HIGH LEVEL PROPPING

STRUCTURAL COLUMN SCHEDULE	
MARK	SIZE
C1	200 x 800 C32/40 CONCRETE COLUMN
C2	250 x 250 C32/40 CONCRETE COLUMN

GENERAL NOTES

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6. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS NOTED OTHERWISE.
7. ALL DIMENSIONS ARE GIVEN TO STRUCTURAL SURFACES UNLESS NOTED OTHERWISE.
8. NO HOLES, CHASES, CUT-OUTS OR THE LIKE MAY BE FORMED IN ANY BEAM, COLUMN, OR LOAD BEARING WALL UNLESS WRITTEN PERMISSION IS OBTAINED FROM THE ENGINEER.
9. HOLES SMALLER THAN 225 X 225mm THROUGH SLABS ARE NOT NECESSARILY SHOWN ON THE ENGINEERS DRAWINGS.
10. FOR SIZE AND LOCATION OF ALL SERVICES PENETRATIONS REFER TO THE SERVICE ENGINEERS AND ARCHITECTS DRAWINGS.
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12. NON-STRUCTURAL FIXINGS ARE GENERALLY NOT SHOWN ON THE ENGINEERS DRAWINGS AND IF ANY SUCH DETAIL IS INDICATED IT MUST BE CONFIRMED BY CROSS-REFERENCE TO OTHER SPECIALISTS BEFORE CONSTRUCTION.
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BELOW GROUND PROPRIETARY WATERPROOFING SYSTEM IS DESIGNED, DETAILED & GUARANTEED BY SPECIALIST SUPPLIER. FINAL WATERPROOFING INSTALLATION IS THE RESPONSIBILITY OF THE PRINCIPAL CONTRACTOR. TO BE IN ACCORDANCE WITH UKPN REQUIREMENTS

X DENOTES SEQUENCE OF NEW MASS CONC. UNDERPINS - MAX. 1m SECTIONS. WORK TO NOT COMMENCE UNTIL SEQUENCE AGREED WITH CONTRACTOR

81 AVENUE ROAD

TRANSITION UNDERPINS - 500mm RISE

1195x650mm DEEP C32/40 R.C. CAPPING BEAM

785x650mm DEEP C32/40 R.C. CAPPING BEAM

CAPPING BEAM 1-1

EXISTING GARDEN BOUNDARY WALL

7.34 m | 7.58 m | 7.69 m | 5.82 m | 5.90 m | 7.03 m

2.69 m | 2.90 m

FLYING SHORE 1-4

FLYING SHORE 1-2

FLYING SHORE 1-1

FLYING SHORE 1-3

TOP DOWN PILE

CROSS BRACING TBC

STAIRWELL | LIFT | RISER | LIGHTWELL

SSL 45.750 | SSL 44.540 | SSL 45.910 | SSL 44.890

250mm DEEP C32/40 R.C. SLAB

step

CU | C1 | C2

300x1050mm DEEP C32/40 R.C. BEAM

250x650mm DEEP C32/40 R.C. BEAM

800x650mm DEEP C32/40 R.C. BEAM

250x450mm DEEP C32/40 R.C. BEAM

300x1620mm DEEP C32/40 R.C. BEAM

400x450mm DEEP C32/40 R.C. BEAM

800x1270mm DEEP C32/40 R.C. BEAM

200mm C32/40 R.C. UPSTANDS AROUND LIGHTWELL

200mm C32/40 R.C. UPSTAND

200mm THICK C32/40 R.C. WALL

R.C. BEAM TO BE LOCALLY THICKENED TO REAR CAPPING SLAB LEVEL

DESIGN SECTION B-B

77 AVENUE ROAD

PROPOSED GROUND FLOOR PLAN

1 : 50 @ A0 / 1:100 @ A3

0m 1m 2m 3m 4m 5m

1:50 @ A0 ; 1:100 @ A2

P2	18/06/21	PRELIMINARY ISSUE	AON/DH
P1	29.01.20	ISSUED FOR COMMENT	PE / WG
Rev.	Date	Amendment	Drawn / Chkd

Drawing Status: PRELIMINARY

Form

Job Title: 79 AVENUE ROAD, LONDON, NW8

Drawing Title: PROPOSED GROUND FLOOR PLAN

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Project Name: 79 AVENUE ROAD		Drawing/Document No.: KB79AR/PILE/001			Revision.
Drawing/Document Title: INITIAL PILE DESIGN AND PROPPING		Date: 26/06	Drawn by: JRC	Checked by:	Status:
		Note: PRELIMINARY			Sheet No:

LOW LEVEL PROPPING

STRUCTURAL COLUMN SCHEDULE	
MARK	SIZE
C1	200 x 800 C32/40 CONCRETE COLUMN
C2	250 x 250 C32/40 CONCRETE COLUMN

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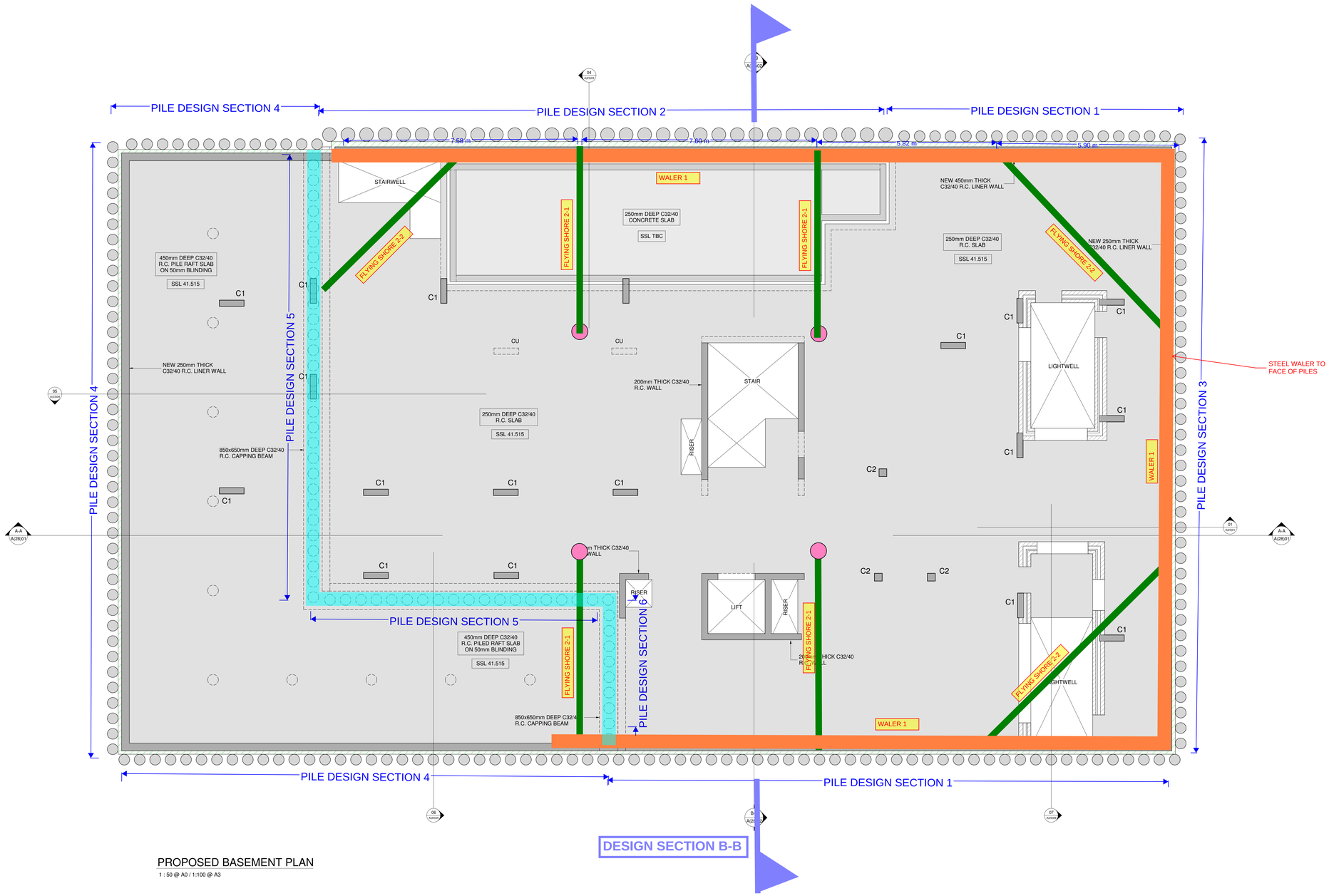

DESIGN SECTION B-B

PROPOSED BASEMENT PLAN

1 : 50 @ A0 / 1:100 @ A3

0m 1m 2m 3m 4m 5m

1:50 @ A0 ; 1:100 @ A2

P3	18/06/21	PRELIMINARY ISSUE	AON/DH
P2	30.01.20	REVISED TO SUIT ARCHS COMMENTS	PE / WG
P1	29.01.20	ISSUED FOR COMMENT	PE / WG
Rev.	Date	Amendment	Drawn / Chkd

Drawing Status: PRELIMINARY

Form

Job Title: 79 AVENUE ROAD, LONDON, NW8

Drawing Title: PROPOSED BASEMENT PLAN

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Project Name: 79 AVENUE ROAD	Drawing/Document No.: KB79AR/PILE/001			Revision:
Drawing/Document Title: INITIAL PILE DESIGN AND PROPPING	Date: 26/06	Drawn by: JRC	Checked by:	Status:
	Note: PRELIMINARY			Sheet No:

