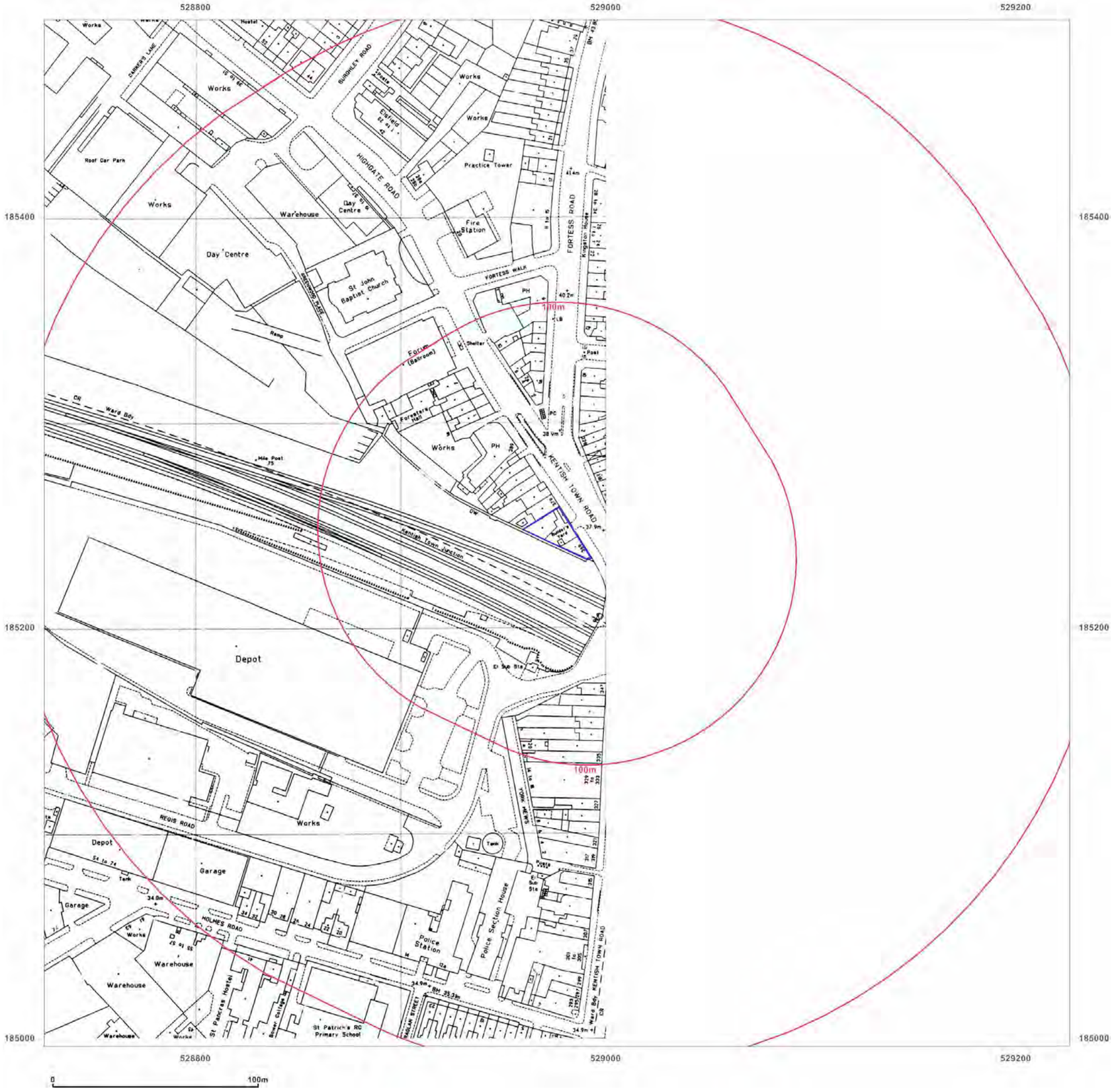

CGL

Site Details:

Kentish Town car wash, NW5 2TJ

Client Ref: 4892
Report Ref: CGL01-4530992
Grid Ref: 528976, 185246

Map Name: National Grid

Map date: **1992**

Scale: 1:1,250

Printed at: 1:2,000

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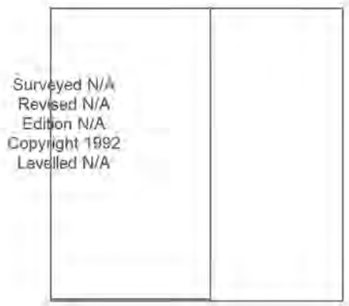

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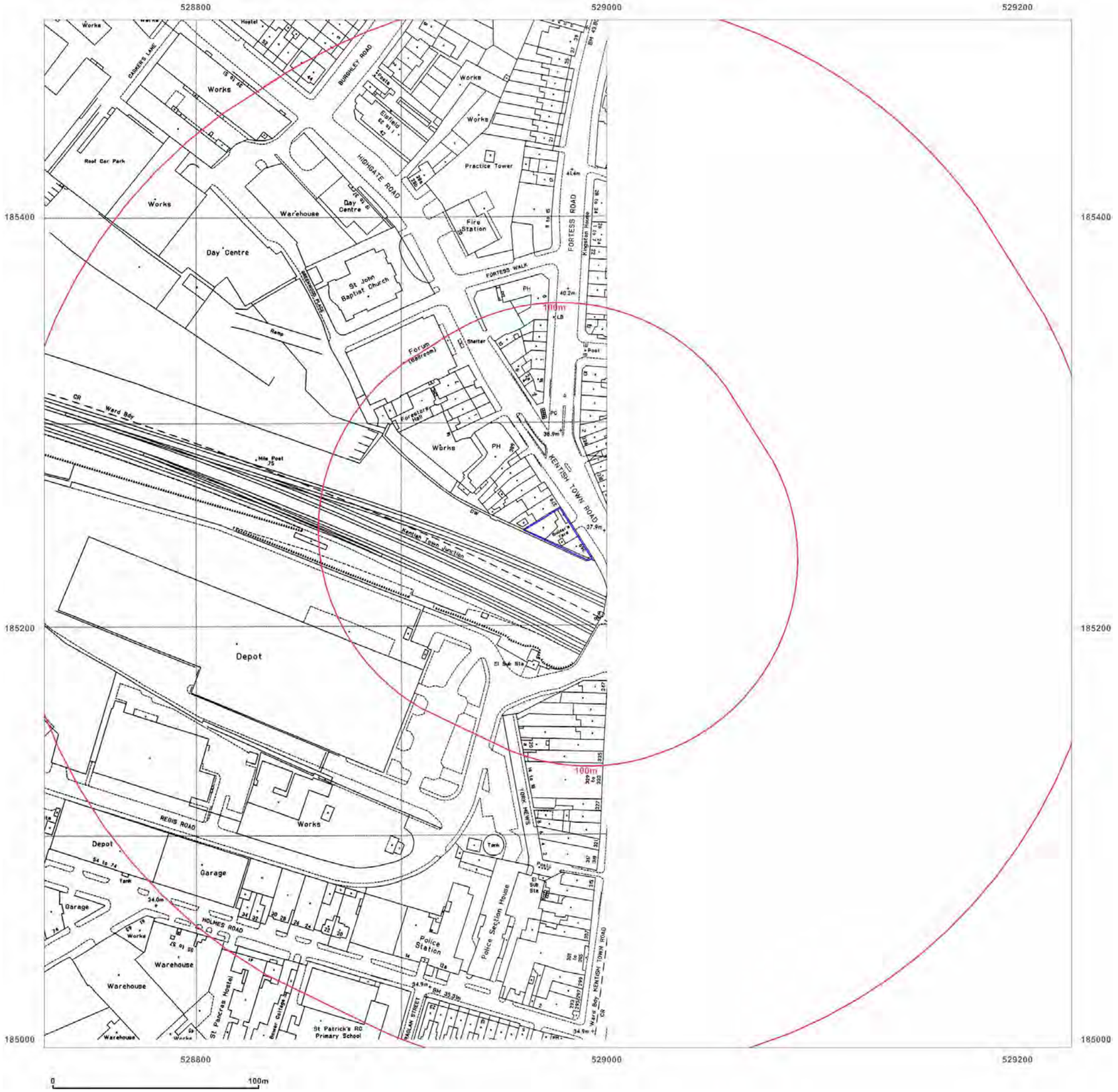

CGL

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Scale: 1:1,250

Printed at: 1:2,000

N
W E
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Surveyed N/A
Revised N/A
Edition N/A
Copyright 1992
Levelled N/A

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Production date: 30 November 2017

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CGL

Site Details:

Kentish Town car wash, NW5 2TJ

Client Ref: 4892
Report Ref: CGL01-4530992
Grid Ref: 528976, 185246

Map Name: National Grid

Map date: **1991-1995**

Scale: 1:1,250

Printed at: 1:2,000

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Surveyed N/A
Revised N/A
Edition N/A
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Surveyed N/A
Revised N/A
Edition N/A
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Levelled N/A

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Production date: 30 November 2017

To view map legend click here *Legend*

Site Details:

Kentish Town car wash, NW5 2TJ

Client Ref: 4892
Report Ref: CGL01-4530992
Grid Ref: 528976, 185246

Map Name: National Grid

Map date: **1991-1995**

Scale: 1:1,250

Printed at: 1:2,000

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W E
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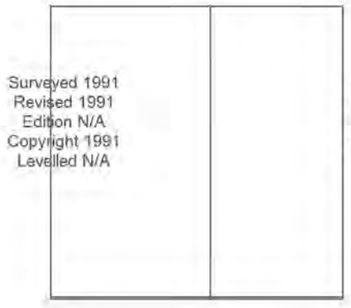

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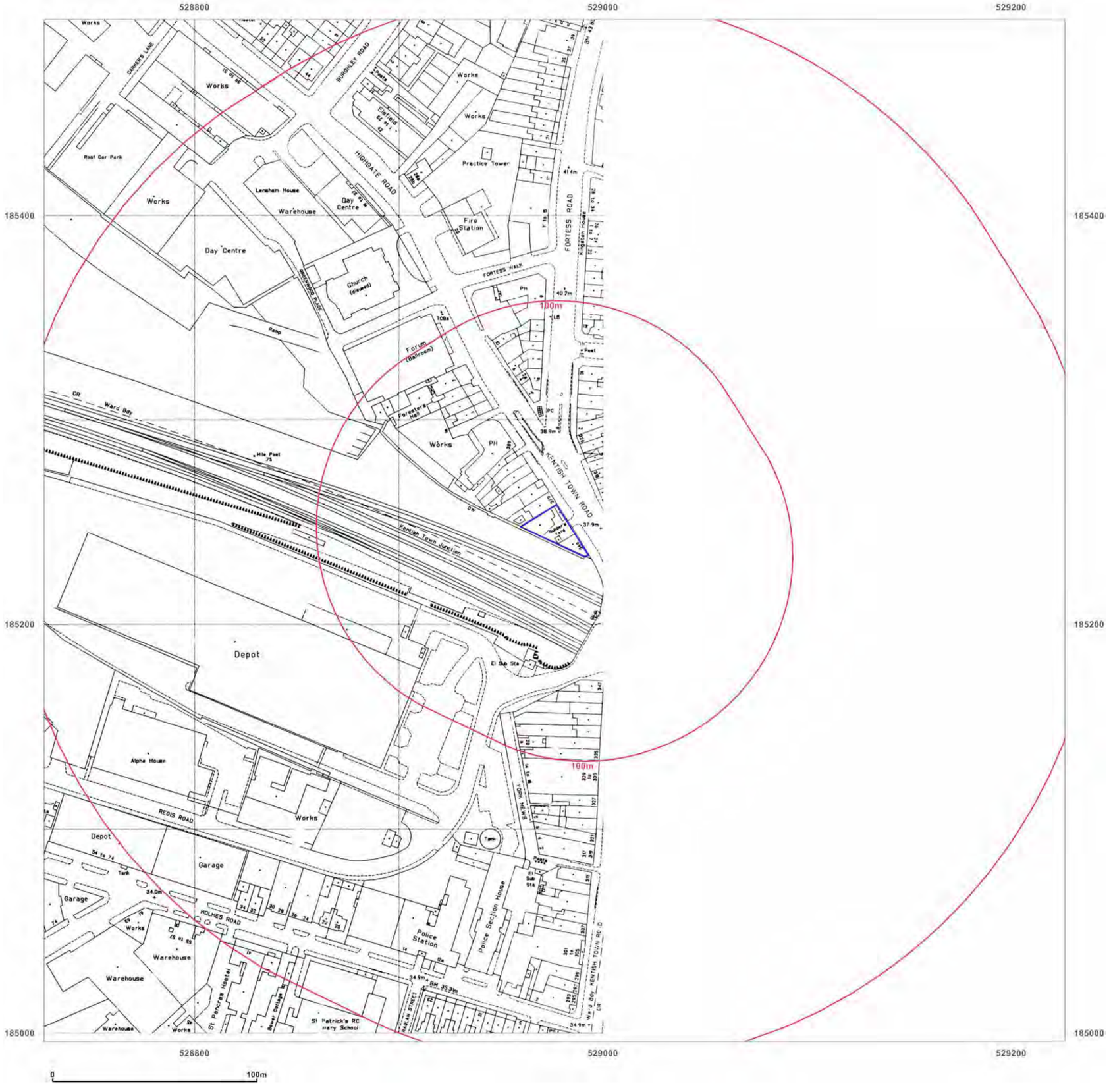


CGL

Site Details:

Kentish Town car wash, NW5 2TJ

Client Ref: 4892
Report Ref: CGL01-4530992
Grid Ref: 528976, 185246

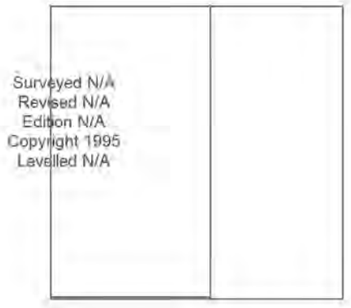
Map Name: National Grid

Map date: **1995**

Scale: 1:1,250

Printed at: 1:2,000

N
W E
S



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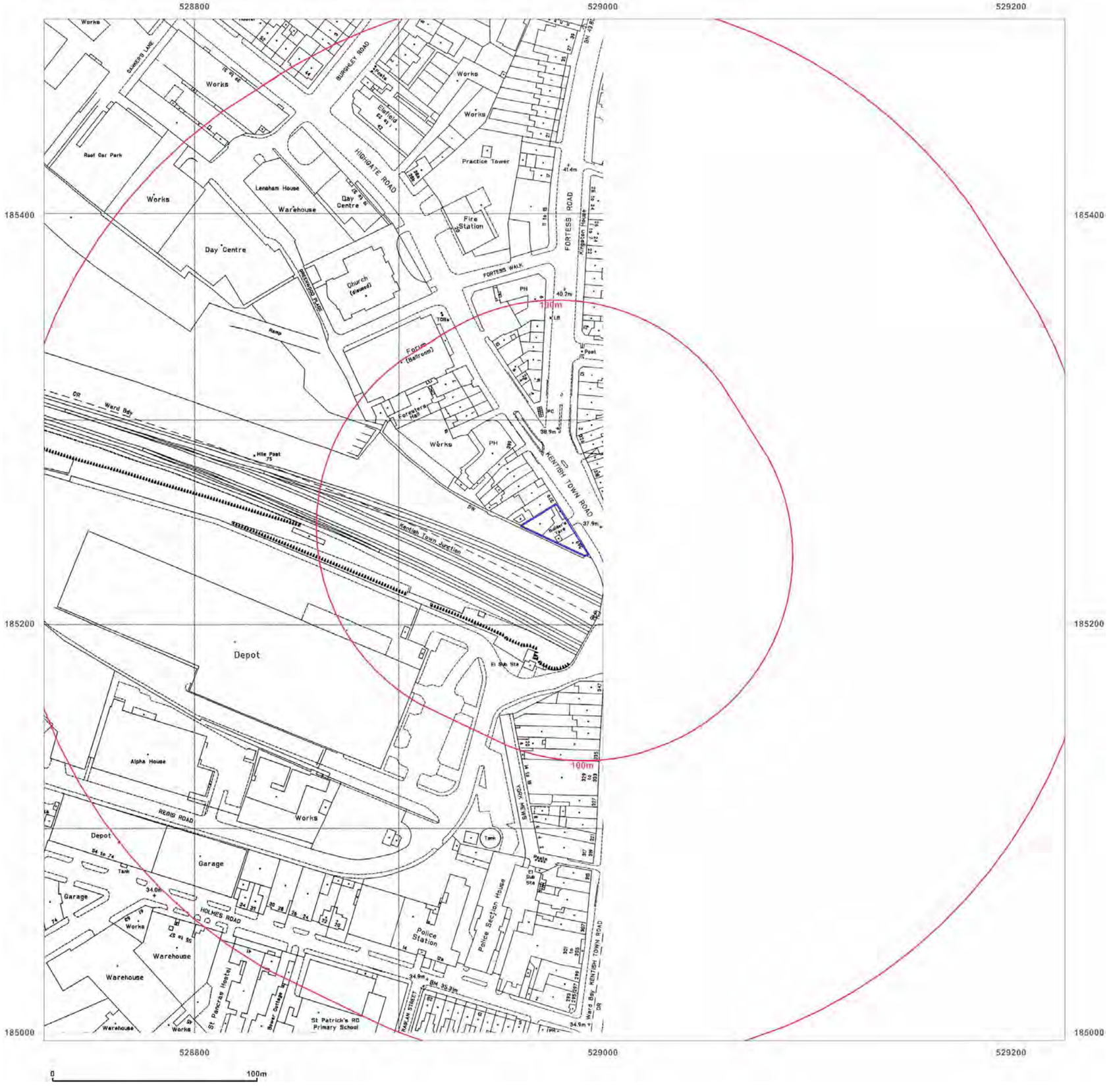


CGL

Site Details:

Kentish Town car wash, NW5 2TJ

Client Ref: 4892
Report Ref: CGL01-4530992
Grid Ref: 528976, 185246

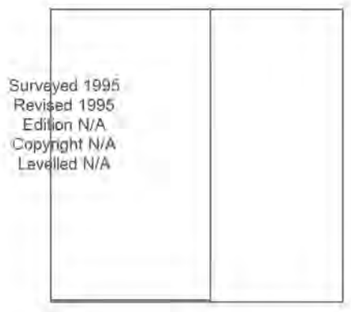
Map Name: National Grid

Map date: **1995**

Scale: 1:1,250

Printed at: 1:2,000

N
W E
S



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W: www.groundsure.com

Production date: 30 November 2017

To view map legend click here *Legend*

APPENDIX G

BGS borehole record

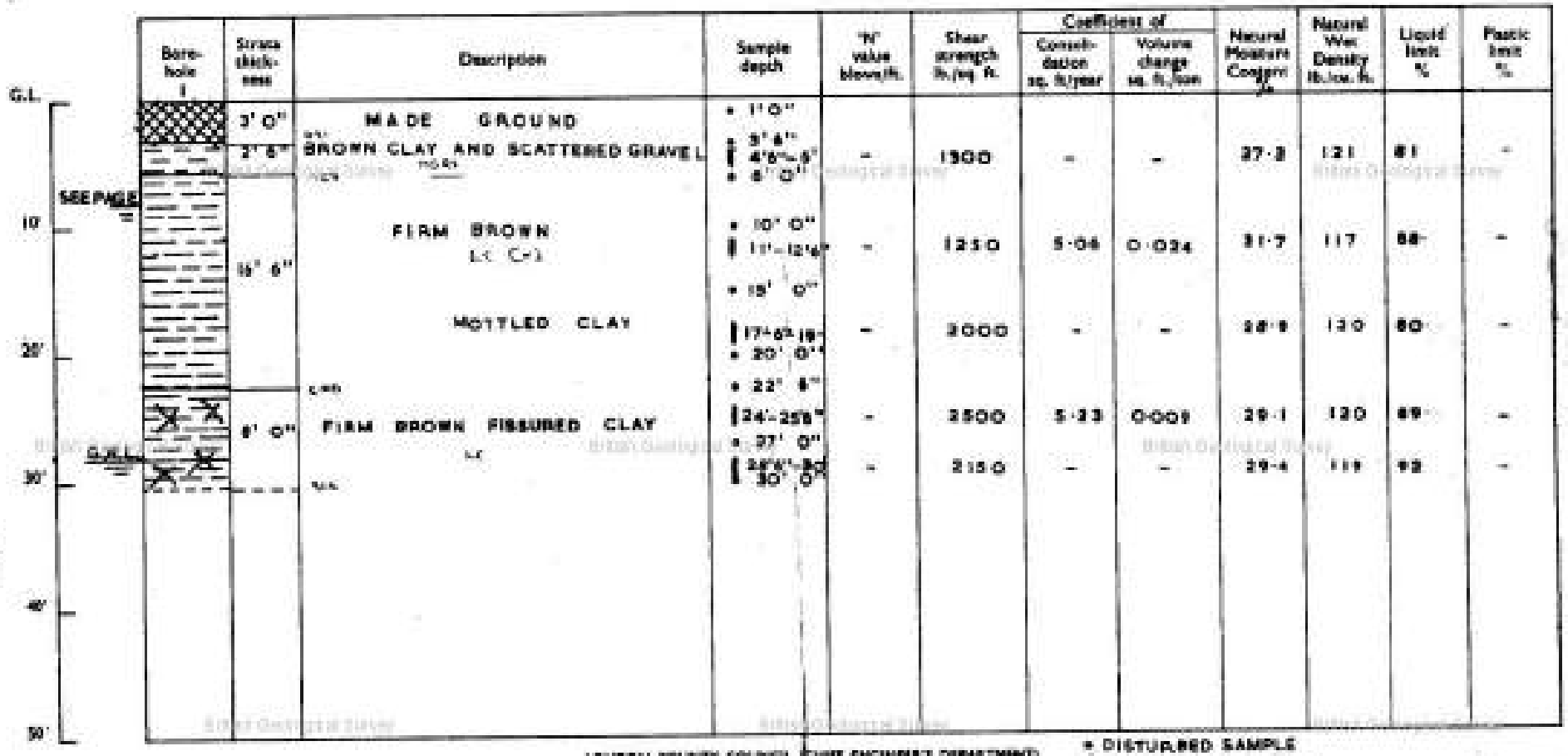
Client	Project	Job No
KTR Carwash Project Limited	**Kentish Town Car Wash**	**CG/28407**
CGL	Title **BGS borehole record**	**Appendix C**

TQ28NE/43
2895-8535
256.

DSIR/TI/120

SITE INVESTIGATION AT KENTISH TOWN FIRE STATION REPORT NO. S/388/08

FOR ARCHITECTS' DEPARTMENT SPECIAL WORKS DIVISION NOVEMBER '62 DATE



LONDON COUNTY COUNCIL (CHIEF ENGINEER'S DEPARTMENT)

* DISTURBED SAMPLE
UNDISTURBED SAMPLE

APPENDIX H

Flood risk assessment and drainage/SUDS proposals

PRICE&MYERS

REPORT

Kentish Town Road

Flood Risk Assessment and Surface Water Drainage Strategy Report

Prepared by: Enrique Madrid MEng

Reviewed by: Dimitris Linardatos BEng MSc CEng MICE FIHE

Job Number: 26778

Date	Version	Notes/Amendments/Issue Purpose
January 2019	01	Issued for BIA

37 Alfred Place London WC1E 7DP 020 7631 5128 mail@pricemyers.com www.pricemyers.com

Contents Page

1 Introduction

This Flood Risk Assessment (FRA) and surface water strategy report has been produced to accompany the Basement Impact Assessment (BIA) for 369-377 Kentish Town Road, London.

This report has been carried out in accordance with the National Planning Policy Framework (NPPF)and the accompanying Planning Practice Guidance (PPG) “Flood Risk and Coastal Change”. This report also incorporates advice and guidance from the Environment Agency, the Borough of Camden Strategic Flood Risk Assessment (SFRA) (July 2014) and CIRIA documents.

2 Flood Risk Assessment

2.1 Flood Risk from Watercourses and Tidal Flooding

The EA’s indicative floodplain map shows that the site is located in Flood Zone 1 and is not at risk of fluvial flooding and/or tidal. Developments in this flood zone do not have any restrictions, provided they do not increase the risk of flooding elsewhere.

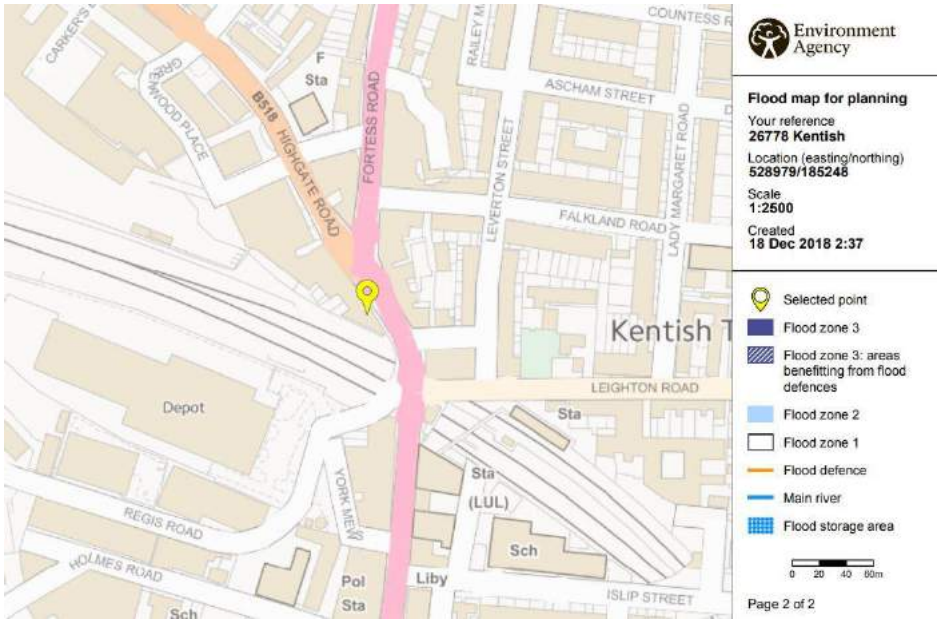


Figure 2.1: Extract from EA Flood Map for Planning

2.2 Flood risk from Groundwater

Groundwater flooding occurs when water originating from sub-surface permeable strata emerges from the ground, typically after prolonged rainfall.

The “Increased Susceptibility to Elevated Groundwater” map in Camden Council's SFRA indicates that the proposed site is in an area with no recorded historic groundwater flooding and is not susceptible to elevated groundwater levels. An extract from the map is included in figure 2.2 below.

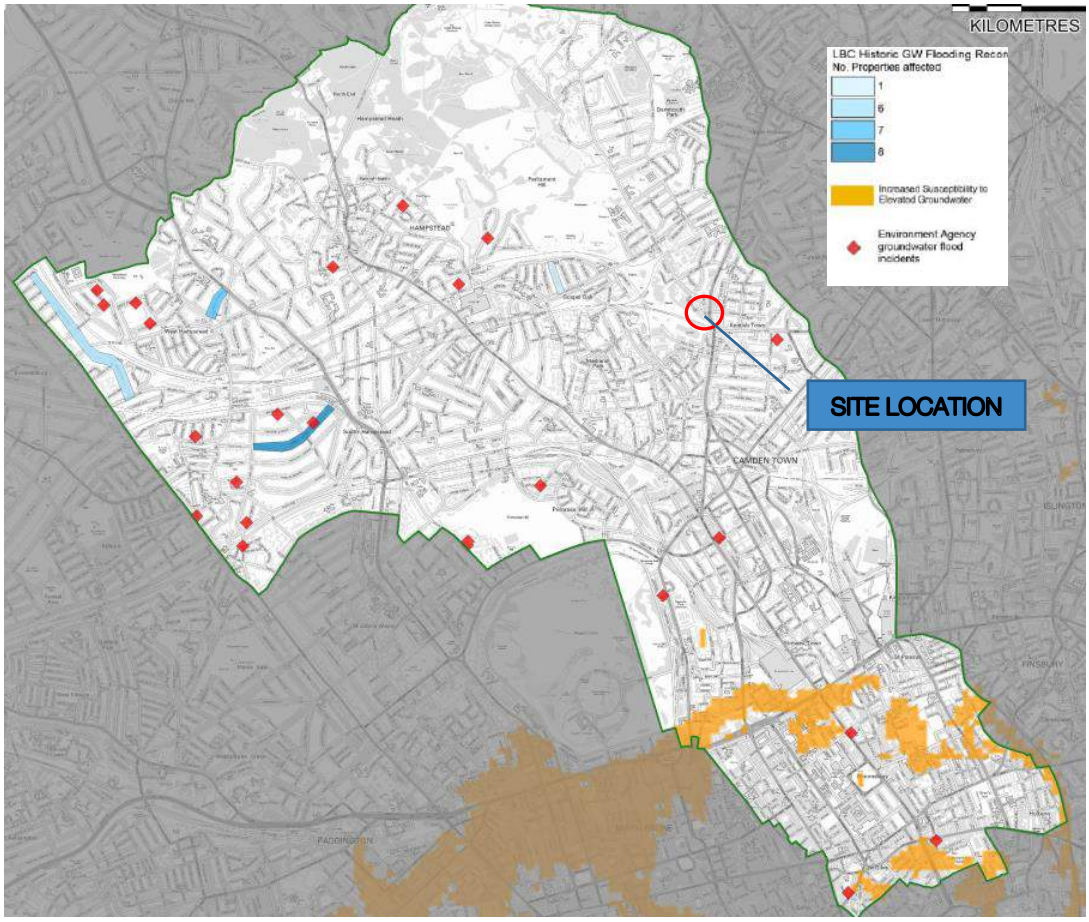


Figure 2.2: Extract from figure 4e (Camden's SFRA-Appendix B)

In addition to the above, the site specific investigation report, found clay in all exploratory holes in a depth from 1 to 2 meters below ground level. These findings match the information from the British Geological Survey (BGS) shown in figure 2.3 below.

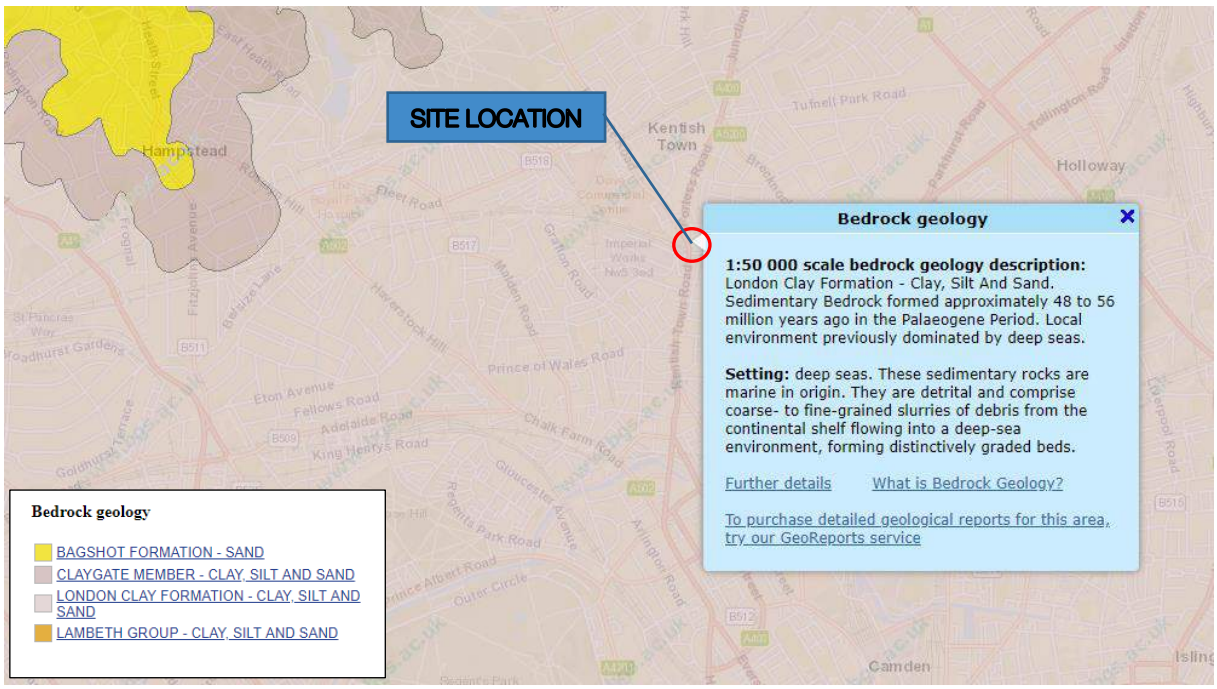


Figure 2.3: Extract from BGS Bedrock Geological Map

Groundwater flood risk is therefore considered negligible.

2.3 Flood Risk from Surface Water and Overland Flows

Surface water flooding occurs when intense rainfall is unable to soak into the ground or enter a drainage system due to blockages or the capacity of the system being exceeded. Overland flows can also be generated by burst water mains, failed dams and any failure in a system storing or transferring water.

The EA's indicative Surface Water Flooding Map, Figure 2.4, shows that the site is at low risk of surface water flooding.

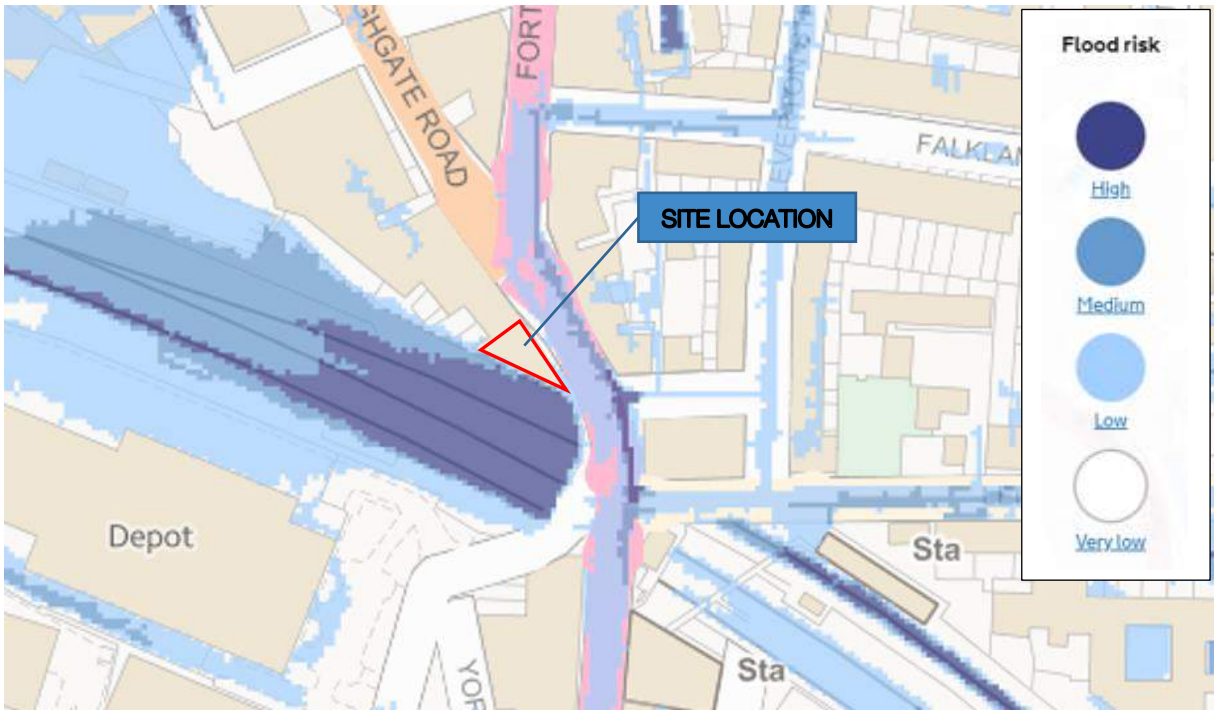


Figure 2.4 Environment Agency Surface Water Flood Risk Map

The site forms a triangle shape bounded to the south by the main railway passing through Kentish Town and to the East by Kentish Town Road.

The map in figure 2.4 shows that the railway is at high risk of flooding from surface water, however this cannot affect the site as the railway is at a lower level in comparison with the site.

This map also shows that the western side of Kentish Town Road is at low risk of flooding, increasing to high risk at the eastern side of the road.

Therefore, the flood risk from surface water and overland flows is considered low.

2.4 Flood Risk from Reservoirs

The EA provides information on flood risk from reservoirs. The figure below shows that the site is not at risk of reservoir flooding.

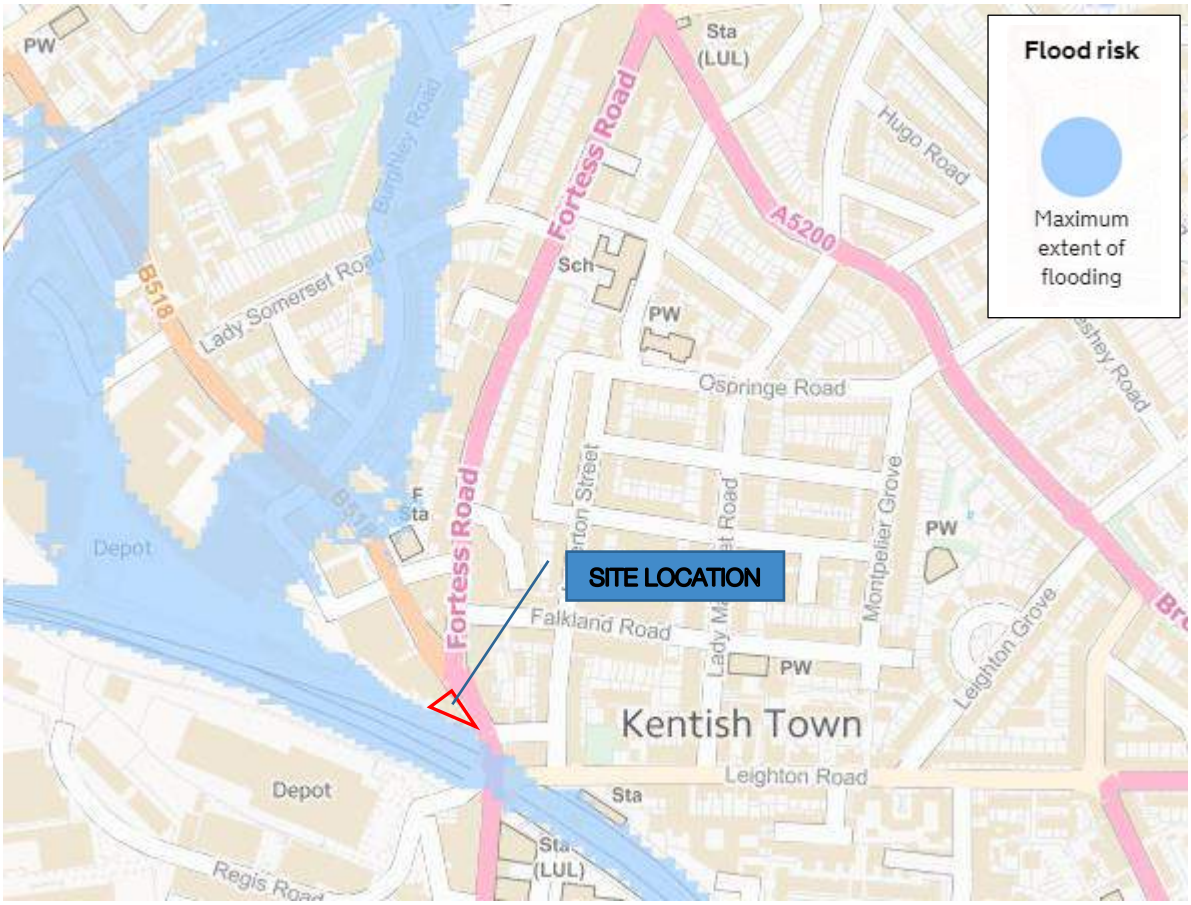


Figure 2.2 Environment Agency Risk of Reservoir Flooding Map

3 Surface water drainage strategy/SUDS proposal

3.1 Existing Run-off

The total site area is approximately 370m^2 or 0.037 ha, which is all currently impermeable

The existing run-off rate for the 1 in 100 year storm event was calculated using the modified rational method as shown below:

$Q_x = 2.78 \times i \times A$

Where 'x' is the return period in years, 'A' is the catchment area in ha and 'i' is the rainfall intensity in mm/hr as estimated from Micro Drainage software.

