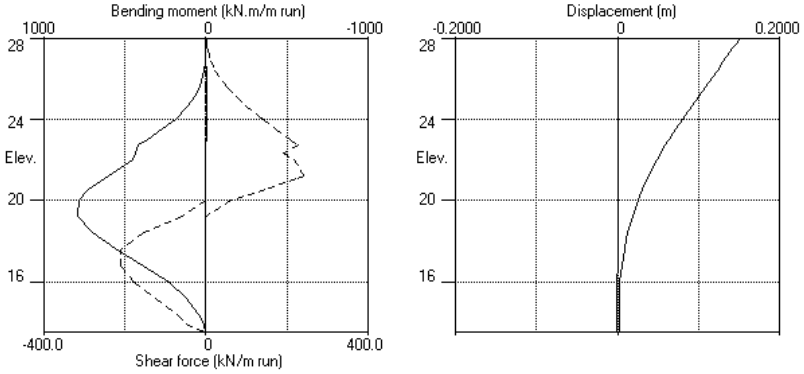
Bending moment, shear force, displacement envelopes



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Section B4 | Checked :

Units: kN,m

INPUT DATA

SOIL PROFILE

Stratum no.	Elevation of top of stratum	Soil types Active side	Passive side
1	27.65	8 Made Ground	8 Made Ground
2	24.00	3 London Cly Top Undr	3 London Cly Top Undr
3	22.00	6 London Cly bt Undr	6 London Cly bt Undr

SOIL PROPERTIES (Unfactored SLS soil strengths)

No.	Soil type Description (Datum elev.)	Bulk density kN/m3	Young's Modulus Eh,kN/m2 (dEh/dy)	At rest coeff. Ko (dKo/dy)	Consol state. NC/OC (Nu)	Active limit Ka (Kac)	Passive limit Kp (Kpc)	Cohesion kN/m2 (dc/dy)
1	Made Ground	19.00	10000	0.577	OC (0.250)	0.390 (0.000)	2.561 (0.000)	
2	Gravels	19.00	30000	0.423	OC (0.300)	0.227 (0.000)	6.084 (0.000)	
3	London Cly Top Undr	19.00	20000	1.000	OC (0.490)	1.000 (2.000)	1.000 (2.000)	40.00u
4	London Cly Top dr	19.00	14000	1.000	OC (0.250)	0.422 (1.299)	2.371 (3.080)	3.000d
5	Concrete	24.00	200000	1.000	OC (0.490)	1.000 (2.000)	1.000 (2.000)	30000u
6	London Cl.. (24.00)	19.00	42500 (2589)	1.400	OC (0.490)	1.000 (2.476)	1.000 (2.390)	80.00u (5.180)
7	London Cl.. (24.00)	19.00	28000 (1813)	1.400	OC (0.250)	0.366 (1.423)	3.077 (4.665)	3.000d
8	Made Ground	19.00	10000	0.577	OC (0.250)	0.337 (0.000)	3.442 (0.000)	

Additional soil parameters associated with Ka and Kp

No.	Soil type Description	--- parameters for Ka --- Soil friction angle	Wall adhesion coeff.	Back-fill angle	--- parameters for Kp --- Soil friction angle	Wall adhesion coeff.	Back-fill angle
1	Made Ground	26.00	0.000	0.00	26.00	0.000	0.00
2	Gravels	35.00	0.670	0.00	35.00	0.500	0.00
3	London Cly Top Undr	0.00	0.000	0.00	0.00	0.000	0.00
4	London Cly Top dr	24.00	0.000	0.00	24.00	0.000	0.00
5	Concrete	0.00	0.000	0.00	0.00	0.000	0.00
6	London Cly bt Undr	0.00	0.670	0.00	0.00	0.500	0.00
7	London Cly bt dr	24.00	0.670	0.00	24.00	0.500	0.00
8	Made Ground	26.00	0.670	0.00	26.00	0.500	0.00

GROUND WATER CONDITIONS

Density of water = 10.00 kN/m3

	Active side	Passive side
Initial water table elevation	25.00	21.86

Automatic water pressure balancing at toe of wall : Yes

Water press. profile no.	Active side Point no.	Elev. m	Piezo elev. m	Water press. kN/m2	Passive side Point no.	Elev. m	Piezo elev. m	Water press. kN/m2	
1	1	28.00	28.00	0.0	1	22.36	22.36	0.0	MC+WC
					2	22.36	28.00	56.4	

WALL PROPERTIES

Type of structure = Fully Embedded Wall
Elevation of toe of wall = 15.00
Maximum finite element length = 0.80 m
Youngs modulus of wall E = 1.4000E+07 kN/m2
Moment of inertia of wall I = 0.017260 m4/m run
E.I = 241640 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	26.60	5.00	0.010000	2.000E+08	10.00	0.00	0	No
2	22.73	1.00	0.300000	1.400E+07	10.00	0.00	0	No
3	27.50	1.00	0.300000	1.400E+07	10.00	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	27.65	0.50(A)	100.00	20.00	20.00	=	N/A	1.10 Var
2	22.36	-0.00(P)	30.00	20.00	50.00	=	N/A	1.00 P/U
3	27.65	0.50(A)	100.00	20.00	7.00	=	N/A	1.00 P/U
4	28.00	0.50(A)	100.00	20.00	20.00	=	N/A	1.10 Var

Note: A = Active side, P = Passive 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 27.65
	No analysis at this stage
2	Apply surcharge no.3 at elevation 27.65
	No analysis at this stage
3	Excavate to elevation 21.98 on PASSIVE side
4	Fill to elevation 22.48 on PASSIVE side with soil type 3
5	Install strut or anchor no.2 at elevation 22.73
6	Fill to elevation 23.10 on PASSIVE side with soil type 6
7	Remove surcharge no.1 at elevation 27.65
	No analysis at this stage
8	Remove surcharge no.3 at elevation 27.65
	No analysis at this stage
9	Fill to elevation 28.00 on ACTIVE side with soil type 1
10	Apply surcharge no.4 at elevation 28.00
	No analysis at this stage
11	Install strut or anchor no.3 at elevation 27.50
12	Change properties of soil type 8 to soil type 1
	No analysis at this stage
	Ko pressures will not be reset
13	Apply water pressure profile no.1 (Mod. Conserv.)
	No analysis at this stage
14	Change properties of soil type 3 to soil type 4
	No analysis at this stage
	Ko pressures will not be reset
15	Change properties of soil type 6 to soil type 7
	No analysis at this stage
	Ko pressures will not be reset
16	Apply surcharge no.2 at elevation 22.36

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 Permanent Variable 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) = 0 m

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

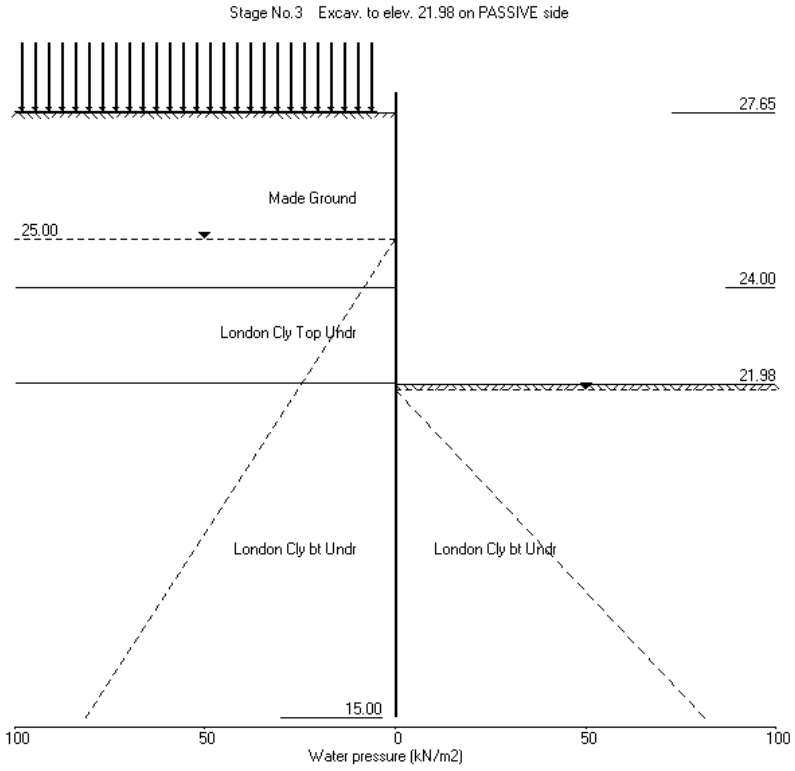
Width of excavation on active side of wall = 20.00 m
Width of excavation on passive side of wall = 20.00 m

Distance to rigid boundary on active side = 20.00 m
Distance to rigid boundary on passive 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. 27.65	No	No	No
2	Apply surcharge no.3 at elev. 27.65	No	No	No
3	Excav. to elev. 21.98 on PASSIVE side	No	No	No
4	Fill to elev. 22.48 on PASSIVE side	No	No	No
5	Install strut no.2 at elev. 22.73	No	No	No
6	Fill to elev. 23.10 on PASSIVE side	No	No	No
7	Remove surcharge no.1 at elev. 27.65	No	No	No
8	Remove surcharge no.3 at elev. 27.65	No	No	No
9	Fill to elev. 28.00 on ACTIVE side	No	No	No
10	Apply surcharge no.4 at elev. 28.00	No	No	No
11	Install strut no.3 at elev. 27.50	No	No	No
12	Change soil type 8 to soil type 1	No	No	No
13	Apply water pressure profile no.1	No	No	No
14	Change soil type 3 to soil type 4	No	No	No
15	Change soil type 6 to soil type 7	No	No	No
16	Apply surcharge no.2 at elev. 22.36	No	No	No
*	Summary output	Yes	-	Yes

Units: kN,m



Units: kN,m

Stage No. 3 Excavate to elevation 21.98 on PASSIVE 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: Active side 20.00 from wall
Passive 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/m2	Wall disp. m	Wall rotation rad.	Shear force kN/m	Bending moment kN.m/m	Strut forces kN/m
1	28.00	0.00	0.048	6.36E-03	0.0	0.0	
2	27.65	0.00	0.046	6.36E-03	0.0	-0.0	
3	27.50	1.06	0.045	6.36E-03	0.1	0.0	
4	26.95	7.45	0.041	6.36E-03	2.4	0.7	
5	26.40	13.25	0.038	6.35E-03	8.1	3.4	
6	25.70	19.18	0.034	6.33E-03	19.5	12.8	
7	25.00	24.41	0.029	6.27E-03	34.7	31.5	
8	24.50	30.65	0.026	6.18E-03	48.5	52.2	
9	24.00	36.80	0.023	6.04E-03	65.3	80.5	
		18.25	0.023	6.04E-03	65.3	80.5	
10	23.55	22.33	0.020	5.86E-03	74.5	111.9	
11	23.10	31.28	0.018	5.62E-03	86.5	147.9	
12	22.73	46.62	0.016	5.37E-03	100.8	183.4	
13	22.48	57.58	0.014	5.17E-03	113.8	210.1	
14	22.36	62.96	0.014	5.05E-03	121.3	224.8	
15	22.00	78.03	0.012	4.68E-03	146.7	272.7	
		36.71	0.012	4.68E-03	146.7	272.7	
16	21.98	37.73	0.012	4.67E-03	147.3	274.9	
		-178.41	0.012	4.67E-03	147.3	274.9	
17	21.86	-173.90	0.011	4.52E-03	125.2	291.9	
18	21.33	-146.69	0.009	3.83E-03	40.3	341.3	
19	20.80	-96.22	0.007	3.08E-03	-24.1	342.1	
20	20.00	-38.12	0.005	2.03E-03	-77.8	292.2	
21	19.20	-0.70	0.004	1.18E-03	-93.4	217.8	
22	18.40	19.71	0.003	5.89E-04	-85.8	143.0	
23	17.60	27.95	0.003	2.18E-04	-66.7	80.8	
24	16.80	28.62	0.003	2.47E-05	-44.1	36.5	
25	16.00	25.40	0.003	-5.30E-05	-22.5	10.5	
26	15.50	22.53	0.003	-6.63E-05	-10.5	2.4	
27	15.00	19.44	0.003	-6.88E-05	0.0	0.0	

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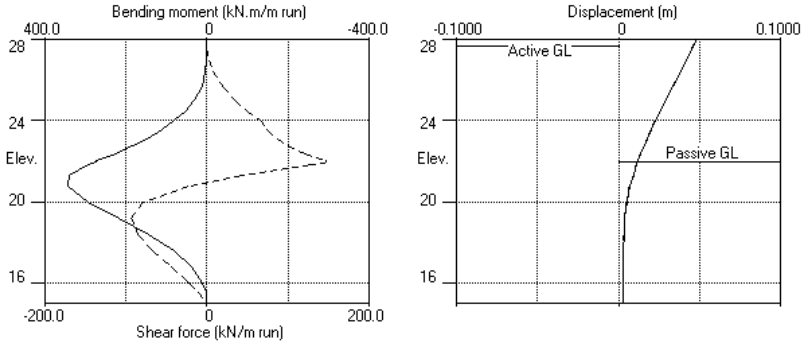
Units: kN,m

Stage No.3 Excav. to elev. 21.98 on PASSIVE side



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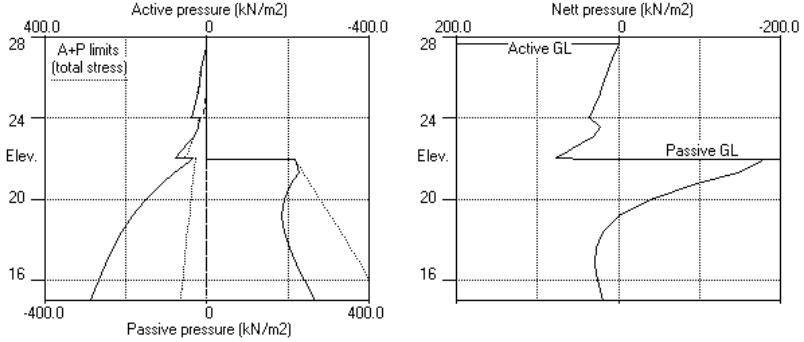
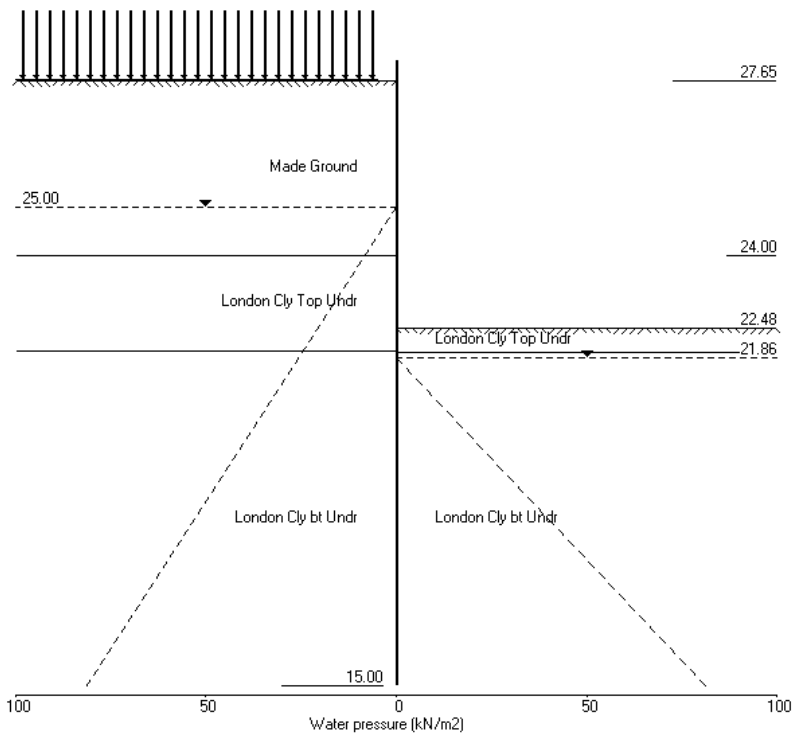


Units: kN,m

Stage No.4 Fill to elev. 22.48 on PASSIVE side



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Units: kN,m

Stage No. 4 Fill to elevation 22.48 on PASSIVE side with soil type 3

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: Active side 20.00 from wall
Passive side 20.00 from wall

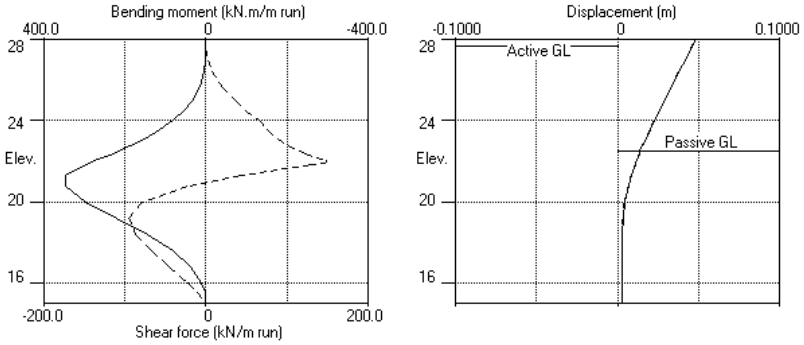
Limit State: ULS DA1 Combination 1

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.

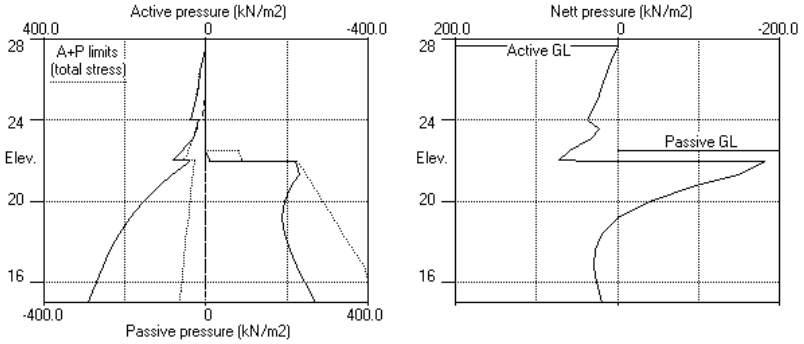
Node no.	Y coord	Nett pressure kN/m2	Wall disp. m	Wall rotation rad.	Shear force kN/m	Bending moment kN.m/m	Strut forces kN/m
1	28.00	0.00	0.048	6.44E-03	0.0	0.0	
2	27.65	0.00	0.046	6.44E-03	0.0	-0.0	
3	27.50	1.14	0.045	6.44E-03	0.1	0.0	
4	26.95	7.57	0.041	6.44E-03	2.5	0.7	
5	26.40	13.42	0.038	6.43E-03	8.3	3.5	
6	25.70	19.40	0.033	6.41E-03	19.7	13.0	
7	25.00	24.70	0.029	6.34E-03	35.2	32.0	
8	24.50	30.98	0.026	6.26E-03	49.1	52.9	
9	24.00	37.17	0.023	6.12E-03	66.1	81.6	
		19.23	0.023	6.12E-03	66.1	81.6	
10	23.55	23.40	0.020	5.94E-03	75.7	113.4	
11	23.10	32.44	0.017	5.69E-03	88.3	150.1	
12	22.73	47.85	0.015	5.44E-03	102.9	186.3	
13	22.48	58.85	0.014	5.23E-03	116.3	213.6	
14	22.36	63.42	0.013	5.12E-03	123.9	228.6	
15	22.00	72.04	0.011	4.74E-03	148.3	277.3	
		32.59	0.011	4.74E-03	148.3	277.3	
16	21.98	33.35	0.011	4.72E-03	148.8	279.5	
		-180.68	0.011	4.72E-03	148.8	279.5	
17	21.86	-176.03	0.011	4.57E-03	126.5	296.7	
18	21.33	-148.26	0.009	3.87E-03	40.6	346.5	
19	20.80	-97.31	0.007	3.11E-03	-24.5	347.2	
20	20.00	-38.62	0.005	2.04E-03	-78.9	296.6	
21	19.20	-0.79	0.003	1.18E-03	-94.6	221.3	
22	18.40	19.89	0.003	5.81E-04	-87.0	145.4	
23	17.60	28.27	0.002	2.04E-04	-67.7	82.3	
24	16.80	29.02	0.002	6.49E-06	-44.8	37.2	
25	16.00	25.82	0.002	-7.27E-05	-22.9	10.7	
26	15.50	22.96	0.002	-8.63E-05	-10.7	2.5	
27	15.00	19.86	0.002	-8.88E-05	0.0	0.0	

Units: kN,m

Stage No.4 Fill to elev. 22.48 on PASSIVE side



Stage No.4 Fill to elev. 22.48 on PASSIVE side



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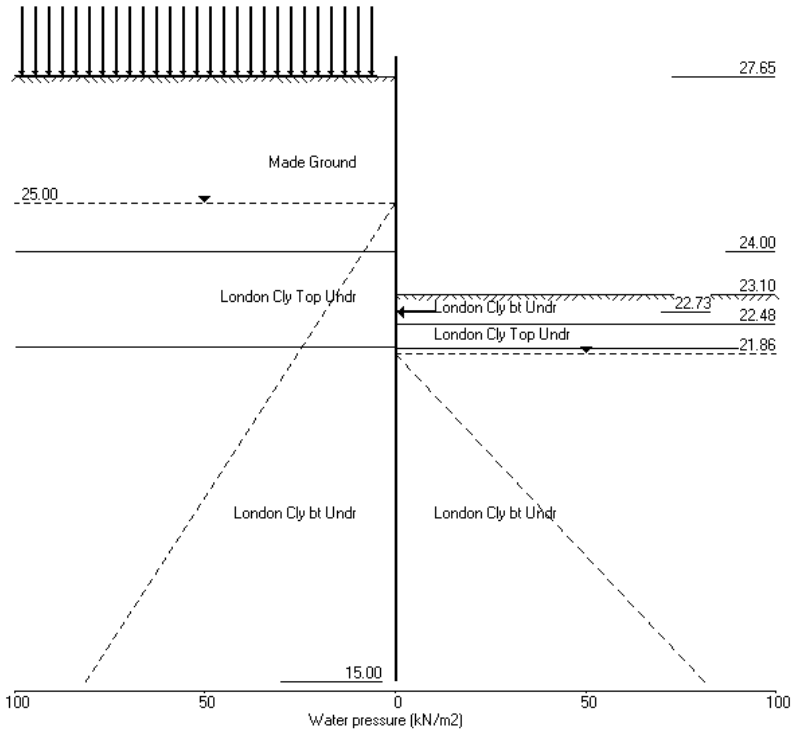
Stage No.6 Fill to elev. 23.10 on PASSIVE side



Units: kN,m

Stage No. 6 Fill to elevation 23.10 on PASSIVE side with soil type 6

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: Active side 20.00 from wall
Passive 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/m2	Wall disp. m	Wall rotation rad.	Shear force kN/m	Bending moment kN.m/m	Strut forces kN/m
1	28.00	0.00	0.048	6.53E-03	0.0	0.0	
2	27.65	0.00	0.046	6.53E-03	0.0	-0.0	
3	27.50	1.43	0.045	6.53E-03	0.1	0.0	
4	26.95	7.91	0.041	6.53E-03	2.7	0.7	
5	26.40	13.81	0.037	6.52E-03	8.6	3.7	
6	25.70	19.85	0.033	6.50E-03	20.4	13.6	
7	25.00	25.21	0.028	6.43E-03	36.2	33.2	
8	24.50	31.53	0.025	6.34E-03	50.4	54.7	
9	24.00	37.76	0.022	6.20E-03	67.7	84.0	
		20.83	0.022	6.20E-03	67.7	84.0	
10	23.55	25.09	0.019	6.01E-03	78.0	116.7	
11	23.10	34.21	0.017	5.76E-03	91.4	154.7	
12	22.73	47.86	0.014	5.50E-03	106.4	192.0	-0.0
13	22.48	54.49	0.013	5.28E-03	119.1	220.0	
		51.65	0.013	5.28E-03	119.1	220.0	
14	22.36	56.26	0.012	5.17E-03	125.9	235.3	
15	22.00	64.96	0.011	4.78E-03	147.7	284.3	
		28.18	0.011	4.78E-03	147.7	284.3	
16	21.98	28.95	0.011	4.76E-03	148.1	286.5	
		-182.00	0.011	4.76E-03	148.1	286.5	
17	21.86	-177.22	0.010	4.61E-03	125.7	303.6	
18	21.33	-148.97	0.008	3.89E-03	39.2	352.8	
19	20.80	-97.63	0.006	3.11E-03	-26.1	352.8	
20	20.00	-38.53	0.004	2.03E-03	-80.6	300.8	
21	19.20	-0.46	0.003	1.16E-03	-96.2	224.1	
22	18.40	20.33	0.002	5.53E-04	-88.2	147.1	
23	17.60	28.73	0.002	1.72E-04	-68.6	83.2	
24	16.80	29.42	0.002	-2.72E-05	-45.3	37.6	
25	16.00	26.12	0.002	-1.07E-04	-23.1	10.8	
26	15.50	23.18	0.002	-1.20E-04	-10.8	2.5	
27	15.00	20.00	0.002	-1.23E-04	0.0	0.0	

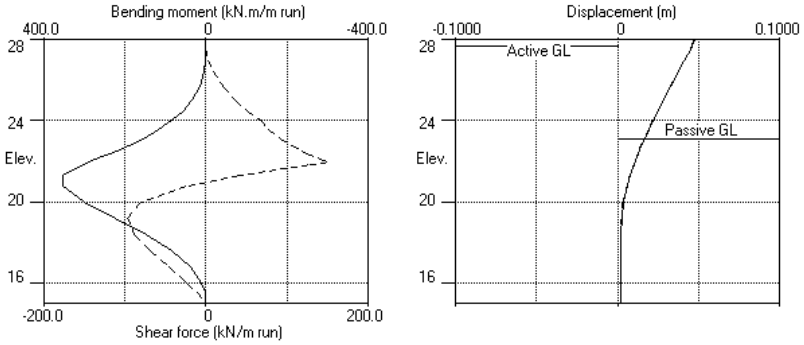
At elev. 22.73 The strut is slack

(continued)

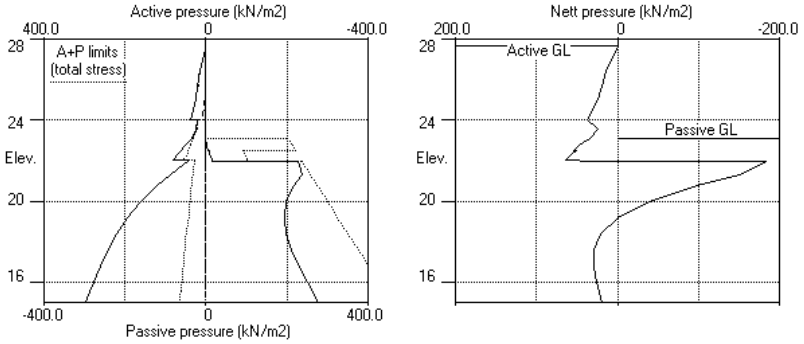
Stage No.6 Fill to elevation 23.10 on PASSIVE side with soil type 6

Units: kN,m

Stage No.6 Fill to elev. 23.10 on PASSIVE side



Stage No.6 Fill to elev. 23.10 on PASSIVE side



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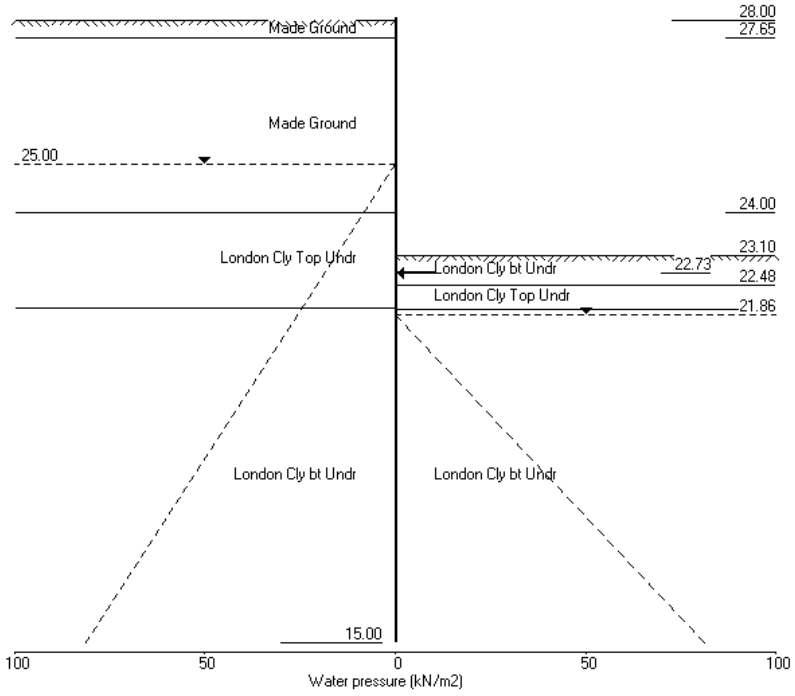
Units: kN,m

Stage No.9 Fill to elev. 28.00 on ACTIVE side



Units: kN,m

Stage No. 9 Fill to elevation 28.00 on ACTIVE 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: Active side 20.00 from wall
Passive 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/m2	Wall disp. m	Wall rotation rad.	Shear force kN/m	Bending moment kN.m/m	Strut forces kN/m
1	28.00	0.00	0.045	6.42E-03	0.0	0.0	
2	27.65	5.36	0.043	6.42E-03	0.9	0.0	
3	27.50	6.67	0.042	6.42E-03	1.8	0.3	
4	26.95	10.24	0.038	6.42E-03	6.5	2.6	
5	26.40	13.80	0.035	6.40E-03	13.1	7.9	
6	25.70	18.30	0.030	6.36E-03	24.3	20.8	
7	25.00	22.78	0.026	6.27E-03	38.7	42.7	
8	24.50	28.66	0.023	6.16E-03	51.6	65.1	
9	24.00	34.53	0.020	5.99E-03	67.4	94.7	
		20.00	0.020	5.99E-03	67.4	94.7	
10	23.55	22.25	0.017	5.79E-03	76.9	127.1	
11	23.10	24.50	0.015	5.52E-03	87.4	164.0	
12	22.73	35.94	0.013	5.24E-03	98.4	199.0	-0.0
13	22.48	45.38	0.011	5.02E-03	108.6	224.8	
14	22.36	50.00	0.011	4.90E-03	114.6	238.7	
15	22.00	58.69	0.009	4.51E-03	134.1	283.1	
		29.12	0.009	4.51E-03	134.1	283.1	
16	21.98	29.84	0.009	4.50E-03	134.6	285.1	
		-171.94	0.009	4.50E-03	134.6	285.1	
17	21.86	-167.59	0.008	4.35E-03	113.3	300.5	
18	21.33	-141.13	0.006	3.64E-03	31.5	344.6	
19	20.80	-91.51	0.005	2.89E-03	-30.1	341.5	
20	20.00	-34.68	0.003	1.84E-03	-80.6	288.2	
21	19.20	1.56	0.002	1.01E-03	-93.8	212.8	
22	18.40	20.99	0.001	4.37E-04	-84.8	138.3	
23	17.60	28.41	0.001	8.11E-05	-65.1	77.3	
24	16.80	28.39	0.001	-1.03E-04	-42.3	34.4	
25	16.00	24.52	0.001	-1.76E-04	-21.2	9.7	
26	15.50	21.24	0.001	-1.89E-04	-9.7	2.2	
27	15.00	17.70	0.001	-1.91E-04	0.0	0.0	

At elev. 22.73 The strut is slack

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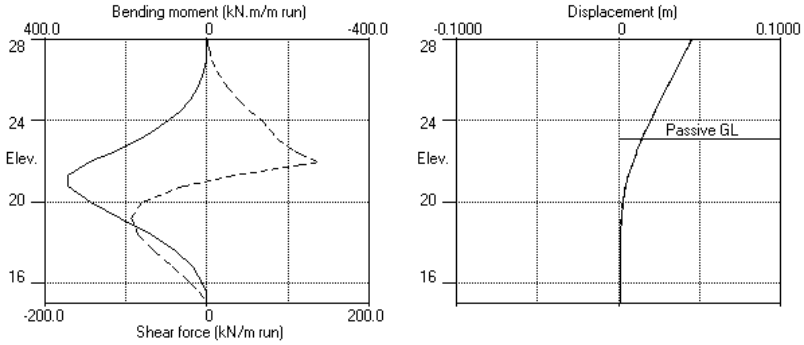
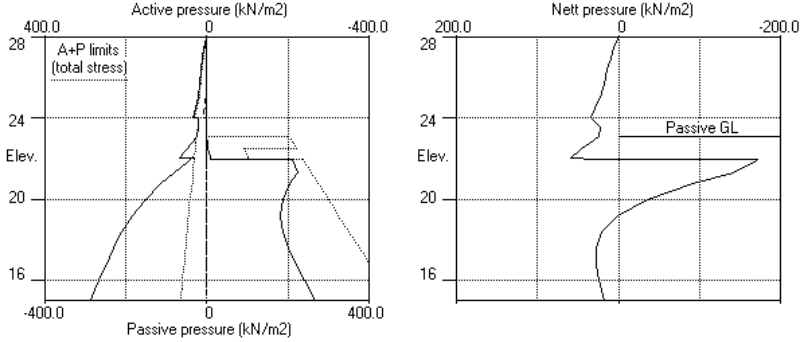
Camley Street | Date: 8-12-2015
Section B4 | Checked :

Units: kN,m

Stage No.9 Fill to elev. 28.00 on ACTIVE side



Stage No.9 Fill to elev. 28.00 on ACTIVE side



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: Active side 20.00 from wall
Passive side 20.00 from wall

Limit State: ULS DA1 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 max.	Displacement min.	Bending moment Calculated max.	Bending moment Calculated min.	Bending moment Factored max.	Bending moment Factored min.	Shear force Calculated max.	Shear force Calculated min.	Shear force Factored max.	Shear force Factored min.
	m	m	m	kN.m/m	kN.m/m	kN.m/m	kN.m/m	kN/m	kN/m	kN/m	kN/m
1	28.00	0.049	0.000	0	0	0	0	0	0	0	0
2	27.65	0.047	0.000	0	-0	0	-0	1	0	1	0
3	27.50	0.046	0.000	0	-0	0	-0	2	-19	3	-25
4	26.95	0.042	0.000	3	-8	4	-11	6	-11	9	-15
5	26.40	0.039	0.000	8	-11	11	-15	13	-3	18	-5
6	25.70	0.034	0.000	21	-5	28	-6	24	-4	33	-5
7	25.00	0.030	0.000	43	-7	58	-10	53	-4	72	-5
8	24.50	0.026	0.000	65	-9	88	-12	79	-3	106	-3
9	24.00	0.023	0.000	103	-10	139	-13	108	-1	145	-1
10	23.55	0.020	0.000	157	-9	212	-13	136	0	183	0
11	23.10	0.018	0.000	225	-8	304	-10	166	0	225	0
12	22.73	0.016	0.000	291	-5	392	-7	186	-36	251	-49
13	22.48	0.014	0.000	283	-3	382	-4	119	-24	161	-32
14	22.36	0.014	0.000	281	-1	379	-2	126	-15	170	-20
15	22.00	0.012	0.000	302	0	407	0	148	-8	200	-10
16	21.98	0.012	0.000	304	0	410	0	149	-7	201	-10
17	21.86	0.012	0.000	321	0	433	0	126	-11	171	-15
18	21.33	0.009	0.000	367	0	496	0	41	-26	55	-35
19	20.80	0.008	0.000	364	0	492	0	4	-37	5	-51
20	20.00	0.006	0.000	308	0	416	0	0	-85	0	-115
21	19.20	0.004	0.000	228	0	308	0	0	-100	0	-135
22	18.40	0.003	0.000	149	0	201	0	0	-90	0	-122
23	17.60	0.003	0.000	91	0	123	0	0	-70	0	-94
24	16.80	0.003	0.000	53	0	71	0	0	-46	0	-62
25	16.00	0.003	0.000	19	0	26	0	0	-33	0	-45
26	15.50	0.003	0.000	6	0	7	0	0	-20	0	-26
27	15.00	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 Calculated max.	elev.	Bending moment Calculated min.	elev.	Bending moment Factored max.	Bending moment Factored min.	Shear force Calculated max.	elev.	Shear force Calculated min.	elev.	Shear force Factored max.	Shear force Factored min.
	kN.m/m		kN.m/m		kN.m/m		kN/m		kN/m		kN/m	kN/m
1	15	20.00	-10	24.00	21	-13	15	22.00	-4	18.40	21	-6
2	No calculation at this stage											
3	342	20.80	-0	27.65	462	-0	147	21.98	-93	19.20	199	-126
4	347	20.80	-0	27.65	469	-0	149	21.98	-95	19.20	201	-128
5	No calculation at this stage											
6	353	21.33	-0	27.65	476	-0	148	21.98	-96	19.20	200	-130
7	No calculation at this stage											
8	No calculation at this stage											
9	345	21.33	0	28.00	465	0	135	21.98	-94	19.20	182	-127
10	367	21.33	0	28.00	496	0	144	21.98	-100	19.20	194	-135
11	No calculation at this stage											
12	No calculation at this stage											
13	No calculation at this stage											
14	No calculation at this stage											
15	No calculation at this stage											
16	291	22.73	-11	26.40	392	-15	186	22.73	-48	17.60	251	-65

Maximum and minimum displacement at each stage

Stage no.	Displacement maximum	elev.	Displacement minimum	elev.	Stage description
	m		m		
1	0.002	28.00	0.000	28.00	Apply surcharge no.1 at elev. 27.65
2	No calculation at this stage				Apply surcharge no.3 at elev. 27.65
3	0.048	28.00	0.000	28.00	Excav. to elev. 21.98 on PASSIVE side
4	0.048	28.00	0.000	28.00	Fill to elev. 22.48 on PASSIVE side
5	No calculation at this stage				Install strut no.2 at elev. 22.73
6	0.048	28.00	0.000	28.00	Fill to elev. 23.10 on PASSIVE side
7	No calculation at this stage				Remove surcharge no.1 at elev. 27.65
8	No calculation at this stage				Remove surcharge no.3 at elev. 27.65
9	0.045	28.00	0.000	28.00	Fill to elev. 28.00 on ACTIVE side
10	0.049	28.00	0.000	28.00	Apply surcharge no.4 at elev. 28.00
11	No calculation at this stage				Install strut no.3 at elev. 27.50
12	No calculation at this stage				Change soil type 8 to soil type 1
13	No calculation at this stage				Apply water pressure profile no.1
14	No calculation at this stage				Change soil type 3 to soil type 4
15	No calculation at this stage				Change soil type 6 to soil type 7
16	0.049	28.00	0.000	28.00	Apply surcharge no.2 at elev. 22.36

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.

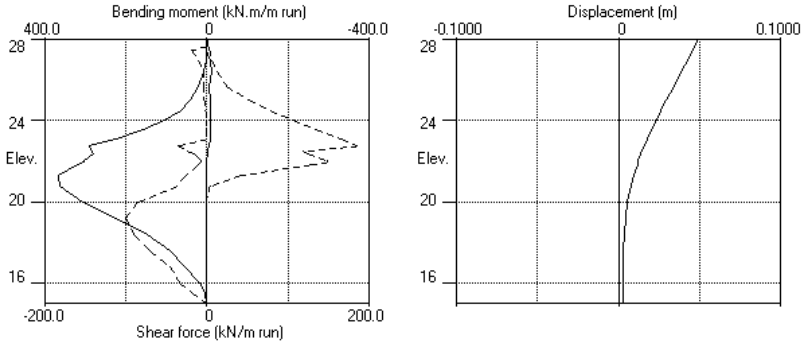
Strut forces at each stage (horizontal components)

Stage no.	Strut no. 2 at elev. 22.73 --Calculated-- kN per m run	Strut no. 2 at elev. 22.73 --Calculated-- kN per strut	Strut no. 2 at elev. 22.73 Factored kN per strut	Strut no. 3 at elev. 27.50 --Calculated-- kN per m run	Strut no. 3 at elev. 27.50 --Calculated-- kN per strut	Strut no. 3 at elev. 27.50 Factored kN per strut
6	slack	slack	slack	---	---	---
9	slack	slack	slack	---	---	---
10	slack	slack	slack	---	---	---
16	222	222	300	21	21	28

* Indicates that the total force shown is the sum of the force in the strut plus a force applied at the same elevation which may represent temperature load or other forces which are part of the strut load. Force components are listed in the detailed results for individual stages.

Units: kN,m

Bending moment, shear force, displacement envelopes



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Camley Street | Date: 8-12-2015
Section B4 | Checked :

Units: kN,m

INPUT DATA

SOIL PROFILE

Stratum no.	Elevation of top of stratum	Soil types Active side	Passive side
1	27.65	8 Made Ground	8 Made Ground
2	24.00	3 London Cly Top Undr	3 London Cly Top Undr
3	22.00	6 London Cly bt Undr	6 London Cly bt Undr

SOIL PROPERTIES (Unfactored SLS soil strengths)

No.	Soil type -- Description (Datum elev.)	Bulk density kN/m3	Young's Modulus Eh,kN/m2 (dEh/dy)	At rest coeff. Ko (dKo/dy)	Consol state. NC/OC (Nu)	Active limit Ka (Kac)	Passive limit Kp (Kpc)	Cohesion kN/m2 (dc/dy)
1	Made Ground	19.00	10000	0.577	OC (0.250)	0.390 (0.000)	2.561 (0.000)	
2	Gravels	19.00	30000	0.423	OC (0.300)	0.227 (0.000)	6.084 (0.000)	
3	London Cly Top Undr	19.00	20000	1.000	OC (0.490)	1.000 (2.000)	1.000 (2.000)	40.00u
4	London Cly Top dr	19.00	14000	1.000	OC (0.250)	0.422 (1.299)	2.371 (3.080)	3.000d
5	Concrete	24.00	200000	1.000	OC (0.490)	1.000 (2.000)	1.000 (2.000)	30000u
6	London Cl.. (24.00)	19.00	42500 (2589)	1.400	OC (0.490)	1.000 (2.476)	1.000 (2.390)	80.00u (5.180)
7	London Cl.. (24.00)	19.00	28000 (1813)	1.400	OC (0.250)	0.366 (1.423)	3.077 (4.665)	3.000d
8	Made Ground	19.00	10000	0.577	OC (0.250)	0.337 (0.000)	3.442 (0.000)	

Additional soil parameters associated with Ka and Kp

No.	Soil type ------- Description	--- parameters for Ka --- Soil friction angle	Wall adhesion coeff.	Back-fill angle	--- parameters for Kp --- Soil friction angle	Wall adhesion coeff.	Back-fill angle
1	Made Ground	26.00	0.000	0.00	26.00	0.000	0.00
2	Gravels	35.00	0.670	0.00	35.00	0.500	0.00
3	London Cly Top Undr	0.00	0.000	0.00	0.00	0.000	0.00
4	London Cly Top dr	24.00	0.000	0.00	24.00	0.000	0.00
5	Concrete	0.00	0.000	0.00	0.00	0.000	0.00
6	London Cly bt Undr	0.00	0.670	0.00	0.00	0.500	0.00
7	London Cly bt dr	24.00	0.670	0.00	24.00	0.500	0.00
8	Made Ground	26.00	0.670	0.00	26.00	0.500	0.00

GROUND WATER CONDITIONS

Density of water = 10.00 kN/m3

	Active side	Passive side
Initial water table elevation	25.00	21.86

Automatic water pressure balancing at toe of wall : Yes

Water press. profile no.	Point no.	Active side Elev. m	Piezo elev. m	Water press. kN/m2	Point no.	Passive side Elev. m	Piezo elev. m	Water press. kN/m2	
1	1	28.00	28.00	0.0	1	22.36	22.36	0.0	MC+WC
					2	22.36	28.00	56.4	

WALL PROPERTIES

Type of structure = Fully Embedded Wall
Elevation of toe of wall = 15.00
Maximum finite element length = 0.80 m
Youngs modulus of wall E = 1.4000E+07 kN/m2
Moment of inertia of wall I = 0.017260 m4/m run
E.I = 241640 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	26.60	5.00	0.010000	2.000E+08	10.00	0.00	0	No
2	22.73	1.00	0.300000	1.400E+07	10.00	0.00	0	No
3	27.50	1.00	0.300000	1.400E+07	10.00	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	27.65	0.50(A)	100.00	20.00	20.00	=	N/A	1.30 Var
2	22.36	-0.00(P)	30.00	20.00	50.00	=	N/A	1.00 P/U
3	27.65	0.50(A)	100.00	20.00	7.00	=	N/A	1.00 P/U
4	28.00	0.50(A)	100.00	20.00	20.00	=	N/A	1.30 Var

Note: A = Active side, P = Passive 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 27.65
	No analysis at this stage
2	Apply surcharge no.3 at elevation 27.65
	No analysis at this stage
3	Excavate to elevation 21.98 on PASSIVE side
4	Fill to elevation 22.48 on PASSIVE side with soil type 3
5	Install strut or anchor no.2 at elevation 22.73
6	Fill to elevation 23.10 on PASSIVE side with soil type 6
7	Remove surcharge no.1 at elevation 27.65
	No analysis at this stage
8	Remove surcharge no.3 at elevation 27.65
	No analysis at this stage
9	Fill to elevation 28.00 on ACTIVE side with soil type 1
10	Apply surcharge no.4 at elevation 28.00
	No analysis at this stage
11	Install strut or anchor no.3 at elevation 27.50
12	Change properties of soil type 8 to soil type 1
	No analysis at this stage
	Ko pressures will not be reset
13	Apply water pressure profile no.1 (Worst Cred.)
	No analysis at this stage
14	Change properties of soil type 3 to soil type 4
	No analysis at this stage
	Ko pressures will not be reset
15	Change properties of soil type 6 to soil type 7
	No analysis at this stage
	Ko pressures will not be reset
16	Apply surcharge no.2 at elevation 22.36

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 Permanent Variable 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) = 0 m

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

Width of excavation on active side of wall = 20.00 m
Width of excavation on passive side of wall = 20.00 m

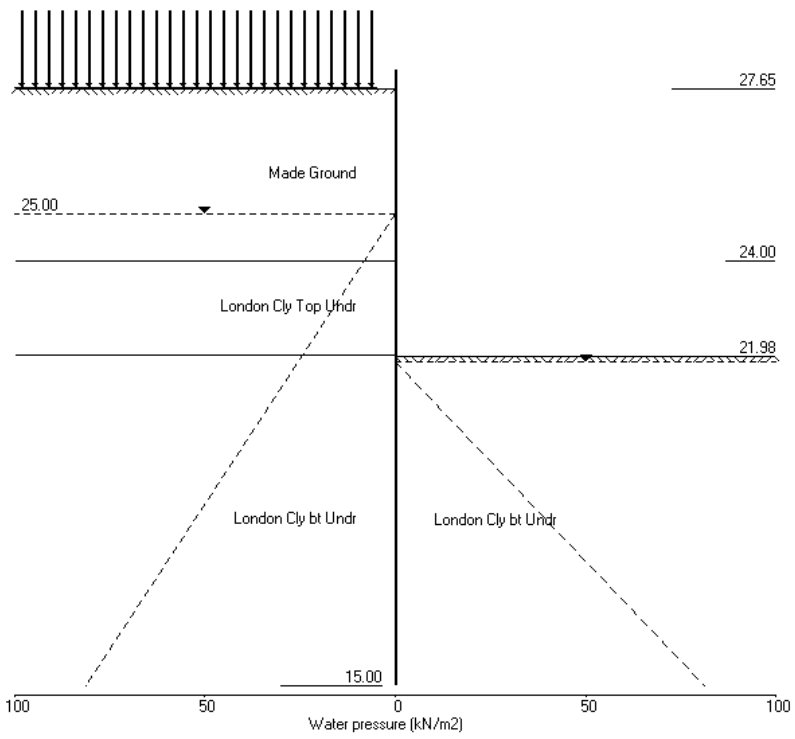
Distance to rigid boundary on active side = 20.00 m
Distance to rigid boundary on passive side = 20.00 m

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. 27.65	No	No	No
2	Apply surcharge no.3 at elev. 27.65	No	No	No
3	Excav. to elev. 21.98 on PASSIVE side	No	No	No
4	Fill to elev. 22.48 on PASSIVE side	No	No	No
5	Install strut no.2 at elev. 22.73	No	No	No
6	Fill to elev. 23.10 on PASSIVE side	No	No	No
7	Remove surcharge no.1 at elev. 27.65	No	No	No
8	Remove surcharge no.3 at elev. 27.65	No	No	No
9	Fill to elev. 28.00 on ACTIVE side	No	No	No
10	Apply surcharge no.4 at elev. 28.00	No	No	No
11	Install strut no.3 at elev. 27.50	No	No	No
12	Change soil type 8 to soil type 1	No	No	No
13	Apply water pressure profile no.1	No	No	No
14	Change soil type 3 to soil type 4	No	No	No
15	Change soil type 6 to soil type 7	No	No	No
16	Apply surcharge no.2 at elev. 22.36	No	No	No
*	Summary output	Yes	-	Yes

Units: kN,m

Stage No.3 Excav. to elev. 21.98 on PASSIVE side



Units: kN,m

Stage No. 3 Excavate to elevation 21.98 on PASSIVE side

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

Stage No.	--- G.L. --- Act.	Pass.	Strut Elev.	Overall FoS for toe elev. = 15.00 Factor of Safety	Moment equilib. at elev.	Toe elev. for FoS = 1.000 Toe elev.	Wall Penetr -ation
3	27.65	21.98	Cant.	1.365	16.29	17.03	4.96

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: Active side 20.00 from wall
Passive side 20.00 from wall
Limit State: ULS DA1 Combination 2

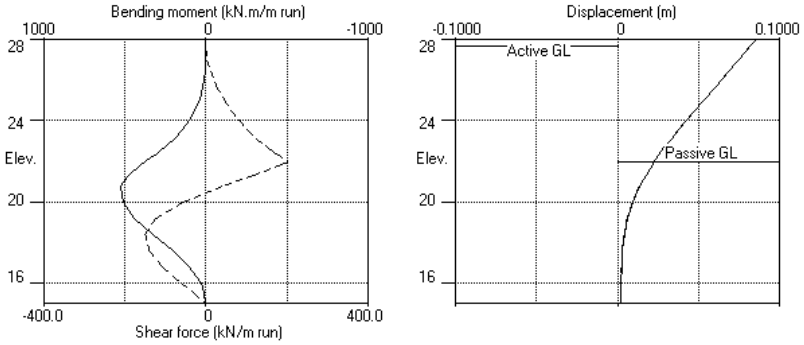
Node no.	Y coord	Nett pressure kN/m2	Wall disp. m	Wall rotation rad.	Shear force kN/m	Bending moment kN.m/m	Strut forces kN/m
1	28.00	0.00	0.086	1.09E-02	0.0	-0.0	
2	27.65	0.00	0.082	1.09E-02	0.0	0.0	
3	27.50	1.31	0.080	1.09E-02	0.1	0.0	
4	26.95	9.57	0.074	1.09E-02	3.1	0.7	
5	26.40	17.03	0.068	1.09E-02	10.4	4.2	
6	25.70	24.49	0.060	1.08E-02	24.9	16.5	
7	25.00	31.00	0.053	1.07E-02	44.4	40.5	
8	24.50	37.77	0.048	1.06E-02	61.5	66.8	
9	24.00	44.42	0.042	1.05E-02	82.1	102.5	
		39.43	0.042	1.05E-02	82.1	102.5	
10	23.55	48.56	0.038	1.02E-02	101.9	143.8	
11	23.10	57.56	0.033	9.95E-03	125.8	194.8	
12	22.73	64.80	0.029	9.62E-03	148.1	244.7	
13	22.48	69.72	0.027	9.35E-03	164.9	283.8	
14	22.36	72.17	0.026	9.20E-03	173.8	305.0	
15	22.00	79.21	0.023	8.69E-03	201.0	372.3	
		28.25	0.023	8.69E-03	201.0	372.3	
16	21.98	28.33	0.023	8.67E-03	201.5	375.4	
		-126.06	0.023	8.67E-03	201.5	375.4	
17	21.86	-128.92	0.021	8.47E-03	185.5	399.5	
18	21.33	-141.03	0.017	7.51E-03	114.0	479.1	
19	20.80	-142.19	0.014	6.40E-03	38.9	526.2	
20	20.00	-99.34	0.009	4.69E-03	-57.7	511.4	
21	19.20	-66.33	0.006	3.10E-03	-123.9	445.1	
22	18.40	-3.44	0.004	1.83E-03	-151.8	324.9	
23	17.60	32.78	0.003	9.59E-04	-140.1	202.4	
24	16.80	50.96	0.002	4.57E-04	-106.6	100.9	
25	16.00	59.36	0.002	2.37E-04	-62.5	32.0	
26	15.50	62.57	0.002	1.95E-04	-32.0	8.2	
27	15.00	65.45	0.002	1.87E-04	0.0	-0.0	

(continued)

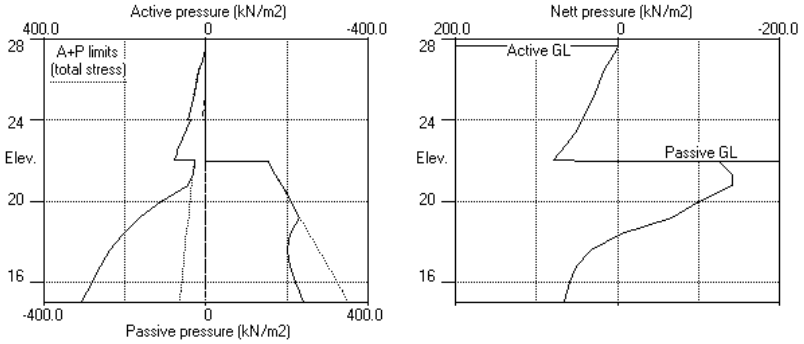
Stage No.3 Excavate to elevation 21.98 on PASSIVE side

Units: kN,m

Stage No.3 Excav. to elev. 21.98 on PASSIVE side



Stage No.3 Excav. to elev. 21.98 on PASSIVE side



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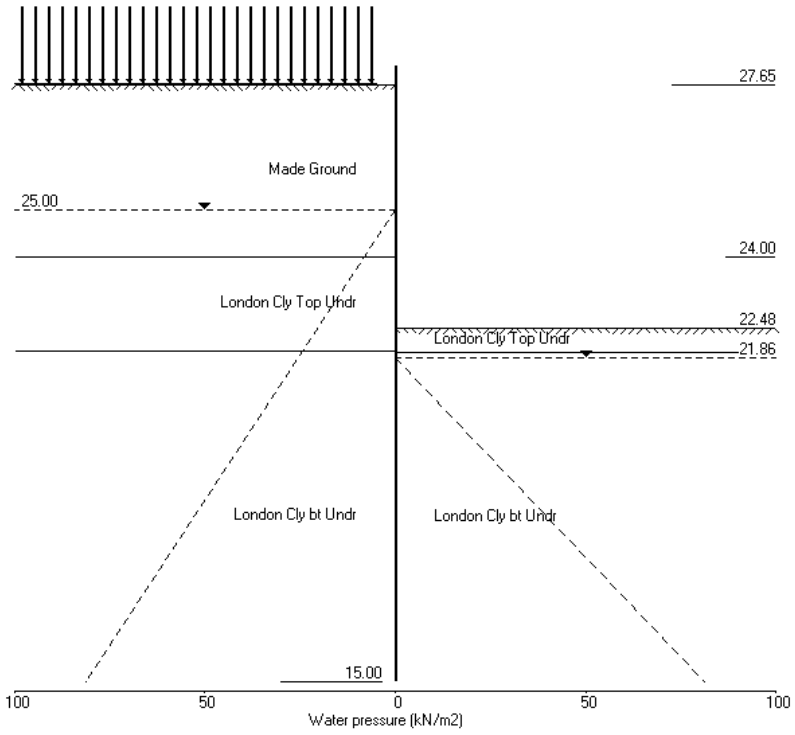
Units: kN,m