SECTION 2-2

DESIGN/CONSTRUCTION SEQUENCE

1 Apply surcharge no.1 at elevation 44.85
No analysis at this stage
2 Apply surcharge no.2 at elevation 44.85
No analysis at this stage
3 Apply surcharge no.3 at elevation 45.60
4 Change EI of wall to 93950 kN.m2/m run
Yield moment not defined
Reset wall displacements to zero at this stage
5 Excavate to elevation 43.75 on RIGHT side
6 Install strut or anchor no.4 at elevation 45.40
7 Excavate to elevation 41.50 on RIGHT side
8 Install strut or anchor no.5 at elevation 42.00
9 Excavate to elevation 37.94 on RIGHT side
10 Fill to elevation 38.50 on RIGHT side with soil type 1
11 Install strut or anchor no.3 at elevation 38.70
12 Change EI of wall to 290309 kN.m2/m run
From elevation 41.50 to 38.50
Yield moment not defined
No adjustments to wall displacements
13 Remove strut or anchor no.5 at elevation 42.00
14 Change EI of wall to 290309 kN.m2/m run
From elevation 45.80 to 41.50
Yield moment not defined
No adjustments to wall displacements
15 Install strut or anchor no.1 at elevation 45.69
16 Remove strut or anchor no.4 at elevation 45.40
17 Apply water pressure profile no.1 (Worst Cred.)
18 Change properties of soil type 2 to soil type 4
No analysis at this stage
Ko pressures will not be reset
19 Change properties of soil type 3 to soil type 5
No analysis at this stage
Ko pressures will not be reset
20 Change EI of wall to 46965 kN.m2/m run
From elevation 38.50 to 30.80
Yield moment not defined
No adjustments to wall displacements
21 Change EI of wall to 145154 kN.m2/m run
From elevation 45.80 to 38.50
Yield moment not defined
No adjustments to wall displacements

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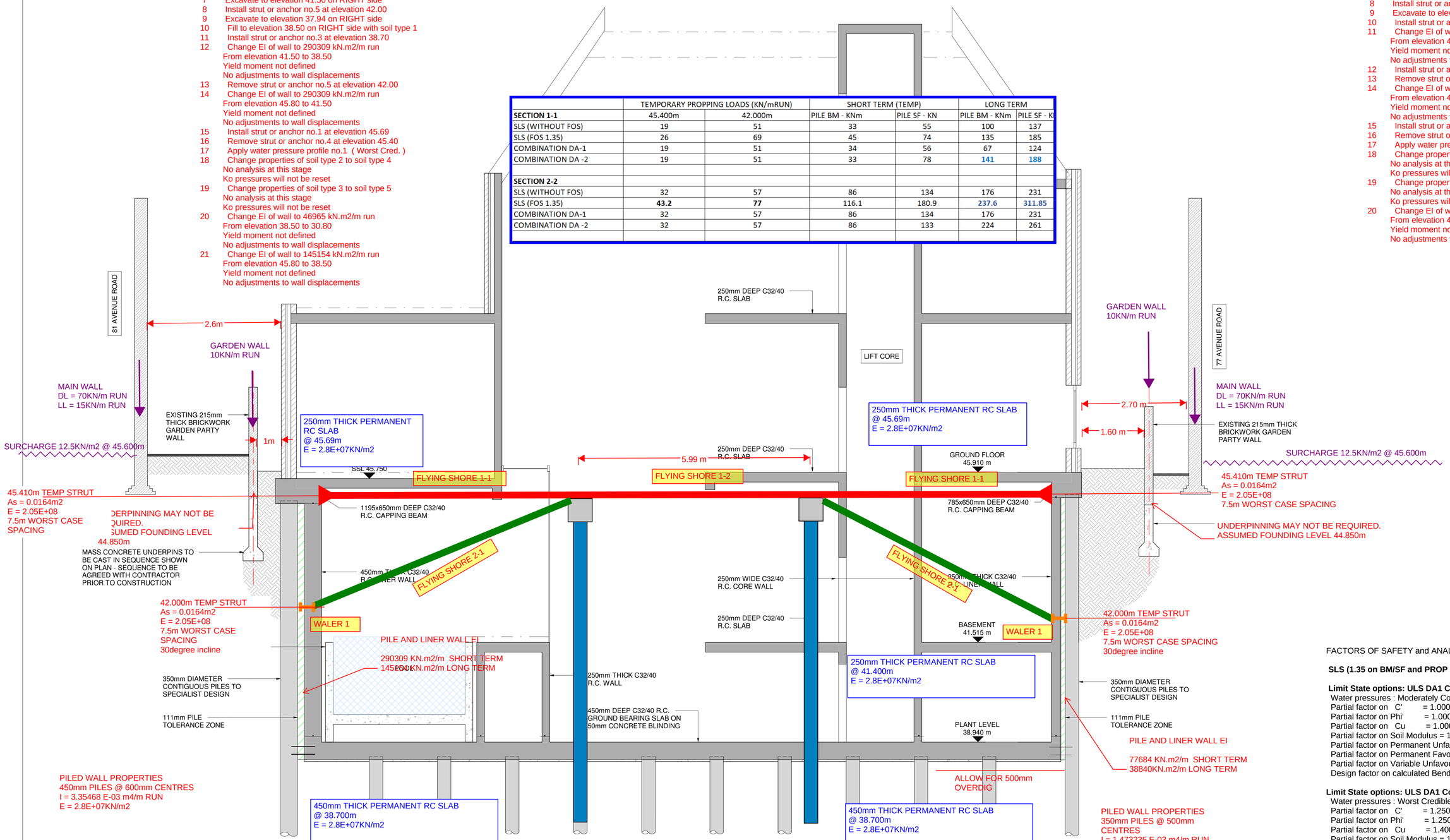
Project Name:	Drawing/Document No.			Revision.
79 AVENUE ROAD	KB79AR/PILE/001			
Drawing/Document Title:	Date:	Drawn by:	Checked by:	Status:
INITIAL PILE DESIGN AND PROPPING	26/06	JRC		
	Note: PRELIMINARY			Sheet No:

	TEMPORARY PROPPING LOADS (KN/mRUN)		SHORT TERM (TEMP)		LONG TERM	
SECTION 1-1	45.400m	42.000m	PILE BM - KNm	PILE SF - KN	PILE BM - KNm	PILE SF - K
SLS (WITHOUT FOS)	19	51	33	55	100	137
SLS (FOS 1.35)	26	69	45	74	135	185
COMBINATION DA-1	19	51	34	56	67	124
COMBINATION DA -2	19	51	33	78	**141**	**188**
SECTION 2-2						
SLS (WITHOUT FOS)	32	57	86	134	176	231
SLS (FOS 1.35)	**43.2**	**77**	116.1	180.9	**237.6**	**311.85**
COMBINATION DA-1	32	57	86	134	176	231
COMBINATION DA -2	32	57	86	133	224	261



PROPOSED CROSS SECTION B - B

1 : 50 @ A1; 1:100 @ A3

SECTION 1-1

DESIGN/CONSTRUCTION SEQUENCE

1 Apply surcharge no.1 at elevation 44.85
No analysis at this stage
2 Apply surcharge no.2 at elevation 44.85
No analysis at this stage
3 Apply surcharge no.3 at elevation 45.60
4 Change EI of wall to 41252 kN.m2/m run
Yield moment not defined
Reset wall displacements to zero at this stage
5 Excavate to elevation 43.75 on RIGHT side
6 Install strut or anchor no.4 at elevation 45.40
7 Excavate to elevation 41.50 on RIGHT side
8 Install strut or anchor no.5 at elevation 42.00
9 Excavate to elevation 37.94 on RIGHT side
10 Install strut or anchor no.3 at elevation 38.70
11 Change EI of wall to 77684 kN.m2/m run
From elevation 41.50 to 38.50
Yield moment not defined
No adjustments to wall displacements
12 Install strut or anchor no.2 at elevation 41.40
13 Remove strut or anchor no.5 at elevation 42.00
14 Change EI of wall to 77684 kN.m2/m run
From elevation 45.80 to 41.50
Yield moment not defined
No adjustments to wall displacements
15 Install strut or anchor no.1 at elevation 45.69
16 Remove strut or anchor no.4 at elevation 45.40
17 Apply water pressure profile no.1 (Mod. Conserv.)
18 Change properties of soil type 2 to soil type 4
No analysis at this stage
Ko pressures will not be reset
19 Change properties of soil type 3 to soil type 5
No analysis at this stage
Ko pressures will not be reset
20 Change EI of wall to 38842 kN.m2/m run
From elevation 45.80 to 38.50
Yield moment not defined
No adjustments to wall displacements

FACTORS OF SAFETY and ANALYSIS OPTIONS

SLS (1.35 on BM/SF and PROP FORCE)

Limit State options: ULS DA1 Combination 1
Water pressures : Moderately Conservative
Partial factor on C' = 1.000
Partial factor on Phi' = 1.000
Partial factor on Cu = 1.000
Partial factor on Soil Modulus = 1.000
Partial factor on Permanent Unfavourable loads = 1.000
Partial factor on Permanent Favourable loads = 1.000
Partial factor on Variable Unfavourable loads = 1.100
Design factor on calculated Bending Moments = 1.350

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

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Project Name:	Drawing No.			Revision.
79 AVENUE ROAD	KB79AR/PILE/001			
Drawing/Document Title:	Date:	Drawn by:	Checked by:	Status:
INITIAL PILE DESIGN AND PROPPING	28/06/21	JRC		
	Note: PRELIMINARY			

APPENDICIES

WALLAP DESIGNS

SECTION 1-1

SLS DESIGN CASE
ULS DA1 - COMBINATION 1
ULS DA1 - COMBINATION 2

SECTION 2-2

SLS DESIGN CASE
ULS DA1 - COMBINATION 1
ULS DA1 - COMBINATION 2

TEMP PROPPING DESIGNS

FLYING SHORE 1-1
FLYING SHORE 1-2
FLYING SHORE 2-1
WALER 1

SECTION 1-1 SLS

KNIGHT BUILD LTD | Sheet No.
Program: WALLAP Version 6.06 Revision A49.B68.R53 | Job No. 79AR
Licensed from GEOSOLVE | Made by : JRC
Data filename/Run ID: SECTION_1-1_SLS |
79 Avenue Road | Date:28-06-2021
SECTION 1-1 ANALYSIS | Checked :