The existing run-off rates for storm events of several different return periods were calculated using the Greenfield Runoff Estimator tool from uksuds.com:

Q_1 = 2.78 x 46.1 x 0.037 = 4.7 l/sec
Q_{30} = 2.78 x 112.2 x 0.037 = 11.6 l/sec
Q_{100} = 2.78 x 147.3 x 0.037 = 15.2 l/sec

3.2 Proposed Run-off

The proposed development will maintain the impermeable areas as existing. An additional allowance for climate change should also be made.

The current EA guidance states that for the years 2070 to 2115 there is a 50% chance the peak rainfall intensity will increase by 20% or more and that there is a 10% change it will increase by 40% or more. In order to decide which allowance to use the vulnerability of the development and the 'built in' resilience measures were considered.

Following the above a 40% increase in the current rainfall has been considered.

The run-off rate from the proposed development was calculated using the modified rational method.

Q_{100+40} = 2.78 x 206.2 x 0.037 = 21.2 l/sec

3.3 SUDS Assessment

In accordance with the London Plan, EA guidelines, the SFRA, and CIRIA documents, surface water run-off should be managed as close to its source as possible. The London Plan states that all new developments should aim to reduce run-off to Greenfield rates "utilising SUDS unless there are practical reasons for not doing so".

The possibility of implementing SUDS at the site was assessed using a hierarchy of preferred surface water management methods. The following paragraphs discuss the various methods in order of that hierarchy and evaluate the site's suitability for each method.

- Store Rainwater for Later Use

Rainwater harvesting promotes the storage and re-use of rainwater collected from roofs and hard surfaced areas. This type of system contributes to the reduction of runoff rates and volumes within a development.

The capacity of rainwater harvesting systems to attenuate rainwater depends on the water use within the building. If there is no activity in the building and the harvester is full, no attenuation will be provided during a subsequent storm event. In the worst-case scenario, the rainwater harvester will provide no attenuation. Therefore, rainwater harvesting systems have not been considered as they will provide no attenuation benefits in the worst case scenario.

- Infiltration

The site investigation confirms that the site is underlain by London Clay which is unsuitable for the use of infiltration techniques. Therefore, infiltration systems are not suitable for this development.

- Attenuation

Where infiltration is not feasible, the next preferred SUDS is attenuation to Greenfield run-off rates. It is preferable to attenuate rainwater in ponds or open water features, opposed to below ground tanks, as these systems provide wider sustainability benefits. However, there is insufficient space within the site boundary to accommodate such systems. Blue roofs will be considered for attenuation.

The Greenfield run-off rate for the proposed site was calculated using the Greenfield Run-off Estimator tool on the UK SUDS website. The 1 in 100 year Greenfield run-off rate has been calculated by multiplying the 100 year growth curve factor by Q_{bar}. The Greenfield run-off rate is estimated based on a minimum catchment area of 0.1ha. Therefore, the Greenfield rate was interpolated for the development area.

Q_{100GF} = (0.037 ÷ 0.1) x 1.59 = 0.59 l/sec

Attenuating the discharge rate to the above value involves a high risk of flooding from blockages as a flow control of a very small diameter must be used to attenuate surface water to 0.59 l/s. Building Regulations Part H states that surface water pipes should be at least 75mm diameter to reduce the flood risk from blockages.

It is therefore proposed to attenuate the flows from the building using a flow control device with at least 75mm intake opening. Calculations from Hydrobrake International manufacturer show that the discharge rate will need to be limited to a minimum of 1.8 l/s to guarantee this minimum intake size, as shown on figure 2.5 below.

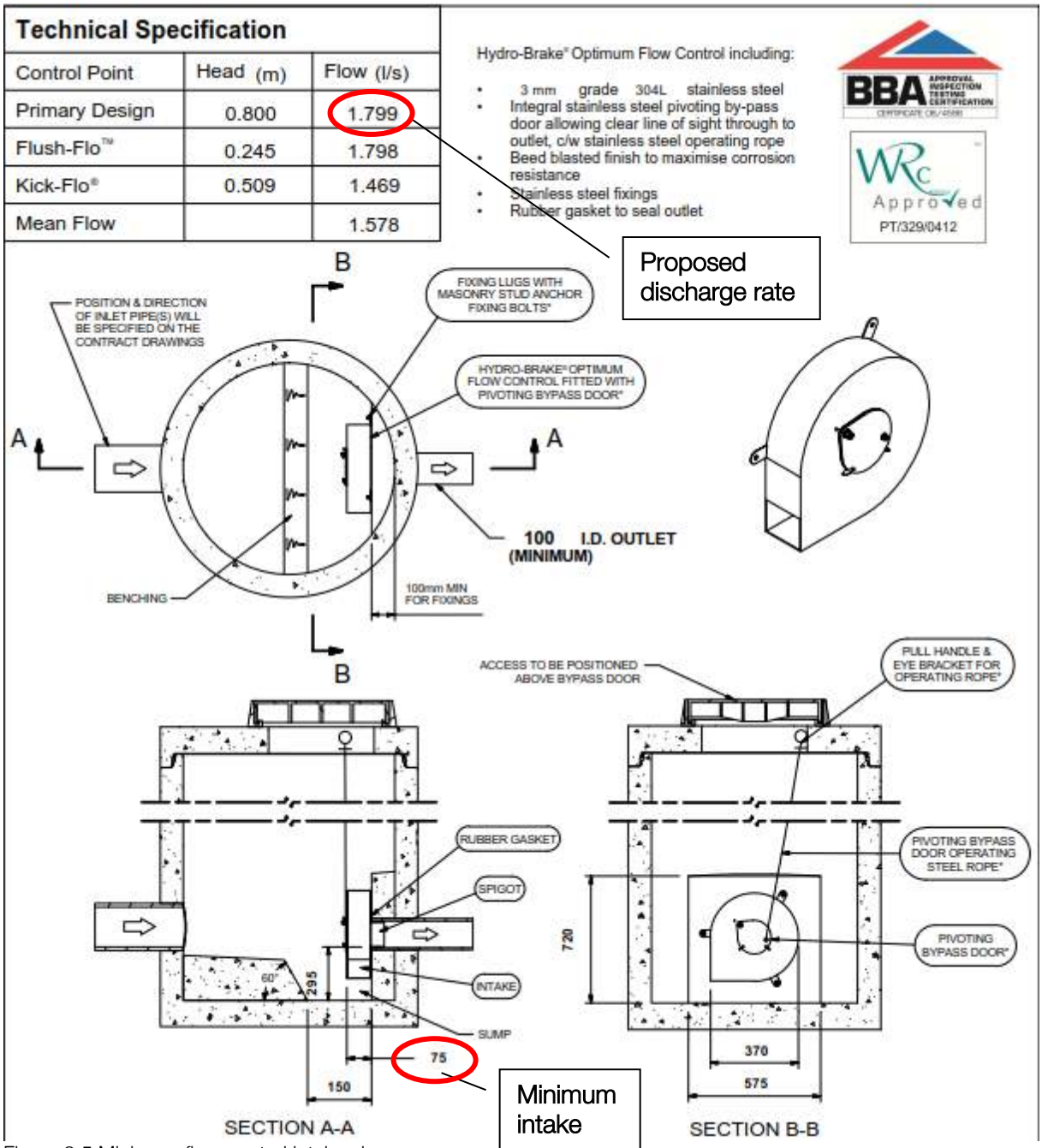


Figure 2.5 Minimum flow control intake size.

The flows from the building footprint will therefore be restricted to 1.8 l/s. The surrounding hardstanding areas, which are approximately 65m^2, are proposed to keep draining unrestricted. The proposed overall discharge rate will therefore be as below:

$Q_{100+40\ Overall\ site} = (2.78 \times 206.2 \times 0.007) + 1.8 = 5.8$ l/sec

Un-restricted flow from hardstanding areas

Restricted flow from roof

Preliminary calculations show that an attenuation volume of 17.0m^3 will be required within the blue roof to attenuate to 1.8 l/sec for the 1 in 100 year plus 40% storm event.

4 Conclusions

- This Flood Risk Assessment and surface water strategy report has been produced to accompany the Basement Impact Assessment for 369-377 Kentish Town Road.

- The site is in Flood Zone 1, an area at low risk of flooding from Rivers and sea. The site is also at low risk of flooding from other sources (Surface water, groundwater, public sewers or reservoirs)

- Surface water from the building footprint will be restricted to 1.8 l/s. The surrounding hardstanding areas, which are approximately 65m^2, will drain to the public sewers unrestricted. However, the proposed development will significantly reduce the peak flows from the site to the public sewer. Preliminary calculations show that an attenuation volume of 17.0m^3 will be required within the blue roof to attenuate to 1.8 l/sec for the 1 in 100 year plus 40% storm event.

- Therefore, the proposed development has an acceptable flood risk within the terms and requirements of the NPPF.

APPENDIX I

CGL exploratory borehole records

BOREHOLE LOG

Project				BOREHOLE No
Kentish Town Car Wash				**BH1**
Job No	Date	Ground Level (m)	Co-Ordinates (m)	
CG/28407	06-12-17	38.09	E 528,979.3 N 185,241.1	
Client				Sheet
KTR Carwash Project Limited				1 of 2

SAMPLES & TESTS			Water	STRATA				Instrument /Backfill
Depth (m)	Type No	Test Result		Reduced Level	Legend	Depth (m) (Thick-ness)	DESCRIPTION	
				37.94		0.15	Concrete.	
				37.69		0.40	[MADE GROUND]	
0.30-0.50	B1						Loose light grey brown slightly clayey gravelly fine to coarse sand. Gravel is angular to subrounded, fine to coarse of brick and concrete.	
0.50-0.60	D1							
0.70-1.00	B2			37.29		0.80	[MADE GROUND]	
1.00-1.10	D2			36.99		1.10	Soft to firm dark grown grey sandy gravelly clay. Sand is fine to coarse. Gravel is angular to subrounded, fine to coarse of concrete, brick and rare flint. Occasional subangular cobbles of brick and concrete.	
1.20-2.00	B3						[MADE GROUND]	
1.20	SPT	N5						
2.00	SPT	N17					Soft to firm light grey brown slightly sandy slightly gravelly clay. Sand is fine to coarse. Gravel is subangular to rounded, fine to medium of brick and concrete. [MADE GROUND - REWORKED LONDON CLAY]	
2.50-3.00	B4						Firm to stiff light brown mottled grey CLAY. [WEATHERED LONDON CLAY FORMATION]	
3.00	SPT	N7						
3.50-4.00	B5							
4.00	SPT	N10						
4.50-5.00	B6					(7.30)	4.50 - 6.00 Becoming slightly silty clay.	
5.00-5.10	D3							
5.00	SPT	N14					5.50 - 6.00 Rare very weak rounded fine to medium claystone.	
6.50-6.95	U1	65 blows						
6.50-7.00	B7							
7.50-8.00	B8							
8.00	SPT	N22						
				29.69		8.40		
8.40-8.50	D4						Stiff light grey CLAY. [LONDON CLAY FORMATION]	
9.00-9.50	B9							
9.50-9.95	U2	75 blows						

Boring Progress and Water Observations

Date	Comment	Strike Depth	Casing Depth	Casing Dia. mm	Standing Depth

General Remarks

1. B - Bulk Sample. D - Disturbed Sample. U - Undisturbed Sample. N - SPT 'N' value.
2. No groundwater encountered.
3. Monitoring installation details: from 0.0m to 1.5mbgl plain pipe with betonite backfill, from 1.5mbgl to 6.0mbgl slotted pipe with gravel filter, from 6.0mbgl to 7.0mbgl bentonite arisings, from 7.0mbgl to 12.45mbgl backfilled with arisings. Monitoring installation fitted with end cap, gas tap and bung.
4. Hand excavated pit to 1.2mbgl prior to commencing drilling.

Method/ Plant Used	Field Crew	Logged By	Checked By
Dando 2000	Borehole Solutions	DMH	ADC

BOREHOLE LOG

Project				BOREHOLE No
Kentish Town Car Wash				**BH1**
Job No	Date	Ground Level (m)	Co-Ordinates (m)	
CG/28407	06-12-17	38.09	E 528,979.3 N 185,241.1	
Client				Sheet
KTR Carwash Project Limited				2 of 2

SAMPLES & TESTS			Water	STRATA				Instrument /Backfill
Depth (m)	Type No	Test Result		Reduced Level	Legend	Depth (m) (Thick-ness)	DESCRIPTION	
10.00-10.10	D5						Stiff light grey CLAY. [LONDON CLAY FORMATION] *(continued)*	
10.50-11.00	B10					(4.05)	10.50 - 11.50 Rare very weak rounded fine to medium claystone.	
11.00	SPT	N28						
12.00-12.45	U3	75 blows						
12.00-12.45	B11			25.64		12.45		
							(Borehole terminated at 12.45m)	

Boring Progress and Water Observations

Date	Comment	Strike Depth	Casing Depth	Casing Dia. mm	Standing Depth

General Remarks

1. B - Bulk Sample. D - Disturbed Sample. U - Undisturbed Sample. N - SPT 'N' value.
2. No groundwater encountered.
3. Monitoring installation details: from 0.0m to 1.5mbgl plain pipe with betonite backfill, from 1.5mbgl to 6.0mbgl slotted pipe with gravel filter, from 6.0mbgl to 7.0mbgl bentonite arisings, from 7.0mbgl to 12.45mbgl backfilled with arisings. Monitoring installation fitted with end cap, gas tap and bung.
4. Hand excavated pit to 1.2mbgl prior to commencing drilling.

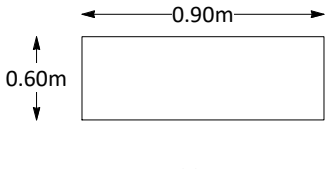
Method/ Plant Used	Field Crew	Logged By	Checked By
Dando 2000	Borehole Solutions	DMH	ADC

TRIAL PIT LOG

Project				TRIAL PIT No
Kentish Town Car Wash				HP1
Job No	Date	Ground Level (m)	Co-Ordinates (m)	
CG/28407	05-12-17	38.26	E 528,975.4 N 185,258.6	
Client				Sheet
KTR Carwash Project Limited				1 of 1

SAMPLES & TESTS			Water	STRATA			
Depth (m)	Type No	Test Result (N/kPa/ppm)		Reduced Level	Legend	Depth (m) (Thick-ness)	DESCRIPTION
				38.24		0.02	Tarmac cover. [MADE GROUND]
				38.09		(0.15) 0.17	Concrete. [MADE GROUND]
0.40 0.40-0.50	B1.1 ES14			37.81		(0.28) 0.45	Loose light grey brown slightly clayey gravelly fine to coarse sand. Gravel is angular to subrounded, fine to coarse of flint, brick and concrete with rare wood. Occasional subrounded cobbles of brick. [MADE GROUND]
				37.46		(0.35) 0.80	Loose light grey brown clayey gravelly fine to coarse sand. Gravel is angular to subrounded, fine to coarse of flint, brick and concrete. [MADE GROUND] 0.45 Concrete strip footing present.
0.80 0.80-0.90	B1.2 ES15			37.16		(0.30) 1.10	Firm light brown slightly sandy slightly gravelly clay. Sand is fine to medium. Gravel is angular to subrounded, fine to medium of brick and concrete. [MADE GROUND - REWORKED LONDON CLAY]
				37.01		(0.15) 1.25	Firm light brown slightly sandy CLAY. Sand is fine to medium. [WEATHERED LONDON CLAY FORMATION]
							(Pit terminated at 1.25m)

Plan



Stability: Stable

General Remarks

1. B - Bulk Sample. ES - Environmental Sample.
2. No groundwater encountered.
3. Trial pit reverse backfilled with arisings, compacted and finished with concrete at surface.

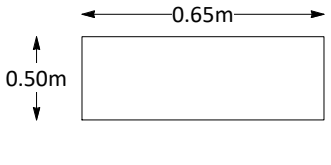
Method/ Plant Used	Field Crew	Logged By	Checked By
Hand excavated	GEH	DMH	ADC

TRIAL PIT LOG

Project				TRIAL PIT No
Kentish Town Car Wash				HP2
Job No	Date	Ground Level (m)	Co-Ordinates (m)	
CG/28407	05-12-17	38.24	E 528,973.5 N 185,257.3	
Client				Sheet
KTR Carwash Project Limited				1 of 1

SAMPLES & TESTS			Water	STRATA			
Depth (m)	Type No	Test Result (N/kPa/ppm)		Reduced Level	Legend	Depth (m) (Thick-ness)	DESCRIPTION
				38.22		0.02	Tarmac cover. [MADE GROUND]
				38.07		(0.15) 0.17	Concrete. [MADE GROUND]
0.40 0.40-0.50	B2.1 ES12			37.74		(0.33) 0.50	Loose light grey brown slightly clayey gravelly fine to coarse sand. Gravel is angular to subrounded, fine to coarse of flint and brick and occasional concrete and rare wood. [MADE GROUND]
0.80 0.80-0.90	B2.2 ES13			37.34		(0.40) 0.90	Dense red gravel of rectangular coarse to cobble sized brick and mortar (relic foundations). [MADE GROUND]
				37.04		(0.30) 1.20	Soft light grey brown slightly sandy gravelly clay. Sand is fine to medium. Gravel is angular to subrounded, fine to coarse of brick and concrete with rare flint, wood and metal. Occasional subrounded cobbles of half and whole bricks. [MADE GROUND]
				36.89		(0.15) 1.35	Firm light brown slightly sandy CLAY. Sand is fine to medium. [WEATHERED LONDON CLAY FORMATION]
							(Pit terminated at 1.35m)

Plan



Stability: Stable

General Remarks

1. B - Bulk Sample. ES - Environmental Sample.
2. No groundwater encountered.
3. Trial pit reverse backfilled with arisings, compacted and finished with concrete at surface.

Method/ Plant Used	Field Crew	Logged By	Checked By
Hand excavated	GEH	DMH	ADC

WINDOW SAMPLE LOG

Project				HOLE No
Kentish Town Car Wash				WS1
Job No	Date	Ground Level (m)	Co-Ordinates (m)	
CG/28407	04-12-17	38.11	E 528,979.3 N 185,253.6	
Client				Sheet
KTR Carwash Project Limited				1 of 1

SAMPLES & TESTS			Water	STRATA				Instrument /Backfill
Depth (m)	Type No	Test Result (N/kPa/ppm)		Reduced Level	Legend	Depth (m) (Thick-ness)	DESCRIPTION	
				38.09		0.02	Tarmac cover.	
				37.94		0.17	[MADE GROUND]	
0.30-0.40	ES1			37.71		0.40	Concrete. [MADE GROUND]	
				37.41		(0.30) 0.70	Loose light grey brown slightly gravelly clayey fine to medium sand. Gravel is subangular to rounded, fine to coarse of chalk. [MADE GROUND]	
0.70-0.80	ES2			37.21		0.90	Dense red gravel of rectangular coarse to cobble sized brick and mortar with pockets of loose grey brown slightly gravelly clayey fine to medium sand. Gravel is subangular to rounded, fine of chalk and medium to coarse of brick (relic foundations). [MADE GROUND]	
1.00-1.10	ES3							
1.00		N8		36.71		(0.50) 1.40		
				36.61		1.50	Soft dark grey brown slightly sandy gravelly clay. Sand is fine. Gravel is subangular to subrounded, fine to coarse of brick. [MADE GROUND]	
1.50	D1.1						Soft to firm light brown mottled grey clay. [MADE GROUND - REWORKED LONDON CLAY]	
2.00	D1.2						Firm light brown gravelly clay. Gravel is angular to subrounded, fine to coarse of flint and brick. [MADE GROUND - REWORKED LONDON CLAY]	
2.00		N9					Firm to stiff light brown mottled grey CLAY. [WEATHERED LONDON CLAY FORMATION]	
3.00	D1.3						3.00 Becoming stiff.	
3.00		N10				(3.50)	3.00 - 3.30 Clay is fissured.	
							3.40 - 3.50 Becoming slightly sandy clay. Sand is orange and fine.	
4.00	D1.4							
4.00		N12		33.11		5.00		
5.00	D1.5						*(Window sample terminated at 5m)*	
5.00		N17						

Boring Progress and Water Observations

Date	Strike depth	Casing depth	Comment	Time measured	Standing Depth

General Remarks

1. D - Disturbed Sample. ES - Environmental Sample. N - SPT 'N' value.
2. No groundwater encountered.
3. Monitoring installation details: from 0.0m to 0.5mbgl plain pipe with betonite backfill, from 0.5mbgl to 1.5mbgl slotted pipe with gravel filter, from 1.5mbgl to 2.0mbgl bentonite arisings, from 2.0mbgl to 5.0mbgl backfilled with arisings. Monitoring installation fitted with end cap, gas tap and bung.

Method/ Plant Used	Field Crew	Logged By	Checked By
Tracked windowless sampler rig	RP Drilling	DMH	ADC

WINDOW SAMPLE LOG

Project				HOLE No
Kentish Town Car Wash				WS2
Job No	Date	Ground Level (m)	Co-Ordinates (m)	
CG/28407	04-12-17	38.06	E 528,976.8 N 185,250.8	
Client				Sheet
KTR Carwash Project Limited				1 of 1

SAMPLES & TESTS			Water	STRATA				
Depth (m)	Type No	Test Result (N/kPa/ppm)		Reduced Level	Legend	Depth (m) (Thick-ness)	DESCRIPTION	Instrument /Backfill
				38.04		0.02	Tarmac cover.	
				37.89		0.17	[MADE GROUND]	
				37.66		0.40	Concrete. [MADE GROUND]	
0.60-0.70	ES4			37.36		(0.30) 0.70	Loose light grey brown slightly clayey silty fine to medium sand. [MADE GROUND]	
0.80-0.90	ES5			37.16		0.90	Dense red gravel of rectangular coarse to cobble sized brick and mortar with pockets of loose grey brown slightly gravelly clayey fine to medium sand. Gravel is subangular to rounded, fine to coarse of brick and concrete (relic foundations). [MADE GROUND]	
1.00		N6						
1.20	D2.1						Soft light brown slightly gravelly sandy clay. Sand is fine to medium. Gravel is subangular to rounded, fine to medium of flint and brick. [MADE GROUND - REWORKED LONDON CLAY]	
1.50	D2.2						Firm to stiff light brown mottled grey CLAY. [WEATHERED LONDON CLAY FORMATION]	
2.00	D2.3						1.50 - 2.00 Clay is becoming light brown mottled brown red, bioturbulated with rare black relict rootlets.	
2.00		N7					2.20 - 2.40 Becoming slightly sandy clay. Sand is orange and fine.	
						(4.10)		
3.00	D2.4							
3.00		N11					3.50 Becoming stiff. 3.60 - 3.80 Becoming sandy clay. Sand is orange and fine.	
4.00	D2.5						4.00 Grey mottling becoming rare.	
4.00		N13						
				33.06		5.00		
5.00	D2.6						*(Window sample terminated at 5m)*	
5.00		N24						

Boring Progress and Water Observations

Date	Strike depth	Casing depth	Comment	Time measured	Standing Depth

General Remarks

1. D - Disturbed Sample. ES - Environmental Sample. N - SPT 'N' value.
2. No groundwater encountered.
3. Hole reverse backfilled with arisings and reinstated with concrete at surface.

Method/ Plant Used	Field Crew	Logged By	Checked By
Tracked windowless sampler rig	RP Drilling	DMH	ADC

WINDOW SAMPLE LOG

Project				HOLE No
Kentish Town Car Wash				WS3
Job No	Date	Ground Level (m)	Co-Ordinates (m)	
CG/28407	04-12-17	38.02	E 528,982.2 N 185,246.2	
Client				Sheet
KTR Carwash Project Limited				1 of 1

SAMPLES & TESTS			Water	STRATA				Instrument /Backfill
Depth (m)	Type No	Test Result (N/kPa/ppm)		Reduced Level	Legend	Depth (m) (Thick-ness)	DESCRIPTION	
				37.87		0.15	Concrete. [MADE GROUND]	
0.20-0.30	ES6			37.77		0.25	Loose light brown grey slightly gravelly silty fine to medium sand. Gravel is subangular to rounded, fine to medium of flint and brick. [MADE GROUND]	
						(0.45)		
0.60-0.70	ES7			37.32		0.70	Medium dense pulverised red gravel of subangular to subrounded fine to coarse brick and mortar with loose pockets of loose brown grey slightly gravelly silty fine to medium sand. Gravel is subangular to rounded, fine to medium of brick and rare chalk (relic foundations). [MADE GROUND]	
				37.22		0.80		
1.00	D3.1							
1.00		N12/ 150 mm				(0.70)	Soft light grey brown slightly gravelly sandy clay. Sand is fine to medium. Gravel is subangular to rounded, fine to coarse of brick and rare chalk. [MADE GROUND]	
				36.52		1.50		
1.50	D3.2						Firm light brown mottled brown red slightly gravelly CLAY. Gravel is subangular to subrounded, fine to medium of flint. Clay is bioturbulated with frequent black relict rootlets. [WEATHERED LONDON CLAY FORMATION]	
				36.32		1.70		
2.00	D3.3						Firm light brown slightly sandy very gravelly CLAY. Clay is fissured. Sand is fine to medium. Gravel is subangular to subrounded, fine to medium of flint. [WEATHERED LONDON CLAY FORMATION]	
2.00		N8						
2.50	D3.4						Firm to stiff light brown mottled grey CLAY. [WEATHERED LONDON CLAY FORMATION] 1.90 - 2.20 Rare single rounded medium gravel inclusions of flint.	
3.00	D3.5							
3.00		N14				(3.30)		
3.50	D3.6							
4.00	D3.7							
4.00		N14						
4.50	D3.8							
				33.02		5.00		
5.00	D3.9						*(Window sample terminated at 5m)*	
5.00		N16						

Boring Progress and Water Observations

Date	Strike depth	Casing depth	Comment	Time measured	Standing Depth

General Remarks

1. D - Disturbed Sample. ES - Environmental Sample. N - SPT 'N' value.
2. No groundwater encountered.
3. Monitoring installation details: from 0.0m to 0.5mbgl plain pipe with betonite backfill, from 0.5mbgl to 1.5mbgl slotted pipe with gravel filter, from 1.5mbgl to 2.0mbgl bentonite arisings, from 2.0mbgl to 5.0mbgl backfilled with arisings. Monitoring installation fitted with end cap, gas tap and bung.

Method/ Plant Used	Field Crew	Logged By	Checked By
Tracked windowless sampler rig	RP Drilling	DMH	ADC

WINDOW SAMPLE LOG

Project				HOLE No
Kentish Town Car Wash				WS4
Job No	Date	Ground Level (m)	Co-Ordinates (m)	
CG/28407	04-12-17	38.11	E 528,973.2 N 185,243.5	
Client				Sheet
KTR Carwash Project Limited				1 of 1

SAMPLES & TESTS			Water	STRATA				Instrument /Backfill
Depth (m)	Type No	Test Result (N/kPa/ppm)		Reduced Level	Legend	Depth (m) (Thick-ness)	DESCRIPTION	
				37.81		(0.30) 0.30	Concrete with brick foundations underlying. [MADE GROUND]	
				37.51		(0.30) 0.60	No recovery of soil due to one rounded brick cobble becoming stuck in the liner. [MADE GROUND]	
0.60-0.70	ES8			37.31		0.80	Loose light brown grey slightly clayey slightly gravelly silty fine to medium sand. Gravel is subangular to rounded, fine to medium of flint and rare brick. [MADE GROUND]	
				37.11		1.00		
1.00-1.10	ES9							
1.00		N3					Soft to firm light brown slightly silty clay. [MADE GROUND]	
						(1.00)	No recovery of soil due to one rounded brick cobble becoming stuck in the liner. [MADE GROUND?]	
				36.11		2.00		
2.00	D4.1						Firm to stiff light brown mottled grey CLAY. [WEATHERED LONDON CLAY FORMATION] 2.20 - 2.30 Becoming slightly sandy clay. Sand is orange and fine.	
2.00		N7						
2.50	D4.2							
3.00	D4.3							
3.00		N12						
3.40	D4.4					(3.00)	3.50 - 3.70 Becoming slightly sandy clay. Sand is orange and fine.	
4.00	D4.5							
4.00		N12						
4.50	D4.6							
				33.11		5.00		
5.00	D4.7						*(Window sample terminated at 5m)*	
5.00		N14						

Boring Progress and Water Observations

Date	Strike depth	Casing depth	Comment	Time measured	Standing Depth

General Remarks

1. D - Disturbed Sample. ES - Environmental Sample. N - SPT 'N' value.
2. No groundwater encountered.
3. Hole reverse backfilled with arisings and reinstated with concrete at surface.

Method/ Plant Used	Field Crew	Logged By	Checked By
Tracked windowless sampler rig	RP Drilling	DMH	ADC

WINDOW SAMPLE LOG

Project				HOLE No
Kentish Town Car Wash				WS5
Job No	Date	Ground Level (m)	Co-Ordinates (m)	
CG/28407	04-12-17	38.08	E 528,978.0 N 185,243.1	
Client				Sheet
KTR Carwash Project Limited				1 of 1

SAMPLES & TESTS			Water	STRATA				Instrument /Backfill
Depth (m)	Type No	Test Result (N/kPa/ppm)		Reduced Level	Legend	Depth (m) (Thick-ness)	DESCRIPTION	
				37.88		0.20	Concrete. [MADE GROUND]	
				37.68		0.40	Loose dark grey silty gravel of subangular to subrounded fine to coarse of brick and concrete. [MADE GROUND]	
0.50-0.60	ES10			37.38		(0.30) 0.70	Soft dark grey gravelly very sandy clay. Sand is fine to medium. Gravel is angular to subrounded, fine to medium of flint and brick fragments. [MADE GROUND]	
0.80-0.90	ES11							
1.00		N9					Soft to firm light brown mottled grey CLAY with rare subrounded to rounded fine gravel of flint throughout. [WEATHERED LONDON CLAY FORMATION]	
1.20	D5.1					(1.00)		
				36.38		1.70		
						(0.40)	Firm light brown mottled orange sandy gravelly CLAY. Sand is fine to medium. Gravel is subangular to rounded, fine to coarse of flint. [WEATHERED LONDON CLAY FORMATION]	
2.00	D5.2			35.98		2.10	1.90 Becoming slightly gravelly sandy clay.	
2.00		N10					Firm to stiff light brown mottled grey CLAY. [WEATHERED LONDON CLAY FORMATION]	
3.00	D5.3							
3.00		N9				(2.90)		
4.00	D5.4							
4.00		N12						
				33.08		5.00		
5.00	D5.5						*(Window sample terminated at 5m)*	
5.00		N14						

Boring Progress and Water Observations

Date	Strike depth	Casing depth	Comment	Time measured	Standing Depth

General Remarks

1. D - Disturbed Sample. ES - Environmental Sample. N - SPT 'N' value.
2. No groundwater encountered.
3. Monitoring installation details: from 0.0m to 1.0mbgl plain pipe with betonite backfill, from 1.0mbgl to 2.0mbgl slotted pipe with gravel filter, from 2.0mbgl to 2.5mbgl bentonite arisings, from 2.5mbgl to 5.0mbgl backfilled with arisings. Monitoring installation fitted with end cap, gas tap and bung.

Method/ Plant Used	Field Crew	Logged By	Checked By
Tracked windowless sampler rig	RP Drilling	DMH	ADC

APPENDIX J

Geotechnical laboratory test results

David Hull
Card Geotechnics Ltd
4 Godalming Business Centre
Woolsack Way
Godalming
Surrey
GU7 1XW

t: 01483 310600
f: 01483 527285
e: davidh@cgl-uk.com

i2 Analytical Ltd.
7 Woodshots Meadow,
Croxley Green
Business Park,
Watford,
Herts,
WD18 8YS

t: 01923 225404
f: 01923 237404
e: reception@i2analytical.com

Analytical Report Number : 17-71542

Project / Site name:	Kentish Town Car Wash	**Samples received on:**	21/12/2017
Your job number:	CG-28407	**Samples instructed on:**	21/12/2017
Your order number:	POP000014	**Analysis completed by:**	04/01/2018
Report Issue Number:	1	**Report issued on:**	04/01/2018
Samples Analysed:	9 soil samples		

Signed: 

Jordan Hill
Reporting Manager
For & on behalf of i2 Analytical Ltd.

Standard Geotechnical, Asbestos and Chemical Testing Laboratory located at: ul. Pionierów 39, 41 -711 Ruda Śląska, Poland.

Accredited tests are defined within the report, opinions and interpretations expressed herein are outside the scope of accreditation.

Standard sample disposal times, unless otherwise agreed with the laboratory, are :

soils	- 4 weeks from reporting
leachates	- 2 weeks from reporting
waters	- 2 weeks from reporting
asbestos	- 6 months from reporting

Excel copies of reports are only valid when accompanied by this PDF certificate.

Analytical Report Number: 17-71542

Project / Site name: Kentish Town Car Wash
Your Order No: POP000014

Lab Sample Number				881316	881317	881318	881319	881320
Sample Reference				WS1	WS4	HP2	WS1	WS3
Sample Number				ES3	ES8	ES12	D1.5	D3.2
Depth (m)				1.00	0.60	0.40	5.00	1.50
Date Sampled				04/12/2017	04/12/2017	05/12/2017	05/12/2017	05/12/2017
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
Stone Content	%	0.1	NONE	< 0.1	< 0.1	< 0.1	< 0.1	33
Moisture Content	%	N/A	NONE	20	18	23	18	5.9
Total mass of sample received	kg	0.001	NONE	1.2	1.3	1.3	0.71	0.64
General Inorganics								
pH - Automated	pH Units	N/A	MCERTS	7.1	8.0	8.6	7.8	8.5
Total Sulphate as SO_4	mg/kg	50	MCERTS	-	-	-	7800	910
Water Soluble SO4 16hr extraction (2:1 Leachate Equivalent)	g/l	0.00125	MCERTS	0.081	0.088	0.25	3.6	0.24
Total Sulphur	mg/kg	50	MCERTS	-	-	-	2600	360

Analytical Report Number: 17-71542

Project / Site name: Kentish Town Car Wash
Your Order No: POP000014

Lab Sample Number				881321	881322	881323	881324	
Sample Reference				WS4	BH1	BH1	BH1	
Sample Number				D4.5	B3	D3	D5	
Depth (m)				4.00	1.20	5.00	10.00	
Date Sampled				05/12/2017	06/12/2017	06/12/2017	06/12/2017	
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
Stone Content	%	0.1	NONE	< 0.1	< 0.1	< 0.1	< 0.1	
Moisture Content	%	N/A	NONE	18	19	20	17	
Total mass of sample received	kg	0.001	NONE	0.55	0.67	1.5	0.62	
General Inorganics								
pH - Automated	pH Units	N/A	MCERTS	7.4	7.9	7.7	7.5	
Total Sulphate as SO_4	mg/kg	50	MCERTS	12000	2600	10000	3700	
Water Soluble SO4 16hr extraction (2:1 Leachate Equivalent)	g/l	0.00125	MCERTS	3.5	1.1	3.3	0.47	
Total Sulphur	mg/kg	50	MCERTS	4900	870	5100	87000	

Analytical Report Number : 17-71542

Project / Site name: Kentish Town Car Wash

* These descriptions are only intended to act as a cross check if sample identities are questioned. The major constituent of the sample is intended to act with respect to MCERTS validation. The laboratory is accredited for sand, clay and loam (MCERTS) soil types. Data for unaccredited types of solid should be interpreted with care.

Stone content of a sample is calculated as the % weight of the stones not passing a 10 mm sieve. Results are not corrected for stone content.

Lab Sample Number	Sample Reference	Sample Number	Depth (m)	Sample Description *
881316	WS1	ES3	1.00	Brown clay.
881317	WS4	ES8	0.60	Brown clay and sand with brick.
881318	HP2	ES12	0.40	Brown clay and sand with gravel.
881319	WS1	D1.5	5.00	Brown clay.
881320	WS3	D3.2	1.50	Brown clay and sand with gravel and stones.
881321	WS4	D4.5	4.00	Brown clay.
881322	BH1	B3	1.20	Brown clay.
881323	BH1	D3	5.00	Brown clay.
881324	BH1	D5	10.00	Grey clay.

Analytical Report Number : 17-71542

Project / Site name: Kentish Town Car Wash

Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Water (PrW)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Moisture Content	Moisture content, determined gravimetrically.	In-house method based on BS1377 Part 2, 1990, Chemical and Electrochemical Tests	L019-UK/PL	W	NONE
pH in soil (automated)	Determination of pH in soil by addition of water followed by automated electrometric measurement.	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests	L099-PL	D	MCERTS
Stones content of soil	Standard preparation for all samples unless otherwise detailed. Gravimetric determination of stone > 10 mm as % dry weight.	In-house method based on British Standard Methods and MCERTS requirements.	L019-UK/PL	D	NONE
Sulphate, water soluble, in soil (16hr extraction)	Determination of water soluble sulphate by ICP-OES. Results reported directly (leachate equivalent) and corrected for extraction ratio (soil equivalent).	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests, 2:1 water:soil extraction, analysis by ICP-OES.	L038-PL	D	MCERTS
Total sulphate (as SO4 in soil)	Determination of total sulphate in soil by extraction with 10% HCl followed by ICP-OES.	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests	L038-PL	D	MCERTS
Total Sulphur in soil	Determination of total sulphur in soil by extraction with aqua-regia, potassium bromide/bromate followed by ICP-OES.	In-house method based on BS1377 Part 3, 1990, and MEWAM 2006 Methods for the Determination of Metals in Soil	L038-PL	D	MCERTS

For method numbers ending in 'UK' analysis have been carried out in our laboratory in the United Kingdom.
For method numbers ending in 'PL' analysis have been carried out in our laboratory in Poland.
Soil analytical results are expressed on a dry weight basis. Where analysis is carried out on as-received the results obtained are multiplied by a moisture correction factor that is determined gravimetrically using the moisture content which is carried out at a maximum of 30oC.