Stage No.4 Fill to elev. 22.48 on PASSIVE side



Units: kN,m

Stage No. 4 Fill to elevation 22.48 on PASSIVE side with soil type 3

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

Stage No.	--- G.L. --- Act.	Pass.	Strut Elev.	Overall FoS for toe elev. = 15.00 Factor of Safety	Moment equilib. at elev.	Toe elev. for FoS = 1.000 Toe elev.	Wall Penetr -ation
4	27.65	22.48	Cant.	1.451	16.29	17.46	5.02

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: Active side 20.00 from wall
Passive side 20.00 from wall
Limit State: ULS DA1 Combination 2

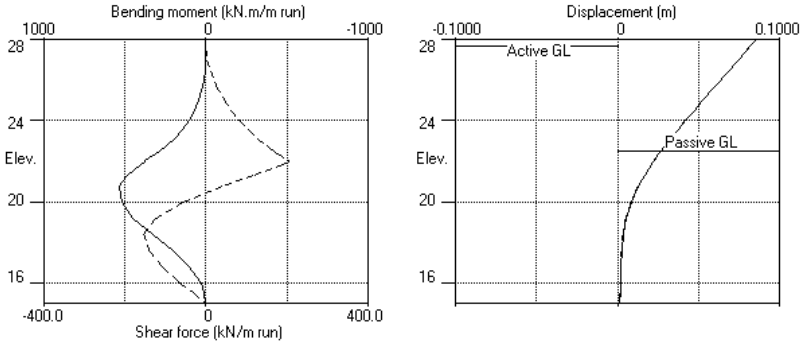
Node no.	Y coord	Nett pressure kN/m2	Wall disp. m	Wall rotation rad.	Shear force kN/m	Bending moment kN.m/m	Strut forces kN/m
1	28.00	0.00	0.086	1.09E-02	0.0	-0.0	
2	27.65	0.00	0.082	1.09E-02	0.0	0.0	
3	27.50	1.39	0.080	1.09E-02	0.1	0.0	
4	26.95	9.69	0.074	1.09E-02	3.2	0.7	
5	26.40	17.19	0.068	1.09E-02	10.5	4.3	
6	25.70	24.72	0.060	1.09E-02	25.2	16.7	
7	25.00	31.28	0.053	1.08E-02	44.8	40.9	
8	24.50	38.10	0.047	1.07E-02	62.2	67.5	
9	24.00	44.78	0.042	1.05E-02	82.9	103.6	
		40.41	0.042	1.05E-02	82.9	103.6	
10	23.55	49.63	0.037	1.03E-02	103.1	145.3	
11	23.10	58.72	0.033	1.00E-02	127.5	197.0	
12	22.73	66.02	0.029	9.69E-03	150.3	247.6	
13	22.48	70.99	0.027	9.41E-03	167.4	287.3	
14	22.36	72.64	0.025	9.26E-03	176.4	308.7	
15	22.00	73.23	0.022	8.75E-03	202.6	376.9	
		24.14	0.022	8.75E-03	202.6	376.9	
16	21.98	23.95	0.022	8.72E-03	203.0	380.0	
		-128.32	0.022	8.72E-03	203.0	380.0	
17	21.86	-131.04	0.021	8.52E-03	186.8	404.4	
18	21.33	-142.59	0.017	7.55E-03	114.3	484.3	
19	20.80	-143.27	0.013	6.43E-03	38.5	531.3	
20	20.00	-99.84	0.009	4.70E-03	-58.7	515.8	
21	19.20	-66.42	0.005	3.10E-03	-125.2	448.6	
22	18.40	-3.26	0.003	1.82E-03	-153.1	327.3	
23	17.60	33.11	0.002	9.44E-04	-141.2	203.8	
24	16.80	51.36	0.002	4.38E-04	-107.4	101.6	
25	16.00	59.78	0.002	2.17E-04	-62.9	32.2	
26	15.50	63.00	0.002	1.75E-04	-32.2	8.2	
27	15.00	65.87	0.001	1.67E-04	0.0	-0.0	

(continued)

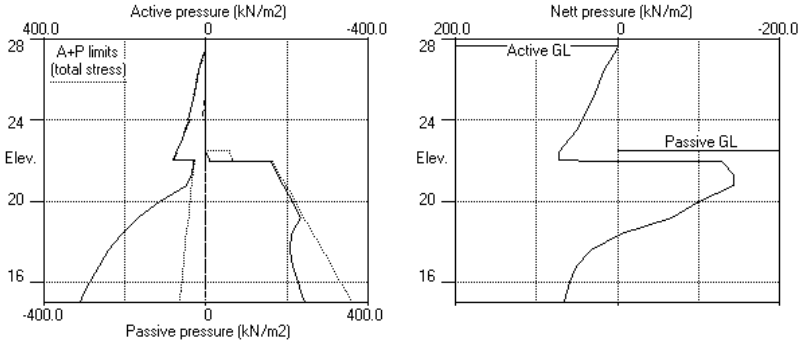
Stage No.4 Fill to elevation 22.48 on PASSIVE side with soil type 3

Units: kN,m

Stage No.4 Fill to elev. 22.48 on PASSIVE side



Stage No.4 Fill to elev. 22.48 on PASSIVE side



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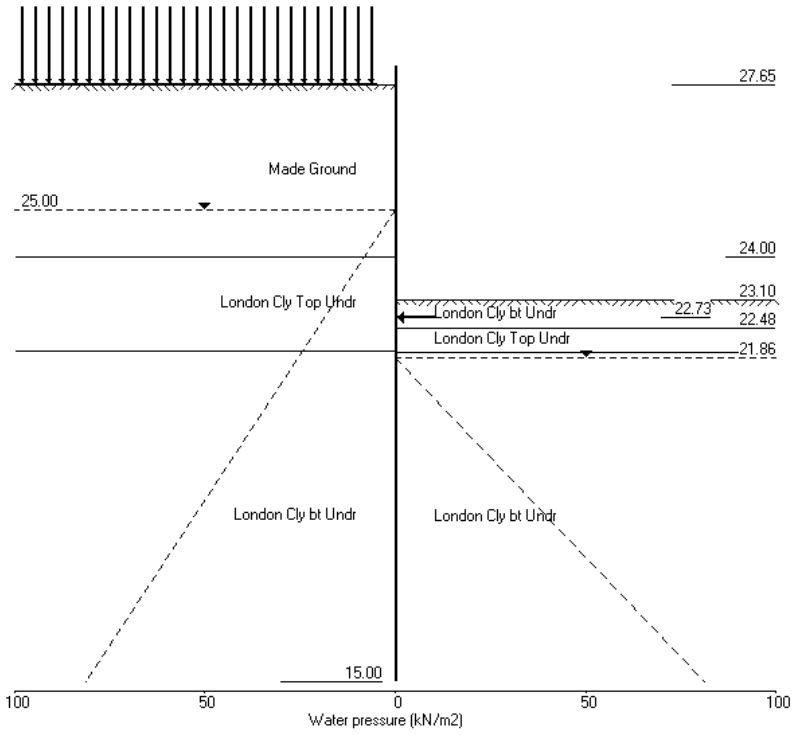
Units: kN,m

Stage No.6 Fill to elev. 23.10 on PASSIVE side



Units: kN,m

Stage No. 6 Fill to elevation 23.10 on PASSIVE side with soil type 6

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

Stage No.	--- G.L. --- Act.	Pass.	Strut Elev.	Overall FoS for toe elev. = 15.00 Factor of Safety	Moment equilib. at elev.	Toe elev. for FoS = 1.000 Toe elev.	Wall Penetr -ation
6	27.65	23.10	22.73	Conditions not suitable for 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: Active side 20.00 from wall
Passive 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
1	28.00	0.00	0.085	1.10E-02	0.0	-0.0	
2	27.65	0.00	0.081	1.10E-02	0.0	0.0	
3	27.50	1.68	0.080	1.10E-02	0.1	0.0	
4	26.95	10.03	0.074	1.10E-02	3.3	0.8	
5	26.40	17.58	0.068	1.10E-02	10.9	4.5	
6	25.70	25.17	0.060	1.10E-02	25.9	17.3	
7	25.00	31.79	0.052	1.09E-02	45.8	42.1	
8	24.50	38.65	0.047	1.08E-02	63.4	69.3	
9	24.00	45.37	0.041	1.06E-02	84.5	106.1	
		42.01	0.041	1.06E-02	84.5	106.1	
10	23.55	51.32	0.037	1.04E-02	105.5	148.6	
11	23.10	60.50	0.032	1.00E-02	130.6	201.5	
12	22.73	66.03	0.028	9.75E-03	153.7	253.2	-0.0
13	22.48	66.63	0.026	9.47E-03	170.3	293.7	
		63.79	0.026	9.47E-03	170.3	293.7	
14	22.36	65.47	0.025	9.31E-03	178.4	315.5	
15	22.00	66.15	0.021	8.79E-03	202.1	384.0	
		19.73	0.021	8.79E-03	202.1	384.0	
16	21.98	19.55	0.021	8.76E-03	202.3	387.0	
		-129.65	0.021	8.76E-03	202.3	387.0	
17	21.86	-132.23	0.020	8.56E-03	186.0	411.3	
18	21.33	-143.31	0.016	7.57E-03	113.0	490.6	
19	20.80	-143.59	0.012	6.44E-03	36.9	536.8	
20	20.00	-99.75	0.008	4.69E-03	-60.4	520.0	
21	19.20	-66.08	0.005	3.08E-03	-126.7	451.4	
22	18.40	-2.82	0.003	1.79E-03	-154.3	329.0	
23	17.60	33.56	0.002	9.12E-04	-142.0	204.7	
24	16.80	51.76	0.001	4.05E-04	-107.9	102.0	
25	16.00	60.09	0.001	1.82E-04	-63.1	32.3	
26	15.50	63.22	0.001	1.41E-04	-32.3	8.2	
27	15.00	66.01	0.001	1.32E-04	0.0	-0.0	

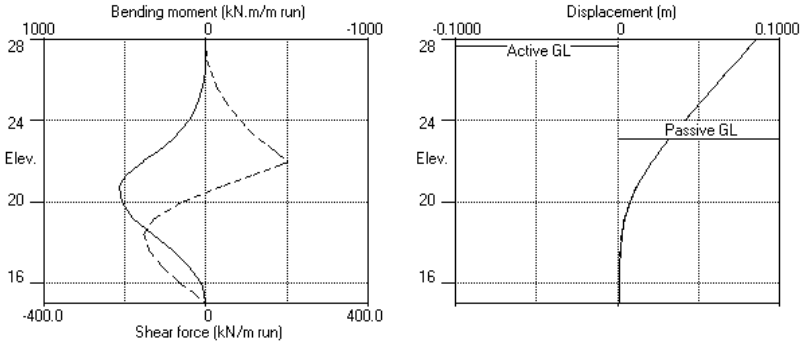
At elev. 22.73 The strut is slack

(continued)

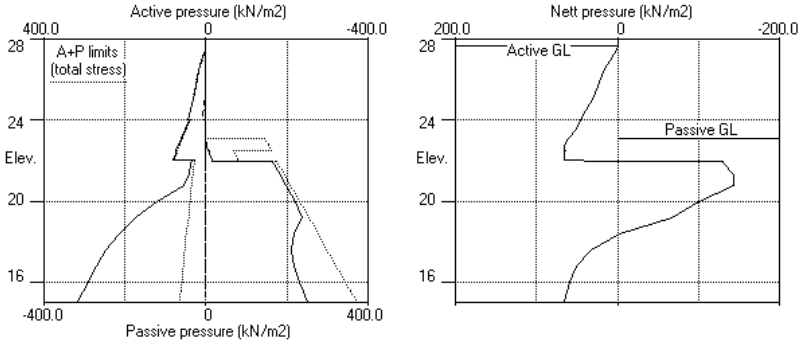
Stage No.6 Fill to elevation 23.10 on PASSIVE side with soil type 6

Units: kN,m

Stage No.6 Fill to elev. 23.10 on PASSIVE side



Stage No.6 Fill to elev. 23.10 on PASSIVE side



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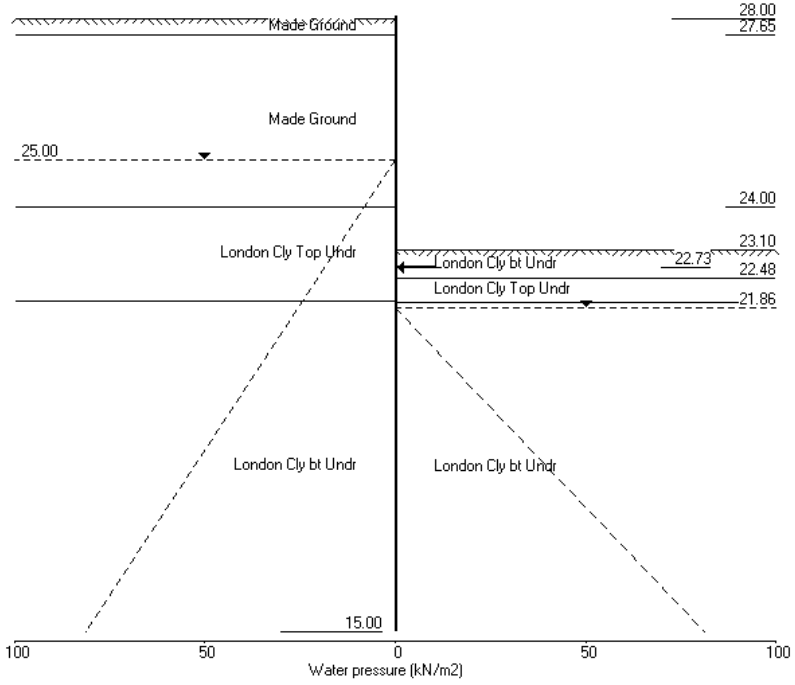
Units: kN,m

Stage No.9 Fill to elev. 28.00 on ACTIVE side



Units: kN,m

Stage No. 9 Fill to elevation 28.00 on ACTIVE side with soil type 1

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

Stage No.	--- G.L. --- Act.	Pass.	Strut Elev.	Overall FoS for toe elev. = 15.00 Factor of Safety	Moment equilib. at elev.	Toe elev. for FoS = 1.000 Toe elev.	Wall Penetr -ation
9	28.00	23.10	22.73	Conditions not suitable for 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: Active side 20.00 from wall
Passive 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
1	28.00	0.00	0.082	1.08E-02	0.0	-0.0	
2	27.65	6.52	0.078	1.08E-02	1.1	0.0	
3	27.50	8.05	0.076	1.08E-02	2.2	0.3	
4	26.95	13.03	0.070	1.08E-02	8.0	3.0	
5	26.40	17.87	0.064	1.08E-02	16.5	9.6	
6	25.70	23.63	0.057	1.08E-02	31.1	26.3	
7	25.00	29.18	0.049	1.07E-02	49.5	54.3	
8	24.50	35.48	0.044	1.05E-02	65.7	82.9	
9	24.00	41.73	0.039	1.03E-02	85.0	120.5	
		30.74	0.039	1.03E-02	85.0	120.5	
10	23.55	39.00	0.034	1.00E-02	100.7	162.1	
11	23.10	47.21	0.030	9.73E-03	120.1	211.6	
12	22.73	52.01	0.026	9.38E-03	138.2	258.6	-0.0
13	22.48	55.28	0.024	9.09E-03	151.6	294.8	
14	22.36	56.91	0.023	8.93E-03	158.6	314.2	
15	22.00	58.86	0.020	8.42E-03	179.5	374.8	
		30.72	0.020	8.42E-03	179.5	374.8	
16	21.98	30.52	0.020	8.40E-03	179.9	377.5	
		-107.49	0.020	8.40E-03	179.9	377.5	
17	21.86	-110.44	0.018	8.20E-03	166.3	399.1	
18	21.33	-122.94	0.014	7.24E-03	104.4	471.2	
19	20.80	-135.30	0.011	6.16E-03	36.0	515.3	
20	20.00	-96.55	0.007	4.48E-03	-56.7	500.1	
21	19.20	-65.09	0.004	2.93E-03	-121.4	435.5	
22	18.40	-3.27	0.002	1.68E-03	-148.7	317.7	
23	17.60	32.27	0.001	8.34E-04	-137.1	197.7	
24	16.80	50.00	0.000	3.44E-04	-104.2	98.4	
25	16.00	58.07	0.000	1.30E-04	-61.0	31.2	
26	15.50	61.08	0.000	8.95E-05	-31.2	7.9	
27	15.00	63.73	0.000	8.13E-05	-0.0	-0.0	

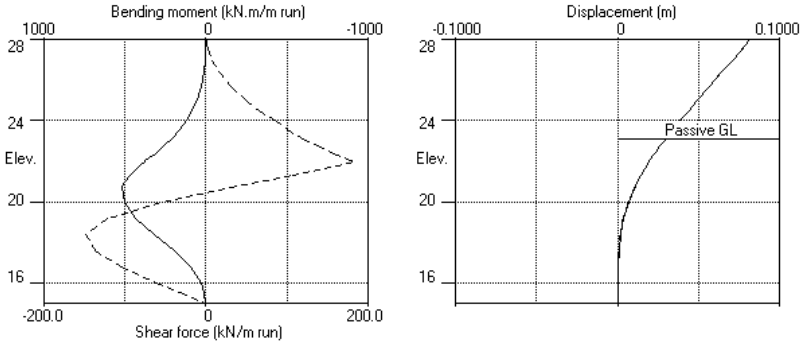
At elev. 22.73 The strut is slack

(continued)

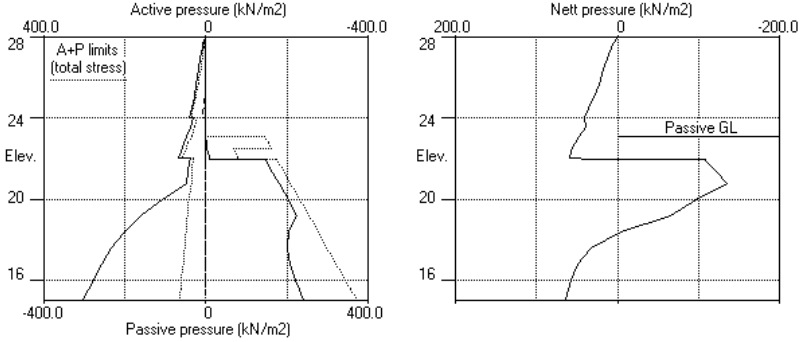
Stage No.9 Fill to elevation 28.00 on ACTIVE side with soil type 1

Units: kN,m

Stage No.9 Fill to elev. 28.00 on ACTIVE side



Stage No.9 Fill to elev. 28.00 on ACTIVE side



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Section B4 | 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 Permanent Variable loads = 1.300

STABILITY ANALYSIS of Fully Embedded Wall according to Strength Factor method

Factor of safety on soil strength

Stage No.	G.L. Act.	G.L. Pass.	Strut Elev.	Overall FoS for toe elev. = 15.00 Factor of Safety	Moment equilib. at elev.	Toe elev. for FoS = 1.000 Toe elev.	Wall Penetration
1	27.65	27.65	Cant.	Conditions not suitable for FoS calc.			
2	27.65	27.65		No analysis at this stage			
3	27.65	21.98	Cant.	1.365	16.29	17.03	4.96
4	27.65	22.48	Cant.	1.451	16.29	17.46	5.02
5	27.65	22.48		No analysis at this stage			
6	27.65	23.10	22.73	Conditions not suitable for FoS calc.			
7	27.65	23.10		No analysis at this stage			
8	27.65	23.10		No analysis at this stage			
9	28.00	23.10	22.73	Conditions not suitable for FoS calc.			
10	28.00	23.10	22.73	Conditions not suitable for FoS calc.			
11	28.00	23.10		No analysis at this stage			

All remaining stages have more than one strut - FoS calculation n/a

Units: kN,m

Summary of results

BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall

Analysis options

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

Rigid boundaries: Active side 20.00 from wall
Passive side 20.00 from wall

Limit State: ULS DA1 Combination 2

Bending moment, shear force and displacement envelopes

Node no.	Y coord	Displacement maximum m	Displacement minimum m	Bending moment maximum kN.m/m	Bending moment minimum kN.m/m	Shear force maximum kN/m	Shear force minimum kN/m
1	28.00	0.087	0.000	0.0	-0.0	0.0	0.0
2	27.65	0.083	0.000	0.0	-0.0	1.4	0.0
3	27.50	0.081	0.000	0.4	-0.0	2.8	-0.3
4	26.95	0.075	0.000	4.1	-0.7	11.7	-2.0
5	26.40	0.068	0.000	14.2	-2.1	26.0	-3.1
6	25.70	0.060	0.000	41.2	-4.4	51.3	-3.8
7	25.00	0.053	0.000	88.1	-7.1	84.1	-3.7
8	24.50	0.048	0.000	137.0	-8.7	112.1	-2.8
9	24.00	0.042	0.000	200.9	-9.7	143.7	-0.7
10	23.55	0.038	0.000	272.4	-9.3	174.6	0.0
11	23.10	0.033	0.000	358.6	-7.5	208.9	0.0
12	22.73	0.030	0.000	439.2	-4.7	232.9	-58.0
13	22.48	0.028	0.000	426.6	-2.1	170.3	-43.1
14	22.36	0.027	0.000	421.8	-0.5	178.4	-33.5
15	22.00	0.024	0.000	411.0	0.0	202.6	-25.2
16	21.98	0.024	0.000	410.7	0.0	203.0	-25.0
17	21.86	0.023	0.000	423.5	0.0	186.8	-26.0
18	21.33	0.019	0.000	498.4	0.0	114.3	-33.1
19	20.80	0.016	0.000	542.6	0.0	38.9	-45.2
20	20.00	0.012	0.000	523.8	0.0	0.0	-70.8
21	19.20	0.009	0.000	453.7	0.0	0.0	-128.4
22	18.40	0.007	0.000	330.1	0.0	0.0	-155.5
23	17.60	0.005	0.000	205.1	0.0	0.0	-142.7
24	16.80	0.004	0.000	102.0	0.0	0.0	-108.1
25	16.00	0.002	0.000	32.3	0.0	0.0	-63.2
26	15.50	0.002	0.000	8.2	0.0	0.0	-32.3
27	15.00	0.002	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 maximum kN.m/m	elev.	Bending moment minimum kN.m/m	elev.	Shear force maximum kN/m	elev.	Shear force minimum kN/m	elev.
1	17.6	20.00	-9.7	24.00	17.1	22.00	-5.1	18.40
2	No calculation at this stage							
3	526.2	20.80	-0.0	28.00	201.5	21.98	-151.8	18.40
4	531.3	20.80	-0.0	28.00	203.0	21.98	-153.1	18.40
5	No calculation at this stage							
6	536.8	20.80	-0.0	28.00	202.3	21.98	-154.3	18.40
7	No calculation at this stage							
8	No calculation at this stage							
9	515.3	20.80	-0.0	28.00	179.9	21.98	-148.7	18.40
10	542.6	20.80	-0.0	27.65	190.9	21.98	-155.5	18.40
11	No calculation at this stage							
12	No calculation at this stage							
13	No calculation at this stage							
14	No calculation at this stage							
15	No calculation at this stage							
16	439.2	22.73	-0.0	28.00	232.9	22.73	-88.8	19.20

Maximum and minimum displacement at each stage

Stage no.	Displacement maximum m	elev.	Displacement minimum m	elev.	Stage description
1	0.003	28.00	0.000	28.00	Apply surcharge no.1 at elev. 27.65
2	No calculation at this stage				Apply surcharge no.3 at elev. 27.65
3	0.086	28.00	0.000	28.00	Excav. to elev. 21.98 on PASSIVE side
4	0.086	28.00	0.000	28.00	Fill to elev. 22.48 on PASSIVE side
5	No calculation at this stage				Install strut no.2 at elev. 22.73
6	0.085	28.00	0.000	28.00	Fill to elev. 23.10 on PASSIVE side
7	No calculation at this stage				Remove surcharge no.1 at elev. 27.65
8	No calculation at this stage				Remove surcharge no.3 at elev. 27.65
9	0.082	28.00	0.000	28.00	Fill to elev. 28.00 on ACTIVE side
10	0.087	28.00	0.000	28.00	Apply surcharge no.4 at elev. 28.00
11	No calculation at this stage				Install strut no.3 at elev. 27.50
12	No calculation at this stage				Change soil type 8 to soil type 1
13	No calculation at this stage				Apply water pressure profile no.1
14	No calculation at this stage				Change soil type 3 to soil type 4
15	No calculation at this stage				Change soil type 6 to soil type 7
16	0.086	28.00	0.000	28.00	Apply surcharge no.2 at elev. 22.36

Summary of results (continued)

Strut forces at each stage (horizontal components)

Stage no.	Strut no. 2 at elev. 22.73 kN/m run	Strut no. 2 at elev. 22.73 kN/strut	Strut no. 3 at elev. 27.50 kN/m run	Strut no. 3 at elev. 27.50 kN/strut
6	slack	slack	---	---
9	slack	slack	---	---
10	slack	slack	---	---
16	290.94	290.94	slack	slack

* Indicates that the total force shown is the sum of the force in the strut plus a force applied at the same elevation which may represent temperature load or other forces which are part of the strut load. Force components are listed in the detailed results for individual stages.

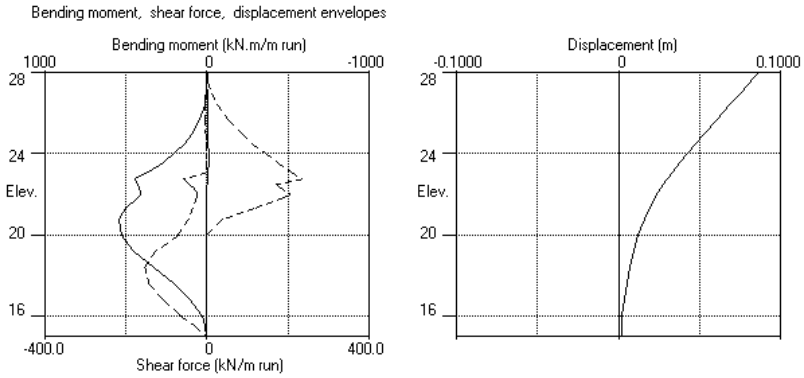
*** Convergence errors have occurred in at least one Construction Stage. The errors are cumulative, and the results of all stages must be inspected for significant out of balance moment or shear at the toe of the wall.

Failure of the iterative procedure to converge to an equilibrium solution may be due to a very high ratio of soil stiffness to wall stiffness. The data should be reviewed to see if realistic values have been specified

Out of balance shear forces.

Percentage Error	Interpretation
< 2%	Generally acceptable
2% to 4%	Use with caution
> 4%	Should not be used

Units: kN,m



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Units: kN,m

INPUT DATA

SOIL PROFILE

Stratum no.	Elevation of top of stratum	Soil types Active side	Passive side
1	27.45	8 Made Ground	8 Made Ground
2	24.00	3 London Cly Top Undr	3 London Cly Top Undr
3	22.00	6 London Cly bt Undr	6 London Cly bt Undr

SOIL PROPERTIES (Unfactored SLS soil strengths)

No.	Soil type -- Description (Datum elev.)	Bulk density kN/m3	Young's Modulus Eh,kN/m2 (dEh/dy)	At rest coeff. Ko (dKo/dy)	Consol state. NC/OC (Nu)	Active limit Ka (Kac)	Passive limit Kp (Kpc)	Cohesion kN/m2 (dc/dy)
1	Made Ground	19.00	10000	0.577	OC (0.250)	0.390 (0.000)	2.561 (0.000)	
2	Gravels	19.00	30000	0.423	OC (0.300)	0.227 (0.000)	6.084 (0.000)	
3	London Cly Top Undr	19.00	20000	1.000	OC (0.490)	1.000 (2.000)	1.000 (2.000)	40.00u
4	London Cly Top dr	19.00	14000	1.000	OC (0.250)	0.422 (1.299)	2.371 (3.080)	3.000d
5	Concrete	24.00	200000	1.000	OC (0.490)	1.000 (2.000)	1.000 (2.000)	30000u
6	London Cl.. (24.00)	19.00	42500 (2589)	1.400	OC (0.490)	1.000 (2.476)	1.000 (2.390)	80.00u (5.180)
7	London Cl.. (24.00)	19.00	28000 (1813)	1.400	OC (0.250)	0.366 (1.423)	3.077 (4.665)	3.000d
8	Made Ground	19.00	10000	0.577	OC (0.250)	0.337 (0.000)	3.442 (0.000)	

Additional soil parameters associated with Ka and Kp

No.	Soil type Description	--- parameters for Ka --- Soil friction angle	Wall adhesion coeff.	Back-fill angle	--- parameters for Kp --- Soil friction angle	Wall adhesion coeff.	Back-fill angle
1	Made Ground	26.00	0.000	0.00	26.00	0.000	0.00
2	Gravels	35.00	0.670	0.00	35.00	0.500	0.00
3	London Cly Top Undr	0.00	0.000	0.00	0.00	0.000	0.00
4	London Cly Top dr	24.00	0.000	0.00	24.00	0.000	0.00
5	Concrete	0.00	0.000	0.00	0.00	0.000	0.00
6	London Cly bt Undr	0.00	0.670	0.00	0.00	0.500	0.00
7	London Cly bt dr	24.00	0.670	0.00	24.00	0.500	0.00
8	Made Ground	26.00	0.670	0.00	26.00	0.500	0.00

GROUND WATER CONDITIONS

Density of water = 10.00 kN/m3

	Active side	Passive side
Initial water table elevation	24.45	21.08

Automatic water pressure balancing at toe of wall : Yes

Water press. profile no.	Point no.	Active side Elev. m	Piezo elev. m	Water press. kN/m2	Point no.	Passive side Elev. m	Piezo elev. m	Water press. kN/m2	
1	1	26.45	26.45	0.0	1	22.36	22.36	0.0	MC+WC
					2	22.36	26.45	40.9	

WALL PROPERTIES

Type of structure = Fully Embedded Wall
Elevation of toe of wall = 13.50
Maximum finite element length = 0.80 m
Youngs modulus of wall E = 1.4000E+07 kN/m2
Moment of inertia of wall I = 0.017260 m4/m run
E.I = 241640 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	26.60	5.00	0.010000	2.000E+08	10.00	0.00	0	No
2	22.73	1.00	0.300000	1.400E+07	10.00	0.00	0	No
3	27.13	1.00	0.300000	1.400E+07	10.00	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	27.45	0.50(A)	100.00	20.00	20.00	=	N/A	1.30 Var
2	22.36	-0.00(P)	30.00	20.00	41.00	=	N/A	1.00 P/U
3	Not defined							
4	28.00	0.50(A)	100.00	20.00	20.00	=	N/A	1.30 Var

Note: A = Active side, P = Passive 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 27.45
	No analysis at this stage
2	Excavate to elevation 21.21 on PASSIVE side
3	Install strut or anchor no.2 at elevation 22.73
4	Fill to elevation 23.01 on PASSIVE side with soil type 6
5	Install strut or anchor no.3 at elevation 27.13
6	Change properties of soil type 8 to soil type 1
	No analysis at this stage
	Ko pressures will not be reset
7	Apply water pressure profile no.1 (Worst Cred.)
	No analysis at this stage
8	Change properties of soil type 3 to soil type 4
	No analysis at this stage
	Ko pressures will not be reset
9	Change properties of soil type 6 to soil type 7
	No analysis at this stage
	Ko pressures will not be reset
10	Apply surcharge no.2 at elevation 22.36

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 Permanent Variable 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) = 0 m

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

   Width of excavation on active side of wall = 20.00 m
   Width of excavation on passive side of wall = 20.00 m

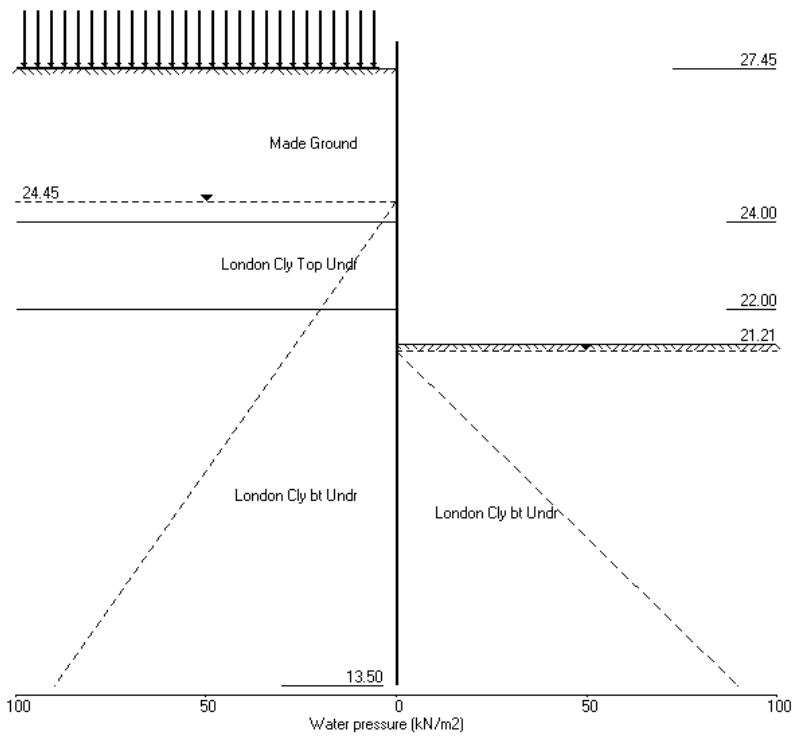
   Distance to rigid boundary on active side = 20.00 m
   Distance to rigid boundary on passive side = 20.00 m

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. 27.45	No	No	No
2	Excav. to elev. 21.21 on PASSIVE side	No	No	No
3	Install strut no.2 at elev. 22.73	No	No	No
4	Fill to elev. 23.01 on PASSIVE side	No	No	No
5	Install strut no.3 at elev. 27.13	No	No	No
6	Change soil type 8 to soil type 1	No	No	No
7	Apply water pressure profile no.1	No	No	No
8	Change soil type 3 to soil type 4	No	No	No
9	Change soil type 6 to soil type 7	No	No	No
10	Apply surcharge no.2 at elev. 22.36	No	No	No
*	Summary output	Yes	-	Yes

Units: kN,m

Stage No.2 Excav. to elev. 21.21 on PASSIVE side



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Units: kN,m

Stage No. 2 Excavate to elevation 21.21 on PASSIVE side

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

Stage No.	--- G.L. --- Act.	Pass.	Strut Elev.	Overall FoS for toe elev. = 13.50 Factor of Safety	Moment equilib. at elev.	Toe elev. for FoS = 1.000 Toe elev.	Wall Penetr -ation
2	27.45	21.21	Cant.	1.483	14.82	16.25	4.96

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: Active side 20.00 from wall
Passive side 20.00 from wall
Limit State: ULS DA1 Combination 2

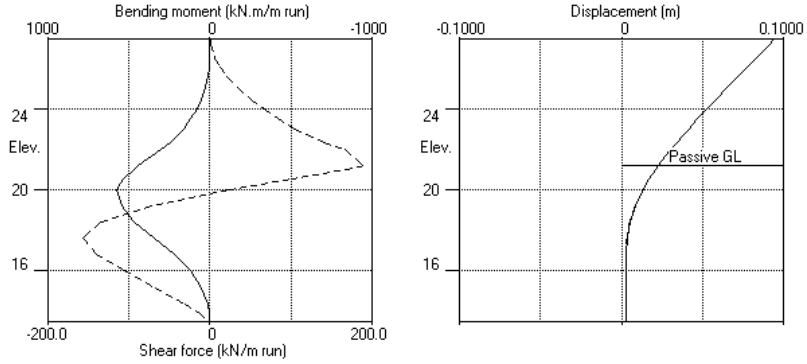
Node no.	Y coord	Nett pressure kN/m2	Wall disp. m	Wall rotation rad.	Shear force kN/m	Bending moment kN.m/m	Strut forces kN/m
1	27.45	0.00	0.094	1.20E-02	0.0	-0.0	
2	27.13	3.34	0.090	1.20E-02	0.5	0.1	
3	26.45	12.59	0.082	1.20E-02	5.9	1.9	
4	26.03	17.36	0.077	1.20E-02	12.3	5.8	
5	25.60	21.58	0.072	1.20E-02	20.6	12.7	
6	25.03	26.83	0.065	1.19E-02	34.5	28.4	
7	24.45	31.81	0.058	1.19E-02	51.3	52.9	
8	24.00	37.76	0.053	1.17E-02	67.0	79.4	
		29.61	0.053	1.17E-02	67.0	79.4	
9	23.51	39.57	0.047	1.15E-02	84.1	116.6	
10	23.01	49.40	0.041	1.12E-02	106.1	163.4	
11	22.73	54.81	0.038	1.10E-02	120.5	194.6	
12	22.36	62.16	0.034	1.07E-02	142.4	243.7	
13	22.00	69.17	0.030	1.03E-02	166.0	299.2	
		27.25	0.030	1.03E-02	166.0	299.2	
14	21.21	31.20	0.023	9.13E-03	189.1	439.0	
		-130.04	0.023	9.13E-03	189.1	439.0	
15	21.08	-132.90	0.022	8.90E-03	172.7	461.6	
16	20.54	-145.29	0.017	7.78E-03	97.2	535.0	
17	20.00	-138.76	0.013	6.53E-03	20.2	573.5	
18	19.20	-94.32	0.009	4.68E-03	-73.0	544.8	
19	18.40	-58.63	0.006	3.01E-03	-134.2	468.3	
20	17.60	4.28	0.004	1.66E-03	-156.0	342.3	
21	16.80	37.05	0.003	7.39E-04	-139.4	219.0	
22	16.00	48.73	0.002	1.79E-04	-105.1	119.4	
23	15.20	47.67	0.002	-1.01E-04	-66.6	50.9	
24	14.40	40.28	0.003	-2.07E-04	-31.4	13.0	
25	13.95	34.94	0.003	-2.22E-04	-14.4	3.0	
26	13.50	29.26	0.003	-2.25E-04	-0.0	-0.0	

(continued)

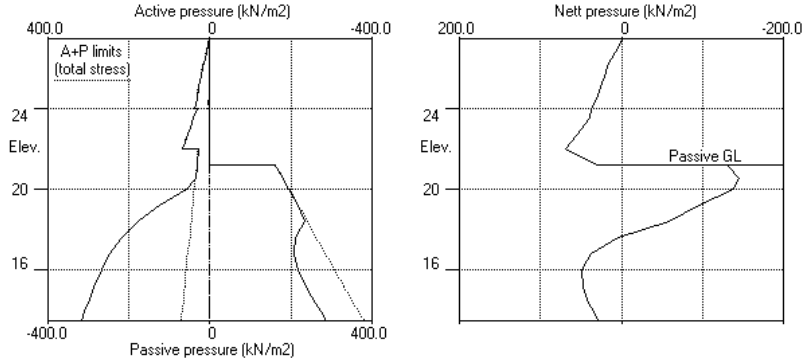
Stage No.2 Excavate to elevation 21.21 on PASSIVE side

Units: kN,m

Stage No.2 Excav. to elev. 21.21 on PASSIVE side

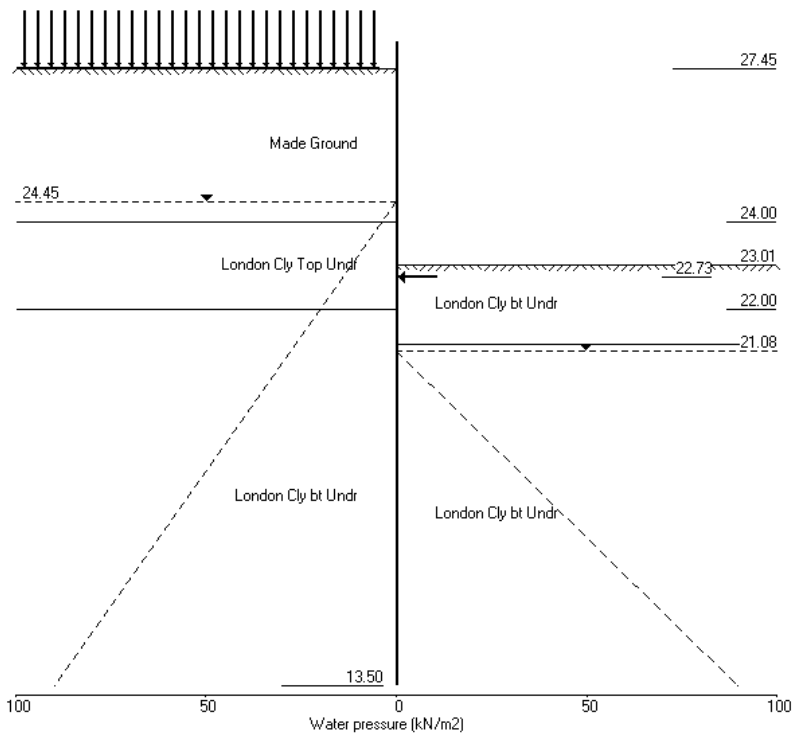


Stage No.2 Excav. to elev. 21.21 on PASSIVE side



Units: kN,m

Stage No.4 Fill to elev. 23.01 on PASSIVE side



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Units: kN,m

Stage No. 4 Fill to elevation 23.01 on PASSIVE side with soil type 6

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

Stage No.	--- G.L. --- Act.	Pass.	Strut Elev.	Overall FoS for toe elev. = 13.50 Factor of Safety	Moment equilib. at elev.	Toe elev. for FoS = 1.000 Toe elev.	Wall Penetr -ation
4	27.45	23.01	22.73	Conditions not suitable for 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: Active side 20.00 from wall
Passive 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
1	27.45	0.00	0.094	1.23E-02	0.0	-0.0	
2	27.13	3.51	0.090	1.23E-02	0.6	0.1	
3	26.45	12.97	0.082	1.23E-02	6.1	2.0	
4	26.03	17.86	0.077	1.23E-02	12.7	6.0	
5	25.60	22.21	0.071	1.23E-02	21.2	13.1	
6	25.03	27.64	0.064	1.23E-02	35.5	29.3	
7	24.45	32.79	0.057	1.22E-02	52.9	54.5	
8	24.00	38.87	0.052	1.20E-02	69.0	81.8	
		32.62	0.052	1.20E-02	69.0	81.8	
9	23.51	42.97	0.046	1.18E-02	87.7	120.4	
10	23.01	53.17	0.040	1.15E-02	111.5	169.4	
11	22.73	57.42	0.037	1.13E-02	126.7	202.2	-0.0
12	22.36	63.16	0.033	1.10E-02	149.3	253.8	
13	22.00	66.43	0.029	1.05E-02	172.7	311.5	
		30.72	0.029	1.05E-02	172.7	311.5	
14	21.21	23.54	0.021	9.32E-03	194.1	456.1	
		-137.70	0.021	9.32E-03	194.1	456.1	
15	21.08	-140.07	0.020	9.08E-03	176.7	479.3	
16	20.54	-150.51	0.015	7.92E-03	97.9	553.9	
17	20.00	-142.29	0.011	6.64E-03	18.5	592.0	
18	19.20	-95.89	0.007	4.73E-03	-76.8	560.8	
19	18.40	-58.84	0.003	3.00E-03	-138.7	480.8	
20	17.60	4.92	0.002	1.63E-03	-160.2	351.1	
21	16.80	38.14	0.001	6.79E-04	-143.0	224.6	
22	16.00	49.96	0.000	1.05E-04	-107.8	122.4	
23	15.20	48.86	0.000	-1.84E-04	-68.3	52.2	
24	14.40	41.31	0.001	-2.92E-04	-32.2	13.3	
25	13.95	35.84	0.001	-3.07E-04	-14.8	3.0	
26	13.50	30.03	0.001	-3.10E-04	-0.0	-0.0	

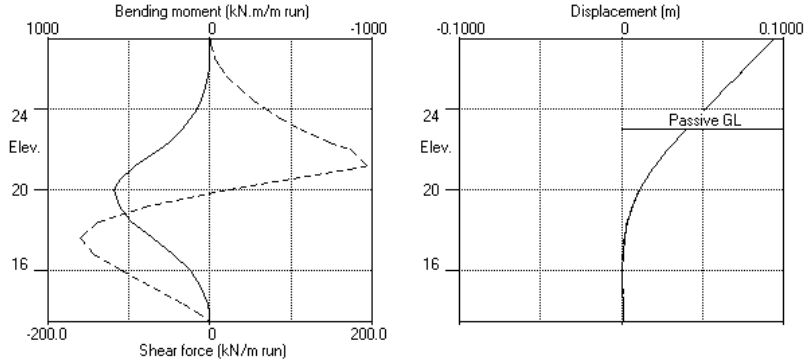
At elev. 22.73 The strut is slack

(continued)

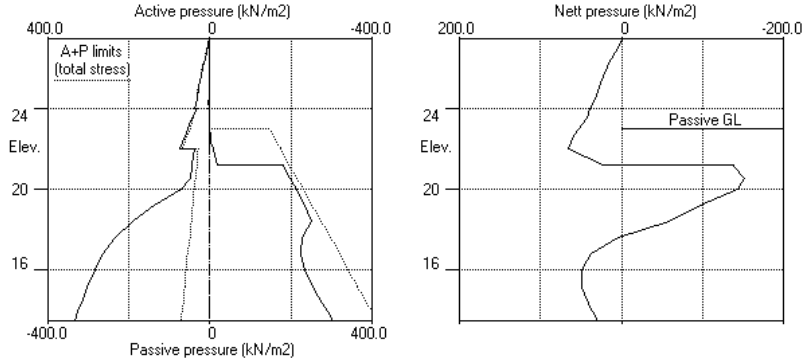
Stage No.4 Fill to elevation 23.01 on PASSIVE side with soil type 6

Units: kN,m

Stage No.4 Fill to elev. 23.01 on PASSIVE side



Stage No.4 Fill to elev. 23.01 on PASSIVE side



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 Permanent Variable loads = 1.300

STABILITY ANALYSIS of Fully Embedded Wall according to Strength Factor method

Factor of safety on soil strength

Stage No.	G.L. Act.	G.L. Pass.	Strut Elev.	Overall FoS for toe elev. = 13.50 Factor of Safety	Moment equilib. at elev.	Toe elev. for FoS = 1.000 Toe elev.	Wall Penetration
1	27.45	27.45	Cant.	Conditions not suitable for FoS calc.			
2	27.45	21.21	Cant.	1.483	14.82	16.25	4.96
3	27.45	21.21		No analysis at this stage			
4	27.45	23.01	22.73	Conditions not suitable for FoS calc.			
5	27.45	23.01		No analysis at this stage			

All remaining stages have more than one strut - FoS calculation n/a

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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: Active side 20.00 from wall
Passive side 20.00 from wall

Limit State: ULS DA1 Combination 2

Bending moment, shear force and displacement envelopes

Node no.	Y coord	Displacement maximum m	Displacement minimum m	Bending moment maximum kN.m/m	Bending moment minimum kN.m/m	Shear force maximum kN/m	Shear force minimum kN/m
1	27.45	0.094	0.000	0.0	-0.0	0.0	0.0
2	27.13	0.090	0.000	0.1	-0.0	1.8	-0.6
3	26.45	0.082	0.000	4.4	-1.1	11.6	-2.4
4	26.03	0.077	0.000	11.4	-2.2	20.9	-3.1
5	25.60	0.072	0.000	22.7	-3.6	32.8	-3.4
6	25.03	0.065	0.000	47.2	-5.6	53.0	-3.4
7	24.45	0.058	0.000	84.6	-7.4	77.6	-2.8
8	24.00	0.053	0.000	124.5	-8.5	100.2	-1.8
9	23.51	0.047	0.000	180.8	-8.6	127.9	0.0
10	23.01	0.041	0.000	251.6	-6.7	159.1	0.0
11	22.73	0.039	0.000	297.7	-4.7	176.1	0.0
12	22.36	0.035	0.000	305.4	-0.7	149.3	0.0
13	22.00	0.032	0.000	318.3	0.0	172.7	0.0
14	21.21	0.025	0.000	456.1	0.0	194.1	0.0
15	21.08	0.024	0.000	479.3	0.0	176.7	0.0
16	20.54	0.020	0.000	553.9	0.0	97.9	0.0
17	20.00	0.016	0.000	592.0	0.0	20.2	-2.8
18	19.20	0.012	0.000	560.8	0.0	0.0	-76.8
19	18.40	0.009	0.000	480.8	0.0	0.0	-138.7
20	17.60	0.006	0.000	351.1	0.0	0.0	-160.2
21	16.80	0.004	0.000	224.6	0.0	0.0	-143.0
22	16.00	0.003	0.000	125.8	0.0	0.0	-107.8
23	15.20	0.002	0.000	72.2	0.0	0.0	-68.3
24	14.40	0.003	0.000	28.1	0.0	0.0	-46.5
25	13.95	0.003	0.000	9.5	0.0	0.0	-31.3
26	13.50	0.003	0.000	0.0	-0.0	0.0	-0.0

Maximum and minimum bending moment and shear force at each stage

Stage no.	Bending moment maximum kN.m/m	Bending moment elev.	Bending moment minimum kN.m/m	Bending moment elev.	Shear force maximum kN/m	Shear force elev.	Shear force minimum kN/m	Shear force elev.
1	18.5	20.00	-8.6	23.51	16.7	22.00	-4.7	17.60
2	573.5	20.00	-0.0	27.45	189.1	21.21	-156.0	17.60
3	No calculation at this stage							
4	592.0	20.00	-0.0	27.45	194.1	21.21	-160.2	17.60
5	No calculation at this stage							
6	No calculation at this stage							
7	No calculation at this stage							
8	No calculation at this stage							
9	No calculation at this stage							
10	388.7	20.00	-0.0	27.45	176.1	22.73	-81.8	17.60

Summary of results (continued)

Maximum and minimum displacement at each stage

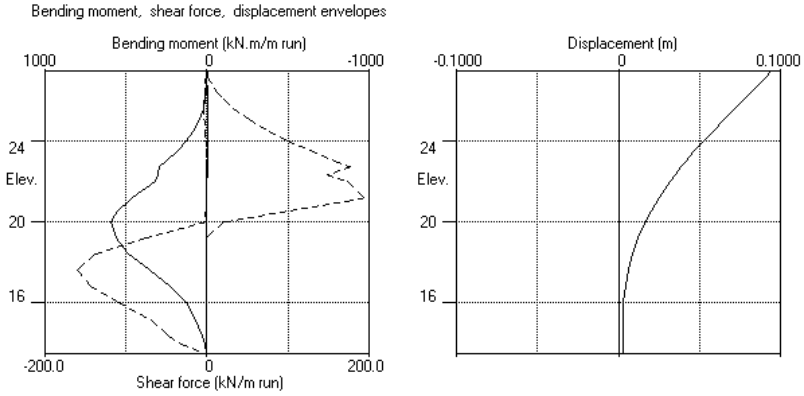
Stage no.	Displacement maximum m	elev.	minimum m	elev.	Stage description
1	0.003	27.45	0.000	27.45	Apply surcharge no.1 at elev. 27.45
2	0.094	27.45	0.000	27.45	Excav. to elev. 21.21 on PASSIVE side
3	No calculation at this stage				Install strut no.2 at elev. 22.73
4	0.094	27.45	0.000	27.45	Fill to elev. 23.01 on PASSIVE side
5	No calculation at this stage				Install strut no.3 at elev. 27.13
6	No calculation at this stage				Change soil type 8 to soil type 1
7	No calculation at this stage				Apply water pressure profile no.1
8	No calculation at this stage				Change soil type 3 to soil type 4
9	No calculation at this stage				Change soil type 6 to soil type 7
10	0.092	27.45	0.000	27.45	Apply surcharge no.2 at elev. 22.36

Strut forces at each stage (horizontal components)

Stage no.	Strut no. 2 at elev. 22.73 kN/m run	kN/strut	Strut no. 3 at elev. 27.13 kN/m run	kN/strut
4	slack	slack	---	---
10	167.56	167.56	slack	slack

* Indicates that the total force shown is the sum of the force in the strut plus a force applied at the same elevation which may represent temperature load or other forces which are part of the strut load. Force components are listed in the detailed results for individual stages.