Units: kN,m

INPUT DATA

SOIL PROFILE

Stratum no.	Elevation of top of stratum	Soil types Left side	Right side
1	45.80	1 Made Ground	1 Made Ground
2	45.40	2 Head	2 Head
3	42.80	3 London Clay	3 London Clay

SOIL PROPERTIES

No.	Soil type -- Description (Datum elev.)	Bulk density kN/m3	Young's Modulus Eh,kN/m2 (dEh/dy)	At rest coeff. Ko (dKo/dy)	Consol state. NC/OC (Nu)	Active limit Ka (Kac)	Passive limit Kp (Kpc)	Cohesion kN/m2 (dc/dy)
1	Made Ground	18.00	13000	0.500	OC (0.200)	0.273 (0.000)	5.026 (0.000)	
2	Head	20.00	51000	1.000	OC (0.490)	1.000 (2.570)	1.000 (2.571)	80.00u
3	London Clay	20.00	51000	1.000	OC (0.490)	1.000 (2.570)	1.000 (2.571)	80.00u (4.500)
	(42.80)		(4500)					
4	Head (drained)	22.00	63750	0.625	OC (0.200)	0.387 (1.517)	3.028 (5.020)	5.000d
5	LC Drained	22.00	60000	0.625	OC (0.200)	0.387 (1.517)	3.028 (5.020)	5.000d
	(42.80)		(3375)					

Additional soil parameters associated with Ka and Kp

No.	Soil type Description	--- parameters for Ka --- Soil friction angle	Wall adhesion coeff.	Back-fill angle	--- parameters for Kp --- Soil friction angle	Wall adhesion coeff.	Back-fill angle
1	Made Ground	30.00	1.000	0.00	30.00	1.000	0.00
2	Head	0.00	1.000	0.00	0.00	0.995	0.00
3	London Clay	0.00	1.000	0.00	0.00	0.995	0.00
4	Head (drained)	22.01	1.000	0.00	22.00	1.000	0.00
5	LC Drained	22.01	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	43.00	43.00

Automatic water pressure balancing at toe of wall : No

Water press. profile no.	Left side Point no.	Elev. m	Piezo elev. m	Water press. kN/m2	Right side Point no.	Elev. m	Piezo elev. m	Water press. kN/m2	
1	1	44.50	44.50	0.0	1	38.50	38.50	0.0	MC+WC

WALL PROPERTIES

Type of structure = Fully Embedded Wall
Elevation of toe of wall = 30.80
Maximum finite element length = 0.80 m
Youngs modulus of wall E = 2.8000E+07 kN/m2
Moment of inertia of wall I = 1.4732E-03 m4/m run
E.I = 41251 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	45.69	1.00	0.250000	2.800E+07	15.00	0.00	0	No
2	41.40	1.00	0.250000	2.800E+07	10.00	0.00	0	No
3	38.70	1.00	0.450000	2.800E+07	10.00	0.00	0	No
4	45.40	7.50	0.016400	2.050E+08	10.00	0.00	0	No
5	42.00	7.50	0.016400	2.050E+08	10.00	30.00	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	44.85	1.60(L)	1000.00	0.60	10.00	=	N/A	1.00 -
2	44.85	2.70(L)	1000.00	0.80	85.00	=	N/A	1.00 -
3	45.60	2.70(L)	1000.00	20.00	12.50	=	N/A	1.00 -

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 44.85
	No analysis at this stage
2	Apply surcharge no.2 at elevation 44.85
	No analysis at this stage
3	Apply surcharge no.3 at elevation 45.60
4	Change EI of wall to 41252 kN.m2/m run
	Yield moment not defined
	Reset wall displacements to zero at this stage
5	Excavate to elevation 43.75 on RIGHT side
6	Install strut or anchor no.4 at elevation 45.40
7	Excavate to elevation 41.50 on RIGHT side
8	Install strut or anchor no.5 at elevation 42.00
9	Excavate to elevation 37.94 on RIGHT side
10	Install strut or anchor no.3 at elevation 38.70
11	Change EI of wall to 77684 kN.m2/m run
	From elevation 41.50 to 38.50
	Yield moment not defined
	No adjustments to wall displacements
12	Install strut or anchor no.2 at elevation 41.40
13	Remove strut or anchor no.5 at elevation 42.00
14	Change EI of wall to 77684 kN.m2/m run
	From elevation 45.80 to 41.50
	Yield moment not defined
	No adjustments to wall displacements
15	Install strut or anchor no.1 at elevation 45.69
16	Remove strut or anchor no.4 at elevation 45.40
17	Apply water pressure profile no.1 (Mod. Conserv.)
18	Change properties of soil type 2 to soil type 4
	No analysis at this stage
	Ko pressures will not be reset
19	Change properties of soil type 3 to soil type 5
	No analysis at this stage
	Ko pressures will not be reset
20	Change EI of wall to 38842 kN.m2/m run
	From elevation 45.80 to 38.50
	Yield moment not defined
	No adjustments to wall displacements

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) = 15.00 m

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

Distance to rigid boundary on Left side = 30.00 m
Distance to rigid boundary on Right side = 30.00 m

OUTPUT OPTIONS

Stage no.	Stage description	Output options: Displacement, Bending mom., Shear force	Active, Passive pressures	Graph. output
1	Apply surcharge no.1 at elev. 44.85	Yes	Yes	Yes
2	Apply surcharge no.2 at elev. 44.85	No	No	No
3	Apply surcharge no.3 at elev. 45.60	Yes	Yes	Yes
4	Change EI of wall to 41252kN.m2/m run	No	No	No
5	Excav. to elev. 43.75 on RIGHT side	Yes	Yes	Yes
6	Install strut no.4 at elev. 45.40	No	No	No
7	Excav. to elev. 41.50 on RIGHT side	Yes	Yes	Yes
8	Install strut no.5 at elev. 42.00	No	No	No
9	Excav. to elev. 37.94 on RIGHT side	No	No	No
10	Install strut no.3 at elev. 38.70	Yes	Yes	Yes
11	Change EI of wall to 77684kN.m2/m run	No	No	No
12	Install strut no.2 at elev. 41.40	No	No	No
13	Remove strut no.5 at elev. 42.00	No	No	No
14	Change EI of wall to 77684kN.m2/m run	No	No	No
15	Install strut no.1 at elev. 45.69	No	No	No
16	Remove strut no.4 at elev. 45.40	No	No	No
17	Apply water pressure profile no.1	Yes	Yes	Yes
18	Change soil type 2 to soil type 4	No	No	No
19	Change soil type 3 to soil type 5	No	No	No
20	Change EI of wall to 38842kN.m2/m run	Yes	Yes	Yes
*	Summary output	Yes	-	Yes

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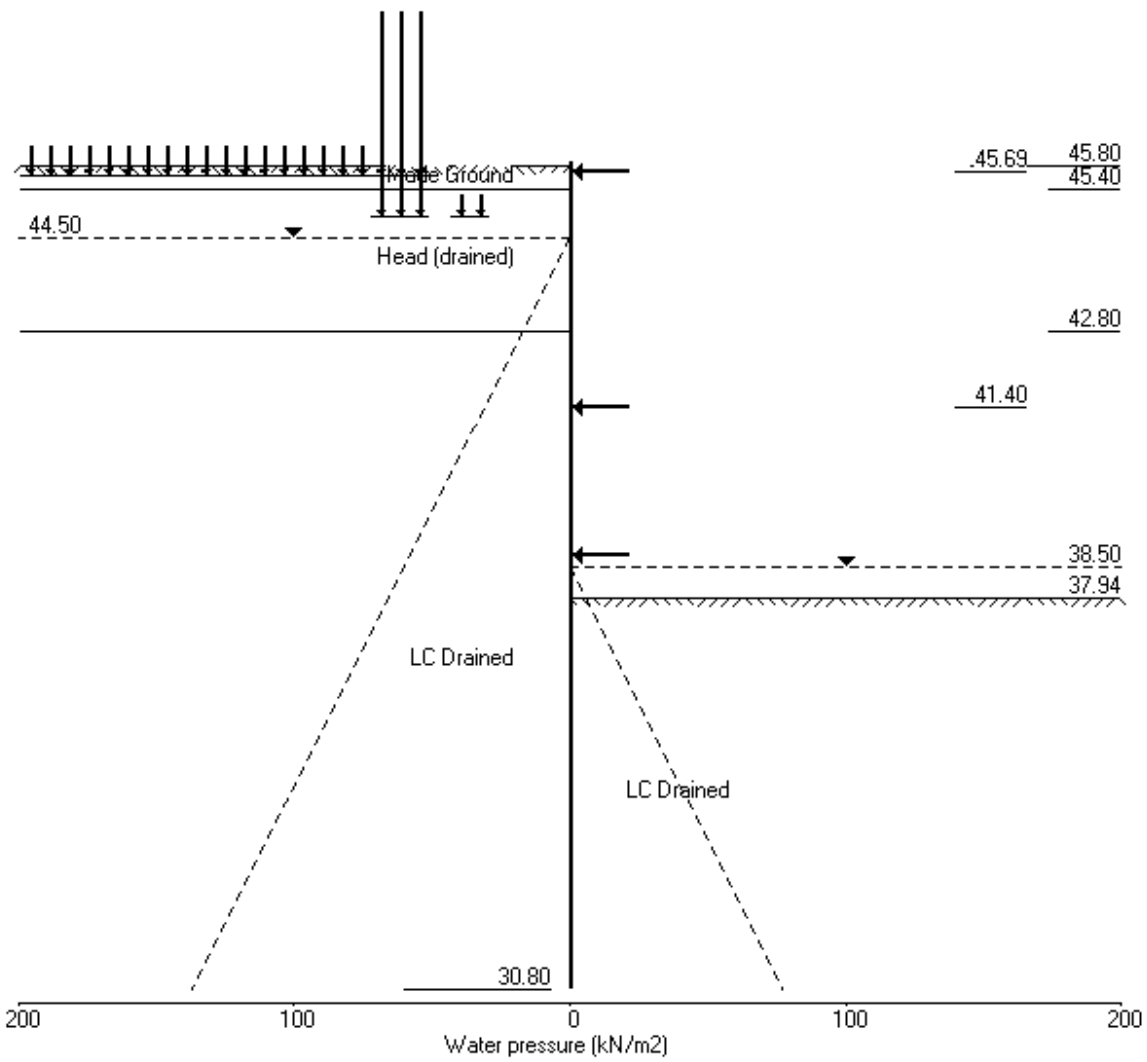
Units: kN,m