SUMMARY OF GEOTECHNICAL TESTING

Sample details					Classification Tests					Density Tests		Undrained Triaxial Compression			Chemical Tests			Other tests and comments
Borehole / Trial Pit	Sample Ref	Depth (m)	Type	Description	WC (%)	LL (%)	PL (%)	PI (%)	<425 µm (%)	Bulk Mg/m³	Dry Mg/m³	Cell Pressure kPa	Deviator Stress kPa	Shear Stress kPa	pH	2:1 W/S SO4 (g/L)	W/S Mg (mg/L)	
BH1	B5	3.50	B	Greyish brown mottled grey CLAY with rare fine to medium gravel.	31.4	66	24	42	98									
BH1	U1	6.50	U	Stiff fissured brown silty CLAY with rare gypsum	29.3	72	27	45	98	1.97	1.52	130	278	139				
BH1	U2	9.50	U	Very stiff dark brown silty CLAY	28.0	76	26	50	100	2.01	1.57	190	291	145				
BH1	U3	12.00	U	Very stiff fissured dark brown silty CLAY	28.7	77	27	50	100	1.98	1.54	240	248	124				
HP1	B1.2	0.80	B	Brown slightly sandy slightly gravelly CLAY. Gravel includes brick.	30.1	51	24	27	56									
WS2	D2.6	5.00	D	Greyish brown CLAY with rare fine to medium gypsum.	24.9	74	28	46	99									
WS3	D3.6	3.50	D	Greyish brown mottled grey CLAY with rare fine gypsum.	28.6	72	27	45	99									

Sample type: B (Bulk disturb.) BLK (Block) C (Core) D (Disturbed) LB (Large Bulk dist.) U (Undisturbed)

Checked and Approved by

S Burke

S Burke - Senior Technician
04/01/2018

Project Number:

GEO / 26871

Project Name:

KENTISH TOWN CAR WASH
CG/28407

GEOLABS®

BS 1377 : Part 7 : 1990 Clause 8

QUICK UNDRAINED TRIAXIAL COMPRESSION TEST

BH/TP No	BH1
Sample Ref	U1
Depth (m)	6.50
Sample Type	U

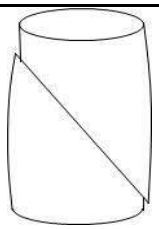
Description:

Stiff fissured brown silty CLAY with rare gypsum

Specimen Details

Specimen conditions		Undisturbed
Length	(mm)	202.5
Diameter	(mm)	102.4
Moisture Content	(%)	29.3
Bulk Density	(Mg/m³)	1.97
Dry Density	(Mg/m³)	1.52
Test Details		
Latex membrane thickness	(mm)	0.3
Membrane correction	(kPa)	0.4
Axial displacement rate	(%/min)	2.0
Cell pressure	(kPa)	130
Strain at failure	(%)	5.4
Maximum Deviator Stress	(kPa)	278
Shear Stress Cu	(kPa)	139

Mode of failure



Orientation of the sample	Vertical
Distance from top of tube mm	20

Checked and Approved by:

S Burke

S Burke - Senior Technician
04/01/2018

Project Number:

GEO / 26871

Project Name:

KENTISH TOWN CAR WASH
CG/28407

GEOLABS

UKAS TESTING 1982

BS 1377 : Part 7 : 1990 Clause 8

QUICK UNDRAINED TRIAXIAL COMPRESSION TEST

BH/TP No	BH1
Sample Ref	U2
Depth (m)	9.50
Sample Type	U

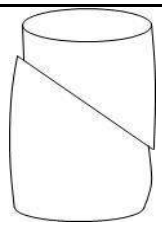
Description:

Very stiff dark brown silty CLAY

Specimen Details

Specimen conditions		Undisturbed
Length	(mm)	202.6
Diameter	(mm)	103.0
Moisture Content	(%)	28.0
Bulk Density	(Mg/m³)	2.01
Dry Density	(Mg/m³)	1.57
Test Details		
Latex membrane thickness	(mm)	0.3
Membrane correction	(kPa)	0.3
Axial displacement rate	(%/min)	2.0
Cell pressure	(kPa)	190
Strain at failure	(%)	4.4
Maximum Deviator Stress	(kPa)	291
Shear Stress Cu	(kPa)	145

Mode of failure



Orientation of the sample	Vertical
Distance from top of tube mm	25

Checked and Approved by:

S Burke

S Burke - Senior Technician
04/01/2018

Project Number:

GEO / 26871

Project Name:

KENTISH TOWN CAR WASH
CG/28407

GEOLABS

UKAS TESTING 1982

BS 1377 : Part 7 : 1990 Clause 8

QUICK UNDRAINED TRIAXIAL COMPRESSION TEST

BH/TP No	BH1
Sample Ref	U3
Depth (m)	12.00
Sample Type	U

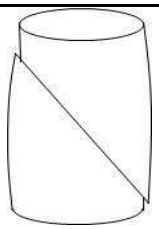
Description:

Very stiff fissured dark brown silty CLAY

Specimen Details

Specimen conditions		Undisturbed
Length	(mm)	202.6
Diameter	(mm)	103.8
Moisture Content	(%)	28.7
Bulk Density	(Mg/m³)	1.98
Dry Density	(Mg/m³)	1.54
Test Details		
Latex membrane thickness	(mm)	0.3
Membrane correction	(kPa)	0.3
Axial displacement rate	(%/min)	2.0
Cell pressure	(kPa)	240
Strain at failure	(%)	4.2
Maximum Deviator Stress	(kPa)	248
Shear Stress Cu	(kPa)	124

Mode of failure



Orientation of the sample	Vertical
Distance from top of tube mm	90

Checked and Approved by:

S Burke

S Burke - Senior Technician
04/01/2018

Project Number:

GEO / 26871

Project Name:

KENTISH TOWN CAR WASH
CG/28407

GEOLABS

UKAS TESTING 1982

APPENDIX K

Proposed building loads

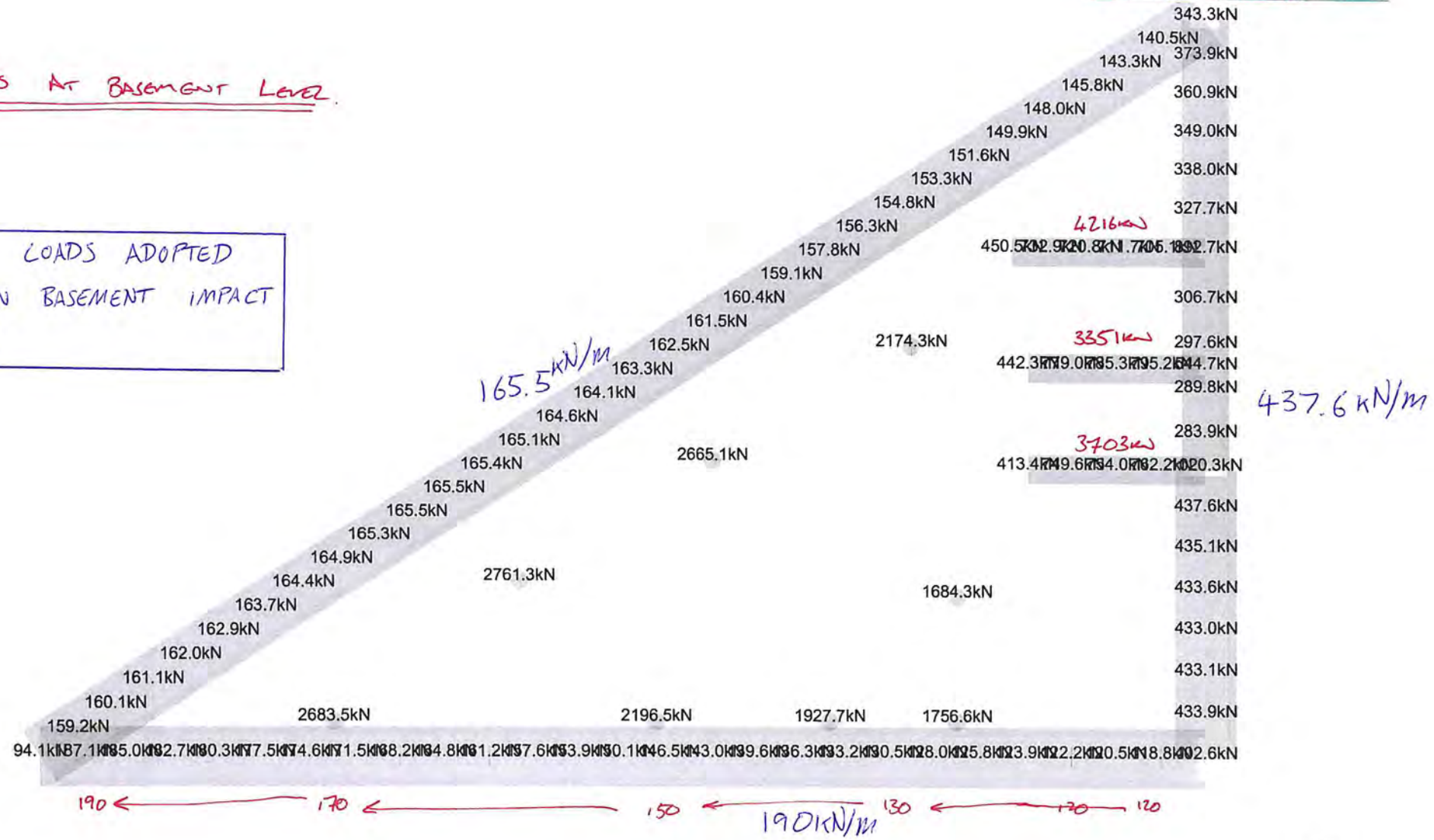
PRICE&MYERS
Consulting Engineers
37 Alfred Place London WC1E 7DP 020 7631 5128

Job No 26778 Page PILE LOADS Ver 1
Date DEC '18 Eng C.AUSTIN Chd
Job KENTISH TOWN ROAD

450 ⌀ 20m ⇒ 1050 kN — 2 No° — 2100 kN
450 ⌀ 25max ⇒ 1500 kN — 3000 kN ∴ ALL MAX 2 No° PILE

ALL LOADS AT BASEMENT LEVEL.

PILE WALL LOADS ADOPTED BY CGL IN BASEMENT IMPACT ASSESSMENT



BASEMENT LEVEL PILE LOADS (SLS)

3D

APPENDIX L

WALLAP retaining wall analysis results

Units: kN,m

INPUT DATA

SOIL PROFILE

Stratum no.	Elevation of top of stratum	Soil types Left side	Soil types Right side
1	38.00	1 MG (undrained)	1 MG (undrained)
2	37.00	2 LC (undrained)	2 LC (undrained)

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	MG (undrained)	20.00	13600	1.000	NC (0.490)	1.000 (2.570)	1.000 (2.571)	34.00u
2	LC (undra.. (37.00)	20.00	40000 (8000)	1.000	OC (0.490)	1.000 (2.570)	1.000 (2.571)	40.00u (8.000)
3	MG (drained)	18.00	10200	0.577	OC (0.200)	0.340 (1.415)	3.627 (5.634)	0.0d
4	LCF (drai.. (37.00)	20.00	30000 (6000)	0.625	OC (0.200)	0.387 (1.517)	3.028 (5.020)	5.000d

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	MG (undrained)	0.00	1.000	0.00	0.00	1.000	0.00
2	LC (undrained)	0.00	1.000	0.00	0.00	1.000	0.00
3	MG (drained)	25.00	1.000	0.00	25.00	1.000	0.00
4	LCF (drained)	22.00	1.000	0.00	22.00	1.000	0.00

GROUND WATER CONDITIONS

Density of water = 10.00 kN/m3

	Left side	Right side
Initial water table elevation	0.00	0.00

Automatic water pressure balancing at toe of wall : No

WALL PROPERTIES

Type of structure = Fully Embedded Wall
Elevation of toe of wall = 26.00
Maximum finite element length = 0.60 m
Youngs modulus of wall E = 1.9600E+07 kN/m2
Moment of inertia of wall I = 3.3548E-03 m4/m run
E.I = 65754 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	37.55	1.00	0.900000	1.960E+07	10.00	0.00	0	No
2	33.83	1.00	0.350000	1.960E+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	36.50	1.00(L)	1000.00	1.00	250.00	=	N/A	1.00 P/U

Note: L = Left side, R = Right side
Limit State Categories P/U = Permanent Unfavourable
P/F = Permanent Favourable
Var = Variable (unfavourable)

CONSTRUCTION STAGES

Construction stage no.	Stage description
1	Apply surcharge no.1 at elevation 36.50
2	Excavate to elevation 37.55 on RIGHT side
3	Install strut or anchor no.1 at elevation 37.55
4	Excavate to elevation 33.50 on RIGHT side
5	Install strut or anchor no.2 at elevation 33.83
6	Change properties of soil type 1 to soil type 3 No analysis at this stage Ko pressures will be reset
7	Change properties of soil type 2 to soil type 4 Ko pressures will be reset
8	Change EI of wall to 46967 kN.m2/m run Yield moment not defined Allow wall to relax with new modulus value

FACTORS OF SAFETY and ANALYSIS OPTIONS

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

Stability analysis:
Method of analysis - Strength Factor method
Factor on soil strength for calculating wall depth = 1.00

Parameters for undrained strata:
Minimum equivalent fluid density = 5.00 kN/m3
Maximum depth of water filled tension crack = 0.00 m

Bending moment and displacement calculation:
Method - Subgrade reaction model using Influence Coefficients
Open Tension Crack analysis? - No
Non-linear Modulus Parameter (L) = 0 m

Boundary conditions:
Length of wall (normal to plane of analysis) = 1000.00 m

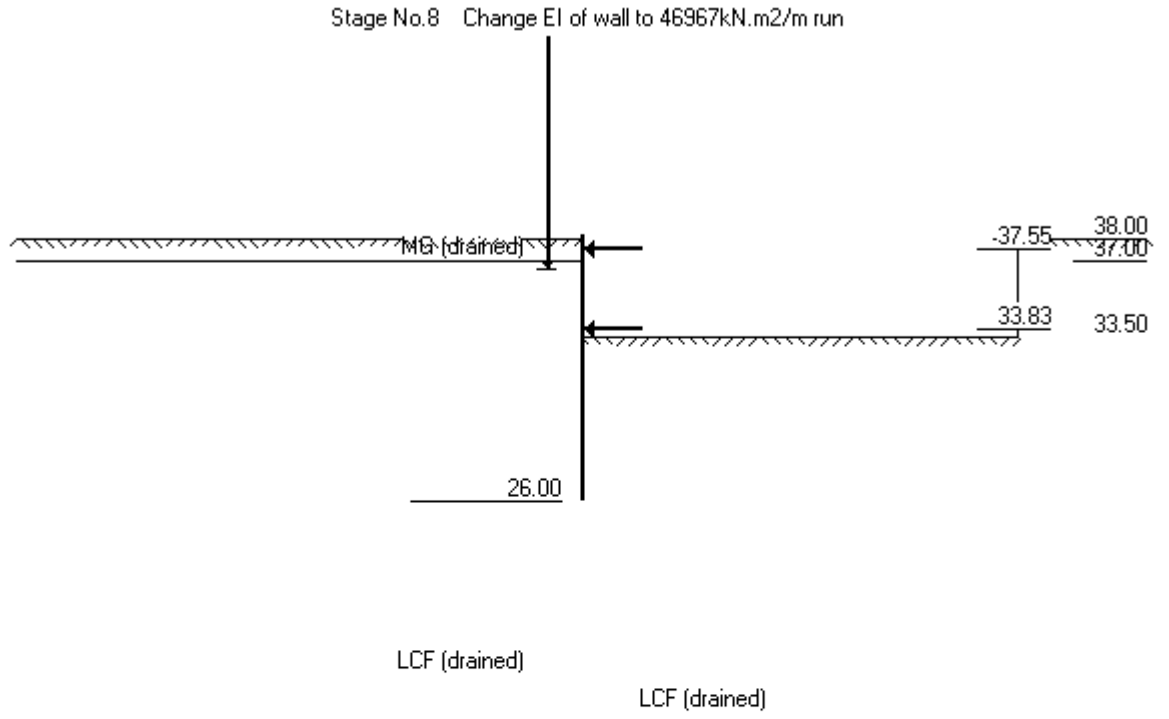
Width of excavation on Left side of wall = 20.00 m
Width of excavation on Right side of wall = 20.00 m

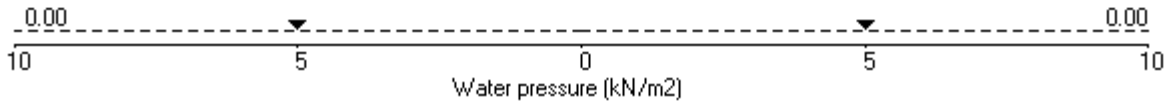
Distance to rigid boundary on Left side = 20.00 m
Distance to rigid boundary on Right side = 20.00 m

OUTPUT OPTIONS

Stage no.	Stage description	Output options: Displacement, Bending mom., Shear force	Active, Passive pressures	Graph. output
1	Apply surcharge no.1 at elev. 36.50	Yes	Yes	Yes
2	Excav. to elev. 37.55 on RIGHT side	Yes	Yes	Yes
3	Install strut no.1 at elev. 37.55	Yes	Yes	Yes
4	Excav. to elev. 33.50 on RIGHT side	Yes	Yes	Yes
5	Install strut no.2 at elev. 33.83	Yes	Yes	Yes
6	Change soil type 1 to soil type 3	Yes	Yes	Yes
7	Change soil type 2 to soil type 4	Yes	Yes	Yes
8	Change EI of wall to 46967kN.m2/m run	Yes	Yes	Yes
*	Summary output	Yes	-	Yes

Units: kN,m


Stage No.8 Change EI of wall to 46967kN.m2/m run
MG (drained)
-37.55
38.00
37.00
33.83
33.50
26.00
LCF (drained)
LCF (drained)


0.00
0.00
10
5
0
5
10
Water pressure (kN/m2)

Units: kN,m

Stage No. 2 Excavate to elevation 37.55 on RIGHT 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. = 26.00 Factor of Safety	Moment equilib. at elev.	Toe elev. for FoS = 1.000	Wall Penetr -ation	Direction of failure
2	38.00	37.55	Cant.	Conditions not suitable for FoS calc.				

BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall

Analysis options

Length of wall perpendicular to section = 1000.00m

Subgrade reaction model - Boussinesq Influence coefficients

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

Open Tension Crack analysis - No

Rigid boundaries: Left side 20.00 from wall
Right side 20.00 from wall

Limit State: Serviceability Limit State

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

Node no.	Y coord	Nett pressure kN/m2	Wall disp. m	Wall rotation rad.	Shear force kN/m	Bending moment kN.m/m	Strut forces kN/m	EI of wall kN.m2/m
1	38.00	2.92	0.001	-5.87E-04	0.0	-0.0		65754
2	37.55	5.88	0.001	-5.89E-04	2.0	0.6		65754
		2.71	0.001	-5.89E-04	2.0	0.6		
3	37.00	1.56	0.001	-6.01E-04	3.2	2.1		65754
		-13.25	0.001	-6.01E-04	3.2	2.1		
4	36.50	-19.01	0.002	-6.17E-04	-4.9	2.0		65754
5	35.95	-15.96	0.002	-6.12E-04	-14.5	-3.0		65754
6	35.40	4.54	0.002	-5.50E-04	-17.7	-12.0		65754
7	34.80	16.63	0.002	-4.02E-04	-11.3	-20.5		65754
8	34.31	16.58	0.003	-2.37E-04	-3.2	-23.8		65754
9	33.83	12.29	0.003	-6.28E-05	3.8	-23.4		65754
10	33.50	8.70	0.003	4.81E-05	7.2	-21.5		65754
11	32.95	3.03	0.003	2.06E-04	10.5	-16.4		65754
12	32.40	-1.16	0.002	3.18E-04	11.0	-10.4		65754
13	31.80	-3.77	0.002	3.86E-04	9.5	-4.3		65754
14	31.20	-4.66	0.002	4.03E-04	7.0	0.5		65754
15	30.60	-4.39	0.002	3.85E-04	4.2	3.6		65754
16	30.00	-3.53	0.002	3.45E-04	1.9	5.1		65754
17	29.40	-2.48	0.001	2.97E-04	0.1	5.4		65754
18	28.80	-1.50	0.001	2.49E-04	-1.1	4.9		65754
19	28.20	-0.68	0.001	2.10E-04	-1.8	3.8		65754
20	27.60	0.05	0.001	1.81E-04	-2.0	2.5		65754
21	27.00	0.82	0.001	1.64E-04	-1.7	1.2		65754
22	26.50	1.64	0.001	1.58E-04	-1.1	0.4		65754
23	26.00	2.72	0.001	1.57E-04	0.0	0.0		---

(continued)

Stage No.2 Excavate to elevation 37.55 on RIGHT side

Node no.	Y coord	LEFT 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	Coeff. of subgrade reaction kN/m3
1	38.00	Total>	0.00	0.00	87.42	2.92	2.92	4210	
2	37.55	Total>	9.00	2.25m	96.42	5.88	5.88	4210	
3	37.00	Total>	20.00	5.00m	107.42	16.30	16.30	4210	
		Total>	20.00	5.00m	122.84	9.12	9.12	12382	
4	36.50	Total>	30.00	7.50m	143.12	16.23	16.23	13621	
5	35.95	Total>	51.80	10.25m	176.24	33.94	33.94	14983	
6	35.40	Total>	92.53	13.00m	228.28	69.47	69.47	16345	
7	34.80	Total>	126.23	16.00m	274.32	97.94	97.94	17831	
8	34.31	Total>	142.46	18.44m	300.58	110.78	110.78	19038	
9	33.83	Total>	152.87	20.87m	321.01	118.70	118.70	20245	
10	33.50	Total>	158.08	22.50m	332.91	122.79	122.79	21050	
11	32.95	Total>	165.48	25.25m	351.62	129.23	129.23	22412	
12	32.40	Total>	172.23	28.00m	369.68	136.10	136.10	23774	
13	31.80	Total>	179.61	31.00m	389.41	144.59	144.59	25260	
14	31.20	Total>	187.32	34.00m	409.46	154.10	154.10	26746	
15	30.60	Total>	195.46	37.00m	429.94	164.39	164.39	28232	
16	30.00	Total>	204.03	40.00m	450.84	175.19	175.19	29718	
17	29.40	Total>	212.99	43.00m	472.14	186.28	186.28	31204	
18	28.80	Total>	222.29	46.00m	493.79	197.49	197.49	32690	
19	28.20	Total>	231.89	49.00m	515.73	208.78	208.78	34175	
20	27.60	Total>	241.76	52.00m	537.94	220.14	220.14	35661	
21	27.00	Total>	251.85	55.00m	560.37	231.63	231.63	37147	
22	26.50	Total>	260.40	57.50m	579.21	241.37	241.37	38385	
23	26.00	Total>	269.08	60.00m	598.16	251.30	251.30	39624	

Node no.	Y coord	RIGHT 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	Coeff. of subgrade reaction kN/m3
1	38.00		0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	37.55		0.00	0.00	0.00	0.00	0.00	0.00	0.0
		Total>	0.00	0.00	87.42	3.17	3.17	4303	
3	37.00	Total>	11.00	2.75m	98.42	14.75	14.75	4303	
		Total>	11.00	2.75m	113.84	22.37	22.37	12655	
4	36.50	Total>	21.00	5.25m	134.12	35.25	35.25	13920	
5	35.95	Total>	32.00	8.00m	156.44	49.91	49.91	15312	
6	35.40	Total>	43.00	10.75m	178.75	64.93	64.93	16704	
7	34.80	Total>	55.01	13.75m	203.10	81.31	81.31	18223	
8	34.31	Total>	64.77	16.19m	222.88	94.20	94.20	19457	
9	33.83	Total>	74.52	18.62m	242.67	106.41	106.41	20691	
10	33.50	Total>	81.03	20.25m	255.86	114.09	114.09	21513	
11	32.95	Total>	92.04	23.00m	278.18	126.20	126.20	22905	
12	32.40	Total>	103.06	25.75m	300.51	137.26	137.26	24297	
13	31.80	Total>	115.08	28.75m	324.88	148.36	148.36	25816	
14	31.20	Total>	127.11	31.75m	349.24	158.76	158.76	27335	
15	30.60	Total>	139.14	34.75m	373.61	168.79	168.79	28853	
16	30.00	Total>	151.18	37.75m	397.99	178.72	178.72	30372	
17	29.40	Total>	163.21	40.75m	422.37	188.75	188.75	31890	
18	28.80	Total>	175.26	43.75m	446.76	198.99	198.99	33409	
19	28.20	Total>	187.31	46.75m	471.15	209.45	209.45	34927	
20	27.60	Total>	199.36	49.75m	495.54	220.09	220.09	36446	
21	27.00	Total>	211.42	52.75m	519.94	230.81	230.81	37965	
22	26.50	Total>	221.47	55.25m	540.27	239.73	239.73	39230	

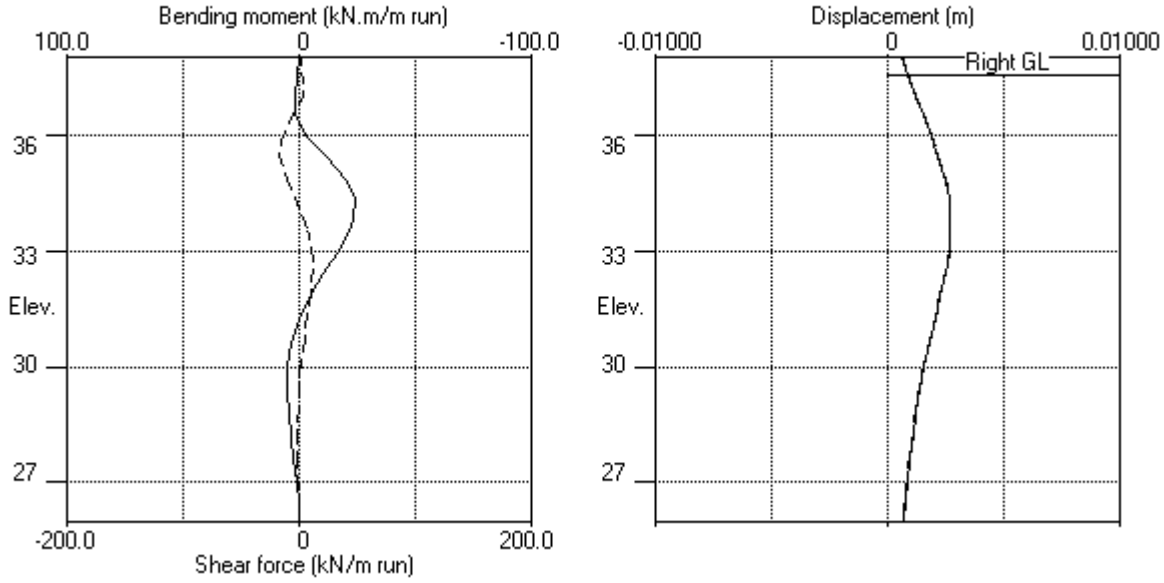
(continued)

Stage No.2 Excavate to elevation 37.55 on RIGHT side

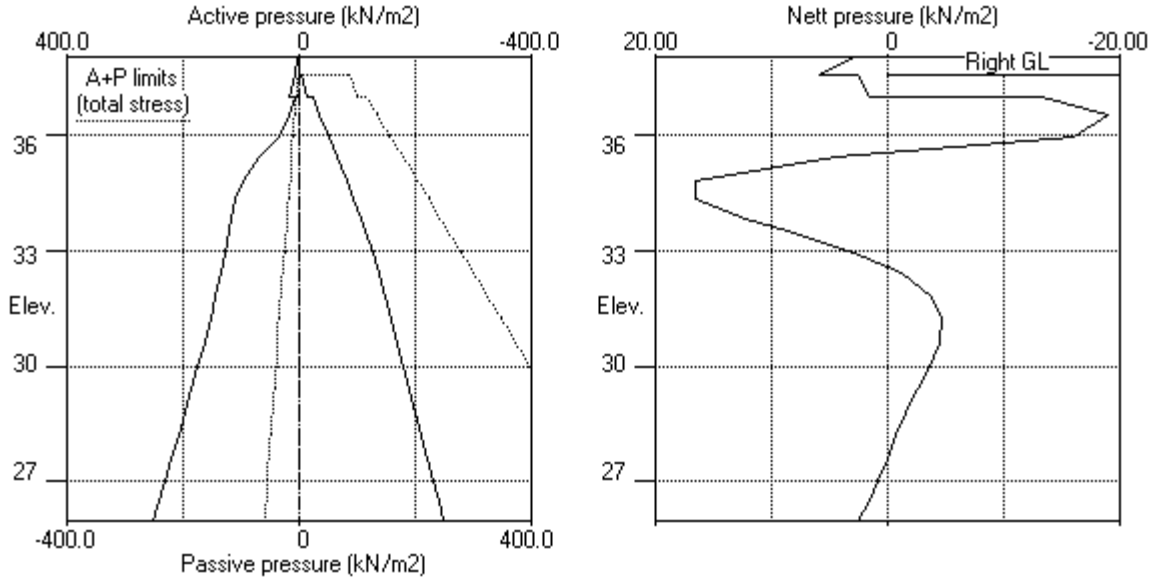
Node no.	Y coord	RIGHT side						
		Effective stresses					Total earth pressure	Coeff. of subgrade reaction
		Water press.	Vertic -al	Active limit	Passive limit	Earth pressure		
		kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m3
23	26.00	Total>	231.52	57.75m	560.61	248.58	248.58	40496

Units: kN,m

Stage No.2 Excav. to elev. 37.55 on RIGHT side



Stage No.2 Excav. to elev. 37.55 on RIGHT side



Units: kN,m

Stage No. 4 Excavate to elevation 33.50 on RIGHT 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. = 26.00 Factor of Safety	Moment equilib. at elev.	Toe elev. for FoS = 1.000 Toe elev.	Wall Penetr -ation	Direction of failure
4	38.00	33.50	37.55	3.733	n/a	33.32	0.18	L to R

BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall

Analysis options

Length of wall perpendicular to section = 1000.00m
Subgrade reaction model - Boussinesq Influence coefficients
Soil deformations are elastic until the active or passive limit is reached
Open Tension Crack analysis - No

Rigid boundaries: Left side 20.00 from wall
Right side 20.00 from wall

Limit State: Serviceability Limit State

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

Node no.	Y coord	Nett pressure kN/m2	Wall disp. m	Wall rotation rad.	Shear force kN/m	Bending moment kN.m/m	Strut forces kN/m	EI of wall kN.m2/m
1	38.00	28.39	-0.000	-2.95E-03	0.0	-0.0		65754
2	37.55	5.80	0.001	-2.96E-03	7.7	3.2	59.2	65754
		5.80	0.001	-2.96E-03	-51.5	3.2		
3	37.00	12.85	0.003	-2.88E-03	-46.4	-23.7		65754
		5.00	0.003	-2.88E-03	-46.4	-23.7		
4	36.50	7.50	0.004	-2.61E-03	-43.3	-45.9		65754
5	35.95	10.25	0.005	-2.13E-03	-38.4	-68.1		65754
6	35.40	28.40	0.006	-1.50E-03	-27.8	-84.2		65754
7	34.80	49.02	0.007	-6.91E-04	-4.5	-93.6		65754
8	34.31	58.39	0.007	-1.35E-05	21.6	-89.2		65754
9	33.83	65.71	0.007	5.80E-04	51.9	-71.2		65754
10	33.50	70.85	0.007	8.82E-04	74.1	-50.7		65754
		-43.82	0.007	8.82E-04	74.1	-50.7		
11	32.95	-40.38	0.006	1.16E-03	50.9	-16.8		65754
12	32.40	-32.89	0.005	1.21E-03	30.8	4.9		65754
13	31.80	-23.12	0.005	1.11E-03	14.0	17.2		65754
14	31.20	-14.01	0.004	9.39E-04	2.8	21.2		65754
15	30.60	-6.85	0.004	7.50E-04	-3.4	20.1		65754
16	30.00	-2.01	0.003	5.83E-04	-6.1	16.6		65754
17	29.40	0.74	0.003	4.50E-04	-6.4	12.4		65754
18	28.80	1.92	0.003	3.54E-04	-5.7	8.5		65754
19	28.20	2.14	0.002	2.91E-04	-4.4	5.3		65754
20	27.60	1.96	0.002	2.53E-04	-3.2	2.9		65754
21	27.00	1.82	0.002	2.34E-04	-2.1	1.2		65754
22	26.50	1.97	0.002	2.28E-04	-1.1	0.4		65754
23	26.00	2.49	0.002	2.26E-04	0.0	-0.0		---

At elev. 37.55 Strut force = 59.2 kN/strut = 59.2 kN/m run

(continued)

Stage No.4 Excavate to elevation 33.50 on RIGHT side

LEFT side

Node no.	Y coord	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	Coeff. of subgrade reaction kN/m3
1	38.00	Total>	0.00	0.00	87.42	28.39	28.39	24650
2	37.55	Total>	9.00	2.25m	96.42	5.80	5.80	2605
3	37.00	Total>	20.00	5.00m	107.42	12.85	12.85	2605
		Total>	20.00	5.00m	122.84	5.00	5.00a	7661
4	36.50	Total>	30.00	7.50m	143.12	7.50	7.50a	8427
5	35.95	Total>	51.80	10.25m	176.24	10.25	10.25a	9270
6	35.40	Total>	92.53	13.00m	228.28	28.40	28.40	10112
7	34.80	Total>	126.23	16.00m	274.32	49.02	49.02	11032
8	34.31	Total>	142.46	18.44m	300.58	58.39	58.39	11778
9	33.83	Total>	152.87	20.87m	321.01	65.71	65.71	12525
10	33.50	Total>	158.08	22.50m	332.91	70.85	70.85	13023
11	32.95	Total>	165.48	25.25m	351.62	80.92	80.92	13866
12	32.40	Total>	172.23	28.00m	369.68	92.44	92.44	14709
13	31.80	Total>	179.61	31.00m	389.41	105.86	105.86	15628
14	31.20	Total>	187.32	34.00m	409.46	119.35	119.35	16547
15	30.60	Total>	195.46	37.00m	429.94	132.40	132.40	17467
16	30.00	Total>	204.03	40.00m	450.84	144.80	144.80	18386
17	29.40	Total>	212.99	43.00m	472.14	156.59	156.59	19305
18	28.80	Total>	222.29	46.00m	493.79	167.93	167.93	20224
19	28.20	Total>	231.89	49.00m	515.73	179.03	179.03	21144
20	27.60	Total>	241.76	52.00m	537.94	190.10	190.10	22063
21	27.00	Total>	251.85	55.00m	560.37	201.31	201.31	22982
22	26.50	Total>	260.40	57.50m	579.21	210.86	210.86	23748
23	26.00	Total>	269.08	60.00m	598.16	220.66	220.66	24514

RIGHT side

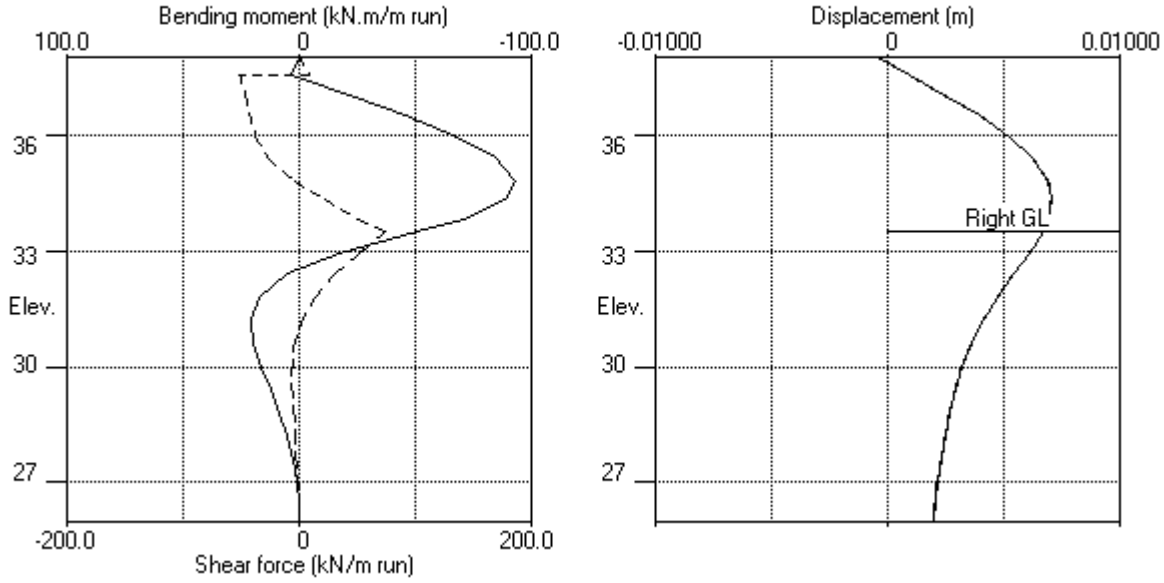
Node no.	Y coord	Water press. kN/m2	Effective stresses: Vertic -al kN/m2	Active limit kN/m2	Passive limit kN/m2	Earth pressure kN/m2	Total earth pressure kN/m2	Coeff. of subgrade reaction kN/m3
1	38.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	37.55	0.00	0.00	0.00	0.00	0.00	0.00	0.0
3	37.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
4	36.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
5	35.95	0.00	0.00	0.00	0.00	0.00	0.00	0.0
6	35.40	0.00	0.00	0.00	0.00	0.00	0.00	0.0
7	34.80	0.00	0.00	0.00	0.00	0.00	0.00	0.0
8	34.31	0.00	0.00	0.00	0.00	0.00	0.00	0.0
9	33.83	0.00	0.00	0.00	0.00	0.00	0.00	0.0
10	33.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
		Total>	0.00	0.00	174.83	114.67	114.67	19666
11	32.95	Total>	11.00	2.75m	197.14	121.30	121.30	20939
12	32.40	Total>	22.01	5.50m	219.46	125.33	125.33	22211
13	31.80	Total>	34.02	8.50m	243.82	128.98	128.98	23600
14	31.20	Total>	46.06	11.50m	268.19	133.36	133.36	24988
15	30.60	Total>	58.11	14.50m	292.59	139.25	139.25	26376
16	30.00	Total>	70.20	17.50m	317.01	146.81	146.81	27764
17	29.40	Total>	82.31	20.50m	341.47	155.85	155.85	29152
18	28.80	Total>	94.46	23.50m	365.96	166.01	166.01	30541
19	28.20	Total>	106.66	26.50m	390.49	176.88	176.88	31929
20	27.60	Total>	118.89	29.50m	415.07	188.13	188.13	33317
21	27.00	Total>	131.16	32.50m	439.68	199.49	199.49	34705
22	26.50	Total>	141.42	35.00m	460.23	208.89	208.89	35862
23	26.00	Total>	151.72	37.50m	480.81	218.17	218.17	37019

(continued)

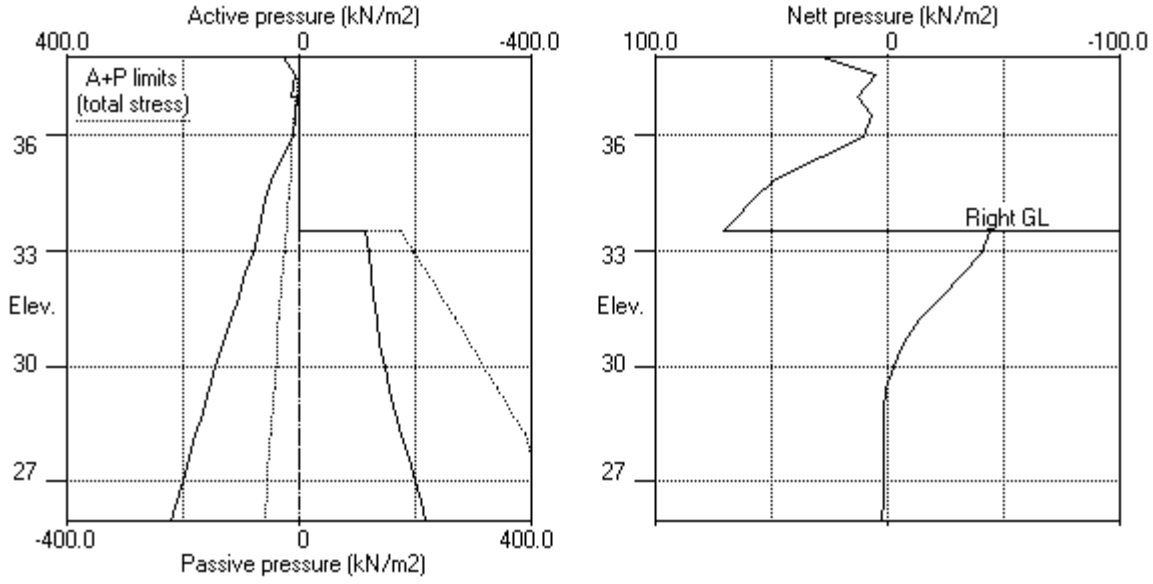
Stage No.4 Excavate to elevation 33.50 on RIGHT side
Note: 10.25a Soil pressure at active limit
123.45p Soil pressure at passive limit

Units: kN,m

Stage No.4 Excav. to elev. 33.50 on RIGHT side



Stage No.4 Excav. to elev. 33.50 on RIGHT side



Units: kN,m

Stage No. 7 Change properties of soil type 2 to soil type 4
Ko pressures will be reset

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. = 26.00 Factor of Safety	Moment equilib. at elev.	Toe elev. for FoS = 1.000 Toe elev.	Wall Penetr -ation	Direction of failure
7	38.00	33.50		More than one strut. No FoS calc.				

BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall
Analysis options
Length of wall perpendicular to section = 1000.00m
Subgrade reaction model - Boussinesq Influence coefficients
Soil deformations are elastic until the active or passive limit is reached
Open Tension Crack analysis - No

Rigid boundaries: Left side 20.00 from wall
Right side 20.00 from wall
Limit State: Serviceability Limit State
Calculated Bending Moments and Strut Forces are to be multiplied by a factor of 1.35 to obtain values for structural design. See summary for factored values.

Node no.	Y coord	Nett pressure kN/m2	Wall disp. m	Wall rotation rad.	Shear force kN/m	Bending moment kN.m/m	Strut forces kN/m	EI of wall kN.m2/m
1	38.00	0.00	-0.001	-3.24E-03	0.0	-0.0		65754
2	37.55	5.57	0.001	-3.25E-03	1.3	1.3	64.0	65754
		5.57	0.001	-3.25E-03	-62.7	1.3		
3	37.00	12.17	0.003	-3.12E-03	-57.8	-31.8		65754
		10.71	0.003	-3.12E-03	-57.8	-31.8		
4	36.50	16.49	0.004	-2.77E-03	-51.0	-58.9		65754
5	35.95	29.76	0.006	-2.18E-03	-38.3	-83.4		65754
6	35.40	55.13	0.007	-1.43E-03	-15.0	-96.2		65754
7	34.80	76.39	0.007	-5.70E-04	24.5	-93.0		65754
8	34.31	86.71	0.007	3.78E-05	64.2	-71.2		65754
9	33.83	93.01	0.007	4.09E-04	108.1	-29.1	149.3	65754
		93.01	0.007	4.09E-04	-41.2	-29.1		
10	33.50	95.72	0.007	5.74E-04	-10.6	-37.5		65754
		70.62	0.007	5.74E-04	-10.6	-37.5		
11	32.95	40.66	0.007	8.74E-04	20.0	-34.4		65754
12	32.40	10.57	0.006	1.09E-03	34.1	-19.3		65754
13	31.80	-21.53	0.005	1.18E-03	30.8	0.3		65754
14	31.20	-24.27	0.005	1.11E-03	17.1	14.3		65754
15	30.60	-15.25	0.004	9.63E-04	5.2	20.0		65754
16	30.00	-8.22	0.003	7.80E-04	-1.8	20.2		65754
17	29.40	-3.40	0.003	6.08E-04	-5.3	17.4		65754
18	28.80	-0.52	0.003	4.68E-04	-6.5	13.5		65754
19	28.20	0.95	0.003	3.64E-04	-6.3	9.3		65754
20	27.60	1.79	0.002	2.96E-04	-5.5	5.6		65754
21	27.00	3.02	0.002	2.59E-04	-4.1	2.5		65754
22	26.50	4.00	0.002	2.47E-04	-2.3	0.7		65754
23	26.00	5.27	0.002	2.44E-04	0.0	-0.0		---

At elev. 37.55 Strut force = 64.0 kN/strut = 64.0 kN/m run
At elev. 33.83 Strut force = 149.3 kN/strut = 149.3 kN/m run

(continued)

Stage No.7 Change properties of soil type 2 to soil type 4
Ko pressures will be reset

LEFT side

Node no.	Y coord	Effective stresses: Water press. kN/m2	Vertic-al kN/m2	Active limit kN/m2	Passive limit kN/m2	Earth pressure kN/m2	Total earth pressure kN/m2	Coeff. of subgrade reaction kN/m3
1	38.00	0.00	0.00	0.00	0.00	0.00	0.00	13581
2	37.55	0.00	8.10	2.76	29.38	5.57	5.57	1226
3	37.00	0.00	18.00	6.12	65.29	12.17	12.17	1226
		0.00	18.00	0.00	79.61	10.71	10.71	3606
4	36.50	0.00	28.00	3.26	109.89	16.49	16.49	3966
5	35.95	0.00	49.80	11.70	175.91	29.76	29.76	4363
6	35.40	0.00	90.53	27.47	299.24	55.13	55.13	4760
7	34.80	0.00	124.23	40.52	401.30	76.39	76.39	5192
8	34.31	0.00	140.46	46.80	450.45	86.71	86.71	5544
9	33.83	0.00	150.87	50.83	481.94	93.01	93.01	5895
10	33.50	0.00	156.08	52.85	497.74	95.72	95.72	6130
11	32.95	0.00	163.48	55.71	520.14	99.07	99.07	6526
12	32.40	0.00	170.23	58.32	540.58	102.31	102.31	6923
13	31.80	0.00	177.61	61.18	562.93	106.60	106.60	7356
14	31.20	0.00	185.32	64.17	586.28	114.81	114.81	7788
15	30.60	0.00	193.46	67.32	610.93	128.63	128.63	8221
16	30.00	0.00	202.03	70.64	636.87	141.94	141.94	8654
17	29.40	0.00	210.99	74.10	663.99	154.58	154.58	9086
18	28.80	0.00	220.29	77.71	692.17	166.62	166.62	9519
19	28.20	0.00	217.92	76.79	685.00	178.24	178.24	9952
20	27.60	0.00	239.76	85.24	751.12	189.76	189.76	33094
21	27.00	0.00	249.85	89.15	781.67	201.66	201.66	34473
22	26.50	0.00	258.40	92.46	807.58	211.63	211.63	35622
23	26.00	0.00	267.08	95.82	833.84	221.80	221.80	36771

RIGHT side

Node no.	Y coord	Effective stresses: Water press. kN/m2	Vertic-al kN/m2	Active limit kN/m2	Passive limit kN/m2	Earth pressure kN/m2	Total earth pressure kN/m2	Coeff. of subgrade reaction kN/m3
1	38.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	37.55	0.00	0.00	0.00	0.00	0.00	0.00	0.0
3	37.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
4	36.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
5	35.95	0.00	0.00	0.00	0.00	0.00	0.00	0.0
6	35.40	0.00	0.00	0.00	0.00	0.00	0.00	0.0
7	34.80	0.00	0.00	0.00	0.00	0.00	0.00	0.0
8	34.31	0.00	0.00	0.00	0.00	0.00	0.00	0.0
9	33.83	0.00	0.00	0.00	0.00	0.00	0.00	0.0
10	33.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
		0.00	0.00	0.00	25.10	25.10	25.10p	8678
11	32.95	0.00	11.00	0.00	58.41	58.41	58.41p	9240
12	32.40	0.00	22.01	0.94	91.74	91.74	91.74p	9801
13	31.80	0.00	34.02	5.59	128.13	128.13	128.13p	10414
14	31.20	0.00	46.06	10.25	164.57	139.08	139.08	11027
15	30.60	0.00	58.11	14.92	201.08	143.88	143.88	11639
16	30.00	0.00	70.20	19.59	237.67	150.16	150.16	12252
17	29.40	0.00	82.31	24.28	274.36	157.99	157.99	12864
18	28.80	0.00	94.46	28.99	311.15	167.15	167.15	13477
19	28.20	0.00	106.66	33.71	348.07	177.29	177.29	14090
20	27.60	0.00	118.89	38.44	385.11	187.97	187.97	33094
21	27.00	0.00	131.16	43.20	422.28	198.64	198.64	34473
22	26.50	0.00	141.42	47.17	453.35	207.63	207.63	35622

(continued)

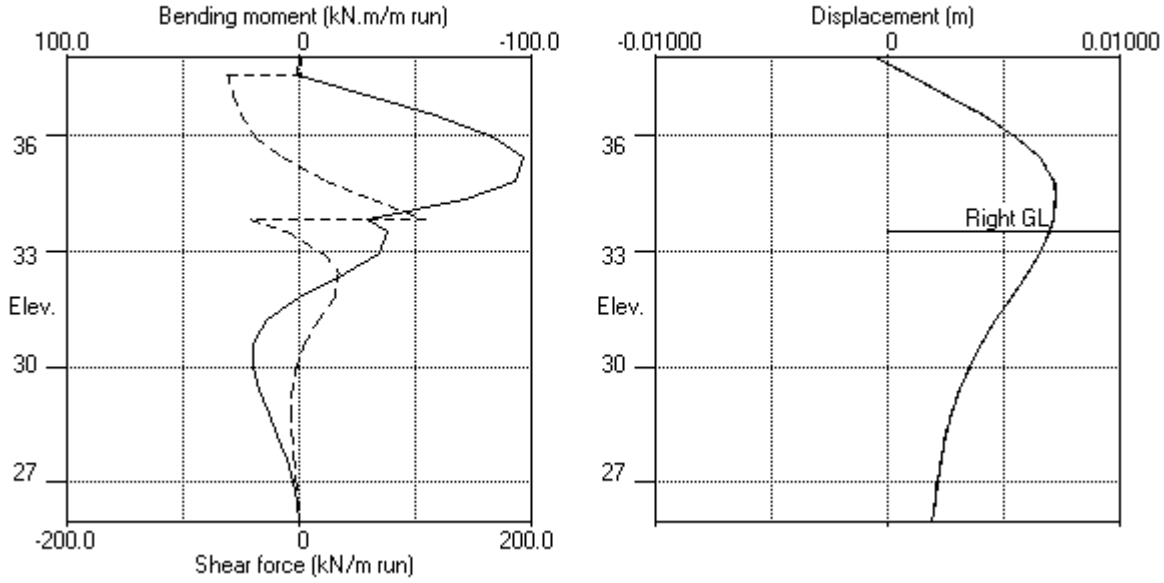
Stage No.7 Change properties of soil type 2 to soil type 4
Ko pressures will be reset

Node no.	Y coord	RIGHT 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	Coeff. of subgrade reaction kN/m3
23	26.00	0.00	151.72	51.16	484.53	216.53	216.53	36771

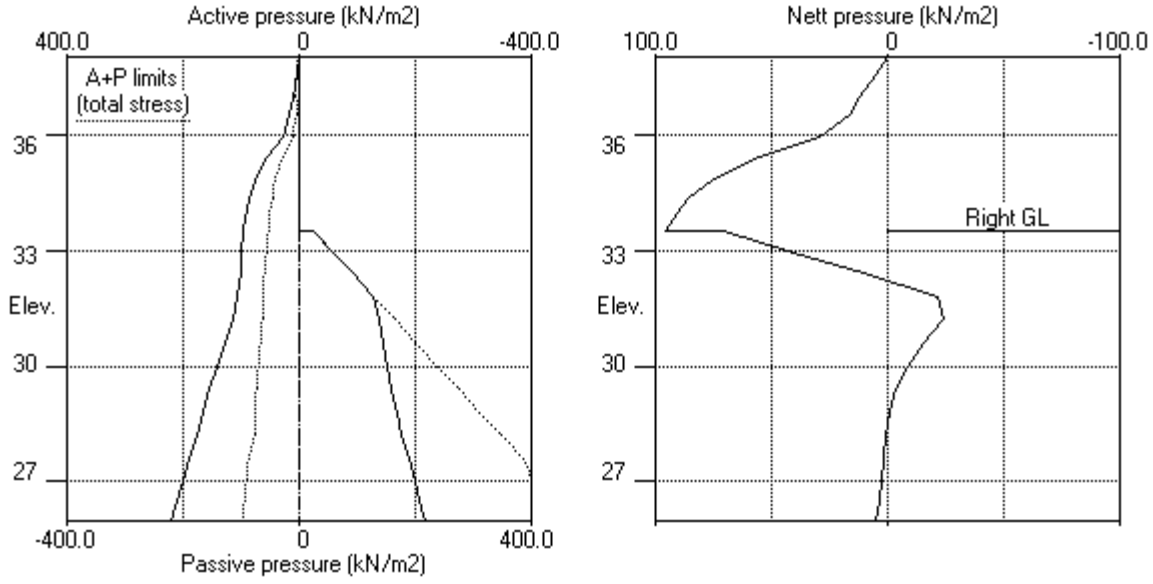
Note: 12.34a Soil pressure at active limit
128.13p Soil pressure at passive limit

Units: kN,m

Stage No.7 Change soil type 2 to soil type 4



Stage No.7 Change soil type 2 to soil type 4



Units: kN,m

Stage No. 8 Change EI of wall to 46967 kN.m2/m run
Yield moment not defined
Allow wall to relax with new modulus value

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

Stage No.	--- G.L. --- Act.	Pass.	Strut Elev.	FoS for toe elev. = 26.00 Factor of Safety	Moment equilib. at elev.	Toe elev. for FoS = 1.000 Toe elev.	Wall Penetr -ation	Direction of failure
8	38.00	33.50		More than one strut. No FoS calc.				

BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall
Analysis options
Length of wall perpendicular to section = 1000.00m
Subgrade reaction model - Boussinesq Influence coefficients
Soil deformations are elastic until the active or passive limit is reached
Open Tension Crack analysis - No

Rigid boundaries: Left side 20.00 from wall
Right side 20.00 from wall
Limit State: Serviceability Limit State
Calculated Bending Moments and Strut Forces are to be multiplied by a factor of 1.35 to obtain values for structural design. See summary for factored values.

Node no.	Y coord	Nett pressure kN/m2	Wall disp. m	Wall rotation rad.	Shear force kN/m	Bending moment kN.m/m	Strut forces kN/m	EI of wall kN.m2/m
1	38.00	0.00	-0.001	-3.52E-03	0.0	-0.0		46967
2	37.55	5.63	0.001	-3.52E-03	1.3	1.3	55.7	46967
		5.63	0.001	-3.52E-03	-54.5	1.3		
3	37.00	11.86	0.003	-3.37E-03	-49.6	-28.3		46967
		9.80	0.003	-3.37E-03	-49.6	-28.3		
4	36.50	14.73	0.004	-2.96E-03	-43.5	-52.2		46967
5	35.95	27.28	0.006	-2.25E-03	-32.0	-73.7		46967
6	35.40	52.42	0.007	-1.36E-03	-10.0	-84.1		46967
7	34.80	74.18	0.007	-3.70E-04	27.9	-79.0		46967
8	34.31	85.44	0.007	2.87E-04	66.8	-56.1		46967
9	33.83	92.83	0.007	6.00E-04	110.3	-13.1	161.5	46967
		92.83	0.007	6.00E-04	-51.2	-13.1		
10	33.50	95.98	0.007	7.00E-04	-20.5	-24.1		46967
		71.15	0.007	7.00E-04	-20.5	-24.1		
11	32.95	42.15	0.006	9.51E-04	10.7	-25.2		46967
12	32.40	12.81	0.006	1.15E-03	25.8	-13.9		46967
13	31.80	-18.63	0.005	1.21E-03	24.0	2.1		46967
14	31.20	-21.01	0.004	1.11E-03	12.1	13.3		46967
15	30.60	-12.05	0.004	9.29E-04	2.2	17.1		46967
16	30.00	-5.47	0.003	7.27E-04	-3.0	16.4		46967
17	29.40	-1.32	0.003	5.51E-04	-5.1	13.4		46967
18	28.80	0.82	0.003	4.16E-04	-5.2	9.9		46967
19	28.20	1.61	0.002	3.23E-04	-4.5	6.5		46967
20	27.60	1.91	0.002	2.66E-04	-3.4	3.7		46967
21	27.00	2.09	0.002	2.37E-04	-2.2	1.6		46967
22	26.50	2.16	0.002	2.28E-04	-1.2	0.5		46967
23	26.00	2.55	0.002	2.26E-04	0.0	-0.0		---

At elev. 37.55 Strut force = 55.7 kN/strut = 55.7 kN/m run
At elev. 33.83 Strut force = 161.5 kN/strut = 161.5 kN/m run

(continued)

Stage No.8 Change EI of wall to 46967 kN.m2/m run
Yield moment not defined
Allow wall to relax with new modulus value

LEFT side

Node no.	Y coord	Water press.	Effective stresses: Vertic -al	Active limit	Passive limit	Earth pressure	Total earth pressure	Coeff. of subgrade reaction
		kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m3
1	38.00	0.00	0.00	0.00	0.00	0.00	0.00	12954
2	37.55	0.00	8.10	2.76	29.38	5.63	5.63	12954
3	37.00	0.00	18.00	6.12	65.29	11.86	11.86	2143
		0.00	18.00	0.00	79.61	9.80	9.80	6304
4	36.50	0.00	28.00	3.26	109.89	14.73	14.73	6935
5	35.95	0.00	49.80	11.70	175.91	27.28	27.28	7628
6	35.40	0.00	90.53	27.47	299.24	52.42	52.42	8322
7	34.80	0.00	124.23	40.52	401.30	74.18	74.18	9078
8	34.31	0.00	140.46	46.80	450.45	85.44	85.44	9693
9	33.83	0.00	150.87	50.83	481.94	92.83	92.83	10307
10	33.50	0.00	156.08	52.85	497.74	95.98	95.98	8099
11	32.95	0.00	163.48	55.71	520.14	99.81	99.81	8624
12	32.40	0.00	170.23	58.32	540.58	103.43	103.43	9148
13	31.80	0.00	177.61	61.18	562.93	108.05	108.05	9719
14	31.20	0.00	185.32	64.17	586.28	116.44	116.44	10291
15	30.60	0.00	193.46	67.32	610.93	130.23	130.23	10863
16	30.00	0.00	202.03	70.64	636.87	143.32	143.32	11435
17	29.40	0.00	210.99	74.10	663.99	155.62	155.62	12006
18	28.80	0.00	220.29	77.71	692.17	167.29	167.29	12578
19	28.20	0.00	217.92	76.79	685.00	178.57	178.57	13150
20	27.60	0.00	239.76	85.24	751.12	189.82	189.82	13721
21	27.00	0.00	249.85	89.15	781.67	201.20	201.20	42760
22	26.50	0.00	258.40	92.46	807.58	210.71	210.71	44185
23	26.00	0.00	267.08	95.82	833.84	220.44	220.44	45610

RIGHT side

Node no.	Y coord	Water press.	Effective stresses: Vertic -al	Active limit	Passive limit	Earth pressure	Total earth pressure	Coeff. of subgrade reaction
		kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m3
1	38.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	37.55	0.00	0.00	0.00	0.00	0.00	0.00	0.0
3	37.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
4	36.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
5	35.95	0.00	0.00	0.00	0.00	0.00	0.00	0.0
6	35.40	0.00	0.00	0.00	0.00	0.00	0.00	0.0
7	34.80	0.00	0.00	0.00	0.00	0.00	0.00	0.0
8	34.31	0.00	0.00	0.00	0.00	0.00	0.00	0.0
9	33.83	0.00	0.00	0.00	0.00	0.00	0.00	0.0
10	33.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
		0.00	0.00	0.00	25.10	24.83	24.83	8099
11	32.95	0.00	11.00	0.00	58.41	57.67	57.67	8624
12	32.40	0.00	22.01	0.94	91.74	90.62	90.62	9148
13	31.80	0.00	34.02	5.59	128.13	126.68	126.68	9719
14	31.20	0.00	46.06	10.25	164.57	137.45	137.45	10291
15	30.60	0.00	58.11	14.92	201.08	142.28	142.28	10863
16	30.00	0.00	70.20	19.59	237.67	148.78	148.78	11435
17	29.40	0.00	82.31	24.28	274.36	156.95	156.95	12006
18	28.80	0.00	94.46	28.99	311.15	166.47	166.47	12578
19	28.20	0.00	106.66	33.71	348.07	176.96	176.96	13150
20	27.60	0.00	118.89	38.44	385.11	187.91	187.91	13721
21	27.00	0.00	131.16	43.20	422.28	199.10	199.10	42760

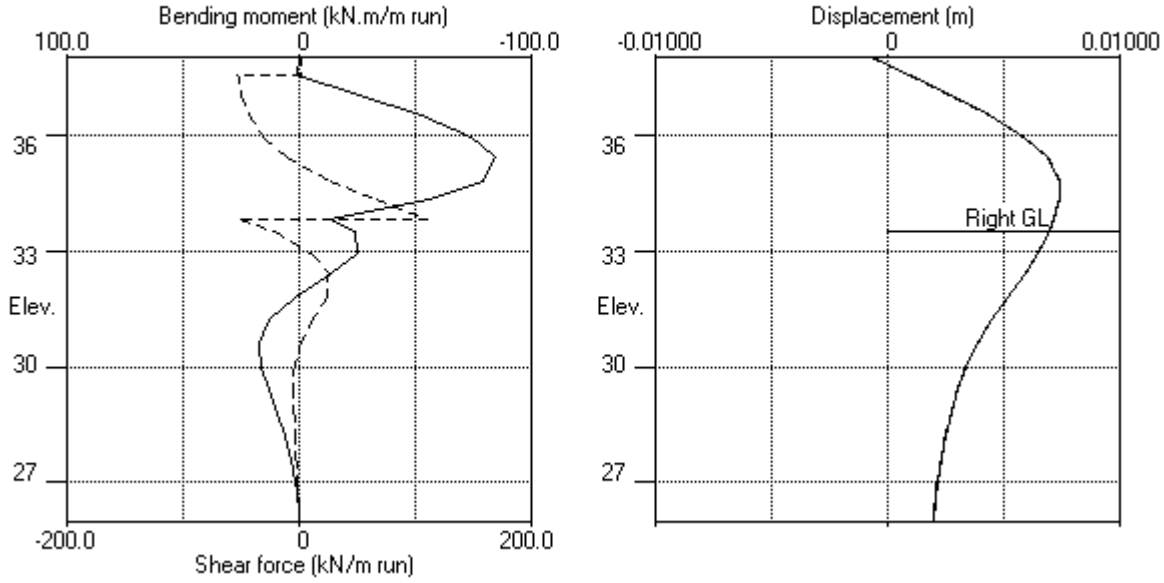
(continued)

Stage No.8 Change EI of wall to 46967 kN.m2/m run
Yield moment not defined
Allow wall to relax with new modulus value

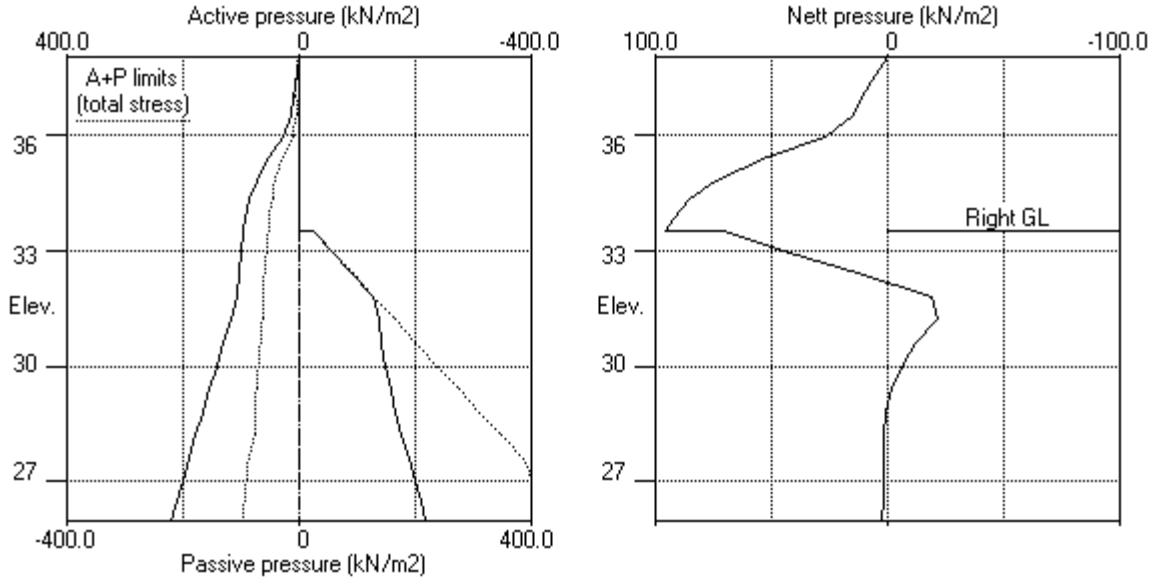
Node no.	Y coord	RIGHT side Water press. kN/m2	Effective stresses Vertic -al kN/m2	Active limit kN/m2	Passive limit kN/m2	Earth pressure kN/m2	Total earth pressure kN/m2	Coeff. of subgrade reaction kN/m3
22	26.50	0.00	141.42	47.17	453.35	208.55	208.55	44185
23	26.00	0.00	151.72	51.16	484.53	217.89	217.89	45610

Units: kN,m

Stage No.8 Change EI of wall to 46967kN.m2/m run



Stage No.8 Change EI of wall to 46967kN.m2/m run



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. = 26.00 Factor of Safety	Moment equilib. at elev.	Toe elev. for FoS = 1.000 Toe elev.	Wall Penetr -ation	Direction of failure
1	38.00	38.00	Cant.	Conditions not suitable for FoS calc.				
2	38.00	37.55	Cant.	Conditions not suitable for FoS calc.				
3	38.00	37.55		No analysis at this stage				
4	38.00	33.50	37.55	3.733	n/a	33.32	0.18	L to R
5	38.00	33.50		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 = 1000.00m
Subgrade reaction model - Boussinesq Influence coefficients
Soil deformations are elastic until the active or passive limit is reached
Open Tension Crack analysis - No

Rigid boundaries: Left side 20.00 from wall
Right side 20.00 from wall

Limit State: Serviceability Limit State

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

Bending moment, shear force and displacement envelopes

Node no.	Y coord	Displacement		Bending moment Calculated		Bending moment Factored		Shear force Calculated		Shear force Factored	
		max.	min.	max.	min.	max.	min.	max.	min.	max.	min.
		m	m	kN.m/m		kN.m/m		kN/m	kN/m	kN/m	kN/m
1	38.00	0.001	-0.001	0	-0	0	-0	0	0	0	0
2	37.55	0.001	0.000	3	0	4	0	8	-63	10	-85
3	37.00	0.003	0.000	2	-32	3	-43	3	-58	4	-78
4	36.50	0.004	0.000	2	-59	3	-79	0	-51	0	-69
5	35.95	0.006	0.000	0	-83	0	-113	0	-38	0	-52
6	35.40	0.007	0.000	0	-96	0	-130	0	-28	0	-37
7	34.80	0.007	0.000	0	-94	0	-126	28	-11	38	-15
8	34.31	0.007	0.000	0	-89	0	-120	67	-3	90	-4
9	33.83	0.007	0.000	0	-71	0	-96	110	-51	149	-69
10	33.50	0.007	0.000	0	-51	0	-69	74	-20	100	-28
11	32.95	0.007	0.000	0	-34	0	-46	51	0	69	0
12	32.40	0.006	0.000	5	-19	7	-26	34	0	46	0
13	31.80	0.005	0.000	17	-4	23	-6	31	0	42	0
14	31.20	0.005	0.000	21	0	29	0	17	0	23	0
15	30.60	0.004	0.000	20	0	27	0	5	-3	7	-5
16	30.00	0.003	0.000	20	0	27	0	2	-6	3	-8
17	29.40	0.003	0.000	17	0	24	0	0	-6	0	-9
18	28.80	0.003	0.000	13	0	18	0	0	-6	0	-9
19	28.20	0.003	0.000	9	0	13	0	0	-6	0	-9
20	27.60	0.002	0.000	6	0	8	0	0	-6	0	-7
21	27.00	0.002	0.000	2	0	3	0	0	-4	0	-5
22	26.50	0.002	0.000	1	0	1	0	0	-2	0	-3
23	26.00	0.002	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 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	5	29.40	-26	34.31	7	-35	11	32.40	-17	35.40	15	-23
2	5	29.40	-24	34.31	7	-32	11	32.40	-18	35.40	15	-24
3	No calculation at this stage											
4	21	31.20	-94	34.80	29	-126	74	33.50	-52	37.55	100	-70
5	No calculation at this stage											
6	No calculation at this stage											
7	20	30.00	-96	35.40	27	-130	108	33.83	-63	37.55	146	-85
8	17	30.60	-84	35.40	23	-114	110	33.83	-54	37.55	149	-74

Summary of results (continued)

Maximum and minimum displacement at each stage

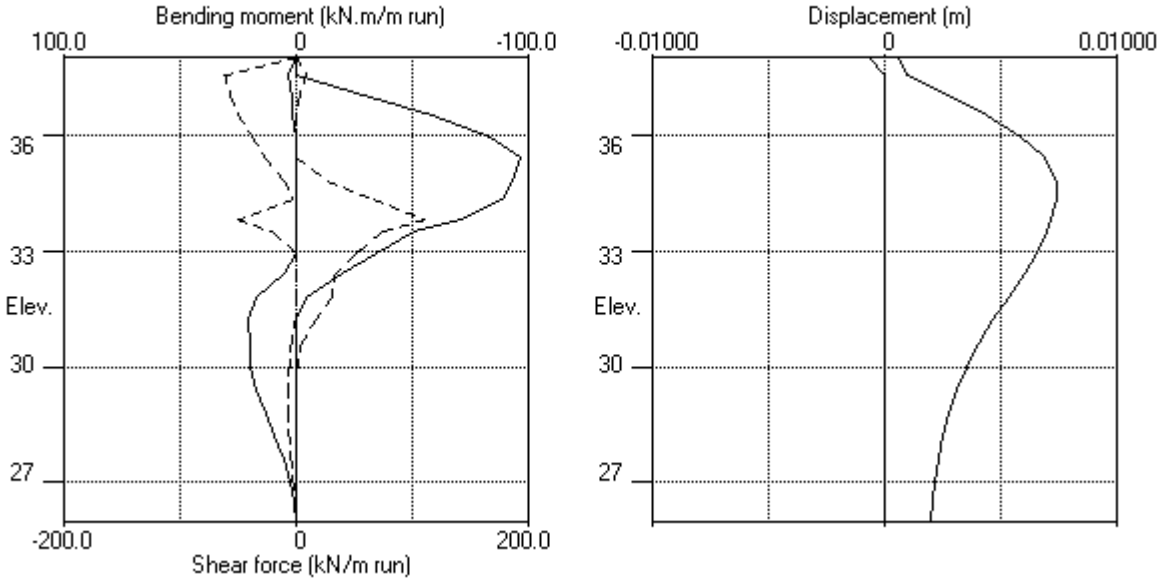
Stage no.	Displacement maximum m	elev.	minimum m	elev.	Stage description
1	0.002	33.50	-0.000	38.00	Apply surcharge no.1 at elev. 36.50
2	0.003	33.50	0.000	38.00	Excav. to elev. 37.55 on RIGHT side
3	No calculation at this stage				Install strut no.1 at elev. 37.55
4	0.007	34.31	-0.000	38.00	Excav. to elev. 33.50 on RIGHT side
5	No calculation at this stage				Install strut no.2 at elev. 33.83
6	No calculation at this stage				Change soil type 1 to soil type 3
7	0.007	34.31	-0.001	38.00	Change soil type 2 to soil type 4
8	0.007	34.31	-0.001	38.00	Change EI of wall to 46967kN.m2/m run

Strut forces at each stage (horizontal components)

Stage no.	Strut no. 1 at elev. 37.55 --Calculated-- kN per m run	Factored kN per strut	Factored kN per strut	Strut no. 2 at elev. 33.83 --Calculated-- kN per m run	Factored kN per strut	Factored kN per strut
4	59	59	80	---	---	---
7	64	64	86	149	149	202
8	56	56	75	161	161	218

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 Left side	Soil types Right side
1	38.00	1 MG (undrained)	1 MG (undrained)
2	37.00	2 LC (undrained)	2 LC (undrained)

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	MG (undrained)	20.00	13600	1.000	NC (0.490)	1.000 (2.570)	1.000 (2.571)	34.00u
2	LC (undra.. (37.00)	20.00	40000 (8000)	1.000	OC (0.490)	1.000 (2.570)	1.000 (2.571)	40.00u (8.000)
3	MG (drained)	18.00	10200	0.577	OC (0.200)	0.340 (1.415)	3.627 (5.634)	0.0d
4	LCF (drai.. (37.00)	20.00	30000 (6000)	0.625	OC (0.200)	0.387 (1.517)	3.028 (5.020)	5.000d

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	MG (undrained)	0.00	1.000	0.00	0.00	1.000	0.00
2	LC (undrained)	0.00	1.000	0.00	0.00	1.000	0.00
3	MG (drained)	25.00	1.000	0.00	25.00	1.000	0.00
4	LCF (drained)	22.00	1.000	0.00	22.00	1.000	0.00

GROUND WATER CONDITIONS

Density of water = 10.00 kN/m3

	Left side	Right side
Initial water table elevation	0.00	0.00

Automatic water pressure balancing at toe of wall : No

WALL PROPERTIES

Type of structure = Fully Embedded Wall
Elevation of toe of wall = 29.50
Maximum finite element length = 0.50 m
Youngs modulus of wall E = 1.9600E+07 kN/m2
Moment of inertia of wall I = 3.3548E-03 m4/m run
E.I = 65754 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	37.55	1.00	0.900000	1.960E+07	10.00	0.00	0	No
2	33.83	1.00	0.350000	1.960E+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	37.50	0.00(L)	1000.00	18.00	10.00	=	N/A	1.00 Var

Note: L = Left side, R = Right side
Limit State Categories P/U = Permanent Unfavourable
P/F = Permanent Favourable
Var = Variable (unfavourable)

CONSTRUCTION STAGES

Construction stage no.	Stage description
1	Apply surcharge no.1 at elevation 37.50
2	Excavate to elevation 37.55 on RIGHT side
3	Install strut or anchor no.1 at elevation 37.55
4	Excavate to elevation 33.50 on RIGHT side
5	Install strut or anchor no.2 at elevation 33.83
6	Change properties of soil type 1 to soil type 3 No analysis at this stage Ko pressures will be reset
7	Change properties of soil type 2 to soil type 4 Ko pressures will be reset
8	Change EI of wall to 46967 kN.m2/m run Yield moment not defined Allow wall to relax with new modulus value

FACTORS OF SAFETY and ANALYSIS OPTIONS

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

Stability analysis:
Method of analysis - Strength Factor method
Factor on soil strength for calculating wall depth = 1.00

Parameters for undrained strata:
Minimum equivalent fluid density = 5.00 kN/m3
Maximum depth of water filled tension crack = 0.00 m

Bending moment and displacement calculation:
Method - Subgrade reaction model using Influence Coefficients
Open Tension Crack analysis? - No
Non-linear Modulus Parameter (L) = 0 m

Boundary conditions:
Length of wall (normal to plane of analysis) = 1000.00 m

Width of excavation on Left side of wall = 20.00 m
Width of excavation on Right side of wall = 20.00 m

Distance to rigid boundary on Left side = 20.00 m
Distance to rigid boundary on Right side = 20.00 m

OUTPUT OPTIONS

Stage no.	Stage description	Output options: Displacement, Bending mom., Shear force	Active, Passive pressures	Graph. output
1	Apply surcharge no.1 at elev. 37.50	Yes	Yes	Yes
2	Excav. to elev. 37.55 on RIGHT side	Yes	Yes	Yes
3	Install strut no.1 at elev. 37.55	Yes	Yes	Yes
4	Excav. to elev. 33.50 on RIGHT side	Yes	Yes	Yes
5	Install strut no.2 at elev. 33.83	Yes	Yes	Yes
6	Change soil type 1 to soil type 3	Yes	Yes	Yes
7	Change soil type 2 to soil type 4	Yes	Yes	Yes
8	Change EI of wall to 46967kN.m2/m run	Yes	Yes	Yes
*	Summary output	Yes	-	Yes

Units: kN,m

Stage No. 1 Apply surcharge no.1 at elevation 37.50

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. = 29.50 Factor of Safety	Moment equilib. at elev.	Toe elev. for FoS = 1.000 Toe elev.	Wall Penetr -ation	Direction of failure
1	38.00	38.00	Cant.	Conditions not suitable for FoS calc.				

BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall
Analysis options
Length of wall perpendicular to section = 1000.00m
Subgrade reaction model - Boussinesq Influence coefficients
Soil deformations are elastic until the active or passive limit is reached
Open Tension Crack analysis - No

Rigid boundaries: Left side 20.00 from wall
Right side 20.00 from wall
Limit State: Serviceability Limit State
Calculated Bending Moments and Strut Forces are to be multiplied by a factor of 1.35 to obtain values for structural design. See summary for factored values.