Units: kN,m



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Camley Street | Date: 8-12-2015
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Units: kN,m

INPUT DATA

SOIL PROFILE

Stratum no.	Elevation of top of stratum	Soil types Active side		Passive side	
1	27.45	8	Made Ground Init	8	Made Ground Init
2	24.00	3	London Cly Top Undr	3	London Cly Top Undr
3	22.00	6	London Cly bt Undr	6	London Cly bt Undr

SOIL PROPERTIES (Unfactored SLS soil strengths)

No.	Soil type / Description	Bulk density kN/m3	Young's Modulus Eh,kN/m2 (dEh/dy)	At rest coeff. Ko (dKo/dy)	Consol state. NC/OC (Nu)	Active limit Ka (Kac)	Passive limit Kp (Kpc)	Cohesion kN/m2 (dc/dy)
	(Datum elev.)							
1	Made Ground	19.00	10000	0.577	OC	0.390	2.561	
					(0.250)	(0.000)	(0.000)	
2	Gravels	19.00	30000	0.423	OC	0.227	6.084	
					(0.300)	(0.000)	(0.000)	
3	London Cly Top Undr	19.00	20000	1.000	OC	1.000	1.000	40.00u
					(0.490)	(2.000)	(2.000)	
4	London Cly Top dr	19.00	14000	1.000	OC	0.422	2.371	3.000d
					(0.250)	(1.299)	(3.080)	
5	Concrete	24.00	200000	1.000	OC	1.000	1.000	30000u
					(0.490)	(2.000)	(2.000)	
6	London Cl..	19.00	42500	1.400	OC	1.000	1.000	80.00u
	(24.00)		(2589)		(0.490)	(2.476)	(2.390)	(5.180)
7	London Cl..	19.00	28000	1.400	OC	0.366	3.077	3.000d
	(24.00)		(1813)		(0.250)	(1.423)	(4.665)	
8	Made Ground Init	19.00	10000	0.577	OC	0.337	3.442	
					(0.250)	(0.000)	(0.000)	

Additional soil parameters associated with Ka and Kp

No.	Soil type / Description	--- parameters for Ka --- Soil friction angle	Wall adhesion coeff.	Back-fill angle	--- parameters for Kp --- Soil friction angle	Wall adhesion coeff.	Back-fill angle
1	Made Ground	26.00	0.000	0.00	26.00	0.000	0.00
2	Gravels	35.00	0.670	0.00	35.00	0.500	0.00
3	London Cly Top Undr	0.00	0.000	0.00	0.00	0.000	0.00
4	London Cly Top dr	24.00	0.000	0.00	24.00	0.000	0.00
5	Concrete	0.00	0.000	0.00	0.00	0.000	0.00
6	London Cly bt Undr	0.00	0.670	0.00	0.00	0.500	0.00
7	London Cly bt dr	24.00	0.670	0.00	24.00	0.500	0.00
8	Made Ground Init	26.00	0.670	0.00	26.00	0.500	0.00

GROUND WATER CONDITIONS

Density of water = 10.00 kN/m3

	Active side	Passive side
Initial water table elevation	25.00	21.86

Automatic water pressure balancing at toe of wall : Yes

Water press. profile no.	Point no.	Active side Elev. m	Piezo elev. m	Water press. kN/m2	Point no.	Passive side Elev. m	Piezo elev. m	Water press. kN/m2	
1	1	27.30	27.30	0.0	1	22.36	22.36	0.0	MC+WC
					2	22.36	27.30	49.4	

WALL PROPERTIES

Type of structure = Fully Embedded Wall
Elevation of toe of wall = 15.00
Maximum finite element length = 0.60 m
Youngs modulus of wall E = 1.4000E+07 kN/m2
Moment of inertia of wall I = 0.017260 m4/m run
E.I = 241640 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	27.13	5.00	0.010000	2.000E+08	10.00	0.00	0	No
2	22.73	1.00	0.300000	1.400E+07	10.00	0.00	0	No
3	27.30	1.00	0.300000	1.400E+07	10.00	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	27.45	0.50(A)	100.00	20.00	20.00	=	N/A	1.10 Var
2	22.36	-0.00(P)	30.00	20.00	50.00	=	N/A	1.00 P/U

Note: A = Active side, P = Passive 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 27.45
	No analysis at this stage
2	Excavate to elevation 21.98 on PASSIVE side
3	Install strut or anchor no.2 at elevation 22.73
4	Fill to elevation 23.01 on PASSIVE side with soil type 6
5	Install strut or anchor no.3 at elevation 27.30
6	Change properties of soil type 8 to soil type 1
	No analysis at this stage
	Ko pressures will not be reset
7	Apply water pressure profile no.1 (Mod. Conserv.)
	No analysis at this stage
8	Change properties of soil type 3 to soil type 4
	No analysis at this stage
	Ko pressures will not be reset
9	Change properties of soil type 6 to soil type 7
	No analysis at this stage
	Ko pressures will not be reset
10	Apply surcharge no.2 at elevation 22.36

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 Permanent Variable 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) = 0 m

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

   Width of excavation on active side of wall = 20.00 m
   Width of excavation on passive side of wall = 20.00 m

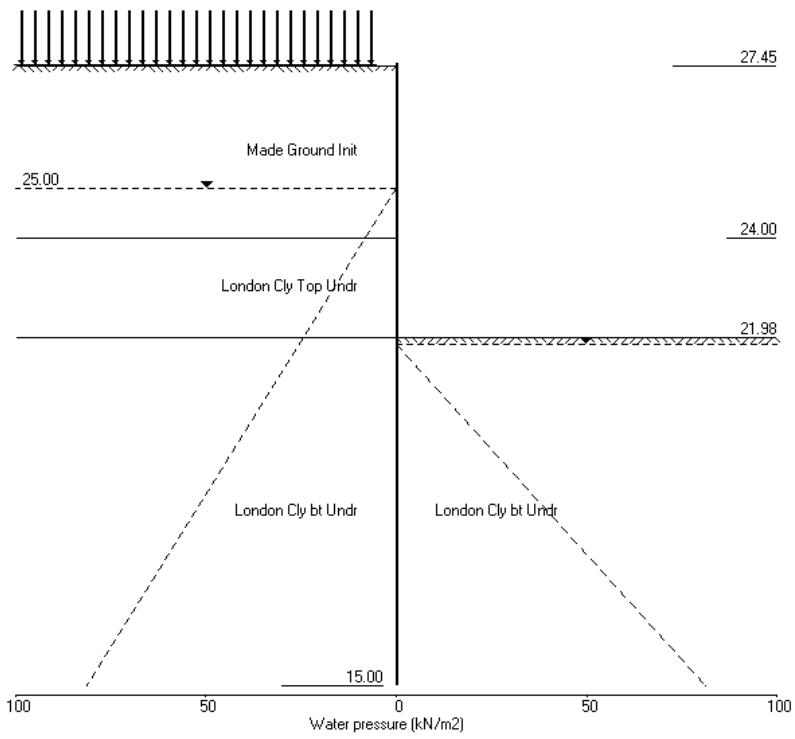
   Distance to rigid boundary on active side = 20.00 m
   Distance to rigid boundary on passive side = 20.00 m

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. 27.45	No	No	No
2	Excav. to elev. 21.98 on PASSIVE side	No	No	No
3	Install strut no.2 at elev. 22.73	No	No	No
4	Fill to elev. 23.01 on PASSIVE side	No	No	No
5	Install strut no.3 at elev. 27.30	No	No	No
6	Change soil type 8 to soil type 1	No	No	No
7	Apply water pressure profile no.1	No	No	No
8	Change soil type 3 to soil type 4	No	No	No
9	Change soil type 6 to soil type 7	No	No	No
10	Apply surcharge no.2 at elev. 22.36	No	No	No
*	Summary output	Yes	-	Yes

Units: kN,m

Stage No.2 Excav. to elev. 21.98 on PASSIVE side



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Units: kN,m

Stage No. 2 Excavate to elevation 21.98 on PASSIVE 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: Active side 20.00 from wall
Passive side 20.00 from wall

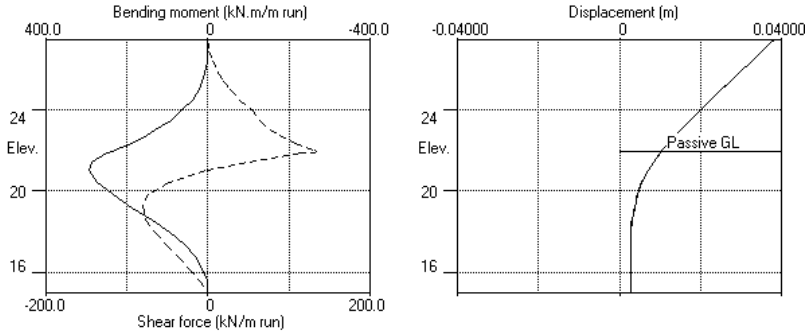
Limit State: ULS DA1 Combination 1

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.

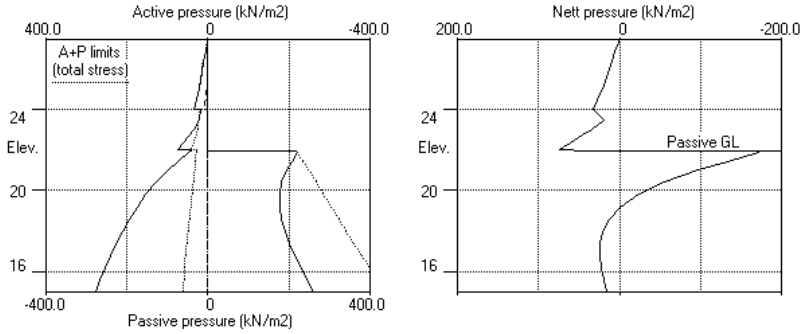
Node no.	Y coord	Nett pressure kN/m2	Wall disp. m	Wall rotation rad.	Shear force kN/m	Bending moment kN.m/m	Strut forces kN/m
1	27.45	0.00	0.038	5.35E-03	0.0	-0.0	
2	27.30	1.04	0.037	5.35E-03	0.1	0.0	
3	26.85	5.65	0.035	5.35E-03	1.6	0.4	
4	26.40	10.20	0.033	5.35E-03	5.1	1.8	
5	25.80	15.26	0.029	5.34E-03	12.8	7.0	
6	25.40	18.30	0.027	5.32E-03	19.5	13.5	
7	25.00	21.20	0.025	5.29E-03	27.4	22.8	
8	24.50	27.40	0.022	5.22E-03	39.5	39.4	
9	24.00	33.51	0.020	5.12E-03	54.8	62.8	
		17.25	0.020	5.12E-03	54.8	62.8	
10	23.51	19.73	0.017	4.96E-03	63.9	92.1	
11	23.01	34.21	0.015	4.73E-03	77.3	129.3	
12	22.73	45.54	0.014	4.57E-03	88.2	151.9	
13	22.36	60.57	0.012	4.31E-03	108.1	188.4	
14	22.00	74.49	0.010	4.00E-03	132.4	231.4	
		40.29	0.010	4.00E-03	132.4	231.4	
15	21.98	41.21	0.010	3.98E-03	133.1	233.4	
		-174.93	0.010	3.98E-03	133.1	233.4	
16	21.86	-171.21	0.010	3.86E-03	111.4	248.7	
17	21.43	-133.87	0.008	3.38E-03	45.8	285.7	
18	21.00	-97.30	0.007	2.87E-03	-3.9	293.1	
19	20.40	-55.02	0.006	2.16E-03	-49.6	273.3	
20	19.80	-23.12	0.004	1.53E-03	-73.0	233.7	
21	19.20	-0.79	0.004	1.01E-03	-80.2	185.8	
22	18.60	13.40	0.003	6.17E-04	-76.4	137.6	
23	18.00	21.18	0.003	3.29E-04	-66.0	94.2	
24	17.40	24.30	0.003	1.39E-04	-52.4	58.4	
25	16.80	24.33	0.003	2.82E-05	-37.8	31.4	
26	16.20	22.54	0.003	-2.70E-05	-23.7	13.2	
27	15.60	19.87	0.003	-4.71E-05	-11.0	3.0	
28	15.00	16.84	0.003	-5.08E-05	0.0	0.0	

Units: kN,m

Stage No.2 Excav. to elev. 21.98 on PASSIVE side



Stage No.2 Excav. to elev. 21.98 on PASSIVE side



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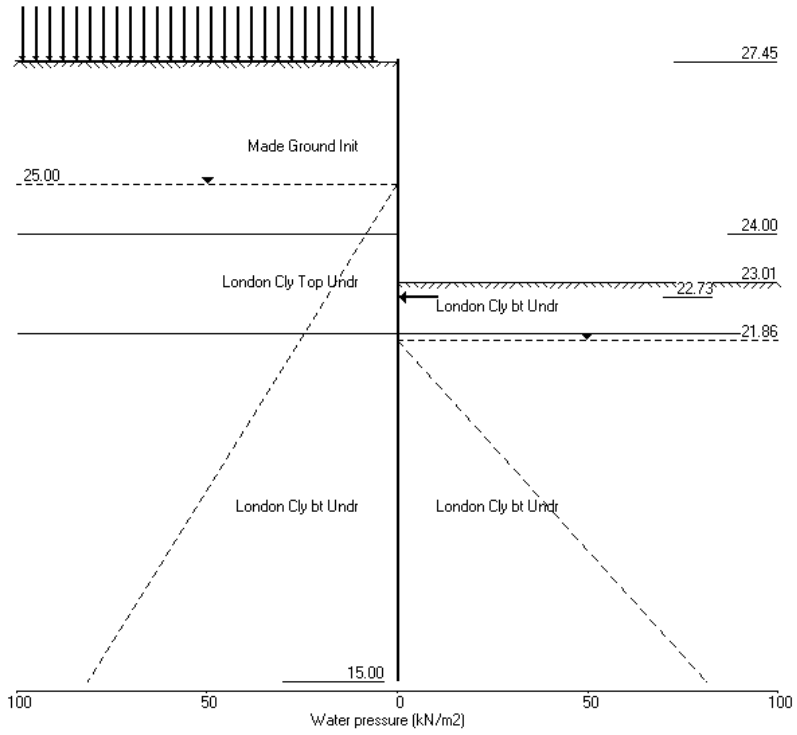
Units: kN,m

Stage No.4 Fill to elev. 23.01 on PASSIVE side



Units: kN,m

Stage No. 4 Fill to elevation 23.01 on PASSIVE side with soil type 6

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: Active side 20.00 from wall
Passive 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/m2	Wall disp. m	Wall rotation rad.	Shear force kN/m	Bending moment kN.m/m	Strut forces kN/m
1	27.45	0.00	0.038	5.51E-03	0.0	-0.0	
2	27.30	1.30	0.037	5.51E-03	0.1	0.0	
3	26.85	5.99	0.035	5.51E-03	1.7	0.4	
4	26.40	10.61	0.032	5.51E-03	5.5	2.0	
5	25.80	15.77	0.029	5.50E-03	13.4	7.5	
6	25.40	18.88	0.027	5.48E-03	20.3	14.2	
7	25.00	21.84	0.024	5.45E-03	28.5	23.9	
8	24.50	28.12	0.022	5.38E-03	40.9	41.1	
9	24.00	34.31	0.019	5.27E-03	56.6	65.3	
		19.40	0.019	5.27E-03	56.6	65.3	
10	23.51	22.07	0.016	5.11E-03	66.8	95.7	
11	23.01	36.75	0.014	4.87E-03	81.4	134.7	
12	22.73	46.79	0.013	4.70E-03	92.9	158.5	-0.0
13	22.36	58.60	0.011	4.43E-03	112.6	196.5	
14	22.00	66.48	0.009	4.10E-03	135.1	240.9	
		36.25	0.009	4.10E-03	135.1	240.9	
15	21.98	36.93	0.009	4.09E-03	135.7	242.9	
		-179.21	0.009	4.09E-03	135.7	242.9	
16	21.86	-175.21	0.009	3.96E-03	113.5	258.4	
17	21.43	-137.00	0.007	3.46E-03	46.4	296.1	
18	21.00	-99.64	0.006	2.93E-03	-4.5	303.4	
19	20.40	-56.43	0.004	2.20E-03	-51.3	282.8	
20	19.80	-23.79	0.003	1.55E-03	-75.4	241.9	
21	19.20	-0.91	0.002	1.01E-03	-82.8	192.5	
22	18.60	13.67	0.002	6.00E-04	-78.9	142.7	
23	18.00	21.72	0.002	3.01E-04	-68.3	97.8	
24	17.40	25.00	0.002	1.04E-04	-54.3	60.8	
25	16.80	25.12	0.002	-1.17E-05	-39.3	32.8	
26	16.20	23.37	0.002	-6.94E-05	-24.7	13.7	
27	15.60	20.69	0.002	-9.04E-05	-11.5	3.2	
28	15.00	17.65	0.002	-9.43E-05	0.0	0.0	

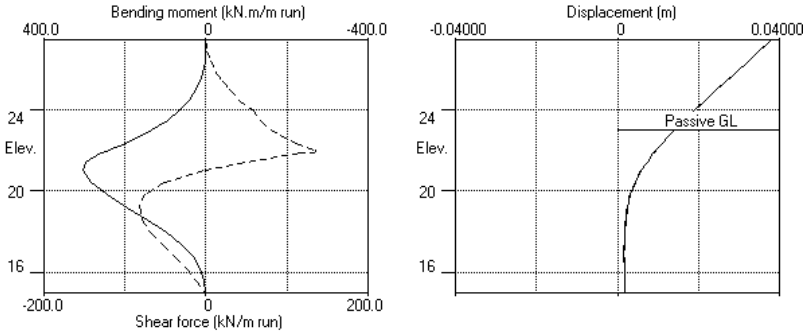
At elev. 22.73 The strut is slack

(continued)

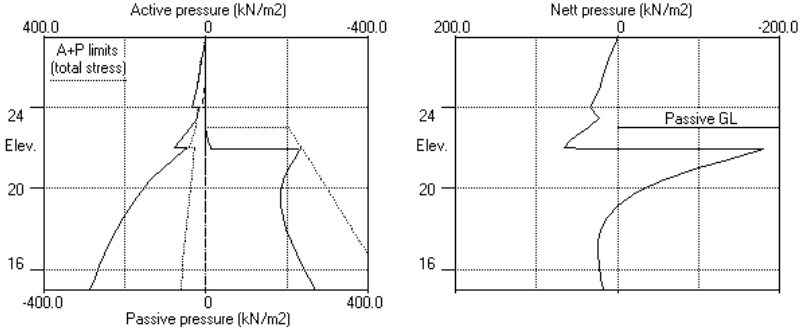
Stage No.4 Fill to elevation 23.01 on PASSIVE side with soil type 6

Units: kN,m

Stage No.4 Fill to elev. 23.01 on PASSIVE side



Stage No.4 Fill to elev. 23.01 on PASSIVE side



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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: Active side 20.00 from wall
Passive side 20.00 from wall

Limit State: ULS DA1 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 max. m	Displacement min. m	Bending moment Calculated max. kN.m/m	Bending moment Calculated min. kN.m/m	Bending moment Factored max. kN.m/m	Bending moment Factored min. kN.m/m	Shear force Calculated max. kN/m	Shear force Calculated min. kN/m	Shear force Factored max. kN/m	Shear force Factored min. kN/m
1	27.45	0.038	0.000	0	-0	0	-0	0	0	0	0
2	27.30	0.037	0.000	0	-0	0	-0	0	-20	0	-27
3	26.85	0.035	0.000	0	-9	1	-12	2	-18	2	-24
4	26.40	0.033	0.000	2	-15	3	-21	5	-12	7	-16
5	25.80	0.029	0.000	7	-19	10	-26	13	-4	18	-5
6	25.40	0.027	0.000	14	-16	19	-22	20	-4	27	-5
7	25.00	0.025	0.000	24	-8	32	-11	28	-4	38	-5
8	24.50	0.023	0.000	41	-8	55	-11	49	-3	66	-4
9	24.00	0.020	0.000	65	-9	88	-12	73	-1	99	-1
10	23.51	0.018	0.000	96	-9	129	-12	100	0	135	0
11	23.01	0.015	0.000	143	-7	193	-9	130	0	176	0
12	22.73	0.014	0.000	181	-5	244	-6	146	0	198	0
13	22.36	0.012	0.000	197	-1	265	-1	113	0	152	0
14	22.00	0.011	0.000	241	0	325	0	135	0	182	0
15	21.98	0.011	0.000	243	0	328	0	136	0	183	0
16	21.86	0.010	0.000	258	0	349	0	114	0	153	0
17	21.43	0.009	0.000	296	0	400	0	46	0	63	0
18	21.00	0.007	0.000	303	0	410	0	5	-4	7	-6
19	20.40	0.006	0.000	283	0	382	0	1	-51	1	-69
20	19.80	0.004	0.000	242	0	327	0	0	-75	0	-102
21	19.20	0.004	0.000	192	0	260	0	0	-83	0	-112
22	18.60	0.003	0.000	150	0	202	0	0	-79	0	-107
23	18.00	0.003	0.000	115	0	156	0	0	-68	0	-92
24	17.40	0.003	0.000	80	0	108	0	0	-56	0	-76
25	16.80	0.003	0.000	48	0	65	0	0	-48	0	-65
26	16.20	0.003	0.000	23	0	31	0	0	-35	0	-48
27	15.60	0.003	0.000	6	0	8	0	0	-19	0	-26
28	15.00	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	Bending moment					Shear force					
no.	Calculated				Factored		Calculated				Factored	
	max. kN.m/m	elev.	min. kN.m/m	elev.	max. kN.m/m	min. kN.m/m	max. kN/m	elev.	min. kN/m	elev.	max. kN/m	min. kN/m
1	15	20.40	-9	24.00	21	-12	15	22.00	-4	18.00	20	-6
2	293	21.00	-0	27.45	396	-0	133	21.98	-80	19.20	180	-108
3	No calculation at this stage											
4	303	21.00	-0	27.45	410	-0	136	21.98	-83	19.20	183	-112
5	No calculation at this stage											
6	No calculation at this stage											
7	No calculation at this stage											
8	No calculation at this stage											
9	No calculation at this stage											
10	227	21.00	-19	25.80	306	-26	146	22.73	-58	18.00	198	-78

Maximum and minimum displacement at each stage

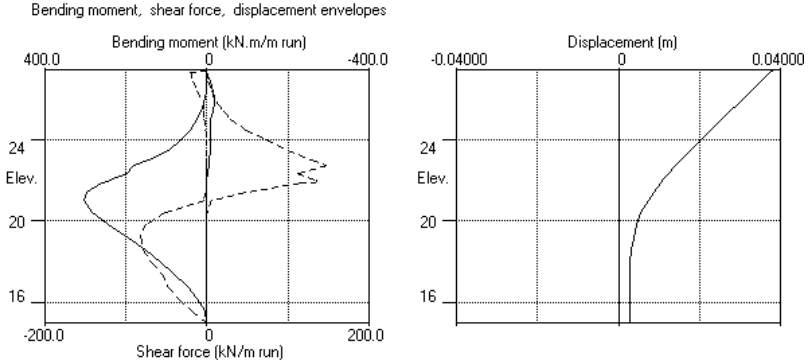
Stage no.	Displacement maximum m	elev.	minimum m	elev.	Stage description
1	0.002	27.45	0.000	27.45	Apply surcharge no.1 at elev. 27.45
2	0.038	27.45	0.000	27.45	Excav. to elev. 21.98 on PASSIVE side
3	No calculation at this stage				Install strut no.2 at elev. 22.73
4	0.038	27.45	0.000	27.45	Fill to elev. 23.01 on PASSIVE side
5	No calculation at this stage				Install strut no.3 at elev. 27.30
6	No calculation at this stage				Change soil type 8 to soil type 1
7	No calculation at this stage				Apply water pressure profile no.1
8	No calculation at this stage				Change soil type 3 to soil type 4
9	No calculation at this stage				Change soil type 6 to soil type 7
10	0.038	27.45	0.000	27.45	Apply surcharge no.2 at elev. 22.36

Strut forces at each stage (horizontal components)

Stage no.	Strut no. 2 at elev. 22.73			Strut no. 3 at elev. 27.30		
	--Calculated-- kN per m run	kN per strut	Factored kN per strut	--Calculated-- kN per m run	kN per strut	Factored kN per strut
4	slack	slack	slack	---	---	---
10	136	136	183	20	20	28

* Indicates that the total force shown is the sum of the force in the strut plus a force applied at the same elevation which may represent temperature load or other forces which are part of the strut load. Force components are listed in the detailed results for individual stages.

Units: kN,m



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Units: kN,m

INPUT DATA

SOIL PROFILE

Stratum no.	Elevation of top of stratum	Soil types Active side	Passive side
1	27.45	8 Made Ground Init	8 Made Ground Init
2	24.00	3 London Cly Top Undr	3 London Cly Top Undr
3	22.00	6 London Cly bt Undr	6 London Cly bt Undr

SOIL PROPERTIES (Unfactored SLS soil strengths)

No.	Soil type -- Description (Datum elev.)	Bulk density kN/m3	Young's Modulus Eh,kN/m2 (dEh/dy)	At rest coeff. Ko (dKo/dy)	Consol state. NC/OC (Nu)	Active limit Ka (Kac)	Passive limit Kp (Kpc)	Cohesion kN/m2 (dc/dy)
1	Made Ground	19.00	10000	0.577	OC (0.250)	0.390 (0.000)	2.561 (0.000)	
2	Gravels	19.00	30000	0.423	OC (0.300)	0.227 (0.000)	6.084 (0.000)	
3	London Cly Top Undr	19.00	20000	1.000	OC (0.490)	1.000 (2.000)	1.000 (2.000)	40.00u
4	London Cly Top dr	19.00	14000	1.000	OC (0.250)	0.422 (1.299)	2.371 (3.080)	3.000d
5	Concrete	24.00	200000	1.000	OC (0.490)	1.000 (2.000)	1.000 (2.000)	30000u
6	London Cl.. (24.00)	19.00	42500 (2589)	1.400	OC (0.490)	1.000 (2.476)	1.000 (2.390)	80.00u (5.180)
7	London Cl.. (24.00)	19.00	28000 (1813)	1.400	OC (0.250)	0.366 (1.423)	3.077 (4.665)	3.000d
8	Made Ground Init	19.00	10000	0.577	OC (0.250)	0.337 (0.000)	3.442 (0.000)	

Additional soil parameters associated with Ka and Kp

No.	Soil type ------- Description	--- parameters for Ka --- Soil friction angle	Wall adhesion coeff.	Back-fill angle	--- parameters for Kp --- Soil friction angle	Wall adhesion coeff.	Back-fill angle
1	Made Ground	26.00	0.000	0.00	26.00	0.000	0.00
2	Gravels	35.00	0.670	0.00	35.00	0.500	0.00
3	London Cly Top Undr	0.00	0.000	0.00	0.00	0.000	0.00
4	London Cly Top dr	24.00	0.000	0.00	24.00	0.000	0.00
5	Concrete	0.00	0.000	0.00	0.00	0.000	0.00
6	London Cly bt Undr	0.00	0.670	0.00	0.00	0.500	0.00
7	London Cly bt dr	24.00	0.670	0.00	24.00	0.500	0.00
8	Made Ground Init	26.00	0.670	0.00	26.00	0.500	0.00

GROUND WATER CONDITIONS

Density of water = 10.00 kN/m3

	Active side	Passive side
Initial water table elevation	25.00	21.86

Automatic water pressure balancing at toe of wall : Yes

Water press. profile no.	Point no.	Active side Elev. m	Piezo elev. m	Water press. kN/m2	Point no.	Passive side Elev. m	Piezo elev. m	Water press. kN/m2	
1	1	27.30	27.30	0.0	1	22.36	22.36	0.0	MC+WC
					2	22.36	27.30	49.4	

WALL PROPERTIES

Type of structure = Fully Embedded Wall
Elevation of toe of wall = 15.00
Maximum finite element length = 0.60 m
Youngs modulus of wall E = 1.4000E+07 kN/m2
Moment of inertia of wall I = 0.017260 m4/m run
E.I = 241640 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	27.13	5.00	0.010000	2.000E+08	10.00	0.00	0	No
2	22.73	1.00	0.300000	1.400E+07	10.00	0.00	0	No
3	27.30	1.00	0.300000	1.400E+07	10.00	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	27.45	0.50(A)	100.00	20.00	20.00	=	N/A	1.30 Var
2	22.36	-0.00(P)	30.00	20.00	50.00	=	N/A	1.00 P/U

Note: A = Active side, P = Passive 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 27.45
	No analysis at this stage
2	Excavate to elevation 21.98 on PASSIVE side
3	Install strut or anchor no.2 at elevation 22.73
4	Fill to elevation 23.01 on PASSIVE side with soil type 6
5	Install strut or anchor no.3 at elevation 27.30
6	Change properties of soil type 8 to soil type 1
	No analysis at this stage
	Ko pressures will not be reset
7	Apply water pressure profile no.1 (Worst Cred.)
	No analysis at this stage
8	Change properties of soil type 3 to soil type 4
	No analysis at this stage
	Ko pressures will not be reset
9	Change properties of soil type 6 to soil type 7
	No analysis at this stage
	Ko pressures will not be reset
10	Apply surcharge no.2 at elevation 22.36

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 Permanent Variable 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) = 0 m

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

Width of excavation on active side of wall = 20.00 m
Width of excavation on passive side of wall = 20.00 m

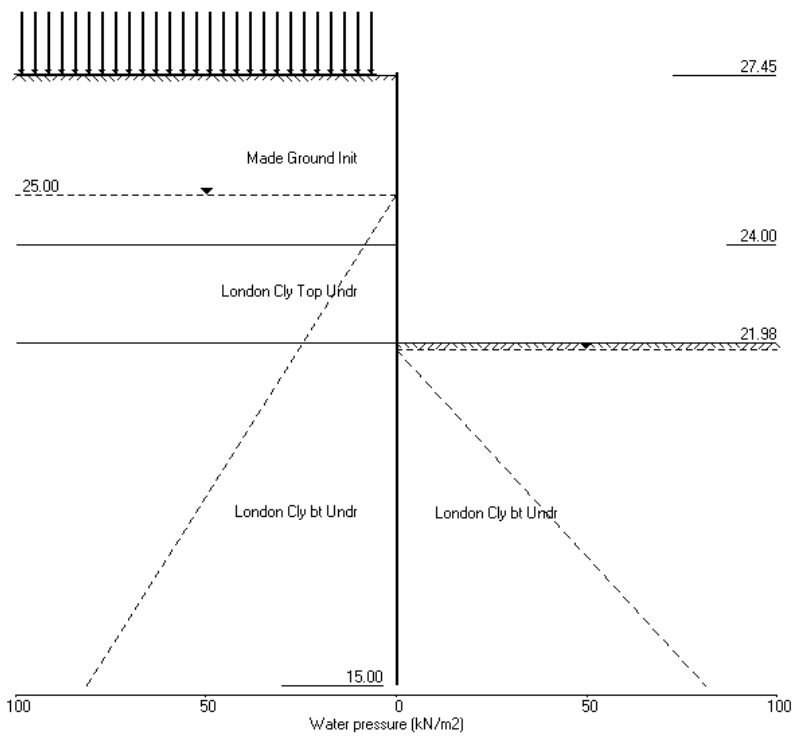
Distance to rigid boundary on active side = 20.00 m
Distance to rigid boundary on passive side = 20.00 m

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. 27.45	No	No	No
2	Excav. to elev. 21.98 on PASSIVE side	No	No	No
3	Install strut no.2 at elev. 22.73	No	No	No
4	Fill to elev. 23.01 on PASSIVE side	No	No	No
5	Install strut no.3 at elev. 27.30	No	No	No
6	Change soil type 8 to soil type 1	No	No	No
7	Apply water pressure profile no.1	No	No	No
8	Change soil type 3 to soil type 4	No	No	No
9	Change soil type 6 to soil type 7	No	No	No
10	Apply surcharge no.2 at elev. 22.36	No	No	No
*	Summary output	Yes	-	Yes

Units: kN,m

Stage No.2 Excav. to elev. 21.98 on PASSIVE side



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Units: kN,m

Stage No. 2 Excavate to elevation 21.98 on PASSIVE side

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

Stage No.	--- G.L. --- Act.	Pass.	Strut Elev.	Overall FoS for toe elev. = 15.00 Factor of Safety	Moment equilib. at elev.	Toe elev. for FoS = 1.000 Toe elev.	Wall Penetr -ation
2	27.45	21.98	Cant.	1.503	16.24	17.54	4.44

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: Active side 20.00 from wall
Passive side 20.00 from wall
Limit State: ULS DA1 Combination 2

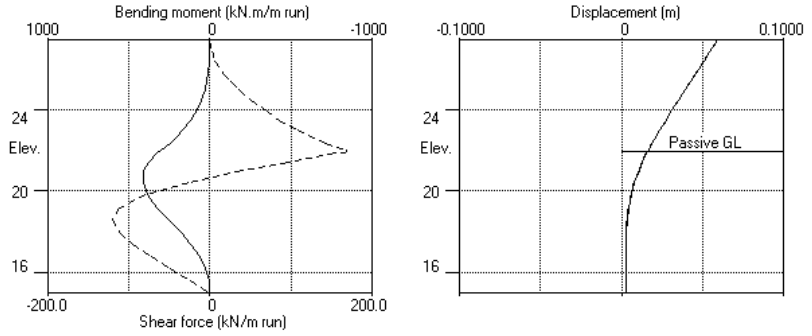
Node no.	Y coord	Nett pressure kN/m2	Wall disp. m	Wall rotation rad.	Shear force kN/m	Bending moment kN.m/m	Strut forces kN/m
1	27.45	0.00	0.059	8.19E-03	0.0	0.0	
2	27.30	1.28	0.058	8.19E-03	0.1	0.0	
3	26.85	7.28	0.054	8.19E-03	2.0	0.4	
4	26.40	13.19	0.051	8.18E-03	6.6	2.2	
5	25.80	19.64	0.046	8.17E-03	16.5	9.2	
6	25.40	23.45	0.042	8.15E-03	25.1	17.4	
7	25.00	27.05	0.039	8.11E-03	35.2	29.4	
8	24.50	33.78	0.035	8.03E-03	50.4	50.7	
9	24.00	40.39	0.031	7.89E-03	69.0	80.4	
		29.61	0.031	7.89E-03	69.0	80.4	
10	23.51	39.57	0.027	7.69E-03	86.1	118.5	
11	23.01	49.40	0.023	7.39E-03	108.1	166.3	
12	22.73	54.81	0.021	7.19E-03	122.4	198.0	
13	22.36	62.16	0.019	6.84E-03	144.4	247.9	
14	22.00	69.18	0.016	6.43E-03	168.0	304.0	
		27.25	0.016	6.43E-03	168.0	304.0	
15	21.98	27.33	0.016	6.41E-03	168.4	306.5	
		-127.06	0.016	6.41E-03	168.4	306.5	
16	21.86	-129.92	0.016	6.25E-03	152.3	326.6	
17	21.43	-139.74	0.013	5.62E-03	94.4	379.7	
18	21.00	-122.09	0.011	4.91E-03	38.1	411.3	
19	20.40	-97.02	0.008	3.89E-03	-27.7	411.9	
20	19.80	-76.27	0.006	2.90E-03	-79.6	384.4	
21	19.20	-29.77	0.005	2.03E-03	-111.5	322.9	
22	18.60	2.45	0.004	1.31E-03	-119.7	250.7	
23	18.00	22.84	0.003	7.84E-04	-112.1	179.4	
24	17.40	34.25	0.003	4.17E-04	-94.9	116.3	
25	16.80	39.49	0.002	1.92E-04	-72.8	65.5	
26	16.20	41.01	0.002	7.49E-05	-48.7	28.9	
27	15.60	40.72	0.002	3.01E-05	-24.2	7.1	
28	15.00	39.84	0.002	2.12E-05	0.0	0.0	

(continued)

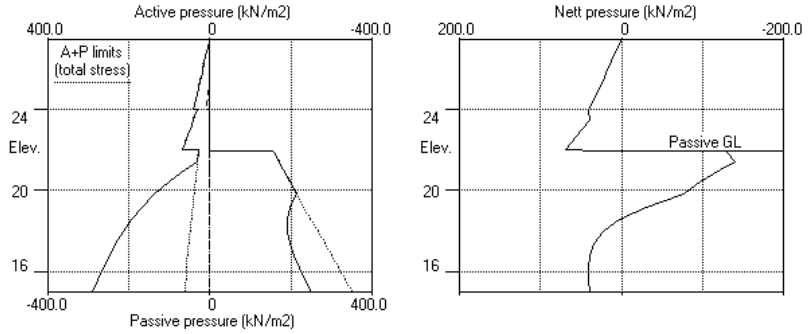
Stage No.2 Excavate to elevation 21.98 on PASSIVE side

Units: kN,m

Stage No.2 Excav. to elev. 21.98 on PASSIVE side

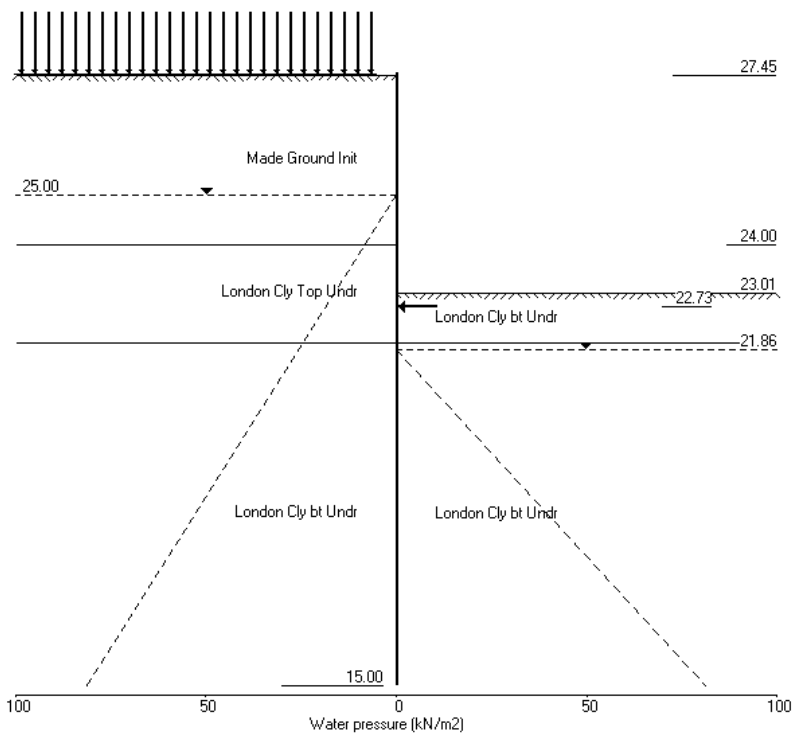


Stage No.2 Excav. to elev. 21.98 on PASSIVE side



Units: kN,m

Stage No.4 Fill to elev. 23.01 on PASSIVE side



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Units: kN,m

Stage No. 4 Fill to elevation 23.01 on PASSIVE side with soil type 6

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

Stage No.	--- G.L. --- Act.	Pass.	Strut Elev.	Overall FoS for toe elev. = 15.00 Factor of Safety	Moment equilib. at elev.	Toe elev. for FoS = 1.000 Toe elev.	Wall Penetr -ation
4	27.45	23.01	22.73	Conditions not suitable for 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: Active side 20.00 from wall
Passive 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
1	27.45	0.00	0.059	8.35E-03	0.0	0.0	
2	27.30	1.54	0.058	8.35E-03	0.1	0.0	
3	26.85	7.62	0.054	8.35E-03	2.2	0.4	
4	26.40	13.61	0.050	8.34E-03	7.0	2.4	
5	25.80	20.15	0.045	8.33E-03	17.1	9.6	
6	25.40	24.02	0.042	8.31E-03	25.9	18.1	
7	25.00	27.69	0.038	8.27E-03	36.3	30.5	
8	24.50	34.50	0.034	8.18E-03	51.8	52.3	
9	24.00	41.19	0.030	8.04E-03	70.7	82.8	
		31.76	0.030	8.04E-03	70.7	82.8	
10	23.51	41.92	0.026	7.83E-03	89.0	122.1	
11	23.01	51.93	0.023	7.53E-03	112.2	171.6	
12	22.73	56.07	0.020	7.32E-03	127.0	204.5	-0.0
13	22.36	60.19	0.018	6.96E-03	148.8	256.0	
14	22.00	61.17	0.015	6.53E-03	170.7	313.5	
		23.21	0.015	6.53E-03	170.7	313.5	
15	21.98	23.05	0.015	6.51E-03	171.0	316.0	
		-131.34	0.015	6.51E-03	171.0	316.0	
16	21.86	-133.92	0.014	6.35E-03	154.5	336.4	
17	21.43	-142.87	0.012	5.70E-03	94.9	390.1	
18	21.00	-124.44	0.010	4.98E-03	37.5	421.6	
19	20.40	-98.43	0.007	3.93E-03	-29.4	421.4	
20	19.80	-76.94	0.005	2.92E-03	-82.0	392.6	
21	19.20	-29.89	0.003	2.02E-03	-114.0	329.6	
22	18.60	2.72	0.002	1.30E-03	-122.2	255.8	
23	18.00	23.38	0.002	7.56E-04	-114.4	183.0	
24	17.40	34.95	0.001	3.82E-04	-96.9	118.6	
25	16.80	40.28	0.001	1.52E-04	-74.3	66.8	
26	16.20	41.84	0.001	3.25E-05	-49.7	29.5	
27	15.60	41.55	0.001	-1.31E-05	-24.6	7.3	
28	15.00	40.65	0.001	-2.22E-05	0.0	0.0	

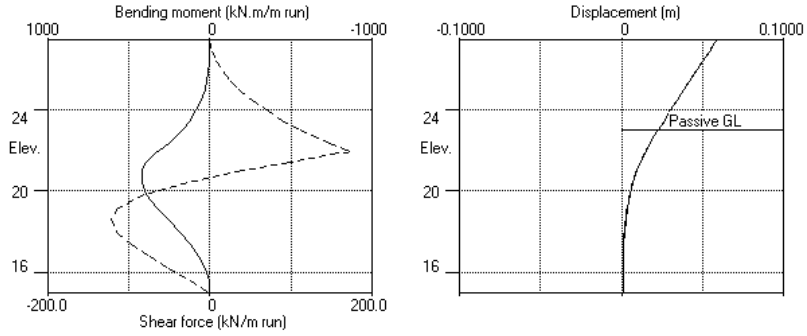
At elev. 22.73 The strut is slack

(continued)

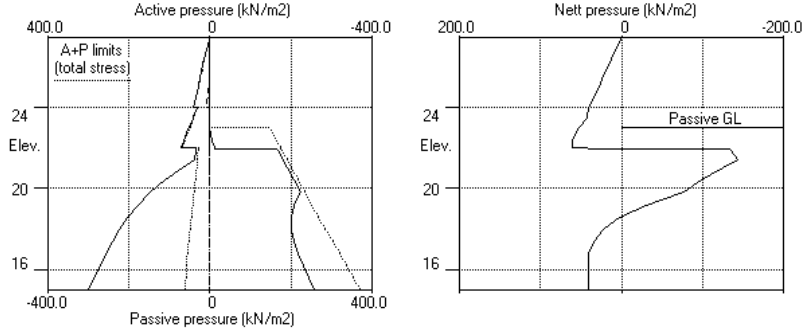
Stage No.4 Fill to elevation 23.01 on PASSIVE side with soil type 6

Units: kN,m

Stage No.4 Fill to elev. 23.01 on PASSIVE side



Stage No.4 Fill to elev. 23.01 on PASSIVE side



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 Permanent Variable loads = 1.300

STABILITY ANALYSIS of Fully Embedded Wall according to Strength Factor method

Factor of safety on soil strength

Stage No.	--- G.L. --- Act.	Pass.	Strut Elev.	Overall FoS for toe elev. = 15.00 Factor of Safety	Moment equilib. at elev.	Toe elev. for FoS = 1.000 Toe elev.	Wall Penetr -ation
1	27.45	27.45	Cant.	Conditions not suitable for FoS calc.			
2	27.45	21.98	Cant.	1.503	16.24	17.54	4.44
3	27.45	21.98		No analysis at this stage			
4	27.45	23.01	22.73	Conditions not suitable for FoS calc.			
5	27.45	23.01		No analysis at this stage			

All remaining stages have more than one strut - FoS calculation n/a

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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: Active side 20.00 from wall
Passive side 20.00 from wall

Limit State: ULS DA1 Combination 2

Bending moment, shear force and displacement envelopes

Node no.	Y coord	Displacement maximum m	Displacement minimum m	Bending moment maximum kN.m/m	Bending moment minimum kN.m/m	Shear force maximum kN/m	Shear force minimum kN/m
1	27.45	0.059	0.000	0.0	0.0	0.0	0.0
2	27.30	0.058	0.000	0.0	-0.0	0.1	-0.6
3	26.85	0.054	0.000	0.4	-0.5	2.2	-1.8
4	26.40	0.051	0.000	2.6	-1.5	9.0	-2.8
5	25.80	0.046	0.000	12.4	-3.3	24.1	-3.5
6	25.40	0.042	0.000	24.6	-4.8	37.5	-3.7
7	25.00	0.039	0.000	42.7	-6.3	53.5	-3.7
8	24.50	0.035	0.000	75.1	-7.9	76.9	-2.8
9	24.00	0.031	0.000	120.2	-8.9	104.1	-0.8
10	23.51	0.027	0.000	178.9	-8.6	133.8	0.0
11	23.01	0.024	0.000	253.2	-6.4	167.2	0.0
12	22.73	0.022	0.000	301.7	-4.2	185.6	-20.4
13	22.36	0.020	0.000	298.7	-0.2	148.8	0.0
14	22.00	0.017	0.000	313.5	0.0	170.7	0.0
15	21.98	0.017	0.000	316.0	0.0	171.0	0.0
16	21.86	0.017	0.000	336.4	0.0	154.5	0.0
17	21.43	0.014	0.000	390.1	0.0	94.9	-2.9
18	21.00	0.012	0.000	421.6	0.0	38.1	-17.8
19	20.40	0.010	0.000	421.4	0.0	1.0	-40.4
20	19.80	0.008	0.000	392.6	0.0	0.0	-82.0
21	19.20	0.006	0.000	329.6	0.0	0.0	-114.0
22	18.60	0.005	0.000	255.8	0.0	0.0	-122.2
23	18.00	0.004	0.000	183.0	0.0	0.0	-114.4
24	17.40	0.003	0.000	118.6	0.0	0.0	-96.9
25	16.80	0.002	0.000	67.2	0.0	0.0	-74.3
26	16.20	0.002	0.000	37.3	0.0	0.0	-49.7
27	15.60	0.002	0.000	13.4	0.0	0.0	-31.3
28	15.00	0.002	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 maximum kN.m/m	elev.	minimum kN.m/m	elev.	Shear force maximum kN/m	elev.	minimum kN/m	elev.
1	17.6	20.40	-8.9	24.00	16.7	22.00	-5.1	18.00
2	411.9	20.40	0.0	27.45	168.4	21.98	-119.7	18.60
3	No calculation at this stage							
4	421.6	21.00	0.0	27.45	171.0	21.98	-122.2	18.60
5	No calculation at this stage							
6	No calculation at this stage							
7	No calculation at this stage							
8	No calculation at this stage							
9	No calculation at this stage							
10	304.5	21.43	0.0	27.45	185.6	22.73	-66.2	18.60

Maximum and minimum displacement at each stage

Stage no.	Displacement maximum m	elev.	minimum m	elev.	Stage description
1	0.003	27.45	0.000	27.45	Apply surcharge no.1 at elev. 27.45
2	0.059	27.45	0.000	27.45	Excav. to elev. 21.98 on PASSIVE side
3	No calculation at this stage				Install strut no.2 at elev. 22.73
4	0.059	27.45	0.000	27.45	Fill to elev. 23.01 on PASSIVE side
5	No calculation at this stage				Install strut no.3 at elev. 27.30
6	No calculation at this stage				Change soil type 8 to soil type 1
7	No calculation at this stage				Apply water pressure profile no.1
8	No calculation at this stage				Change soil type 3 to soil type 4
9	No calculation at this stage				Change soil type 6 to soil type 7
10	0.059	27.45	0.000	27.45	Apply surcharge no.2 at elev. 22.36

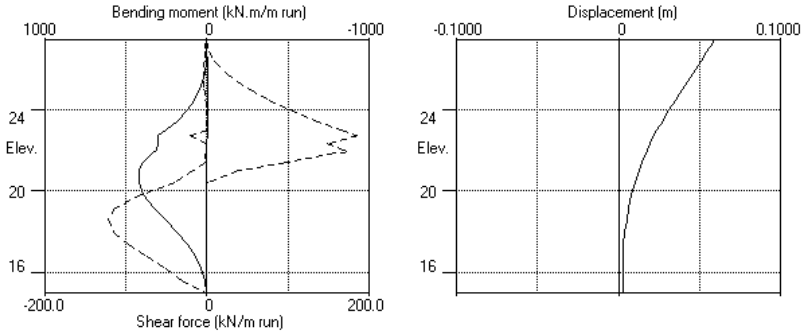
Strut forces at each stage (horizontal components)

Stage no.	Strut no. 2 at elev. 22.73 kN/m run	kN/strut	Strut no. 3 at elev. 27.30 kN/m run	kN/strut
4	slack	slack	---	---
10	205.98	205.98	0.70	0.70

* Indicates that the total force shown is the sum of the force in the strut plus a force applied at the same elevation which may represent temperature load or other forces which are part of the strut load. Force components are listed in the detailed results for individual stages.

Units: kN,m

Bending moment, shear force, displacement envelopes



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Section C2 | Checked :

Units: kN,m

INPUT DATA

SOIL PROFILE

Stratum no.	Elevation of top of stratum	Soil types Active side	Passive side
1	27.45	8 Made Ground Init	8 Made Ground Init
2	24.00	3 London Cly Top Undr	3 London Cly Top Undr
3	22.00	6 London Cly bt Undr	6 London Cly bt Undr

SOIL PROPERTIES (Unfactored SLS soil strengths)

No.	Soil type / Description	Bulk density kN/m3	Young's Modulus Eh,kN/m2 (Datum elev.)	At rest coeff. Ko (dEh/dy)	Consol state. NC/OC (dKo/dy)	Active limit Ka (Nu)	Passive limit Kp (Kac)	Cohesion kN/m2 (Kpc)	(dc/dy)
1	Made Ground	19.00	10000	0.577	OC (0.250)	0.390 (0.000)	2.561 (0.000)		
2	Gravels	19.00	30000	0.423	OC (0.300)	0.227 (0.000)	6.084 (0.000)		
3	London Cly Top Undr	19.00	20000	1.000	OC (0.490)	1.000 (2.000)	1.000 (2.000)	40.00u	
4	London Cly Top dr	19.00	14000	1.000	OC (0.250)	0.422 (1.299)	2.371 (3.080)	3.000d	
5	Concrete	24.00	200000	1.000	OC (0.490)	1.000 (2.000)	1.000 (2.000)	30000u	
6	London Cl.. (24.00)	19.00	42500 (2589)	1.400	OC (0.490)	1.000 (2.476)	1.000 (2.390)	80.00u (5.180)	
7	London Cl.. (24.00)	19.00	28000 (1813)	1.400	OC (0.250)	0.366 (1.423)	3.077 (4.665)	3.000d	
8	Made Ground Init	19.00	10000	0.577	OC (0.250)	0.337 (0.000)	3.442 (0.000)		

Additional soil parameters associated with Ka and Kp

No.	Soil type / Description	--- parameters for Ka --- Soil friction angle	Wall adhesion coeff.	Back-fill angle	--- parameters for Kp --- Soil friction angle	Wall adhesion coeff.	Back-fill angle
1	Made Ground	26.00	0.000	0.00	26.00	0.000	0.00
2	Gravels	35.00	0.670	0.00	35.00	0.500	0.00
3	London Cly Top Undr	0.00	0.000	0.00	0.00	0.000	0.00
4	London Cly Top dr	24.00	0.000	0.00	24.00	0.000	0.00
5	Concrete	0.00	0.000	0.00	0.00	0.000	0.00
6	London Cly bt Undr	0.00	0.670	0.00	0.00	0.500	0.00
7	London Cly bt dr	24.00	0.670	0.00	24.00	0.500	0.00
8	Made Ground Init	26.00	0.670	0.00	26.00	0.500	0.00

GROUND WATER CONDITIONS

Density of water = 10.00 kN/m3

	Active side	Passive side
Initial water table elevation	25.00	20.36

Automatic water pressure balancing at toe of wall : Yes

Water press. profile no.	Point no.	Active side Elev. m	Piezo elev. m	Water press. kN/m2	Point no.	Passive side Elev. m	Piezo elev. m	Water press. kN/m2	
1	1	27.30	27.30	0.0	1	22.36	22.36	0.0	MC+WC
					2	22.36	27.30	49.4	

WALL PROPERTIES

Type of structure = Fully Embedded Wall
Elevation of toe of wall = 15.00
Maximum finite element length = 0.60 m
Youngs modulus of wall E = 1.4000E+07 kN/m2
Moment of inertia of wall I = 0.017260 m4/m run
E.I = 241640 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	27.13	5.00	0.010000	2.000E+08	10.00	0.00	0	No
2	23.56	1.00	0.300000	1.400E+07	10.00	0.00	0	No
3	27.15	1.00	0.300000	1.400E+07	10.00	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	27.45	0.50(A)	100.00	20.00	20.00	=	N/A	1.10 Var
2	22.36	-0.00(P)	30.00	20.00	50.00	=	N/A	1.00 P/U

Note: A = Active side, P = Passive 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 27.45
	No analysis at this stage
2	Excavate to elevation 23.18 on PASSIVE side
	Toe of berm at elevation 20.36
	Width of top of berm = 1.50
	Width of toe of berm = 1.51
3	Install strut or anchor no.2 at elevation 23.56
4	Fill to elevation 23.71 on PASSIVE side with soil type 6
5	Install strut or anchor no.3 at elevation 27.15
6	Change properties of soil type 8 to soil type 1
	No analysis at this stage
	Ko pressures will not be reset
7	Apply water pressure profile no.1 (Mod. Conserv.)
	No analysis at this stage
8	Change properties of soil type 3 to soil type 4
	No analysis at this stage
	Ko pressures will not be reset
9	Change properties of soil type 6 to soil type 7
	No analysis at this stage
	Ko pressures will not be reset
10	Apply surcharge no.2 at elevation 22.36

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 Permanent Variable 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) = 0 m

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

Width of excavation on active side of wall = 20.00 m
Width of excavation on passive side of wall = 20.00 m

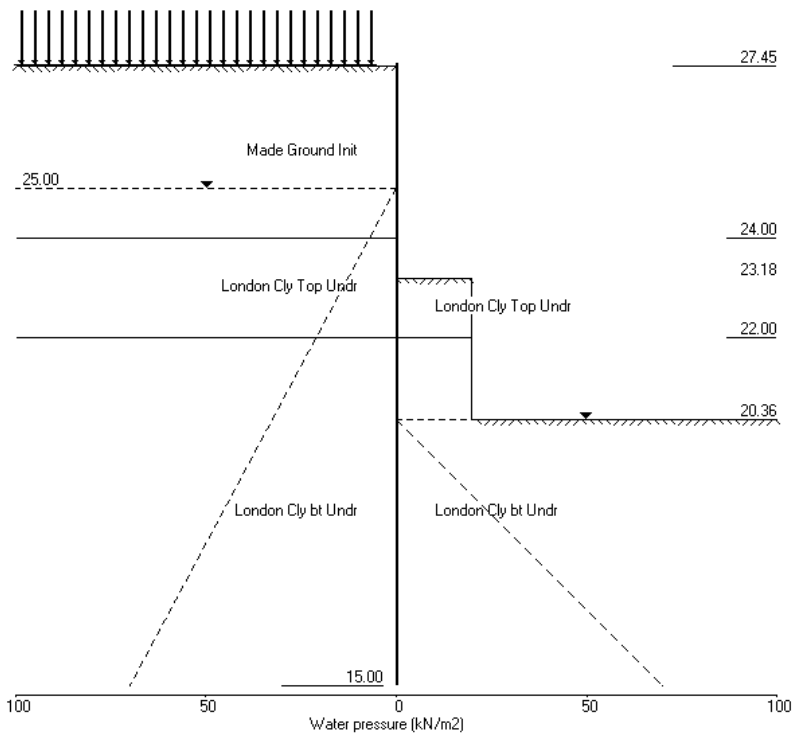
Distance to rigid boundary on active side = 20.00 m
Distance to rigid boundary on passive side = 20.00 m

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. 27.45	No	No	No
2	Excav. to elev. 23.18 on PASSIVE side	No	No	No
3	Install strut no.2 at elev. 23.56	No	No	No
4	Fill to elev. 23.71 on PASSIVE side	No	No	No
5	Install strut no.3 at elev. 27.15	No	No	No
6	Change soil type 8 to soil type 1	No	No	No
7	Apply water pressure profile no.1	No	No	No
8	Change soil type 3 to soil type 4	No	No	No
9	Change soil type 6 to soil type 7	No	No	No
10	Apply surcharge no.2 at elev. 22.36	No	No	No
*	Summary output	Yes	-	Yes

Units: kN,m

Stage No.2 Excav. to elev. 23.18 on PASSIVE side



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Units: kN,m

Stage No. 2 Excavate to elevation 23.18 on PASSIVE side
Toe of berm at elevation 20.36
Width of top of berm = 1.50
Width of toe of berm = 1.51

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: Active side 20.00 from wall
Passive 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.