Stage No.20 Change EI of wall to 38842kN.m2/m run



Units: kN,m

Stage No. 5 Excavate to elevation 43.75 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. = 30.80 Factor of Safety	Moment equilib. at elev.	Toe elev. for FoS = 1.000 Toe elev.	Wall Penetr -ation	Direction of failure
5	45.80	43.75	Cant.	8.747	31.36	43.59	0.16	L to R

BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall

Analysis options

Length of wall perpendicular to section = 15.00m

Subgrade reaction model - Boussinesq Influence coefficients

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

Open Tension Crack analysis - No

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

Limit State: Serviceability Limit State

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

*** Wall displacements reset to zero at stage 4

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	45.80	0.00	0.004	8.47E-04	0.0	0.0		41252
2	45.69	0.54	0.004	8.47E-04	0.0	-0.0		41252
3	45.60	0.98	0.004	8.47E-04	0.1	0.0		41252
4	45.40	1.97	0.004	8.47E-04	0.4	0.1		41252
		2.00	0.004	8.47E-04	0.4	0.1		
5	44.85	4.75	0.003	8.46E-04	2.2	0.9		41252
6	44.50	6.50	0.003	8.39E-04	4.2	2.0		41252
7	43.75	10.25	0.002	7.63E-04	10.5	7.5		41252
		-22.71	0.002	7.63E-04	10.5	7.5		
8	43.00	-10.25	0.002	5.81E-04	-1.9	12.2		41252
9	42.80	-6.87	0.002	5.18E-04	-3.6	11.6		41252
10	42.00	0.01	0.001	3.02E-04	-6.3	7.0		41252
11	41.50	2.17	0.001	2.03E-04	-5.8	3.9		41252
12	41.40	2.44	0.001	1.87E-04	-5.5	3.3		41252
13	40.70	3.14	0.001	1.03E-04	-3.6	0.2		41252
14	40.00	2.57	0.001	6.31E-05	-1.6	-1.5		41252
15	39.35	1.65	0.001	5.01E-05	-0.2	-2.0		41252
16	38.70	0.79	0.001	4.88E-05	0.6	-1.8		41252
17	38.50	0.56	0.001	4.97E-05	0.7	-1.6		41252
18	37.94	0.08	0.001	5.27E-05	0.9	-1.1		41252
19	37.37	-0.21	0.001	5.53E-05	0.9	-0.6		41252
20	36.80	-0.33	0.001	5.66E-05	0.7	-0.2		41252
21	36.00	-0.33	0.001	5.60E-05	0.4	0.2		41252
22	35.20	-0.23	0.001	5.34E-05	0.2	0.4		41252
23	34.40	-0.14	0.001	4.99E-05	0.1	0.5		41252
24	33.60	-0.08	0.001	4.65E-05	-0.0	0.4		41252
25	32.80	-0.05	0.001	4.36E-05	-0.1	0.3		41252
26	32.00	-0.01	0.001	4.16E-05	-0.1	0.2		41252

(continued)

Stage No.5 Excavate to elevation 43.75 on RIGHT side

Node no.	Y coord	Nett pressure kN/m2	Wall disp. m	Wall rotation rad.	Shear force kN/m	Bending moment kN.m/m	Strut forces kN/m	EI of wall kN.m2/m
27	31.40	0.07	0.001	4.08E-05	-0.1	0.1		41252
28	30.80	0.21	0.001	4.06E-05	0.0	0.0		---

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	45.80	0.00	0.00	0.00	0.00	0.00	0.00	2728
2	45.69	0.00	1.98	0.54	9.95	0.54	0.54a	2728
3	45.60	0.00	3.60	0.98	18.09	0.98	0.98a	2728
4	45.40	0.00	7.20	1.97	36.20	1.97	1.97a	2728
		Total>	7.20	2.00m	212.88	2.00	2.00a	13911
5	44.85	Total>	18.30	4.75m	223.98	4.75	4.75a	13911
6	44.50	Total>	25.56	6.50m	231.24	6.50	6.50a	13911
7	43.75	Total>	42.75	10.25m	248.43	10.25	10.25a	13911
8	43.00	Total>	61.63	14.00m	267.31	32.44	32.44	13911
9	42.80	Total>	66.71	15.00m	272.39	38.73	38.73	13911
10	42.00	Total>	86.49	19.00m	301.43	60.16	60.16	14893
11	41.50	Total>	98.26	21.50m	318.98	72.15	72.15	15507
12	41.40	Total>	100.55	22.00m	322.43	74.44	74.44	15630
13	40.70	Total>	116.17	25.50m	346.15	89.61	89.61	16489
14	40.00	Total>	131.14	29.00m	369.21	103.82	103.82	17348
15	39.35	Total>	144.64	32.25m	390.24	116.62	116.62	18146
16	38.70	Total>	157.89	35.50m	411.00	129.33	129.33	18944
17	38.50	Total>	161.93	36.50m	417.36	133.24	133.24	19190
18	37.94	Total>	173.17	39.30m	435.07	144.26	144.26	19877
19	37.37	Total>	184.53	42.15m	453.03	155.55	155.55	20577
20	36.80	Total>	195.84	45.00m	470.94	166.91	166.91	21276
21	36.00	Total>	211.66	49.00m	496.01	182.93	182.93	22258
22	35.20	Total>	227.44	53.00m	521.05	199.00	199.00	23240
23	34.40	Total>	243.20	57.00m	546.06	215.07	215.07	24222
24	33.60	Total>	258.94	61.00m	571.06	231.14	231.14	25204
25	32.80	Total>	274.68	65.00m	596.05	247.21	247.21	26186
26	32.00	Total>	290.42	69.00m	621.05	263.30	263.30	27168
27	31.40	Total>	302.22	72.00m	639.79	275.39	275.39	27905
28	30.80	Total>	314.03	75.00m	658.54	287.53	287.53	28641

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	45.80	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	45.69	0.00	0.00	0.00	0.00	0.00	0.00	0.0
3	45.60	0.00	0.00	0.00	0.00	0.00	0.00	0.0
4	45.40	0.00	0.00	0.00	0.00	0.00	0.00	0.0
5	44.85	0.00	0.00	0.00	0.00	0.00	0.00	0.0
6	44.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
7	43.75	0.00	0.00	0.00	0.00	0.00	0.00	0.0
		Total>	0.00	0.00	205.68	32.96	32.96	12378
8	43.00	Total>	15.00	3.75m	220.68	42.68	42.68	12378
9	42.80	Total>	19.00	4.75m	224.68	45.60	45.60	12378
10	42.00	Total>	35.01	8.75m	249.95	60.15	60.15	13252
11	41.50	Total>	45.02	11.25m	265.74	69.98	69.98	13798
12	41.40	Total>	47.03	11.75m	268.90	72.00	72.00	13907

(continued)