Node no.	Y coord	Nett pressure kN/m2	Wall disp. m	Wall rotation rad.	Shear force kN/m	Bending moment kN.m/m	Strut forces kN/m	EI of wall kN.m2/m
1	38.00	-2.06	0.001	9.50E-05	0.0	0.0		65754
2	37.55	-3.86	0.001	9.57E-05	-1.3	-0.2		65754
3	37.50	-3.83	0.001	9.59E-05	-1.5	-0.3		65754
		6.17	0.001	9.59E-05	-1.5	-0.3		
4	37.00	6.46	0.001	9.80E-05	1.6	-0.3		65754
		-0.80	0.001	9.80E-05	1.6	-0.3		
5	36.50	-0.89	0.001	9.73E-05	1.2	0.4		65754
6	36.00	-0.85	0.000	9.20E-05	0.8	0.9		65754
7	35.50	-0.71	0.000	8.38E-05	0.4	1.2		65754
8	35.00	-0.54	0.000	7.40E-05	0.1	1.3		65754
9	34.50	-0.36	0.000	6.40E-05	-0.1	1.3		65754
10	34.16	-0.25	0.000	5.75E-05	-0.3	1.2		65754
11	33.83	-0.15	0.000	5.14E-05	-0.3	1.1		65754
12	33.50	-0.08	0.000	4.61E-05	-0.4	1.0		65754
13	33.00	0.01	0.000	3.90E-05	-0.4	0.8		65754
14	32.50	0.06	0.000	3.34E-05	-0.4	0.6		65754
15	32.00	0.09	0.000	2.92E-05	-0.3	0.5		65754
16	31.50	0.10	0.000	2.61E-05	-0.3	0.3		65754
17	31.00	0.11	0.000	2.42E-05	-0.2	0.2		65754
18	30.50	0.12	0.000	2.30E-05	-0.2	0.1		65754
19	30.00	0.16	0.000	2.25E-05	-0.1	0.0		65754
20	29.50	0.22	0.000	2.24E-05	-0.0	0.0		---

(continued)

Stage No.1 Apply surcharge no.1 at elevation 37.50

LEFT side

Node no.	Y coord	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	Coeff. of subgrade reaction kN/m3
1	38.00	Total>	0.00	0.00	87.42	0.00	0.00a	2987
2	37.55	Total>	9.00	2.25m	96.42	7.07	7.07	2987
3	37.50	Total>	10.00	2.50m	97.42	8.09	8.09	2987
		Total>	20.00	2.50m	107.42	18.09	18.09	2987
4	37.00	Total>	30.00	5.00m	117.42	28.23	28.23	2987
		Total>	30.00	5.00m	132.84	24.40	24.40	8786
5	36.50	Total>	40.00	7.50m	153.12	34.36	34.36	9665
6	36.00	Total>	50.00	10.00m	173.41	44.38	44.38	10543
7	35.50	Total>	59.99	12.50m	193.69	54.44	54.44	11422
8	35.00	Total>	69.99	15.00m	213.96	64.53	64.53	12301
9	34.50	Total>	79.98	17.50m	234.24	74.61	74.61	13179
10	34.16	Total>	86.72	19.19m	247.93	81.42	81.42	13772
11	33.83	Total>	93.47	20.87m	261.61	88.21	88.21	14365
12	33.50	Total>	99.96	22.50m	274.78	94.74	94.74	14936
13	33.00	Total>	109.94	25.00m	295.05	104.78	104.78	15815
14	32.50	Total>	119.92	27.50m	315.31	114.80	114.80	16694
15	32.00	Total>	129.89	30.00m	335.57	124.80	124.80	17572
16	31.50	Total>	139.86	32.50m	355.83	134.79	134.79	18451
17	31.00	Total>	149.83	35.00m	376.08	144.77	144.77	19330
18	30.50	Total>	159.79	37.50m	396.32	154.76	154.76	20208
19	30.00	Total>	169.75	40.00m	416.56	164.76	164.76	21087
20	29.50	Total>	179.70	42.50m	436.80	174.77	174.77	21965

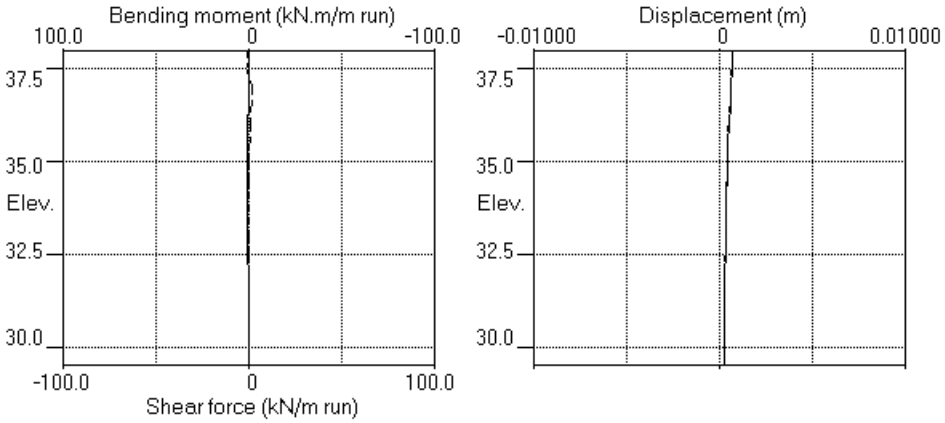
RIGHT side

Node no.	Y coord	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	Coeff. of subgrade reaction kN/m3
1	38.00	Total>	0.00	0.00	87.42	2.06	2.06	2987
2	37.55	Total>	9.00	2.25m	96.42	10.93	10.93	2987
3	37.50	Total>	10.00	2.50m	97.42	11.91	11.91	2987
4	37.00	Total>	20.00	5.00m	107.42	21.77	21.77	2987
		Total>	20.00	5.00m	122.84	25.20	25.20	8786
5	36.50	Total>	30.00	7.50m	143.12	35.25	35.25	9665
6	36.00	Total>	40.00	10.00m	163.41	45.23	45.23	10543
7	35.50	Total>	50.00	12.50m	183.69	55.16	55.16	11422
8	35.00	Total>	60.00	15.00m	203.98	65.07	65.07	12301
9	34.50	Total>	70.00	17.50m	224.26	74.98	74.98	13179
10	34.16	Total>	76.75	19.19m	237.95	81.67	81.67	13772
11	33.83	Total>	83.50	20.87m	251.64	88.36	88.36	14365
12	33.50	Total>	90.00	22.50m	264.83	94.82	94.82	14936
13	33.00	Total>	100.00	25.00m	285.11	104.77	104.77	15815
14	32.50	Total>	110.00	27.50m	305.40	114.73	114.73	16694
15	32.00	Total>	120.00	30.00m	325.68	124.71	124.71	17572
16	31.50	Total>	130.00	32.50m	345.96	134.69	134.69	18451
17	31.00	Total>	140.00	35.00m	366.25	144.67	144.67	19330
18	30.50	Total>	150.00	37.50m	386.53	154.64	154.64	20208
19	30.00	Total>	160.00	40.00m	406.82	164.60	164.60	21087
20	29.50	Total>	170.00	42.50m	427.10	174.55	174.55	21965

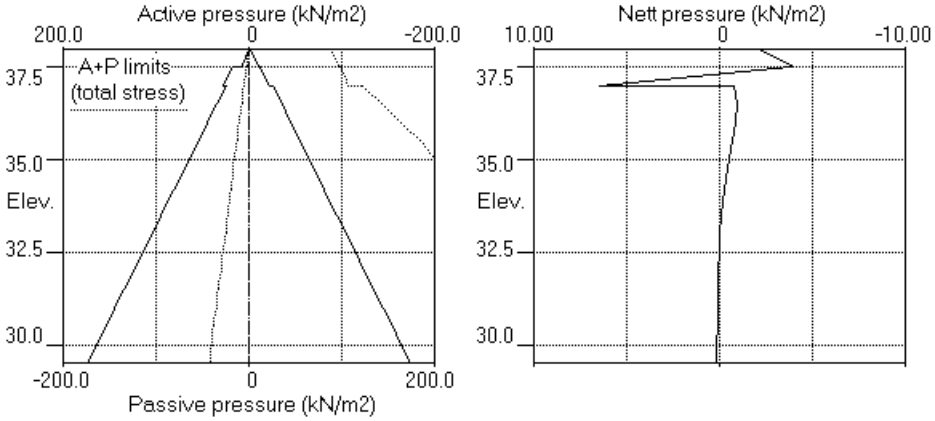
Note: 0.00a Soil pressure at active limit
123.45p Soil pressure at passive limit

Units: kN,m

Stage No.1 Apply surcharge no.1 at elev. 37.50



Stage No.1 Apply surcharge no.1 at elev. 37.50



Units: kN,m

Stage No. 2 Excavate to elevation 37.55 on RIGHT 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. = 29.50: Factor of Safety	Moment equilib. at elev.	Toe elev. for FoS = 1.000: Toe elev.	Wall Penetr -ation	Direction of failure
2	38.00	37.55	Cant.	14.934	30.03	37.47	0.08	L to R

BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall

Analysis options

Length of wall perpendicular to section = 1000.00m

Subgrade reaction model - Boussinesq Influence coefficients

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

Open Tension Crack analysis - No

Rigid boundaries: Left side 20.00 from wall
Right side 20.00 from wall

Limit State: Serviceability Limit State

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

Node no.	Y coord	Nett pressure kN/m2	Wall disp. m	Wall rotation rad.	Shear force kN/m	Bending moment kN.m/m	Strut forces kN/m	EI of wall kN.m2/m
1	38.00	0.00	0.001	2.93E-04	0.0	0.0		65754
2	37.55	4.21	0.001	2.92E-04	0.9	0.3		65754
		-0.66	0.001	2.92E-04	0.9	0.3		
3	37.50	-0.54	0.001	2.92E-04	0.9	0.3		65754
		9.46	0.001	2.92E-04	0.9	0.3		
4	37.00	10.68	0.001	2.83E-04	6.0	2.0		65754
		-6.23	0.001	2.83E-04	6.0	2.0		
5	36.50	-5.00	0.001	2.59E-04	3.1	4.2		65754
6	36.00	-3.59	0.001	2.24E-04	1.0	5.1		65754
7	35.50	-2.26	0.001	1.85E-04	-0.5	5.2		65754
8	35.00	-1.14	0.001	1.47E-04	-1.3	4.7		65754
9	34.50	-0.31	0.001	1.15E-04	-1.7	3.9		65754
10	34.16	0.09	0.001	9.68E-05	-1.7	3.3		65754
11	33.83	0.36	0.001	8.14E-05	-1.6	2.7		65754
12	33.50	0.52	0.000	6.92E-05	-1.5	2.2		65754
13	33.00	0.62	0.000	5.51E-05	-1.2	1.5		65754
14	32.50	0.59	0.000	4.55E-05	-0.9	1.0		65754
15	32.00	0.49	0.000	3.94E-05	-0.6	0.6		65754
16	31.50	0.37	0.000	3.58E-05	-0.4	0.4		65754
17	31.00	0.25	0.000	3.37E-05	-0.3	0.2		65754
18	30.50	0.17	0.000	3.27E-05	-0.2	0.1		65754
19	30.00	0.14	0.000	3.22E-05	-0.1	0.0		65754
20	29.50	0.17	0.000	3.21E-05	-0.0	0.0		---

(continued)

Stage No.2 Excavate to elevation 37.55 on RIGHT side

LEFT side

Node no.	Y coord	Effective stresses: Water press. kN/m2	Vertic -al kN/m2	Active limit kN/m2	Passive limit kN/m2	Earth pressure kN/m2	Total earth pressure kN/m2	Coeff. of subgrade reaction kN/m3
1	38.00	Total>	0.00	0.00	87.42	0.00	0.00a	4754
2	37.55	Total>	9.00	2.25m	96.42	4.21	4.21	4754
3	37.50	Total>	10.00	2.50m	97.42	5.27	5.27	4754
		Total>	20.00	2.50m	107.42	15.27	15.27	4754
4	37.00	Total>	30.00	5.00m	117.42	25.87	25.87	4754
		Total>	30.00	5.00m	132.84	17.48	17.48	13982
5	36.50	Total>	40.00	7.50m	153.12	28.08	28.08	15381
6	36.00	Total>	50.00	10.00m	173.41	38.77	38.77	16779
7	35.50	Total>	59.99	12.50m	193.69	49.43	49.43	18177
8	35.00	Total>	69.99	15.00m	213.96	59.98	59.98	19575
9	34.50	Total>	79.98	17.50m	234.24	70.39	70.39	20974
10	34.16	Total>	86.72	19.19m	247.93	77.33	77.33	21917
11	33.83	Total>	93.47	20.87m	261.61	84.22	84.22	22861
12	33.50	Total>	99.96	22.50m	274.78	90.80	90.80	23770
13	33.00	Total>	109.94	25.00m	295.05	100.84	100.84	25168
14	32.50	Total>	119.92	27.50m	315.31	110.83	110.83	26567
15	32.00	Total>	129.89	30.00m	335.57	120.77	120.77	27965
16	31.50	Total>	139.86	32.50m	355.83	130.71	130.71	29363
17	31.00	Total>	149.83	35.00m	376.08	140.65	140.65	30761
18	30.50	Total>	159.79	37.50m	396.32	150.60	150.60	32160
19	30.00	Total>	169.75	40.00m	416.56	160.58	160.58	33558
20	29.50	Total>	179.70	42.50m	436.80	170.59	170.59	34956

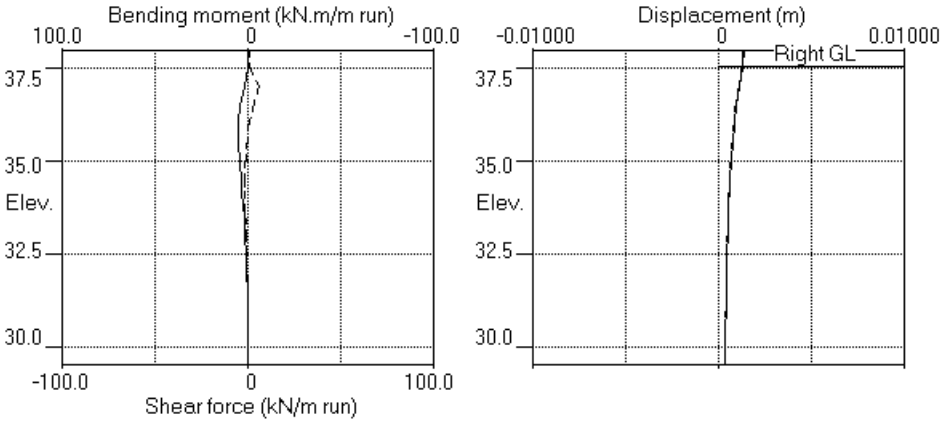
RIGHT side

Node no.	Y coord	Effective stresses: Water press. kN/m2	Vertic -al kN/m2	Active limit kN/m2	Passive limit kN/m2	Earth pressure kN/m2	Total earth pressure kN/m2	Coeff. of subgrade reaction kN/m3
1	38.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	37.55	0.00	0.00	0.00	0.00	0.00	0.00	0.0
		Total>	0.00	0.00	87.42	4.88	4.88	4903
3	37.50	Total>	1.00	0.25m	88.42	5.81	5.81	4903
4	37.00	Total>	11.00	2.75m	98.42	15.20	15.20	4903
		Total>	11.00	2.75m	113.84	23.70	23.70	14422
5	36.50	Total>	21.00	5.25m	134.12	33.08	33.08	15864
6	36.00	Total>	31.00	7.75m	154.41	42.36	42.36	17306
7	35.50	Total>	41.00	10.25m	174.70	51.69	51.69	18748
8	35.00	Total>	51.01	12.75m	194.98	61.12	61.12	20190
9	34.50	Total>	61.01	15.25m	215.27	70.70	70.70	21632
10	34.16	Total>	67.77	16.94m	228.97	77.25	77.25	22606
11	33.83	Total>	74.52	18.62m	242.67	83.86	83.86	23579
12	33.50	Total>	81.03	20.25m	255.86	90.27	90.27	24517
13	33.00	Total>	91.04	22.75m	276.15	100.22	100.22	25959
14	32.50	Total>	101.06	25.25m	296.45	110.23	110.23	27401
15	32.00	Total>	111.07	27.75m	316.75	120.28	120.28	28843
16	31.50	Total>	121.10	30.25m	337.06	130.34	130.34	30285
17	31.00	Total>	131.12	32.75m	357.37	140.39	140.39	31727
18	30.50	Total>	141.15	35.25m	377.68	150.43	150.43	33169
19	30.00	Total>	151.18	37.75m	397.99	160.44	160.44	34612
20	29.50	Total>	161.21	40.25m	418.31	170.42	170.42	36054

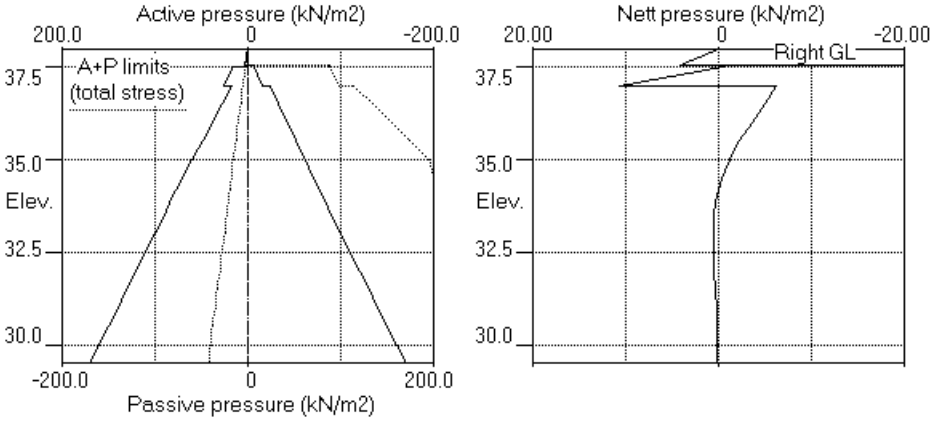
Note: 0.00a Soil pressure at active limit
123.45p Soil pressure at passive limit

Units: kN,m

Stage No.2 Excav. to elev. 37.55 on RIGHT side



Stage No.2 Excav. to elev. 37.55 on RIGHT side



Units: kN,m

Stage No. 4 Excavate to elevation 33.50 on RIGHT side

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. = 29.50 Factor of Safety	Moment equilib. at elev.	Toe elev. for FoS = 1.000 Toe elev.	Wall Penetr -ation	Direction of failure
4	38.00	33.50	37.55	3.943	n/a	33.31	0.19	L to R

BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall

Analysis options

Length of wall perpendicular to section = 1000.00m

Subgrade reaction model - Boussinesq Influence coefficients

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

Open Tension Crack analysis - No

Rigid boundaries: Left side 20.00 from wall
Right side 20.00 from wall

Limit State: Serviceability Limit State

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

Node no.	Y coord	Nett pressure kN/m2	Wall disp. m	Wall rotation rad.	Shear force kN/m	Bending moment kN.m/m	Strut forces kN/m	EI of wall kN.m2/m
1	38.00	21.52	0.001	-1.70E-03	0.0	0.0		65754
2	37.55	4.15	0.001	-1.71E-03	5.8	2.5	47.0	65754
		4.15	0.001	-1.71E-03	-41.2	2.5		
3	37.50	4.96	0.001	-1.71E-03	-41.0	0.4		65754
		14.96	0.001	-1.71E-03	-41.0	0.4		
4	37.00	23.13	0.002	-1.64E-03	-31.5	-17.8		65754
		9.41	0.002	-1.64E-03	-31.5	-17.8		
5	36.50	11.92	0.003	-1.46E-03	-26.2	-32.0		65754
6	36.00	14.36	0.004	-1.17E-03	-19.6	-43.2		65754
7	35.50	17.33	0.004	-8.17E-04	-11.7	-50.8		65754
8	35.00	21.44	0.004	-4.18E-04	-2.0	-54.1		65754
9	34.50	27.22	0.005	-1.53E-05	10.2	-52.0		65754
10	34.16	32.26	0.005	2.38E-04	20.2	-46.9		65754
11	33.83	38.24	0.004	4.56E-04	32.1	-38.1		65754
12	33.50	44.85	0.004	6.13E-04	45.6	-25.5		65754
		-33.13	0.004	6.13E-04	45.6	-25.5		
13	33.00	-29.73	0.004	7.36E-04	29.9	-6.8		65754
14	32.50	-24.17	0.004	7.45E-04	16.4	4.4		65754
15	32.00	-17.77	0.003	6.91E-04	6.0	9.6		65754
16	31.50	-11.37	0.003	6.15E-04	-1.3	10.4		65754
17	31.00	-5.28	0.003	5.44E-04	-5.5	8.3		65754
18	30.50	0.57	0.002	4.94E-04	-6.7	4.9		65754
19	30.00	6.53	0.002	4.69E-04	-4.9	1.6		65754
20	29.50	13.01	0.002	4.63E-04	-0.0	0.0		---

At elev. 37.55 Strut force = 47.0 kN/strut = 47.0 kN/m run

(continued)

Stage No.4 Excavate to elevation 33.50 on RIGHT side

LEFT side

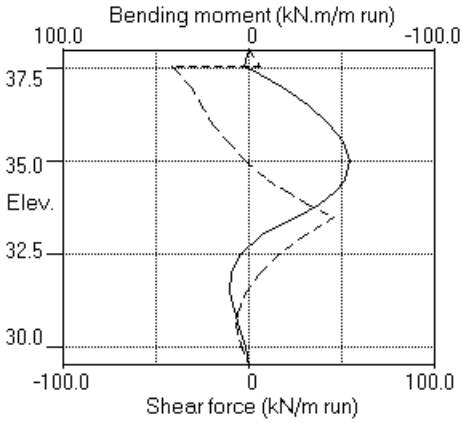
Node no.	Y coord	Water press. kN/m2	Effective stresses: Vertic-al kN/m2	Active limit kN/m2	Passive limit kN/m2	Earth pressure kN/m2	Total earth pressure kN/m2	Coeff. of subgrade reaction kN/m3
1	38.00	Total>	0.00	0.00	87.42	21.52	21.52	24614
2	37.55	Total>	9.00	2.25m	96.42	4.15	4.15	2452
3	37.50	Total>	10.00	2.50m	97.42	4.96	4.96	2452
		Total>	20.00	2.50m	107.42	14.96	14.96	2452
4	37.00	Total>	30.00	5.00m	117.42	23.13	23.13	2452
		Total>	30.00	5.00m	132.84	9.41	9.41	7212
5	36.50	Total>	40.00	7.50m	153.12	11.92	11.92	7933
6	36.00	Total>	50.00	10.00m	173.41	14.36	14.36	8654
7	35.50	Total>	59.99	12.50m	193.69	17.33	17.33	9375
8	35.00	Total>	69.99	15.00m	213.96	21.44	21.44	10097
9	34.50	Total>	79.98	17.50m	234.24	27.22	27.22	10818
10	34.16	Total>	86.72	19.19m	247.93	32.26	32.26	11305
11	33.83	Total>	93.47	20.87m	261.61	38.24	38.24	11791
12	33.50	Total>	99.96	22.50m	274.78	44.85	44.85	12260
13	33.00	Total>	109.94	25.00m	295.05	56.25	56.25	12981
14	32.50	Total>	119.92	27.50m	315.31	68.53	68.53	13703
15	32.00	Total>	129.89	30.00m	335.57	81.15	81.15	14424
16	31.50	Total>	139.86	32.50m	355.83	93.78	93.78	15145
17	31.00	Total>	149.83	35.00m	376.08	106.28	106.28	15866
18	30.50	Total>	159.79	37.50m	396.32	118.69	118.69	16587
19	30.00	Total>	169.75	40.00m	416.56	131.15	131.15	17309
20	29.50	Total>	179.70	42.50m	436.80	143.84	143.84	18030

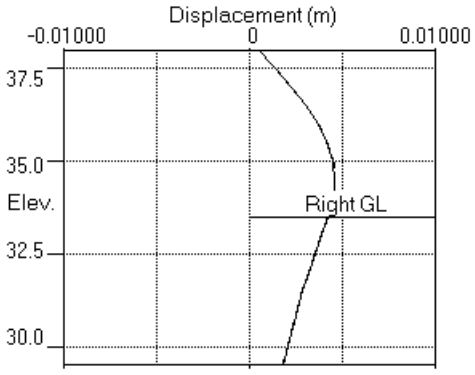
RIGHT side

Node no.	Y coord	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	Coeff. of subgrade reaction kN/m3
1	38.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	37.55	0.00	0.00	0.00	0.00	0.00	0.00	0.0
3	37.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
4	37.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
5	36.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
6	36.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
7	35.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
8	35.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
9	34.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
10	34.16	0.00	0.00	0.00	0.00	0.00	0.00	0.0
11	33.83	0.00	0.00	0.00	0.00	0.00	0.00	0.0
12	33.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
		Total>	0.00	0.00	174.83	77.97	77.97	17490
13	33.00	Total>	10.00	2.50m	195.11	85.98	85.98	18519
14	32.50	Total>	20.00	5.00m	215.40	92.70	92.70	19548
15	32.00	Total>	30.02	7.50m	235.70	98.92	98.92	20577
16	31.50	Total>	40.04	10.00m	256.00	105.14	105.14	21606
17	31.00	Total>	50.07	12.50m	276.32	111.56	111.56	22634
18	30.50	Total>	60.13	15.00m	296.66	118.11	118.11	23663
19	30.00	Total>	70.20	17.50m	317.01	124.62	124.62	24692
20	29.50	Total>	80.29	20.00m	337.39	130.83	130.83	25721

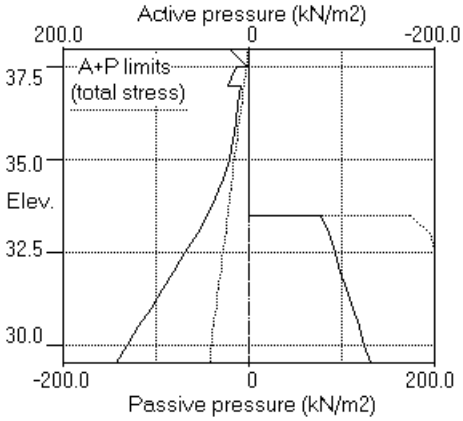
Units: kN,m

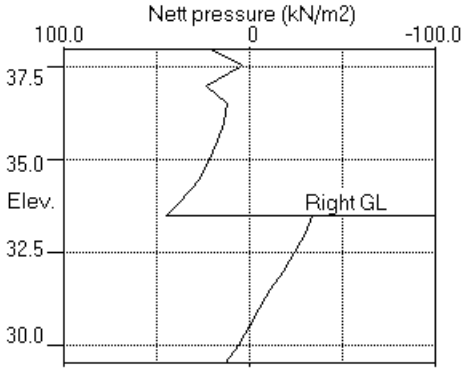
Stage No.4 Excav. to elev. 33.50 on RIGHT side





Stage No.4 Excav. to elev. 33.50 on RIGHT side





Units: kN,m

Stage No. 7 Change properties of soil type 2 to soil type 4
Ko pressures will be reset

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. = 29.50 Factor of Safety	Moment equilib. at elev.	Toe elev. for FoS = 1.000 Toe elev.	Wall Penetr -ation	Direction of failure
7	38.00	33.50		More than one strut. No FoS calc.				

BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall
Analysis options
Length of wall perpendicular to section = 1000.00m
Subgrade reaction model - Boussinesq Influence coefficients
Soil deformations are elastic until the active or passive limit is reached
Open Tension Crack analysis - No

Rigid boundaries: Left side 20.00 from wall
Right side 20.00 from wall
Limit State: Serviceability Limit State
Calculated Bending Moments and Strut Forces are to be multiplied by a factor of 1.35 to obtain values for structural design. See summary for factored values.

Node no.	Y coord	Nett pressure kN/m2	Wall disp. m	Wall rotation rad.	Shear force kN/m	Bending moment kN.m/m	Strut forces kN/m	EI of wall kN.m2/m
1	38.00	0.00	0.000	-2.00E-03	0.0	0.0		65754
2	37.55	3.92	0.001	-2.00E-03	0.9	1.0	53.7	65754
		3.92	0.001	-2.00E-03	-52.8	1.0		
3	37.50	4.68	0.001	-2.00E-03	-52.6	-1.6		65754
		14.68	0.001	-2.00E-03	-52.6	-1.6		
4	37.00	22.32	0.002	-1.90E-03	-43.4	-25.7		65754
		16.58	0.002	-1.90E-03	-43.4	-25.7		
5	36.50	22.04	0.003	-1.63E-03	-33.7	-44.8		65754
6	36.00	27.70	0.004	-1.24E-03	-21.3	-58.4		65754
7	35.50	33.72	0.004	-7.72E-04	-5.9	-65.0		65754
8	35.00	40.15	0.005	-2.85E-04	12.5	-63.3		65754
9	34.50	46.92	0.005	1.51E-04	34.3	-51.6		65754
10	34.16	51.54	0.005	3.79E-04	50.9	-37.2		65754
11	33.83	56.04	0.005	5.18E-04	69.1	-17.0	79.9	65754
		56.04	0.005	5.18E-04	-10.8	-17.0		
12	33.50	60.12	0.004	6.04E-04	8.1	-17.5		65754
		35.02	0.004	6.04E-04	8.1	-17.5		
13	33.00	10.78	0.004	7.09E-04	19.5	-10.2		65754
14	32.50	-13.41	0.004	7.50E-04	18.9	-0.4		65754
15	32.00	-21.08	0.003	7.25E-04	10.2	6.8		65754
16	31.50	-14.28	0.003	6.64E-04	1.4	9.3		65754
17	31.00	-7.64	0.003	5.97E-04	-4.1	8.2		65754
18	30.50	-1.15	0.002	5.46E-04	-6.3	5.2		65754
19	30.00	5.48	0.002	5.19E-04	-5.2	1.9		65754
20	29.50	15.34	0.002	5.11E-04	-0.0	0.0		---

At elev. 37.55 Strut force = 53.7 kN/strut = 53.7 kN/m run
At elev. 33.83 Strut force = 79.9 kN/strut = 79.9 kN/m run

(continued)

Stage No.7 Change properties of soil type 2 to soil type 4
Ko pressures will be reset

LEFT side

Node no.	Y coord	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	Coeff. of subgrade reaction kN/m3
1	38.00	0.00	0.00	0.00	0.00	0.00	0.00	13675
2	37.55	0.00	8.10	2.76	29.38	3.92	3.92	2004
3	37.50	0.00	9.00	3.06	32.64	4.68	4.68	2004
		0.00	19.00	6.46	68.92	14.68	14.68	2004
4	37.00	0.00	28.00	9.53	101.56	22.32	22.32	2004
		0.00	28.00	3.26	109.89	16.58	16.58	5895
5	36.50	0.00	38.00	7.13	140.17	22.04	22.04	6485
6	36.00	0.00	48.00	11.00	170.44	27.70	27.70	7074
7	35.50	0.00	57.99	14.87	200.71	33.72	33.72	7664
8	35.00	0.00	67.99	18.74	230.98	40.15	40.15	8253
9	34.50	0.00	77.98	22.61	261.24	46.92	46.92	8843
10	34.16	0.00	84.72	25.22	281.66	51.54	51.54	9240
11	33.83	0.00	91.47	27.83	302.07	56.04	56.04	9638
12	33.50	0.00	97.96	30.34	321.72	60.12	60.12	10022
13	33.00	0.00	107.94	34.21	351.95	66.17	66.17	10611
14	32.50	0.00	117.92	38.07	382.17	72.27	72.27	11201
15	32.00	0.00	127.89	41.93	412.37	79.27	79.27	11790
16	31.50	0.00	137.86	45.79	442.56	92.08	92.08	12380
17	31.00	0.00	147.83	49.65	472.74	104.86	104.86	12969
18	30.50	0.00	157.79	53.51	502.91	117.58	117.58	13559
19	30.00	0.00	167.75	57.36	533.06	130.38	130.38	14148
20	29.50	0.00	177.70	61.22	563.20	144.76	144.76	271459

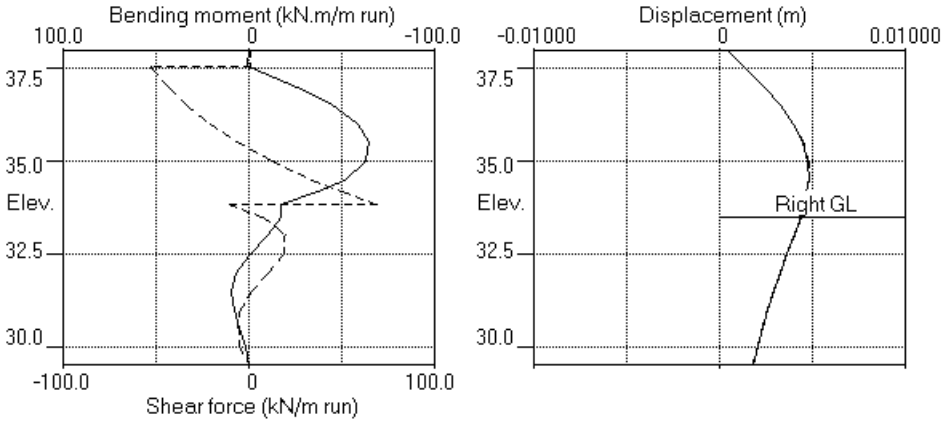
RIGHT side

Node no.	Y coord	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	Coeff. of subgrade reaction kN/m3
1	38.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	37.55	0.00	0.00	0.00	0.00	0.00	0.00	0.0
3	37.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
4	37.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
5	36.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
6	36.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
7	35.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
8	35.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
9	34.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
10	34.16	0.00	0.00	0.00	0.00	0.00	0.00	0.0
11	33.83	0.00	0.00	0.00	0.00	0.00	0.00	0.0
12	33.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
		0.00	0.00	0.00	25.10	25.10	25.10p	10262
13	33.00	0.00	10.00	0.00	55.38	55.38	55.38p	10866
14	32.50	0.00	20.00	0.16	85.68	85.68	85.68p	11469
15	32.00	0.00	30.02	4.04	115.99	100.34	100.34	12073
16	31.50	0.00	40.04	7.92	146.34	106.37	106.37	12676
17	31.00	0.00	50.07	11.80	176.73	112.50	112.50	13280
18	30.50	0.00	60.13	15.69	207.17	118.73	118.73	13884
19	30.00	0.00	70.20	19.59	237.67	124.90	124.90	14487
20	29.50	0.00	80.29	23.50	268.23	129.42	129.42	271459

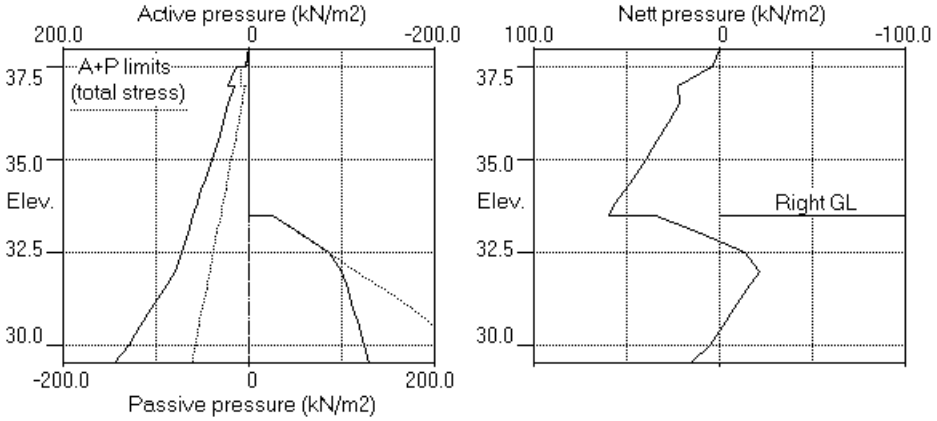
Note: 12.34a Soil pressure at active limit
85.68p Soil pressure at passive limit

Units: kN,m

Stage No.7 Change soil type 2 to soil type 4



Stage No.7 Change soil type 2 to soil type 4



Units: kN,m

Stage No. 8 Change EI of wall to 46967 kN.m2/m run
Yield moment not defined
Allow wall to relax with new modulus value

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

Stage No.	--- G.L. --- Act.	Pass.	Strut Elev.	FoS for toe elev. = 29.50 Factor of Safety	Moment equilib. at elev.	Toe elev. for FoS = 1.000 Toe elev.	Wall Penetr -ation	Direction of failure
8	38.00	33.50		More than one strut. No FoS calc.				

BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall
Analysis options
Length of wall perpendicular to section = 1000.00m
Subgrade reaction model - Boussinesq Influence coefficients
Soil deformations are elastic until the active or passive limit is reached
Open Tension Crack analysis - No

Rigid boundaries: Left side 20.00 from wall
Right side 20.00 from wall
Limit State: Serviceability Limit State
Calculated Bending Moments and Strut Forces are to be multiplied by a factor of 1.35 to obtain values for structural design. See summary for factored values.

Node no.	Y coord	Nett pressure kN/m2	Wall disp. m	Wall rotation rad.	Shear force kN/m	Bending moment kN.m/m	Strut forces kN/m	EI of wall kN.m2/m
1	38.00	0.00	0.000	-2.22E-03	0.0	0.0		46967
2	37.55	3.96	0.001	-2.23E-03	0.9	1.0	48.3	46967
		3.96	0.001	-2.23E-03	-47.4	1.0		
3	37.50	4.66	0.001	-2.23E-03	-47.2	-1.4		46967
		14.66	0.001	-2.23E-03	-47.2	-1.4		
4	37.00	22.07	0.002	-2.10E-03	-38.0	-23.4		46967
		15.84	0.002	-2.10E-03	-38.0	-23.4		
5	36.50	20.62	0.003	-1.77E-03	-28.9	-40.5		46967
6	36.00	25.77	0.004	-1.29E-03	-17.3	-52.3		46967
7	35.50	31.60	0.005	-7.32E-04	-3.0	-57.6		46967
8	35.00	38.24	0.005	-1.57E-04	14.5	-55.0		46967
9	34.50	45.63	0.005	3.36E-04	35.4	-42.7		46967
10	34.16	50.83	0.005	5.72E-04	51.7	-28.1		46967
11	33.83	55.93	0.005	6.82E-04	69.7	-7.7	87.3	46967
		55.93	0.005	6.82E-04	-17.6	-7.7		
12	33.50	60.48	0.004	7.26E-04	1.4	-9.9		46967
		35.73	0.004	7.26E-04	1.4	-9.9		
13	33.00	12.57	0.004	7.87E-04	13.4	-5.2		46967
14	32.50	-10.88	0.004	7.89E-04	13.9	2.5		46967
15	32.00	-18.17	0.003	7.27E-04	6.6	8.0		46967
16	31.50	-11.42	0.003	6.33E-04	-0.8	9.4		46967
17	31.00	-5.20	0.003	5.42E-04	-5.0	7.7		46967
18	30.50	0.56	0.002	4.79E-04	-6.1	4.6		46967
19	30.00	6.29	0.002	4.48E-04	-4.4	1.5		46967
20	29.50	11.33	0.002	4.40E-04	-0.0	0.0		---

At elev. 37.55 Strut force = 48.3 kN/strut = 48.3 kN/m run
At elev. 33.83 Strut force = 87.3 kN/strut = 87.3 kN/m run

(continued)

Stage No.8 Change EI of wall to 46967 kN.m2/m run
Yield moment not defined
Allow wall to relax with new modulus value

LEFT side

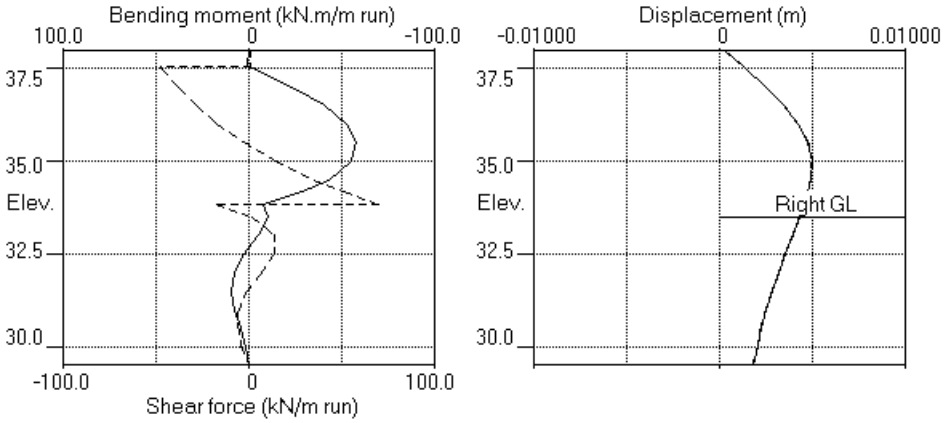
Node no.	Y coord	Water press. kN/m2	Effective stresses: Vertic -al kN/m2	Active limit kN/m2	Passive limit kN/m2	Earth pressure kN/m2	Total earth pressure kN/m2	Coeff. of subgrade reaction kN/m3
1	38.00	0.00	0.00	0.00	0.00	0.00	0.00	13033
2	37.55	0.00	8.10	2.76	29.38	3.96	3.96	13033
3	37.50	0.00	9.00	3.06	32.64	4.66	4.66	2138
		0.00	19.00	6.46	68.92	14.66	14.66	2138
4	37.00	0.00	28.00	9.53	101.56	22.07	22.07	2138
		0.00	28.00	3.26	109.89	15.84	15.84	6288
5	36.50	0.00	38.00	7.13	140.17	20.62	20.62	6916
6	36.00	0.00	48.00	11.00	170.44	25.77	25.77	7545
7	35.50	0.00	57.99	14.87	200.71	31.60	31.60	8174
8	35.00	0.00	67.99	18.74	230.98	38.24	38.24	8803
9	34.50	0.00	77.98	22.61	261.24	45.63	45.63	9432
10	34.16	0.00	84.72	25.22	281.66	50.83	50.83	9856
11	33.83	0.00	91.47	27.83	302.07	55.93	55.93	10280
12	33.50	0.00	97.96	30.34	321.72	60.48	60.48	9967
13	33.00	0.00	107.94	34.21	351.95	67.06	67.06	10554
14	32.50	0.00	117.92	38.07	382.17	73.53	73.53	11140
15	32.00	0.00	127.89	41.93	412.37	80.72	80.72	11726
16	31.50	0.00	137.86	45.79	442.56	93.52	93.52	12313
17	31.00	0.00	147.83	49.65	472.74	106.08	106.08	12899
18	30.50	0.00	157.79	53.51	502.91	118.44	118.44	13485
19	30.00	0.00	167.75	57.36	533.06	130.78	130.78	14072
20	29.50	0.00	177.70	61.22	563.20	142.75	142.75	287685