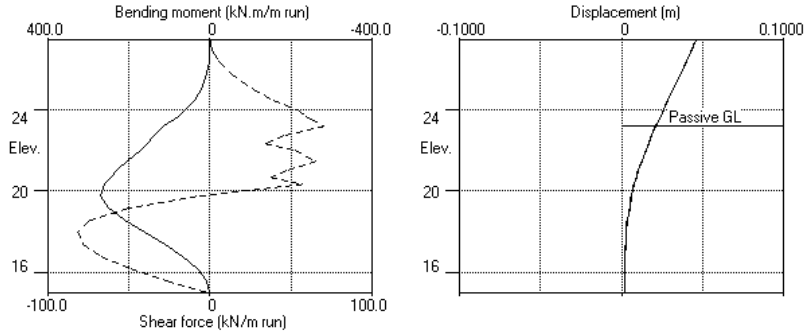
Node no.	Y coord	Nett pressure kN/m2	Wall disp. m	Wall rotation rad.	Shear force kN/m	Bending moment kN.m/m	Strut forces kN/m
1	27.45	0.00	0.046	6.04E-03	0.0	0.0	
2	27.30	1.04	0.045	6.04E-03	0.1	0.0	
3	27.15	2.39	0.044	6.04E-03	0.3	0.0	
4	26.78	6.46	0.042	6.04E-03	2.0	0.5	
5	26.40	10.20	0.040	6.04E-03	5.1	1.8	
6	25.80	15.26	0.036	6.03E-03	12.8	7.0	
7	25.40	18.30	0.034	6.01E-03	19.5	13.4	
8	25.00	21.20	0.031	5.98E-03	27.4	22.7	
9	24.50	27.01	0.028	5.92E-03	39.4	39.3	
10	24.00	32.74	0.026	5.81E-03	54.4	62.6	
		17.25	0.026	5.81E-03	54.4	62.6	
11	23.71	18.70	0.024	5.73E-03	59.6	79.1	
12	23.56	19.45	0.023	5.68E-03	62.4	88.2	
13	23.18	21.33	0.021	5.52E-03	70.1	113.0	
		-58.68	0.021	5.52E-03	70.1	113.0	
14	22.77	-60.06	0.019	5.31E-03	45.6	136.9	
		-31.39	0.019	5.31E-03	45.6	136.9	
15	22.36	-22.17	0.017	5.06E-03	34.5	155.2	
		42.14	0.017	5.06E-03	34.5	155.2	
16	22.00	56.97	0.015	4.81E-03	52.4	170.5	
		22.39	0.015	4.81E-03	52.4	170.5	
17	21.50	28.00	0.012	4.43E-03	65.0	204.9	
		-49.69	0.012	4.43E-03	65.0	204.9	
18	21.00	-22.98	0.010	3.97E-03	46.8	231.4	
		-36.62	0.010	3.97E-03	46.8	231.4	
19	20.68	-20.81	0.009	3.66E-03	37.6	244.6	
		51.62	0.009	3.66E-03	37.6	244.6	
20	20.36	69.28	0.008	3.33E-03	57.0	259.4	
		-136.30	0.008	3.33E-03	57.0	259.4	
21	19.78	-91.03	0.006	2.69E-03	-9.0	269.6	
22	19.20	-53.77	0.005	2.07E-03	-50.9	249.2	
23	18.60	-23.79	0.004	1.50E-03	-74.2	209.0	
24	18.00	-1.65	0.003	1.04E-03	-81.8	160.2	
25	17.40	14.12	0.003	7.08E-04	-78.1	110.9	
26	16.80	25.28	0.002	4.88E-04	-66.3	66.7	
27	16.20	33.60	0.002	3.66E-04	-48.6	31.5	
28	15.60	40.58	0.002	3.16E-04	-26.4	8.5	
29	15.00	47.30	0.002	3.06E-04	-0.0	0.0	

(continued)

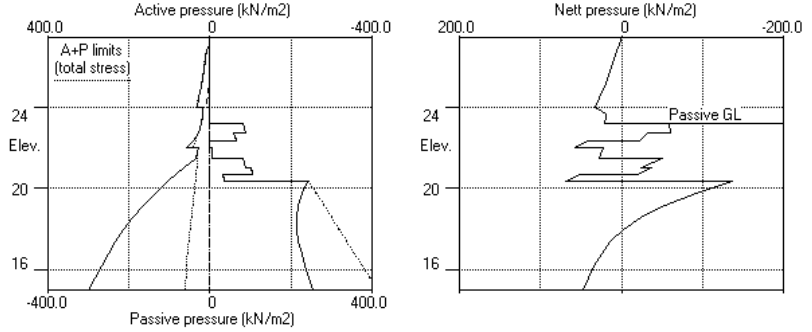
Stage No.2 Excavate to elevation 23.18 on PASSIVE side
Toe of berm at elevation 20.36
Width of top of berm = 1.50
Width of toe of berm = 1.51

Units: kN,m

Stage No.2 Excav. to elev. 23.18 on PASSIVE side

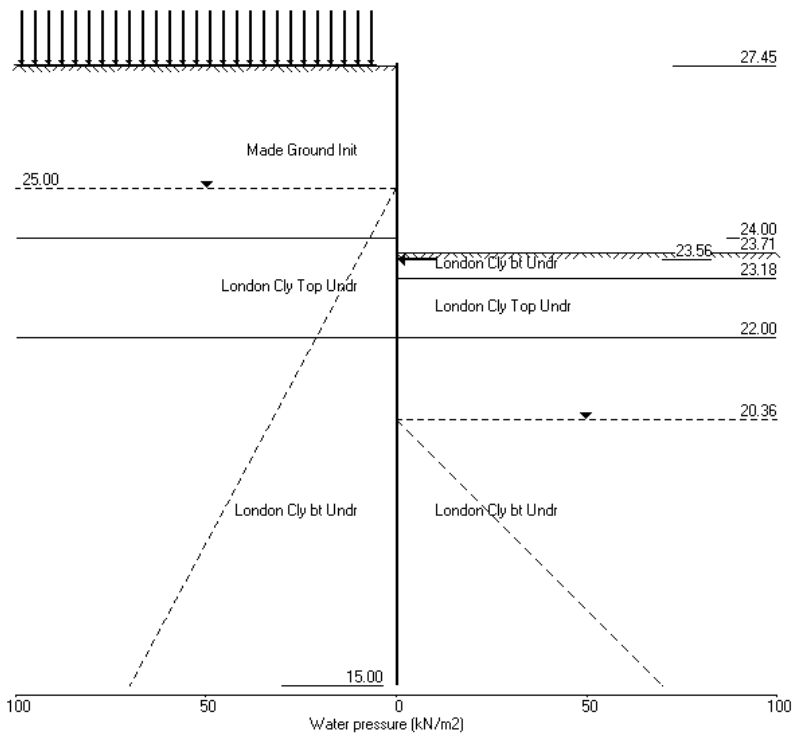


Stage No.2 Excav. to elev. 23.18 on PASSIVE side



Units: kN,m

Stage No.4 Fill to elev. 23.71 on PASSIVE side



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Units: kN,m

Stage No. 4 Fill to elevation 23.71 on PASSIVE side with soil type 6

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: Active side 20.00 from wall
Passive 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/m2	Wall disp. m	Wall rotation rad.	Shear force kN/m	Bending moment kN.m/m	Strut forces kN/m
1	27.45	0.00	0.046	6.09E-03	0.0	0.0	
2	27.30	1.65	0.045	6.09E-03	0.1	0.0	
3	27.15	3.01	0.044	6.09E-03	0.5	0.1	
4	26.78	7.10	0.041	6.09E-03	2.4	0.6	
5	26.40	10.85	0.039	6.09E-03	5.7	2.1	
6	25.80	15.95	0.036	6.07E-03	13.8	7.8	
7	25.40	19.00	0.033	6.05E-03	20.8	14.6	
8	25.00	21.91	0.031	6.02E-03	29.0	24.5	
9	24.50	27.75	0.028	5.95E-03	41.4	42.0	
10	24.00	33.49	0.025	5.84E-03	56.7	66.4	
		19.29	0.025	5.84E-03	56.7	66.4	
11	23.71	20.76	0.023	5.75E-03	62.5	83.6	
12	23.56	20.76	0.022	5.70E-03	65.6	93.2	-0.0
13	23.18	19.11	0.020	5.53E-03	73.1	119.1	
		-63.81	0.020	5.53E-03	73.1	119.1	
14	22.77	-65.18	0.018	5.31E-03	46.5	143.7	
		-36.50	0.018	5.31E-03	46.5	143.7	
15	22.36	-27.30	0.016	5.05E-03	33.3	162.0	
		37.01	0.016	5.05E-03	33.3	162.0	
16	22.00	50.64	0.014	4.79E-03	49.1	176.6	
		23.36	0.014	4.79E-03	49.1	176.6	
17	21.50	27.11	0.012	4.39E-03	61.7	209.6	
		-48.62	0.012	4.39E-03	61.7	209.6	
18	21.00	-21.87	0.010	3.94E-03	44.1	234.6	
		-35.51	0.010	3.94E-03	44.1	234.6	
19	20.68	-19.71	0.008	3.62E-03	35.2	246.9	
		52.71	0.008	3.62E-03	35.2	246.9	
20	20.36	70.34	0.007	3.28E-03	54.9	261.0	
		-135.24	0.007	3.28E-03	54.9	261.0	
21	19.78	-90.06	0.006	2.64E-03	-10.4	270.2	
22	19.20	-52.93	0.004	2.02E-03	-51.9	249.1	
23	18.60	-23.11	0.003	1.45E-03	-74.7	208.5	
24	18.00	-1.14	0.002	9.98E-04	-82.0	159.6	
25	17.40	14.45	0.002	6.63E-04	-78.0	110.3	
26	16.80	25.43	0.002	4.44E-04	-66.0	66.2	
27	16.20	33.55	0.001	3.23E-04	-48.3	31.3	
28	15.60	40.33	0.001	2.74E-04	-26.1	8.4	
29	15.00	46.83	0.001	2.64E-04	-0.0	0.0	

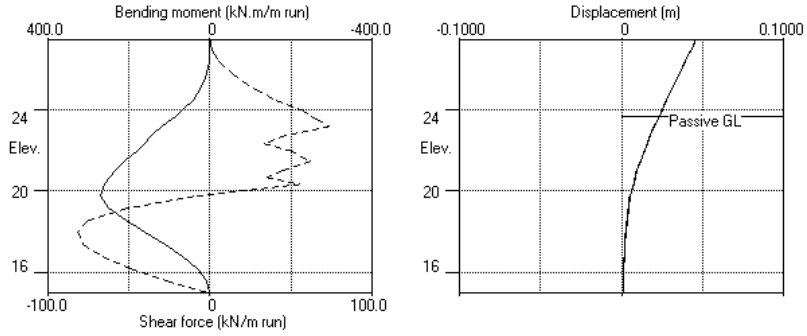
At elev. 23.56 The strut is slack

(continued)

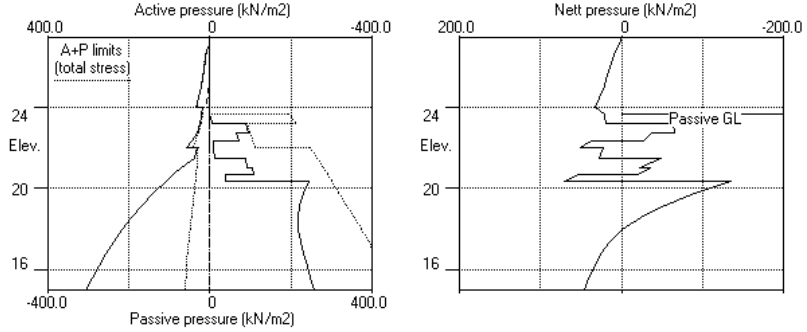
Stage No.4 Fill to elevation 23.71 on PASSIVE side with soil type 6

Units: kN,m

Stage No.4 Fill to elev. 23.71 on PASSIVE side



Stage No.4 Fill to elev. 23.71 on PASSIVE side



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: Active side 20.00 from wall
Passive side 20.00 from wall

Limit State: ULS DA1 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 max. m	Displacement min. m	Bending moment Calculated max. kN.m/m	Bending moment Calculated min. kN.m/m	Bending moment Factored max. kN.m/m	Bending moment Factored min. kN.m/m	Shear force Calculated max. kN/m	Shear force Calculated min. kN/m	Shear force Factored max. kN/m	Shear force Factored min. kN/m
1	27.45	0.046	0.000	0	0	0	0	0	0	0	0
2	27.30	0.045	0.000	0	-0	0	-0	0	-0	0	-0
3	27.15	0.044	0.000	0	-0	0	-0	1	-30	1	-41
4	26.78	0.042	0.000	1	-11	1	-14	2	-27	3	-37
5	26.40	0.040	0.000	2	-20	3	-27	6	-22	8	-30
6	25.80	0.036	0.000	8	-30	10	-40	14	-9	19	-12
7	25.40	0.034	0.000	15	-31	20	-42	21	-4	28	-5
8	25.00	0.032	0.000	25	-27	33	-36	29	-4	39	-5
9	24.50	0.029	0.000	42	-13	57	-17	41	-3	56	-4
10	24.00	0.026	0.000	66	-9	90	-13	63	-1	85	-1
11	23.71	0.024	0.000	84	-9	113	-13	78	0	106	0
12	23.56	0.023	0.000	93	-9	126	-13	85	0	115	0
13	23.18	0.021	0.000	119	-8	161	-11	73	0	99	0
14	22.77	0.019	0.000	144	-5	194	-7	72	0	97	0
15	22.36	0.017	0.000	162	-1	219	-2	76	0	103	0
16	22.00	0.015	0.000	177	0	238	0	82	0	111	0
17	21.50	0.012	0.000	210	0	283	0	87	0	118	0
18	21.00	0.010	0.000	237	0	319	0	57	0	77	0
19	20.68	0.009	0.000	251	0	339	0	38	0	51	0
20	20.36	0.008	0.000	264	0	356	0	57	0	77	0
21	19.78	0.006	0.000	274	0	370	0	1	-10	1	-14
22	19.20	0.005	0.000	261	0	353	0	0	-52	0	-70
23	18.60	0.004	0.000	228	0	308	0	0	-75	0	-101
24	18.00	0.003	0.000	181	0	244	0	0	-83	0	-112
25	17.40	0.003	0.000	129	0	174	0	0	-85	0	-115
26	16.80	0.002	0.000	79	0	107	0	0	-76	0	-102
27	16.20	0.002	-0.000	38	0	52	0	0	-58	0	-78
28	15.60	0.002	-0.001	11	0	14	0	0	-32	0	-44
29	15.00	0.002	-0.001	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 Calculated max. kN.m/m	elev.	Bending moment Calculated min. kN.m/m	elev.	Bending moment Factored max. kN.m/m	Bending moment Factored min. kN.m/m	Shear force Calculated max. kN/m	elev.	Shear force Calculated min. kN/m	elev.	Shear force Factored max. kN/m	Shear force Factored min. kN/m
1	19	19.78	-9	23.71	25	-13	16	22.00	-6	18.00	21	-8
2	270	19.78	0	27.45	364	0	70	23.18	-82	18.00	95	-110
3	No calculation at this stage											
4	270	19.78	0	27.45	365	0	73	23.18	-82	18.00	99	-111
5	No calculation at this stage											
6	No calculation at this stage											
7	No calculation at this stage											
8	No calculation at this stage											
9	No calculation at this stage											
10	274	19.78	-31	25.40	370	-42	87	21.50	-85	17.40	118	-115

Maximum and minimum displacement at each stage

Stage no.	Displacement maximum m	elev.	Displacement minimum m	elev.	Stage description
1	0.002	27.45	0.000	27.45	Apply surcharge no.1 at elev. 27.45
2	0.046	27.45	0.000	27.45	Excav. to elev. 23.18 on PASSIVE side
3	No calculation at this stage				Install strut no.2 at elev. 23.56
4	0.046	27.45	0.000	27.45	Fill to elev. 23.71 on PASSIVE side
5	No calculation at this stage				Install strut no.3 at elev. 27.15
6	No calculation at this stage				Change soil type 8 to soil type 1
7	No calculation at this stage				Apply water pressure profile no.1
8	No calculation at this stage				Change soil type 3 to soil type 4
9	No calculation at this stage				Change soil type 6 to soil type 7
10	0.046	27.45	-0.001	15.00	Apply surcharge no.2 at elev. 22.36

Strut forces at each stage (horizontal components)

Stage no.	Strut no. 2 at elev. 23.56 --Calculated-- kN per m run	Strut no. 2 at elev. 23.56 Factored kN per strut	Strut no. 3 at elev. 27.15 --Calculated-- kN per m run	Strut no. 3 at elev. 27.15 Factored kN per strut
4	slack	slack	---	---
10	41	56	31	41

* Indicates that the total force shown is the sum of the force in the strut plus a force applied at the same elevation which may represent temperature load or other forces which are part of the strut load. Force components are listed in the detailed results for individual stages.

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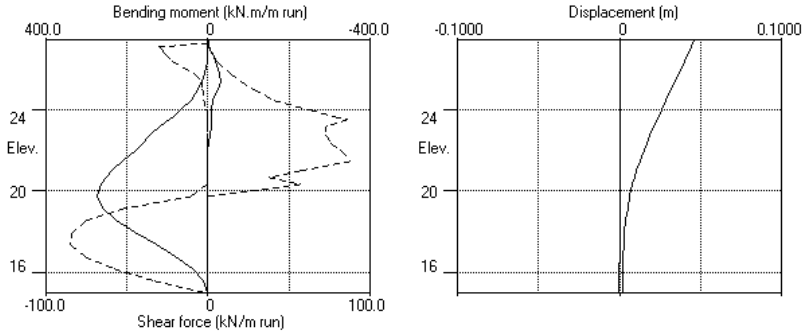
Camley Street | Date: 8-12-2015
Section C2 | Checked :

Units: kN,m

Bending moment, shear force, displacement envelopes



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Camley Street | Date: 8-12-2015
Section C2 | Checked :

Units: kN,m

INPUT DATA

SOIL PROFILE

Stratum no.	Elevation of top of stratum	Soil types Active side	Passive side
1	27.45	8 Made Ground Init	8 Made Ground Init
2	24.00	3 London Cly Top Undr	3 London Cly Top Undr
3	22.00	6 London Cly bt Undr	6 London Cly bt Undr

SOIL PROPERTIES (Unfactored SLS soil strengths)

No.	Soil type -- Description	Bulk density kN/m3	Young's Modulus Eh,kN/m2 (dEh/dy)	At rest coeff. Ko (dKo/dy)	Consol state. NC/OC (Nu)	Active limit Ka (Kac)	Passive limit Kp (Kpc)	Cohesion kN/m2 (dc/dy)
	(Datum elev.)							
1	Made Ground	19.00	10000	0.577	OC	0.390	2.561	
					(0.250)	(0.000)	(0.000)	
2	Gravels	19.00	30000	0.423	OC	0.227	6.084	
					(0.300)	(0.000)	(0.000)	
3	London Cly Top Undr	19.00	20000	1.000	OC	1.000	1.000	40.00u
					(0.490)	(2.000)	(2.000)	
4	London Cly Top dr	19.00	14000	1.000	OC	0.422	2.371	3.000d
					(0.250)	(1.299)	(3.080)	
5	Concrete	24.00	200000	1.000	OC	1.000	1.000	30000u
					(0.490)	(2.000)	(2.000)	
6	London Cl..	19.00	42500	1.400	OC	1.000	1.000	80.00u
	(24.00)		(2589)		(0.490)	(2.476)	(2.390)	(5.180)
7	London Cl..	19.00	28000	1.400	OC	0.366	3.077	3.000d
	(24.00)		(1813)		(0.250)	(1.423)	(4.665)	
8	Made Ground Init	19.00	10000	0.577	OC	0.337	3.442	
					(0.250)	(0.000)	(0.000)	

Additional soil parameters associated with Ka and Kp

No.	Soil type ------- Description	--- parameters for Ka --- Soil friction angle	Wall adhesion coeff.	Back-fill angle	--- parameters for Kp --- Soil friction angle	Wall adhesion coeff.	Back-fill angle
1	Made Ground	26.00	0.000	0.00	26.00	0.000	0.00
2	Gravels	35.00	0.670	0.00	35.00	0.500	0.00
3	London Cly Top Undr	0.00	0.000	0.00	0.00	0.000	0.00
4	London Cly Top dr	24.00	0.000	0.00	24.00	0.000	0.00
5	Concrete	0.00	0.000	0.00	0.00	0.000	0.00
6	London Cly bt Undr	0.00	0.670	0.00	0.00	0.500	0.00
7	London Cly bt dr	24.00	0.670	0.00	24.00	0.500	0.00
8	Made Ground Init	26.00	0.670	0.00	26.00	0.500	0.00

GROUND WATER CONDITIONS

Density of water = 10.00 kN/m3

	Active side	Passive side
Initial water table elevation	25.00	20.36

Automatic water pressure balancing at toe of wall : Yes

Water press. profile no.	Point no.	Active side Elev. m	Piezo elev. m	Water press. kN/m2	Point no.	Passive side Elev. m	Piezo elev. m	Water press. kN/m2	
1	1	27.30	27.30	0.0	1	22.36	22.36	0.0	MC+WC
					2	22.36	27.30	49.4	

WALL PROPERTIES

Type of structure = Fully Embedded Wall
Elevation of toe of wall = 15.00
Maximum finite element length = 0.60 m
Youngs modulus of wall E = 1.4000E+07 kN/m2
Moment of inertia of wall I = 0.017260 m4/m run
E.I = 241640 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	27.13	5.00	0.010000	2.000E+08	10.00	0.00	0	No
2	23.56	1.00	0.300000	1.400E+07	10.00	0.00	0	No
3	27.15	1.00	0.300000	1.400E+07	10.00	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	27.45	0.50(A)	100.00	20.00	20.00	=	N/A	1.30 Var
2	22.36	-0.00(P)	30.00	20.00	50.00	=	N/A	1.00 P/U

Note: A = Active side, P = Passive 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 27.45
	No analysis at this stage
2	Excavate to elevation 23.18 on PASSIVE side
	Toe of berm at elevation 20.36
	Width of top of berm = 1.50
	Width of toe of berm = 1.51
3	Install strut or anchor no.2 at elevation 23.56
4	Fill to elevation 23.71 on PASSIVE side with soil type 6
5	Install strut or anchor no.3 at elevation 27.15
6	Change properties of soil type 8 to soil type 1
	No analysis at this stage
	Ko pressures will not be reset
7	Apply water pressure profile no.1 (Worst Cred.)
	No analysis at this stage
8	Change properties of soil type 3 to soil type 4
	No analysis at this stage
	Ko pressures will not be reset
9	Change properties of soil type 6 to soil type 7
	No analysis at this stage
	Ko pressures will not be reset
10	Apply surcharge no.2 at elevation 22.36

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 Permanent Variable 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) = 0 m

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

   Width of excavation on active side of wall = 20.00 m
   Width of excavation on passive side of wall = 20.00 m

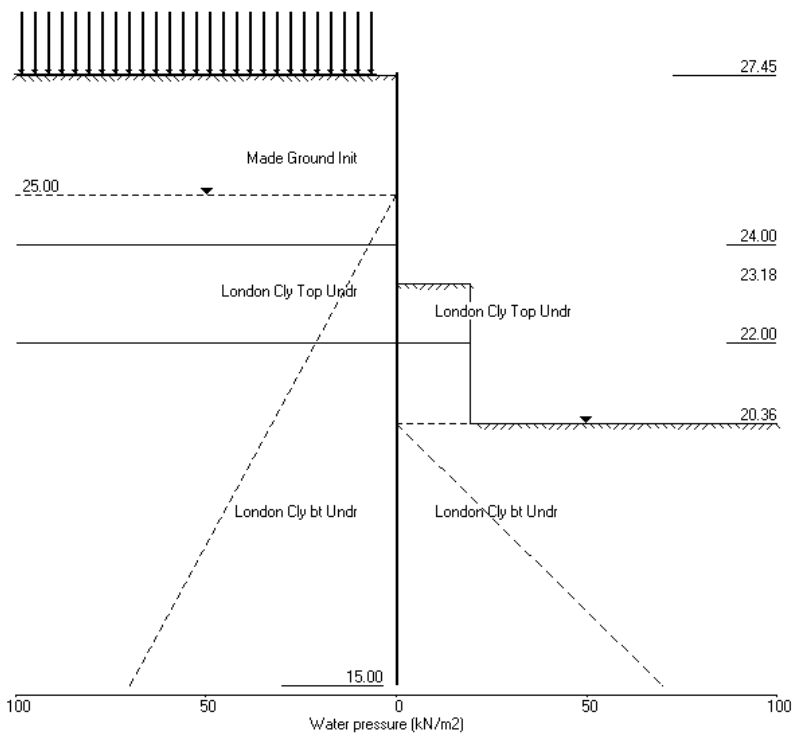
   Distance to rigid boundary on active side = 20.00 m
   Distance to rigid boundary on passive side = 20.00 m

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. 27.45	No	No	No
2	Excav. to elev. 23.18 on PASSIVE side	No	No	No
3	Install strut no.2 at elev. 23.56	No	No	No
4	Fill to elev. 23.71 on PASSIVE side	No	No	No
5	Install strut no.3 at elev. 27.15	No	No	No
6	Change soil type 8 to soil type 1	No	No	No
7	Apply water pressure profile no.1	No	No	No
8	Change soil type 3 to soil type 4	No	No	No
9	Change soil type 6 to soil type 7	No	No	No
10	Apply surcharge no.2 at elev. 22.36	No	No	No
*	Summary output	Yes	-	Yes

Units: kN,m

Stage No.2 Excav. to elev. 23.18 on PASSIVE side



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Camley Street | Date: 8-12-2015
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Units: kN,m

Stage No. 2 Excavate to elevation 23.18 on PASSIVE side
Toe of berm at elevation 20.36
Width of top of berm = 1.50
Width of toe of berm = 1.51

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

Stage No.	--- G.L. --- Act.	Pass.	Strut Elev.	Overall FoS for toe elev. = 15.00 Factor of Safety	Moment equilib. at elev.	Toe elev. for FoS = 1.000 Toe elev.	Wall Penetr -ation
2	27.45	23.18	Cant.	1.173	16.27	16.11	7.07

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: Active side 20.00 from wall
Passive 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
1	27.45	0.00	0.098	1.21E-02	0.0	0.0	
2	27.30	1.28	0.096	1.21E-02	0.1	0.0	
3	27.15	3.01	0.095	1.21E-02	0.4	0.1	
4	26.78	8.35	0.090	1.21E-02	2.5	0.5	
5	26.40	13.19	0.085	1.21E-02	6.6	2.2	
6	25.80	19.64	0.078	1.21E-02	16.4	9.1	
7	25.40	23.45	0.073	1.20E-02	25.1	17.3	
8	25.00	27.05	0.068	1.20E-02	35.2	29.3	
9	24.50	33.44	0.062	1.19E-02	50.3	50.5	
10	24.00	39.71	0.057	1.18E-02	68.6	80.1	
		29.61	0.057	1.18E-02	68.6	80.1	
11	23.71	35.47	0.053	1.17E-02	78.0	101.3	
12	23.56	38.47	0.051	1.16E-02	83.5	113.4	
13	23.18	45.94	0.047	1.14E-02	99.4	147.6	
		-11.21	0.047	1.14E-02	99.4	147.6	
14	22.77	-10.91	0.042	1.11E-02	94.8	187.6	
		13.50	0.042	1.11E-02	94.8	187.6	
15	22.36	16.68	0.038	1.08E-02	101.0	228.0	
		62.06	0.038	1.08E-02	101.0	228.0	
16	22.00	69.07	0.034	1.04E-02	124.6	268.5	
		3.16	0.034	1.04E-02	124.6	268.5	
17	21.50	3.76	0.029	9.82E-03	126.4	331.1	
		-43.23	0.029	9.82E-03	126.4	331.1	
18	21.00	-46.06	0.024	9.08E-03	104.0	388.7	
		29.16	0.024	9.08E-03	104.0	388.7	
19	20.68	30.63	0.021	8.54E-03	113.6	423.5	
		-3.78	0.021	8.54E-03	113.6	423.5	
20	20.36	-3.75	0.019	7.96E-03	112.4	459.7	
		-139.81	0.019	7.96E-03	112.4	459.7	

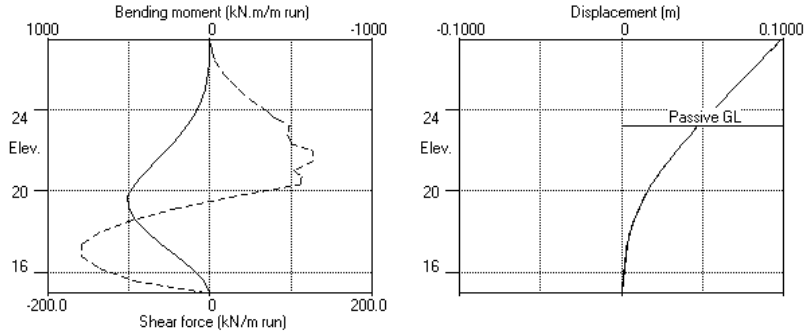
(continued)

Stage No.2 Excavate to elevation 23.18 on PASSIVE side
Toe of berm at elevation 20.36
Width of top of berm = 1.50
Width of toe of berm = 1.51

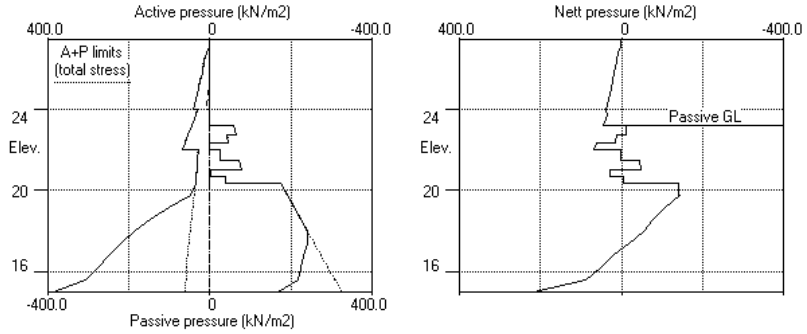
Node no.	Y coord	Nett pressure kN/m2	Wall disp. m	Wall rotation rad.	Shear force kN/m	Bending moment kN.m/m	Strut forces kN/m
21	19.78	-141.63	0.014	6.79E-03	30.8	509.9	
		-143.44	0.014	6.79E-03	30.8	509.9	
22	19.20	-106.46	0.011	5.58E-03	-41.7	503.6	
		-108.24	0.011	5.58E-03	-41.7	503.6	
23	18.60	-76.46	0.008	4.38E-03	-97.1	459.0	
		-78.21	0.008	4.38E-03	-97.1	459.0	
24	18.00	-52.95	0.006	3.33E-03	-136.4	386.6	
		-54.65	0.006	3.33E-03	-136.4	386.6	
25	17.40	-18.45	0.004	2.48E-03	-158.4	299.3	
26	16.80	21.44	0.003	1.86E-03	-157.5	201.1	
27	16.20	53.51	0.002	1.47E-03	-135.0	110.5	
28	15.60	89.20	0.001	1.28E-03	-92.2	39.2	
29	15.00	218.05	-0.000	1.24E-03	-0.0	-0.0	

Units: kN,m

Stage No.2 Excav. to elev. 23.18 on PASSIVE side

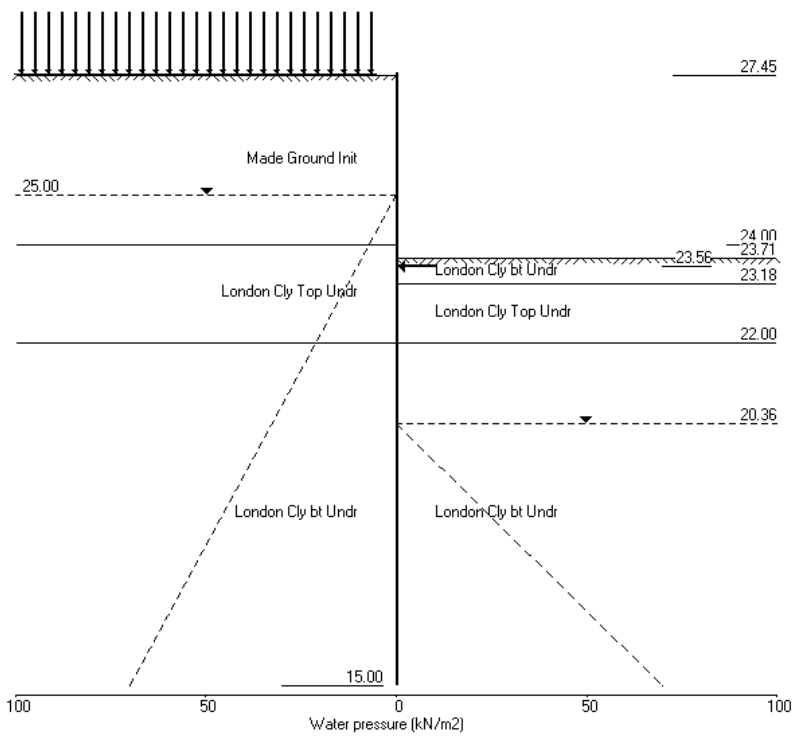


Stage No.2 Excav. to elev. 23.18 on PASSIVE side



Units: kN,m

Stage No.4 Fill to elev. 23.71 on PASSIVE side



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Program: WALLAP Version 6.05 Revision A45.B58.R49 | Job No. JMP008
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Data filename/Run ID: Section C3 Deep Rev A_ULS2 |
Camley Street | Date: 8-12-2015
Section C2 | Checked :

Units: kN,m

Stage No. 4 Fill to elevation 23.71 on PASSIVE side with soil type 6

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

Stage No.	--- G.L. --- Act.	Pass.	Strut Elev.	Overall FoS for toe elev. = 15.00 Factor of Safety	Moment equilib. at elev.	Toe elev. for FoS = 1.000 Toe elev.	Wall Penetr -ation
4	27.45	23.71	23.56	Conditions not suitable for 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: Active side 20.00 from wall
Passive 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
1	27.45	0.00	0.098	1.21E-02	0.0	0.0	
2	27.30	1.91	0.096	1.21E-02	0.1	0.0	
3	27.15	3.65	0.094	1.21E-02	0.6	0.1	
4	26.78	9.01	0.089	1.21E-02	2.9	0.7	
5	26.40	13.87	0.085	1.21E-02	7.2	2.5	
6	25.80	20.34	0.077	1.21E-02	17.5	9.9	
7	25.40	24.17	0.073	1.21E-02	26.4	18.6	
8	25.00	27.79	0.068	1.20E-02	36.8	31.2	
9	24.50	34.20	0.062	1.20E-02	52.3	53.3	
10	24.00	40.48	0.056	1.18E-02	71.0	84.0	
		31.72	0.056	1.18E-02	71.0	84.0	
11	23.71	37.59	0.052	1.17E-02	81.0	106.0	
12	23.56	39.86	0.051	1.16E-02	86.8	118.5	-0.0
13	23.18	44.00	0.046	1.14E-02	102.5	153.9	
		-16.18	0.046	1.14E-02	102.5	153.9	
14	22.77	-15.86	0.041	1.11E-02	95.9	194.8	
		8.55	0.041	1.11E-02	95.9	194.8	
15	22.36	11.72	0.037	1.08E-02	100.1	235.1	
		57.11	0.037	1.08E-02	100.1	235.1	
16	22.00	62.78	0.033	1.04E-02	121.7	275.0	
		4.54	0.033	1.04E-02	121.7	275.0	
17	21.50	5.27	0.028	9.79E-03	124.1	336.4	
		-41.72	0.028	9.79E-03	124.1	336.4	
18	21.00	-44.52	0.023	9.04E-03	102.6	393.0	
		23.91	0.023	9.04E-03	102.6	393.0	
19	20.68	23.91	0.021	8.49E-03	110.2	427.1	
		-2.25	0.021	8.49E-03	110.2	427.1	
20	20.36	-2.27	0.018	7.91E-03	109.5	462.2	
		-138.33	0.018	7.91E-03	109.5	462.2	
21	19.78	-140.28	0.014	6.74E-03	28.7	511.0	
		-142.09	0.014	6.74E-03	28.7	511.0	

(continued)

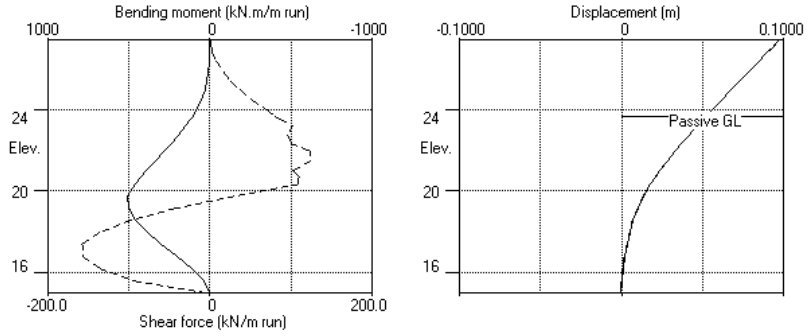
Stage No.4 Fill to elevation 23.71 on PASSIVE side with soil type 6

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
22	19.20	-105.29	0.010	5.52E-03	-43.0	503.7	
		-107.07	0.010	5.52E-03	-43.0	503.7	
23	18.60	-75.51	0.007	4.32E-03	-97.8	458.5	
		-77.26	0.007	4.32E-03	-97.8	458.5	
24	18.00	-52.25	0.005	3.28E-03	-136.7	385.9	
		-53.94	0.005	3.28E-03	-136.7	385.9	
25	17.40	-17.99	0.003	2.43E-03	-158.2	298.6	
26	16.80	21.65	0.002	1.81E-03	-157.1	200.5	
27	16.20	53.46	0.001	1.42E-03	-134.6	110.2	
28	15.60	88.88	0.000	1.24E-03	-91.9	39.1	
29	15.00	217.45	-0.001	1.19E-03	-0.0	-0.0	

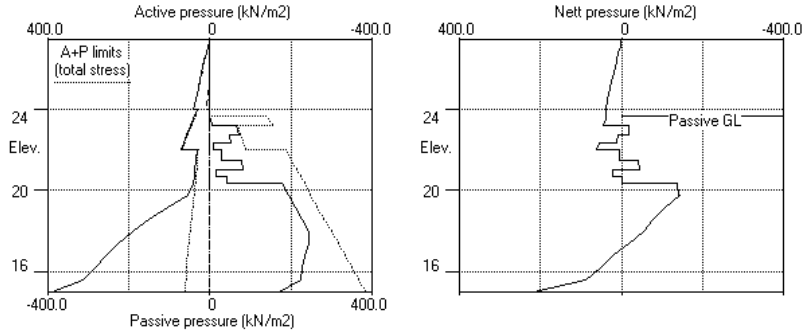
At elev. 23.56 The strut is slack

Units: kN,m

Stage No.4 Fill to elev. 23.71 on PASSIVE side



Stage No.4 Fill to elev. 23.71 on PASSIVE side



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 Permanent Variable loads = 1.300

STABILITY ANALYSIS of Fully Embedded Wall according to Strength Factor method

Factor of safety on soil strength

Stage No.	--- G.L. --- Act.	Pass.	Strut Elev.	Overall FoS for toe elev. = 15.00 Factor of Safety	Moment equilib. at elev.	Toe elev. for FoS = 1.000 Toe elev.	Wall Penetr -ation
1	27.45	27.45	Cant.	Conditions not suitable for FoS calc.			
2	27.45	23.18	Cant.	1.173	16.27	16.11	7.07
3	27.45	23.18		No analysis at this stage			
4	27.45	23.71	23.56	Conditions not suitable for FoS calc.			
5	27.45	23.71		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: Section C3 Deep Rev A_ULS2 |
Camley Street | Date: 8-12-2015
Section C2 | 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: Active side 20.00 from wall
Passive side 20.00 from wall

Limit State: ULS DA1 Combination 2

Bending moment, shear force and displacement envelopes

Node no.	Y coord	Displacement maximum m	Displacement minimum m	Bending moment maximum kN.m/m	Bending moment minimum kN.m/m	Shear force maximum kN/m	Shear force minimum kN/m
1	27.45	0.098	0.000	0.0	-0.0	0.0	0.0
2	27.30	0.096	0.000	0.0	-0.0	0.2	-0.3
3	27.15	0.095	0.000	0.1	-0.1	0.7	-11.1
4	26.78	0.090	0.000	0.7	-3.6	2.9	-7.9
5	26.40	0.085	0.000	2.5	-5.5	7.2	-2.9
6	25.80	0.078	0.000	9.9	-3.4	17.5	-3.6
7	25.40	0.073	0.000	18.6	-4.9	26.6	-3.8
8	25.00	0.068	0.000	31.2	-6.5	42.5	-3.8
9	24.50	0.062	0.000	53.3	-8.2	66.0	-3.0
10	24.00	0.057	0.000	85.9	-9.3	93.2	-1.1
11	23.71	0.053	0.000	115.3	-9.3	110.1	0.0
12	23.56	0.052	0.000	132.5	-9.1	118.8	0.0
13	23.18	0.047	0.000	154.0	-7.8	102.5	0.0
14	22.77	0.043	0.000	194.8	-5.0	95.9	0.0
15	22.36	0.038	0.000	235.1	-0.4	101.0	0.0
16	22.00	0.035	0.000	275.0	0.0	124.6	0.0
17	21.50	0.030	0.000	336.4	0.0	126.4	0.0
18	21.00	0.025	0.000	393.0	0.0	104.0	0.0
19	20.68	0.022	0.000	427.1	0.0	113.6	0.0
20	20.36	0.019	0.000	462.2	0.0	112.4	0.0
21	19.78	0.015	0.000	511.0	0.0	30.8	-1.8
22	19.20	0.012	0.000	503.7	0.0	0.0	-43.0
23	18.60	0.008	0.000	459.0	0.0	0.0	-97.8
24	18.00	0.006	0.000	386.6	0.0	0.0	-136.7
25	17.40	0.004	0.000	299.3	0.0	0.0	-158.4
26	16.80	0.003	0.000	202.5	0.0	0.0	-157.5
27	16.20	0.002	0.000	116.4	0.0	0.0	-135.0
28	15.60	0.001	-0.000	42.3	0.0	0.0	-97.3
29	15.00	0.001	-0.001	0.0	-0.0	0.0	-0.0

Summary of results (continued)

Maximum and minimum bending moment and shear force at each stage

Stage	Bending moment				Shear force			
no.	maximum kN.m/m	elev.	minimum kN.m/m	elev.	maximum kN/m	elev.	minimum kN/m	elev.
1	20.7	20.36	-9.3	23.71	17.4	22.00	-6.3	18.00
2	509.9	19.78	-0.0	15.00	126.4	21.50	-158.4	17.40
3	No calculation at this stage							
4	511.0	19.78	-0.0	15.00	124.1	21.50	-158.2	17.40
5	No calculation at this stage							
6	No calculation at this stage							
7	No calculation at this stage							
8	No calculation at this stage							
9	No calculation at this stage							
10	451.1	19.78	-5.5	26.40	118.8	23.56	-142.5	16.80

Maximum and minimum displacement at each stage

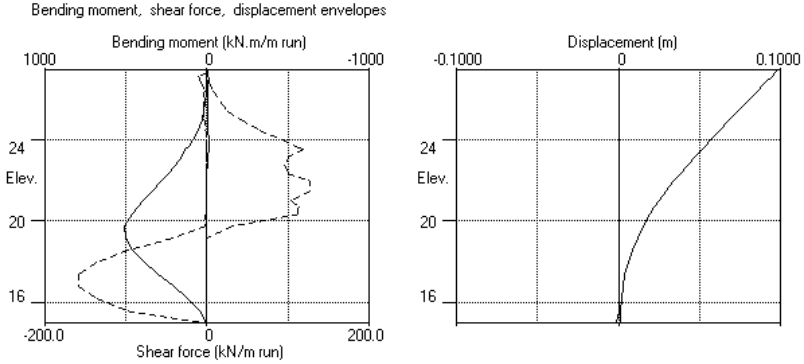
Stage	Displacement				Stage description
no.	maximum m	elev.	minimum m	elev.	
1	0.003	27.45	0.000	27.45	Apply surcharge no.1 at elev. 27.45
2	0.098	27.45	-0.000	15.00	Excav. to elev. 23.18 on PASSIVE side
3	No calculation at this stage				Install strut no.2 at elev. 23.56
4	0.098	27.45	-0.001	15.00	Fill to elev. 23.71 on PASSIVE side
5	No calculation at this stage				Install strut no.3 at elev. 27.15
6	No calculation at this stage				Change soil type 8 to soil type 1
7	No calculation at this stage				Apply water pressure profile no.1
8	No calculation at this stage				Change soil type 3 to soil type 4
9	No calculation at this stage				Change soil type 6 to soil type 7
10	0.097	27.45	-0.001	15.00	Apply surcharge no.2 at elev. 22.36

Strut forces at each stage (horizontal components)

Stage	Strut no. 2 at elev. 23.56		Strut no. 3 at elev. 27.15	
no.	kN/m run	kN/strut	kN/m run	kN/strut
4	slack	slack	---	---
10	71.97	71.97	11.83	11.83

* Indicates that the total force shown is the sum of the force in the strut plus a force applied at the same elevation which may represent temperature load or other forces which are part of the strut load. Force components are listed in the detailed results for individual stages.

Units: kN,m



SLS Analysis

GEOFIRMA LTD | Sheet No.
Program: WALLAP Version 6.05 Revision A45.B58.R49 | Job No. JMP0014
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Data filename/Run ID: Section A1 Rev A_SLS |
Camley Street | Date:10-12-2015
Section A1 Adjacent to Sub Station Rev A | Checked :

Units: kN,m

INPUT DATA

SOIL PROFILE

Stratum no.	Elevation of top of stratum	Soil types Active side	Passive side
1	28.30	8 Made Ground Init	8 Made Ground Init
2	24.00	3 London Cly Top Undr	3 London Cly Top Undr
3	22.00	6 London Cly bt Undr	6 London Cly bt Undr

SOIL PROPERTIES

No.	Soil type / Description	Bulk density kN/m3	Young's Modulus Eh,kN/m2 (dEh/dy)	At rest coeff. Ko (dKo/dy)	Consol state. NC/OC (Nu)	Active limit Ka (Kac)	Passive limit Kp (Kpc)	Cohesion kN/m2 (dc/dy)
1	Made Ground (Datum elev.)	19.00	20000	0.577	OC (0.250)	0.390 (0.000)	2.561 (0.000)	
2	Gravels	19.00	60000	0.423	OC (0.300)	0.227 (0.000)	6.084 (0.000)	
3	London Cly Top Undr	19.00	40000	1.000	OC (0.490)	1.000 (2.000)	1.000 (2.000)	40.00u
4	London Cly Top dr	19.00	28000	1.000	OC (0.250)	0.422 (1.299)	2.371 (3.080)	3.000d
5	Concrete	24.00	400000	1.000	OC (0.490)	1.000 (2.000)	1.000 (2.000)	30000u
6	London Cl.. (24.00)	19.00	85000 (5178)	1.400	OC (0.490)	1.000 (2.476)	1.000 (2.390)	80.00u (5.180)
7	London Cl.. (24.00)	19.00	56000 (3626)	1.400	OC (0.250)	0.366 (1.423)	3.077 (4.665)	3.000d
8	Made Ground Init	19.00	20000	0.577	OC (0.250)	0.337 (0.000)	3.442 (0.000)	

Additional soil parameters associated with Ka and Kp

No.	Soil type / Description	--- parameters for Ka --- Soil friction angle	Wall adhesion coeff.	Back-fill angle	--- parameters for Kp --- Soil friction angle	Wall adhesion coeff.	Back-fill angle
1	Made Ground	26.00	0.000	0.00	26.00	0.000	0.00
2	Gravels	35.00	0.670	0.00	35.00	0.500	0.00
3	London Cly Top Undr	0.00	0.000	0.00	0.00	0.000	0.00
4	London Cly Top dr	24.00	0.000	0.00	24.00	0.000	0.00
5	Concrete	0.00	0.000	0.00	0.00	0.000	0.00
6	London Cly bt Undr	0.00	0.670	0.00	0.00	0.500	0.00
7	London Cly bt dr	24.00	0.670	0.00	24.00	0.500	0.00
8	Made Ground Init	26.00	0.670	0.00	26.00	0.500	0.00

GROUND WATER CONDITIONS

Density of water = 10.00 kN/m3

	Active side	Passive side
Initial water table elevation	26.30	21.86

Automatic water pressure balancing at toe of wall : Yes

Water press. profile no.	Active side Point no.	Elev. m	Piezo elev. m	Water press. kN/m2	Passive side Point no.	Elev. m	Piezo elev. m	Water press. kN/m2	
1	1	26.30	26.30	0.0	1	22.36	22.36	0.0	MC+WC
					2	22.36	26.30	39.4	

WALL PROPERTIES

Type of structure = Fully Embedded Wall
Elevation of toe of wall = 18.00
Maximum finite element length = 0.60 m
Youngs modulus of wall E = 1.9600E+07 kN/m2
Moment of inertia of wall I = 0.017260 m4/m run
E.I = 338296 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	27.70	8.00	0.010000	2.000E+08	10.00	0.00	0	No
2	22.73	1.00	0.300000	1.400E+07	10.00	0.00	0	No
3	28.15	1.00	0.300000	1.400E+07	10.00	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	28.30	0.50(A)	100.00	1.95	5.00	=	N/A	1.00 Var
2	22.36	-0.00(P)	30.00	20.00	40.00	=	N/A	1.00 P/U
3	28.30	2.45(A)	10.00	10.00	40.00	=	N/A	1.00 -

Note: A = Active side, P = Passive 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.3 at elevation 28.30
	No analysis at this stage
2	Apply surcharge no.1 at elevation 28.30
	No analysis at this stage
3	Excavate to elevation 27.10 on PASSIVE side
	Toe of berm at elevation 22.48
	Width of top of berm = 2.00
	Width of toe of berm = 6.62
4	Install strut or anchor no.1 at elevation 27.70
5	Excavate to elevation 22.48 on PASSIVE side
6	Install strut or anchor no.2 at elevation 22.73
7	Fill to elevation 23.01 on PASSIVE side with soil type 5
8	Install strut or anchor no.3 at elevation 28.15
9	Remove strut or anchor no.1 at elevation 27.70
10	Change properties of soil type 9 to soil type 1
	No analysis at this stage
	Ko pressures will not be reset
11	Apply water pressure profile no.1 (Mod. Conserv.)
	No analysis at this stage
12	Change properties of soil type 3 to soil type 4
	No analysis at this stage
	Ko pressures will not be reset
13	Change properties of soil type 6 to soil type 7
	No analysis at this stage
	Ko pressures will not be reset
14	Apply surcharge no.2 at elevation 22.36

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 = 1.50

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) = 10.15 m

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

Width of excavation on active side of wall = 20.00 m
Width of excavation on passive side of wall = 20.00 m

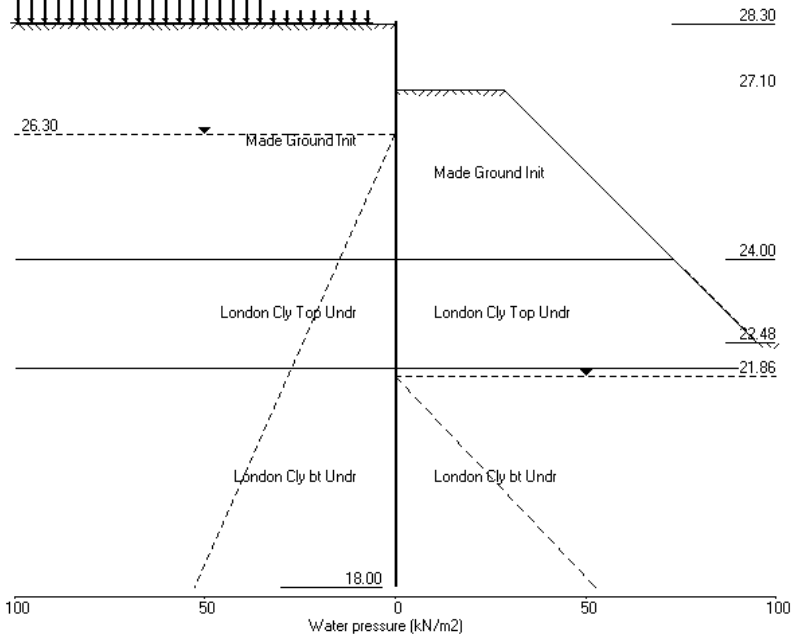
Distance to rigid boundary on active side = 20.00 m
Distance to rigid boundary on passive side = 20.00 m

OUTPUT OPTIONS

Stage no.	Stage description	Output options: Displacement, Bending mom., Shear force	Active, Passive pressures	Graph. output
1	Apply surcharge no.3 at elev. 28.30	No	No	No
2	Apply surcharge no.1 at elev. 28.30	No	No	No
3	Excav. to elev. 27.10 on PASSIVE side	No	No	No
4	Install strut no.1 at elev. 27.70	No	No	No
5	Excav. to elev. 22.48 on PASSIVE side	No	No	No
6	Install strut no.2 at elev. 22.73	No	No	No
7	Fill to elev. 23.01 on PASSIVE side	No	No	No
8	Install strut no.3 at elev. 28.15	No	No	No
9	Remove strut no.1 at elev. 27.70	No	No	No
10	Change soil type 9 to soil type 1	No	No	No
11	Apply water pressure profile no.1	No	No	No
12	Change soil type 3 to soil type 4	No	No	No
13	Change soil type 6 to soil type 7	No	No	No
14	Apply surcharge no.2 at elev. 22.36	No	No	No
*	Summary output	Yes	-	Yes

Units: kN,m

Stage No.3 Excav. to elev. 27.10 on PASSIVE side



Units: kN,m

Stage No. 3 Excavate to elevation 27.10 on PASSIVE side
Toe of berm at elevation 22.48
Width of top of berm = 2.00
Width of toe of berm = 6.62

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

Stage No.	--- G.L. --- Act.	Pass.	Strut Elev.	FoS for toe elev. = 18.00 Factor of Safety	Moment equilib. at elev.	Toe elev. for FoS = 1.500 Toe elev.	Wall Penetr -ation
3	28.30	27.10	Cant.	2.083	19.25	20.25	6.85

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: Active side 20.00 from wall
Passive 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.