Stage No.5 Excavate to elevation 43.75 on RIGHT side

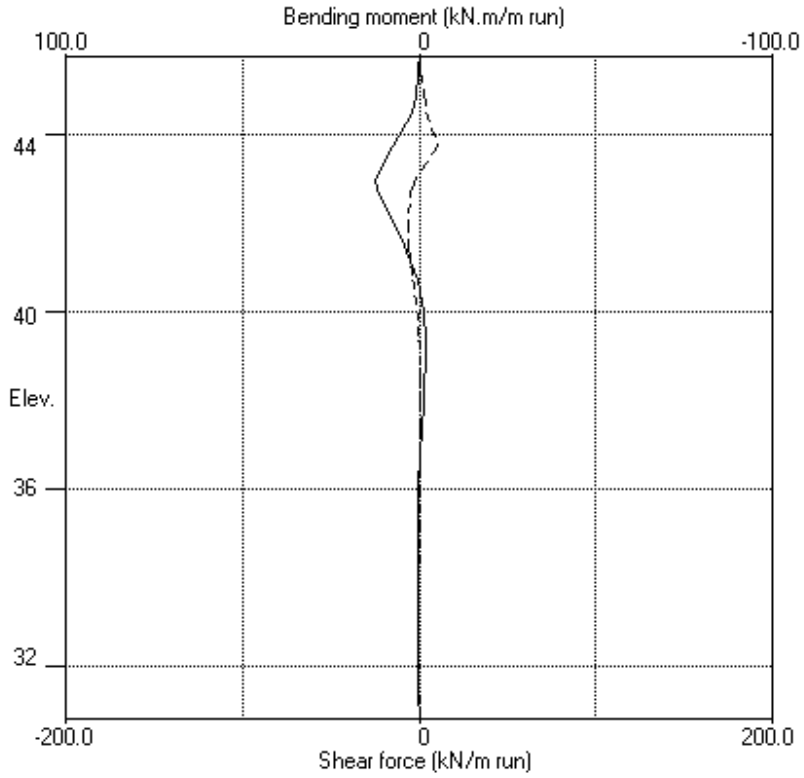
Node no.	Y coord	RIGHT side Water press. kN/m2	Effective stresses Vertic -al kN/m2	Active limit kN/m2	Passive limit kN/m2	Earth pressure kN/m2	Total earth pressure kN/m2	Coeff. of subgrade reaction kN/m3
13	40.70	Total>	61.06	15.25m	291.03	86.47	86.47	14672
14	40.00	Total>	75.11	18.75m	313.18	101.24	101.24	15436
15	39.35	Total>	88.17	22.00m	333.77	114.96	114.96	16146
16	38.70	Total>	101.25	25.25m	354.37	128.54	128.54	16856
17	38.50	Total>	105.28	26.25m	360.71	132.68	132.68	17075
18	37.94	Total>	116.58	29.05m	378.49	144.18	144.18	17686
19	37.37	Total>	128.09	31.90m	396.60	155.76	155.76	18309
20	36.80	Total>	139.62	34.75m	414.72	167.24	167.24	18931
21	36.00	Total>	155.84	38.75m	440.19	183.26	183.26	19805
22	35.20	Total>	172.09	42.75m	465.70	199.23	199.23	20679
23	34.40	Total>	188.37	46.75m	491.24	215.21	215.21	21553
24	33.60	Total>	204.69	50.75m	516.81	231.22	231.22	22426
25	32.80	Total>	221.04	54.75m	542.41	247.26	247.26	23300
26	32.00	Total>	237.42	58.75m	568.05	263.30	263.30	24174
27	31.40	Total>	249.72	61.75m	587.29	275.33	275.33	24829
28	30.80	Total>	262.03	64.75m	606.54	287.33	287.33	25484

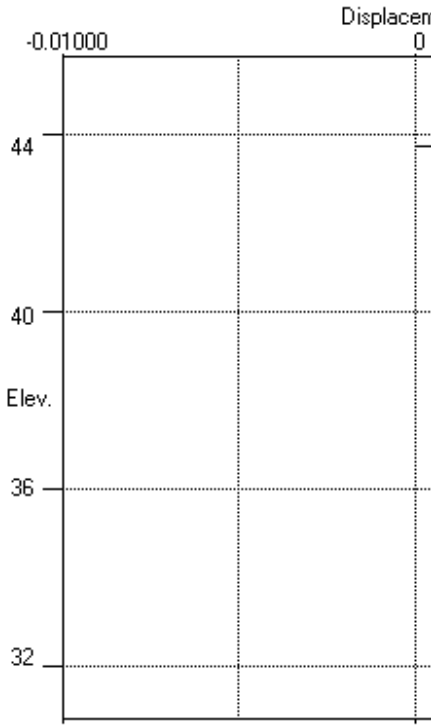
Note: 10.25a Soil pressure at active limit
123.45p Soil pressure at passive limit

KNIGHT BUILD LTD | Sheet No.
Program: WALLAP Version 6.06 Revision A49.B68.R53 | Job No. 79AR
Licensed from GEOSOLVE | Made by : JRC
Data filename/Run ID: SECTION_1-1_SLS |
79 Avenue Road | Date:28-06-2021
SECTION 1-1 ANALYSIS | Checked :

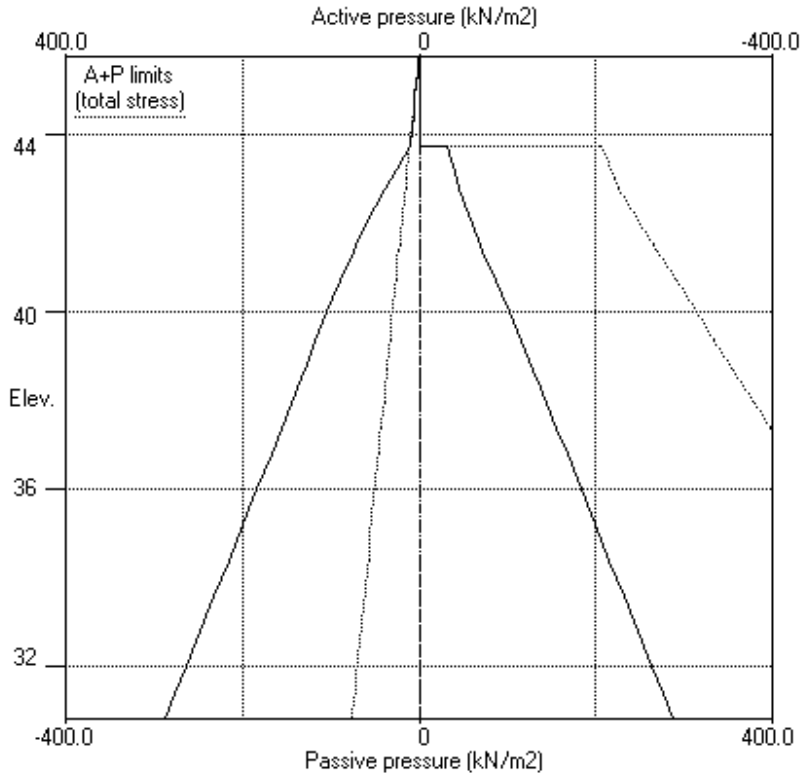
Units: kN,m

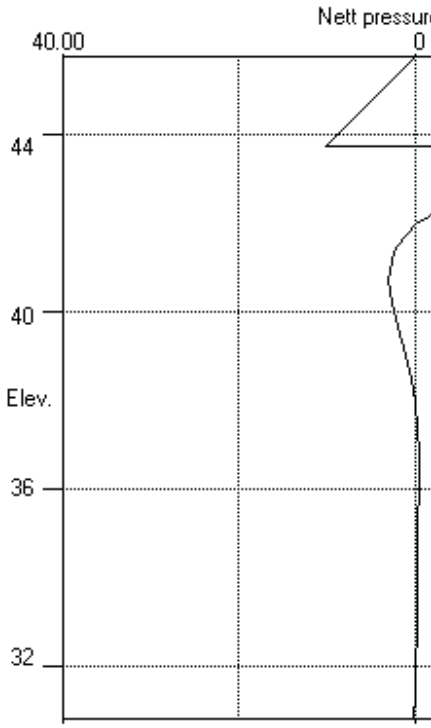
Stage No.5 Excav. to elev. 43.75 on RIGHT side





Stage No.5 Excav. to elev. 43.75 on RIGHT side





Units: kN,m

Stage No. 7 Excavate to elevation 41.50 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. = 30.80 Factor of Safety	Moment equilib. at elev.	Toe elev. for FoS = 1.000 Toe elev.	Wall Penetr -ation	Direction of failure
7	45.80	41.50	45.40	6.754	n/a	41.41	0.09	L to R

BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall

Analysis options

Length of wall perpendicular to section = 15.00m

Subgrade reaction model - Boussinesq Influence coefficients

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

Open Tension Crack analysis - No

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

Limit State: Serviceability Limit State

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

*** Wall displacements reset to zero at stage 4

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	45.80	0.00	0.004	-5.57E-04	0.0	0.0		41252
2	45.69	0.54	0.004	-5.57E-04	0.0	-0.0		41252
3	45.60	0.98	0.004	-5.57E-04	0.1	0.0		41252
4	45.40	1.97	0.004	-5.57E-04	0.4	0.1	19.1	41252
		2.00	0.004	-5.57E-04	-18.7	0.1		
5	44.85	4.75	0.004	-4.88E-04	-16.9	-9.7		41252
6	44.50	6.50	0.005	-3.77E-04	-14.9	-15.2		41252
7	43.75	10.25	0.005	-9.32E-06	-8.6	-24.0		41252
8	43.00	14.00	0.005	4.36E-04	0.5	-25.3		41252
9	42.80	13.00	0.004	5.52E-04	3.2	-24.9		41252
10	42.00	23.50	0.004	9.00E-04	17.8	-14.6		41252
11	41.50	33.29	0.003	9.71E-04	31.9	-2.5		41252
		-38.41	0.003	9.71E-04	31.9	-2.5		
12	41.40	-36.15	0.003	9.66E-04	28.2	0.5		41252
13	40.70	-20.67	0.003	8.11E-04	8.3	11.5		41252
14	40.00	-8.58	0.002	5.57E-04	-1.9	12.3		41252
15	39.35	-1.62	0.002	3.46E-04	-5.2	9.3		41252
16	38.70	1.75	0.002	1.98E-04	-5.2	5.6		41252
17	38.50	2.24	0.002	1.66E-04	-4.8	4.6		41252
18	37.94	2.70	0.002	1.04E-04	-3.4	2.3		41252
19	37.37	2.31	0.002	7.39E-05	-2.0	0.8		41252
20	36.80	1.60	0.002	6.44E-05	-0.9	-0.0		41252
21	36.00	0.67	0.002	6.63E-05	0.1	-0.2		41252
22	35.20	0.08	0.001	7.23E-05	0.3	-0.0		41252
23	34.40	-0.17	0.001	7.53E-05	0.3	0.2		41252
24	33.60	-0.22	0.001	7.46E-05	0.2	0.4		41252
25	32.80	-0.17	0.001	7.19E-05	-0.0	0.3		41252
26	32.00	-0.07	0.001	6.91E-05	-0.1	0.2		41252

(continued)

Stage No.7 Excavate to elevation 41.50 on RIGHT side

Node no.	Y coord	Nett pressure kN/m2	Wall disp. m	Wall rotation rad.	Shear force kN/m	Bending moment kN.m/m	Strut forces kN/m	EI of wall kN.m2/m
27	31.40	0.06	0.001	6.79E-05	-0.1	0.1		41252
28	30.80	0.29	0.001	6.75E-05	0.0	0.0		---