RIGHT side

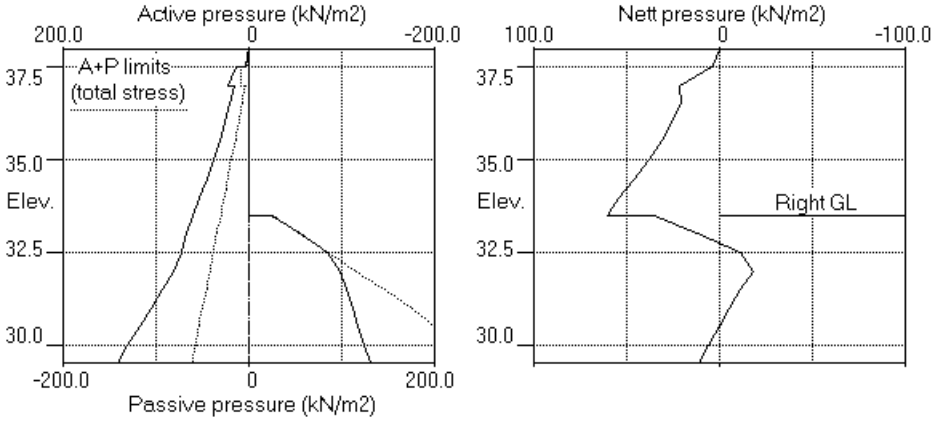
Node no.	Y coord	Water press. kN/m2	Effective stresses: Vertic -al kN/m2	Active limit kN/m2	Passive limit kN/m2	Earth pressure kN/m2	Total earth pressure kN/m2	Coeff. of subgrade reaction kN/m3
1	38.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	37.55	0.00	0.00	0.00	0.00	0.00	0.00	0.0
3	37.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
4	37.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
5	36.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
6	36.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
7	35.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
8	35.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
9	34.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
10	34.16	0.00	0.00	0.00	0.00	0.00	0.00	0.0
11	33.83	0.00	0.00	0.00	0.00	0.00	0.00	0.0
12	33.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
		0.00	0.00	0.00	25.10	24.75	24.75	9967
13	33.00	0.00	10.00	0.00	55.38	54.49	54.49	10554
14	32.50	0.00	20.00	0.16	85.68	84.41	84.41	11140
15	32.00	0.00	30.02	4.04	115.99	98.89	98.89	11726
16	31.50	0.00	40.04	7.92	146.34	104.93	104.93	12313
17	31.00	0.00	50.07	11.80	176.73	111.28	111.28	12899
18	30.50	0.00	60.13	15.69	207.17	117.88	117.88	13485
19	30.00	0.00	70.20	19.59	237.67	124.49	124.49	14072
20	29.50	0.00	80.29	23.50	268.23	131.42	131.42	287685

Units: kN,m

Stage No.8 Change EI of wall to 46967kN.m2/m run



Stage No.8 Change EI of wall to 46967kN.m2/m run



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. = 29.50 Factor of Safety	Moment equilib. at elev.	Toe elev. for FoS = 1.000 Toe elev.	Wall Penetr -ation	Direction of failure
1	38.00	38.00	Cant.	Conditions not suitable for FoS calc.				
2	38.00	37.55	Cant.	14.934	30.03	37.47	0.08	L to R
3	38.00	37.55		No analysis at this stage				
4	38.00	33.50	37.55	3.943	n/a	33.31	0.19	L to R
5	38.00	33.50		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 = 1000.00m
Subgrade reaction model - Boussinesq Influence coefficients
Soil deformations are elastic until the active or passive limit is reached
Open Tension Crack analysis - No

Rigid boundaries: Left side 20.00 from wall
Right side 20.00 from wall

Limit State: Serviceability Limit State

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

Bending moment, shear force and displacement envelopes

Node no.	Y coord	Displacement		Bending moment Calculated		Bending moment Factored		Shear force Calculated		Shear force Factored	
		max.	min.	max.	min.	max.	min.	max.	min.	max.	min.
		m	m	kN.m/m		kN.m/m		kN/m	kN/m	kN/m	kN/m
1	38.00	0.001	0.000	0	0	0	0	0	0	0	0
2	37.55	0.001	0.000	2	-0	3	-0	6	-53	8	-71
3	37.50	0.001	0.000	0	-2	1	-2	1	-53	1	-71
4	37.00	0.002	0.000	2	-26	3	-35	6	-43	8	-59
5	36.50	0.003	0.000	4	-45	6	-60	3	-34	4	-46
6	36.00	0.004	0.000	5	-58	7	-79	1	-21	1	-29
7	35.50	0.005	0.000	5	-65	7	-88	0	-12	1	-16
8	35.00	0.005	0.000	5	-63	6	-85	14	-2	20	-3
9	34.50	0.005	0.000	4	-52	5	-70	35	-2	48	-2
10	34.16	0.005	0.000	3	-47	4	-63	52	-2	70	-2
11	33.83	0.005	0.000	3	-38	4	-51	70	-18	94	-24
12	33.50	0.004	0.000	2	-25	3	-34	46	-1	62	-2
13	33.00	0.004	0.000	2	-10	2	-14	30	-1	40	-2
14	32.50	0.004	0.000	4	-0	6	-1	19	-1	25	-1
15	32.00	0.003	0.000	10	0	13	0	10	-1	14	-1
16	31.50	0.003	0.000	10	0	14	0	1	-1	2	-2
17	31.00	0.003	0.000	8	0	11	0	0	-5	0	-7
18	30.50	0.002	0.000	5	0	7	0	0	-7	0	-9
19	30.00	0.002	0.000	2	0	3	0	0	-5	0	-7
20	29.50	0.002	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 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	1	35.00	-0	37.50	2	-0	2	37.00	-2	37.50	2	-2
2	5	35.50	0	38.00	7	0	6	37.00	-2	34.16	8	-2
3	No calculation at this stage											
4	10	31.50	-54	35.00	14	-73	46	33.50	-41	37.55	62	-56
5	No calculation at this stage											
6	No calculation at this stage											
7	9	31.50	-65	35.50	13	-88	69	33.83	-53	37.55	93	-71
8	9	31.50	-58	35.50	13	-78	70	33.83	-47	37.55	94	-64

Summary of results (continued)

Maximum and minimum displacement at each stage

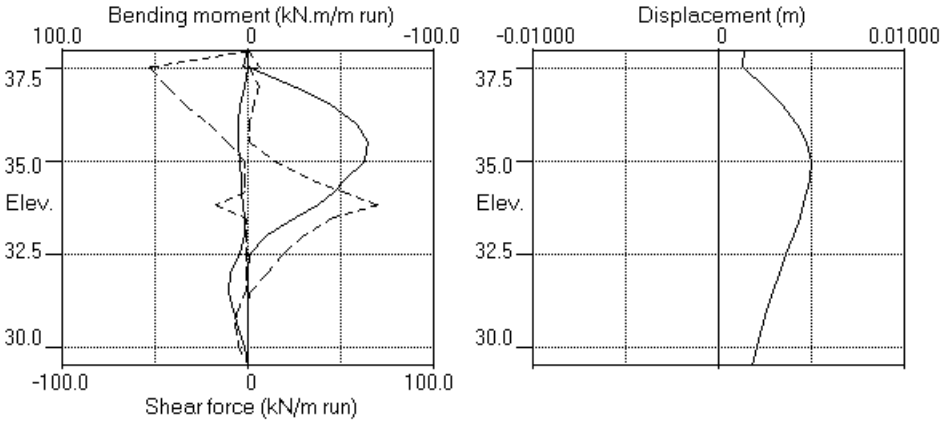
Stage no.	Displacement maximum m	elev.	minimum m	elev.	Stage description
1	0.001	38.00	0.000	38.00	Apply surcharge no.1 at elev. 37.50
2	0.001	38.00	0.000	38.00	Excav. to elev. 37.55 on RIGHT side
3	No calculation at this stage				Install strut no.1 at elev. 37.55
4	0.005	34.50	0.000	38.00	Excav. to elev. 33.50 on RIGHT side
5	No calculation at this stage				Install strut no.2 at elev. 33.83
6	No calculation at this stage				Change soil type 1 to soil type 3
7	0.005	34.50	0.000	38.00	Change soil type 2 to soil type 4
8	0.005	35.00	0.000	38.00	Change EI of wall to 46967kN.m2/m run

Strut forces at each stage (horizontal components)

Stage no.	Strut no. 1 at elev. 37.55 --Calculated-- kN per m run	Factored kN per strut	Factored kN per strut	Strut no. 2 at elev. 33.83 --Calculated-- kN per m run	Factored kN per strut	Factored kN per strut
4	47	47	63	---	---	---
7	54	54	73	80	80	108
8	48	48	65	87	87	118

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 Left side	Soil types Right side
1	38.00	1 MG (undrained)	1 MG (undrained)
2	37.00	5 LCF (ineffective)	5 LCF (ineffective)
3	32.00	2 LC (undrained)	2 LC (undrained)

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)
	(Datum elev.)							
1	MG (undrained)	18.00	13600	1.000	NC (0.490)	1.000 (2.570)	1.000 (2.571)	34.00u
2	LC (undra.. (37.00)	20.00	40000 (8000)	1.000	OC (0.490)	1.000 (2.570)	1.000 (2.571)	40.00u (8.000)
3	MG (drained)	18.00	10200	0.577	OC (0.200)	0.340 (1.415)	3.627 (5.634)	0.0d
4	LCF (drai.. (37.00)	20.00	30000 (6000)	0.625	OC (0.200)	0.387 (1.517)	3.028 (5.020)	5.000d
5	LCF (inef.. (37.00)	20.00	40000 (8000)	1.000	OC (0.490)	1.000 (2.000)	1.000 (2.000)	40.00u (8.000)

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	MG (undrained)	0.00	1.000	0.00	0.00	1.000	0.00
2	LC (undrained)	0.00	1.000	0.00	0.00	1.000	0.00
3	MG (drained)	25.00	1.000	0.00	25.00	1.000	0.00
4	LCF (drained)	22.00	1.000	0.00	22.00	1.000	0.00
5	LCF (ineffective)	0.00	0.000	0.00	0.00	0.000	0.00

GROUND WATER CONDITIONS

Density of water = 10.00 kN/m3

	Left side	Right side
Initial water table elevation	0.00	0.00

Automatic water pressure balancing at toe of wall : No

WALL PROPERTIES

Type of structure = Fully Embedded Wall
Elevation of toe of wall = 12.00
Maximum finite element length = 1.60 m
Youngs modulus of wall E = 1.9600E+07 kN/m2
Moment of inertia of wall I = 3.3548E-03 m4/m run
E.I = 65754 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	Inclination (degs)	Pre-stress /strut kN	Tension allowed
1	37.55	1.00	0.900000	1.960E+07	10.00	0.00	0	No
2	33.83	1.00	0.350000	1.960E+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	37.50	0.00(L)	1000.00	3.00	20.00	=	N/A	1.00 Var

Note: L = Left side, R = Right side
Limit State Categories P/U = Permanent Unfavourable
P/F = Permanent Favourable
Var = Variable (unfavourable)

CONSTRUCTION STAGES

Construction stage no.	Stage description
1	Apply surcharge no.1 at elevation 37.50
2	Excavate to elevation 37.55 on RIGHT side
3	Install strut or anchor no.1 at elevation 37.55
4	Excavate to elevation 34.00 on RIGHT side
5	Install strut or anchor no.2 at elevation 33.83
6	Change properties of soil type 1 to soil type 3 No analysis at this stage Ko pressures will be reset
7	Change properties of soil type 2 to soil type 4 Ko pressures will be reset
8	Change EI of wall to 46967 kN.m2/m run Yield moment not defined Allow wall to relax with new modulus value

FACTORS OF SAFETY and ANALYSIS OPTIONS

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

Stability analysis:
Method of analysis - Strength Factor method
Factor on soil strength for calculating wall depth = 1.00

Parameters for undrained strata:
Minimum equivalent fluid density = 5.00 kN/m3
Maximum depth of water filled tension crack = 0.00 m

Bending moment and displacement calculation:
Method - Subgrade reaction model using Influence Coefficients
Open Tension Crack analysis? - No
Non-linear Modulus Parameter (L) = 0 m

Boundary conditions:
Length of wall (normal to plane of analysis) = 1000.00 m

Width of excavation on Left side of wall = 20.00 m
Width of excavation on Right side of wall = 20.00 m

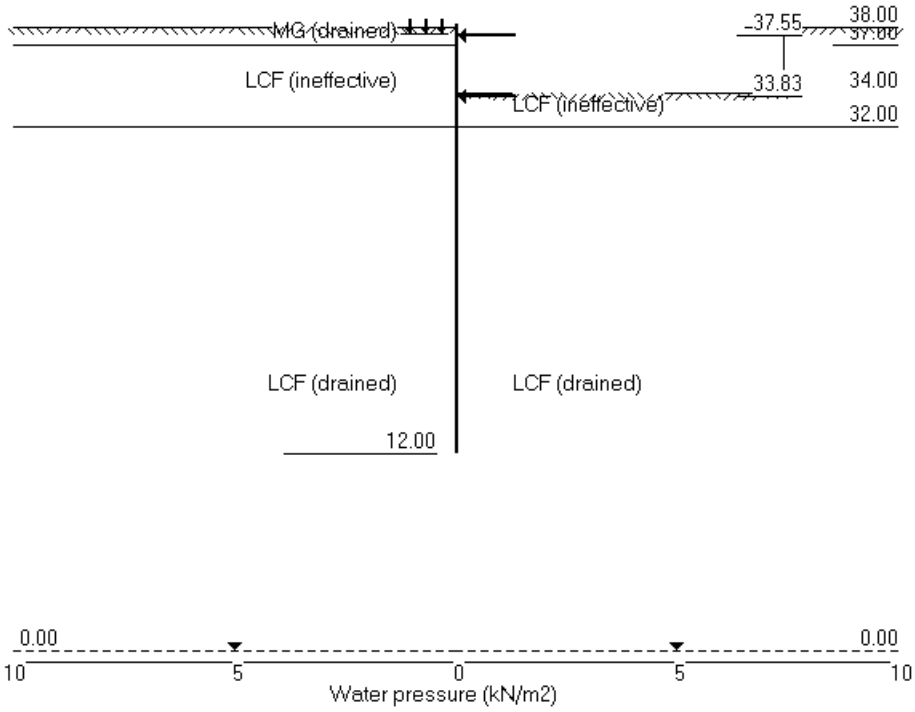
Distance to rigid boundary on Left side = 20.00 m
Distance to rigid boundary on Right side = 20.00 m

OUTPUT OPTIONS

Stage no.	Stage description	Output options: Displacement, Bending mom., Shear force	Active, Passive pressures	Graph. output
1	Apply surcharge no.1 at elev. 37.50	Yes	Yes	Yes
2	Excav. to elev. 37.55 on RIGHT side	Yes	Yes	Yes
3	Install strut no.1 at elev. 37.55	Yes	Yes	Yes
4	Excav. to elev. 34.00 on RIGHT side	Yes	Yes	Yes
5	Install strut no.2 at elev. 33.83	Yes	Yes	Yes
6	Change soil type 1 to soil type 3	Yes	Yes	Yes
7	Change soil type 2 to soil type 4	Yes	Yes	Yes
8	Change EI of wall to 46967kN.m2/m run	Yes	Yes	Yes
*	Summary output	Yes	-	Yes

Units: kN,m

Stage No.8 Change EI of wall to 46967kN.m2/m run



Units: kN,m

Stage No. 1 Apply surcharge no.1 at elevation 37.50

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. = 12.00 Factor of Safety	Moment equilib. at elev.	Toe elev. for FoS = 1.000 Toe elev.	Wall Penetr -ation	Direction of failure
1	38.00	38.00	Cant.	Conditions not suitable for FoS calc.				

BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall
Analysis options
Length of wall perpendicular to section = 1000.00m
Subgrade reaction model - Boussinesq Influence coefficients
Soil deformations are elastic until the active or passive limit is reached
Open Tension Crack analysis - No

Rigid boundaries: Left side 20.00 from wall
Right side 20.00 from wall
Limit State: Serviceability Limit State
Calculated Bending Moments and Strut Forces are to be multiplied by a factor of 1.35 to obtain values for structural design. See summary for factored values.

Node no.	Y coord	Nett pressure kN/m2	Wall disp. m	Wall rotation rad.	Shear force kN/m	Bending moment kN.m/m	Strut forces kN/m	EI of wall kN.m2/m
1	38.00	-4.18	0.001	1.97E-04	0.0	-0.0		65754
2	37.55	-7.73	0.001	1.98E-04	-2.7	-0.4		65754
3	37.50	-7.66	0.001	1.99E-04	-3.1	-0.6		65754
		12.34	0.001	1.99E-04	-3.1	-0.6		
4	37.00	13.00	0.001	2.03E-04	3.3	-0.6		65754
		-1.31	0.001	2.03E-04	3.3	-0.6		
5	35.50	-1.03	0.001	1.83E-04	1.5	2.3		65754
6	34.00	-0.59	0.000	1.30E-04	0.3	2.3		65754
7	33.83	-0.52	0.000	1.24E-04	0.2	2.4		65754
8	32.91	-0.17	0.000	9.36E-05	-0.1	2.1		65754
9	32.00	0.08	0.000	6.72E-05	-0.2	1.7		65754
10	30.40	0.15	0.000	3.74E-05	0.0	0.7		65754
11	28.80	0.04	0.000	2.41E-05	0.2	0.4		65754
12	27.20	-0.02	0.000	1.70E-05	0.2	0.2		65754
13	25.60	-0.02	0.000	1.22E-05	0.2	0.2		65754
14	24.00	-0.01	0.000	9.00E-06	0.1	0.1		65754
15	22.40	-0.01	0.000	6.75E-06	0.1	0.1		65754
16	20.80	-0.01	0.000	5.20E-06	0.1	0.1		65754
17	19.20	-0.01	0.000	4.09E-06	0.1	0.0		65754
18	17.60	-0.01	0.000	3.27E-06	0.1	0.0		65754
19	16.00	-0.01	0.000	2.62E-06	0.1	0.0		65754
20	14.40	-0.01	0.000	2.16E-06	0.0	0.0		65754
21	13.20	-0.02	0.000	1.87E-06	0.0	0.0		65754
22	12.00	-0.02	0.000	1.71E-06	0.0	-0.0		---

(continued)

Stage No.1 Apply surcharge no.1 at elevation 37.50

Node no.	Y coord	LEFT 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	Coeff. of subgrade reaction kN/m3
1	38.00	Total>	0.00	0.00	87.42	0.00	0.00a		3477
2	37.55	Total>	8.10	2.25m	95.52	4.23	4.23		3477
3	37.50	Total>	9.00	2.50m	96.42	5.17	5.17		3477
		Total>	29.00	2.50m	116.42	25.17	25.17		3477
4	37.00	Total>	37.96	5.00m	125.38	34.48	34.48		3477
		Total>	37.96	5.00m	117.97	26.94	26.94		10228
5	35.50	Total>	66.39	12.50m	170.40	56.32	56.32		13296
6	34.00	Total>	87.66	20.00m	215.67	85.06	85.06		16365
7	33.83	Total>	96.45	20.87m	227.27	88.42	88.42		16723
8	32.91	Total>	112.96	25.44m	258.37	106.01	106.01		18589
9	32.00	Total>	129.71	30.00m	289.73	123.67	123.67		20456
		Total>	129.71	30.00m	335.39	123.67	123.67		20456
10	30.40	Total>	159.65	38.00m	398.24	154.71	154.71		23729
11	28.80	Total>	190.15	46.00m	461.65	185.93	185.93		27002
12	27.20	Total>	221.03	54.00m	525.43	217.37	217.37		30275
13	25.60	Total>	252.16	62.00m	589.48	248.95	248.95		33548
14	24.00	Total>	283.48	70.00m	653.70	280.63	280.63		36821
15	22.40	Total>	314.93	78.00m	718.06	312.36	312.36		40094
16	20.80	Total>	346.48	86.00m	782.52	344.15	344.15		43366
17	19.20	Total>	378.10	94.00m	847.05	375.97	375.97		46639
18	17.60	Total>	409.78	102.00m	911.64	407.81	407.81		49912
19	16.00	Total>	441.51	110.00m	976.28	439.68	439.68		53185
20	14.40	Total>	473.27	118.00m	1040.95	471.56	471.56		56458
21	13.20	Total>	497.11	124.00m	1089.47	495.49	495.49		58913
22	12.00	Total>	520.97	130.00m	1138.01	519.42	519.42		61368

Node no.	Y coord	RIGHT 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	Coeff. of subgrade reaction kN/m3
1	38.00	Total>	0.00	0.00	87.42	4.18	4.18		3477
2	37.55	Total>	8.10	2.25m	95.52	11.97	11.97		3477
3	37.50	Total>	9.00	2.50m	96.42	12.83	12.83		3477
4	37.00	Total>	18.00	5.00m	105.42	21.48	21.48		3477
		Total>	18.00	5.00m	98.01	28.24	28.24		10228
5	35.50	Total>	48.00	12.50m	152.01	57.35	57.35		13296
6	34.00	Total>	78.00	20.00m	206.01	85.65	85.65		16365
7	33.83	Total>	81.50	20.87m	212.31	88.94	88.94		16723
8	32.91	Total>	99.75	25.44m	245.16	106.18	106.18		18589
9	32.00	Total>	118.00	30.00m	278.02	123.58	123.58		20456
		Total>	118.00	30.00m	323.68	123.58	123.58		20456
10	30.40	Total>	150.00	38.00m	388.59	154.56	154.56		23729
11	28.80	Total>	182.00	46.00m	453.50	185.90	185.90		27002
12	27.20	Total>	214.00	54.00m	518.41	217.38	217.38		30275
13	25.60	Total>	246.00	62.00m	583.32	248.97	248.97		33548
14	24.00	Total>	278.00	70.00m	648.22	280.64	280.64		36821
15	22.40	Total>	310.00	78.00m	713.13	312.37	312.37		40094
16	20.80	Total>	342.00	86.00m	778.04	344.16	344.16		43366
17	19.20	Total>	374.00	94.00m	842.95	375.97	375.97		46639
18	17.60	Total>	406.00	102.00m	907.86	407.82	407.82		49912
19	16.00	Total>	438.00	110.00m	972.77	439.69	439.69		53185
20	14.40	Total>	470.00	118.00m	1037.68	471.58	471.58		56458
21	13.20	Total>	494.00	124.00m	1086.36	495.50	495.50		58913

(continued)

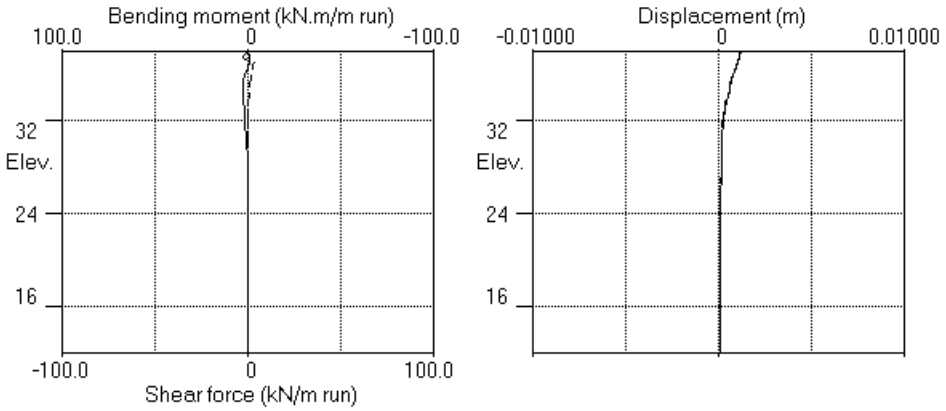
Stage No.1 Apply surcharge no.1 at elevation 37.50

Node no.	Y coord	RIGHT 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	Coeff. of subgrade reaction kN/m3
22	12.00	Total>	518.00	130.00m	1135.04	519.44	519.44	61368

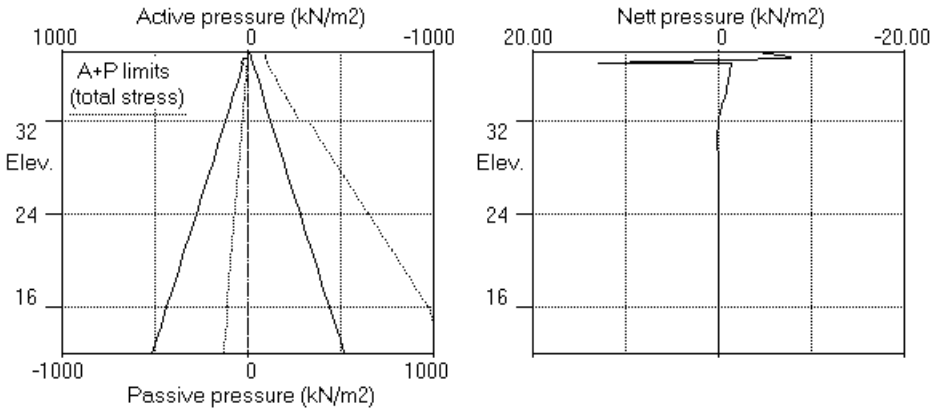
Note: 0.00a Soil pressure at active limit
123.45p Soil pressure at passive limit

Units: kN,m

Stage No.1 Apply surcharge no.1 at elev. 37.50



Stage No.1 Apply surcharge no.1 at elev. 37.50



Units: kN,m

Stage No. 2 Excavate to elevation 37.55 on RIGHT 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. = 12.00 Factor of Safety	Moment equilib. at elev.	Toe elev. for FoS = 1.000 Toe elev.	Wall Penetr -ation	Direction of failure
2	38.00	37.55	Cant.	24.172	15.66	37.47	0.08	L to R

BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall

Analysis options

Length of wall perpendicular to section = 1000.00m

Subgrade reaction model - Boussinesq Influence coefficients

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

Open Tension Crack analysis - No

Rigid boundaries: Left side 20.00 from wall
Right side 20.00 from wall

Limit State: Serviceability Limit State

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

Node no.	Y coord	Nett pressure kN/m2	Wall disp. m	Wall rotation rad.	Shear force kN/m	Bending moment kN.m/m	Strut forces kN/m	EI of wall kN.m2/m
1	38.00	0.00	0.002	3.91E-04	0.0	0.0		65754
2	37.55	2.25	0.002	3.90E-04	0.5	0.2		65754
		-4.42	0.002	3.90E-04	0.5	0.2		
3	37.50	-4.94	0.002	3.90E-04	0.3	0.2		65754
		15.06	0.002	3.90E-04	0.3	0.2		
4	37.00	16.61	0.001	3.81E-04	8.2	2.2		65754
		-6.71	0.001	3.81E-04	8.2	2.2		
5	35.50	-2.65	0.001	2.82E-04	1.2	6.4		65754
6	34.00	-0.23	0.001	1.63E-04	-1.0	4.1		65754
7	33.83	-0.08	0.001	1.53E-04	-1.0	3.9		65754
8	32.91	0.38	0.000	1.07E-04	-0.9	2.7		65754
9	32.00	0.47	0.000	7.68E-05	-0.5	1.8		65754
10	30.40	0.22	0.000	4.62E-05	0.0	0.7		65754
11	28.80	0.02	0.000	3.26E-05	0.2	0.4		65754
12	27.20	-0.03	0.000	2.42E-05	0.2	0.3		65754
13	25.60	-0.02	0.000	1.81E-05	0.2	0.2		65754
14	24.00	-0.01	0.000	1.39E-05	0.2	0.1		65754
15	22.40	-0.01	0.000	1.10E-05	0.2	0.1		65754
16	20.80	-0.01	0.000	8.88E-06	0.1	0.1		65754
17	19.20	-0.01	0.000	7.30E-06	0.1	0.1		65754
18	17.60	-0.01	0.000	6.07E-06	0.1	0.0		65754
19	16.00	-0.01	0.000	5.06E-06	0.1	0.0		65754
20	14.40	-0.03	0.000	4.32E-06	0.1	0.0		65754
21	13.20	-0.03	0.000	3.81E-06	0.0	0.0		65754
22	12.00	-0.05	0.000	3.51E-06	0.0	-0.0		---

(continued)

Stage No.2 Excavate to elevation 37.55 on RIGHT side

LEFT side

Node no.	Y coord	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	Coeff. of subgrade reaction kN/m3
1	38.00	Total>	0.00	0.00	87.42	0.00	0.00a	4660
2	37.55	Total>	8.10	2.25m	95.52	2.25	2.25a	4660
3	37.50	Total>	9.00	2.50m	96.42	2.55	2.55	4660
		Total>	29.00	2.50m	116.42	22.55	22.55	4660
4	37.00	Total>	37.96	5.00m	125.38	32.29	32.29	4660
		Total>	37.96	5.00m	117.97	20.51	20.51	13706
5	35.50	Total>	66.39	12.50m	170.40	51.73	51.73	17817
6	34.00	Total>	87.66	20.00m	215.67	81.45	81.45	21929
7	33.83	Total>	96.45	20.87m	227.27	84.85	84.85	22409
8	32.91	Total>	112.96	25.44m	258.37	102.50	102.50	24910
9	32.00	Total>	129.71	30.00m	289.73	120.09	120.09	27411
		Total>	129.71	30.00m	335.39	120.09	120.09	27411
10	30.40	Total>	159.65	38.00m	398.24	151.02	151.02	31797
11	28.80	Total>	190.15	46.00m	461.65	182.24	182.24	36183
12	27.20	Total>	221.03	54.00m	525.43	213.74	213.74	40568
13	25.60	Total>	252.16	62.00m	589.48	245.39	245.39	44954
14	24.00	Total>	283.48	70.00m	653.70	277.15	277.15	49340
15	22.40	Total>	314.93	78.00m	718.06	308.97	308.97	53726
16	20.80	Total>	346.48	86.00m	782.52	340.85	340.85	58112
17	19.20	Total>	378.10	94.00m	847.05	372.76	372.76	62497
18	17.60	Total>	409.78	102.00m	911.64	404.71	404.71	66883
19	16.00	Total>	441.51	110.00m	976.28	436.67	436.67	71269
20	14.40	Total>	473.27	118.00m	1040.95	468.64	468.64	75655
21	13.20	Total>	497.11	124.00m	1089.47	492.63	492.63	78944
22	12.00	Total>	520.97	130.00m	1138.01	516.63	516.63	82233

RIGHT side

Node no.	Y coord	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	Coeff. of subgrade reaction kN/m3
1	38.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	37.55	0.00	0.00	0.00	0.00	0.00	0.00	0.0
		Total>	0.00	0.00	87.42	6.67	6.67	4898
3	37.50	Total>	0.90	0.25m	88.32	7.49	7.49	4898
4	37.00	Total>	9.90	2.75m	97.32	15.68	15.68	4898
		Total>	9.90	2.75m	89.91	27.22	27.22	14406
5	35.50	Total>	39.90	10.25m	143.91	54.39	54.39	18728
6	34.00	Total>	69.92	17.75m	197.93	81.68	81.68	23050
7	33.83	Total>	73.42	18.62m	204.23	84.94	84.94	23554
8	32.91	Total>	91.69	23.19m	237.10	102.12	102.12	26184
9	32.00	Total>	109.97	27.75m	269.98	119.63	119.63	28813
		Total>	109.97	27.75m	315.65	119.63	119.63	28813
10	30.40	Total>	142.04	35.75m	380.62	150.80	150.80	33423
11	28.80	Total>	174.13	43.75m	445.63	182.22	182.22	38033
12	27.20	Total>	206.26	51.75m	510.66	213.76	213.76	42643
13	25.60	Total>	238.41	59.75m	575.72	245.41	245.41	47253
14	24.00	Total>	270.58	67.75m	640.80	277.16	277.16	51863
15	22.40	Total>	302.76	75.75m	705.89	308.98	308.98	56473
16	20.80	Total>	334.96	83.75m	771.00	340.86	340.86	61083
17	19.20	Total>	367.16	91.75m	836.11	372.77	372.77	65693
18	17.60	Total>	399.37	99.75m	901.22	404.71	404.71	70303
19	16.00	Total>	431.57	107.75m	966.34	436.68	436.68	74913
20	14.40	Total>	463.77	115.75m	1031.45	468.67	468.67	79523

(continued)

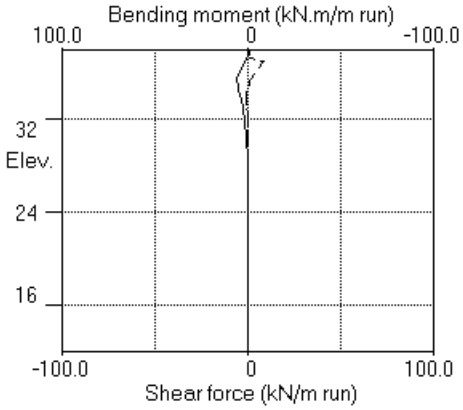
Stage No.2 Excavate to elevation 37.55 on RIGHT side

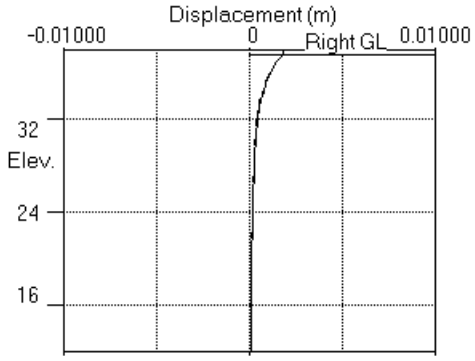
Node no.	Y coord	RIGHT side						
		Effective stresses				Total earth pressure	Coeff. of subgrade reaction
		Water press. kN/m2	Vertic -al kN/m2	Active limit kN/m2	Passive limit kN/m2	Earth pressure kN/m2		
21	13.20	Total>	487.92	121.75m	1080.28	492.67	492.67	82981
22	12.00	Total>	512.07	127.75m	1129.11	516.67	516.67	86438

Note: 2.25a Soil pressure at active limit
123.45p Soil pressure at passive limit

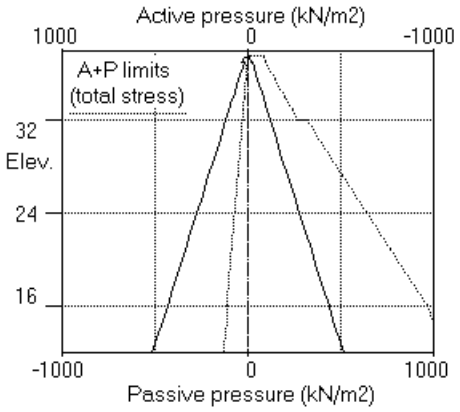
Units: kN,m

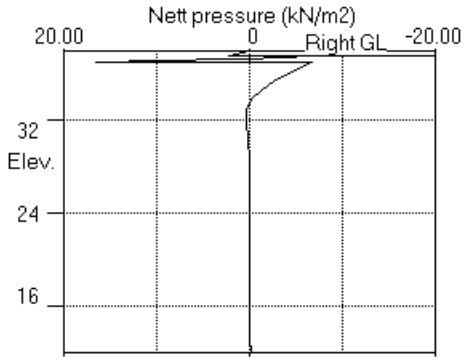
Stage No.2 Excav. to elev. 37.55 on RIGHT side





Stage No.2 Excav. to elev. 37.55 on RIGHT side





Units: kN,m

Stage No. 4 Excavate to elevation 34.00 on RIGHT 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. = 12.00 Factor of Safety	Moment equilib. at elev.	Toe elev. for FoS = 1.000 Toe elev.	Wall Penetr -ation	Direction of failure
4	38.00	34.00	37.55	11.717	n/a	33.79	0.21	L to R

BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall

Analysis options

Length of wall perpendicular to section = 1000.00m

Subgrade reaction model - Boussinesq Influence coefficients

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

Open Tension Crack analysis - No

Rigid boundaries: Left side 20.00 from wall
Right side 20.00 from wall

Limit State: Serviceability Limit State

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

Node no.	Y coord	Nett pressure kN/m2	Wall disp. m	Wall rotation rad.	Shear force kN/m	Bending moment kN.m/m	Strut forces kN/m	EI of wall kN.m2/m
1	38.00	20.75	0.001	-1.53E-03	0.0	-0.0		65754
2	37.55	2.25	0.002	-1.54E-03	5.2	2.3	56.0	65754
		2.25	0.002	-1.54E-03	-50.8	2.3		
3	37.50	2.50	0.002	-1.54E-03	-50.7	-0.2		65754
		22.26	0.002	-1.54E-03	-50.7	-0.2		
4	37.00	29.86	0.003	-1.46E-03	-37.7	-22.5		65754
		13.34	0.003	-1.46E-03	-37.7	-22.5		
5	35.50	24.04	0.004	-5.85E-04	-9.6	-54.4		65754
6	34.00	43.12	0.004	4.06E-04	40.7	-32.6		65754
		-19.10	0.004	4.06E-04	40.7	-32.6		
7	33.83	-19.60	0.004	4.84E-04	37.3	-25.8		65754
8	32.91	-17.10	0.004	6.64E-04	20.6	-0.1		65754
9	32.00	-10.67	0.003	5.86E-04	7.9	11.3		65754
10	30.40	-1.62	0.002	3.34E-04	-1.9	9.4		65754
11	28.80	1.24	0.002	1.75E-04	-2.2	3.6		65754
12	27.20	0.87	0.002	1.21E-04	-0.5	0.9		65754
13	25.60	0.21	0.002	1.04E-04	0.3	0.5		65754
14	24.00	-0.01	0.001	9.28E-05	0.5	0.5		65754
15	22.40	-0.01	0.001	8.05E-05	0.5	0.5		65754
16	20.80	0.02	0.001	6.97E-05	0.5	0.4		65754
17	19.20	0.02	0.001	6.08E-05	0.5	0.3		65754
18	17.60	0.01	0.001	5.34E-05	0.5	0.3		65754
19	16.00	-0.03	0.001	4.68E-05	0.5	0.3		65754
20	14.40	-0.12	0.001	4.15E-05	0.4	0.2		65754
21	13.20	-0.18	0.001	3.79E-05	0.2	0.2		65754
22	12.00	-0.22	0.001	3.59E-05	0.0	0.0		---

At elev. 37.55 Strut force = 56.0 kN/strut = 56.0 kN/m run

(continued)

Stage No.4 Excavate to elevation 34.00 on RIGHT side

LEFT side

Node no.	Y coord	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	Coeff. of subgrade reaction kN/m3
1	38.00	Total>	0.00	0.00	87.42	20.75	20.75	24755
2	37.55	Total>	8.10	2.25m	95.52	2.25	2.25a	2251
3	37.50	Total>	9.00	2.50m	96.42	2.50	2.50a	2251
		Total>	29.00	2.50m	116.42	22.26	22.26	2251
4	37.00	Total>	37.96	5.00m	125.38	29.86	29.86	2251
		Total>	37.96	5.00m	117.97	13.34	13.34	6619
5	35.50	Total>	66.39	12.50m	170.40	24.04	24.04	8605
6	34.00	Total>	87.66	20.00m	215.67	43.12	43.12	10591
7	33.83	Total>	96.45	20.87m	227.27	46.23	46.23	10822
8	32.91	Total>	112.96	25.44m	258.37	64.78	64.78	12030
9	32.00	Total>	129.71	30.00m	289.73	85.19	85.19	13238
		Total>	129.71	30.00m	335.39	85.19	85.19	13238
10	30.40	Total>	159.65	38.00m	398.24	120.30	120.30	15357
11	28.80	Total>	190.15	46.00m	461.65	152.99	152.99	17475
12	27.20	Total>	221.03	54.00m	525.43	184.55	184.55	19593
13	25.60	Total>	252.16	62.00m	589.48	216.22	216.22	21711
14	24.00	Total>	283.48	70.00m	653.70	248.29	248.29	23829
15	22.40	Total>	314.93	78.00m	718.06	280.63	280.63	25947
16	20.80	Total>	346.48	86.00m	782.52	313.11	313.11	28065
17	19.20	Total>	378.10	94.00m	847.05	345.69	345.69	30184
18	17.60	Total>	409.78	102.00m	911.64	378.34	378.34	32302
19	16.00	Total>	441.51	110.00m	976.28	411.03	411.03	34420
20	14.40	Total>	473.27	118.00m	1040.95	443.73	443.73	36538
21	13.20	Total>	497.11	124.00m	1089.47	468.27	468.27	38127
22	12.00	Total>	520.97	130.00m	1138.01	492.82	492.82	39715

RIGHT side

Node no.	Y coord	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	Coeff. of subgrade reaction kN/m3
1	38.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	37.55	0.00	0.00	0.00	0.00	0.00	0.00	0.0
3	37.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
4	37.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
5	35.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
6	34.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
		Total>	0.00	0.00	128.01	62.21	62.21	13180
7	33.83	Total>	3.50	0.87m	134.31	65.83	65.83	13468
8	32.91	Total>	21.76	5.44m	167.17	81.88	81.88	14971
9	32.00	Total>	40.03	10.00m	200.05	95.86	95.86	16475
		Total>	40.03	10.00m	245.71	95.86	95.86	16475
10	30.40	Total>	72.19	18.00m	310.77	121.91	121.91	19111
11	28.80	Total>	104.54	26.00m	376.04	151.75	151.75	21746
12	27.20	Total>	137.14	34.00m	441.55	183.68	183.68	24382
13	25.60	Total>	170.02	42.00m	507.33	216.01	216.01	27018
14	24.00	Total>	203.16	50.00m	573.38	248.30	248.30	29654
15	22.40	Total>	236.55	58.00m	639.68	280.64	280.64	32290
16	20.80	Total>	270.14	66.00m	706.18	313.10	313.10	34926
17	19.20	Total>	303.89	74.00m	772.84	345.67	345.67	37562
18	17.60	Total>	337.76	82.00m	839.62	378.33	378.33	40198
19	16.00	Total>	371.70	90.00m	906.47	411.06	411.06	42834
20	14.40	Total>	405.68	98.00m	973.35	443.85	443.85	45470
21	13.20	Total>	431.16	104.00m	1023.52	468.45	468.45	47447

(continued)

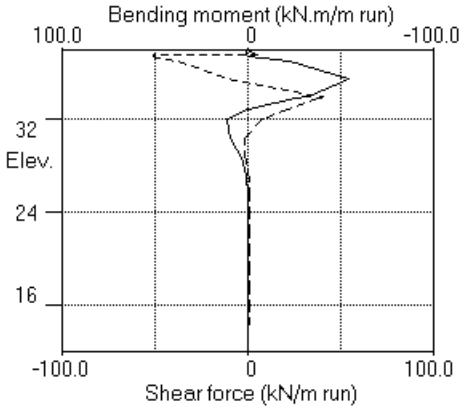
Stage No.4 Excavate to elevation 34.00 on RIGHT side

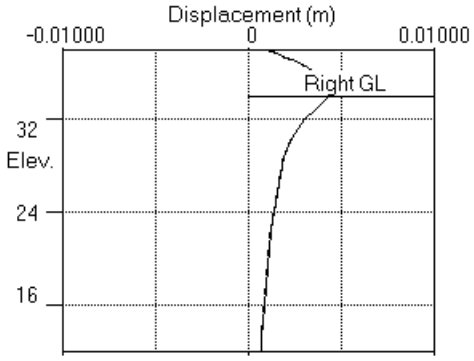
Node no.	Y coord	RIGHT side						
		Effective stresses				Total earth pressure	Coeff. of subgrade reaction
		Water press. kN/m2	Vertic -al kN/m2	Active limit kN/m2	Passive limit kN/m2	Earth pressure kN/m2		
22	12.00	Total>	456.65	110.00m	1073.69	493.04	493.04	49424

Note: 2.50a Soil pressure at active limit
123.45p Soil pressure at passive limit

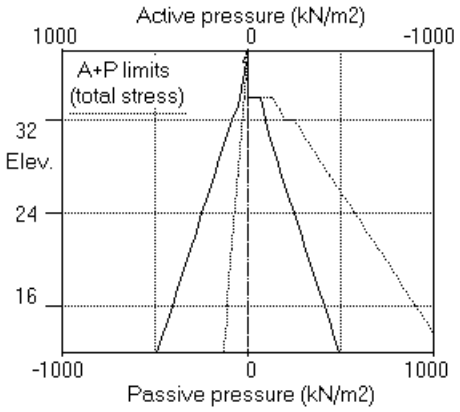
Units: kN,m

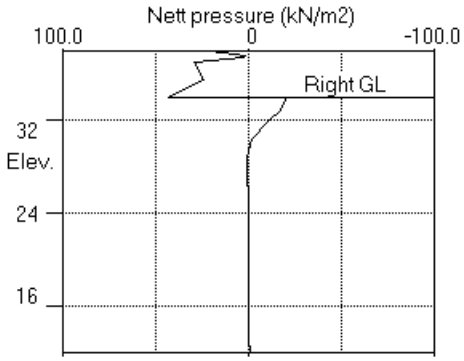
Stage No.4 Excav. to elev. 34.00 on RIGHT side





Stage No.4 Excav. to elev. 34.00 on RIGHT side





Units: kN,m

Stage No. 7 Change properties of soil type 2 to soil type 4
Ko pressures will be reset

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. = 12.00 Factor of Safety	Moment equilib. at elev.	Toe elev. for FoS = 1.000 Toe elev.	Wall Penetr -ation	Direction of failure
7	38.00	34.00		More than one strut. No FoS calc.				

BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall
Analysis options
Length of wall perpendicular to section = 1000.00m
Subgrade reaction model - Boussinesq Influence coefficients
Soil deformations are elastic until the active or passive limit is reached
Open Tension Crack analysis - No

Rigid boundaries: Left side 20.00 from wall
Right side 20.00 from wall
Limit State: Serviceability Limit State
Calculated Bending Moments and Strut Forces are to be multiplied by a factor of 1.35 to obtain values for structural design. See summary for factored values.

Node no.	Y coord	Nett pressure kN/m2	Wall disp. m	Wall rotation rad.	Shear force kN/m	Bending moment kN.m/m	Strut forces kN/m	EI of wall kN.m2/m
1	38.00	0.00	0.001	-1.56E-03	0.0	-0.0		65754
2	37.55	2.76	0.002	-1.56E-03	0.6	0.9	50.9	65754
		2.76	0.002	-1.56E-03	-50.3	0.9		
3	37.50	3.06	0.002	-1.56E-03	-50.1	-1.6		65754
		22.28	0.002	-1.56E-03	-50.1	-1.6		
4	37.00	29.85	0.003	-1.47E-03	-37.1	-23.5		65754
		13.27	0.003	-1.47E-03	-37.1	-23.5		
5	35.50	23.90	0.004	-5.81E-04	-9.2	-54.6		65754
6	34.00	43.09	0.004	4.10E-04	41.0	-32.4		65754
		-19.32	0.004	4.10E-04	41.0	-32.4		
7	33.83	-19.70	0.004	4.88E-04	37.6	-25.5	0.4	65754
		-19.70	0.004	4.88E-04	37.2	-25.5		
8	32.91	-17.04	0.004	6.65E-04	20.5	-0.0		65754
9	32.00	-10.59	0.003	5.86E-04	7.9	11.4		65754
		-10.63	0.003	5.86E-04	7.9	11.4		
10	30.40	-1.60	0.002	3.33E-04	-1.9	9.4		65754
11	28.80	1.24	0.002	1.75E-04	-2.2	3.5		65754
12	27.20	0.87	0.002	1.21E-04	-0.5	0.9		65754
13	25.60	0.20	0.002	1.04E-04	0.3	0.5		65754
14	24.00	-0.01	0.001	9.28E-05	0.5	0.5		65754
15	22.40	-0.01	0.001	8.05E-05	0.5	0.5		65754
16	20.80	0.02	0.001	6.97E-05	0.5	0.4		65754
17	19.20	0.02	0.001	6.08E-05	0.5	0.3		65754
18	17.60	0.01	0.001	5.34E-05	0.5	0.3		65754
19	16.00	-0.03	0.001	4.68E-05	0.5	0.3		65754
20	14.40	-0.12	0.001	4.15E-05	0.4	0.2		65754
21	13.20	-0.18	0.001	3.79E-05	0.2	0.2		65754
22	12.00	-0.22	0.001	3.59E-05	0.0	0.0		---

At elev. 37.55 Strut force = 50.9 kN/strut = 50.9 kN/m run
At elev. 33.83 Strut force = 0.4 kN/strut = 0.4 kN/m run

(continued)

Stage No.7 Change properties of soil type 2 to soil type 4
Ko pressures will be reset

LEFT side

Node no.	Y coord	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	Coeff. of subgrade reaction kN/m3
1	38.00	0.00	0.00	0.00	0.00	0.00	0.00	11036
2	37.55	0.00	8.10	2.76	29.38	2.76	2.76a	11036
3	37.50	0.00	9.00	3.06	32.64	3.06	3.06a	11036
		0.00	29.00	9.87	105.19	22.28	22.28	11036
4	37.00	0.00	37.96	12.91	137.69	29.85	29.85	2140
		Total>	37.96	5.00m	117.97	13.27	13.27	11940
5	35.50	Total>	66.39	12.50m	170.40	23.90	23.90	15523
6	34.00	Total>	87.66	20.00m	215.67	43.09	43.09	19105
7	33.83	Total>	96.45	20.87m	227.27	46.21	46.21	19523
8	32.91	Total>	112.96	25.44m	258.37	64.81	64.81	20223
9	32.00	Total>	129.71	30.00m	289.73	85.23	85.23	22253
		0.00	129.71	42.64	417.88	85.21	85.21	11677
10	30.40	0.00	150.27	50.60	480.15	120.31	120.31	13545
11	28.80	0.00	190.15	66.04	600.90	152.99	152.99	15413
12	27.20	0.00	221.03	77.99	694.40	184.55	184.55	18345
13	25.60	0.00	252.16	90.05	788.68	216.22	216.22	20328
14	24.00	0.00	283.48	102.17	883.52	248.29	248.29	22311
15	22.40	0.00	314.93	114.35	978.75	280.63	280.63	23015
16	20.80	0.00	346.48	126.56	1074.28	313.11	313.11	24894
17	19.20	0.00	378.10	138.81	1170.04	345.69	345.69	26773
18	17.60	0.00	409.78	151.07	1265.97	378.34	378.34	30439
19	16.00	0.00	441.51	163.36	1362.04	411.03	411.03	32435
20	14.40	0.00	473.27	175.65	1458.22	443.73	443.73	34431
21	13.20	0.00	497.11	184.88	1530.42	468.27	468.27	62520
22	12.00	0.00	520.97	194.12	1602.66	492.82	492.82	65125

RIGHT side

Node no.	Y coord	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	Coeff. of subgrade reaction kN/m3
1	38.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	37.55	0.00	0.00	0.00	0.00	0.00	0.00	0.0
3	37.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
4	37.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
5	35.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
6	34.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
		Total>	0.00	0.00	128.01	62.41	62.41	152908
7	33.83	Total>	3.50	0.87m	134.31	65.91	65.91	156253
8	32.91	Total>	21.76	5.44m	167.17	81.85	81.85	20223
9	32.00	Total>	40.03	10.00m	200.05	95.82	95.82	22253
		0.00	40.03	7.91	146.32	95.84	95.84	11677
10	30.40	0.00	72.19	20.36	243.69	121.90	121.90	13545
11	28.80	0.00	104.54	32.89	341.65	151.75	151.75	15413
12	27.20	0.00	137.14	45.51	440.38	183.68	183.68	18345
13	25.60	0.00	170.02	58.24	539.93	216.01	216.01	20328
14	24.00	0.00	203.16	71.07	640.30	248.30	248.30	22311
15	22.40	0.00	236.55	84.00	741.40	280.64	280.64	23015
16	20.80	0.00	270.14	97.01	843.12	313.10	313.10	24894
17	19.20	0.00	303.89	110.07	945.32	345.67	345.67	26773
18	17.60	0.00	337.76	123.19	1047.87	378.33	378.33	30439
19	16.00	0.00	371.70	136.33	1150.65	411.06	411.06	32435
20	14.40	0.00	405.68	149.48	1253.54	443.85	443.85	34431

(continued)

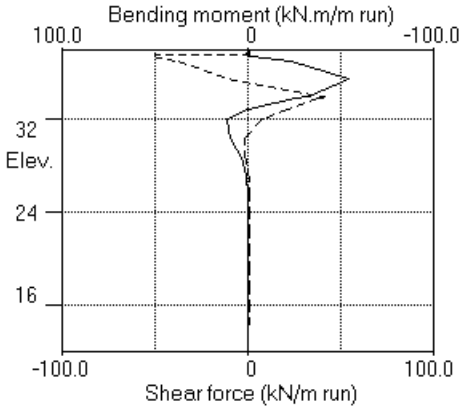
Stage No.7 Change properties of soil type 2 to soil type 4
Ko pressures will be reset

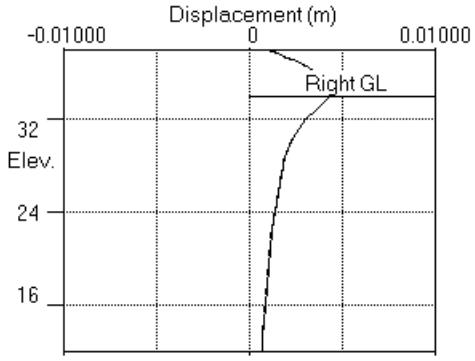
Node no.	Y coord	RIGHT side Water press. kN/m2	Effective stresses Vertic -al kN/m2	Active limit kN/m2	Passive limit kN/m2	Earth pressure kN/m2	Total earth pressure kN/m2	Coeff. of subgrade reaction kN/m3
21	13.20	0.00	431.16	159.35	1330.72	468.45	468.45	62520
22	12.00	0.00	456.65	169.22	1407.89	493.04	493.04	65125

Note: 3.06a Soil pressure at active limit
123.45p Soil pressure at passive limit

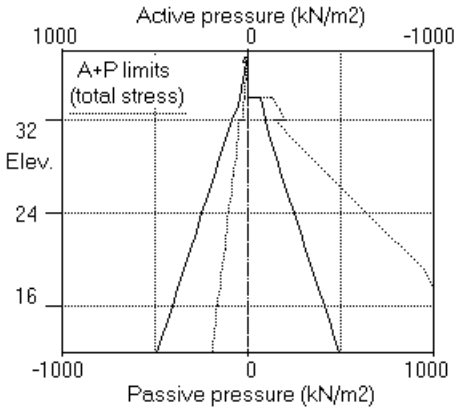
Units: kN,m

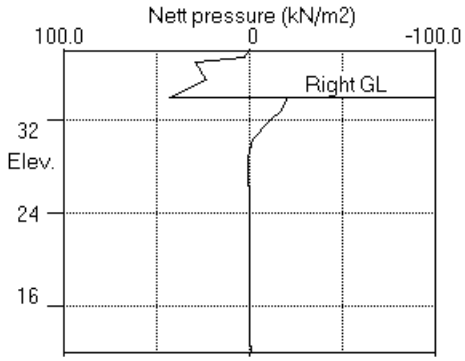
Stage No.7 Change soil type 2 to soil type 4





Stage No.7 Change soil type 2 to soil type 4





Units: kN,m

Stage No. 8 Change EI of wall to 46967 kN.m2/m run
Yield moment not defined
Allow wall to relax with new modulus value

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

Stage No.	--- G.L. --- Act.	Pass.	Strut Elev.	FoS for toe elev. = 12.00 Factor of Safety	Moment equilib. at elev.	Toe elev. for FoS = 1.000 Toe elev.	Wall Penetr -ation	Direction of failure
8	38.00	34.00		More than one strut. No FoS calc.				

BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall
Analysis options
Length of wall perpendicular to section = 1000.00m
Subgrade reaction model - Boussinesq Influence coefficients
Soil deformations are elastic until the active or passive limit is reached
Open Tension Crack analysis - No

Rigid boundaries: Left side 20.00 from wall
Right side 20.00 from wall
Limit State: Serviceability Limit State
Calculated Bending Moments and Strut Forces are to be multiplied by a factor of 1.35 to obtain values for structural design. See summary for factored values.

Node no.	Y coord	Nett pressure kN/m2	Wall disp. m	Wall rotation rad.	Shear force kN/m	Bending moment kN.m/m	Strut forces kN/m	EI of wall kN.m2/m
1	38.00	0.00	0.001	-1.71E-03	0.0	-0.0		46967
2	37.55	2.79	0.002	-1.72E-03	0.6	0.9	45.8	46967
		2.79	0.002	-1.72E-03	-45.1	0.9		
3	37.50	3.06	0.002	-1.72E-03	-45.0	-1.4		46967
		22.27	0.002	-1.72E-03	-45.0	-1.4		
4	37.00	29.67	0.003	-1.60E-03	-32.0	-21.3		46967
		12.30	0.003	-1.60E-03	-32.0	-21.3		
5	35.50	21.23	0.004	-5.52E-04	-6.8	-47.3		46967
6	34.00	42.53	0.004	5.28E-04	41.0	-24.7		46967
		-25.12	0.004	5.28E-04	41.0	-24.7		
7	33.83	-21.42	0.004	5.99E-04	36.9	-17.9	6.0	46967
		-21.42	0.004	5.99E-04	30.9	-17.9		
8	32.91	-14.38	0.004	7.18E-04	14.6	2.6		46967
9	32.00	-6.70	0.003	5.84E-04	4.9	10.7		46967
		-8.59	0.003	5.84E-04	4.9	10.7		
10	30.40	-0.34	0.002	2.97E-04	-2.2	7.1		46967
11	28.80	1.31	0.002	1.58E-04	-1.4	2.1		46967
12	27.20	0.52	0.002	1.21E-04	0.0	0.5		46967
13	25.60	0.03	0.002	1.08E-04	0.5	0.4		46967
14	24.00	-0.03	0.001	9.39E-05	0.5	0.5		46967
15	22.40	0.02	0.001	8.04E-05	0.5	0.4		46967
16	20.80	0.02	0.001	6.95E-05	0.5	0.3		46967
17	19.20	0.02	0.001	6.08E-05	0.5	0.3		46967
18	17.60	0.01	0.001	5.35E-05	0.6	0.2		46967
19	16.00	-0.02	0.001	4.68E-05	0.5	0.2		46967
20	14.40	-0.11	0.001	4.16E-05	0.4	0.1		46967
21	13.20	-0.16	0.001	3.78E-05	0.3	0.2		46967
22	12.00	-0.28	0.001	3.56E-05	0.0	0.0		---

At elev. 37.55 Strut force = 45.8 kN/strut = 45.8 kN/m run
At elev. 33.83 Strut force = 6.0 kN/strut = 6.0 kN/m run

(continued)

Stage No.8 Change EI of wall to 46967 kN.m2/m run
Yield moment not defined
Allow wall to relax with new modulus value

LEFT side

Node no.	Y coord	Water press.	Effective stresses: Vertic-al	Active limit	Passive limit	Earth pressure	Total earth pressure	Coeff. of subgrade reaction
		kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m3
1	38.00	0.00	0.00	0.00	0.00	0.00	0.00	12908
2	37.55	0.00	8.10	2.76	29.38	2.79	2.79	12908
3	37.50	0.00	9.00	3.06	32.64	3.06	3.06a	2226
		0.00	29.00	9.87	105.19	22.27	22.27	2226
4	37.00	0.00	37.96	12.91	137.69	29.67	29.67	2226
		Total>	37.96	5.00m	117.97	12.30	12.30	12395
5	35.50	Total>	66.39	12.50m	170.40	21.23	21.23	16114
6	34.00	Total>	87.66	20.00m	215.67	42.53	42.53	19833
7	33.83	Total>	96.45	20.87m	227.27	46.05	46.05	20267
8	32.91	Total>	112.96	25.44m	258.37	66.14	66.14	19613
9	32.00	Total>	129.71	30.00m	289.73	87.18	87.18	21583
		0.00	129.71	42.64	417.88	86.23	86.23	11301
10	30.40	0.00	150.27	50.60	480.15	120.94	120.94	13109
11	28.80	0.00	190.15	66.04	600.90	153.03	153.03	14917
12	27.20	0.00	221.03	77.99	694.40	184.37	184.37	20603
13	25.60	0.00	252.16	90.05	788.68	216.13	216.13	22830
14	24.00	0.00	283.48	102.17	883.52	248.28	248.28	25058
15	22.40	0.00	314.93	114.35	978.75	280.64	280.64	34497
16	20.80	0.00	346.48	126.56	1074.28	313.12	313.12	37313
17	19.20	0.00	378.10	138.81	1170.04	345.69	345.69	50343
18	17.60	0.00	409.78	151.07	1265.97	378.34	378.34	53876
19	16.00	0.00	441.51	163.36	1362.04	411.03	411.03	46269
20	14.40	0.00	473.27	175.65	1458.22	443.73	443.73	49116
21	13.20	0.00	497.11	184.88	1530.42	468.28	468.28	51252
22	12.00	0.00	520.97	194.12	1602.66	492.79	492.79	163634

RIGHT side

Node no.	Y coord	Water press.	Effective stresses: Vertic-al	Active limit	Passive limit	Earth pressure	Total earth pressure	Coeff. of subgrade reaction
		kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m3
1	38.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	37.55	0.00	0.00	0.00	0.00	0.00	0.00	0.0
3	37.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
4	37.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
5	35.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
6	34.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
		Total>	0.00	0.00	128.01	67.65	67.65	185302
7	33.83	Total>	3.50	0.87m	134.31	67.47	67.47	189355
8	32.91	Total>	21.76	5.44m	167.17	80.51	80.51	19613
9	32.00	Total>	40.03	10.00m	200.05	93.88	93.88	21583
		0.00	40.03	7.91	146.32	94.82	94.82	11301
10	30.40	0.00	72.19	20.36	243.69	121.28	121.28	13109
11	28.80	0.00	104.54	32.89	341.65	151.72	151.72	14917
12	27.20	0.00	137.14	45.51	440.38	183.86	183.86	20603
13	25.60	0.00	170.02	58.24	539.93	216.10	216.10	22830
14	24.00	0.00	203.16	71.07	640.30	248.31	248.31	25058
15	22.40	0.00	236.55	84.00	741.40	280.63	280.63	34497
16	20.80	0.00	270.14	97.01	843.12	313.09	313.09	37313
17	19.20	0.00	303.89	110.07	945.32	345.67	345.67	50343
18	17.60	0.00	337.76	123.19	1047.87	378.33	378.33	53876
19	16.00	0.00	371.70	136.33	1150.65	411.06	411.06	46269

(continued)

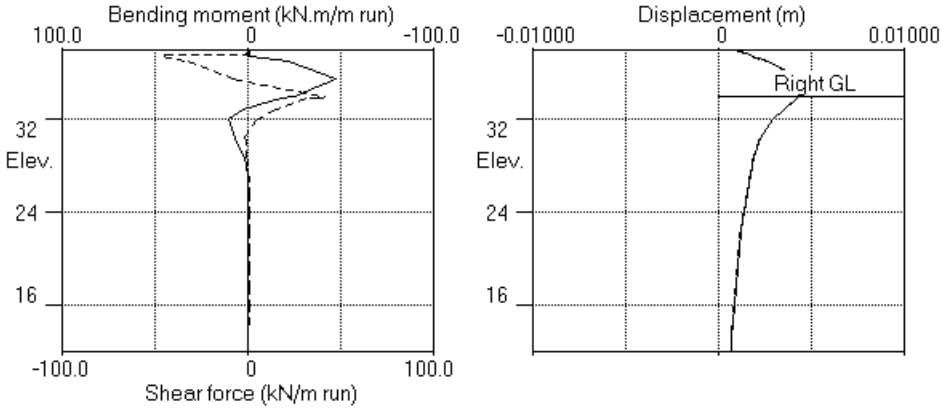
Stage No.8 Change EI of wall to 46967 kN.m2/m run
Yield moment not defined
Allow wall to relax with new modulus value

Node no.	Y coord	RIGHT 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	Coeff. of subgrade reaction kN/m3
20	14.40	0.00	405.68	149.48	1253.54	443.85	443.85	49116
21	13.20	0.00	431.16	159.35	1330.72	468.44	468.44	51252
22	12.00	0.00	456.65	169.22	1407.89	493.07	493.07	163634

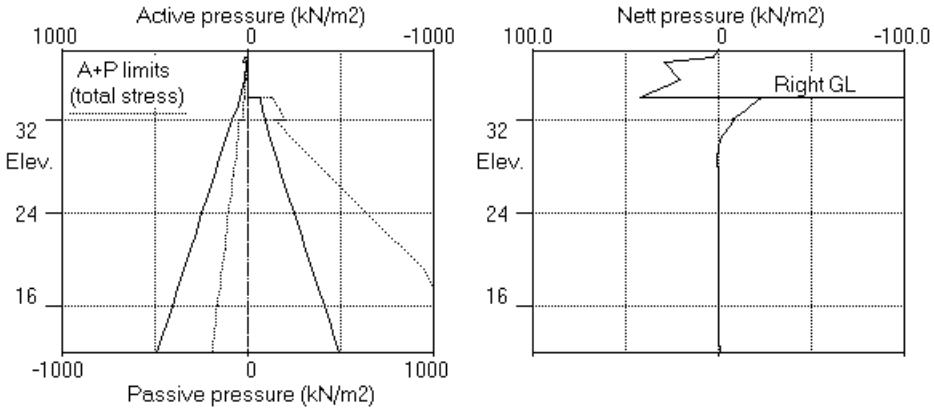
Note: 3.06a Soil pressure at active limit
123.45p Soil pressure at passive limit

Units: kN,m

Stage No.8 Change EI of wall to 46967kN.m2/m run



Stage No.8 Change EI of wall to 46967kN.m2/m run



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. = 12.00 Factor of Safety	Moment equilib. at elev.	Toe elev. for FoS = 1.000 Toe elev.	Wall Penetr -ation	Direction of failure
1	38.00	38.00	Cant.	Conditions not suitable for FoS calc.				
2	38.00	37.55	Cant.	24.172	15.66	37.47	0.08	L to R
3	38.00	37.55		No analysis at this stage				
4	38.00	34.00	37.55	11.717	n/a	33.79	0.21	L to R
5	38.00	34.00		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 = 1000.00m
Subgrade reaction model - Boussinesq Influence coefficients
Soil deformations are elastic until the active or passive limit is reached
Open Tension Crack analysis - No

Rigid boundaries: Left side 20.00 from wall
Right side 20.00 from wall

Limit State: Serviceability Limit State

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

Bending moment, shear force and displacement envelopes

Node no.	Y coord	Displacement		Bending moment Calculated		Bending moment Factored		Shear force Calculated		Shear force Factored	
		max.	min.	max.	min.	max.	min.	max.	min.	max.	min.
		m	m	kN.m/m		kN.m/m		kN/m	kN/m	kN/m	kN/m
1	38.00	0.002	0.000	0	-0	0	-0	0	0	0	0
2	37.55	0.002	0.000	2	-0	3	-1	5	-51	7	-69
3	37.50	0.002	0.000	0	-2	0	-2	0	-51	0	-68
4	37.00	0.003	0.000	2	-24	3	-32	8	-38	11	-51
5	35.50	0.004	0.000	6	-55	9	-74	2	-10	2	-13
6	34.00	0.004	0.000	4	-33	5	-44	41	-1	55	-1
7	33.83	0.004	0.000	4	-26	5	-35	38	-1	51	-1
8	32.91	0.004	0.000	3	-0	4	-0	21	-1	28	-1
9	32.00	0.003	0.000	11	0	15	0	8	-1	11	-1
10	30.40	0.002	0.000	9	0	13	0	0	-2	0	-3
11	28.80	0.002	0.000	4	0	5	0	0	-2	0	-3
12	27.20	0.002	0.000	1	0	1	0	0	-1	0	-1
13	25.60	0.002	0.000	0	0	1	0	0	0	1	0
14	24.00	0.001	0.000	1	0	1	0	0	0	1	0
15	22.40	0.001	0.000	0	0	1	0	0	0	1	0
16	20.80	0.001	0.000	0	0	1	0	0	0	1	0
17	19.20	0.001	0.000	0	0	0	0	1	0	1	0
18	17.60	0.001	0.000	0	0	0	0	1	0	1	0
19	16.00	0.001	0.000	0	0	0	0	1	0	1	0
20	14.40	0.001	0.000	0	0	0	0	0	0	1	0
21	13.20	0.001	0.000	0	0	0	0	0	0	0	0
22	12.00	0.001	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 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	2	33.83	-1	37.50	3	-1	3	37.00	-3	37.50	4	-4
2	6	35.50	-0	12.00	9	-0	8	37.00	-1	33.83	11	-1
3	No calculation at this stage											
4	11	32.00	-54	35.50	15	-73	41	34.00	-51	37.55	55	-69
5	No calculation at this stage											
6	No calculation at this stage											
7	11	32.00	-55	35.50	15	-74	41	34.00	-50	37.55	55	-68
8	11	32.00	-47	35.50	14	-64	41	34.00	-45	37.55	55	-61

Summary of results (continued)

Maximum and minimum displacement at each stage

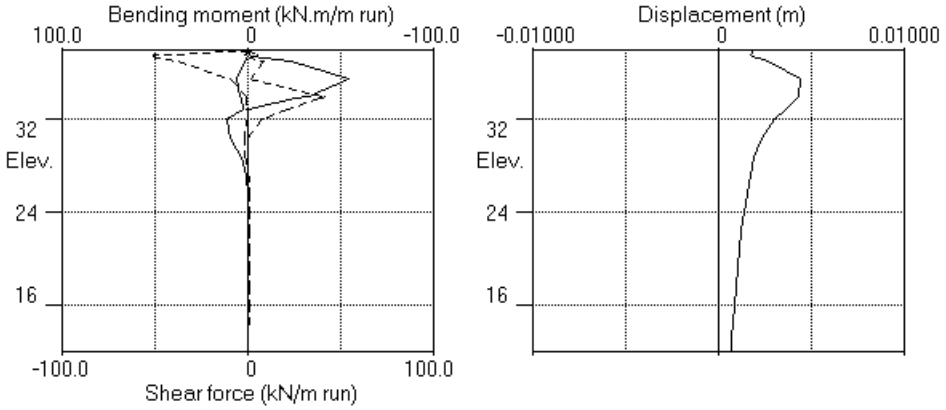
Stage no.	Displacement maximum m	elev.	minimum m	elev.	Stage description
1	0.001	38.00	0.000	38.00	Apply surcharge no.1 at elev. 37.50
2	0.002	38.00	0.000	38.00	Excav. to elev. 37.55 on RIGHT side
3	No calculation at this stage				Install strut no.1 at elev. 37.55
4	0.004	34.00	0.000	38.00	Excav. to elev. 34.00 on RIGHT side
5	No calculation at this stage				Install strut no.2 at elev. 33.83
6	No calculation at this stage				Change soil type 1 to soil type 3
7	0.004	34.00	0.000	38.00	Change soil type 2 to soil type 4
8	0.004	35.50	0.000	38.00	Change EI of wall to 46967kN.m2/m run

Strut forces at each stage (horizontal components)

Stage no.	Strut no. 1 at elev. 37.55 --Calculated-- kN per m run	kN per strut	Factored kN per strut	Strut no. 2 at elev. 33.83 --Calculated-- kN per m run	kN per strut	Factored kN per strut
4	56	56	76	---	---	---
7	51	51	69	0	0	1
8	46	46	62	6	6	8

Units: kN,m

Bending moment, shear force, displacement envelopes



APPENDIX M

Masonry gravity retaining wall surcharge model

CARD GEOTECHNICS LIMITED | Sheet No.
Program: WALLAP Version 6.06 Revision A51.B69.R55 | Job No. CG28407
Licensed from GEOSOLVE | Made by : TBP
Data filename/Run ID: KentishTown_ULS |
Kentish Town Car Wash | Date:11-01-2019
Masonry gravity retaining wall surcharge model | Checked :

Units: kN,m

INPUT DATA

SOIL PROFILE

Stratum no.	Elevation of top of stratum	Soil types Left side	Soil types Right side
1	38.00	1 MG (undrained)	1 MG (undrained)
2	37.00	2 LC (undrained)	2 LC (undrained)
3	32.00	2 LC (undrained)	2 LC (undrained)

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	MG (undrained)	18.00	13600	1.000	NC (0.490)	1.000 (2.570)	1.000 (2.571)	34.00u
2	LC (undra.. (37.00)	20.00	40000 (8000)	1.000	OC (0.490)	1.000 (2.570)	1.000 (2.571)	40.00u (8.000)
3	MG (drained)	18.00	10200	0.577	OC (0.200)	0.340 (1.415)	3.627 (5.634)	0.0d
4	LCF (drai.. (37.00)	20.00	30000 (6000)	0.625	OC (0.200)	0.387 (1.517)	3.028 (5.020)	5.000d
5	LCF (inef.. (37.00)	20.00	40000 (8000)	1.000	OC (0.490)	1.000 (2.000)	1.000 (2.000)	40.00u (8.000)

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	MG (undrained)	0.00	1.000	0.00	0.00	1.000	0.00
2	LC (undrained)	0.00	1.000	0.00	0.00	1.000	0.00
3	MG (drained)	25.00	1.000	0.00	25.00	1.000	0.00
4	LCF (drained)	22.00	1.000	0.00	22.00	1.000	0.00
5	LCF (ineffective)	0.00	0.000	0.00	0.00	0.000	0.00

GROUND WATER CONDITIONS

Density of water = 10.00 kN/m3

	Left side	Right side
Initial water table elevation	0.00	0.00

Automatic water pressure balancing at toe of wall : No

WALL PROPERTIES

Type of structure = Fully Embedded Wall
Elevation of toe of wall = 20.00
Maximum finite element length = 1.00 m
Youngs modulus of wall E = 1.9600E+07 kN/m2
Moment of inertia of wall I = 3.3548E-03 m4/m run
E.I = 65754 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	37.55	1.00	0.900000	1.960E+07	10.00	0.00	0	No
2	33.83	1.00	0.350000	1.960E+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	38.00	0.00(L)	1000.00	3.00	20.00	=	N/A	1.00 Var

Note: L = Left side, R = Right side
Limit State Categories P/U = Permanent Unfavourable
P/F = Permanent Favourable
Var = Variable (unfavourable)

CONSTRUCTION STAGES

Construction stage no.	Stage description
1	Excavate to elevation 32.25 on RIGHT side
2	Apply surcharge no.1 at elevation 38.00
3	Change properties of soil type 1 to soil type 3 No analysis at this stage Ko pressures will not be reset
4	Change properties of soil type 2 to soil type 4 Ko pressures will be reset

FACTORS OF SAFETY and ANALYSIS OPTIONS

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

Stability analysis:
Method of analysis - Strength Factor method
Factor on soil strength for calculating wall depth = 1.00

Parameters for undrained strata:
Minimum equivalent fluid density = 5.00 kN/m3
Maximum depth of water filled tension crack = 0.00 m

Bending moment and displacement calculation:
Method - Subgrade reaction model using Influence Coefficients
Open Tension Crack analysis? - No
Non-linear Modulus Parameter (L) = 0 m

Boundary conditions:
Length of wall (normal to plane of analysis) = 1000.00 m

Width of excavation on Left side of wall = 20.00 m
Width of excavation on Right side of wall = 20.00 m

Distance to rigid boundary on Left side = 20.00 m
Distance to rigid boundary on Right side = 20.00 m

OUTPUT OPTIONS

Stage no.	Stage description	Output options: Displacement, Bending mom., Shear force	Active, Passive pressures	Graph. output
1	Excav. to elev. 32.25 on RIGHT side	Yes	Yes	Yes
2	Apply surcharge no.1 at elev. 38.00	Yes	Yes	Yes
3	Change soil type 1 to soil type 3	Yes	Yes	Yes
4	Change soil type 2 to soil type 4	Yes	Yes	Yes
*	Summary output	Yes	-	Yes

Units: kN,m

Stage No. 1 Excavate to elevation 32.25 on RIGHT 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. = 20.00 Factor of Safety	Moment equilib. at elev.	Toe elev. for FoS = 1.000 Toe elev.	Wall Penetr -ation	Direction of failure
1	38.00	32.25	Cant.	3.914	21.22	29.91	2.34	L to R

BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall

Analysis options

Length of wall perpendicular to section = 1000.00m

Subgrade reaction model - Boussinesq Influence coefficients

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

Open Tension Crack analysis - No

Rigid boundaries: Left side 20.00 from wall
Right side 20.00 from wall

Limit State: Serviceability Limit State

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

Node no.	Y coord	Nett pressure kN/m2	Wall disp. m	Wall rotation rad.	Shear force kN/m	Bending moment kN.m/m	Strut forces kN/m
1	38.00	0.00	0.055	9.06E-03	0.0	-0.0	
2	37.00	5.00	0.046	9.05E-03	2.5	0.8	
3	36.00	10.00	0.037	9.00E-03	10.0	6.7	
4	35.00	15.00	0.028	8.77E-03	22.5	22.5	
5	34.00	20.00	0.019	8.20E-03	40.0	53.3	
6	33.13	24.38	0.013	7.20E-03	59.4	96.5	
7	32.25	28.75	0.007	5.50E-03	82.7	158.4	
		-171.79	0.007	5.50E-03	82.7	158.4	
8	32.00	-180.68	0.006	4.87E-03	38.6	173.6	
9	31.00	-49.25	0.002	2.26E-03	-76.4	170.1	
10	30.00	41.05	0.001	4.45E-04	-80.5	69.1	
11	29.00	41.99	0.001	-1.49E-04	-38.9	9.1	
12	28.00	19.43	0.001	-1.51E-04	-8.2	-8.9	
13	27.00	3.42	0.001	-2.72E-05	3.2	-7.4	
14	26.00	-2.08	0.001	4.91E-05	3.9	-2.6	
15	25.00	-2.04	0.001	6.82E-05	1.8	0.1	
16	24.00	-0.80	0.001	6.16E-05	0.4	0.8	
17	23.00	-0.05	0.001	5.13E-05	-0.0	0.6	
18	22.00	0.11	0.001	4.42E-05	-0.0	0.3	
19	21.00	-0.01	0.001	4.02E-05	0.0	0.2	
20	20.00	-0.07	0.001	3.88E-05	0.0	0.0	

(continued)