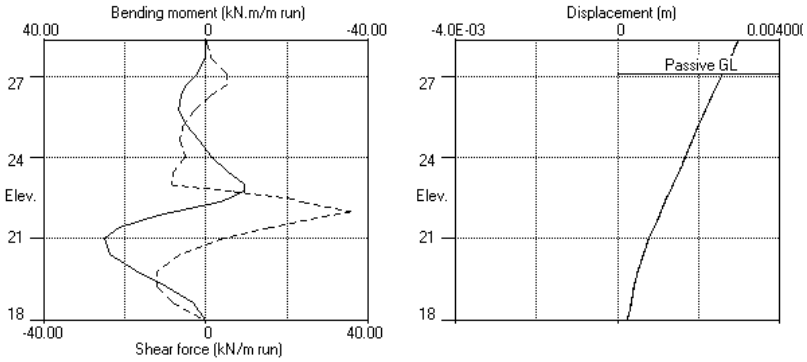
Node no.	Y coord	Nett pressure kN/m2	Wall disp. m	Wall rotation rad.	Shear force kN/m	Bending moment kN.m/m	Strut forces kN/m
1	28.30	0.00	0.003	3.23E-04	0.0	0.0	
2	28.15	0.98	0.003	3.23E-04	0.1	0.0	
3	27.70	4.31	0.003	3.23E-04	1.3	0.3	
4	27.10	8.97	0.003	3.21E-04	5.2	2.1	
5	26.70	-9.92	0.002	3.17E-04	5.1	4.7	
		-8.84	0.002	3.17E-04	5.1	4.7	
6	26.30	-10.50	0.002	3.11E-04	1.2	6.3	
		-5.96	0.002	3.11E-04	1.2	6.3	
7	25.75	-8.40	0.002	3.00E-04	-2.8	6.8	
		-5.42	0.002	3.00E-04	-2.8	6.8	
8	25.20	-4.62	0.002	2.90E-04	-5.5	4.8	
		-2.15	0.002	2.90E-04	-5.5	4.8	
9	24.60	-0.71	0.002	2.85E-04	-6.4	1.6	
		1.36	0.002	2.85E-04	-6.4	1.6	
10	24.00	2.98	0.002	2.85E-04	-5.1	-1.5	
		-7.95	0.002	2.85E-04	-5.1	-1.5	
11	23.51	-3.46	0.002	2.90E-04	-7.9	-5.0	
12	23.01	0.84	0.001	3.00E-04	-8.5	-9.3	
		53.55	0.001	3.00E-04	-8.5	-9.3	
13	22.73	58.55	0.001	3.08E-04	6.9	-9.6	
		51.90	0.001	3.08E-04	6.9	-9.6	
14	22.48	56.22	0.001	3.14E-04	20.4	-6.2	
		29.56	0.001	3.14E-04	20.4	-6.2	
15	22.36	31.33	0.001	3.15E-04	24.2	-3.5	
		28.98	0.001	3.15E-04	24.2	-3.5	
16	22.00	33.94	0.001	3.13E-04	35.5	7.2	
		-39.98	0.001	3.13E-04	35.5	7.2	

(continued)

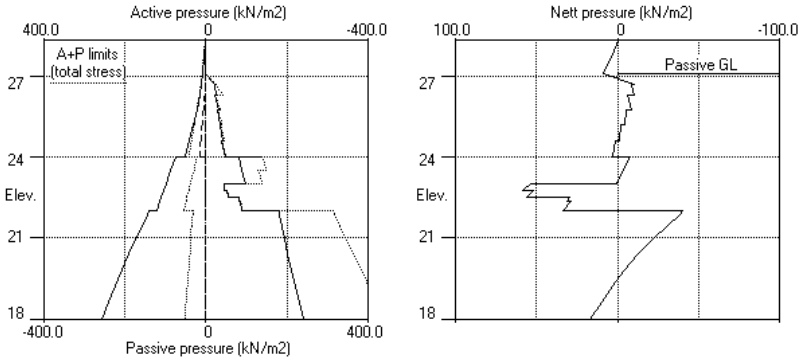
Stage No.3 Excavate to elevation 27.10 on PASSIVE side
Toe of berm at elevation 22.48
Width of top of berm = 2.00
Width of toe of berm = 6.62

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
17	21.86	-38.09	0.001	3.09E-04	30.0	11.8	
18	21.43	-30.06	0.001	2.88E-04	15.4	21.2	
19	21.00	-22.46	0.001	2.59E-04	4.1	25.1	
20	20.40	-12.88	0.001	2.16E-04	-6.5	23.6	
21	19.80	-4.49	0.001	1.79E-04	-11.7	17.5	
22	19.20	3.02	0.000	1.55E-04	-12.1	9.7	
23	18.60	10.11	0.000	1.44E-04	-8.2	3.0	
24	18.00	17.25	0.000	1.41E-04	-0.0	0.0	

Stage No.3 Excav. to elev. 27.10 on PASSIVE side



Stage No.3 Excav. to elev. 27.10 on PASSIVE side



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Program: WALLAP Version 6.05 Revision A45.B58.R49 | Job No. JMP0014
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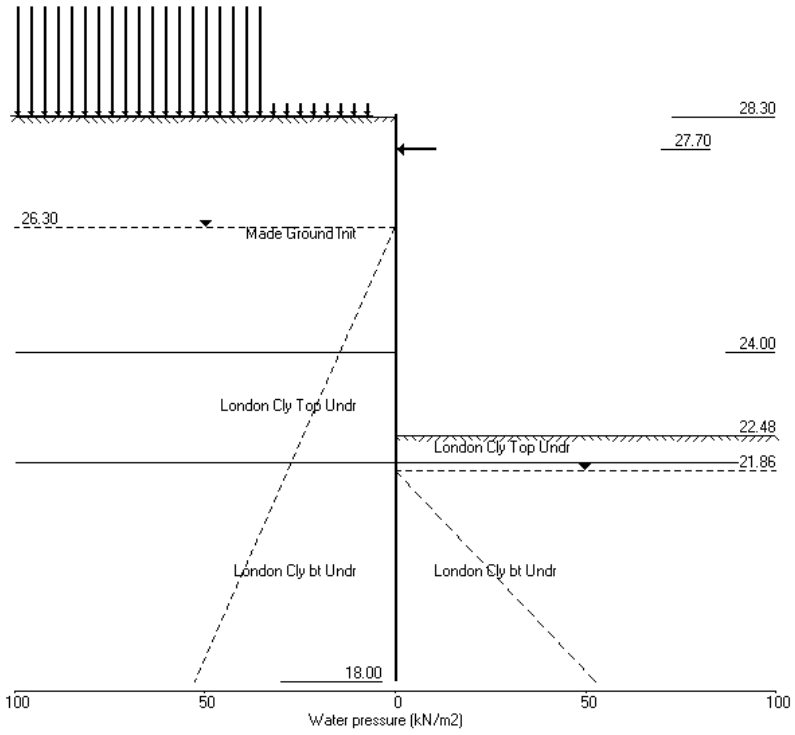
Data filename/Run ID: Section A1 Rev A_SLS |
Camley Street | Date:10-12-2015
Section A1 Adjacent to Sub Station Rev A | Checked :
Units: kN,m

Stage No.5 Excav. to elev. 22.48 on PASSIVE side



Units: kN,m

Stage No. 5 Excavate to elevation 22.48 on PASSIVE side

STABILITY ANALYSIS of Fully Embedded Wall according to Strength Factor method

Factor of safety on soil strength

Stage No.	--- G.L. --- Act.	Pass.	Strut Elev.	FoS for toe elev. = 18.00 Factor of Safety	Moment equilib. at elev.	Toe elev. for FoS = 1.500 Toe elev.	Wall Penetr -ation
5	28.30	22.48	27.70	3.058	n/a	21.14	1.35

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: Active side 20.00 from wall
Passive 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.

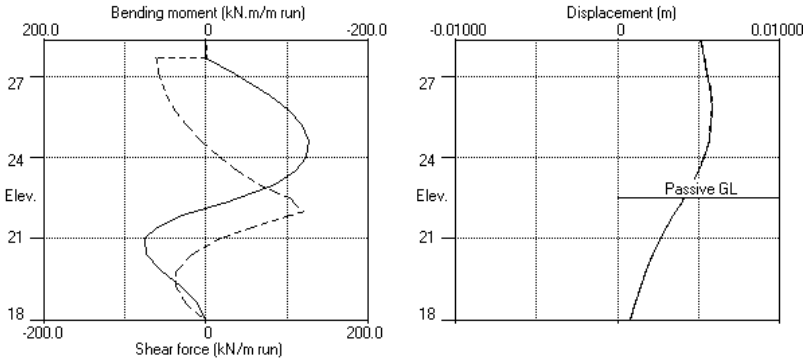
Node no.	Y coord	Nett pressure kN/m2	Wall disp. m	Wall rotation rad.	Shear force kN/m	Bending moment kN.m/m	Strut forces kN/m
1	28.30	0.00	0.005	-3.49E-04	0.0	-0.0	
2	28.15	0.98	0.005	-3.49E-04	0.1	0.0	
3	27.70	4.31	0.005	-3.49E-04	1.3	0.3	63.4
		4.31	0.005	-3.49E-04	-62.2	0.3	
4	27.10	8.97	0.006	-3.18E-04	-58.2	-35.9	
5	26.70	12.10	0.006	-2.62E-04	-54.0	-58.1	
6	26.30	15.25	0.006	-1.81E-04	-48.5	-78.4	
7	25.75	21.86	0.006	-3.56E-05	-38.3	-101.6	
8	25.20	28.37	0.006	1.43E-04	-24.5	-118.6	
9	24.60	35.31	0.006	3.61E-04	-5.4	-127.4	
10	24.00	42.10	0.005	5.84E-04	17.8	-123.6	
		34.33	0.005	5.84E-04	17.8	-123.6	
11	23.51	48.35	0.005	7.55E-04	38.3	-110.2	
12	23.01	62.98	0.005	8.98E-04	65.9	-85.0	
13	22.73	71.32	0.004	9.58E-04	84.3	-64.5	
14	22.48	79.00	0.004	9.97E-04	103.1	-41.1	
		26.77	0.004	9.97E-04	103.1	-41.1	
15	22.36	32.19	0.004	1.01E-03	106.8	-28.0	
16	22.00	44.75	0.004	1.01E-03	120.6	12.6	
		-131.00	0.004	1.01E-03	120.6	12.6	
17	21.86	-123.57	0.003	1.01E-03	102.8	28.2	
18	21.43	-98.44	0.003	9.53E-04	55.1	61.0	
19	21.00	-74.28	0.003	8.66E-04	18.0	75.7	
20	20.40	-43.48	0.002	7.34E-04	-17.4	73.2	
21	19.80	-16.30	0.002	6.21E-04	-35.3	55.0	
22	19.20	8.14	0.001	5.44E-04	-37.8	30.9	
23	18.60	31.39	0.001	5.08E-04	-25.9	9.8	
24	18.00	54.94	0.001	5.00E-04	-0.0	0.0	

At elev. 27.70 Strut force = 507.6 kN/strut = 63.4 kN/m run

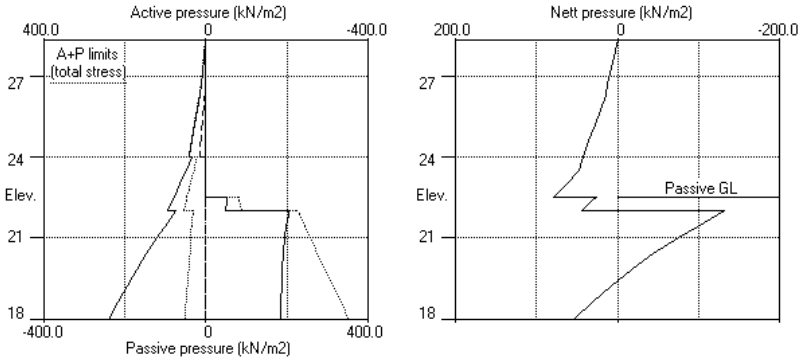
(continued)

Stage No.5 Excavate to elevation 22.48 on PASSIVE side

Stage No.5 Excav. to elev. 22.48 on PASSIVE side



Stage No.5 Excav. to elev. 22.48 on PASSIVE side



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Program: WALLAP Version 6.05 Revision A45.B58.R49 | Job No. JMP0014
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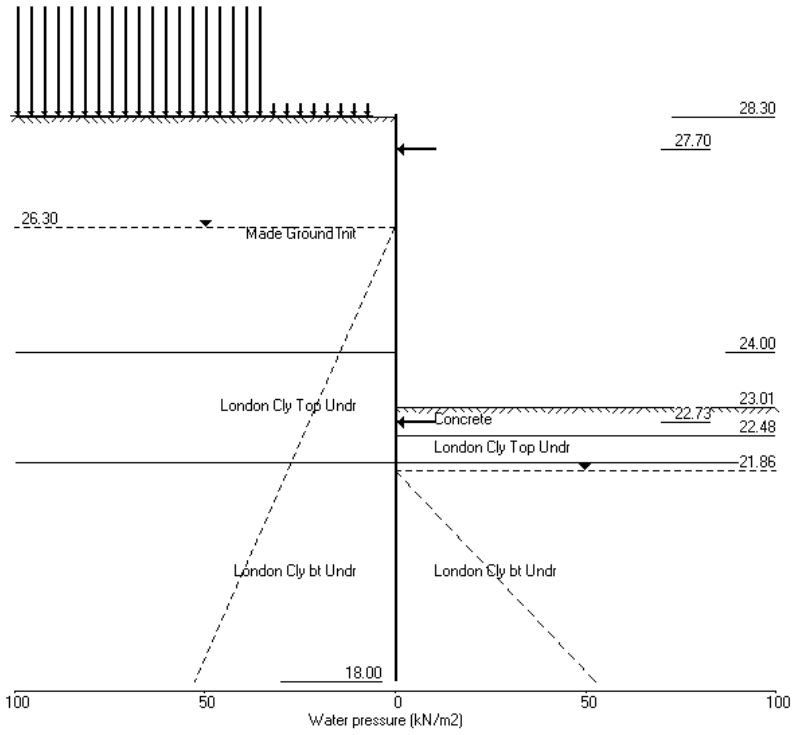
Data filename/Run ID: Section A1 Rev A_SLS |
Camley Street | Date:10-12-2015
Section A1 Adjacent to Sub Station Rev A | Checked :
Units: kN,m

Stage No.7 Fill to elev. 23.01 on PASSIVE side



Units: kN,m

Stage No. 7 Fill to elevation 23.01 on PASSIVE side with soil type 5

STABILITY ANALYSIS of Fully Embedded Wall according to Strength Factor method

Factor of safety on soil strength

Stage No.	--- G.L. --- Act.	Pass.	Strut Elev.	FoS for toe elev. = 18.00 Factor of Safety	Moment equilib. at elev.	Toe elev. for FoS = 1.500 Toe elev.	Wall Penetr -ation
7	28.30	23.01		More than one strut			

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: Active side 20.00 from wall
Passive 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
1	28.30	0.00	0.005	-3.12E-04	0.0	-0.0	
2	28.15	0.98	0.005	-3.12E-04	0.1	0.0	
3	27.70	4.31	0.005	-3.12E-04	1.3	0.3	63.5
		4.31	0.005	-3.12E-04	-62.2	0.3	
4	27.10	9.05	0.006	-2.81E-04	-58.2	-36.0	
5	26.70	12.24	0.006	-2.25E-04	-53.9	-58.1	
6	26.30	15.44	0.006	-1.44E-04	-48.4	-78.4	
7	25.75	22.13	0.006	1.41E-06	-38.1	-101.5	
8	25.20	28.72	0.006	1.80E-04	-24.1	-118.4	
9	24.60	35.75	0.006	3.97E-04	-4.7	-126.9	
10	24.00	42.62	0.005	6.18E-04	18.8	-122.5	
		35.81	0.005	6.18E-04	18.8	-122.5	
11	23.51	50.02	0.005	7.87E-04	40.0	-108.5	
12	23.01	64.82	0.004	9.27E-04	68.4	-82.3	
13	22.73	71.87	0.004	9.85E-04	87.2	-61.0	-0.0
14	22.48	78.37	0.004	1.02E-03	106.0	-36.9	
		18.91	0.004	1.02E-03	106.0	-36.9	
15	22.36	24.39	0.004	1.03E-03	108.7	-23.5	
16	22.00	37.12	0.003	1.03E-03	119.8	17.3	
		-132.43	0.003	1.03E-03	119.8	17.3	
17	21.86	-124.79	0.003	1.02E-03	101.8	32.8	
18	21.43	-99.09	0.003	9.63E-04	53.6	65.1	
19	21.00	-74.49	0.002	8.71E-04	16.3	79.0	
20	20.40	-43.25	0.002	7.34E-04	-19.0	75.5	
21	19.80	-15.77	0.002	6.18E-04	-36.7	56.4	
22	19.20	8.86	0.001	5.40E-04	-38.8	31.6	
23	18.60	32.24	0.001	5.03E-04	-26.4	10.0	
24	18.00	55.90	0.001	4.94E-04	-0.0	0.0	

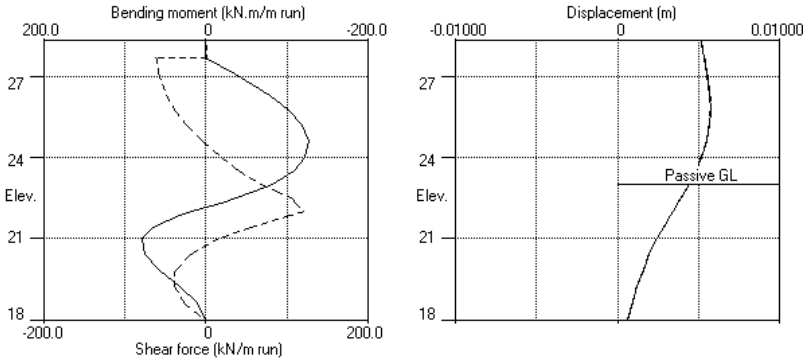
At elev. 27.70 Strut force = 507.8 kN/strut = 63.5 kN/m run

At elev. 22.73 The strut is slack

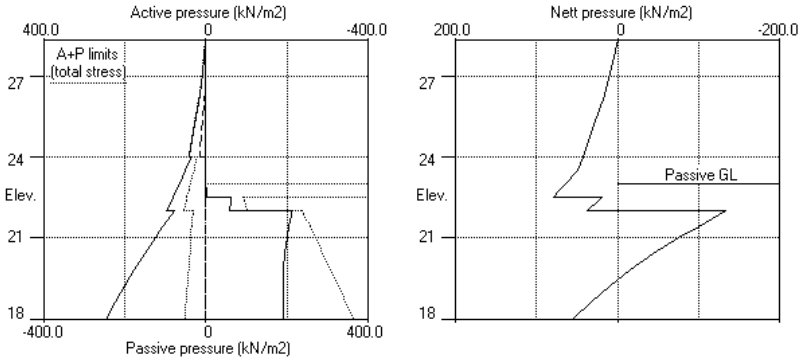
(continued)

Stage No.7 Fill to elevation 23.01 on PASSIVE side with soil type 5

Stage No.7 Fill to elev. 23.01 on PASSIVE side



Stage No.7 Fill to elev. 23.01 on PASSIVE side



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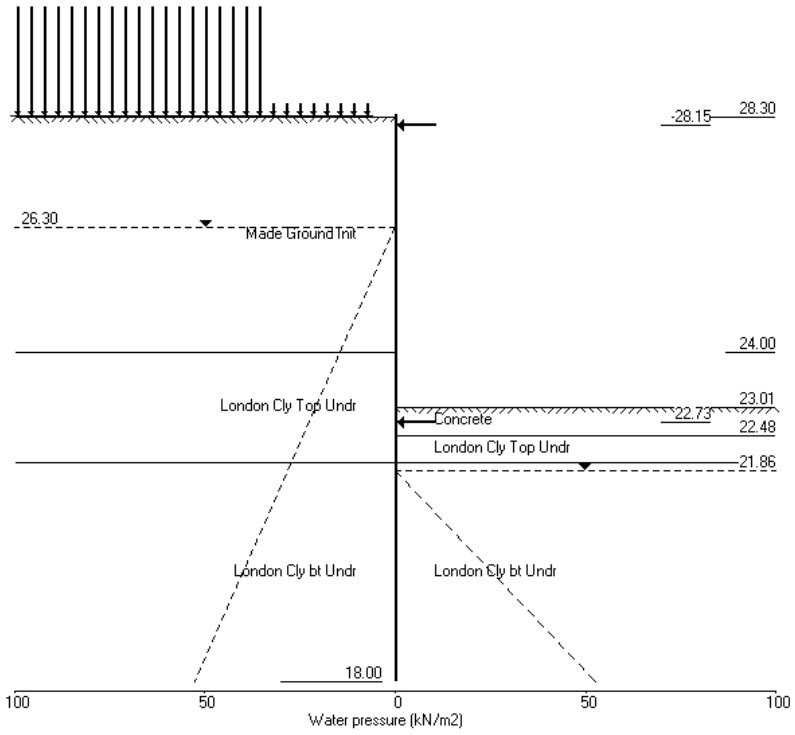
Data filename/Run ID: Section A1 Rev A_SLS |
Camley Street | Date:10-12-2015
Section A1 Adjacent to Sub Station Rev A | Checked :
Units: kN,m

Stage No.9 Remove strut no.1 at elev. 27.70



Units: kN,m

Stage No. 9 Remove strut or anchor no.1 at elevation 27.70

STABILITY ANALYSIS of Fully Embedded Wall according to Strength Factor method

Factor of safety on soil strength

Stage No.	--- G.L. --- Act.	Pass.	Strut Elev.	FoS for toe elev. = 18.00 Factor of Safety	Moment equilib. at elev.	Toe elev. for FoS = 1.500 Toe elev.	Wall Penetr -ation
9	28.30	23.01		More than one strut			

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: Active side 20.00 from wall
Passive 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
1	28.30	0.00	0.005	-3.97E-04	0.0	-0.0	
2	28.15	0.98	0.005	-3.97E-04	0.1	0.0	56.0
		0.98	0.005	-3.97E-04	-55.9	0.0	
3	27.70	4.31	0.005	-3.81E-04	-54.7	-24.9	
4	27.10	8.97	0.006	-3.08E-04	-50.7	-56.7	
5	26.70	12.10	0.006	-2.30E-04	-46.5	-75.9	
6	26.30	15.25	0.006	-1.30E-04	-41.1	-93.2	
7	25.75	21.86	0.006	3.66E-05	-30.9	-112.2	
8	25.20	28.37	0.006	2.29E-04	-17.0	-125.2	
9	24.60	35.31	0.006	4.55E-04	2.1	-129.5	
10	24.00	42.15	0.005	6.77E-04	25.3	-121.2	
		34.53	0.005	6.77E-04	25.3	-121.2	
11	23.51	49.12	0.005	8.42E-04	46.0	-104.1	
12	23.01	64.26	0.004	9.73E-04	74.1	-75.0	
		44.68	0.004	9.73E-04	74.1	-75.0	
13	22.73	57.38	0.004	1.02E-03	88.1	-52.9	-0.0
14	22.48	68.29	0.004	1.05E-03	103.8	-29.0	
		17.64	0.004	1.05E-03	103.8	-29.0	
15	22.36	23.37	0.004	1.06E-03	106.4	-15.9	
16	22.00	36.69	0.003	1.06E-03	117.2	24.0	
		-133.45	0.003	1.06E-03	117.2	24.0	
17	21.86	-125.37	0.003	1.04E-03	99.1	39.1	
18	21.43	-98.83	0.003	9.77E-04	50.9	70.1	
19	21.00	-73.86	0.002	8.80E-04	13.7	82.9	
20	20.40	-42.34	0.002	7.37E-04	-21.1	77.9	
21	19.80	-14.79	0.002	6.17E-04	-38.3	57.7	
22	19.20	9.80	0.001	5.37E-04	-39.8	32.1	
23	18.60	33.07	0.001	5.00E-04	-26.9	10.1	
24	18.00	56.60	0.001	4.91E-04	0.0	0.0	

At elev. 28.15 Strut force = 56.0 kN/strut = 56.0 kN/m run

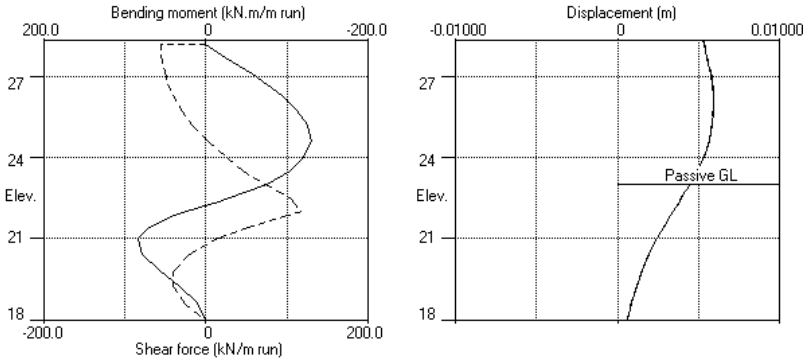
At elev. 22.73 The strut is slack

(continued)

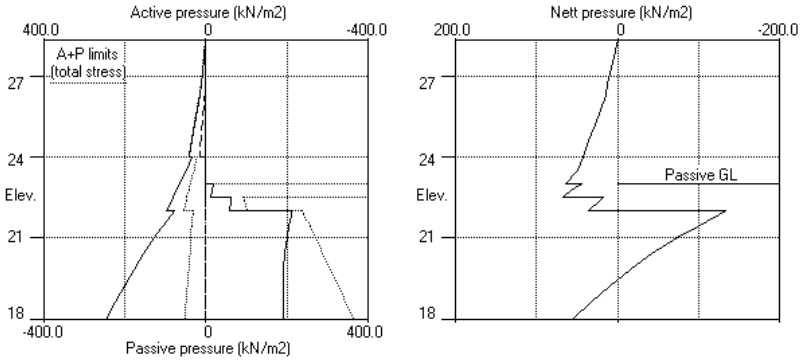
Stage No.9 Remove strut or anchor no.1 at elevation 27.70

Units: kN,m

Stage No.9 Remove strut no.1 at elev. 27.70



Stage No.9 Remove strut no.1 at elev. 27.70



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Data filename/Run ID: Section A1 Rev A_SLS |
Camley Street | Date:10-12-2015
Section A1 Adjacent to Sub Station Rev A | 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 No.	--- G.L. --- Act.	Pass.	Strut Elev.	FoS for toe elev. = 18.00 Factor of Safety	Moment equilib. at elev.	Toe elev. for FoS = 1.500 Toe elev.	Wall Penetr -ation
1	28.30	28.30	Cant.	Conditions not suitable for FoS calc.			
2	28.30	28.30		No analysis at this stage			
3	28.30	27.10	Cant.	2.083	19.25	20.25	6.85
4	28.30	27.10		No analysis at this stage			
5	28.30	22.48	27.70	3.058	n/a	21.14	1.35
6	28.30	22.48		No analysis at this stage			

All remaining stages have more than one strut - FoS calculation n/a

Units: kN,m

Summary of results

BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall

Analysis options

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

Rigid boundaries: Active side 20.00 from wall
Passive 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 max. m	Displacement min. m	Bending moment Calculated max. kN.m/m	Bending moment Calculated min. kN.m/m	Bending moment Factored max. kN.m/m	Bending moment Factored min. kN.m/m	Shear force Calculated max. kN/m	Shear force Calculated min. kN/m	Shear force Factored max. kN/m	Shear force Factored min. kN/m
1	28.30	0.005	0.000	0	-0	0	-0	0	0	0	0
2	28.15	0.005	0.000	0	-0	0	-0	0	-56	0	-75
3	27.70	0.006	0.000	0	-25	0	-34	1	-62	2	-84
4	27.10	0.006	0.000	2	-57	3	-77	5	-58	7	-79
5	26.70	0.006	0.000	5	-76	6	-102	5	-54	7	-73
6	26.30	0.006	0.000	6	-93	8	-126	1	-49	2	-65
7	25.75	0.006	0.000	7	-112	9	-152	0	-38	0	-52
8	25.20	0.006	0.000	5	-125	7	-169	0	-24	0	-33
9	24.60	0.006	0.000	2	-130	2	-175	7	-6	10	-9
10	24.00	0.005	0.000	0	-124	0	-167	33	-5	45	-7
11	23.51	0.005	0.000	0	-110	0	-149	60	-8	81	-11
12	23.01	0.005	0.000	0	-85	0	-115	91	-9	123	-12
13	22.73	0.005	0.000	0	-64	0	-87	96	0	130	0
14	22.48	0.004	0.000	0	-41	0	-55	106	0	143	0
15	22.36	0.004	0.000	0	-28	0	-38	109	0	147	0
16	22.00	0.004	0.000	24	0	32	0	121	0	163	0
17	21.86	0.004	0.000	39	0	53	0	103	0	139	0
18	21.43	0.003	0.000	70	0	95	0	55	0	74	0
19	21.00	0.003	0.000	83	0	112	0	18	0	24	0
20	20.40	0.002	0.000	78	0	105	0	1	-21	2	-29
21	19.80	0.002	0.000	58	0	78	0	0	-38	0	-52
22	19.20	0.002	0.000	32	0	43	0	0	-40	0	-54
23	18.60	0.001	0.000	10	0	14	0	0	-27	0	-36
24	18.00	0.001	0.000	0	0	0	0	0	-0	0	-0

Summary of results (continued)

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

Maximum and minimum bending moment and shear force at each stage

Stage no.	Bending moment Calculated max. kN.m/m	elev.	Bending moment Calculated min. kN.m/m	elev.	Bending moment Factored max. kN.m/m	Bending moment Factored min. kN.m/m	Shear force Calculated max. kN/m	elev.	Shear force Calculated min. kN/m	elev.	Shear force Factored max. kN/m	Shear force Factored min. kN/m
1	7	21.00	-11	24.00	10	-15	12	22.00	-5	25.75	16	-7
2	No calculation at this stage											
3	25	21.00	-10	22.73	34	-13	36	22.00	-12	19.20	48	-16
4	No calculation at this stage											
5	76	21.00	-127	24.60	102	-172	121	22.00	-62	27.70	163	-84
6	No calculation at this stage											
7	79	21.00	-127	24.60	107	-171	120	22.00	-62	27.70	162	-84
8	No calculation at this stage											
9	83	21.00	-130	24.60	112	-175	117	22.00	-56	28.15	158	-75
10	No calculation at this stage											
11	No calculation at this stage											
12	No calculation at this stage											
13	No calculation at this stage											
14	28	20.40	-122	24.60	37	-165	96	22.73	-54	28.15	130	-73

Maximum and minimum displacement at each stage

Stage no.	Displacement maximum m	elev.	Displacement minimum m	elev.	Stage description
1	0.000	25.20	0.000	28.30	Apply surcharge no.3 at elev. 28.30
2	No calculation at this stage				Apply surcharge no.1 at elev. 28.30
3	0.003	28.30	0.000	28.30	Excav. to elev. 27.10 on PASSIVE side
4	No calculation at this stage				Install strut no.1 at elev. 27.70
5	0.006	25.75	0.000	28.30	Excav. to elev. 22.48 on PASSIVE side
6	No calculation at this stage				Install strut no.2 at elev. 22.73
7	0.006	25.75	0.000	28.30	Fill to elev. 23.01 on PASSIVE side
8	No calculation at this stage				Install strut no.3 at elev. 28.15
9	0.006	25.75	0.000	28.30	Remove strut no.1 at elev. 27.70
10	No calculation at this stage				Change soil type 9 to soil type 1
11	No calculation at this stage				Apply water pressure profile no.1
12	No calculation at this stage				Change soil type 3 to soil type 4
13	No calculation at this stage				Change soil type 6 to soil type 7
14	0.006	25.75	0.000	28.30	Apply surcharge no.2 at elev. 22.36

Strut forces at each stage (horizontal components)

Stage no.	Strut no. 1 at elev. 27.70 --Calculated-- kN per m run	Strut no. 1 at elev. 27.70 Factored kN per strut	Strut no. 1 at elev. 27.70 Factored kN per strut	Strut no. 2 at elev. 22.73 --Calculated-- kN per m run	Strut no. 2 at elev. 22.73 Factored kN per strut	Strut no. 2 at elev. 22.73 Factored kN per strut	Strut no. 3 at elev. 28.15 --Calculated-- kN per m run	Strut no. 3 at elev. 28.15 Factored kN per strut	Strut no. 3 at elev. 28.15 Factored kN per strut
5	63	508	685	---	---	---	---	---	---
7	63	508	686	slack	slack	slack	---	---	---
9	---	---	---	slack	slack	slack	56	56	76
14	---	---	---	70	70	95	54	54	74

* Indicates that the total force shown is the sum of the force in the strut plus a force applied at the same elevation which may represent temperature load or other forces which are part of the strut load. Force components are listed in the detailed results for individual stages.

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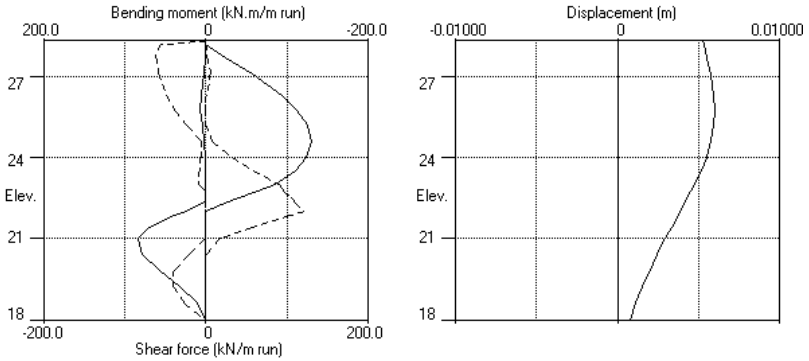
Data filename/Run ID: Section A1 Rev A_SLS |
Camley Street | Date:10-12-2015
Section A1 Adjacent to Sub Station Rev A | Checked :

Units: kN,m

Bending moment, shear force, displacement envelopes



GEOFIRMA LTD | Sheet No.
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Data filename/Run ID: Section A2 Rev A SLS |
Camley Street | Date:10-12-2015
Section A2 | Checked :

Units: kN,m

INPUT DATA

SOIL PROFILE

Stratum no.	Elevation of top of stratum	Soil types Active side	Passive side
1	28.30	8 Made Ground Init	8 Made Ground Init
2	24.00	3 London Cly Top Undr	3 London Cly Top Undr
3	22.00	6 London Cly bt Undr	6 London Cly bt Undr

SOIL PROPERTIES

No.	Soil type -- Description (Datum elev.)	Bulk density kN/m3	Young's Modulus Eh,kN/m2 (dEh/dy)	At rest coeff. Ko (dKo/dy)	Consol state. NC/OC (Nu)	Active limit Ka (Kac)	Passive limit Kp (Kpc)	Cohesion kN/m2 (dc/dy)
1	Made Ground	19.00	20000	0.577	OC (0.250)	0.390 (0.000)	2.561 (0.000)	
2	Gravels	19.00	60000	0.423	OC (0.300)	0.227 (0.000)	6.084 (0.000)	
3	London Cly Top Undr	19.00	40000	1.000	OC (0.490)	1.000 (2.000)	1.000 (2.000)	40.00u
4	London Cly Top dr	19.00	28000	1.000	OC (0.250)	0.422 (1.299)	2.371 (3.080)	3.000d
5	Concrete	24.00	400000	1.000	OC (0.490)	1.000 (2.000)	1.000 (2.000)	30000u
6	London Cl.. (24.00)	19.00	85000 (5178)	1.400	OC (0.490)	1.000 (2.476)	1.000 (2.390)	80.00u (5.180)
7	London Cl.. (24.00)	19.00	56000 (3626)	1.400	OC (0.250)	0.366 (1.423)	3.077 (4.665)	3.000d
8	Made Ground Init	19.00	20000	0.577	OC (0.250)	0.337 (0.000)	3.442 (0.000)	

Additional soil parameters associated with Ka and Kp

No.	Soil type ------- Description	--- parameters for Ka --- Soil friction angle	Wall adhesion coeff.	Back-fill angle	--- parameters for Kp --- Soil friction angle	Wall adhesion coeff.	Back-fill angle
1	Made Ground	26.00	0.000	0.00	26.00	0.000	0.00
2	Gravels	35.00	0.670	0.00	35.00	0.500	0.00
3	London Cly Top Undr	0.00	0.000	0.00	0.00	0.000	0.00
4	London Cly Top dr	24.00	0.000	0.00	24.00	0.000	0.00
5	Concrete	0.00	0.000	0.00	0.00	0.000	0.00
6	London Cly bt Undr	0.00	0.670	0.00	0.00	0.500	0.00
7	London Cly bt dr	24.00	0.670	0.00	24.00	0.500	0.00
8	Made Ground Init	26.00	0.670	0.00	26.00	0.500	0.00

GROUND WATER CONDITIONS

Density of water = 10.00 kN/m3

	Active side	Passive side
Initial water table elevation	26.30	21.86

Automatic water pressure balancing at toe of wall : Yes

Water press. profile no.	Active side Point no.	Elev. m	Piezo elev. m	Water press. kN/m2	Passive side Point no.	Elev. m	Piezo elev. m	Water press. kN/m2	
1	1	26.30	26.30	0.0	1	22.36	22.36	0.0	MC+WC
					2	22.36	26.30	39.4	

WALL PROPERTIES

Type of structure = Fully Embedded Wall
Elevation of toe of wall = 18.00
Maximum finite element length = 0.60 m
Youngs modulus of wall E = 1.9600E+07 kN/m2
Moment of inertia of wall I = 0.017260 m4/m run
E.I = 338296 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	27.70	8.00	0.010000	2.000E+08	10.00	0.00	0	No
2	23.44	1.00	0.300000	1.400E+07	10.00	0.00	0	No
3	28.15	1.00	0.300000	1.400E+07	10.00	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	28.30	0.50(A)	100.00	1.95	5.00	=	N/A	1.00 Var
2	22.36	-0.00(P)	30.00	20.00	40.00	=	N/A	1.00 P/U
3	28.30	2.45(A)	10.00	10.00	40.00	=	N/A	1.00 -

Note: A = Active side, P = Passive 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.3 at elevation 28.30
	No analysis at this stage
2	Apply surcharge no.1 at elevation 28.30
	No analysis at this stage
3	Excavate to elevation 27.10 on PASSIVE side
	Toe of berm at elevation 23.18
	Width of top of berm = 2.00
	Width of toe of berm = 5.92
4	Install strut or anchor no.1 at elevation 27.70
5	Excavate to elevation 23.18 on PASSIVE side
6	Install strut or anchor no.2 at elevation 23.44
7	Fill to elevation 23.71 on PASSIVE side with soil type 5
8	Install strut or anchor no.3 at elevation 28.15
9	Remove strut or anchor no.1 at elevation 27.70
10	Change properties of soil type 9 to soil type 1
	No analysis at this stage
	Ko pressures will not be reset
11	Apply water pressure profile no.1 (Mod. Conserv.)
	No analysis at this stage
12	Change properties of soil type 3 to soil type 4
	No analysis at this stage
	Ko pressures will not be reset
13	Change properties of soil type 6 to soil type 7
	No analysis at this stage
	Ko pressures will not be reset
14	Apply surcharge no.2 at elevation 22.36

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 = 1.50

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) = 0 m

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

Width of excavation on active side of wall = 20.00 m
Width of excavation on passive side of wall = 20.00 m

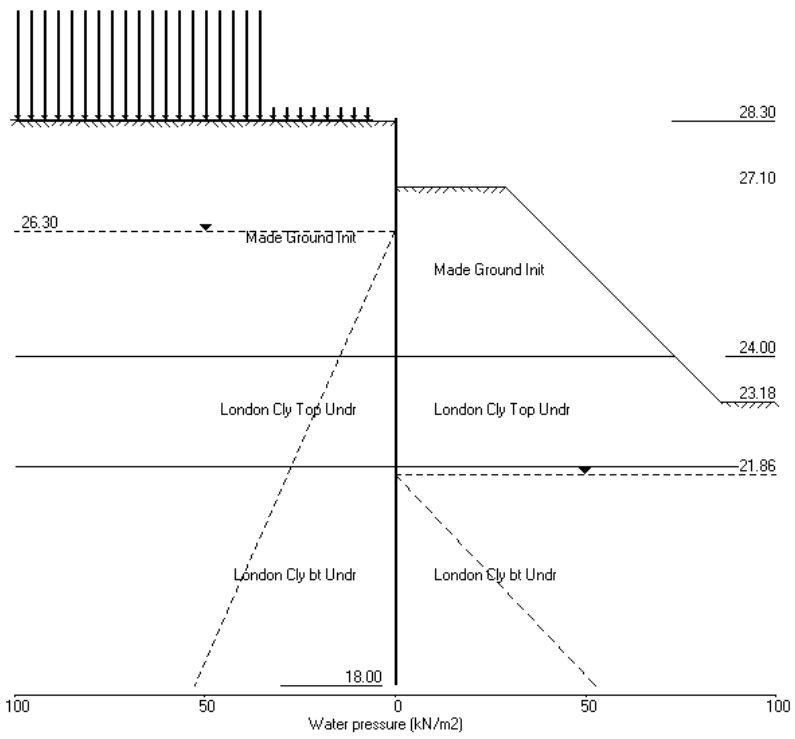
Distance to rigid boundary on active side = 20.00 m
Distance to rigid boundary on passive side = 20.00 m

OUTPUT OPTIONS

Stage no.	Stage description	Output options: Displacement, Bending mom., Shear force	Active, Passive pressures	Graph. output
1	Apply surcharge no.3 at elev. 28.30	No	No	No
2	Apply surcharge no.1 at elev. 28.30	No	No	No
3	Excav. to elev. 27.10 on PASSIVE side	No	No	No
4	Install strut no.1 at elev. 27.70	No	No	No
5	Excav. to elev. 23.18 on PASSIVE side	No	No	No
6	Install strut no.2 at elev. 23.44	No	No	No
7	Fill to elev. 23.71 on PASSIVE side	No	No	No
8	Install strut no.3 at elev. 28.15	No	No	No
9	Remove strut no.1 at elev. 27.70	No	No	No
10	Change soil type 9 to soil type 1	No	No	No
11	Apply water pressure profile no.1	No	No	No
12	Change soil type 3 to soil type 4	No	No	No
13	Change soil type 6 to soil type 7	No	No	No
14	Apply surcharge no.2 at elev. 22.36	No	No	No
*	Summary output	Yes	-	Yes

Units: kN,m

Stage No.3 Excav. to elev. 27.10 on PASSIVE side



Units: kN,m

Stage No. 3 Excavate to elevation 27.10 on PASSIVE side
Toe of berm at elevation 23.18
Width of top of berm = 2.00
Width of toe of berm = 5.92

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

Stage No.	--- G.L. --- Act.	Pass.	Strut Elev.	FoS for toe elev. = 18.00 Factor of Safety	Moment equilib. at elev.	Toe elev. for FoS = 1.500 Toe elev.	Wall Penetr -ation
3	28.30	27.10	Cant.	2.172	19.25	20.70	6.40

BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall
Analysis options
Length of wall perpendicular to section = 20.00m
Subgrade reaction model - Boussinesq Influence coefficients
Soil deformations are elastic until the active or passive limit is reached
Open Tension Crack analysis - No

Rigid boundaries: Active side 20.00 from wall
Passive 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.

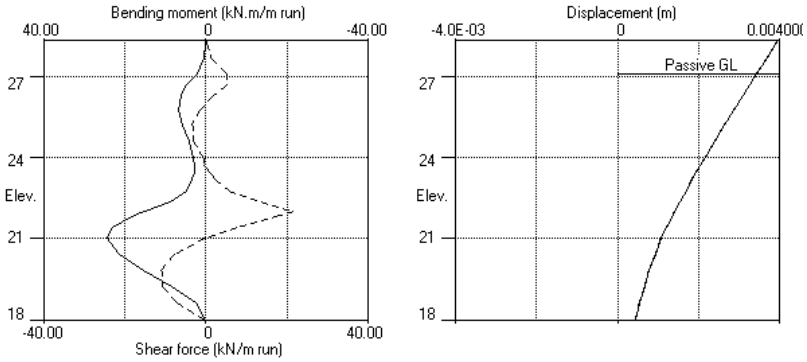
Node no.	Y coord	Nett pressure kN/m2	Wall disp. m	Wall rotation rad.	Shear force kN/m	Bending moment kN.m/m	Strut forces kN/m
1	28.30	0.00	0.004	4.34E-04	0.0	-0.0	
2	28.15	0.98	0.004	4.34E-04	0.1	0.0	
3	27.70	4.31	0.004	4.33E-04	1.3	0.3	
4	27.10	8.97	0.003	4.31E-04	5.2	2.1	
5	26.70	-8.68	0.003	4.27E-04	5.3	4.7	
6	26.30	-9.30	0.003	4.21E-04	1.7	6.1	
		-5.96	0.003	4.21E-04	1.7	6.1	
7	25.75	-5.97	0.003	4.10E-04	-1.6	6.9	
		-4.14	0.003	4.10E-04	-1.6	6.9	
8	25.20	-2.27	0.003	4.00E-04	-3.3	5.8	
		-0.91	0.003	4.00E-04	-3.3	5.8	
9	24.60	1.55	0.002	3.91E-04	-3.1	4.1	
		2.55	0.002	3.91E-04	-3.1	4.1	
10	24.00	5.15	0.002	3.85E-04	-0.8	3.1	
		0.59	0.002	3.85E-04	-0.8	3.1	
11	23.71	2.94	0.002	3.82E-04	-0.3	2.9	
12	23.44	5.02	0.002	3.80E-04	0.8	2.9	
13	23.18	6.93	0.002	3.77E-04	2.3	3.3	
14	22.77	9.77	0.002	3.72E-04	5.7	4.8	
		17.42	0.002	3.72E-04	5.7	4.8	
15	22.36	22.27	0.002	3.64E-04	13.9	8.8	
		19.05	0.002	3.64E-04	13.9	8.8	
16	22.00	23.05	0.001	3.51E-04	21.4	15.0	
		-27.72	0.001	3.51E-04	21.4	15.0	
17	21.86	-26.57	0.001	3.45E-04	17.6	17.8	
18	21.43	-20.87	0.001	3.19E-04	7.4	22.9	
19	21.00	-15.50	0.001	2.89E-04	-0.4	24.2	

(continued)

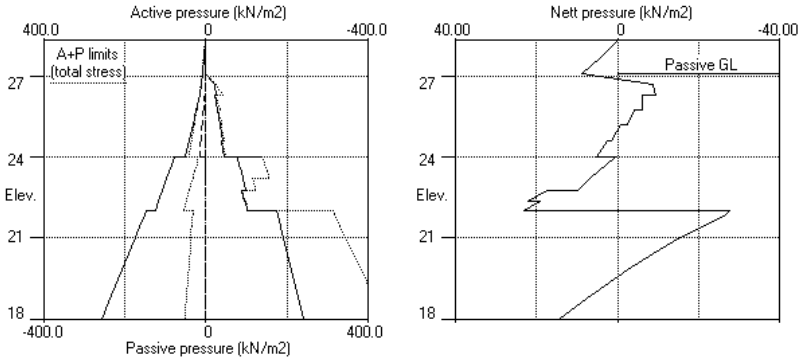
Stage No.3 Excavate to elevation 27.10 on PASSIVE side
Toe of berm at elevation 23.18
Width of top of berm = 2.00
Width of toe of berm = 5.92

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
20	20.40	-8.66	0.001	2.48E-04	-7.6	21.3	
21	19.80	-2.46	0.001	2.16E-04	-11.0	15.3	
22	19.20	3.29	0.001	1.95E-04	-10.7	8.3	
23	18.60	8.90	0.001	1.85E-04	-7.1	2.6	
24	18.00	14.60	0.000	1.83E-04	-0.0	-0.0	

Stage No.3 Excav. to elev. 27.10 on PASSIVE side



Stage No.3 Excav. to elev. 27.10 on PASSIVE side



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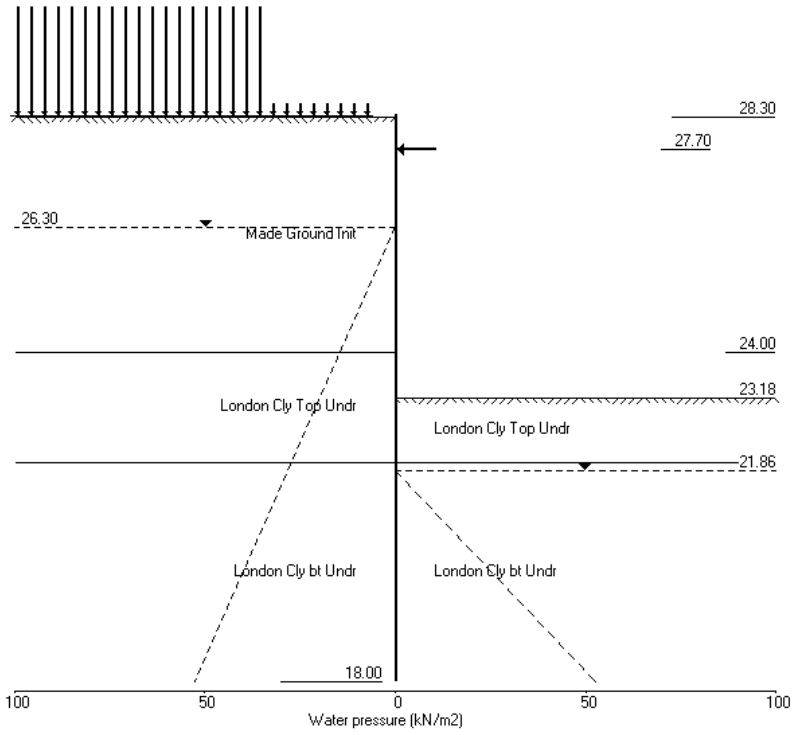
Camley Street | Date:10-12-2015
Section A2 | Checked :
Units: kN,m

Stage No.5 Excav. to elev. 23.18 on PASSIVE side



Units: kN,m

Stage No. 5 Excavate to elevation 23.18 on PASSIVE side

STABILITY ANALYSIS of Fully Embedded Wall according to Strength Factor method

Factor of safety on soil strength

Stage No.	--- G.L. --- Act.	Pass.	Strut Elev.	FoS for toe elev. = 18.00 Factor of Safety	Moment equilib. at elev.	Toe elev. for FoS = 1.500 Toe elev.	Wall Penetr -ation
5	28.30	23.18	27.70	3.401	n/a	21.45	1.73

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: Active side 20.00 from wall
Passive 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.