At elev. 45.40 Strut force = 143.6 kN/strut = 19.1 kN/m run

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	45.80	0.00	0.00	0.00	0.00	0.00	0.00	62508
2	45.69	0.00	1.98	0.54	9.95	0.54	0.54a	6134
3	45.60	0.00	3.60	0.98	18.09	0.98	0.98a	1952
4	45.40	0.00	7.20	1.97	36.20	1.97	1.97a	1952
		Total>	7.20	2.00m	212.88	2.00	2.00a	10013
5	44.85	Total>	18.30	4.75m	223.98	4.75	4.75a	10013
6	44.50	Total>	25.56	6.50m	231.24	6.50	6.50a	10013
7	43.75	Total>	42.75	10.25m	248.43	10.25	10.25a	10013
8	43.00	Total>	61.63	14.00m	267.31	14.00	14.00a	10013
9	42.80	Total>	66.71	15.00m	272.39	15.00	15.00a	10013
10	42.00	Total>	86.49	19.00m	301.43	33.50	33.50	10720
11	41.50	Total>	98.26	21.50m	318.98	48.29	48.29	11161
12	41.40	Total>	100.55	22.00m	322.43	51.26	51.26	11250
13	40.70	Total>	116.17	25.50m	346.15	71.50	71.50	11868
14	40.00	Total>	131.14	29.00m	369.21	90.04	90.04	12487
15	39.35	Total>	144.64	32.25m	390.24	105.54	105.54	13061
16	38.70	Total>	157.89	35.50m	411.00	119.69	119.69	13635
17	38.50	Total>	161.93	36.50m	417.36	123.85	123.85	13812
18	37.94	Total>	173.17	39.30m	435.07	135.18	135.18	14307
19	37.37	Total>	184.53	42.15m	453.03	146.43	146.43	14810
20	36.80	Total>	195.84	45.00m	470.94	157.58	157.58	15314
21	36.00	Total>	211.66	49.00m	496.01	173.27	173.27	16020
22	35.20	Total>	227.44	53.00m	521.05	189.11	189.11	16727
23	34.40	Total>	243.20	57.00m	546.06	205.08	205.08	17434
24	33.60	Total>	258.94	61.00m	571.06	221.14	221.14	18141
25	32.80	Total>	274.68	65.00m	596.05	237.24	237.24	18848
26	32.00	Total>	290.42	69.00m	621.05	253.39	253.39	19554
27	31.40	Total>	302.22	72.00m	639.79	265.55	265.55	20084
28	30.80	Total>	314.03	75.00m	658.54	277.76	277.76	20615

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	45.80	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	45.69	0.00	0.00	0.00	0.00	0.00	0.00	0.0
3	45.60	0.00	0.00	0.00	0.00	0.00	0.00	0.0
4	45.40	0.00	0.00	0.00	0.00	0.00	0.00	0.0
5	44.85	0.00	0.00	0.00	0.00	0.00	0.00	0.0
6	44.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
7	43.75	0.00	0.00	0.00	0.00	0.00	0.00	0.0
8	43.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
9	42.80	2.00	0.00	0.00	0.00	0.00	2.00	0.0
10	42.00	10.00	0.00	0.00	0.00	0.00	10.00	0.0
11	41.50	15.00	0.00	0.00	0.00	0.00	15.00	0.0
		Total>	15.00	15.00w	235.72	86.70	86.70	21307

(continued)

Stage No.7 Excavate to elevation 41.50 on RIGHT side

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
12	41.40	Total>	17.00	8.00m	238.88	87.41	87.41	21476
13	40.70	Total>	31.00	11.50m	260.98	92.17	92.17	22657
14	40.00	Total>	45.01	15.00m	283.09	98.62	98.62	23837
15	39.35	Total>	58.04	18.25m	303.63	107.16	107.16	24933
16	38.70	Total>	71.08	21.50m	324.19	117.94	117.94	26030
17	38.50	Total>	75.10	22.50m	330.53	121.61	121.61	26367
18	37.94	Total>	86.36	25.30m	348.27	132.48	132.48	27311
19	37.37	Total>	97.85	28.15m	366.35	144.12	144.12	28273
20	36.80	Total>	109.36	31.00m	384.46	155.98	155.98	29234
21	36.00	Total>	125.57	35.00m	409.92	172.61	172.61	30583
22	35.20	Total>	141.83	39.00m	435.44	189.03	189.03	31933
23	34.40	Total>	158.16	43.00m	461.02	205.25	205.25	33282
24	33.60	Total>	174.54	47.00m	486.66	221.35	221.35	34631
25	32.80	Total>	190.99	51.00m	512.36	237.41	237.41	35981
26	32.00	Total>	207.50	55.00m	538.13	253.47	253.47	37330
27	31.40	Total>	219.92	58.00m	557.49	265.49	265.49	38342
28	30.80	Total>	232.37	61.00m	576.88	277.48	277.48	39354

Note: 15.00a Soil pressure at active limit
123.45p Soil pressure at passive limit

KNIGHT BUILD LTD | Sheet No.
Program: WALLAP Version 6.06 Revision A49.B68.R53 | Job No. 79AR
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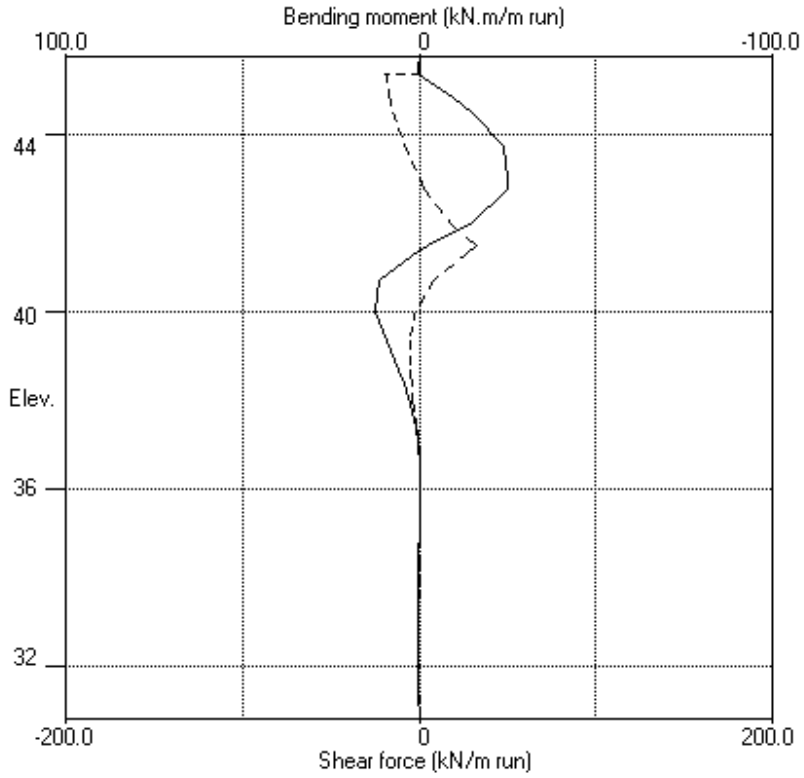
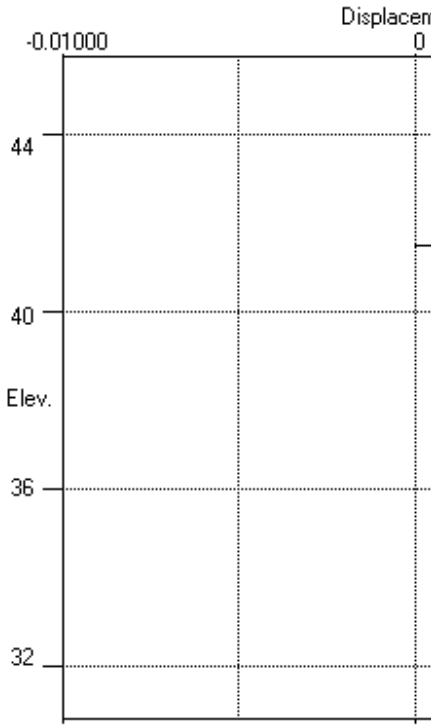
Data filename/Run ID: SECTION_1-1_SLS |
79 Avenue Road | Date:28-06-2021
SECTION 1-1 ANALYSIS | Checked :