Stage No.1 Excavate to elevation 32.25 on RIGHT side

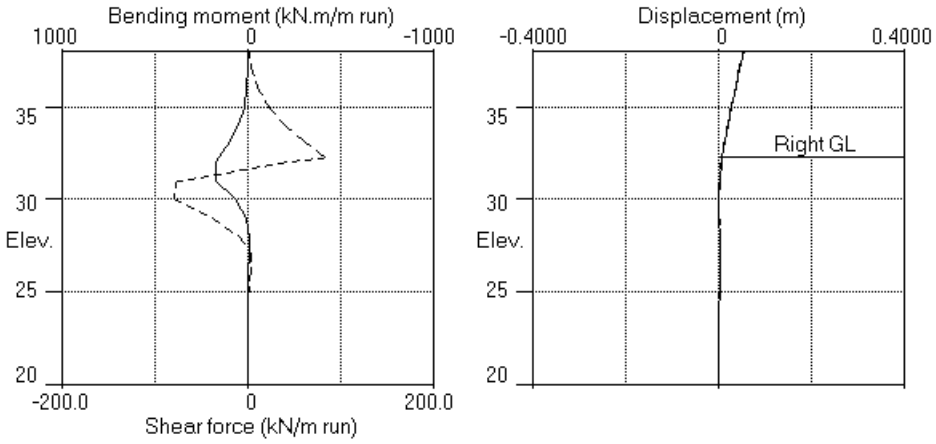
Node no.	Y coord	LEFT side	Effective stresses			Total earth pressure	Coeff. of subgrade reaction
		Water press. kN/m2	Vertic -al kN/m2	Active limit kN/m2	Passive limit kN/m2	Earth pressure kN/m2	kN/m2	kN/m3
1	38.00	Total>	0.00	0.00	87.42	0.00	0.00a	3552
2	37.00	Total>	18.00	5.00m	105.42	5.00	5.00a	3552
		Total>	18.00	5.00m	120.84	5.00	5.00a	10446
3	36.00	Total>	38.00	10.00m	161.41	10.00	10.00a	12535
4	35.00	Total>	58.00	15.00m	201.98	15.00	15.00a	14624
5	34.00	Total>	78.00	20.00m	242.54	20.00	20.00a	16713
6	33.13	Total>	95.50	24.38m	278.04	24.38	24.38a	18541
7	32.25	Total>	113.00	28.75m	313.54	28.75	28.75a	20369
8	32.00	Total>	118.00	30.00m	323.68	30.00	30.00a	20891
9	31.00	Total>	138.00	35.00m	364.25	91.64	91.64	22981
10	30.00	Total>	158.00	40.00m	404.82	138.18	138.18	25070
11	29.00	Total>	178.00	45.00m	445.38	158.50	158.50	27159
12	28.00	Total>	198.00	50.00m	485.95	171.94	171.94	29248
13	27.00	Total>	218.00	55.00m	526.52	187.34	187.34	31337
14	26.00	Total>	238.00	60.00m	567.09	205.86	205.86	33426
15	25.00	Total>	258.00	65.00m	607.66	226.06	226.06	35515
16	24.00	Total>	278.00	70.00m	648.22	246.66	246.66	37605
17	23.00	Total>	298.00	75.00m	688.79	267.15	267.15	39694
18	22.00	Total>	318.00	80.00m	729.36	287.51	287.51	41783
19	21.00	Total>	338.00	85.00m	769.93	307.83	307.83	43872
20	20.00	Total>	358.00	90.00m	810.50	328.20	328.20	45961

Node no.	Y coord	RIGHT side	Effective stresses			Total earth pressure	Coeff. of subgrade reaction
		Water press. kN/m2	Vertic -al kN/m2	Active limit kN/m2	Passive limit kN/m2	Earth pressure kN/m2	kN/m2	kN/m3
1	38.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	37.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
3	36.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
4	35.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
5	34.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
6	33.13	0.00	0.00	0.00	0.00	0.00	0.00	0.0
7	32.25	0.00	0.00	0.00	0.00	0.00	0.00	0.0
		Total>	0.00	0.00	200.54	200.54	200.54p	48963
8	32.00	Total>	5.00	1.25m	210.68	210.68	210.68p	50219
9	31.00	Total>	25.01	6.25m	251.26	140.89	140.89	55241
10	30.00	Total>	45.07	11.25m	291.88	97.13	97.13	60263
11	29.00	Total>	65.20	16.25m	332.58	116.51	116.51	65285
12	28.00	Total>	85.44	21.25m	373.39	152.50	152.50	70306
13	27.00	Total>	105.80	26.25m	414.32	183.91	183.91	75328
14	26.00	Total>	126.31	31.25m	455.40	207.94	207.94	80350
15	25.00	Total>	146.97	36.25m	496.62	228.10	228.10	85372
16	24.00	Total>	167.79	41.25m	538.01	247.45	247.45	90394
17	23.00	Total>	188.76	46.25m	579.55	267.20	267.20	95416
18	22.00	Total>	209.87	51.25m	621.23	287.40	287.40	100438
19	21.00	Total>	231.12	56.25m	663.05	307.84	307.84	105460
20	20.00	Total>	252.49	61.25m	704.99	328.27	328.27	110481

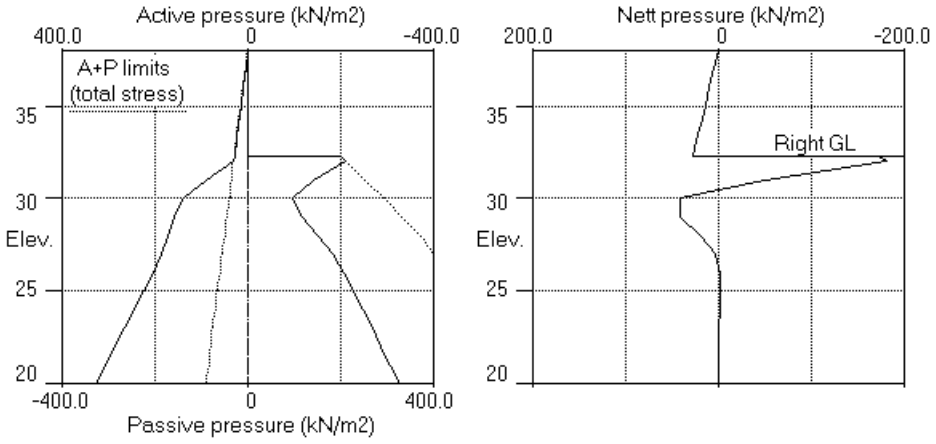
Note: 30.00a Soil pressure at active limit
210.68p Soil pressure at passive limit

Units: kN,m

Stage No.1 Excav. to elev. 32.25 on RIGHT side



Stage No.1 Excav. to elev. 32.25 on RIGHT side



Units: kN,m

Stage No. 2 Apply surcharge no.1 at elevation 38.00

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. = 20.00 Factor of Safety	Moment equilib. at elev.	Toe elev. for FoS = 1.000 Toe elev.	Wall Penetr -ation	Direction of failure
2	38.00	32.25	Cant.	3.451	21.38	29.92	2.33	L to R

BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall

Analysis options

Length of wall perpendicular to section = 1000.00m

Subgrade reaction model - Boussinesq Influence coefficients

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

Open Tension Crack analysis - No

Rigid boundaries: Left side 20.00 from wall
Right side 20.00 from wall

Limit State: Serviceability Limit State

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

Node no.	Y coord	Nett pressure kN/m2	Wall disp. m	Wall rotation rad.	Shear force kN/m	Bending moment kN.m/m	Strut forces kN/m
1	38.00	0.73	0.060	9.98E-03	0.0	-0.0	
2	37.00	8.76	0.050	9.97E-03	4.7	1.1	
		5.00	0.050	9.97E-03	4.7	1.1	
3	36.00	10.00	0.040	9.89E-03	12.2	9.2	
4	35.00	15.00	0.030	9.61E-03	24.7	27.3	
5	34.00	20.00	0.021	8.95E-03	42.2	60.4	
6	33.13	24.38	0.014	7.84E-03	61.7	105.6	
7	32.25	28.75	0.008	6.01E-03	84.9	169.4	
		-171.79	0.008	6.01E-03	84.9	169.4	
8	32.00	-180.68	0.006	5.34E-03	40.8	185.2	
9	31.00	-58.63	0.002	2.52E-03	-78.8	185.4	
10	30.00	42.47	0.001	5.29E-04	-86.9	77.1	
11	29.00	45.41	0.001	-1.42E-04	-43.0	11.3	
12	28.00	21.51	0.001	-1.59E-04	-9.5	-9.1	
13	27.00	4.04	0.001	-2.90E-05	3.3	-8.0	
14	26.00	-2.14	0.001	5.36E-05	4.2	-2.9	
15	25.00	-2.22	0.001	7.47E-05	2.0	0.1	
16	24.00	-0.90	0.001	6.75E-05	0.5	0.8	
17	23.00	-0.08	0.001	5.60E-05	-0.0	0.7	
18	22.00	0.10	0.001	4.78E-05	0.0	0.4	
19	21.00	-0.02	0.001	4.31E-05	0.1	0.2	
20	20.00	-0.08	0.001	4.15E-05	0.0	0.0	

(continued)

Stage No.2 Apply surcharge no.1 at elevation 38.00

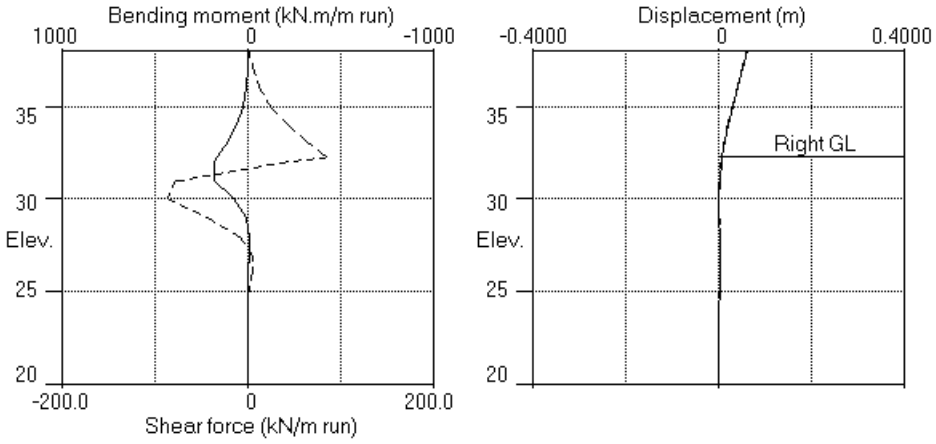
Node no.	Y coord	LEFT side						
		Water press. kN/m2	Effective stresses Vertic -al kN/m2	Active limit kN/m2	Passive limit kN/m2	Earth pressure kN/m2	Total earth pressure kN/m2	Coeff. of subgrade reaction kN/m3
1	38.00	Total>	20.00	0.00	107.42	0.73	0.73	3604
2	37.00	Total>	37.72	5.00m	125.14	8.76	8.76	3604
		Total>	37.72	5.00m	140.56	5.00	5.00a	10601
3	36.00	Total>	56.39	10.00m	179.80	10.00	10.00a	12722
4	35.00	Total>	74.37	15.00m	218.34	15.00	15.00a	14842
5	34.00	Total>	92.30	20.00m	256.85	20.00	20.00a	16962
6	33.13	Total>	108.21	24.38m	290.75	24.38	24.38a	18818
7	32.25	Total>	124.34	28.75m	324.88	28.75	28.75a	20673
8	32.00	Total>	129.00	30.00m	334.68	30.00	30.00a	21203
9	31.00	Total>	147.77	35.00m	374.01	95.21	95.21	23323
10	30.00	Total>	166.75	40.00m	413.57	144.43	144.43	25444
11	29.00	Total>	185.92	45.00m	453.30	164.81	164.81	27564
12	28.00	Total>	205.22	50.00m	493.17	177.36	177.36	29684
13	27.00	Total>	224.62	55.00m	533.14	191.92	191.92	31804
14	26.00	Total>	244.11	60.00m	573.20	209.90	209.90	33925
15	25.00	Total>	263.68	65.00m	613.33	229.77	229.77	36045
16	24.00	Total>	283.30	70.00m	653.52	250.14	250.14	38165
17	23.00	Total>	302.96	75.00m	693.75	270.43	270.43	40286
18	22.00	Total>	322.67	80.00m	734.03	290.60	290.60	42406
19	21.00	Total>	342.40	85.00m	774.33	310.75	310.75	44526
20	20.00	Total>	362.17	90.00m	814.66	330.96	330.96	46646

Node no.	Y coord	RIGHT 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	Coeff. of subgrade reaction kN/m3
1	38.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	37.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
3	36.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
4	35.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
5	34.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
6	33.13	0.00	0.00	0.00	0.00	0.00	0.00	0.0
7	32.25	0.00	0.00	0.00	0.00	0.00	0.00	0.0
		Total>	0.00	0.00	200.54	200.54	200.54p	46093
8	32.00	Total>	5.00	1.25m	210.68	210.68	210.68p	47275
9	31.00	Total>	25.01	6.25m	251.26	153.84	153.84	52003
10	30.00	Total>	45.07	11.25m	291.88	101.96	101.96	56730
11	29.00	Total>	65.20	16.25m	332.58	119.40	119.40	61458
12	28.00	Total>	85.44	21.25m	373.39	155.86	155.86	66185
13	27.00	Total>	105.80	26.25m	414.32	187.88	187.88	70913
14	26.00	Total>	126.31	31.25m	455.40	212.04	212.04	75640
15	25.00	Total>	146.97	36.25m	496.62	231.99	231.99	80368
16	24.00	Total>	167.79	41.25m	538.01	251.04	251.04	85096
17	23.00	Total>	188.76	46.25m	579.55	270.51	270.51	89823
18	22.00	Total>	209.87	51.25m	621.23	290.50	290.50	94551
19	21.00	Total>	231.12	56.25m	663.05	310.76	310.76	99278
20	20.00	Total>	252.49	61.25m	704.99	331.04	331.04	104006

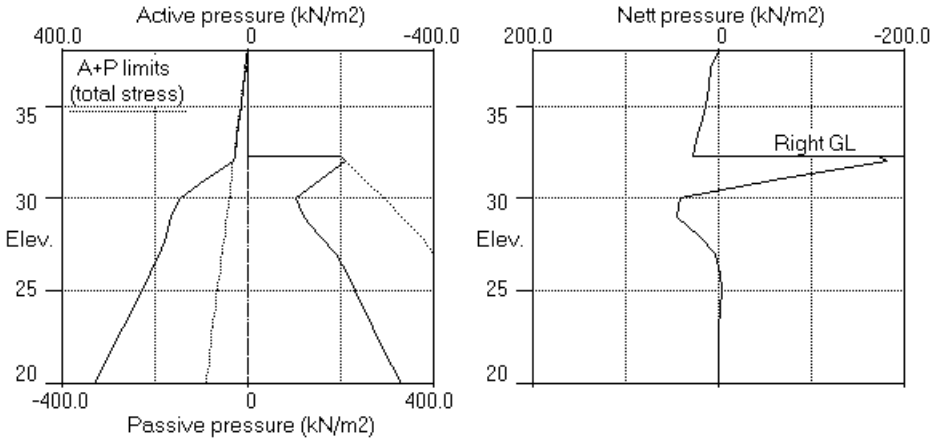
Note: 30.00a Soil pressure at active limit
210.68p Soil pressure at passive limit

Units: kN,m

Stage No.2 Apply surcharge no.1 at elev. 38.00



Stage No.2 Apply surcharge no.1 at elev. 38.00



Units: kN,m

Stage No. 4 Change properties of soil type 2 to soil type 4
Ko pressures will be reset

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. = 20.00 Factor of Safety	Moment equilib. at elev.	Toe elev. for FoS = 1.000 Toe elev.	Wall Penetr -ation	Direction of failure
4	38.00	32.25	Cant.	1.705	21.51	26.80	5.45	L to R

BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall
Analysis options
Length of wall perpendicular to section = 1000.00m
Subgrade reaction model - Boussinesq Influence coefficients
Soil deformations are elastic until the active or passive limit is reached
Open Tension Crack analysis - No

Rigid boundaries: Left side 20.00 from wall
Right side 20.00 from wall
Limit State: Serviceability Limit State
Calculated Bending Moments and Strut Forces are to be multiplied by a factor of 1.35 to obtain values for structural design. See summary for factored values.

Node no.	Y coord	Nett pressure kN/m2	Wall disp. m	Wall rotation rad.	Shear force kN/m	Bending moment kN.m/m	Strut forces kN/m
1	38.00	6.80	0.278	3.65E-02	0.0	0.0	
2	37.00	12.83	0.241	3.65E-02	9.8	3.9	
		7.02	0.241	3.65E-02	9.8	3.9	
3	36.00	14.25	0.205	3.63E-02	20.5	18.4	
4	35.00	21.21	0.168	3.58E-02	38.2	47.1	
5	34.00	28.15	0.133	3.47E-02	62.9	97.1	
6	33.13	34.31	0.103	3.30E-02	90.2	163.6	
7	32.25	40.56	0.076	3.02E-02	122.9	256.5	
		15.46	0.076	3.02E-02	122.9	256.5	
8	32.00	-0.71	0.068	2.91E-02	124.8	287.5	
9	31.00	-51.21	0.041	2.37E-02	98.8	433.0	
10	30.00	-104.59	0.021	1.67E-02	20.9	480.3	
11	29.00	-142.23	0.008	9.65E-03	-102.5	456.1	
12	28.00	3.61	0.001	3.91E-03	-171.8	299.5	
13	27.00	67.37	-0.001	6.48E-04	-136.3	129.4	
14	26.00	61.66	-0.001	-5.36E-04	-71.8	26.6	
15	25.00	35.49	0.000	-6.28E-04	-23.2	-14.6	
16	24.00	12.95	0.001	-3.63E-04	1.0	-20.2	
17	23.00	0.65	0.001	-1.11E-04	7.8	-12.9	
18	22.00	-3.60	0.001	2.47E-05	6.3	-5.0	
19	21.00	-3.53	0.001	6.86E-05	2.8	-0.7	
20	20.00	-2.00	0.001	7.42E-05	0.0	0.0	

(continued)

Stage No.4 Change properties of soil type 2 to soil type 4
Ko pressures will be reset

LEFT side

Node no.	Y coord	Effective stresses: Water press. kN/m2	Vertic-al kN/m2	Active limit kN/m2	Passive limit kN/m2	Earth pressure kN/m2	Total earth pressure kN/m2	Coeff. of subgrade reaction kN/m3
1	38.00	0.00	20.00	6.80	72.54	6.80	6.80a	1526
2	37.00	0.00	37.72	12.83	136.82	12.83	12.83a	1526
		0.00	37.72	7.02	139.33	7.02	7.02a	4488
3	36.00	0.00	56.39	14.25	195.86	14.25	14.25a	5386
4	35.00	0.00	74.37	21.21	250.29	21.21	21.21a	6284
5	34.00	0.00	92.30	28.15	304.61	28.15	28.15a	7181
6	33.13	0.00	108.21	34.31	352.76	34.31	34.31a	7967
7	32.25	0.00	124.34	40.56	401.63	40.56	40.56a	8752
8	32.00	0.00	121.70	39.54	393.64	39.54	39.54a	8977
9	31.00	0.00	147.77	49.63	472.55	49.63	49.63a	9875
10	30.00	0.00	166.75	56.98	530.05	56.98	56.98a	10772
11	29.00	0.00	185.92	64.40	588.08	80.30	80.30	11670
12	28.00	0.00	205.22	71.87	646.52	171.33	171.33	12568
13	27.00	0.00	224.62	79.38	705.28	223.58	223.58	18886
14	26.00	0.00	244.11	86.93	764.31	241.80	241.80	20145
15	25.00	0.00	263.68	94.50	823.55	248.63	248.63	21404
16	24.00	0.00	283.30	102.10	882.96	257.06	257.06	22663
17	23.00	0.00	302.96	109.71	942.51	270.80	270.80	23922
18	22.00	0.00	322.67	117.34	1002.18	288.75	288.75	26534
19	21.00	0.00	342.40	124.98	1061.94	308.99	308.99	27861
20	20.00	0.00	362.17	132.64	1121.79	330.00	330.00	29187

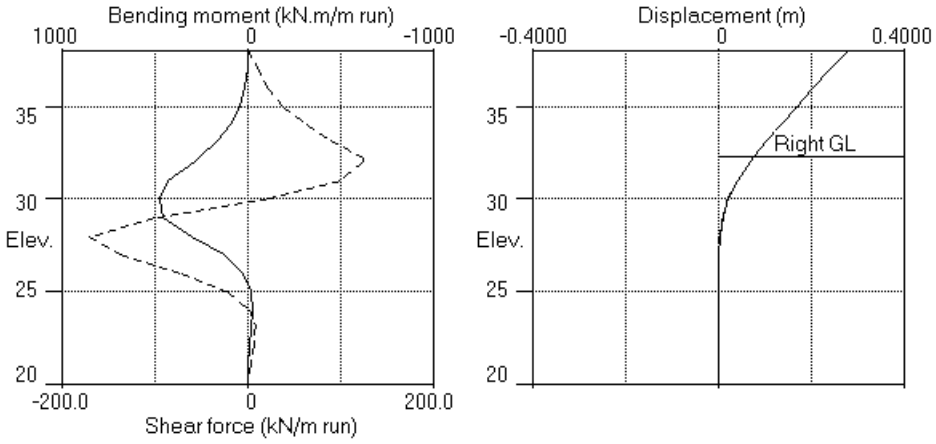
RIGHT side

Node no.	Y coord	Effective stresses: Water press. kN/m2	Vertic-al kN/m2	Active limit kN/m2	Passive limit kN/m2	Earth pressure kN/m2	Total earth pressure kN/m2	Coeff. of subgrade reaction kN/m3
1	38.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	37.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
3	36.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
4	35.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
5	34.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
6	33.13	0.00	0.00	0.00	0.00	0.00	0.00	0.0
7	32.25	0.00	0.00	0.00	0.00	0.00	0.00	0.0
		0.00	0.00	0.00	25.10	25.10	25.10p	17208
8	32.00	0.00	5.00	0.00	40.24	40.24	40.24p	17649
9	31.00	0.00	25.01	2.10	100.84	100.84	100.84p	19414
10	30.00	0.00	45.07	9.86	161.57	161.57	161.57p	21179
11	29.00	0.00	65.20	17.66	222.53	222.53	222.53p	22944
12	28.00	0.00	85.44	25.49	283.81	167.72	167.72	24709
13	27.00	0.00	105.80	33.38	345.48	156.21	156.21	18886
14	26.00	0.00	126.31	41.32	407.58	180.14	180.14	20145
15	25.00	0.00	146.97	49.32	470.14	213.13	213.13	21404
16	24.00	0.00	167.79	57.38	533.18	244.11	244.11	22663
17	23.00	0.00	188.76	65.50	596.67	270.14	270.14	23922
18	22.00	0.00	209.87	73.67	660.62	292.35	292.35	26534
19	21.00	0.00	231.12	81.90	724.97	312.52	312.52	27861
20	20.00	0.00	252.49	90.17	789.68	332.00	332.00	29187

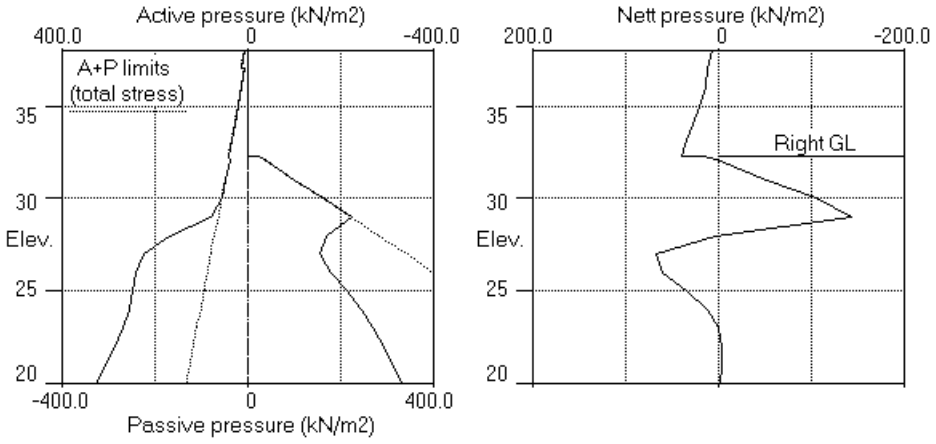
Note: 56.98a Soil pressure at active limit
222.53p Soil pressure at passive limit

Units: kN,m

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



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



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. = 20.00 Factor of Safety	FoS for toe elev. = 20.00 Moment equilib. at elev.	Toe elev. for FoS = 1.000 Toe elev.	Wall Penetr -ation	Direction of failure
1	38.00	32.25	Cant.	3.914	21.22	29.91	2.34	L to R
2	38.00	32.25	Cant.	3.451	21.38	29.92	2.33	L to R
3	38.00	32.25		No analysis at this stage				
4	38.00	32.25	Cant.	1.705	21.51	26.80	5.45	L to R

Units: kN,m

Summary of results

BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall

Analysis options

Length of wall perpendicular to section = 1000.00m
Subgrade reaction model - Boussinesq Influence coefficients
Soil deformations are elastic until the active or passive limit is reached
Open Tension Crack analysis - No

Rigid boundaries: Left side 20.00 from wall
Right side 20.00 from wall

Limit State: Serviceability Limit State

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

Bending moment, shear force and displacement envelopes

Node no.	Y coord	Displacement		Bending moment Calculated		Bending moment Factored		Shear force Calculated		Shear force Factored	
		max.	min.	max.	min.	max.	min.	max.	min.	max.	min.
		m	m	kN.m/m		kN.m/m		kN/m	kN/m	kN/m	kN/m
1	38.00	0.278	0.000	0	-0	0	-0	0	0	0	0
2	37.00	0.241	0.000	4	0	5	0	10	0	13	0
3	36.00	0.205	0.000	18	0	25	0	20	0	28	0
4	35.00	0.168	0.000	47	0	64	0	38	0	52	0
5	34.00	0.133	0.000	97	0	131	0	63	0	85	0
6	33.13	0.103	0.000	164	0	221	0	90	0	122	0
7	32.25	0.076	0.000	256	0	346	0	123	0	166	0
8	32.00	0.068	0.000	288	0	388	0	125	0	168	0
9	31.00	0.041	0.000	433	0	585	0	99	-79	133	-106
10	30.00	0.021	0.000	480	0	648	0	21	-87	28	-117
11	29.00	0.008	0.000	456	0	616	0	0	-102	0	-138
12	28.00	0.001	0.000	300	-9	404	-12	0	-172	0	-232
13	27.00	0.001	-0.001	129	-8	175	-11	3	-136	4	-184
14	26.00	0.001	-0.001	27	-3	36	-4	4	-72	6	-97
15	25.00	0.001	0.000	0	-15	0	-20	2	-23	3	-31
16	24.00	0.001	0.000	1	-20	1	-27	1	0	1	0
17	23.00	0.001	0.000	1	-13	1	-17	8	-0	11	-0
18	22.00	0.001	0.000	0	-5	1	-7	6	-0	9	-0
19	21.00	0.001	0.000	0	-1	0	-1	3	0	4	0
20	20.00	0.001	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 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	174	32.00	-9	28.00	234	-12	83	32.25	-80	30.00	112	-109
2	185	31.00	-9	28.00	250	-12	85	32.25	-87	30.00	115	-117
3	No calculation at this stage											
4	480	30.00	-20	24.00	648	-27	125	32.00	-172	28.00	168	-232

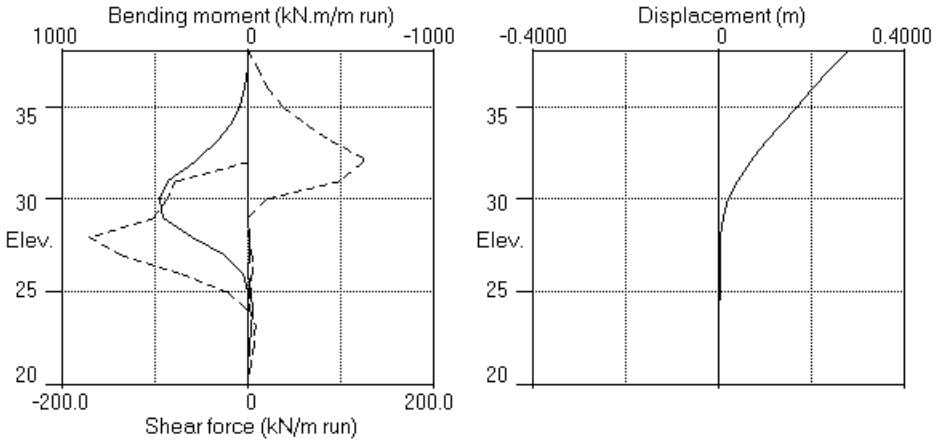
Summary of results (continued)

Maximum and minimum displacement at each stage

Stage no.	Displacement maximum	elev.	minimum	elev.	Stage description
	m		m		
1	0.055	38.00	0.000	38.00	Excav. to elev. 32.25 on RIGHT side
2	0.060	38.00	0.000	38.00	Apply surcharge no.1 at elev. 38.00
3	No calculation at this stage				Change soil type 1 to soil type 3
4	0.278	38.00	-0.001	27.00	Change soil type 2 to soil type 4

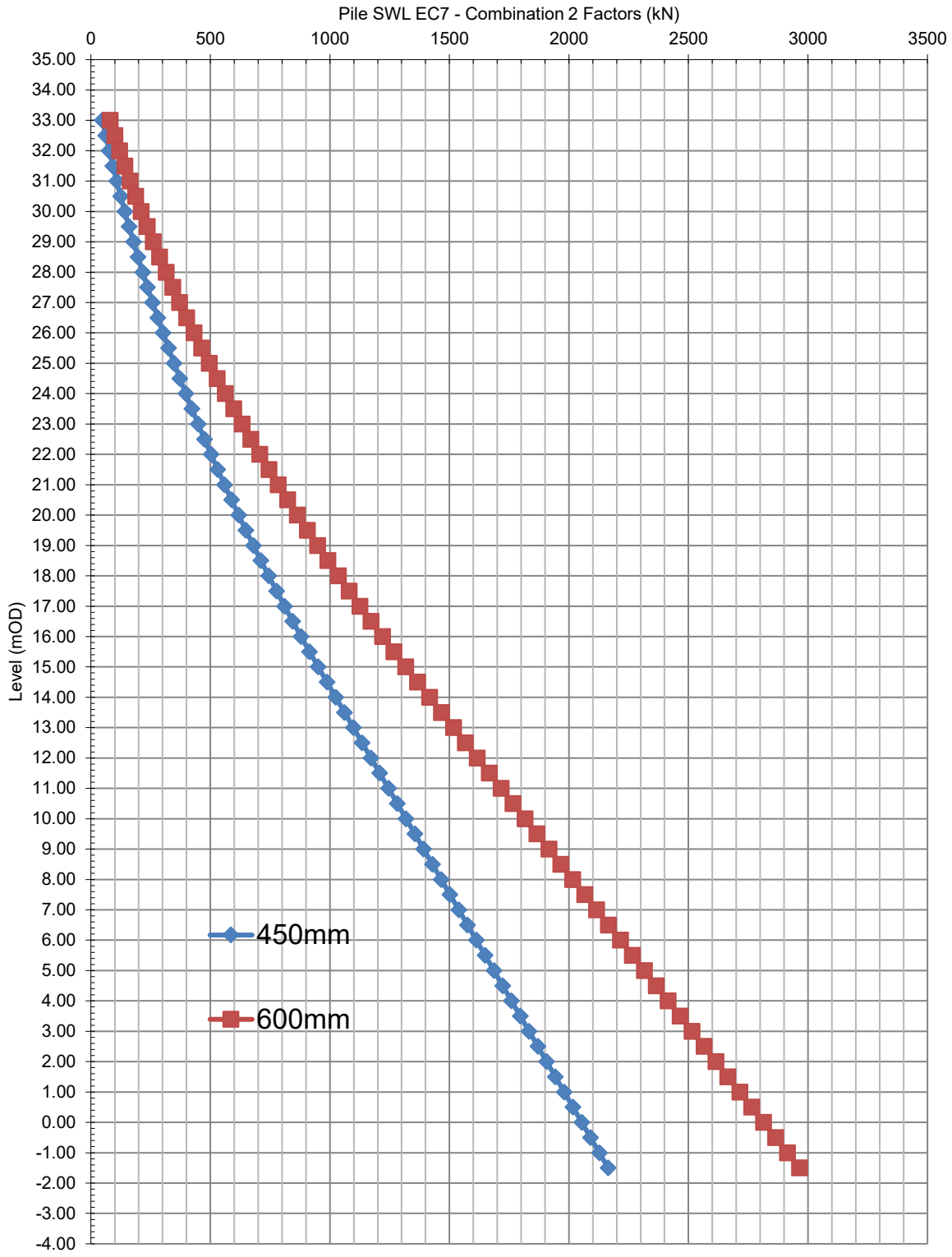
Units: kN,m

Bending moment, shear force, displacement envelopes

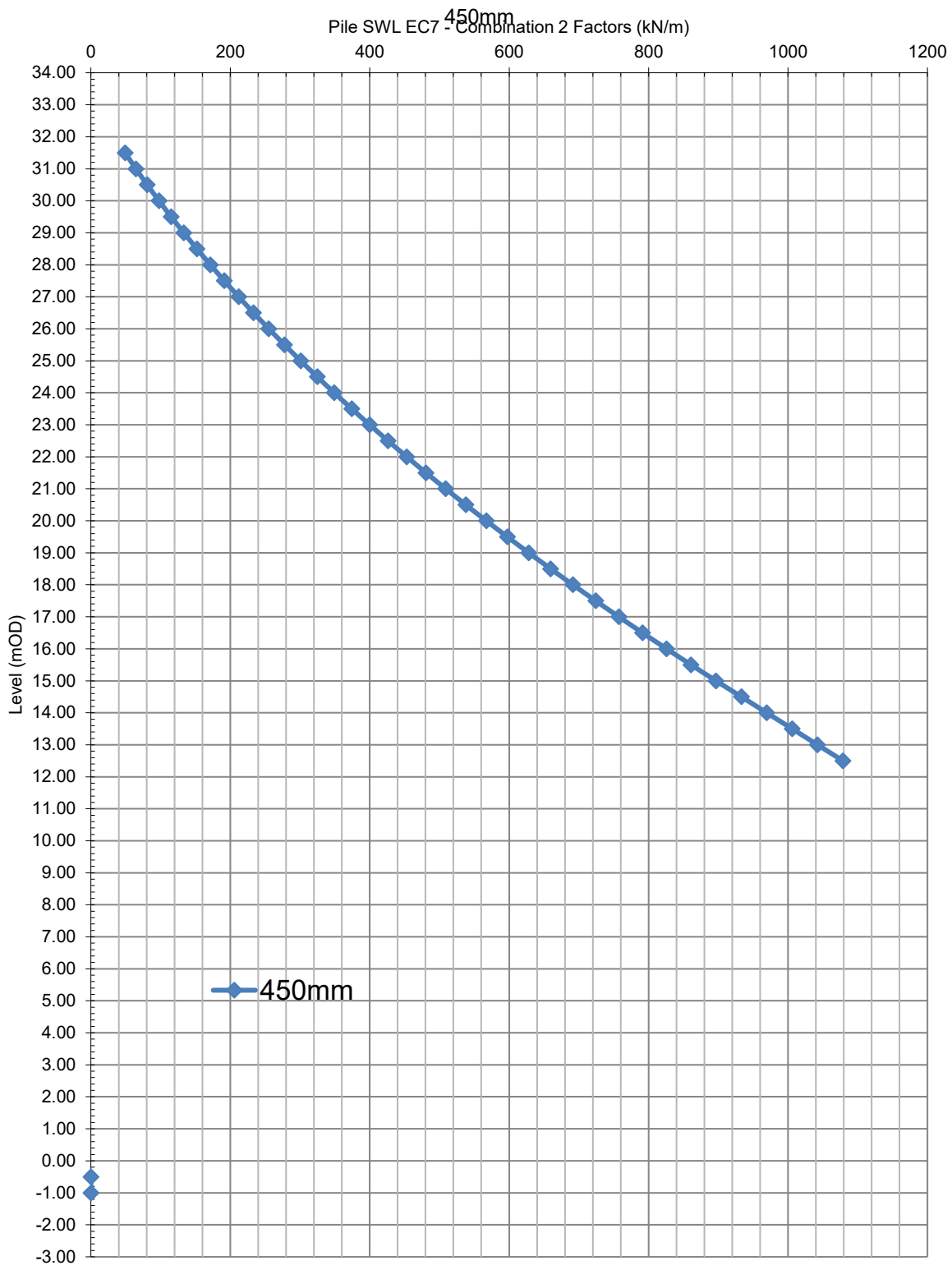


APPENDIX N

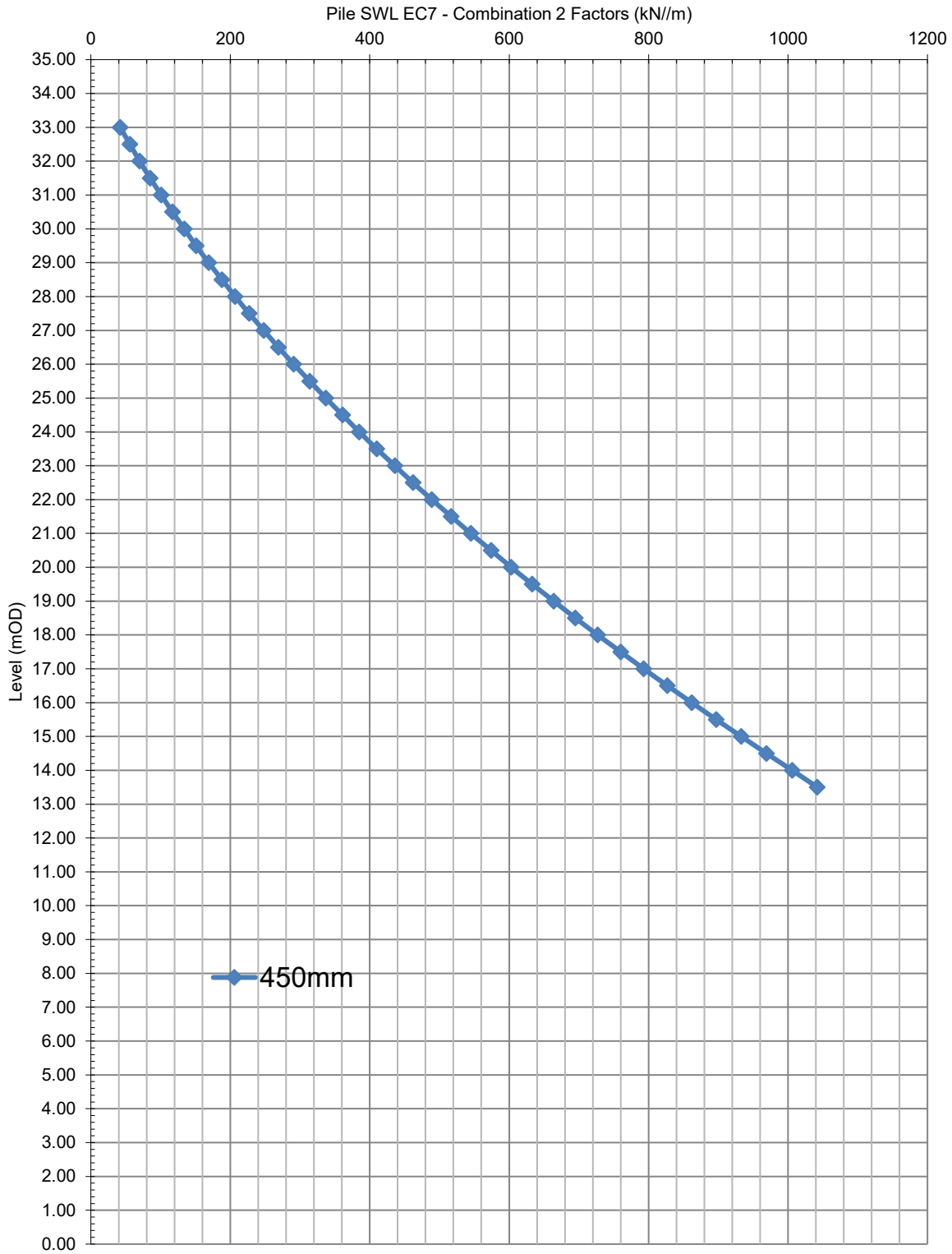
Preliminary pile design



Client	Project	Job No.
KTR Carwash Ltd	**Kentish Town Car Wash**	**CG/28407**
CGL	Title **Bearing Pile Compressive Design Resistance (EC7) - Pile Foundations**	**Appendix M**



Client	Project	Job No.
KTR Carwash Ltd	**Kentish Town Car Wash**	**CG/28407**
CGL	Title **Bearing Pile Compressive Design Resistance (EC7) - Sleeved Retaining Wall Piles (Wall A)**	**Appendix M**



Client	Project	Job No.
KTR Carwash Ltd	**Kentish Town Car Wash**	**CG/28407**
CGL	Title **Bearing Pile Compressive Design Resistance (EC7) - Retaining Wall Piles (Wall B & C)**	**Appendix M**