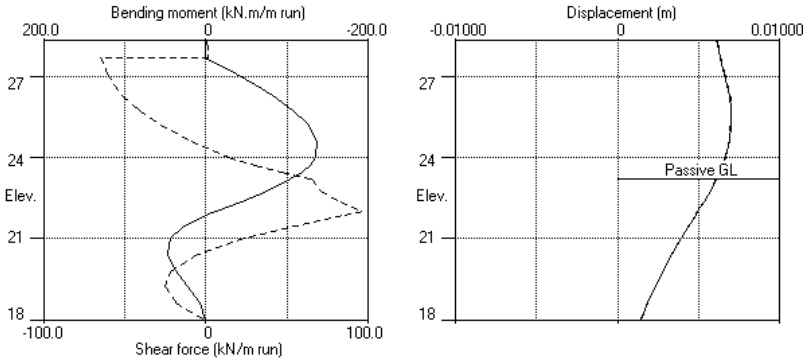
Node no.	Y coord	Nett pressure kN/m2	Wall disp. m	Wall rotation rad.	Shear force kN/m	Bending moment kN.m/m	Strut forces kN/m
1	28.30	0.00	0.006	-4.56E-04	0.0	-0.0	
2	28.15	0.98	0.006	-4.56E-04	0.1	0.0	
3	27.70	4.31	0.006	-4.56E-04	1.3	0.3	66.4
		4.31	0.006	-4.56E-04	-65.2	0.3	
4	27.10	8.97	0.007	-4.23E-04	-61.2	-37.7	
5	26.70	12.10	0.007	-3.65E-04	-57.0	-61.1	
6	26.30	15.25	0.007	-2.80E-04	-51.5	-82.9	
7	25.75	21.86	0.007	-1.25E-04	-41.3	-107.8	
8	25.20	28.37	0.007	6.54E-05	-27.5	-126.6	
9	24.60	35.31	0.007	2.99E-04	-8.4	-137.2	
10	24.00	42.10	0.007	5.41E-04	14.9	-135.2	
		51.30	0.007	5.41E-04	14.9	-135.2	
11	23.71	58.55	0.006	6.54E-04	30.8	-128.7	
12	23.44	65.39	0.006	7.52E-04	47.5	-118.2	
13	23.18	72.04	0.006	8.37E-04	65.4	-103.6	
		11.32	0.006	8.37E-04	65.4	-103.6	
14	22.77	17.55	0.006	9.46E-04	71.3	-75.8	
		25.21	0.006	9.46E-04	71.3	-75.8	
15	22.36	34.09	0.005	1.01E-03	83.5	-44.4	
		30.86	0.005	1.01E-03	83.5	-44.4	
16	22.00	38.75	0.005	1.04E-03	96.0	-12.3	
		-89.50	0.005	1.04E-03	96.0	-12.3	
17	21.86	-85.62	0.005	1.05E-03	83.7	0.3	
18	21.43	-71.00	0.004	1.03E-03	50.1	28.4	
19	21.00	-56.27	0.004	9.88E-04	22.7	43.4	
20	20.40	-36.16	0.003	9.08E-04	-5.0	47.0	
21	19.80	-16.80	0.003	8.33E-04	-20.9	37.5	
22	19.20	2.05	0.002	7.80E-04	-25.4	22.0	
23	18.60	20.97	0.002	7.54E-04	-18.5	7.2	
24	18.00	40.54	0.001	7.47E-04	0.0	0.0	

At elev. 27.70 Strut force = 531.4 kN/strut = 66.4 kN/m run

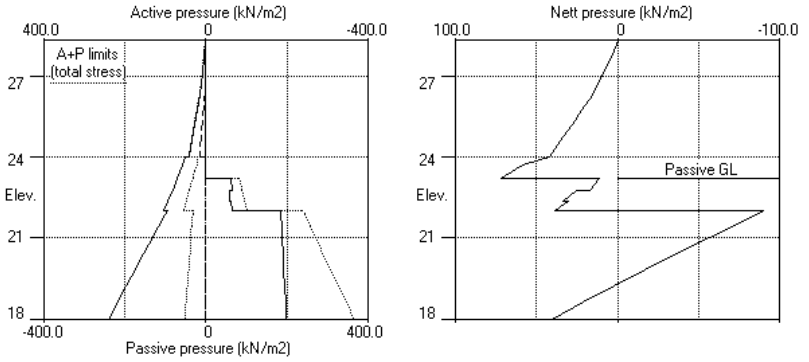
(continued)

Stage No.5 Excavate to elevation 23.18 on PASSIVE side

Stage No.5 Excav. to elev. 23.18 on PASSIVE side



Stage No.5 Excav. to elev. 23.18 on PASSIVE side



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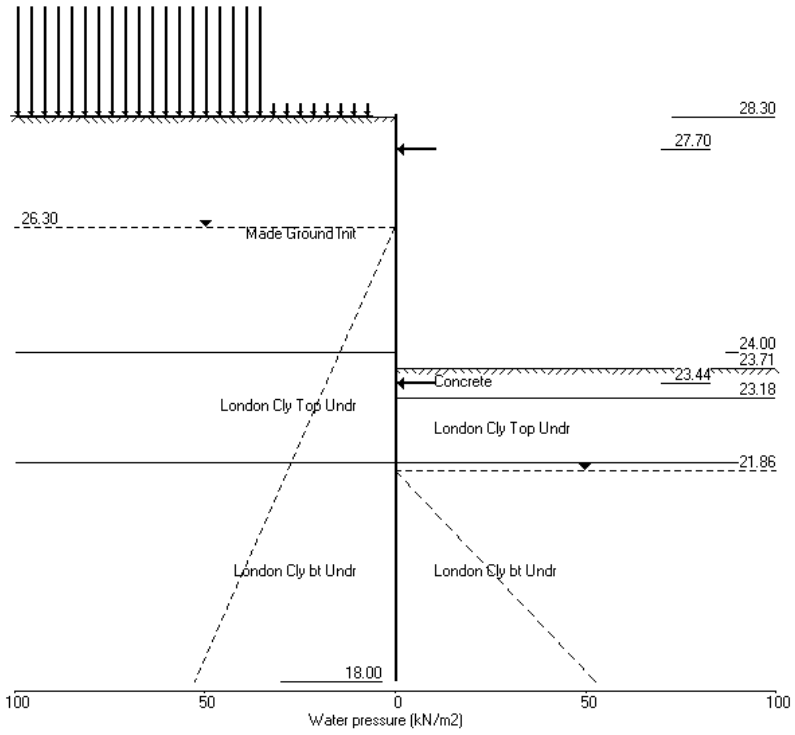
Units: kN,m

Stage No.7 Fill to elev. 23.71 on PASSIVE side



Units: kN,m

Stage No. 7 Fill to elevation 23.71 on PASSIVE side with soil type 5

STABILITY ANALYSIS of Fully Embedded Wall according to Strength Factor method

Factor of safety on soil strength

Stage No.	--- G.L. --- Act.	Pass.	Strut Elev.	FoS for toe elev. = 18.00 Factor of Safety	Moment equilib. at elev.	Toe elev. for FoS = 1.500 Toe elev.	Wall Penetr -ation
7	28.30	23.71		More than one strut			

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: Active side 20.00 from wall
Passive 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
1	28.30	0.00	0.006	-3.68E-04	0.0	-0.0	
2	28.15	0.98	0.006	-3.68E-04	0.1	0.0	
3	27.70	4.41	0.006	-3.68E-04	1.3	0.3	65.4
		4.41	0.006	-3.68E-04	-64.1	0.3	
4	27.10	9.19	0.007	-3.35E-04	-60.0	-37.1	
5	26.70	12.40	0.007	-2.78E-04	-55.7	-60.0	
6	26.30	15.62	0.007	-1.94E-04	-50.1	-81.2	
7	25.75	22.34	0.007	-4.31E-05	-39.7	-105.3	
8	25.20	28.95	0.007	1.42E-04	-25.5	-123.1	
9	24.60	36.00	0.007	3.69E-04	-6.1	-132.5	
10	24.00	42.87	0.006	6.01E-04	17.6	-129.0	
		53.35	0.006	6.01E-04	17.6	-129.0	
11	23.71	60.71	0.006	7.08E-04	34.1	-121.6	
12	23.44	66.28	0.006	8.01E-04	51.3	-110.1	-0.0
13	23.18	71.70	0.006	8.79E-04	69.2	-94.5	
		4.11	0.006	8.79E-04	69.2	-94.5	
14	22.77	10.54	0.005	9.76E-04	72.2	-65.8	
		18.19	0.005	9.76E-04	72.2	-65.8	
15	22.36	27.19	0.005	1.03E-03	81.5	-34.5	
		23.97	0.005	1.03E-03	81.5	-34.5	
16	22.00	31.92	0.005	1.05E-03	91.6	-3.6	
		-88.87	0.005	1.05E-03	91.6	-3.6	
17	21.86	-84.87	0.004	1.05E-03	79.4	8.4	
18	21.43	-69.95	0.004	1.02E-03	46.1	34.7	
19	21.00	-55.05	0.004	9.76E-04	19.3	48.1	
20	20.40	-34.85	0.003	8.89E-04	-7.7	49.9	
21	19.80	-15.52	0.002	8.10E-04	-22.8	39.0	
22	19.20	3.21	0.002	7.56E-04	-26.5	22.6	
23	18.60	21.94	0.002	7.29E-04	-19.0	7.4	
24	18.00	41.29	0.001	7.23E-04	0.0	0.0	

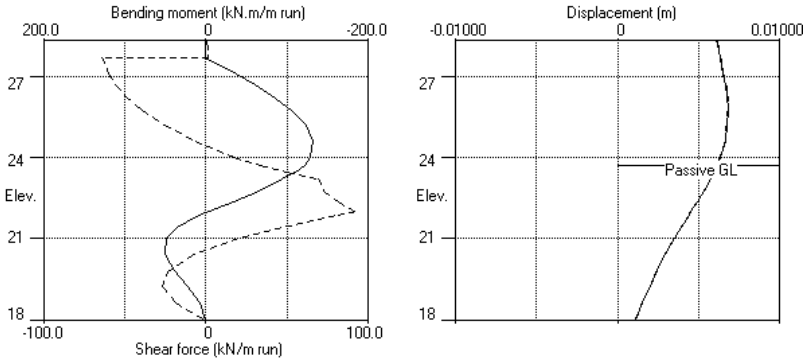
At elev. 27.70 Strut force = 523.0 kN/strut = 65.4 kN/m run

At elev. 23.44 The strut is slack

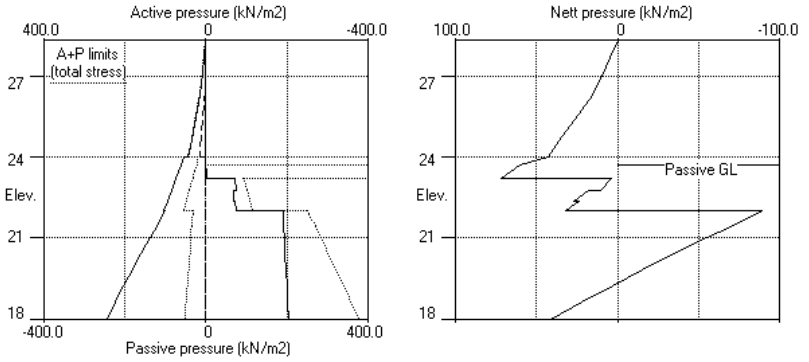
(continued)

Stage No.7 Fill to elevation 23.71 on PASSIVE side with soil type 5

Stage No.7 Fill to elev. 23.71 on PASSIVE side



Stage No.7 Fill to elev. 23.71 on PASSIVE side



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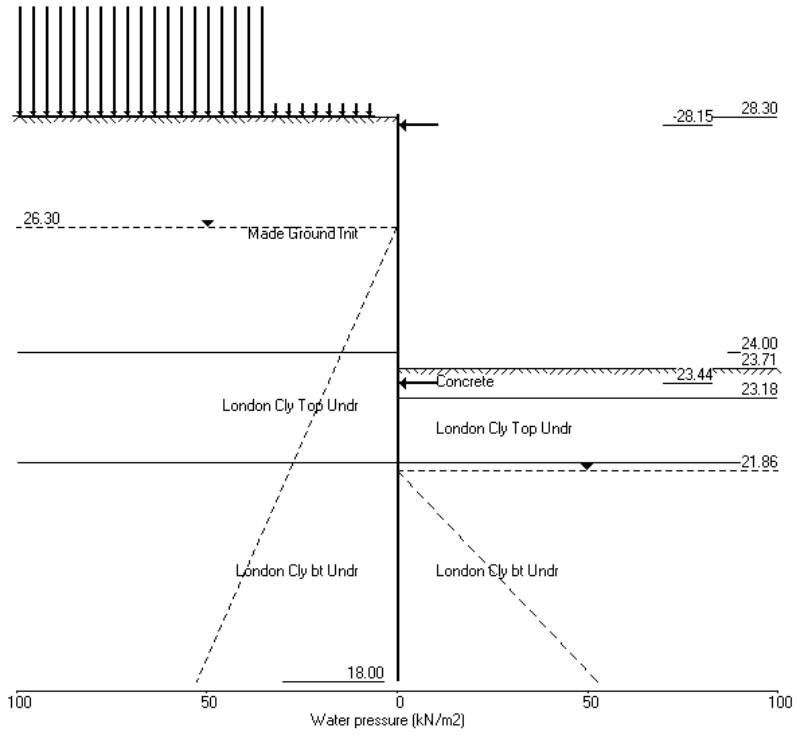
Units: kN,m

Stage No.9 Remove strut no.1 at elev. 27.70



Units: kN,m

Stage No. 9 Remove strut or anchor no.1 at elevation 27.70

STABILITY ANALYSIS of Fully Embedded Wall according to Strength Factor method

Factor of safety on soil strength

Stage No.	--- G.L. --- Act.	Pass.	Strut Elev.	FoS for toe elev. = 18.00 Factor of Safety	Moment equilib. at elev.	Toe elev. for FoS = 1.500 Toe elev.	Wall Penetr -ation
9	28.30	23.71		More than one strut			

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: Active side 20.00 from wall
Passive 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
1	28.30	0.00	0.006	-4.46E-04	0.0	-0.0	
2	28.15	0.98	0.006	-4.46E-04	0.1	0.0	56.9
		0.98	0.006	-4.46E-04	-56.9	0.0	
3	27.70	4.31	0.006	-4.30E-04	-55.7	-25.3	
4	27.10	8.97	0.007	-3.56E-04	-51.7	-57.7	
5	26.70	12.10	0.007	-2.76E-04	-47.5	-77.3	
6	26.30	15.25	0.007	-1.74E-04	-42.0	-95.3	
7	25.75	21.86	0.007	-3.71E-06	-31.8	-115.0	
8	25.20	28.46	0.007	1.94E-04	-18.0	-128.5	
9	24.60	35.61	0.007	4.26E-04	1.3	-133.4	
10	24.00	42.60	0.006	6.56E-04	24.7	-125.6	
		52.64	0.006	6.56E-04	24.7	-125.6	
11	23.71	60.13	0.006	7.59E-04	41.1	-116.1	
		42.52	0.006	7.59E-04	41.1	-116.1	
12	23.44	51.65	0.006	8.47E-04	53.8	-103.5	-0.0
13	23.18	60.15	0.006	9.20E-04	68.3	-87.7	
		2.63	0.006	9.20E-04	68.3	-87.7	
14	22.77	9.58	0.005	1.01E-03	70.8	-59.5	
		17.23	0.005	1.01E-03	70.8	-59.5	
15	22.36	26.66	0.005	1.06E-03	79.8	-28.9	
		23.43	0.005	1.06E-03	79.8	-28.9	
16	22.00	31.67	0.005	1.07E-03	89.7	1.4	
		-89.46	0.005	1.07E-03	89.7	1.4	
17	21.86	-85.24	0.004	1.07E-03	77.5	13.1	
18	21.43	-69.83	0.004	1.04E-03	44.2	38.6	
19	21.00	-54.70	0.004	9.85E-04	17.4	51.2	
20	20.40	-34.29	0.003	8.93E-04	-9.3	51.8	
21	19.80	-14.87	0.002	8.12E-04	-24.1	40.2	
22	19.20	3.90	0.002	7.56E-04	-27.3	23.1	
23	18.60	22.63	0.002	7.28E-04	-19.4	7.5	

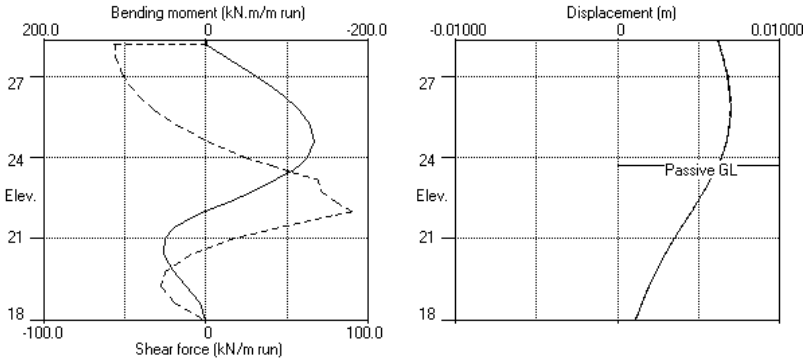
(continued)

Stage No.9 Remove strut or anchor no.1 at elevation 27.70

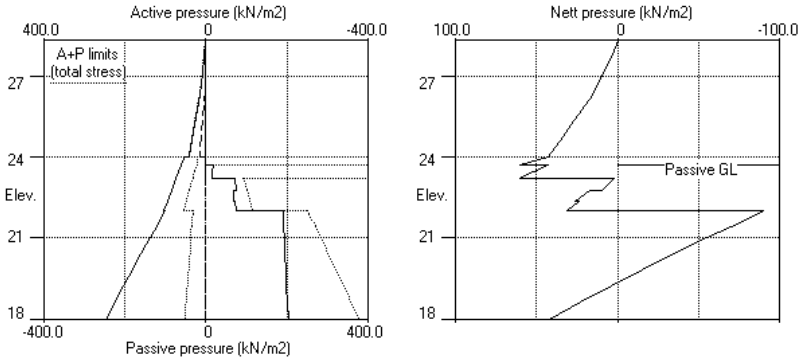
Node no.	Y coord	Nett pressure kN/m2	Wall disp. m	Wall rotation rad.	Shear force kN/m	Bending moment kN.m/m	Strut forces kN/m
24	18.00	41.98	0.001	7.22E-04	0.0	0.0	
At elev. 28.15 Strut force =			56.9 kN/strut =			56.9 kN/m run	
At elev. 23.44 The strut is slack							

Units: kN,m

Stage No.9 Remove strut no.1 at elev. 27.70



Stage No.9 Remove strut no.1 at elev. 27.70



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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 No.	--- G.L. --- Act.	Pass.	Strut Elev.	FoS for toe elev. = 18.00 Factor of Safety	Moment equilib. at elev.	Toe elev. for FoS = 1.500 Toe elev.	Wall Penetration
1	28.30	28.30	Cant.	Conditions not suitable for FoS calc.			
2	28.30	28.30		No analysis at this stage			
3	28.30	27.10	Cant.	2.172	19.25	20.70	6.40
4	28.30	27.10		No analysis at this stage			
5	28.30	23.18	27.70	3.401	n/a	21.45	1.73
6	28.30	23.18		No analysis at this stage			

All remaining stages have more than one strut - FoS calculation n/a

Units: kN,m

Summary of results

BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall

Analysis options

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

Rigid boundaries: Active side 20.00 from wall
Passive 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 max.	Displacement min.	Bending moment Calculated max.	Bending moment Calculated min.	Bending moment Factored max.	Bending moment Factored min.	Shear force Calculated max.	Shear force Calculated min.	Shear force Factored max.	Shear force Factored min.
	m	m	m	kN.m/m	kN.m/m	kN.m/m	kN.m/m	kN/m	kN/m	kN/m	kN/m
1	28.30	0.006	0.000	0	-0	0	-0	0	0	0	0
2	28.15	0.006	0.000	0	-0	0	-0	0	-61	0	-82
3	27.70	0.007	0.000	0	-27	0	-37	1	-65	2	-88
4	27.10	0.007	0.000	2	-62	3	-84	5	-61	7	-83
5	26.70	0.007	0.000	5	-83	6	-113	5	-57	7	-77
6	26.30	0.007	0.000	6	-103	8	-139	2	-51	2	-70
7	25.75	0.007	0.000	7	-125	9	-169	0	-41	0	-56
8	25.20	0.007	0.000	6	-140	8	-189	0	-27	0	-37
9	24.60	0.007	0.000	4	-146	6	-198	1	-8	2	-11
10	24.00	0.007	0.000	3	-138	4	-187	27	-1	36	-1
11	23.71	0.007	0.000	3	-129	4	-174	44	-0	60	-0
12	23.44	0.006	0.000	3	-118	4	-160	54	0	73	0
13	23.18	0.006	0.000	3	-104	4	-140	69	0	93	0
14	22.77	0.006	0.000	5	-79	7	-107	72	0	97	0
15	22.36	0.005	0.000	9	-49	12	-66	83	0	113	0
16	22.00	0.005	0.000	15	-20	20	-27	96	0	130	0
17	21.86	0.005	0.000	18	-10	24	-13	84	0	113	0
18	21.43	0.004	0.000	39	0	52	0	52	0	71	0
19	21.00	0.004	0.000	51	0	69	0	33	-0	45	-1
20	20.40	0.003	0.000	52	0	70	0	7	-9	10	-13
21	19.80	0.003	0.000	41	0	56	0	0	-24	0	-32
22	19.20	0.002	0.000	26	0	35	0	0	-27	0	-37
23	18.60	0.002	0.000	9	0	12	0	0	-22	0	-30
24	18.00	0.001	0.000	0	-0	0	-0	0	-0	0	-0

Summary of results (continued)

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

Maximum and minimum bending moment and shear force at each stage

Stage no.	Bending moment Calculated max.	elev.	Bending moment Calculated min.	elev.	Bending moment Factored max.	Bending moment Factored min.	Shear force Calculated max.	elev.	Shear force Calculated min.	elev.	Shear force Factored max.	Shear force Factored min.
	kN.m/m		kN.m/m		kN.m/m		kN/m		kN/m		kN/m	kN/m
1	7	20.40	-13	24.00	9	-18	13	22.00	-5	25.75	17	-7
2	No calculation at this stage											
3	24	21.00	-0	28.30	33	-0	21	22.00	-11	19.80	29	-15
4	No calculation at this stage											
5	47	20.40	-137	24.60	63	-185	96	22.00	-65	27.70	130	-88
6	No calculation at this stage											
7	50	20.40	-133	24.60	67	-179	92	22.00	-64	27.70	124	-87
8	No calculation at this stage											
9	52	20.40	-133	24.60	70	-180	90	22.00	-57	28.15	121	-77
10	No calculation at this stage											
11	No calculation at this stage											
12	No calculation at this stage											
13	No calculation at this stage											
14	45	20.40	-146	24.60	61	-198	81	22.36	-61	28.15	109	-82

Maximum and minimum displacement at each stage

Stage no.	Displacement maximum	elev.	Displacement minimum	elev.	Stage description
	m		m		
1	0.001	25.75	0.000	28.30	Apply surcharge no.3 at elev. 28.30
2	No calculation at this stage				Apply surcharge no.1 at elev. 28.30
3	0.004	28.30	0.000	28.30	Excav. to elev. 27.10 on PASSIVE side
4	No calculation at this stage				Install strut no.1 at elev. 27.70
5	0.007	25.20	0.000	28.30	Excav. to elev. 23.18 on PASSIVE side
6	No calculation at this stage				Install strut no.2 at elev. 23.44
7	0.007	25.75	0.000	28.30	Fill to elev. 23.71 on PASSIVE side
8	No calculation at this stage				Install strut no.3 at elev. 28.15
9	0.007	25.75	0.000	28.30	Remove strut no.1 at elev. 27.70
10	No calculation at this stage				Change soil type 9 to soil type 1
11	No calculation at this stage				Apply water pressure profile no.1
12	No calculation at this stage				Change soil type 3 to soil type 4
13	No calculation at this stage				Change soil type 6 to soil type 7
14	0.007	25.75	0.000	28.30	Apply surcharge no.2 at elev. 22.36

Strut forces at each stage (horizontal components)

Stage no.	Strut no. 1 at elev. 27.70 --Calculated-- kN per m run	Strut no. 1 Calculated kN per strut	Strut no. 1 Factored kN per strut	Strut no. 2 at elev. 23.44 --Calculated-- kN per m run	Strut no. 2 Calculated kN per strut	Strut no. 2 Factored kN per strut	Strut no. 3 at elev. 28.15 --Calculated-- kN per m run	Strut no. 3 Calculated kN per strut	Strut no. 3 Factored kN per strut
5	66	531	717	---	---	---	---	---	---
7	65	523	706	slack	slack	slack	---	---	---
9	---	---	---	slack	slack	slack	57	57	77
14	---	---	---	3	3	5	61	61	83

* Indicates that the total force shown is the sum of the force in the strut plus a force applied at the same elevation which may represent temperature load or other forces which are part of the strut load. Force components are listed in the detailed results for individual stages.

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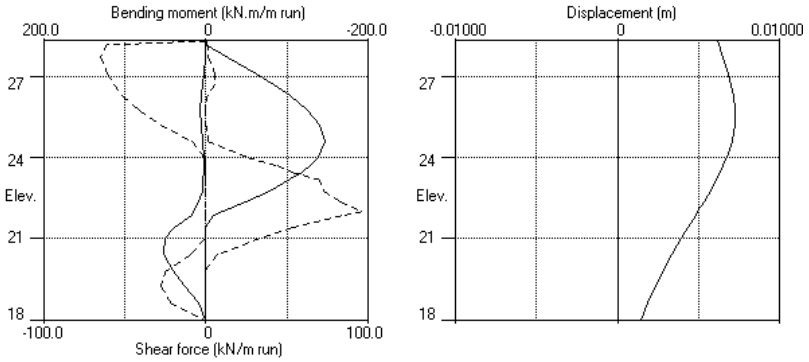
Units: kN,m

Bending moment, shear force, displacement envelopes



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Camley Street | Date: 5-10-2015
Wall B | Checked :

Units: kN,m

INPUT DATA

SOIL PROFILE

Stratum no.	Elevation of top of stratum	Soil types Active side	Passive side
1	27.65	8 Made Ground	8 Made Ground
2	24.00	3 London Cly Top Undr	3 London Cly Top Undr
3	22.00	6 London Cly bt Undr	6 London Cly bt Undr

SOIL PROPERTIES

-- Soil type -- No.	Description (Datum elev.)	Bulk density kN/m3	Young's Modulus Eh,kN/m2 (dEh/dy)	At rest coeff. Ko (dKo/dy)	Consol state. NC/OC (Nu)	Active limit Ka (Kac)	Passive limit Kp (Kpc)	Cohesion kN/m2 (dc/dy)
1	Made Ground	19.00	20000	0.577	OC	0.390	2.561	
					(0.250)	(0.000)	(0.000)	
2	Gravels	19.00	60000	0.423	OC	0.227	6.084	
					(0.300)	(0.000)	(0.000)	
3	London Cly Top Undr	19.00	40000	1.000	OC	1.000	1.000	40.00u
					(0.490)	(2.000)	(2.000)	
4	London Cly Top dr	19.00	28000	1.000	OC	0.422	2.371	3.000d
					(0.250)	(1.299)	(3.080)	
5	Concrete	24.00	400000	1.000	OC	1.000	1.000	30000u
					(0.490)	(2.000)	(2.000)	
6	London Cl..	19.00	85000	1.400	OC	1.000	1.000	80.00u
	(24.00)		(5178)		(0.490)	(2.476)	(2.390)	(5.180)
7	London Cl..	19.00	56000	1.400	OC	0.366	3.077	3.000d
	(24.00)		(3626)		(0.250)	(1.423)	(4.665)	
8	Made Ground	19.00	20000	0.577	OC	0.337	3.442	
					(0.250)	(0.000)	(0.000)	

Additional soil parameters associated with Ka and Kp

------- Soil type ------- No.	Description	--- parameters for Ka --- Soil friction angle	Wall adhesion coeff.	Back-fill angle	--- parameters for Kp --- Soil friction angle	Wall adhesion coeff.	Back-fill angle
1	Made Ground	26.00	0.000	0.00	26.00	0.000	0.00
2	Gravels	35.00	0.670	0.00	35.00	0.500	0.00
3	London Cly Top Undr	0.00	0.000	0.00	0.00	0.000	0.00
4	London Cly Top dr	24.00	0.000	0.00	24.00	0.000	0.00
5	Concrete	0.00	0.000	0.00	0.00	0.000	0.00
6	London Cly bt Undr	0.00	0.670	0.00	0.00	0.500	0.00
7	London Cly bt dr	24.00	0.670	0.00	24.00	0.500	0.00
8	Made Ground	26.00	0.670	0.00	26.00	0.500	0.00

GROUND WATER CONDITIONS

Density of water = 10.00 kN/m3

	Active side	Passive side
Initial water table elevation	25.00	21.86

Automatic water pressure balancing at toe of wall : Yes

Water press. profile no.	Point no.	Active side Elev. m	Piezo elev. m	Water press. kN/m2	Point no.	Passive side Elev. m	Piezo elev. m	Water press. kN/m2	
1	1	26.00	26.00	0.0	1	22.36	22.36	0.0	MC+WC
					2	22.36	26.00	36.4	

WALL PROPERTIES

Type of structure = Fully Embedded Wall
Elevation of toe of wall = 15.00
Maximum finite element length = 0.80 m
Youngs modulus of wall E = 1.4000E+07 kN/m2
Moment of inertia of wall I = 0.017260 m4/m run
E.I = 241640 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	26.60	5.00	0.010000	2.000E+08	10.00	0.00	0	No
2	22.73	1.00	0.300000	1.400E+07	10.00	0.00	0	No
3	27.50	1.00	0.300000	1.400E+07	10.00	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	27.65	0.50(A)	100.00	20.00	10.00	=	N/A	1.00 Var
2	22.36	-0.00(P)	30.00	20.00	40.00	=	N/A	1.00 P/U
3	27.65	0.50(A)	100.00	20.00	7.00	=	N/A	1.00 P/U
4	28.00	0.50(A)	100.00	20.00	20.00	=	N/A	1.00 Var

Note: A = Active side, P = Passive 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 27.65
	No analysis at this stage
2	Apply surcharge no.3 at elevation 27.65
	No analysis at this stage
3	Excavate to elevation 22.36 on PASSIVE side
4	Install strut or anchor no.2 at elevation 22.73
5	Fill to elevation 22.89 on PASSIVE side with soil type 6
6	Remove surcharge no.1 at elevation 27.65
	No analysis at this stage
7	Remove surcharge no.3 at elevation 27.65
	No analysis at this stage
8	Fill to elevation 28.00 on ACTIVE side with soil type 1
9	Apply surcharge no.4 at elevation 28.00
	No analysis at this stage
10	Install strut or anchor no.3 at elevation 27.50
11	Change properties of soil type 8 to soil type 1
	No analysis at this stage
	Ko pressures will not be reset
12	Apply water pressure profile no.1 (Mod. Conserv.)
	No analysis at this stage
13	Change properties of soil type 3 to soil type 4
	No analysis at this stage
	Ko pressures will not be reset
14	Change properties of soil type 6 to soil type 7
	No analysis at this stage
	Ko pressures will not be reset
15	Apply surcharge no.2 at elevation 22.36

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 = 1.50

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) = 0 m

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

Width of excavation on active side of wall = 20.00 m
Width of excavation on passive side of wall = 20.00 m

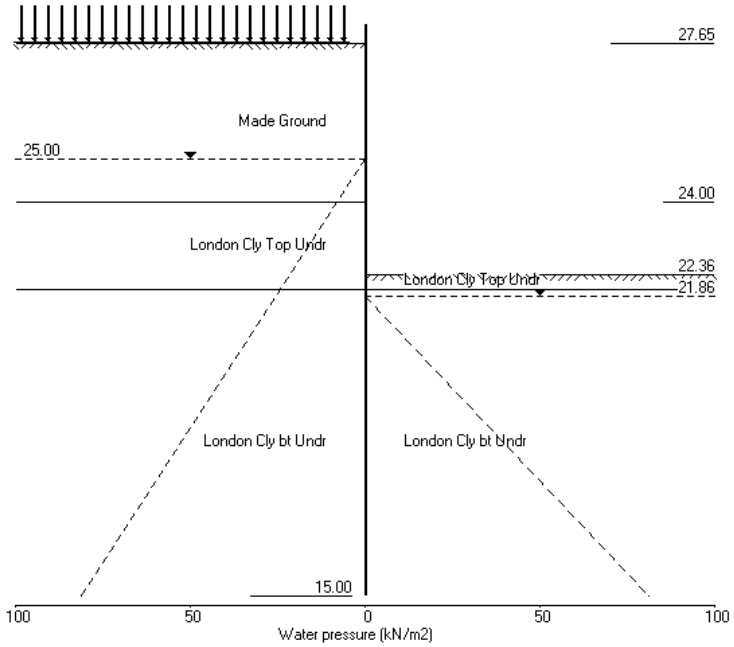
Distance to rigid boundary on active side = 20.00 m
Distance to rigid boundary on passive side = 20.00 m

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. 27.65	No	No	No
2	Apply surcharge no.3 at elev. 27.65	No	No	No
3	Excav. to elev. 22.36 on PASSIVE side	No	No	No
4	Install strut no.2 at elev. 22.73	No	No	No
5	Fill to elev. 22.89 on PASSIVE side	No	No	No
6	Remove surcharge no.1 at elev. 27.65	No	No	No
7	Remove surcharge no.3 at elev. 27.65	No	No	No
8	Fill to elev. 28.00 on ACTIVE side	No	No	No
9	Apply surcharge no.4 at elev. 28.00	No	No	No
10	Install strut no.3 at elev. 27.50	No	No	No
11	Change soil type 8 to soil type 1	No	No	No
12	Apply water pressure profile no.1	No	No	No
13	Change soil type 3 to soil type 4	No	No	No
14	Change soil type 6 to soil type 7	No	No	No
15	Apply surcharge no.2 at elev. 22.36	No	No	No
*	Summary output	Yes	-	Yes

Units: kN,m

Stage No.3 Excav. to elev. 22.36 on PASSIVE side



Units: kN,m

Stage No. 3 Excavate to elevation 22.36 on PASSIVE side

STABILITY ANALYSIS of Fully Embedded Wall according to Strength Factor method

Factor of safety on soil strength

Stage No.	--- G.L. --- Act.	Pass.	Strut Elev.	FoS for toe elev. = 15.00 Factor of Safety	Moment equilib. at elev.	Toe elev. for FoS = 1.500 Toe elev.	Wall Penetr -ation
3	27.65	22.36	Cant.	2.236	16.27	17.49	4.87

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: Active side 20.00 from wall
Passive 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
1	28.00	0.00	0.028	4.19E-03	0.0	-0.0	
2	27.65	0.00	0.027	4.19E-03	0.0	0.0	
3	27.50	1.02	0.026	4.19E-03	0.1	0.0	
4	26.75	8.09	0.023	4.19E-03	3.5	1.1	
5	26.00	14.19	0.020	4.18E-03	11.8	6.6	
6	25.50	17.84	0.018	4.16E-03	19.9	14.4	
7	25.00	21.33	0.016	4.11E-03	29.6	26.7	
8	24.50	27.42	0.014	4.04E-03	41.8	44.5	
9	24.00	33.47	0.012	3.92E-03	57.1	69.0	
		18.25	0.012	3.92E-03	57.1	69.0	
10	23.44	21.04	0.010	3.72E-03	68.0	103.8	
11	22.89	29.82	0.008	3.43E-03	82.2	149.2	
12	22.73	37.73	0.007	3.33E-03	87.2	161.9	
13	22.36	56.81	0.006	3.06E-03	105.0	197.4	
		-23.20	0.006	3.06E-03	105.0	197.4	
14	22.00	-12.81	0.005	2.73E-03	98.5	233.7	
		-181.56	0.005	2.73E-03	98.5	233.7	
15	21.86	-174.69	0.004	2.60E-03	73.6	245.7	
16	21.33	-128.30	0.003	2.03E-03	-6.7	268.0	
17	20.80	-66.11	0.002	1.47E-03	-58.3	246.4	
18	20.00	-4.80	0.001	7.68E-04	-86.6	178.8	
19	19.20	24.53	0.001	2.93E-04	-78.7	108.1	
20	18.40	32.42	0.001	2.72E-05	-55.9	53.0	
21	17.60	28.43	0.001	-9.16E-05	-31.6	18.8	
22	16.80	19.28	0.001	-1.27E-04	-12.5	2.7	
23	16.00	8.49	0.001	-1.29E-04	-1.4	-1.1	
24	15.50	1.46	0.001	-1.27E-04	1.1	-0.7	
25	15.00	-5.75	0.001	-1.27E-04	0.0	-0.0	

(continued)

Stage No.3 Excavate to elevation 22.36 on PASSIVE side

Node no.	Y coord	ACTIVE side: Water press. kN/m2	Effective stresses: Vertic -al kN/m2	Active limit kN/m2	Passive limit kN/m2	Earth pressure kN/m2	Total earth pressure kN/m2	Soil stiffness coeff. kN/m3
1	28.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	27.65	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	3811
3	27.50	0.00	3.03	1.02	10.41	1.02	1.02a	3811
4	26.75	0.00	24.02	8.09	82.67	8.09	8.09a	3811
5	26.00	0.00	42.16	14.19	145.12	14.19	14.19a	3811
6	25.50	0.00	52.98	17.84	182.37	17.84	17.84a	3811
7	25.00	0.00	63.34	21.33	218.04	21.33	21.33a	3811
8	24.50	4.07	69.38	23.36	238.80	23.36	27.42a	3811
9	24.00	8.14	75.24	25.33	259.00	25.33	33.47a	3811
		Total>	83.38	18.25m	163.39	18.25	18.25a	9906
10	23.44	Total>	94.33	21.04m	174.34	21.04	21.04a	9906
11	22.89	Total>	105.19	25.20	185.20	29.82	29.82	9906
12	22.73	Total>	108.10	28.11	188.11	37.73	37.73	9906
13	22.36	Total>	115.36	35.37	195.37	56.81	56.81	9906
14	22.00	Total>	122.30	42.31	202.31	74.04	74.04	9906
		Total>	122.30	28.25m	338.26	41.23	41.23	23616
15	21.86	Total>	125.00	28.95m	342.69	52.50	52.50	23795
16	21.33	Total>	135.18	31.60m	359.43	91.87	91.87	24475
17	20.80	Total>	145.33	34.25m	376.14	125.29	125.29	25155
18	20.00	Total>	160.61	38.25m	401.32	164.58	164.58	26180
19	19.20	Total>	175.84	42.25m	426.46	192.89	192.89	27206
20	18.40	Total>	191.03	46.25m	451.56	213.84	213.84	28232
21	17.60	Total>	206.20	50.25m	476.62	230.68	230.68	29258
22	16.80	Total>	221.33	54.25m	501.66	245.73	245.73	30284
23	16.00	Total>	236.44	58.25m	526.68	260.21	260.21	31310
24	15.50	Total>	245.88	60.75m	542.30	269.16	269.16	31951
25	15.00	Total>	255.30	63.25m	557.92	278.05	278.05	32592

Node no.	Y coord	PASSIVE side: Water press. kN/m2	Effective stresses: Vertic -al kN/m2	Active limit kN/m2	Passive limit kN/m2	Earth pressure kN/m2	Total earth pressure kN/m2	Soil stiffness coeff. kN/m3
1	28.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	27.65	0.00	0.00	0.00	0.00	0.00	0.00	0.0
3	27.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
4	26.75	0.00	0.00	0.00	0.00	0.00	0.00	0.0
5	26.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
6	25.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
7	25.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
8	24.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
9	24.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
10	23.44	0.00	0.00	0.00	0.00	0.00	0.00	0.0
11	22.89	0.00	0.00	0.00	0.00	0.00	0.00	0.0
12	22.73	0.00	0.00	0.00	0.00	0.00	0.00	0.0
13	22.36	0.00	0.00	0.00	0.00	0.00	0.00	0.0
		Total>	0.00	0.00	80.01	80.01	80.01p	19310
14	22.00	Total>	6.84	1.80m	86.85	86.85	86.85p	19310
		Total>	6.84	1.80m	222.80	222.80	222.80p	46033
15	21.86	Total>	9.50	2.50m	227.19	227.19	227.19p	46383
16	21.33	Total>	19.58	5.15m	243.83	220.17	220.17	47708
17	20.80	Total>	29.66	7.80m	260.47	191.39	191.39	49032
18	20.00	Total>	44.91	11.80m	285.62	169.38	169.38	51032

(continued)

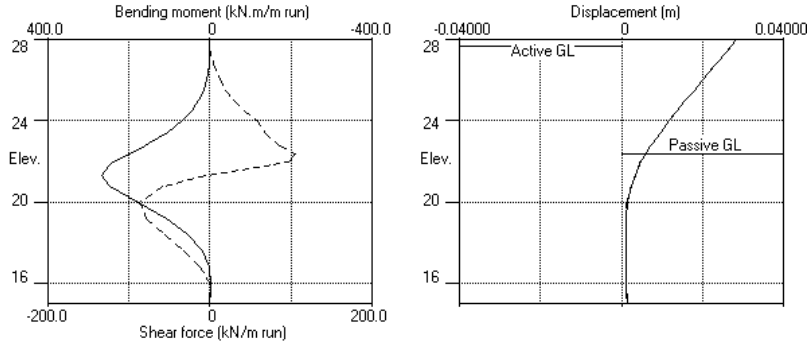
Stage No.3 Excavate to elevation 22.36 on PASSIVE side

Node no.	Y coord	PASSIVE side: Water press.	Effective stresses: Vertic -al	Active limit	Passive limit	Earth pressure	Total earth pressure	Soil stiffness coeff.
		kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m3
19	19.20	Total> 60.20		15.80m	310.82	168.36	168.36	53032
20	18.40	Total> 75.56		19.80m	336.08	181.42	181.42	55032
21	17.60	Total> 90.98		23.80m	361.41	202.25	202.25	57031
22	16.80	Total> 106.48		27.80m	386.81	226.45	226.45	59031
23	16.00	Total> 122.06		31.80m	412.30	251.72	251.72	61031
24	15.50	Total> 131.85		34.30m	428.27	267.70	267.70	62281
25	15.00	Total> 141.66		36.80m	444.28	283.80	283.80	63530

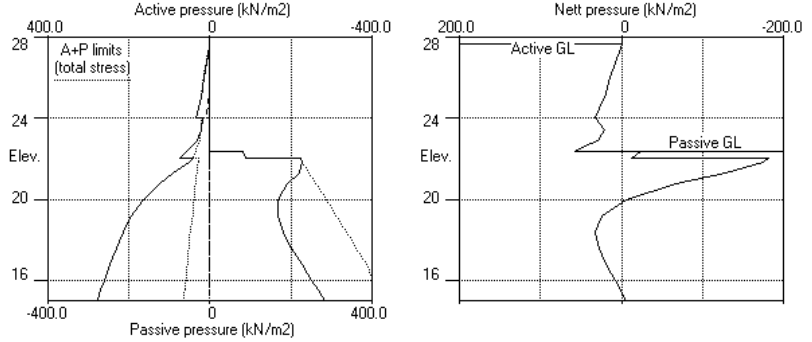
Note: 21.04a Soil pressure at active limit
227.19p Soil pressure at passive limit

Units: kN,m

Stage No.3 Excav. to elev. 22.36 on PASSIVE side

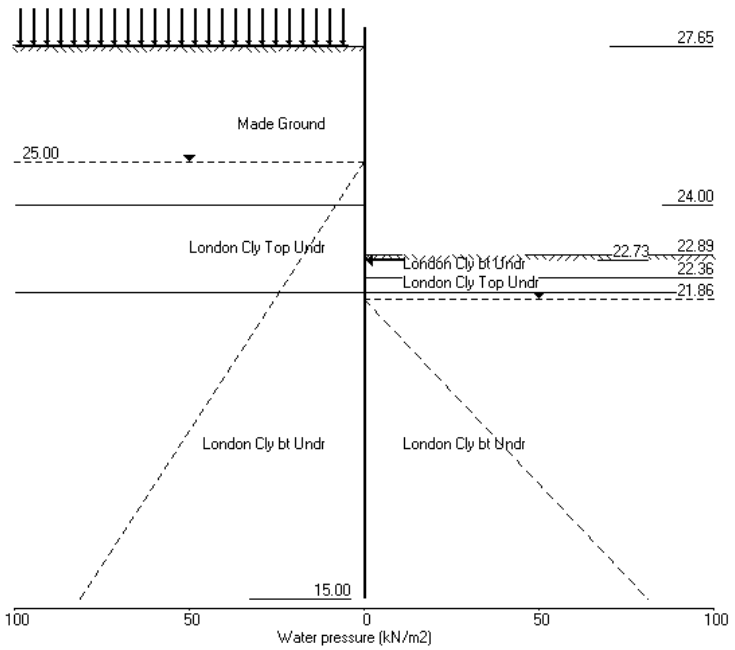


Stage No.3 Excav. to elev. 22.36 on PASSIVE side



Units: kN,m

Stage No.5 Fill to elev. 22.89 on PASSIVE side



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Licensed from GEOSOLVE | Made by : EA
Data filename/Run ID: Wall B Movement_SLS |
Camley Street | Date: 5-10-2015
Wall B | Checked :

Units: kN,m

Stage No. 5 Fill to elevation 22.89 on PASSIVE side with soil type 6

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

Stage No.	--- G.L. --- Act.	Pass.	Strut Elev.	FoS for toe elev. = 15.00 Factor of Safety	Moment equilib. at elev.	Toe elev. for FoS = 1.500 Toe elev.	Wall Penetr -ation
5	27.65	22.89	22.73	Conditions not suitable for 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: Active side 20.00 from wall
Passive 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
1	28.00	0.00	0.028	4.25E-03	0.0	-0.0	
2	27.65	0.00	0.027	4.25E-03	0.0	0.0	
3	27.50	1.08	0.026	4.25E-03	0.1	0.0	
4	26.75	8.23	0.023	4.24E-03	3.6	1.2	
5	26.00	14.42	0.020	4.23E-03	12.1	6.7	
6	25.50	18.12	0.018	4.21E-03	20.2	14.7	
7	25.00	21.66	0.016	4.17E-03	30.2	27.2	
8	24.50	27.82	0.014	4.09E-03	42.5	45.2	
9	24.00	33.91	0.012	3.97E-03	58.0	70.2	
		19.44	0.012	3.97E-03	58.0	70.2	
10	23.44	22.38	0.009	3.77E-03	69.6	105.7	
11	22.89	31.29	0.007	3.47E-03	84.6	152.1	
12	22.73	38.49	0.007	3.37E-03	89.8	165.2	-0.0
13	22.36	52.91	0.006	3.09E-03	106.9	201.5	
		-29.45	0.006	3.09E-03	106.9	201.5	
14	22.00	-18.94	0.005	2.76E-03	98.2	238.1	
		-182.91	0.005	2.76E-03	98.2	238.1	
15	21.86	-175.87	0.004	2.62E-03	73.1	250.1	
16	21.33	-128.96	0.003	2.05E-03	-7.7	272.0	
17	20.80	-66.36	0.002	1.47E-03	-59.4	249.8	
18	20.00	-4.66	0.001	7.65E-04	-87.8	181.2	
19	19.20	24.87	0.001	2.84E-04	-79.7	109.5	
20	18.40	32.81	0.001	1.42E-05	-56.7	53.8	
21	17.60	28.79	0.001	-1.06E-04	-32.0	19.1	
22	16.80	19.54	0.001	-1.42E-04	-12.7	2.7	
23	16.00	8.62	0.001	-1.45E-04	-1.5	-1.1	
24	15.50	1.50	0.001	-1.43E-04	1.1	-0.7	
25	15.00	-5.81	0.001	-1.42E-04	0.0	-0.0	

At elev. 22.73 The strut is slack

(continued)

Stage No.5 Fill to elevation 22.89 on PASSIVE side with soil type 6

Node no.	Y coord	ACTIVE side: 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	Soil stiffness coeff. kN/m3
1	28.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	27.65	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	2033
3	27.50	0.00	3.03	1.02	10.41	1.08	1.08	2033
4	26.75	0.00	24.02	8.09	82.67	8.23	8.23	2033
5	26.00	0.00	42.16	14.19	145.12	14.42	14.42	2033
6	25.50	0.00	52.98	17.84	182.37	18.12	18.12	2033
7	25.00	0.00	63.34	21.33	218.04	21.66	21.66	2033
8	24.50	4.07	69.38	23.36	238.80	23.75	27.82	2033
9	24.00	8.14	75.24	25.33	259.00	25.77	33.91	2033
		Total> 83.38	18.25m	163.39	19.44	19.44	5475	
10	23.44	Total> 94.33	21.04m	174.34	22.38	22.38	5475	
11	22.89	Total> 105.19	25.20	185.20	31.29	31.29	5475	
12	22.73	Total> 108.10	28.11	188.11	39.24	39.24	5475	
13	22.36	Total> 115.36	35.37	195.37	58.39	58.39	5475	
14	22.00	Total> 122.30	42.31	202.31	75.68	75.68	5475	
		Total> 122.30	28.25m	338.26	45.14	45.14	13053	
15	21.86	Total> 125.00	28.95m	342.69	56.49	56.49	13152	
16	21.33	Total> 135.18	31.60m	359.43	96.11	96.11	13528	
17	20.80	Total> 145.33	34.25m	376.14	129.72	129.72	13904	
18	20.00	Total> 160.61	38.25m	401.32	169.21	169.21	14471	
19	19.20	Total> 175.84	42.25m	426.46	197.63	197.63	15038	
20	18.40	Total> 191.03	46.25m	451.56	218.61	218.61	15605	
21	17.60	Total> 206.20	50.25m	476.62	235.45	235.45	16172	
22	16.80	Total> 221.33	54.25m	501.66	250.46	250.46	16739	
23	16.00	Total> 236.44	58.25m	526.68	264.88	264.88	17306	
24	15.50	Total> 245.88	60.75m	542.30	273.79	273.79	17660	
25	15.00	Total> 255.30	63.25m	557.92	282.64	282.64	18015	

Node no.	Y coord	PASSIVE side: 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	Soil stiffness coeff. kN/m3
1	28.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	27.65	0.00	0.00	0.00	0.00	0.00	0.00	0.0
3	27.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
4	26.75	0.00	0.00	0.00	0.00	0.00	0.00	0.0
5	26.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
6	25.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
7	25.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
8	24.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
9	24.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
10	23.44	0.00	0.00	0.00	0.00	0.00	0.00	0.0
11	22.89	0.00	0.00	0.00	0.00	0.00	0.00	0.0
		Total> 0.00	0.00	205.00	0.00	0.00a	13776	
12	22.73	Total> 2.85	0.75m	209.71	0.75	0.75a	13894	
13	22.36	Total> 9.98	2.63m	221.47	5.49	5.49	14189	
		Total> 9.98	2.63m	89.98	87.84	87.84	6071	
14	22.00	Total> 16.82	4.43m	96.83	94.62	94.62	6071	
		Total> 16.82	4.43m	232.77	228.05	228.05	14472	
15	21.86	Total> 19.48	5.13m	237.17	232.36	232.36	14582	
16	21.33	Total> 29.56	7.77m	253.81	225.07	225.07	14998	
17	20.80	Total> 39.66	10.42m	270.47	196.09	196.09	15415	

Run ID. Wall B Movement_SLS | Sheet No.
Camley Street | Date: 5-10-2015
Wall B | Checked :

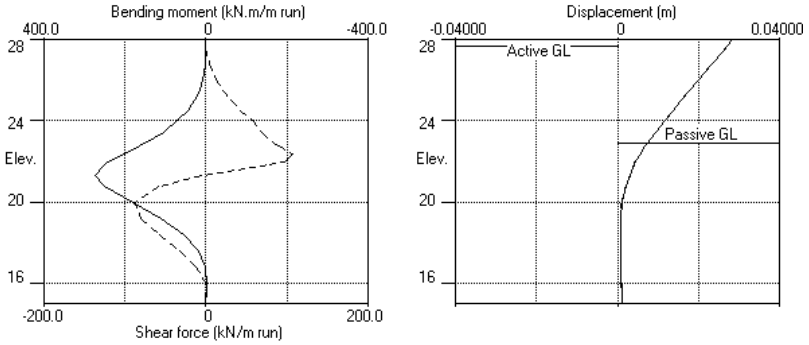
(continued)

Stage No.5 Fill to elevation 22.89 on PASSIVE side with soil type 6

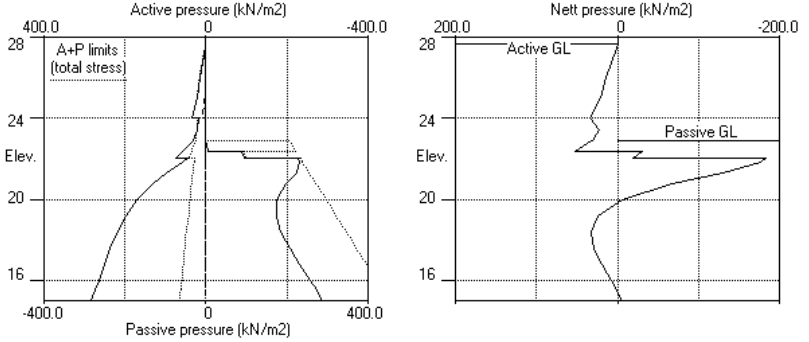
Node no.	Y coord	PASSIVE side: Water press. kN/m2	Vertic -al kN/m2	Effective stresses: Active limit kN/m2	Passive limit kN/m2	Earth pressure kN/m2	Total earth pressure kN/m2	Soil stiffness coeff. kN/m3
18	20.00	Total> 54.93	14.43m	295.64	173.87	173.87	16043	
19	19.20	Total> 70.25	18.42m	320.87	172.76	172.76	16672	
20	18.40	Total> 85.62	22.43m	346.15	185.80	185.80	17301	
21	17.60	Total> 101.07	26.43m	371.50	206.66	206.66	17930	
22	16.80	Total> 116.59	30.42m	396.92	230.92	230.92	18558	
23	16.00	Total> 132.18	34.43m	422.42	256.27	256.27	19187	
24	15.50	Total> 141.97	36.93m	438.40	272.29	272.29	19580	
25	15.00	Total> 151.79	39.43m	454.41	288.45	288.45	19973	

Note: 0.75a Soil pressure at active limit
123.45p Soil pressure at passive limit

Stage No.5 Fill to elev. 22.89 on PASSIVE side

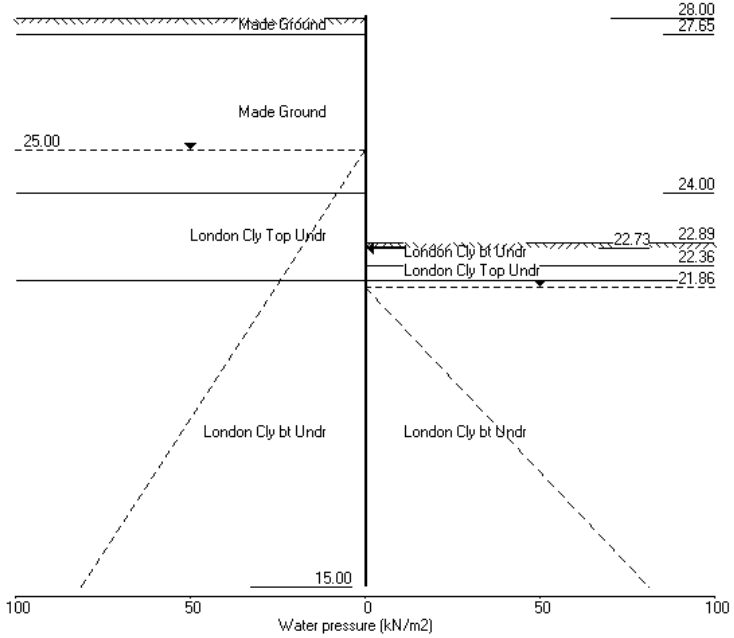


Stage No.5 Fill to elev. 22.89 on PASSIVE side



GEOFIRMA LTD | Sheet No.
Program: WALLAP Version 6.05 Revision A45.B58.R49 | Job No. JMP0014
Licensed from GEOSOLVE | Made by : EA
Data filename/Run ID: Wall B Movement_SLS |
Camley Street | Date: 5-10-2015
Wall B | Checked :
Units: kN,m

Stage No.8 Fill to elev. 28.00 on ACTIVE side



Units: kN,m

Stage No. 8 Fill to elevation 28.00 on ACTIVE side with soil type 1

STABILITY ANALYSIS of Fully Embedded Wall according to Strength Factor method

Factor of safety on soil strength

Stage No.	--- G.L. --- Act.	Pass.	Strut Elev.	FoS for toe elev. = 15.00 Factor of Safety	Moment equilib. at elev.	Toe elev. for FoS = 1.500 Toe elev.	Wall Penetr -ation
8	28.00	22.89	22.73	Conditions not suitable for 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: Active side 20.00 from wall
Passive 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
1	28.00	0.00	0.028	4.29E-03	0.0	-0.0	
2	27.65	2.87	0.027	4.29E-03	0.5	0.0	
3	27.50	3.91	0.026	4.29E-03	1.0	0.2	
4	26.75	8.88	0.023	4.29E-03	5.8	2.6	
5	26.00	13.83	0.019	4.27E-03	14.3	9.9	
6	25.50	17.12	0.017	4.24E-03	22.1	18.9	
7	25.00	20.40	0.015	4.18E-03	31.4	32.2	
8	24.50	26.36	0.013	4.10E-03	43.1	50.7	
9	24.00	32.32	0.011	3.97E-03	57.8	75.8	
		20.00	0.011	3.97E-03	57.8	75.8	
10	23.44	22.79	0.009	3.75E-03	69.7	111.2	
11	22.89	25.84	0.007	3.44E-03	83.3	157.4	
12	22.73	32.95	0.006	3.34E-03	87.7	170.2	-0.0
13	22.36	50.04	0.005	3.05E-03	103.3	205.4	
		-32.49	0.005	3.05E-03	103.3	205.4	
14	22.00	-22.26	0.004	2.72E-03	93.4	240.5	
		-179.78	0.004	2.72E-03	93.4	240.5	
15	21.86	-172.88	0.004	2.57E-03	68.7	251.8	
16	21.33	-126.48	0.003	2.00E-03	-10.6	271.8	
17	20.80	-64.40	0.002	1.43E-03	-61.2	248.4	
18	20.00	-3.42	0.001	7.27E-04	-88.3	179.0	
19	19.20	25.53	0.000	2.53E-04	-79.5	107.3	
20	18.40	33.05	0.000	-1.05E-05	-56.1	52.0	
21	17.60	28.75	0.000	-1.26E-04	-31.3	17.8	
22	16.80	19.33	0.001	-1.59E-04	-12.1	2.1	
23	16.00	8.29	0.001	-1.60E-04	-1.1	-1.3	
24	15.50	1.10	0.001	-1.58E-04	1.3	-0.8	
25	15.00	-6.28	0.001	-1.57E-04	0.0	-0.0	

At elev. 22.73 The strut is slack

(continued)

Stage No.8 Fill to elevation 28.00 on ACTIVE side with soil type 1

Node no.	Y coord	ACTIVE 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	Soil stiffness coeff. kN/m3
1	28.00	0.00	0.00	0.00	0.00	0.00	0.00	1958
2	27.65	0.00	6.65	2.60	17.03	2.87	2.87	1958
		0.00	6.65	2.24	22.89	2.87	2.87	1958
3	27.50	0.00	9.50	3.20	32.70	3.91	3.91	1958
4	26.75	0.00	23.75	8.00	81.75	8.88	8.88	1958
5	26.00	0.00	38.00	12.79	130.80	13.83	13.83	1958
6	25.50	0.00	47.50	15.99	163.50	17.12	17.12	1958
7	25.00	0.00	57.00	19.19	196.20	20.40	20.40	1958
8	24.50	4.07	62.43	21.02	214.90	22.29	26.36	1958
9	24.00	8.14	67.86	22.85	233.60	24.18	32.32	1958
		Total> 76.00	20.00m	156.01	20.00	20.00a	5297	
10	23.44	Total> 86.59	22.79m	166.60	22.79	22.79a	5297	
11	22.89	Total> 97.18	25.57m	177.19	25.84	25.84	5297	
12	22.73	Total> 100.04	26.33m	180.04	33.70	33.70	5297	
13	22.36	Total> 107.16	28.20m	187.17	52.66	52.66	5297	
14	22.00	Total> 114.00	34.01	194.01	69.77	69.77	5297	
		Total> 114.00	30.00m	329.96	42.09	42.09	12628	
15	21.86	Total> 116.66	30.70m	334.35	53.37	53.37	12724	
16	21.33	Total> 126.73	33.35m	350.98	92.69	92.69	13088	
17	20.80	Total> 136.80	36.00m	367.61	126.03	126.03	13451	
18	20.00	Total> 152.00	40.00m	392.72	165.16	165.16	14000	
19	19.20	Total> 167.20	44.00m	417.82	193.31	193.31	14548	
20	18.40	Total> 182.40	48.00m	442.92	214.11	214.11	15097	
21	17.60	Total> 197.60	52.00m	468.03	230.84	230.84	15645	
22	16.80	Total> 212.80	56.00m	493.13	245.81	245.81	16194	
23	16.00	Total> 228.00	60.00m	518.24	260.23	260.23	16742	
24	15.50	Total> 237.50	62.50m	533.93	269.14	269.14	17085	
25	15.00	Total> 247.00	65.00m	549.62	277.99	277.99	17428	