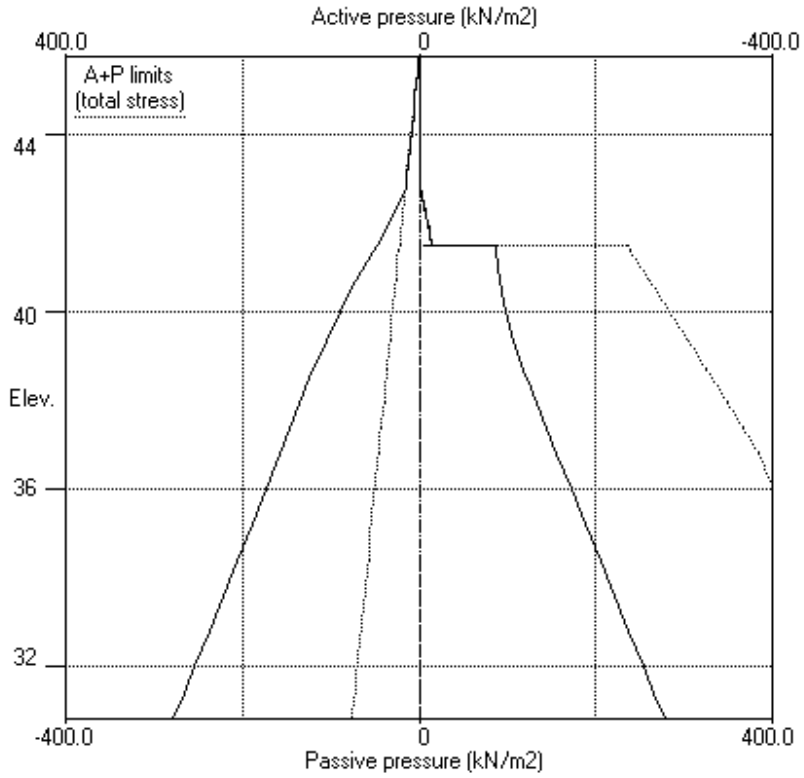
Units: kN,m

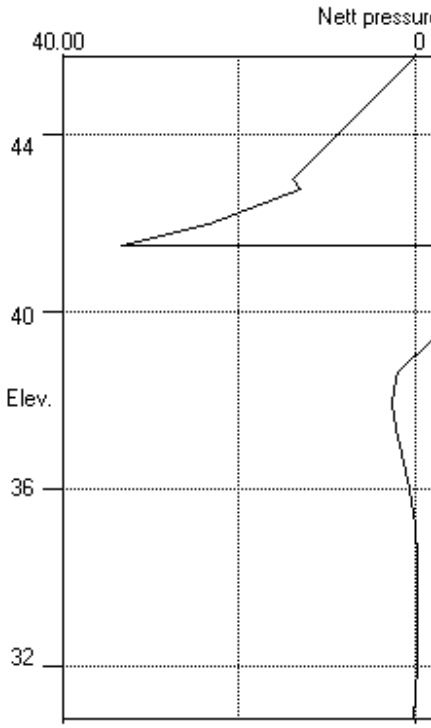
Stage No.7 Excav. to elev. 41.50 on RIGHT side





Stage No.7 Excav. to elev. 41.50 on RIGHT side





Units: kN,m

Stage No. 9 Excavate to elevation 37.94 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. = 30.80 Factor of Safety	Moment equilib. at elev.	Toe elev. for FoS = 1.000 Toe elev.	Wall Penetr -ation	Direction of failure
9	45.80	37.94		More than one strut. No FoS calc.				

BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall

Analysis options

Length of wall perpendicular to section = 15.00m

Subgrade reaction model - Boussinesq Influence coefficients

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

Open Tension Crack analysis - No

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

Limit State: Serviceability Limit State

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

*** Wall displacements reset to zero at stage 4

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	45.80	0.00	0.004	-6.85E-04	0.0	0.0		41252
2	45.69	1.70	0.004	-6.85E-04	0.1	-0.0		41252
3	45.60	2.06	0.004	-6.85E-04	0.3	0.0		41252
4	45.40	2.86	0.004	-6.85E-04	0.8	0.1	13.7	41252
		6.49	0.004	-6.85E-04	-13.0	0.1		
5	44.85	6.44	0.004	-6.43E-04	-9.4	-5.7		41252
6	44.50	6.50	0.005	-5.77E-04	-7.1	-8.6		41252
7	43.75	10.25	0.005	-3.83E-04	-0.9	-11.6		41252
8	43.00	14.00	0.005	-2.18E-04	8.2	-6.9		41252
9	42.80	13.00	0.005	-1.93E-04	10.9	-5.0		41252
10	42.00	9.00	0.005	-2.77E-04	19.7	9.9	50.7	41252
		9.00	0.005	-2.77E-04	-30.9	9.9		
11	41.50	9.42	0.006	-3.49E-04	-26.3	-3.5		41252
12	41.40	9.72	0.006	-3.45E-04	-25.4	-6.1		41252
13	40.70	11.78	0.006	-1.65E-04	-17.9	-21.5		41252
14	40.00	15.60	0.006	2.30E-04	-8.3	-31.1		41252
15	39.35	22.65	0.005	6.95E-04	4.2	-33.0		41252
16	38.70	34.03	0.005	1.12E-03	22.6	-25.2		41252
17	38.50	38.38	0.005	1.22E-03	29.8	-20.0		41252
18	37.94	51.99	0.004	1.32E-03	55.1	3.0		41252
		-77.80	0.004	1.32E-03	55.1	3.0		
19	37.37	-47.43	0.003	1.14E-03	19.4	21.7		41252
20	36.80	-22.76	0.003	8.18E-04	-0.6	25.1		41252
21	36.00	-2.18	0.002	4.06E-04	-10.5	17.3		41252
22	35.20	5.15	0.002	1.62E-04	-9.4	8.2		41252
23	34.40	5.32	0.002	6.57E-05	-5.2	2.3		41252
24	33.60	3.17	0.002	4.99E-05	-1.8	-0.2		41252
25	32.80	1.18	0.002	6.15E-05	-0.0	-0.6		41252

(continued)

Stage No.9 Excavate to elevation 37.94 on RIGHT side

Node no.	Y coord	Nett pressure kN/m2	Wall disp. m	Wall rotation rad.	Shear force kN/m	Bending moment kN.m/m	Strut forces kN/m	EI of wall kN.m2/m
26	32.00	0.01	0.002	7.32E-05	0.5	-0.3		41252
27	31.40	-0.43	0.002	7.70E-05	0.3	-0.1		41252
28	30.80	-0.66	0.002	7.79E-05	0.0	0.0		---

At elev. 45.40 Strut force = 102.8 kN/strut = 13.7 kN/m run
At elev. 42.00 Strut force = 380.1 kN/strut = 50.7 kN/m run (horiz.)
= 58.5 kN/m run (inclined)

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	45.80	0.00	0.00	0.00	0.00	0.00	0.00	7329
2	45.69	0.00	1.98	0.54	9.95	1.70	1.70	7329
3	45.60	0.00	3.60	0.98	18.09	2.06	2.06	7329
4	45.40	0.00	7.20	1.97	36.20	2.86	2.86	7329
		Total>	7.20	2.00m	212.88	6.49	6.49	37043
5	44.85	Total>	18.30	4.75m	223.98	6.44	6.44	37043
6	44.50	Total>	25.56	6.50m	231.24	6.50	6.50a	9982
7	43.75	Total>	42.75	10.25m	248.43	10.25	10.25a	9982
8	43.00	Total>	61.63	14.00m	267.31	14.00	14.00a	9982
9	42.80	Total>	66.71	15.00m	272.39	15.00	15.00a	9982
10	42.00	Total>	86.49	19.00m	301.43	19.00	19.00a	10687
11	41.50	Total>	98.26	21.50m	318.98	24.42	24.42	11127
12	41.40	Total>	100.55	22.00m	322.43	25.72	25.72	11215
13	40.70	Total>	116.17	25.50m	346.15	34.78	34.78	11832
14	40.00	Total>	131.14	29.00m	369.21	45.60	45.60	12448
15	39.35	Total>	144.64	32.25m	390.24	59.15	59.15	13021
16	38.70	Total>	157.89	35.50m	411.00	77.03	77.03	13593
17	38.50	Total>	161.93	36.50m	417.36	83.38	83.38	13769
18	37.94	Total>	173.17	39.30m	435.07	102.59	102.59	14263
19	37.37	Total>	184.53	42.15m	453.03	122.54	122.54	14765
20	36.80	Total>	195.84	45.00m	470.94	140.87	140.87	15267
21	36.00	Total>	211.66	49.00m	496.01	162.62	162.62	15971
22	35.20	Total>	227.44	53.00m	521.05	180.65	180.65	16676
23	34.40	Total>	243.20	57.00m	546.06	196.69	196.69	17380
24	33.60	Total>	258.94	61.00m	571.06	212.09	212.09	18085
25	32.80	Total>	274.68	65.00m	596.05	227.57	227.57	18790
26	32.00	Total>	290.42	69.00m	621.05	243.32	243.32	19494
27	31.40	Total>	302.22	72.00m	639.79	255.29	255.29	20023
28	30.80	Total>	314.03	75.00m	658.54	267.35	267.35	20551

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	45.80	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	45.69	0.00	0.00	0.00	0.00	0.00	0.00	0.0
3	45.60	0.00	0.00	0.00	0.00	0.00	0.00	0.0
4	45.40	0.00	0.00	0.00	0.00	0.00	0.00	0.0
5	44.85	0.00	0.00	0.00	0.00	0.00	0.00	0.0
6	44.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
7	43.75	0.00	0.00	0.00	0.00	0.00	0.00	0.0
8	43.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
9	42.80	2.00	0.00	0.00	0.00	0.00	2.00	0.0

(continued)