Node no.	Y coord	PASSIVE 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	Soil stiffness coeff. kN/m3
1	28.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	27.65	0.00	0.00	0.00	0.00	0.00	0.00	0.0
3	27.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
4	26.75	0.00	0.00	0.00	0.00	0.00	0.00	0.0
5	26.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
6	25.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
7	25.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
8	24.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
9	24.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
10	23.44	0.00	0.00	0.00	0.00	0.00	0.00	0.0
11	22.89	0.00	0.00	0.00	0.00	0.00	0.00	0.0
		Total> 0.00	0.00	0.00	205.00	0.00	0.00a	15050
12	22.73	Total> 2.85	0.75m	209.71	0.75	0.75a	15179	
13	22.36	Total> 9.98	2.63m	221.47	2.63	2.63a	15501	
		Total> 9.98	2.63m	89.98	85.15	85.15	6632	
14	22.00	Total> 16.82	4.43m	96.83	92.03	92.03	6632	
		Total> 16.82	4.43m	232.77	221.88	221.88	15810	
15	21.86	Total> 19.48	5.13m	237.17	226.24	226.24	15930	
16	21.33	Total> 29.56	7.77m	253.81	219.18	219.18	16385	
17	20.80	Total> 39.66	10.42m	270.47	190.44	190.44	16840	

(continued)

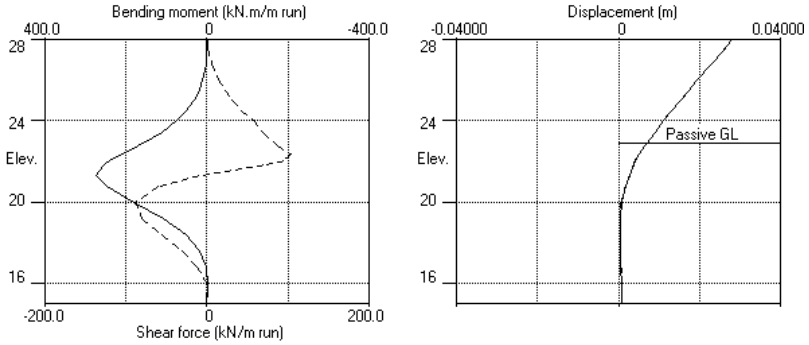
Stage No.8 Fill to elevation 28.00 on ACTIVE side with soil type 1

Node no.	Y coord	PASSIVE side Water press. kN/m2	Effective stresses Vertic -al kN/m2	Active limit kN/m2	Passive limit kN/m2	Earth pressure kN/m2	Total earth pressure kN/m2	Soil stiffness coeff. kN/m3
18	20.00	Total>	54.93	14.43m	295.64	168.58	168.58	17527
19	19.20	Total>	70.25	18.42m	320.87	167.78	167.78	18214
20	18.40	Total>	85.62	22.43m	346.15	181.05	181.05	18901
21	17.60	Total>	101.07	26.43m	371.50	202.09	202.09	19587
22	16.80	Total>	116.59	30.42m	396.92	226.48	226.48	20274
23	16.00	Total>	132.18	34.43m	422.42	251.94	251.94	20961
24	15.50	Total>	141.97	36.93m	438.40	268.04	268.04	21390
25	15.00	Total>	151.79	39.43m	454.41	284.27	284.27	21820

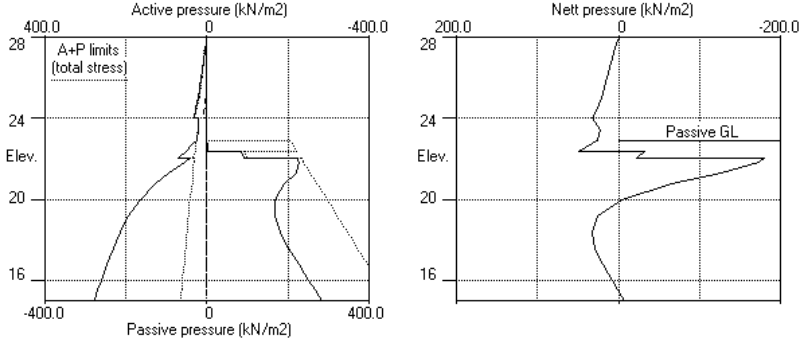
Note: 2.63a Soil pressure at active limit
123.45p Soil pressure at passive limit

Units: kN,m

Stage No.8 Fill to elev. 28.00 on ACTIVE side



Stage No.8 Fill to elev. 28.00 on ACTIVE side



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 No.	G.L. Act.	G.L. Pass.	Strut Elev.	FoS for toe elev. = 15.00 Factor of Safety	Moment equilib. at elev.	Toe elev. for FoS = 1.500 Toe elev.	Wall Penetr -ation
1	27.65	27.65	Cant.	Conditions not suitable for FoS calc.			
2	27.65	27.65		No analysis at this stage			
3	27.65	22.36	Cant.	2.236	16.27	17.49	4.87
4	27.65	22.36		No analysis at this stage			
5	27.65	22.89	22.73	Conditions not suitable for FoS calc.			
6	27.65	22.89		No analysis at this stage			
7	27.65	22.89		No analysis at this stage			
8	28.00	22.89	22.73	Conditions not suitable for FoS calc.			
9	28.00	22.89	22.73	Conditions not suitable for FoS calc.			
10	28.00	22.89		No analysis at this stage			

All remaining stages have more than one strut - FoS calculation n/a

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Camley Street | Date: 5-10-2015
Wall B | 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: Active side 20.00 from wall

Passive 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 max. m	Displacement min. m	Bending moment Calculated max. kN.m/m	Bending moment Calculated min. kN.m/m	Bending moment Factored max. kN.m/m	Bending moment Factored min. kN.m/m	Shear force Calculated max. kN/m	Shear force Calculated min. kN/m	Shear force Factored max. kN/m	Shear force Factored min. kN/m
1	28.00	0.032	0.000	0	-0	0	-0	0	0	0	0
2	27.65	0.030	0.000	0	-0	0	-0	1	0	1	0
3	27.50	0.029	0.000	0	-0	0	-0	1	-2	2	-3
4	26.75	0.026	0.000	3	-0	4	-1	7	-1	10	-2
5	26.00	0.022	0.000	12	-2	16	-2	18	-2	24	-3
6	25.50	0.020	0.000	24	-3	32	-4	29	-2	40	-3
7	25.00	0.017	0.000	40	-4	54	-5	45	-2	61	-3
8	24.50	0.015	0.000	66	-5	89	-6	64	-1	86	-2
9	24.00	0.013	0.000	103	-5	139	-7	86	0	117	0
10	23.44	0.010	0.000	159	-4	214	-6	115	0	155	0
11	22.89	0.008	0.000	235	-3	317	-4	147	0	199	0
12	22.73	0.008	0.000	258	-2	348	-3	154	-30	208	-41
13	22.36	0.006	0.000	249	0	336	0	107	-15	144	-20
14	22.00	0.005	0.000	273	0	369	0	98	-16	133	-22
15	21.86	0.005	0.000	284	0	383	0	74	-22	99	-29
16	21.33	0.004	0.000	301	0	406	0	4	-39	5	-53
17	20.80	0.003	0.000	272	0	368	0	1	-72	1	-97
18	20.00	0.002	0.000	194	0	262	0	0	-98	0	-133
19	19.20	0.001	0.000	115	0	156	0	0	-87	0	-118
20	18.40	0.001	0.000	70	0	94	0	0	-61	0	-82
21	17.60	0.001	0.000	38	0	51	0	0	-34	0	-46
22	16.80	0.001	0.000	16	0	21	0	0	-21	0	-29
23	16.00	0.001	0.000	4	-2	6	-2	0	-10	0	-13
24	15.50	0.001	0.000	1	-1	1	-1	2	-4	2	-6
25	15.00	0.001	0.000	0	-0	0	-0	0	0	0	0

Summary of results (continued)

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

Maximum and minimum bending moment and shear force at each stage

Stage	Bending moment				Shear force					
	Calculated				Factored		Calculated				Factored	
no.	max.	elev.	min.	elev.	max.	min.	max.	elev.	min.	elev.	max.	min.
	kN.m/m		kN.m/m		kN.m/m		kN/m		kN/m		kN/m	kN/m
1	8	20.80	-5	24.00	11	-7	9	22.00	-3	18.40	12	-3
2	No calculation at this stage											
3	268	21.33	-1	16.00	362	-1	105	22.36	-87	20.00	142	-117
4	No calculation at this stage											
5	272	21.33	-1	16.00	367	-1	107	22.36	-88	20.00	144	-119
6	No calculation at this stage											
7	No calculation at this stage											
8	272	21.33	-1	16.00	367	-2	103	22.36	-88	20.00	139	-119
9	301	21.33	-2	16.00	406	-2	103	22.73	-98	20.00	139	-133
10	No calculation at this stage											
11	No calculation at this stage											
12	No calculation at this stage											
13	No calculation at this stage											
14	No calculation at this stage											
15	258	22.73	-0	28.00	348	-0	154	22.73	-53	20.00	208	-72

Maximum and minimum displacement at each stage

Stage	Displacement				Stage description
no.	maximum	elev.	minimum	elev.	
	m		m		
1	0.000	28.00	0.000	28.00	Apply surcharge no.1 at elev. 27.65
2	No calculation at this stage				Apply surcharge no.3 at elev. 27.65
3	0.028	28.00	0.000	28.00	Excav. to elev. 22.36 on PASSIVE side
4	No calculation at this stage				Install strut no.2 at elev. 22.73
5	0.028	28.00	0.000	28.00	Fill to elev. 22.89 on PASSIVE side
6	No calculation at this stage				Remove surcharge no.1 at elev. 27.65
7	No calculation at this stage				Remove surcharge no.3 at elev. 27.65
8	0.028	28.00	0.000	28.00	Fill to elev. 28.00 on ACTIVE side
9	0.032	28.00	0.000	28.00	Apply surcharge no.4 at elev. 28.00
10	No calculation at this stage				Install strut no.3 at elev. 27.50
11	No calculation at this stage				Change soil type 8 to soil type 1
12	No calculation at this stage				Apply water pressure profile no.1
13	No calculation at this stage				Change soil type 3 to soil type 4
14	No calculation at this stage				Change soil type 6 to soil type 7
15	0.032	28.00	0.000	28.00	Apply surcharge no.2 at elev. 22.36

Run ID. Wall B Movement_SLS | Sheet No.
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Wall B | Checked :

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.

Strut forces at each stage (horizontal components)

Stage	Strut no. 2 at elev. 22.73			Strut no. 3 at elev. 27.50		
no.	Calculated	Factored		Calculated	Factored	
	kN per m run	kN per strut	kN per strut	kN per m run	kN per strut	kN per strut
5	slack	slack	slack	---	---	---
8	slack	slack	slack	---	---	---
9	16	16	22	---	---	---
15	184	184	249	3	3	5

* Indicates that the total force shown is the sum of the force in the strut plus a force applied at the same elevation which may represent temperature load or other forces which are part of the strut load. Force components are listed in the detailed results for individual stages.

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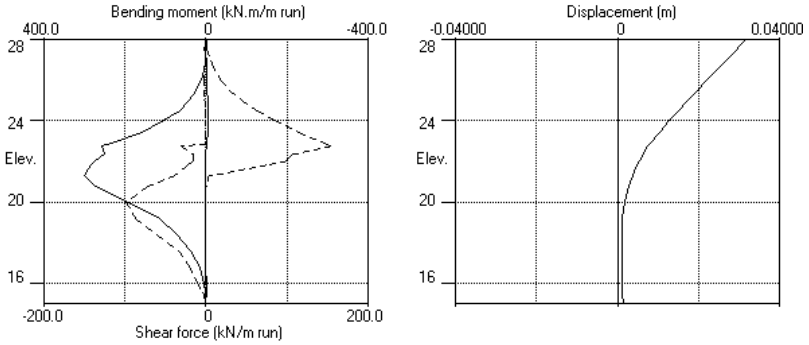
Units: kN,m

Bending moment, shear force, displacement envelopes



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Data filename/Run ID: Wall C Movement_SLS |
Camley Street | Date: 5-10-2015
Wall C movement | Checked :

Units: kN,m

INPUT DATA

SOIL PROFILE

Stratum no.	Elevation of top of stratum	Soil types Active side	Passive side
1	27.45	8 Made Ground Init	8 Made Ground Init
2	24.00	3 London Cly Top Undr	3 London Cly Top Undr
3	22.00	6 London Cly bt Undr	6 London Cly bt Undr

SOIL PROPERTIES (Unfactored SLS soil strengths)

No.	Soil type -- Description (Datum elev.)	Bulk density kN/m3	Young's Modulus Eh,kN/m2 (dEh/dy)	At rest coeff. Ko (dKo/dy)	Consol state. NC/OC (Nu)	Active limit Ka (Kac)	Passive limit Kp (Kpc)	Cohesion kN/m2 (dc/dy)
1	Made Ground	19.00	20000	0.577	OC (0.250)	0.390 (0.000)	2.561 (0.000)	
2	Gravels	19.00	60000	0.423	OC (0.300)	0.227 (0.000)	6.084 (0.000)	
3	London Cly Top Undr	19.00	40000	1.000	OC (0.490)	1.000 (2.000)	1.000 (2.000)	40.00u
4	London Cly Top dr	19.00	28000	1.000	OC (0.250)	0.422 (1.299)	2.371 (3.080)	3.000d
5	Concrete	24.00	400000	1.000	OC (0.490)	1.000 (2.000)	1.000 (2.000)	30000u
6	London Cl.. (24.00)	19.00	85000 (5178)	1.400	OC (0.490)	1.000 (2.476)	1.000 (2.390)	80.00u (5.180)
7	London Cl.. (24.00)	19.00	56000 (3626)	1.400	OC (0.250)	0.366 (1.423)	3.077 (4.665)	3.000d
8	Made Ground Init	19.00	20000	0.577	OC (0.250)	0.337 (0.000)	3.442 (0.000)	

Additional soil parameters associated with Ka and Kp

No.	Soil type Description	--- parameters for Ka --- Soil friction angle	Wall adhesion coeff.	Back-fill angle	--- parameters for Kp --- Soil friction angle	Wall adhesion coeff.	Back-fill angle
1	Made Ground	26.00	0.000	0.00	26.00	0.000	0.00
2	Gravels	35.00	0.670	0.00	35.00	0.500	0.00
3	London Cly Top Undr	0.00	0.000	0.00	0.00	0.000	0.00
4	London Cly Top dr	24.00	0.000	0.00	24.00	0.000	0.00
5	Concrete	0.00	0.000	0.00	0.00	0.000	0.00
6	London Cly bt Undr	0.00	0.670	0.00	0.00	0.500	0.00
7	London Cly bt dr	24.00	0.670	0.00	24.00	0.500	0.00
8	Made Ground Init	26.00	0.670	0.00	26.00	0.500	0.00

GROUND WATER CONDITIONS

Density of water = 10.00 kN/m3

	Active side	Passive side
Initial water table elevation	25.00	21.86

Automatic water pressure balancing at toe of wall : Yes

Water press. profile no.	Point no.	Active side Elev. m	Piezo elev. m	Water press. kN/m2	Passive side Point no.	Elev. m	Piezo elev. m	Water press. kN/m2	
1	1	25.45	25.45	0.0	1	22.36	22.36	0.0	MC+WC
					2	22.36	25.45	30.9	

WALL PROPERTIES

Type of structure = Fully Embedded Wall
Elevation of toe of wall = 15.00
Maximum finite element length = 0.60 m
Youngs modulus of wall E = 1.4000E+07 kN/m2
Moment of inertia of wall I = 0.017260 m4/m run
E.I = 241640 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	27.13	5.00	0.010000	2.000E+08	10.00	0.00	0	No
2	22.73	1.00	0.300000	1.400E+07	10.00	0.00	0	No
3	27.13	1.00	0.300000	1.400E+07	10.00	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	27.45	0.50(A)	100.00	20.00	10.00	=	N/A	1.10 Var
2	22.36	-0.00(P)	30.00	20.00	31.00	=	N/A	1.00 P/U

Note: A = Active side, P = Passive 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 27.45
	No analysis at this stage
2	Excavate to elevation 22.36 on PASSIVE side
3	Install strut or anchor no.2 at elevation 22.73
4	Fill to elevation 22.89 on PASSIVE side with soil type 6
5	Install strut or anchor no.3 at elevation 27.13
6	Change properties of soil type 8 to soil type 1
	No analysis at this stage
	Ko pressures will not be reset
7	Apply water pressure profile no.1 (Mod. Conserv.)
	No analysis at this stage
8	Change properties of soil type 3 to soil type 4
	No analysis at this stage
	Ko pressures will not be reset
9	Change properties of soil type 6 to soil type 7
	No analysis at this stage
	Ko pressures will not be reset
10	Apply surcharge no.2 at elevation 22.36

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 Permanent Variable 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) = 0 m

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

   Width of excavation on active side of wall = 20.00 m
   Width of excavation on passive side of wall = 20.00 m

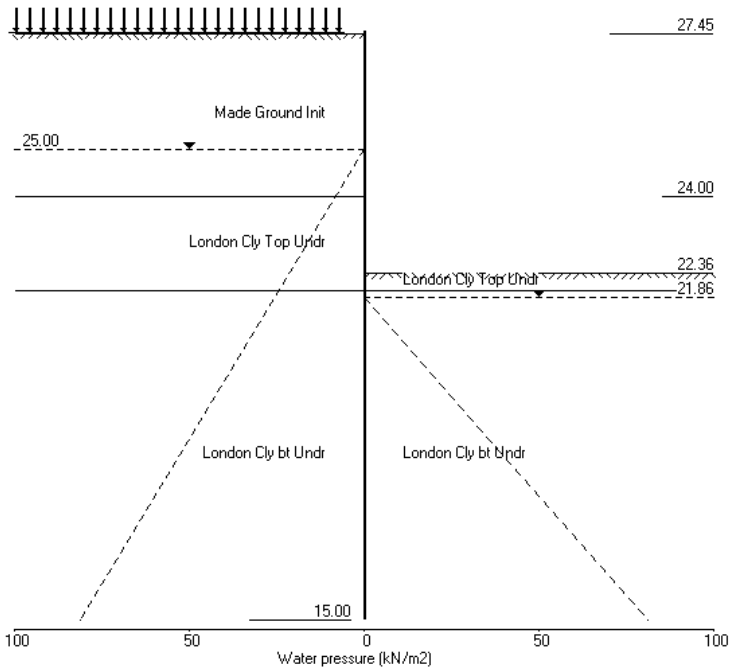
   Distance to rigid boundary on active side = 20.00 m
   Distance to rigid boundary on passive side = 20.00 m

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. 27.45	No	No	No
2	Excav. to elev. 22.36 on PASSIVE side	No	No	No
3	Install strut no.2 at elev. 22.73	No	No	No
4	Fill to elev. 22.89 on PASSIVE side	No	No	No
5	Install strut no.3 at elev. 27.13	No	No	No
6	Change soil type 8 to soil type 1	No	No	No
7	Apply water pressure profile no.1	No	No	No
8	Change soil type 3 to soil type 4	No	No	No
9	Change soil type 6 to soil type 7	No	No	No
10	Apply surcharge no.2 at elev. 22.36	No	No	No
*	Summary output	Yes	-	Yes

Units: kN,m

Stage No.2 Excav. to elev. 22.36 on PASSIVE side



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Camley Street | Date: 5-10-2015
Wall C movement | Checked :

Units: kN,m

Stage No. 2 Excavate to elevation 22.36 on PASSIVE 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: Active side 20.00 from wall
Passive 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/m2	Wall disp. m	Wall rotation rad.	Shear force kN/m	Bending moment kN.m/m	Strut forces kN/m
1	27.45	0.00	0.022	3.45E-03	0.0	0.0	
2	27.13	2.36	0.021	3.45E-03	0.4	0.1	
3	26.76	5.50	0.019	3.45E-03	1.8	0.5	
4	26.40	8.46	0.018	3.45E-03	4.3	1.5	
5	25.93	12.01	0.016	3.44E-03	9.2	4.7	
6	25.45	15.36	0.015	3.43E-03	15.7	10.5	
7	25.00	18.44	0.013	3.40E-03	23.3	19.2	
8	24.50	24.48	0.012	3.34E-03	34.0	33.4	
9	24.00	30.49	0.010	3.25E-03	47.8	53.8	
		17.25	0.010	3.25E-03	47.8	53.8	
10	23.44	20.04	0.008	3.09E-03	58.2	83.2	
11	22.89	31.59	0.006	2.86E-03	72.6	122.5	
12	22.73	38.71	0.006	2.78E-03	77.8	133.8	
13	22.36	55.91	0.005	2.55E-03	95.6	165.8	
		-24.10	0.005	2.55E-03	95.6	165.8	
14	22.00	-15.36	0.004	2.27E-03	88.5	198.7	
		-176.83	0.004	2.27E-03	88.5	198.7	
15	21.86	-169.81	0.004	2.16E-03	64.2	209.9	
16	21.43	-115.89	0.003	1.77E-03	2.8	221.8	
17	21.00	-71.32	0.002	1.39E-03	-37.5	212.3	
18	20.40	-25.09	0.002	9.06E-04	-66.4	177.0	
19	19.80	4.30	0.001	5.22E-04	-72.6	132.7	
20	19.20	20.14	0.001	2.45E-04	-65.3	90.0	
21	18.60	26.15	0.001	6.61E-05	-51.4	54.5	
22	18.00	25.75	0.001	-3.67E-05	-35.8	28.4	
23	17.40	21.66	0.001	-8.63E-05	-21.6	11.6	
24	16.80	15.80	0.001	-1.03E-04	-10.4	2.5	
25	16.20	9.24	0.001	-1.05E-04	-2.9	-0.8	
26	15.60	2.44	0.001	-1.03E-04	0.6	-0.8	
27	15.00	-4.56	0.001	-1.02E-04	0.0	0.0	

Node no.	Y coord	ACTIVE 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	Soil stiffness coeff. kN/m3
1	27.45	0.00	0.00	0.00	0.00	0.00	0.00	3867
2	27.13	0.00	7.01	2.36	24.13	2.36	2.36a	3867
3	26.76	0.00	16.33	5.50	56.20	5.50	5.50a	3867
4	26.40	0.00	25.12	8.46	86.46	8.46	8.46a	3867
5	25.93	0.00	35.68	12.01	122.82	12.01	12.01a	3867

(continued)

Stage No.2 Excavate to elevation 22.36 on PASSIVE side

Node no.	Y coord	ACTIVE side: 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	Soil stiffness coeff. kN/m3
6	25.45	0.00	45.63	15.36	157.08	15.36	15.36a	3867
7	25.00	0.00	54.76	18.44	188.50	18.44	18.44a	3867
8	24.50	4.07	60.64	20.41	208.73	20.41	24.48a	3867
9	24.00	8.14	66.39	22.35	228.52	22.35	30.49a	3867
		Total>	74.53	17.25m	154.55	17.25	17.25a	10048
10	23.44	Total>	85.38	20.04m	165.40	20.04	20.04a	10048
11	22.89	Total>	96.16	22.83m	176.19	31.59	31.59	10048
12	22.73	Total>	99.06	23.58m	179.08	38.71	38.71	10048
13	22.36	Total>	106.27	26.27	186.30	55.91	55.91	10048
14	22.00	Total>	113.19	33.18	193.21	71.49	71.49	10048
		Total>	113.19	27.25m	329.17	45.97	45.97	23954
15	21.86	Total>	115.87	27.95m	333.58	55.94	55.94	24137
16	21.43	Total>	124.11	30.10m	347.15	84.64	84.64	24696
17	21.00	Total>	132.33	32.25m	360.69	110.07	110.07	25255
18	20.40	Total>	143.79	35.25m	379.58	139.98	139.98	26036
19	19.80	Total>	155.22	38.25m	398.44	163.98	163.98	26816
20	19.20	Total>	166.64	41.25m	417.29	183.23	183.23	27597
21	18.60	Total>	178.04	44.25m	436.12	199.02	199.02	28377
22	18.00	Total>	189.44	47.25m	454.94	212.55	212.55	29158
23	17.40	Total>	200.82	50.25m	473.75	224.77	224.77	29938
24	16.80	Total>	212.19	53.25m	492.55	236.37	236.37	30718
25	16.20	Total>	223.55	56.25m	511.34	247.71	247.71	31499
26	15.60	Total>	234.90	59.25m	530.13	258.98	258.98	32279
27	15.00	Total>	246.25	62.25m	548.90	270.18	270.18	33060

Node no.	Y coord	PASSIVE side: 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	Soil stiffness coeff. kN/m3
1	27.45	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	27.13	0.00	0.00	0.00	0.00	0.00	0.00	0.0
3	26.76	0.00	0.00	0.00	0.00	0.00	0.00	0.0
4	26.40	0.00	0.00	0.00	0.00	0.00	0.00	0.0
5	25.93	0.00	0.00	0.00	0.00	0.00	0.00	0.0
6	25.45	0.00	0.00	0.00	0.00	0.00	0.00	0.0
7	25.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
8	24.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
9	24.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
10	23.44	0.00	0.00	0.00	0.00	0.00	0.00	0.0
11	22.89	0.00	0.00	0.00	0.00	0.00	0.00	0.0
12	22.73	0.00	0.00	0.00	0.00	0.00	0.00	0.0
13	22.36	0.00	0.00	0.00	0.00	0.00	0.00	0.0
		Total>	0.00	0.00	80.01	80.01	80.01p	18970
14	22.00	Total>	6.84	1.80m	86.85	86.85	86.85p	18970
		Total>	6.84	1.80m	222.80	222.80	222.80p	45222
15	21.86	Total>	9.50	2.50m	227.19	225.75	225.75	45566
16	21.43	Total>	17.67	4.65m	240.69	200.53	200.53	46622
17	21.00	Total>	25.85	6.80m	254.19	181.39	181.39	47678
18	20.40	Total>	37.28	9.80m	273.05	165.07	165.07	49151
19	19.80	Total>	48.72	12.80m	291.92	159.68	159.68	50625
20	19.20	Total>	60.20	15.80m	310.82	163.09	163.09	52098
21	18.60	Total>	71.70	18.80m	329.76	172.87	172.87	53571
22	18.00	Total>	83.24	21.80m	348.73	186.80	186.80	55045

Run ID. Wall C Movement_SLS | Sheet No.
Camley Street | Date: 5-10-2015
Wall C movement | Checked :

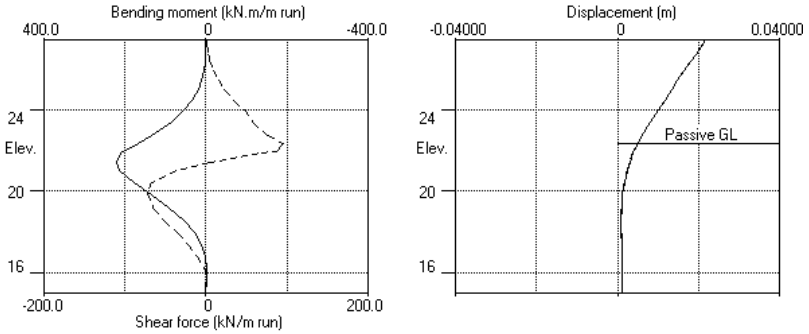
(continued)

Stage No.2 Excavate to elevation 22.36 on PASSIVE side

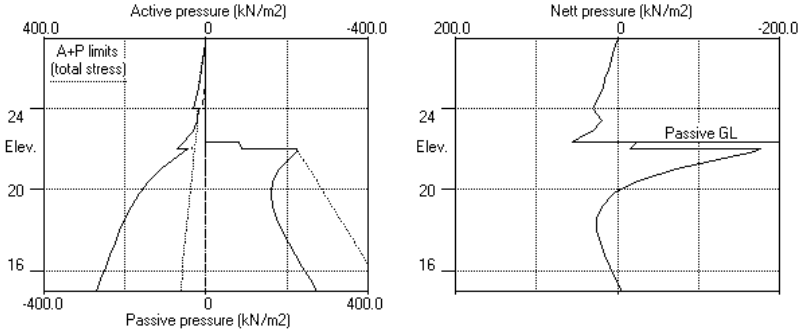
Node no.	Y coord	PASSIVE side: Water press. kN/m2	Vertic -al kN/m2	Effective stresses: Active limit kN/m2	Passive limit kN/m2	Earth pressure kN/m2	Total earth pressure kN/m2	Soil stiffness coeff. kN/m3
23	17.40	Total>	94.82	24.80m	367.74	203.11	203.11	56518
24	16.80	Total>	106.45	27.80m	386.79	220.57	220.57	57992
25	16.20	Total>	118.12	30.80m	405.89	238.47	238.47	59465
26	15.60	Total>	129.83	33.80m	425.03	256.54	256.54	60938
27	15.00	Total>	141.60	36.80m	444.22	274.73	274.73	62412

Note: 20.04a Soil pressure at active limit
222.80p Soil pressure at passive limit

Stage No.2 Excav. to elev. 22.36 on PASSIVE side



Stage No.2 Excav. to elev. 22.36 on PASSIVE side



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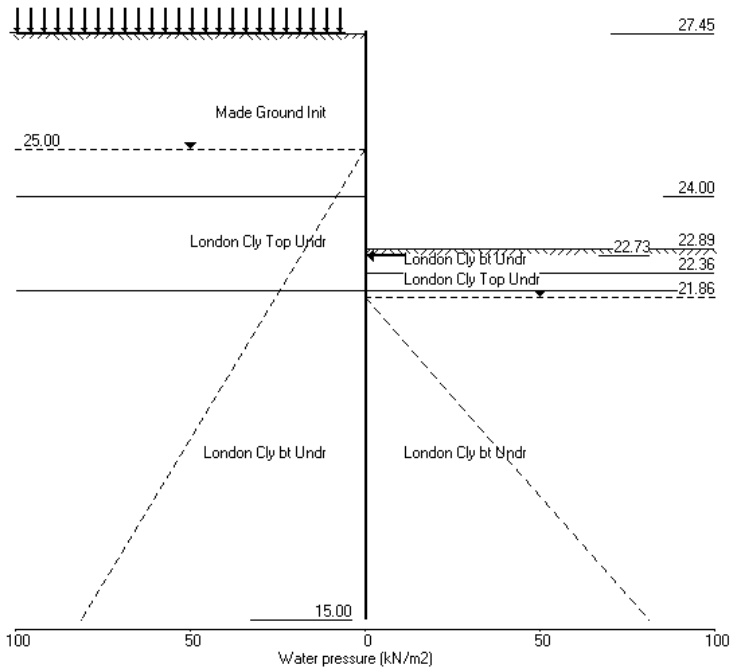
Camley Street | Date: 5-10-2015
Wall C movement | Checked :
Units: kN,m

Stage No.4 Fill to elev. 22.89 on PASSIVE side



Units: kN,m

Stage No. 4 Fill to elevation 22.89 on PASSIVE side with soil type 6

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: Active side 20.00 from wall
Passive 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/m2	Wall disp. m	Wall rotation rad.	Shear force kN/m	Bending moment kN.m/m	Strut forces kN/m
1	27.45	0.00	0.022	3.50E-03	0.0	0.0	
2	27.13	2.47	0.021	3.50E-03	0.4	0.1	
3	26.76	5.65	0.019	3.50E-03	1.9	0.5	
4	26.40	8.65	0.018	3.50E-03	4.5	1.6	
5	25.93	12.25	0.016	3.49E-03	9.4	4.8	
6	25.45	15.66	0.015	3.48E-03	16.1	10.8	
7	25.00	18.78	0.013	3.45E-03	23.8	19.7	
8	24.50	24.88	0.011	3.39E-03	34.7	34.2	
9	24.00	30.93	0.010	3.30E-03	48.7	54.9	
		18.45	0.010	3.30E-03	48.7	54.9	
10	23.44	21.38	0.008	3.14E-03	59.8	85.0	
11	22.89	33.07	0.006	2.90E-03	74.9	125.4	
12	22.73	39.47	0.006	2.82E-03	80.4	137.1	-0.0
13	22.36	52.01	0.005	2.58E-03	97.5	169.9	
		-30.35	0.005	2.58E-03	97.5	169.9	
14	22.00	-21.48	0.004	2.30E-03	88.2	203.1	
		-178.17	0.004	2.30E-03	88.2	203.1	
15	21.86	-170.99	0.004	2.18E-03	63.8	214.2	
16	21.43	-116.64	0.003	1.79E-03	1.9	225.9	
17	21.00	-71.72	0.002	1.39E-03	-38.6	215.9	
18	20.40	-25.13	0.001	9.07E-04	-67.6	179.9	
19	19.80	4.50	0.001	5.17E-04	-73.8	134.9	
20	19.20	20.48	0.001	2.36E-04	-66.3	91.5	
21	18.60	26.53	0.001	5.37E-05	-52.2	55.4	
22	18.00	26.12	0.001	-5.09E-05	-36.4	28.9	
23	17.40	21.99	0.001	-1.01E-04	-22.0	11.8	
24	16.80	16.05	0.001	-1.19E-04	-10.6	2.6	
25	16.20	9.40	0.001	-1.21E-04	-2.9	-0.8	
26	15.60	2.50	0.001	-1.19E-04	0.6	-0.9	
27	15.00	-4.62	0.001	-1.18E-04	0.0	0.0	

At elev. 22.73 The strut is slack

Node no.	Y coord	ACTIVE side: 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	Soil stiffness coeff. kN/m3
1	27.45	0.00	0.00	0.00	0.00	0.00	0.00	2031
2	27.13	0.00	7.01	2.36	24.13	2.47	2.47	2031
3	26.76	0.00	16.33	5.50	56.20	5.65	5.65	2031
4	26.40	0.00	25.12	8.46	86.46	8.65	8.65	2031

(continued)

Stage No.4 Fill to elevation 22.89 on PASSIVE side with soil type 6

Node no.	Y coord	ACTIVE side: 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	Soil stiffness coeff. kN/m3
5	25.93	0.00	35.68	12.01	122.82	12.25	12.25	2031
6	25.45	0.00	45.63	15.36	157.08	15.66	15.66	2031
7	25.00	0.00	54.76	18.44	188.50	18.78	18.78	2031
8	24.50	4.07	60.64	20.41	208.73	20.81	24.88	2031
9	24.00	8.14	66.39	22.35	228.52	22.79	30.93	2031
		Total>	74.53	17.25m	154.55	18.45	18.45	5470
10	23.44	Total>	85.38	20.04m	165.40	21.38	21.38	5470
11	22.89	Total>	96.16	22.83m	176.19	33.07	33.07	5470
12	22.73	Total>	99.06	23.58m	179.08	40.22	40.22	5470
13	22.36	Total>	106.27	26.27	186.30	57.49	57.49	5470
14	22.00	Total>	113.19	33.18	193.21	73.13	73.13	5470
		Total>	113.19	27.25m	329.17	49.88	49.88	13039
15	21.86	Total>	115.87	27.95m	333.58	59.93	59.93	13138
16	21.43	Total>	124.11	30.10m	347.15	88.83	88.83	13443
17	21.00	Total>	132.33	32.25m	360.69	114.43	114.43	13747
18	20.40	Total>	143.79	35.25m	379.58	144.52	144.52	14172
19	19.80	Total>	155.22	38.25m	398.44	168.64	168.64	14597
20	19.20	Total>	166.64	41.25m	417.29	187.96	187.96	15022
21	18.60	Total>	178.04	44.25m	436.12	203.78	203.78	15447
22	18.00	Total>	189.44	47.25m	454.94	217.31	217.31	15871
23	17.40	Total>	200.82	50.25m	473.75	229.52	229.52	16296
24	16.80	Total>	212.19	53.25m	492.55	241.09	241.09	16721
25	16.20	Total>	223.55	56.25m	511.34	252.40	252.40	17146
26	15.60	Total>	234.90	59.25m	530.13	263.61	263.61	17571
27	15.00	Total>	246.25	62.25m	548.90	274.76	274.76	17995

Node no.	Y coord	PASSIVE side: 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	Soil stiffness coeff. kN/m3
1	27.45	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	27.13	0.00	0.00	0.00	0.00	0.00	0.00	0.0
3	26.76	0.00	0.00	0.00	0.00	0.00	0.00	0.0
4	26.40	0.00	0.00	0.00	0.00	0.00	0.00	0.0
5	25.93	0.00	0.00	0.00	0.00	0.00	0.00	0.0
6	25.45	0.00	0.00	0.00	0.00	0.00	0.00	0.0
7	25.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
8	24.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
9	24.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
10	23.44	0.00	0.00	0.00	0.00	0.00	0.00	0.0
11	22.89	0.00	0.00	0.00	0.00	0.00	0.00	0.0
		Total>	0.00	0.00	205.00	0.00	0.00a	13776
12	22.73	Total>	2.85	0.75m	209.71	0.75	0.75a	13894
13	22.36	Total>	9.98	2.63m	221.48	5.48	5.48	14189
		Total>	9.98	2.63m	89.99	87.84	87.84	6071
14	22.00	Total>	16.82	4.43m	96.83	94.62	94.62	6071
		Total>	16.82	4.43m	232.78	228.05	228.05	14472
15	21.86	Total>	19.48	5.13m	237.17	230.92	230.92	14582
16	21.43	Total>	27.66	7.28m	250.68	205.47	205.47	14920
17	21.00	Total>	35.85	9.43m	264.19	186.15	186.15	15258
18	20.40	Total>	47.28	12.42m	283.05	169.64	169.64	15729
19	19.80	Total>	58.75	15.42m	301.95	164.14	164.14	16201
20	19.20	Total>	70.24	18.42m	320.86	167.48	167.48	16672

(continued)

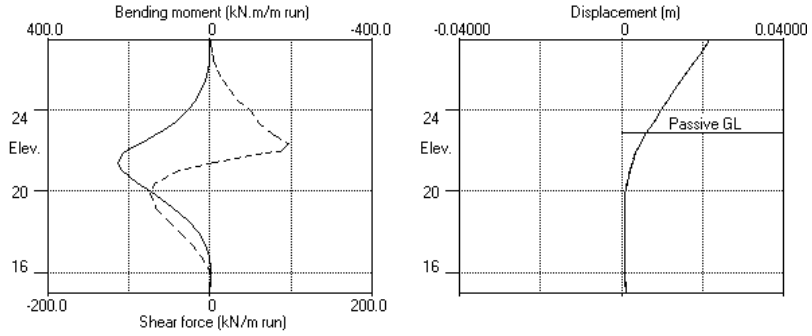
Stage No.4 Fill to elevation 22.89 on PASSIVE side with soil type 6

Node no.	Y coord	PASSIVE side: Water press.	Effective stresses: Vertic -al	Active limit	Passive limit	Earth pressure	Total earth pressure	Soil stiffness coeff.
		kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m3
21	18.60	Total>	81.76	21.43m	339.82	177.25	177.25	17144
22	18.00	Total>	93.32	24.43m	358.80	191.19	191.19	17615
23	17.40	Total>	104.91	27.42m	377.83	207.53	207.53	18087
24	16.80	Total>	116.55	30.42m	396.89	225.03	225.03	18558
25	16.20	Total>	128.23	33.42m	416.00	242.99	242.99	19030
26	15.60	Total>	139.95	36.42m	435.15	261.11	261.11	19501
27	15.00	Total>	151.71	39.43m	454.34	279.37	279.37	19973

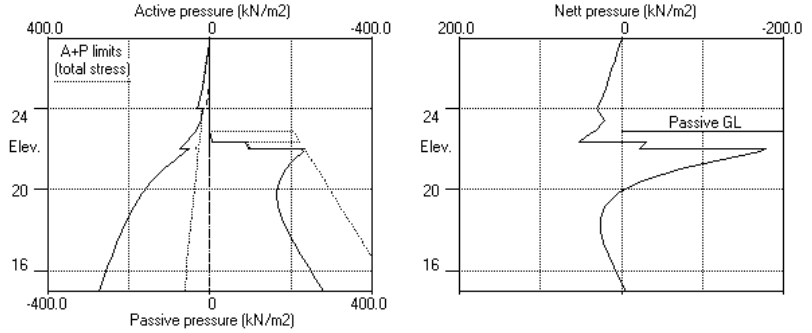
Note: 0.75a Soil pressure at active limit
123.45p Soil pressure at passive limit

Units: kN,m

Stage No.4 Fill to elev. 22.89 on PASSIVE side



Stage No.4 Fill to elev. 22.89 on PASSIVE side



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: Active side 20.00 from wall
Passive side 20.00 from wall

Limit State: ULS DA1 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 max. m	Displacement min. m	Bending moment Calculated max. kN.m/m	Bending moment Calculated min. kN.m/m	Bending moment Factored max. kN.m/m	Bending moment Factored min. kN.m/m	Shear force Calculated max. kN/m	Shear force Calculated min. kN/m	Shear force Factored max. kN/m	Shear force Factored min. kN/m
1	27.45	0.022	0.000	0	0	0	0	0	0	0	0
2	27.13	0.021	0.000	0	0	0	0	0	-1	1	-1
3	26.76	0.019	0.000	0	-0	1	-0	2	-1	3	-2
4	26.40	0.018	0.000	2	-1	2	-1	4	-2	6	-2
5	25.93	0.016	0.000	5	-2	6	-2	9	-2	13	-3
6	25.45	0.015	0.000	11	-3	15	-4	17	-2	23	-3
7	25.00	0.013	0.000	20	-4	27	-5	26	-2	35	-3
8	24.50	0.012	0.000	36	-5	48	-6	40	-2	54	-2
9	24.00	0.010	0.000	60	-5	81	-7	57	0	77	0
10	23.44	0.008	0.000	98	-5	132	-6	80	0	107	0
11	22.89	0.007	0.000	153	-3	206	-4	106	0	143	0
12	22.73	0.006	0.000	169	-2	228	-3	113	-18	153	-24
13	22.36	0.005	0.000	170	-0	229	-0	98	0	132	0
14	22.00	0.005	0.000	203	0	274	0	88	-0	119	-0
15	21.86	0.004	0.000	214	0	289	0	64	-5	87	-6
16	21.43	0.004	0.000	226	0	305	0	4	-17	6	-23
17	21.00	0.003	0.000	216	0	292	0	2	-39	3	-52
18	20.40	0.002	0.000	180	0	243	0	0	-68	0	-91
19	19.80	0.002	0.000	135	0	182	0	0	-74	0	-100
20	19.20	0.001	0.000	91	0	123	0	0	-66	0	-90
21	18.60	0.001	0.000	68	0	92	0	0	-52	0	-70
22	18.00	0.001	0.000	48	0	65	0	0	-36	0	-49
23	17.40	0.001	0.000	31	0	42	0	0	-26	0	-35
24	16.80	0.001	0.000	17	0	23	0	0	-20	0	-27
25	16.20	0.001	0.000	7	-1	10	-1	0	-13	0	-18
26	15.60	0.001	0.000	2	-1	2	-1	1	-6	1	-9
27	15.00	0.001	0.000	0	0	0	0	0	-0	0	-0

Summary of results (continued)

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

Maximum and minimum bending moment and shear force at each stage

Stage no.	Bending moment Calculated max. kN.m/m	elev.	Bending moment Calculated min. kN.m/m	elev.	Bending moment Factored max. kN.m/m	Bending moment Factored min. kN.m/m	Shear force Calculated max. kN/m	elev.	Shear force Calculated min. kN/m	elev.	Shear force Factored max. kN/m	Shear force Factored min. kN/m
1	8	20.40	-5	24.00	11	-7	9	22.00	-3	18.60	12	-3
2	222	21.43	-1	15.60	299	-1	96	22.36	-73	19.80	129	-98
3	No calculation at this stage											
4	226	21.43	-1	15.60	305	-1	98	22.36	-74	19.80	132	-100
5	No calculation at this stage											
6	No calculation at this stage											
7	No calculation at this stage											
8	No calculation at this stage											
9	No calculation at this stage											
10	169	22.73	0	27.45	228	0	113	22.73	-33	18.60	153	-45

Maximum and minimum displacement at each stage

Stage no.	Displacement maximum m	elev.	Displacement minimum m	elev.	Stage description
1	0.001	27.45	0.000	27.45	Apply surcharge no.1 at elev. 27.45
2	0.022	27.45	0.000	27.45	Excav. to elev. 22.36 on PASSIVE side
3	No calculation at this stage				Install strut no.2 at elev. 22.73
4	0.022	27.45	0.000	27.45	Fill to elev. 22.89 on PASSIVE side
5	No calculation at this stage				Install strut no.3 at elev. 27.13
6	No calculation at this stage				Change soil type 8 to soil type 1
7	No calculation at this stage				Apply water pressure profile no.1
8	No calculation at this stage				Change soil type 3 to soil type 4
9	No calculation at this stage				Change soil type 6 to soil type 7
10	0.022	27.45	0.000	27.45	Apply surcharge no.2 at elev. 22.36

Strut forces at each stage (horizontal components)

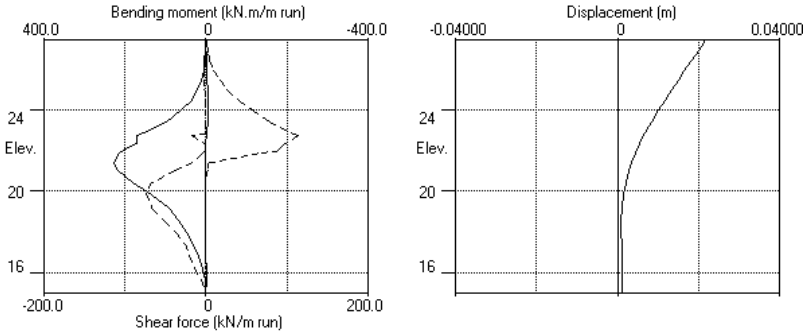
Stage no.	Strut no. 2 at elev. 22.73 --Calculated-- kN per m run	Strut no. 2 at elev. 22.73 Factored kN per strut	Strut no. 3 at elev. 27.13 --Calculated-- kN per m run	Strut no. 3 at elev. 27.13 Factored kN per strut
4	slack	slack	slack	---	---	---
10	131	131	176	1	1	2

* Indicates that the total force shown is the sum of the force in the strut plus a force applied at the same elevation which may represent temperature load or other forces which are part of the strut load. Force components are listed in the detailed results for individual stages.

GEOFIRMA LTD | Sheet No.
Program: WALLAP Version 6.05 Revision A45.B58.R49 | Job No. JMP0014
Licensed from GEOSOLVE | Made by : EA
Data filename/Run ID: Wall C Movement_SLS |
Camley Street | Date: 5-10-2015
Wall C movement | Checked :

Units: kN,m

Bending moment, shear force, displacement envelopes



PILE BEARING AND SETTLEMENT ANALYSIS

Analysis Options

Design method	Working load
Are compression calculations enabled?	Yes
Is global FoS criterion for compression active?	Yes
Global factor on ultimate bearing capacity Fg	2.6000
Is partial FoS criterion for compression active?	No
Is shaft FoS criterion for compression active?	Yes
Factor applied to ultimate skin friction Fs2	1.2000
Is pile limiting stress criterion for compression active?	No
Are tension calculations enabled?	No
Datum type	Elevation based
Effective stress profile	Calculated

Pile Properties

Pile type	Solid
Pile cross-section	Circular
Under-ream	No
Calculation profile	Range
Minimum pile length	10.000 m
Maximum pile length	25.000 m
Increment size	0.50000

Cross-section	Shaft diameter [m]
Cross-section 1	0.75000

Undrained Materials - General Data

No.	Material description	Bulk unit weight [kN/m³]	Cu material factor	Top Cu [kPa]	Base Cu [kPa]
1	London Clay 1	19.000	NA	40.000	40.000
2	London Clay 2	19.000	NA	80.000	225.00
3	London Clay 3	19.000	NA	225.00	225.00

Undrained Materials - Skin Friction Data

No.	Material description	Skin friction computation	Alpha	q_s Top [kPa]	q_s Base [kPa]	$q_{s,lim}$ Spec.	$q_{s,lim}$ Value [kPa]
1	London Clay 1	Alpha specified	0.50000	NA	NA	No	NA
2	London Clay 2	Alpha specified	0.50000	NA	NA	No	NA
3	London Clay 3	Alpha specified	0.50000	NA	NA	No	NA

Undrained Materials - End Bearing Data

No.	Material description	End bearing computation	Nc	q_b Top [kPa]	q_b Base [kPa]	$q_{b,lim}$ Spec.	$q_{b,lim}$ Value [kPa]
1	London Clay 1	Nc specified	9.0000	NA	NA	No	NA
2	London Clay 2	Nc specified	9.0000	NA	NA	No	NA
3	London Clay 3	Nc specified	9.0000	NA	NA	No	NA

STAGE SPECIFIC DATA

Oasys
GEOFIRMA LTD
Camley Street
Wall Bearing Capacity
Job No. JMP0014 | Sheet No. | Rev.
Drg. Ref.
Made by EA | Date | Checked

No.	Material description	End bearing computation	Nc	q_b Top [kPa]	q_b Base [kPa]	$q_{b,lim}$ Spec.	$q_{b,lim}$ Value [kPa]

Stage 0 : Initial Stage

Groundwater

No.	Level [m]	Pressure [kPa]	Unit weight of water [kN/m³]
1	27.300	0.0	10.000

Soil Profiles

Soil Profile 1: Soil Profile 1

No.	Level [mOD]	Material description	Contributes to negative skin friction
1	22.400	London Clay 1	No
2	22.000	London Clay 2	No
3	-2.0000	London Clay 3	No

Soil Profile - Groundwater Map

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

Stage specific warnings

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

CAPACITY RESULTS

Stress Profiles

Soil Profile 1: Soil Profile 1

Level [mOD]	Density [kN/m³]	Undrained Cohesion [kPa]	Nq	Total vertical stress [kPa]	Porewater pressure [kPa]	Effective vertical stress [kPa]	Effective horizontal stress* [kPa]	Cumulative skin friction per unit perimeter [kN/m]
27.300	10.000	0.0	0.0	0.0	0.0	0.0	NA	0.0
22.400	10.000	0.0	0.0	49.000	49.000	0.0	NA	0.0
22.400	19.000	40.000	N.A.	49.000	49.000	0.0	NA	0.0
22.000	19.000	40.000	N.A.	56.600	53.000	3.6000	NA	8.0000
22.000	19.000	80.000	N.A.	56.600	53.000	3.6000	NA	8.0000
12.400	19.000	138.00	N.A.	239.00	149.00	90.000	NA	531.20
11.900	19.000	141.02	N.A.	248.50	154.00	94.500	NA	566.08
11.400	19.000	144.04	N.A.	258.00	159.00	99.000	NA	601.71
10.900	19.000	147.06	N.A.	267.50	164.00	103.50	NA	638.10
10.400	19.000	150.08	N.A.	277.00	169.00	108.00	NA	675.24
9.9000	19.000	153.10	N.A.	286.50	174.00	112.50	NA	713.14
9.4000	19.000	156.13	N.A.	296.00	179.00	117.00	NA	751.79
8.9000	19.000	159.15	N.A.	305.50	184.00	121.50	NA	791.20
8.4000	19.000	162.17	N.A.	315.00	189.00	126.00	NA	831.37
7.9000	19.000	165.19	N.A.	324.50	194.00	130.50	NA	872.29
7.4000	19.000	168.21	N.A.	334.00	199.00	135.00	NA	913.96
6.9000	19.000	171.23	N.A.	343.50	204.00	139.50	NA	956.39
6.4000	19.000	174.25	N.A.	353.00	209.00	144.00	NA	999.58
5.9000	19.000	177.27	N.A.	362.50	214.00	148.50	NA	1043.5

Level	Density	Undrained Cohesion	Nq	Total vertical stress	Porewater pressure	Effective vertical stress	Effective horizontal stress*	Cumulative skin friction per unit
5.4000	19.000	180.29	N.A.	372.00	219.00	153.00	NA	1088.2
4.9000	19.000	183.31	N.A.	381.50	224.00	157.50	NA	1133.7
4.4000	19.000	186.33	N.A.	391.00	229.00	162.00	NA	1179.9
3.9000	19.000	189.35	N.A.	400.50	234.00	166.50	NA	1226.8
3.4000	19.000	192.38	N.A.	410.00	239.00	171.00	NA	1274.5
2.9000	19.000	195.40	N.A.	419.50	244.00	175.50	NA	1323.0
2.4000	19.000	198.42	N.A.	429.00	249.00	180.00	NA	1372.2
1.9000	19.000	201.44	N.A.	438.50	254.00	184.50	NA	1422.2
1.4000	19.000	204.46	N.A.	448.00	259.00	189.00	NA	1473.0
0.90000	19.000	207.48	N.A.	457.50	264.00	193.50	NA	1524.5
0.40000	19.000	210.50	N.A.	467.00	269.00	198.00	NA	1576.7
-0.10000	19.000	213.52	N.A.	476.50	274.00	202.50	NA	1629.7
-0.60000	19.000	216.54	N.A.	486.00	279.00	207.00	NA	1683.5
-1.1000	19.000	219.56	N.A.	495.50	284.00	211.50	NA	1738.0
-1.6000	19.000	222.58	N.A.	505.00	289.00	216.00	NA	1793.2
-2.0000	19.000	225.00	N.A.	512.60	293.00	219.60	NA	1838.0
-2.0000	19.000	225.00	N.A.	512.60	293.00	219.60	NA	1838.0
-2.1000	19.000	225.00	N.A.	514.50	294.00	220.50	NA	1849.3
-2.6000	19.000	225.00	N.A.	524.00	299.00	225.00	NA	1905.5

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

Cross-section 1 results:

Results - Compression

Soil Profile 1: Soil Profile 1

Level	Pile length	Ultimate base capacity (Q_b)	Cumulative external Friction (Q_s)	Negative skin friction (Q_{nsf})	Ultimate capacity	Allowable capacity	Limiting criterion #
[mOD]	[m]	[kN]	[kN]	[kN]	[kN]	[kN]	
12.400	10.000	548.70	1251.6	0.0	1800.3	692.43	1
11.900	10.500	560.71	1333.8	0.0	1894.5	728.65	1
11.400	11.000	572.72	1417.7	0.0	1990.5	765.56	1
10.900	11.500	584.73	1503.5	0.0	2088.2	803.16	1
10.400	12.000	596.74	1591.0	0.0	2187.7	841.44	1
9.9000	12.500	608.75	1680.3	0.0	2289.1	880.40	1
9.4000	13.000	620.77	1771.4	0.0	2392.1	920.05	1
8.9000	13.500	632.78	1864.2	0.0	2497.0	960.39	1
8.4000	14.000	644.79	1958.9	0.0	2603.6	1001.4	1
7.9000	14.500	656.80	2055.3	0.0	2712.1	1043.1	1
7.4000	15.000	668.81	2153.5	0.0	2822.3	1085.5	1
6.9000	15.500	680.82	2253.4	0.0	2934.3	1128.6	1
6.4000	16.000	692.83	2355.2	0.0	3048.0	1172.3	1
5.9000	16.500	704.84	2458.7	0.0	3163.6	1216.8	1
5.4000	17.000	716.85	2564.0	0.0	3280.9	1261.9	1
4.9000	17.500	728.86	2671.1	0.0	3400.0	1307.7	1
4.4000	18.000	740.88	2780.0	0.0	3520.9	1354.2	1
3.9000	18.500	752.89	2890.6	0.0	3643.5	1401.4	1
3.4000	19.000	764.90	3003.1	0.0	3768.0	1449.2	1
2.9000	19.500	776.91	3117.3	0.0	3894.2	1497.8	1
2.4000	20.000	788.92	3233.3	0.0	4022.2	1547.0	1
1.9000	20.500	800.93	3351.0	0.0	4152.0	1596.9	1
1.4000	21.000	812.94	3470.6	0.0	4283.5	1647.5	1
0.90000	21.500	824.95	3591.9	0.0	4416.9	1698.8	1
0.40000	22.000	836.96	3715.0	0.0	4552.0	1750.8	1
-0.10000	22.500	848.98	3839.9	0.0	4688.9	1803.4	1
-0.60000	23.000	860.99	3966.6	0.0	4827.5	1856.7	1
-1.1000	23.500	873.00	4095.0	0.0	4968.0	1910.8	1
-1.6000	24.000	885.01	4225.2	0.0	5110.2	1965.5	1
-2.1000	24.500	894.62	4357.2	0.0	5251.8	2019.9	1
-2.6000	25.000	894.62	4489.7	0.0	5384.3	2070.9	1

Limiting criteria :
1: Global factor of safety
2: Shaft and base factors of safety
3: Shaft factor of safety
4: Pile material limiting stress [Compression]

Nq Calculation Details

Oasys
GEOFIRMA LTD
Camley Street
Wall Bearing Capacity
Job No. JMP0014 | Sheet No. | Rev.
Drg. Ref.
Made by EA | Date | Checked

Level	Pile length	Ultimate base capacity (Q_b)	Cumulative external Friction (Q_s)	Negative skin friction (Q_{nsf})	Ultimate capacity	Allowable capacity	Limiting criterion #

Soil Profile 1: Soil Profile 1

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

Analysis Options

Datum type	Elevation based
Effective stress profile	Calculated
Rigid boundary level	-10.000 mOD
Poisson's ratio of soil	0.25000
Young's modulus of soil above toe level of pile	75000. kPa
Young's modulus of soil below toe level of pile	75000. kPa
Number of pile elements	10
Increment type:	Both loads and displacements
Number of load & displacement increments	100
Increment results would be printed once every	100 increments
Include effect of soil above pile base in base displacement calculation	Yes

Pile Properties

Pile type	Solid
Pile cross-section	Circular
Under-ream	No
Use different values of Young's modulus for compression and tension	No
Young's modulus of pile	20.000E+6 kPa
Is fixed head boundary condition active?	No
Calculation profile	Single
Pile length	24.000 m

Cross-section	Shaft diameter [m]
Cross-section 1	0.75000

Undrained Materials - General Data

No.	Material description	Bulk unit weight [kN/m³]	Cu material factor	Top Cu [kPa]	Base Cu [kPa]
1	London Clay 1	19.000	NA	40.000	40.000
2	London Clay 2	19.000	NA	80.000	225.00
3	London Clay 3	19.000	NA	225.00	225.00

Undrained Materials - Skin Friction Data

No.	Material description	Skin friction computation	Alpha	q_s Top [kPa]	q_s Base [kPa]	$q_{s,lim}$ Spec.	$q_{s,lim}$ Value [kPa]
1	London Clay 1	Alpha specified	0.50000	NA	NA	No	NA
2	London Clay 2	Alpha specified	0.50000	NA	NA	No	NA
3	London Clay 3	Alpha specified	0.50000	NA	NA	No	NA

Undrained Materials - End Bearing Data

No.	Material description	End bearing computation	Nc	q_b Top [kPa]	q_b Base [kPa]	$q_{b,lim}$ Spec.	$q_{b,lim}$ Value [kPa]
1	London Clay 1	Nc specified	9.0000	NA	NA	No	NA
2	London Clay 2	Nc specified	9.0000	NA	NA	No	NA
3	London Clay 3	Nc specified	9.0000	NA	NA	No	NA

Oasys GEOFIRMA LTD

Job No. JMP0014 | Sheet No. | Rev.
Drg. Ref.
Made by EA | Date | Checked

Camley Street
Pile Settlement
Heavily loaded Pile

No.	Material description	End bearing computation	Nc	q_b Top [kPa]	q_b Base [kPa]	$q_{b,lim}$ Spec.	$q_{b,lim}$ Value [kPa]

Convergence Control Data

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

STAGE SPECIFIC DATA

Stage 0 : Initial Stage

Soil Profiles

Soil Profile 1: Soil Profile 1

No.	Level [mOD]	Material description	Contributes to negative skin friction
1	22.400	London Clay 1	No
2	22.000	London Clay 2	No
3	-2.0000	London Clay 3	No

Soil Profile - Groundwater Map

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

Static Loads & Displacements

Level [mOD]	Applied load [kN]	Prescribed soil displacement [mm]
22.400	1961.5	0.0

Calculated Limiting shaft skin friction

Soil Profile 1: Soil Profile 1

Cross Section 1

Level [mOD]	Limiting shaft skin friction [kPa]
22.400	20.000
22.000	20.000
22.000	40.000
-1.6000	111.29

Stage specific warnings

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

SETTLEMENT RESULTS

Level [mOD]	Limiting shaft skin friction [kPa]

Soil Profile 1: Soil Profile 1

Results for Length 24.000 [m] Cross-section 1 Load & Displacement increment 100

Load applied to pile = 1961.5 kN
Converged at iteration number = 3
Maximum displacement = 3.1415 mm at node 1
Displacement error = 0.0019488 mm
Skin friction error = 0.15411 kPa

Stresses and Displacements along Pile

Level [mOD]	Shaft skin friction [kPa]	Pile stress [kPa]	Pile displacement [mm]
21.200	42.417	4168.5	3.1415
18.800	49.667	3579.1	2.6741
16.400	47.080	2960.0	2.2832
14.000	36.172	2427.1	1.9646
11.600	30.193	2002.4	1.7016
9.2000	25.864	1643.6	1.4850
6.8000	22.903	1331.5	1.3081
4.4000	21.232	1049.1	1.1664
2.0000	20.801	780.06	1.0573
-0.40000	29.052	460.99	0.98009

Base pressure = 289.47 kPa Base displacement = 0.95745 mm

Analysis Options

Datum type	Elevation based
Effective stress profile	Calculated
Rigid boundary level	-10.000 mOD
Poisson's ratio of soil	0.25000
Young's modulus of soil above toe level of pile	52000. kPa
Young's modulus of soil below toe level of pile	52000. kPa
Number of pile elements	10
Increment type:	Both loads and displacements
Number of load & displacement increments	100
Increment results would be printed once every	100 increments
Include effect of soil above pile base in base displacement calculation	Yes

Pile Properties

Pile type	Solid
Pile cross-section	Circular
Under-ream	No
Use different values of Young's modulus for compression and tension	No
Young's modulus of pile	20.000E+6 kPa
Is fixed head boundary condition active?	No
Calculation profile	Single
Pile length	12.000 m

Cross-section	Shaft diameter [m]
Cross-section 1	0.75000

Undrained Materials - General Data

No.	Material description	Bulk unit weight [kN/m³]	Cu material factor	Top Cu [kPa]	Base Cu [kPa]
1	London Clay 1	19.000	NA	40.000	40.000
2	London Clay 2	19.000	NA	80.000	225.00
3	London Clay 3	19.000	NA	225.00	225.00

Undrained Materials - Skin Friction Data

No.	Material description	Skin friction computation	Alpha	q_s Top [kPa]	q_s Base [kPa]	$q_{s,lim}$ Spec.	$q_{s,lim}$ Value [kPa]
1	London Clay 1	Alpha specified	0.50000	NA	NA	No	NA
2	London Clay 2	Alpha specified	0.50000	NA	NA	No	NA
3	London Clay 3	Alpha specified	0.50000	NA	NA	No	NA

Undrained Materials - End Bearing Data

No.	Material description	End bearing computation	Nc	q_b Top [kPa]	q_b Base [kPa]	$q_{b,lim}$ Spec.	$q_{b,lim}$ Value [kPa]
1	London Clay 1	Nc specified	9.0000	NA	NA	No	NA
2	London Clay 2	Nc specified	9.0000	NA	NA	No	NA
3	London Clay 3	Nc specified	9.0000	NA	NA	No	NA

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Job No. JMP0014 | Sheet No. | Rev.
Drg. Ref.
Made by EA | Date | Checked

Camley Street
Pile Settlement
Heavily loaded Pile

No.	Material description	End bearing computation	Nc	q_b Top [kPa]	q_b Base [kPa]	$q_{b,lim}$ Spec.	$q_{b,lim}$ Value [kPa]

Convergence Control Data

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

STAGE SPECIFIC DATA

Stage 0 : Initial Stage

Soil Profiles

Soil Profile 1: Soil Profile 1

No.	Level [mOD]	Material description	Contributes to negative skin friction
1	22.400	London Clay 1	No
2	22.000	London Clay 2	No
3	-2.0000	London Clay 3	No

Soil Profile - Groundwater Map

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

Static Loads & Displacements

Level [mOD]	Applied load [kN]	Prescribed soil displacement [mm]
22.400	552.00	0.0

Calculated Limiting shaft skin friction

Soil Profile 1: Soil Profile 1

Cross Section 1

Level [mOD]	Limiting shaft skin friction [kPa]
22.400	20.000
22.000	20.000
22.000	40.000
10.400	75.042

Stage specific warnings

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

SETTLEMENT RESULTS

Level [mOD]	Limiting shaft skin friction [kPa]

Soil Profile 1: Soil Profile 1

Results for Length 12.000 [m] Cross-section 1 Load & Displacement increment 100

Load applied to pile = 552.00 kN
Converged at iteration number = 3
Maximum displacement = 1.3438 mm at node 1
Displacement error = 0.0 mm
Skin friction error = 0.0 kPa

Stresses and Displacements along Pile

Level [mOD]	Shaft skin friction [kPa]	Pile stress [kPa]	Pile displacement [mm]
21.800	17.496	1193.5	1.3438
20.600	16.838	1083.6	1.2755
19.400	16.339	977.45	1.2137
18.200	15.673	875.01	1.1582
17.000	15.138	776.41	1.1087
15.800	14.778	680.68	1.0650
14.600	14.647	586.52	1.0270
13.400	14.925	491.89	0.99466
12.200	15.218	395.43	0.96801
11.000	25.475	265.21	0.94721

Base pressure = 195.01 kPa Base displacement = 0.94023 mm

STEEL QUANTITY ASSESSMENT USING ADC and GEOFIRMA SPREADSHEET

Camley

750 mm
Reinforcement Calculation

Notes:

None

History

Date	Time	Name	Note
05-Oct-2015	18:00	ebscool72	

Input Data

General Specification

Design code	EN 1992-1-1:2004 Eurocode 2 (GB)
Country	United Kingdom
Bending Axes	Biaxial
Imperfection Moment yy	No
Imperfection Moment zz	No
2nd Order Moments	No
Width to Depth Ratio	Yes
Height to Thickness Ratio	Yes

Column Section and Slenderness

Sec.	STD C 713.
Clear height between end restraints y	14.00 m
Clear height between end restraints z	14.00 m
Compression member in regular frame	Yes
Bracing y	Yes
Bracing z	Yes
Rel. flex. of rotational restraint y top	0.0
Rel. flex. of rotational restraint y bottom	0.0
Rel. flex. of rotational restraint z top	0.0
Rel. flex. of rotational restraint z bottom	0.0

Notes:
Sections are defined as follows:
STD C Diameter => Circular Section

Concrete Material Specification

Prop.	Name	fck	Max. Agg. Size	Tensile Strength	Static E	Gamma c	Maximum Strain
		[N/mm²]	[mm]	[N/mm²]	[N/mm²]		
Column	C32/40	32.00	20.00	2.016	33350.	1.500	0.003500

Reinforcement Specification

Prop.	Name	fy	Bond Coeff. Tension	Bond Coeff. Compr.	Young's Modulus	Gamma s	Maximum Strain
		[N/mm²]			[N/mm²]		
Main	500A	500.0	0.5000	0.6300	200000.	1.150	0.02500
Links	500A	500.0	0.5000	0.6300	200000.	1.150	0.02500

Loads

Load Case	Axial Design Force 'N'	Moments			
		Top		Bottom	
		Myy	Mzz	Myy	Mzz
	[kN]	[kNm]	[kNm]	[kNm]	[kNm]
1	0.0	756.0	0.0	0.0	0.0

Analysis Cases

Analysis Case	Name	Description	Moment Ratio(y)	Moment Ratio(z)	Creep Coefficient
1	Analysis Case 1	1L1	0.7000	0.7000	0.2000

Covers

Min. Nominal Cover (outer) 75.00 mm

Available Bar Sizes

Name	Size [mm]
0	8.000
1	10.00
2	12.00
3	16.00
4	20.00
5	25.00
6	32.00
7	40.00

Bar Limits

	Minimum [mm]	Maximum [mm]
Main	12.00	40.00
Links	8.000	10.00

Checks and Limits

Max. Area of Reinf.	None
Min. Area of Reinf.	None
Min. Bar Size	None
Min. No of Bars	None
Max. bar spacing (tension)	None
Max. bar spacing (compression)	None
Min. Bar Spacing	None
Link size	None
Maximum Link Spacing	EN 1992-1-1:2004 Eurocode 2 (GB)
Top and bottom of column connected to beams or slabs	No
Cover check: bar size	None
Cover check: aggregate size	None
Deviation (Δc_{dev})	10.00 mm

Oasys

Camley
750 mm
Reinforcement Calculation

Job No. | Sheet No. | Rev.
Murphy
Drg. Ref.
Made by EA | Date 02-Oct-2015 | Checked

	Minimum [mm]	Maximum [mm]

Bar Arrangements

Nr of Rings	Nr of Bars per Ring	Ring Diameter
1	6; 7; 8; 9; 10	Cover and min. pitch

Eurocode 2 Nationally Determined Parameters

The following Nationally Determined Parameters (NDPs) are given the default values that are recommended in Eurocode 2.

Clause	Parameter	Default Value
5.2	a_g	1/200
8.2	k_1	1
8.2	k_2	5 mm
9.5.2(2)	AS_{min}	$\max(0.10N_{Ed}/f_{yd}, 0.002A_c)$
9.5.2(2)	AS_{max}	$0.04A_c$
9.5.2.9	ϕ_{min}	8 mm
9.5.3(3)	$s_{cl,tmax}$	min(20 x dia_{min}, min(width, depth), 400 mm)

The following NDPs are country specific and may found in its National Annex.

Clause	Parameter	Value
3.1.6	α_{cc}	0.8500

Design Results

Column Design Moment Derivation (for bending about y axis)

Derivation of column/Pile design moments output for the following selection:

Analysis Case All
Capacity All

Sec.	Analysis Case	Axial Design Force 'N'	Init. Top Moment	Init. Bottom Moment	l_0 (E5.14)	λ (E5.14)	A (E5.13)	B (E5.13)	C (E5.13)	n (E5.13)	λ_{lim} (E5.13)	K_r (E5.34)	K_ϕ (E5.34)	d (E5.35)	1/r (E5.33)	e_2 (E5.33)	e_0 (C6.1(4))	e_i (E5.2)	Braced	2nd Order Moment	Imp. Moment	Design Moment
		[kN]	[kNm]	[kNm]	[m]	[m]					[m]			[mm]	[/m]	[mm]	[mm]	[mm]		[kNm]	[kNm]	[kNm]
1	1	0.0	756.0	0.0	7.000	39.27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Yes	0.0 (0.0)		*756.0
2	1	0.0	756.0	0.0	7.000	39.27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Yes	0.0 (0.0)		*756.0
3	1	0.0	756.0	0.0	7.000	39.27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Yes	0.0 (0.0)		*756.0
4	1	0.0	756.0	0.0	7.000	39.27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Yes	0.0 (0.0)		*756.0
5	1	0.0	756.0	0.0	7.000	39.27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Yes	0.0 (0.0)		*756.0
6	1	0.0	756.0	0.0	7.000	39.27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Yes	0.0 (0.0)		*756.0
7	1	0.0	756.0	0.0	7.000	39.27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Yes	0.0 (0.0)		*756.0
8	1	0.0	756.0	0.0	7.000	39.27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Yes	0.0 (0.0)		*756.0
9	1	0.0	756.0	0.0	7.000	39.27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Yes	0.0 (0.0)		*756.0
10	1	0.0	756.0	0.0	7.000	39.27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Yes	0.0 (0.0)		*756.0
11	1	0.0	756.0	0.0	7.000	39.27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Yes	0.0 (0.0)		*756.0
12	1	0.0	756.0	0.0	7.000	39.27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Yes	0.0 (0.0)		*756.0
13	1	0.0	756.0	0.0	7.000	39.27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Yes	0.0 (0.0)		*756.0
14	1	0.0	756.0	0.0	7.000	39.27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Yes	0.0 (0.0)		*756.0
15	1	0.0	756.0	0.0	7.000	39.27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Yes	0.0 (0.0)		*756.0
16	1	0.0	756.0	0.0	7.000	39.27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Yes	0.0 (0.0)		*756.0
17	1	0.0	756.0	0.0	7.000	39.27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Yes	0.0 (0.0)		*756.0
18	1	0.0	756.0	0.0	7.000	39.27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Yes	0.0 (0.0)		*756.0
19	1	0.0	756.0	0.0	7.000	39.27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Yes	0.0 (0.0)		*756.0
20	1	0.0	756.0	0.0	7.000	39.27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Yes	0.0 (0.0)		*756.0
21	1	0.0	756.0	0.0	7.000	39.27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Yes	0.0 (0.0)		*756.0
22	1	0.0	756.0	0.0	7.000	39.27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Yes	0.0 (0.0)		*756.0
23	1	0.0	756.0	0.0	7.000	39.27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Yes	0.0 (0.0)		*756.0
24	1	0.0	756.0	0.0	7.000	39.27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Yes	0.0 (0.0)		*756.0
25	1	0.0	756.0	0.0	7.000	39.27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Yes	0.0 (0.0)		*756.0
26	1	0.0	756.0	0.0	7.000	39.27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Yes	0.0 (0.0)		*756.0
27	1	0.0	756.0	0.0	7.000	39.27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Yes	0.0 (0.0)		*756.0
28	1	0.0	756.0	0.0	7.000	39.27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Yes	0.0 (0.0)		*756.0
29	1	0.0	756.0	0.0	7.000	39.27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Yes	0.0 (0.0)		*756.0
30	1	0.0	756.0	0.0	7.000	39.27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Yes	0.0 (0.0)		*756.0
31	1	0.0	756.0	0.0	7.000	39.27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Yes	0.0 (0.0)		*756.0
32	1	0.0	756.0	0.0	7.000	39.27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Yes	0.0 (0.0)		*756.0
33	1	0.0	756.0	0.0	7.000	39.27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Yes	0.0 (0.0)		*756.0
34	1	0.0	756.0	0.0	7.000	39.27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Yes	0.0 (0.0)		*756.0
35	1	0.0	756.0	0.0	7.000	39.27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Yes	0.0 (0.0)		*756.0
36	1	0.0	756.0	0.0	7.000	39.27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Yes	0.0 (0.0)		*756.0
37	1	0.0	756.0	0.0	7.000	39.27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Yes	0.0 (0.0)		*756.0
38	1	0.0	756.0	0.0	7.000	39.27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Yes	0.0 (0.0)		*756.0
39	1	0.0	756.0	0.0	7.000	39.27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Yes	0.0 (0.0)		*756.0
40	1	0.0	756.0	0.0	7.000	39.27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Yes	0.0 (0.0)		*756.0
41	1	0.0	756.0	0.0	7.000	39.27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Yes	0.0 (0.0)		*756.0
42	1	0.0	756.0	0.0	7.000	39.27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Yes	0.0 (0.0)		*756.0
43	1	0.0	756.0	0.0	7.000	39.27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Yes	0.0 (0.0)		*756.0
44	1	0.0	756.0	0.0	7.000	39.27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Yes	0.0 (0.0)		*756.0
45	1	0.0	756.0	0.0	7.000	39.27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Yes	0.0 (0.0)		*756.0
46	1	0.0	756.0	0.0	7.000	39.27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Yes	0.0 (0.0)		*756.0
47	1	0.0	756.0	0.0	7.000	39.27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Yes	0.0 (0.0)		*756.0
48	1	0.0	756.0	0.0	7.000	39.27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Yes	0.0 (0.0)		*756.0
49	1	0.0	756.0	0.0	7.000	39.27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Yes	0.0 (0.0)		*756.0
50	1	0.0	756.0	0.0	7.000	39.27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Yes	0.0 (0.0)		*756.0
51	1	0.0	756.0	0.0	7.000	39.27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Yes	0.0 (0.0)		*756.0
52	1	0.0	756.0	0.0	7.000	39.27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Yes	0.0 (0.0)		*756.0
53	1	0.0	756.0	0.0	7.000	39.27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Yes	0.0 (0.0)		*756.0
54	1	0.0	756.0	0.0	7.000	39.27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Yes	0.0 (0.0)		*756.0
55	1	0.0	756.0	0.0	7.000	39.27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Yes	0.0 (0.0)		*756.0
56	1	0.0	756.0	0.0	7.000	39.27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Yes	0.0 (0.0)		*756.0
57	1	0.0	756.0	0.0	7.000	39.27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Yes	0.0 (0.0)		*756.0
58	1	0.0	756.0	0.0	7.000	39.27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Yes	0.0 (0.0)		*756.0
59	1	0.0	756.0	0.0	7.000	39.27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Yes	0.0 (0.0)		*756.0
60	1	0.0	756.0	0.0	7.000	39.27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Yes	0.0 (0.0)		*756.0

Notes:
( ) Moments shown thus have been excluded from the final design moment (ref Eurocode Cl 5.8.2(6) or Eurocode 2 Cl 5.8.9(2)).
* Design moments shown thus result from maximum end moment plus imperfection moment - if imperfection moment is to be applied about this axis.

Column Design Moment Derivation (for bending about z axis)

Derivation of column/Pile design moments output for the following selection:

Analysis Case All
Capacity All

Sec.	Analysis Case	Axial Design Force 'N'	Init. Top Moment	Init. Bottom Moment	l_0 (E5.14)	λ (E5.14)	A (E5.13)	B (E5.13)	C (E5.13)	n (E5.13)	λ_{lim} (E5.13)	K_r (E5.34)	K_ϕ (E5.34)	d (E5.35)	1/r (E5.33)	e_2 (E5.33)	e_0 (C6.1(4))	e_i (E5.2)	Braced	2nd Order Moment	Imp. Moment	Design Moment
		[kN]	[kNm]	[kNm]	[m]	[m]					[m]			[mm]	[/m]	[mm]	[mm]	[mm]		[kNm]	[kNm]	[kNm]
1	1	0.0	0.0	0.0	7.000	39.27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Yes	0.0	0.0	0.0
2	1	0.0	0.0	0.0	7.000	39.27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Yes	0.0	0.0	0.0
3	1	0.0	0.0	0.0	7.000	39.27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Yes	0.0	0.0	0.0
4	1	0.0	0.0	0.0	7.000	39.27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Yes	0.0	0.0	0.0
5	1	0.0	0.0	0.0	7.000	39.27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Yes	0.0	0.0	0.0
6	1	0.0	0.0	0.0	7.000	39.27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Yes	0.0	0.0	0.0
7	1	0.0	0.0	0.0	7.000	39.27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Yes	0.0	0.0	0.0
8	1	0.0	0.0	0.0	7.000	39.27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Yes	0.0	0.0	0.0

Sec.	Analysis Case	Design Axial Force 'N'	Init. Top Moment	Init. Bottom Moment	l_0 (E5.14)	λ (E5.14)	A (E5.13)	B (E5.13)	C (E5.13)	n (E5.13)	λ_{lim} (E5.13)	K_r (E5.34)	K_ϕ (E5.34)	d (E5.35)	1/r (E5.33)	e_2 (E5.33)	e_0 (C6.1(4))	e_i (E5.2)	Braced	2nd Order Moment	Imp. Moment	Design Moment
9	1	0.0	0.0	0.0	7.000	39.27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Yes	0.0	0.0	0.0
10	1	0.0	0.0	0.0	7.000	39.27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Yes	0.0	0.0	0.0
11	1	0.0	0.0	0.0	7.000	39.27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Yes	0.0	0.0	0.0
12	1	0.0	0.0	0.0	7.000	39.27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Yes	0.0	0.0	0.0
13	1	0.0	0.0	0.0	7.000	39.27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Yes	0.0	0.0	0.0
14	1	0.0	0.0	0.0	7.000	39.27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Yes	0.0	0.0	0.0
15	1	0.0	0.0	0.0	7.000	39.27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Yes	0.0	0.0	0.0
16	1	0.0	0.0	0.0	7.000	39.27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Yes	0.0	0.0	0.0
17	1	0.0	0.0	0.0	7.000	39.27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Yes	0.0	0.0	0.0
18	1	0.0	0.0	0.0	7.000	39.27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Yes	0.0	0.0	0.0
19	1	0.0	0.0	0.0	7.000	39.27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Yes	0.0	0.0	0.0
20	1	0.0	0.0	0.0	7.000	39.27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Yes	0.0	0.0	0.0
21	1	0.0	0.0	0.0	7.000	39.27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Yes	0.0	0.0	0.0
22	1	0.0	0.0	0.0	7.000	39.27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Yes	0.0	0.0	0.0
23	1	0.0	0.0	0.0	7.000	39.27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Yes	0.0	0.0	0.0
24	1	0.0	0.0	0.0	7.000	39.27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Yes	0.0	0.0	0.0
25	1	0.0	0.0	0.0	7.000	39.27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Yes	0.0	0.0	0.0
26	1	0.0	0.0	0.0	7.000	39.27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Yes	0.0	0.0	0.0
27	1	0.0	0.0	0.0	7.000	39.27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Yes	0.0	0.0	0.0
28	1	0.0	0.0	0.0	7.000	39.27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Yes	0.0	0.0	0.0
29	1	0.0	0.0	0.0	7.000	39.27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Yes	0.0	0.0	0.0
30	1	0.0	0.0	0.0	7.000	39.27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Yes	0.0	0.0	0.0
31	1	0.0	0.0	0.0	7.000	39.27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Yes	0.0	0.0	0.0
32	1	0.0	0.0	0.0	7.000	39.27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Yes	0.0	0.0	0.0
33	1	0.0	0.0	0.0	7.000	39.27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Yes	0.0	0.0	0.0
34	1	0.0	0.0	0.0	7.000	39.27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Yes	0.0	0.0	0.0
35	1	0.0	0.0	0.0	7.000	39.27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Yes	0.0	0.0	0.0
36	1	0.0	0.0	0.0	7.000	39.27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Yes	0.0	0.0	0.0
37	1	0.0	0.0	0.0	7.000	39.27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Yes	0.0	0.0	0.0
38	1	0.0	0.0	0.0	7.000	39.27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Yes	0.0	0.0	0.0
39	1	0.0	0.0	0.0	7.000	39.27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Yes	0.0	0.0	0.0
40	1	0.0	0.0	0.0	7.000	39.27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Yes	0.0	0.0	0.0
41	1	0.0	0.0	0.0	7.000	39.27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Yes	0.0	0.0	0.0
42	1	0.0	0.0	0.0	7.000	39.27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Yes	0.0	0.0	0.0
43	1	0.0	0.0	0.0	7.000	39.27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Yes	0.0	0.0	0.0
44	1	0.0	0.0	0.0	7.000	39.27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Yes	0.0	0.0	0.0
45	1	0.0	0.0	0.0	7.000	39.27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Yes	0.0	0.0	0.0
46	1	0.0	0.0	0.0	7.000	39.27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Yes	0.0	0.0	0.0
47	1	0.0	0.0	0.0	7.000	39.27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Yes	0.0	0.0	0.0
48	1	0.0	0.0	0.0	7.000	39.27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Yes	0.0	0.0	0.0
49	1	0.0	0.0	0.0	7.000	39.27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Yes	0.0	0.0	0.0
50	1	0.0	0.0	0.0	7.000	39.27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Yes	0.0	0.0	0.0
51	1	0.0	0.0	0.0	7.000	39.27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Yes	0.0	0.0	0.0
52	1	0.0	0.0	0.0	7.000	39.27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Yes	0.0	0.0	0.0
53	1	0.0	0.0	0.0	7.000	39.27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Yes	0.0	0.0	0.0
54	1	0.0	0.0	0.0	7.000	39.27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Yes	0.0	0.0	0.0
55	1	0.0	0.0	0.0	7.000	39.27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Yes	0.0	0.0	0.0
56	1	0.0	0.0	0.0	7.000	39.27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Yes	0.0	0.0	0.0
57	1	0.0	0.0	0.0	7.000	39.27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Yes	0.0	0.0	0.0
58	1	0.0	0.0	0.0	7.000	39.27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Yes	0.0	0.0	0.0
59	1	0.0	0.0	0.0	7.000	39.27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Yes	0.0	0.0	0.0
60	1	0.0	0.0	0.0	7.000	39.27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Yes	0.0	0.0	0.0

Notes:
( ) Moments shown thus have been excluded from the final design moment (ref Eurocode Cl 5.8.2(6) or Eurocode 2 Cl 5.8.9(2)).
* Design moments shown thus result from maximum end moment plus imperfection moment - if imperfection moment is to be applied about this axis.

Column Summary Results

Derivation of column/Pile design moments output for the following selection:

Analysis Case All
Capacity All
Sorted By Section

Sec.	Analysis Case	Bar Arrangement	No.of Bars	Bar Size	Area of Reinf.	Link Size	Maximum Spacing of Links	Nominal Cover (outer)	Axial Design Force 'N'	N_{max}	N/N_{max}	Resultant Design Moment 'M'	Moment Angle	M_u	M/M_u
				[mm]	[mm²] [%]	[mm]	[mm]	[mm]	[kN]	[kN]		[kNm]	[°]	[kNm]	
1	1 Analysis Case 1	1 ring(s)/6 bars per ring	6	12.00	678.6 0.1700	8.000	240.0	75.00	0.0	7499.	0.0	756.0	0.0	96.96	7.797 !
2	1 Analysis Case 1	1 ring(s)/6 bars per ring	6	12.00	678.6 0.1700	10.00	240.0	75.00	0.0	7499.	0.0	756.0	0.0	97.09	7.786 !
3	1 Analysis Case 1	1 ring(s)/6 bars per ring	6	16.00	1206. 0.3021	8.000	320.0	75.00	0.0	7701.	0.0	756.0	0.0	158.0	4.784 !
4	1 Analysis Case 1	1 ring(s)/6 bars per ring	6	16.00	1206. 0.3021	10.00	320.0	75.00	0.0	7701.	0.0	756.0	0.0	157.7	4.793 !
5	1 Analysis Case 1	1 ring(s)/6 bars per ring	6	20.00	1885. 0.4721	8.000	400.0	75.00	0.0	7960.	0.0	756.0	0.0	231.2	3.270 !
6	1 Analysis Case 1	1 ring(s)/6 bars per ring	6	20.00	1885. 0.4721	10.00	400.0	75.00	0.0	7960.	0.0	756.0	0.0	230.9	3.274 !
7	1 Analysis Case 1	1 ring(s)/6 bars per ring	6	25.00	2945. 0.7377	8.000	400.0	75.00	0.0	8365.	0.0	756.0	0.0	339.2	2.229 !
8	1 Analysis Case 1	1 ring(s)/6 bars per ring	6	25.00	2945. 0.7377	10.00	400.0	75.00	0.0	8365.	0.0	756.0	0.0	338.3	2.235 !
9	1 Analysis Case 1	1 ring(s)/6 bars per ring	6	32.00	4825. 1.209	8.000	400.0	75.00	0.0	9083.	0.0	756.0	0.0	518.0	1.459 !
10	1 Analysis Case 1	1 ring(s)/6 bars per ring	6	32.00	4825. 1.209	10.00	400.0	75.00	0.0	9083.	0.0	756.0	0.0	516.1	1.465 !
11	1 Analysis Case 1	1 ring(s)/6 bars per ring	6	40.00	7540. 1.888	8.000	400.0	75.00	0.0	10120.	0.0	756.0	0.0	744.0	1.016 !
12	1 Analysis Case 1	1 ring(s)/6 bars per ring	6	40.00	7540. 1.888	10.00	400.0	75.00	0.0	10120.	0.0	756.0	0.0	739.3	1.023 !
13	1 Analysis Case 1	1 ring(s)/7 bars per ring	7	12.00	791.7 0.1983	8.000	240.0	75.00	0.0	7542.	0.0	756.0	0.0	110.6	6.837 !
14	1 Analysis Case 1	1 ring(s)/7 bars per ring	7	12.00	791.7 0.1983	10.00	240.0	75.00	0.0	7542.	0.0	756.0	0.0	110.7	6.829 !
15	1 Analysis Case 1	1 ring(s)/7 bars per ring	7	16.00	1407. 0.3525	8.000	320.0	75.00	0.0	7778.	0.0	756.0	0.0	182.9	4.133 !
16	1 Analysis Case 1	1 ring(s)/7 bars per ring	7	16.00	1407. 0.3525	10.00	320.0	75.00	0.0	7778.	0.0	756.0	0.0	182.4	4.144 !
17	1 Analysis Case 1	1 ring(s)/7 bars per ring	7	20.00	2199. 0.5508	8.000	400.0	75.00	0.0	8080.	0.0	756.0	0.0	267.8	2.823 !
18	1 Analysis Case 1	1 ring(s)/7 bars per ring	7	20.00	2199. 0.5508	10.00	400.0	75.00	0.0	8080.	0.0	756.0	0.0	267.1	2.830 !
19	1 Analysis Case 1	1 ring(s)/7 bars per ring	7	25.00	3436. 0.8606	8.000	400.0	75.00	0.0	8552.	0.0	756.0	0.0	386.8	1.954 !
20	1 Analysis Case 1	1 ring(s)/7 bars per ring	7	25.00	3436. 0.8606	10.00	400.0	75.00	0.0	8552.	0.0	756.0	0.0	385.7	1.960 !
21	1 Analysis Case 1	1 ring(s)/7 bars per ring	7	32.00	5630. 1.410	8.000	400.0	75.00	0.0	9390.	0.0	756.0	0.0	578.4	1.307 !
22	1 Analysis Case 1	1 ring(s)/7 bars per ring	7	32.00	5630. 1.410	10.00	400.0	75.00	0.0	9390.	0.0	756.0	0.0	575.9	1.313 !
23	1 Analysis Case 1	1 ring(s)/7 bars per ring	7	40.00	8796. 2.203	8.000	400.0	75.00	0.0	10600.	0.0	756.0	0.0	820.3	0.9216
24	1 Analysis Case 1	1 ring(s)/7 bars per ring	7	40.00	8796. 2.203	10.00	400.0	75.00	0.0	10600.	0.0	756.0	0.0	815.5	0.9271
25	1 Analysis Case 1	1 ring(s)/8 bars per ring	8	12.00	904.8 0.2266	8.000	240.0	75.00	0.0	7586.	0.0	756.0	0.0	125.2	6.037 !
26	1 Analysis Case 1	1 ring(s)/8 bars per ring	8	12.00	904.8 0.2266	10.00	240.0	75.00	0.0	7586.	0.0	756.0	0.0	125.0	6.047 !
27	1 Analysis Case 1	1 ring(s)/8 bars per ring	8	16.00	1608. 0.4029	8.000	320.0	75.00	0.0	7854.	0.0	756.0	0.0	205.0	3.688 !
28	1 Analysis Case 1	1 ring(s)/8 bars per ring	8	16.00	1608. 0.4029	10.00	320.0	75.00	0.0	7854.	0.0	756.0	0.0	204.8	3.692 !
29	1 Analysis Case 1	1 ring(s)/8 bars per ring	8	20.00	2513. 0.6295	8.000	400.0	75.00	0.0	8200.	0.0	756.0	0.0	296.3	2.551 !
30	1 Analysis Case 1	1 ring(s)/8 bars per ring	8	20.00	2513. 0.6295	10.00	400.0	75.00	0.0	8200.	0.0	756.0	0.0	295.7	2.556 !
31	1 Analysis Case 1	1 ring(s)/8 bars per ring	8	25.00	3927. 0.9835	8.000	400.0	75.00	0.0	8740.	0.0	756.0	0.0	431.1	1.754 !
32	1 Analysis Case 1	1 ring(s)/8 bars per ring	8	25.00	3927. 0.9835	10.00	400.0	75.00	0.0	8740.	0.0	756.0	0.0	429.7	1.759 !
33	1 Analysis Case 1	1 ring(s)/8 bars per ring	8	32.00	6434. 1.611	8.000	400.0	75.00	0.0	9697.	0.0	756.0	0.0	654.0	1.156 !
34	1 Analysis Case 1	1 ring(s)/8 bars per ring	8	32.00	6434. 1.611	10.00	400.0	75.00	0.0	9697.	0.0	756.0	0.0	651.1	1.161 !
35	1 Analysis Case 1	1 ring(s)/8 bars per ring	8	40.00	10050. 2.518	8.000	400.0	75.00	0.0	11080.	0.0	756.0	0.0	914.6	0.8266
36	1 Analysis Case 1	1 ring(s)/8 bars per ring	8	40.00	10050. 2.518	10.00	400.0	75.00	0.0	11080.	0.0	756.0	0.0	908.5	0.8321
37	1 Analysis Case 1	1 ring(s)/9 bars per ring	9	12.00	1018. 0.2549	8.000	240.0	75.00	0.0	7629.	0.0	756.0	0.0	138.0	5.477 !
38	1 Analysis Case 1	1 ring(s)/9 bars per ring	9	12.00	1018. 0.2549	10.00	240.0	75.00	0.0	7629.	0.0	756.0	0.0	138.1	5.474 !
39	1 Analysis Case 1	1 ring(s)/9 bars per ring	9	16.00	1810. 0.4532	8.000	320.0	75.00	0.0	7931.	0.0	756.0	0.0	226.7	3.334 !
40	1 Analysis Case 1	1 ring(s)/9 bars per ring	9	16.00	1810. 0.4532	10.00	320.0	75.00	0.0	7931.	0.0	756.0	0.0	226.5	3.338 !
41	1 Analysis Case 1	1 ring(s)/9 bars per ring	9	20.00	2827. 0.7081	8.000	400.0	75.00	0.0	8320.	0.0	756.0	0.0	330.6	2.287 !
42	1 Analysis Case 1	1 ring(s)/9 bars per ring	9	20.00	2827. 0.7081	10.00	400.0	75.00	0.0	8320.	0.0	756.0	0.0	329.7	2.293 !
43	1 Analysis Case 1	1 ring(s)/9 bars per ring	9	25.00	4418. 1.106	8.000	400.0	75.00	0.0	8927.	0.0	756.0	0.0	476.5	1.586 !
44	1 Analysis Case 1	1 ring(s)/9 bars per ring	9	25.00	4418. 1.106	10.00	400.0	75.00	0.0	8927.	0.0	756.0	0.0	474.8	1.592 !
45	1 Analysis Case 1	1 ring(s)/9 bars per ring	9	32.00	7238. 1.813	8.000	400.0	75.00	0.0	10000.	0.0	756.0	0.0	711.9	1.062 !
46	1 Analysis Case 1	1 ring(s)/9 bars per ring	9	32.00	7238. 1.813	10.00	400.0	75.00	0.0	10000.	0.0	756.0	0.0	708.5	1.067 !
47	1 Analysis Case 1	1 ring(s)/9 bars per ring	9	40.00	11310. 2.833	8.000	400.0	75.00	0.0	11560.	0.0	756.0	0.0	1004.	0.7527
48	1 Analysis Case 1	1 ring(s)/9 bars per ring	9	40.00	11310. 2.833	10.00	400.0	75.00	0.0	11560.	0.0	756.0	0.0	998.0	0.7575
49	1 Analysis Case 1	1 ring(s)/10 bars per ring	10	12.00	1131. 0.2833	8.000	240.0	75.00	0.0	7672.	0.0	756.0	0.0	151.5	4.989 !
50	1 Analysis Case 1	1 ring(s)/10 bars per ring	10	12.00	1131. 0.2833	10.00	240.0	75.00	0.0	7672.	0.0	756.0	0.0	151.5	4.992 !
51	1 Analysis Case 1	1 ring(s)/10 bars per ring	10	16.00	2011. 0.5036	8.000	320.0	75.00	0.0	8008.	0.0	756.0	0.0	249.2	3.034 !
52	1 Analysis Case 1	1 ring(s)/10 bars per ring	10	16.00	2011. 0.5036	10.00	320.0	75.00	0.0	8008.	0.0	756.0	0.0	248.8	3.039 !
53	1 Analysis Case 1	1 ring(s)/10 bars per ring	10	20.00	3142. 0.7868	8.000	400.0	75.00	0.0	8440.	0.0	756.0	0.0	358.8	2.107 !
54	1 Analysis Case 1	1 ring(s)/10 bars per ring	10	20.00	3142. 0.7868	10.00	400.0	75.00	0.0	8440.	0.0	756.0	0.0	357.8	2.113 !
55	1 Analysis Case 1	1 ring(s)/10 bars per ring	10	25.00	4909. 1.229	8.000	400.0	75.00	0.0	9115.	0.0	756.0	0.0	519.5	1.455 !
56	1 Analysis Case 1	1 ring(s)/10 bars per ring	10	25.00	4909. 1.229	10.00	400.0	75.00	0.0	9115.	0.0	756.0	0.0	517.5	1.461 !
57	1 Analysis Case 1	1 ring(s)/10 bars per ring	10	32.00	8042. 2.014	8.000	400.0	75.00	0.0	10310.	0.0	756.0	0.0	780.1	0.9691 %
58	1 Analysis Case 1	1 ring(s)/10 bars per ring	10	32.00	8042. 2.014	10.00	400.0	75.00	0.0	10310.	0.0	756.0	0.0	775.4	0.9750 %
59	1 Analysis Case 1	1 ring(s)/10 bars per ring	10	40.00	12570. 3.147	8.000	400.0	75.00	0.0	12040.	0.0	756.0	0.0	1089.	0.6941
60	1 Analysis Case 1	1 ring(s)/10 bars per ring	10	40.00	12570. 3.147	10.00	400.0	75.00	0.0	12040.	0.0	756.0	0.0	1082.	0.6990

Notes:
! Section/analysis case combinations with inadequate axial or bending capacity are marked thus.
% Sections with adequate axial and bending capacity for all analysis cases, with lowest area of longitudinal reinforcement are marked thus.

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	Part of Structure	Wall A and B1		Page 1 of 1
	Drawing Ref SKM-STRUCT-CO-001 Rev.A	Prepared E Adenmosun	Date 06/10/2015	Rev N/a / Date N/a

Subject: **Front Wall Foundation Design - Circular Sections (Cast In-situ) using helical reinforcement**

EC2 — **Shear to EN 1992-1-1:2004 (EC2)**

PILE DETAILS

	pile diameter, d_{nom}	=	750	mm		
2.3.4.2 (2)	design pile diameter, b_w	=	712.5	mm	*(Supplementary requirements for cast in place piles)*	
	A_c	=	398712	mm^2	*(Pile cross sectional area based on design diameter)*	
4.4.1.3(4)	nominal cover, c_{nom}	=	56.25	mm	*(k_2 defined in Table NA 1, 4.4.1.3 (4):* 75 mm	$C_{nom}=C_{min}+\Delta C_{dev}$
	main bar diameter	=	25	mm		
	no. of main bars	=	8	no.		
	helical diameter	=	10	mm		
	effective depth, d	=	525	mm	(d = ($2r_s$ / PI) + radius of design pile)	
(2.4.2.4)	f_{ck}	=	32	N/mm^2	γ_c = 1.65	*(adjusted for k_f = 1.1, Cl.2.4.2.5)*
	f_{yk}	=	500	N/mm^2	γ_s = 1.15	

DESIGN ACTION INPUT

V_{Ed} (ultimate) = 253 kN N_{Ed} (ultimate) = 0 kN

6.2.2 **CHECK IF SHEAR REINFORCEMENT REQUIRED**

	$C_{Rd,c}$	=	0.18 / γc	=	0.109091
	k	=	1+(200/d)1/2 <= 2.0	=	1.617
	ρ_1	=	A_{sl} / b_wd <= 0.02	=	0.00525
	σ_{cp}	=	N_{Ed}/A_c	=	0 N/mm^2
				(k_1 defined in Table NA 1, 6.2.2 (1):	0.15 mm
(6.2.a)	Shear resistance (no links), $V_{Rd,c}$	=	$[C_{Rd,c}k(100\rho_1 f_{ck})^{1/3}+k_1\sigma_{cp}]b_w d$		
(6.2.b)	minimum value	=	$(v_{min}+k_1\sigma_{cp})b_w d$	where v_{min} = $0.035k^{3/2}f_{ck}^{1/2}$ =	0.407197
	$V_{Rd,c}$	=	**152.30** kN		

$V_{Rd,c}$ < ***V_{Ed}***

Shear resistance < *Shear applied* — ***Shear reinforcement required***

6.2.3 **SHEAR REINFORCEMENT (check concrete strut capacity)**

				(α_{cw} defined in Table NA 1, 6.2.3(3)) =		1
6.2.3 (3)	z	=	0.9d	=	472.4588 mm	
	v_1	=	0.6(1-(f_{ck}/250))	=	0.5232	
				(α_{cc} defined in Table NA 1, 3.1.6(1)) =		0.85
3.1.6	f_{cd}	=	f_{ck} * α_{cc} / γ_c	=	16.48485	
				cot θ =		2.5
	tan θ	=	0.4			

exp 6.9 Concrete strut capacity, $V_{Rd,c}$ = $\alpha_{cw} b_w z v_1 f_{cd}$ / (cotθ+tanθ)

$V_{Rd,c}$ = **1001.16** kN

is $V_{Rd,c}$ > V_{Ed} YES — ***Determine spacing of links***

6.2.3 **SHEAR REINFORCEMENT (determine link spacing)**

	A_{sw}	=	157.08	mm^2	λ1 = 0.85
	f_{ywd}	=	435	N/mm^2	λ2 = 1.0

exp 6.8 Shear r'ment capacity, $V_{Rd,s}$ = $\lambda_1 \lambda_2$ (A_{sw} / s) z f_{ywd} cot θ

= 0.85 (A_{sw} / s) z f_{ywd} cot θ

Calculated min. link spacing (s) = (0.85 A_{sw} z f_{ywd} cot θ) / V_{Ed}

= **271** mm *Link spacing less than 0.75d, Cl.9.2.2 satisfied*

Provide 10 mm diameter links/helical reinforcment @ 270 mm spacing/pitch

Geofirma Ltd	Project	102 Camley Street			Project no JM0014
	Part of Structure	Wall B			Page 1 of 1
	Drawing Ref	Prepared		Date	Rev / Date
	SKM-STRUCT-CO-001 Rev.A	E Adenmosun		06/10/2015	N/a / N/a

Subject: **Front Wall Foundation Design - Circular Sections (Cast In-situ) using helical reinforcement**

EC2 — **Shear to EN 1992-1-1:2004 (EC2)**

PILE DETAILS

	pile diameter, d_{nom}	=	750	mm		
2.3.4.2 (2)	design pile diameter, b_w	=	712.5	mm	*(Supplementary requirements for cast in place piles)*	
	A_c	=	398712	mm^2	*(Pile cross sectional area based on design diameter)*	
4.4.1.3(4)	nominal cover, c_{nom}	=	56.25	mm	*(k_2 defined in Table NA 1, 4.4.1.3 (4):* 75 mm	$C_{nom}=C_{min}+\Delta C_{dev}$
	main bar diameter	=	40	mm		
	no. of main bars	=	8	no.		
	helical diameter	=	10	mm		
	effective depth, d	=	515	mm	(d = ($2r_s$ / PI) + radius of design pile)	
(2.4.2.4)	f_{ck}	=	32	N/mm^2	γ_c = 1.65	*(adjusted for k_f = 1.1, Cl.2.4.2.5)*
	f_{yk}	=	500	N/mm^2	γ_s = 1.15	

DESIGN ACTION INPUT

V_{Ed} (ultimate) = 253 kN N_{Ed} (ultimate) = 0 kN

6.2.2 — **CHECK IF SHEAR REINFORCEMENT REQUIRED**

	$C_{Rd,c}$	=	0.18 / γc	=	0.109091
	k	=	1+(200/d)1/2 <= 2.0	=	1.623
	ρ_1	=	A_{sl} / b_wd <= 0.02	=	0.013688
	σ_{cp}	=	N_{Ed}/A_c	=	0 N/mm^2

(k_1 defined in Table NA 1, 6.2.2 (1): 0.15 mm

(6.2.a) Shear resistance (no links), $V_{Rd,c}$ = $[C_{Rd,c}k(100\rho_1 f_{ck})^{1/3}+k_1\sigma_{cp}]b_w d$

(6.2.b) minimum value = $(v_{min}+k_1\sigma_{cp})b_w d$ where v_{min} = $0.035k^{3/2}f_{ck}^{1/2}$ = 0.409349

$V_{Rd,c}$ = **150.32** kN

$V_{Rd,c}$ < ***V_{Ed}***

Shear resistance < *Shear applied* — ***Shear reinforcement required***

6.2.3 — **SHEAR REINFORCEMENT (check concrete strut capacity)**

(α_{cw} defined in Table NA 1, 6.2.3(3)) = 1

6.2.3 (3)	z	=	0.9d	=	463.8644	mm
	v_1	=	0.6(1-(f_{ck}/250))	=	0.5232	
	(α_{cc} defined in Table NA 1, 3.1.6(1))					= 0.85
3.1.6	f_{cd}	=	f_{ck} * α_{cc} / γ_c	=	16.48485	
					cot θ	= 2.5
	tan θ	=	0.4			

exp 6.9 — Concrete strut capacity, $V_{Rd,c}$ = $\alpha_{cw} b_w z v_1 f_{cd} / (\cot\theta+\tan\theta)$

$V_{Rd,c}$ = **982.95** kN

is $V_{Rd,c}$ > V_{Ed} YES — ***Determine spacing of links***

6.2.3 — **SHEAR REINFORCEMENT (determine link spacing)**

	A_{sw}	=	157.08	mm^2	λ1 = 0.85
	f_{ywd}	=	435	N/mm^2	λ2 = 1.0

exp 6.8 — Shear r'ment capacity, $V_{Rd,s}$ = $\lambda_1 \lambda_2 (A_{sw}/s) z f_{ywd} \cot\theta$

= 0.85 $(A_{sw}/s) z f_{ywd} \cot\theta$

Calculated min. link spacing (s) = $(0.85 A_{sw} z f_{ywd} \cot\theta) / V_{Ed}$

= **266** mm *Link spacing less than 0.75d, Cl.9.2.2 satisfied*

Provide 10 mm diameter links/helical reinforcment @ 265 mm spacing/pitch

Geofirma Ltd	Project	102 Camley Street		Project no JM0014
	Part of Structure	Wall B		Page 1 of 1
	Drawing Ref SKM-STRUCT-CO-001 Rev.A	Prepared E Adenmosun	Date 06/10/2015	Rev N/a / Date N/a

Subject: **Front Wall Foundation Design - Circular Sections (Cast In-situ) using helical reinforcement**

EC2 — **Shear to EN 1992-1-1:2004 (EC2)**

PILE DETAILS

	pile diameter, d_{nom}	=	750	mm		
2.3.4.2 (2)	design pile diameter, b_w	=	712.5	mm	*(Supplementary requirements for cast in place piles)*	
	A_c	=	398712	mm^2	*(Pile cross sectional area based on design diameter)*	
4.4.1.3(4)	nominal cover, c_{nom}	=	56.25	mm	*(k_2 defined in Table NA 1, 4.4.1.3 (4):* 75 mm	$C_{nom}=C_{min}+\Delta C_{dev}$
	main bar diameter	=	25	mm		
	no. of main bars	=	8	no.		
	helical diameter	=	10	mm		
	effective depth, d	=	525	mm	(d = ($2r_s$ / PI) + radius of design pile)	
(2.4.2.4)	f_{ck}	=	32	N/mm^2	γ_c = 1.65	*(adjusted for k_f = 1.1, Cl.2.4.2.5)*
	f_{yk}	=	500	N/mm^2	γ_s = 1.15	

DESIGN ACTION INPUT

V_{Ed} (ultimate) = 185 kN N_{Ed} (ultimate) = 0 kN

6.2.2 — **CHECK IF SHEAR REINFORCEMENT REQUIRED**

	$C_{Rd,c}$	=	0.18 / γc	=	0.109091
	k	=	1+(200/d)1/2 <= 2.0	=	1.617
	ρ_1	=	A_{sl} / b_wd <= 0.02	=	0.00525
	σ_{cp}	=	N_{Ed}/A_c	=	0 N/mm^2
				(k_1 defined in Table NA 1, 6.2.2 (1):	0.15 mm
(6.2.a)	Shear resistance (no links), $V_{Rd,c}$	=	$[C_{Rd,c}k(100\rho_1 f_{ck})^{1/3}+k_1\sigma_{cp}]b_w d$		
(6.2.b)	minimum value	=	$(v_{min}+k_1\sigma_{cp})b_w d$	where v_{min} = $0.035k^{3/2}f_{ck}^{1/2}$ =	0.407197
	$V_{Rd,c}$	=	**152.30** kN		

$V_{Rd,c}$ < ***V_{Ed}***

Shear resistance < *Shear applied* — ***Shear reinforcement required***

6.2.3 — **SHEAR REINFORCEMENT (check concrete strut capacity)**

				(α_{cw} defined in Table NA 1, 6.2.3(3))	=	1
6.2.3 (3)	z	=	0.9d	= 472.4588 mm		
	v_1	=	0.6(1-(f_{ck}/250))	= 0.5232		
				(α_{cc} defined in Table NA 1, 3.1.6(1))	=	0.85
3.1.6	f_{cd}	=	f_{ck} * α_{cc} / γ_c	= 16.48485		
				cot θ	=	2.5
	tan θ	=	0.4			
exp 6.9	Concrete strut capacity, $V_{Rd,c}$	=	$\alpha_{cw} b_w z v_1 f_{cd} / (\cot\theta+\tan\theta)$			
	$V_{Rd,c}$	=	**1001.16** kN			
	is $V_{Rd,c}$ > V_{Ed}		YES	***Determine spacing of links***		

6.2.3 — **SHEAR REINFORCEMENT (determine link spacing)**

	A_{sw}	=	157.08	mm^2	λ1 = 0.85
	f_{ywd}	=	435	N/mm^2	λ2 = 1.0
exp 6.8	Shear r'ment capacity, $V_{Rd,s}$	=	$\lambda_1 \lambda_2 (A_{sw}/s) z f_{ywd} \cot\theta$		
		=	$0.85 (A_{sw}/s) z f_{ywd} \cot\theta$		
	Calculated min. link spacing (s)	=	$(0.85 A_{sw} z f_{ywd} \cot\theta) / V_{Ed}$		
		=	**371** mm	*Link spacing less than 0.75d, Cl.9.2.2 satisfied*	

Provide 10 mm diameter links/helical reinforcment @ 370 mm spacing/pitch