Stage No.9 Excavate to elevation 37.94 on RIGHT side

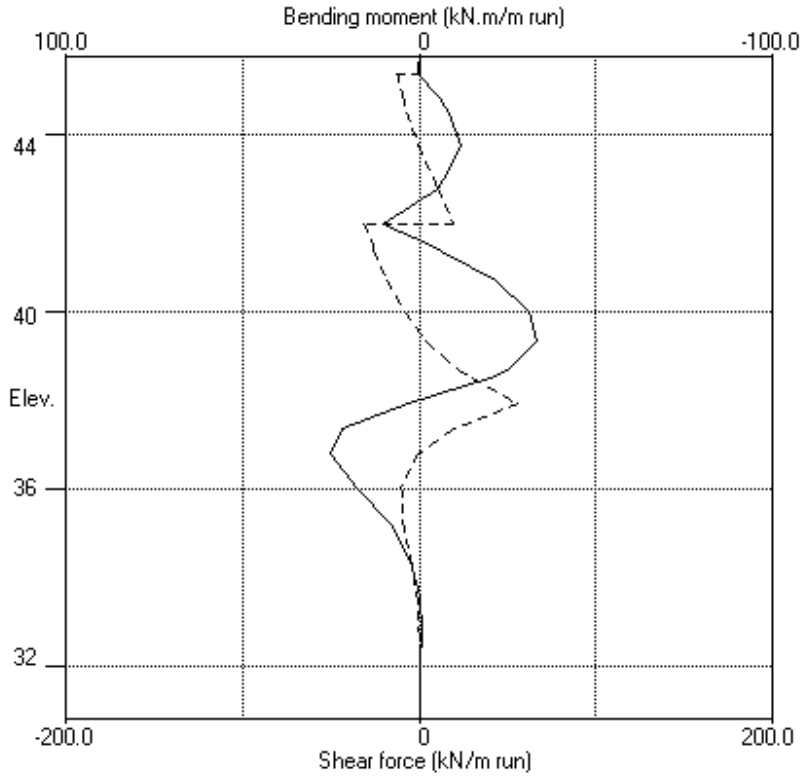
Node no.	Y coord	RIGHT side Effective stresses Water press. kN/m2	Vertic -al kN/m2	Active limit kN/m2	Passive limit kN/m2	Earth pressure kN/m2	Total earth pressure kN/m2	Coeff. of subgrade reaction kN/m3
10	42.00	10.00	0.00	0.00	0.00	0.00	10.00	0.0
11	41.50	15.00	0.00	0.00	0.00	0.00	15.00	0.0
12	41.40	16.00	0.00	0.00	0.00	0.00	16.00	0.0
13	40.70	23.00	0.00	0.00	0.00	0.00	23.00	0.0
14	40.00	30.00	0.00	0.00	0.00	0.00	30.00	0.0
15	39.35	36.50	0.00	0.00	0.00	0.00	36.50	0.0
16	38.70	43.00	0.00	0.00	0.00	0.00	43.00	0.0
17	38.50	45.00	0.00	0.00	0.00	0.00	45.00	0.0
18	37.94	50.60	0.00	0.00	0.00	0.00	50.60	0.0
		Total> 50.60	50.60w	312.51	180.40	180.40		36010
19	37.37	Total> 62.00	28.15m	330.50	169.97	169.97		37278
20	36.80	Total> 73.41	31.00m	348.51	163.62	163.62		38546
21	36.00	Total> 89.44	35.00m	373.79	164.80	164.80		40325
22	35.20	Total> 105.51	39.00m	399.12	175.50	175.50		42104
23	34.40	Total> 121.64	43.00m	424.50	191.37	191.37		43883
24	33.60	Total> 137.83	47.00m	449.95	208.92	208.92		45662
25	32.80	Total> 154.11	51.00m	475.48	226.39	226.39		47441
26	32.00	Total> 170.46	55.00m	501.09	243.31	243.31		49220
27	31.40	Total> 182.79	58.00m	520.36	255.72	255.72		50554
28	30.80	Total> 195.17	61.00m	539.68	268.01	268.01		51888

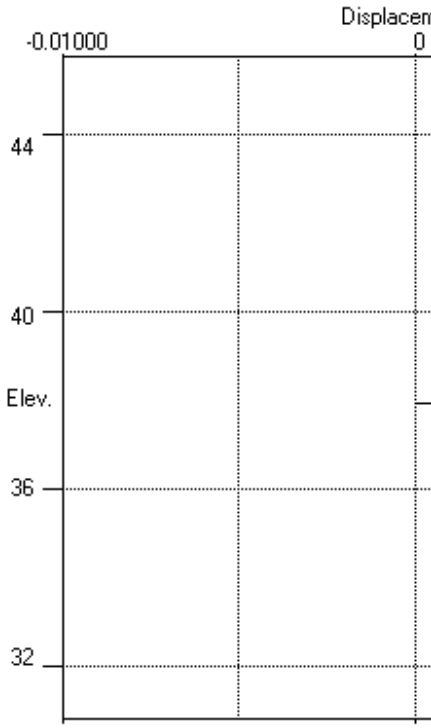
Note: 19.00a Soil pressure at active limit
123.45p Soil pressure at passive limit

KNIGHT BUILD LTD | Sheet No.
Program: WALLAP Version 6.06 Revision A49.B68.R53 | Job No. 79AR
Licensed from GEOSOLVE | Made by : JRC
Data filename/Run ID: SECTION_1-1_SLS |
79 Avenue Road | Date:28-06-2021
SECTION 1-1 ANALYSIS | Checked :

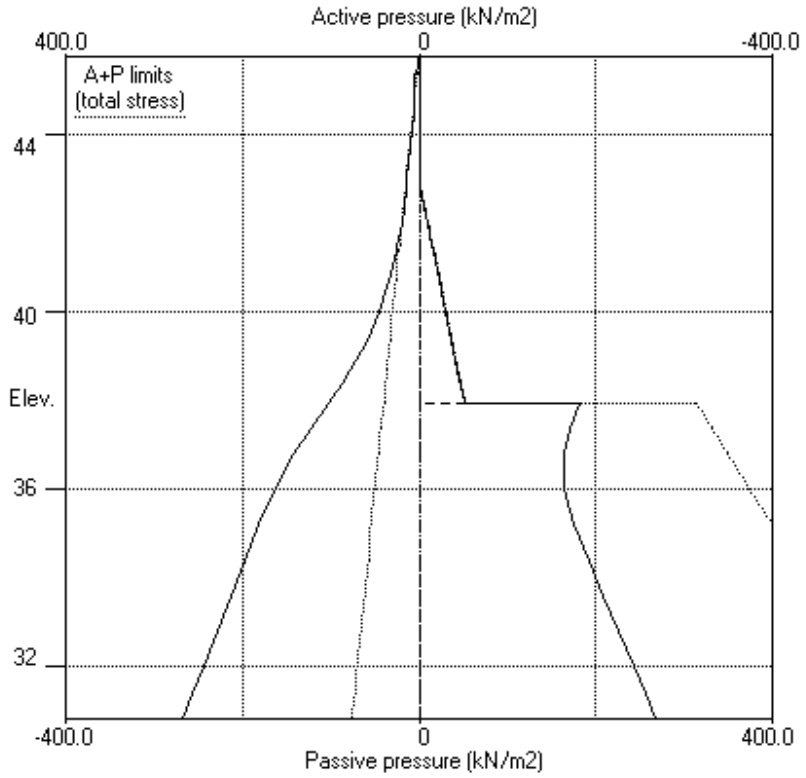
Units: kN,m

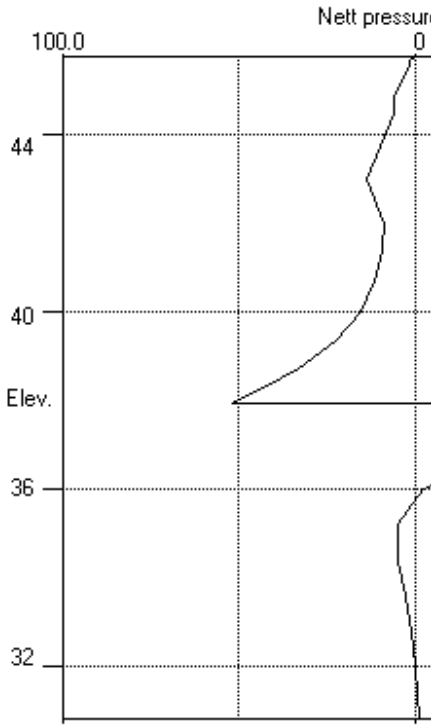
Stage No.9 Excav. to elev. 37.94 on RIGHT side





Stage No.9 Excav. to elev. 37.94 on RIGHT side





Units: kN,m

Stage No. 11 Change EI of wall to 77684 kN.m2/m run
From elevation 41.50 to 38.50
Yield moment not defined
No adjustments to wall displacements

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. = 30.80 Factor of Safety	Moment equilib. at elev.	Toe elev. for FoS = 1.000 Toe elev.	Wall Penetr -ation	Direction of failure
11	45.80	37.94		More than one strut. No FoS calc.				

BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall
Analysis options
Length of wall perpendicular to section = 15.00m
Subgrade reaction model - Boussinesq Influence coefficients
Soil deformations are elastic until the active or passive limit is reached
Open Tension Crack analysis - No

Rigid boundaries: Left side 30.00 from wall
Right side 30.00 from wall
Limit State: Serviceability Limit State
Calculated Bending Moments and Strut Forces are to be multiplied by a factor of 1.35 to obtain values for structural design. See summary for factored values.

*** Wall displacements reset to zero at stage 4

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	45.80	0.00	0.004	-6.85E-04	0.0	0.0		41252
2	45.69	1.70	0.004	-6.85E-04	0.1	-0.0		41252
3	45.60	2.06	0.004	-6.85E-04	0.3	0.0		41252
4	45.40	2.86	0.004	-6.85E-04	0.8	0.1	13.7	41252
		6.49	0.004	-6.85E-04	-13.0	0.1		
5	44.85	6.44	0.004	-6.43E-04	-9.4	-5.7		41252
6	44.50	6.50	0.005	-5.77E-04	-7.1	-8.6		41252
7	43.75	10.25	0.005	-3.83E-04	-0.9	-11.6		41252
8	43.00	14.00	0.005	-2.18E-04	8.2	-6.9		41252
9	42.80	13.00	0.005	-1.93E-04	10.9	-5.0		41252
10	42.00	9.00	0.005	-2.77E-04	19.7	9.9	50.7	41252
		9.00	0.005	-2.77E-04	-30.9	9.9		
11	41.50	9.42	0.006	-3.49E-04	-26.3	-3.5		77684
12	41.40	9.72	0.006	-3.45E-04	-25.4	-6.1		77684
13	40.70	11.78	0.006	-1.65E-04	-17.9	-21.5		77684
14	40.00	15.60	0.006	2.30E-04	-8.3	-31.1		77684
15	39.35	22.65	0.005	6.95E-04	4.2	-33.0		77684
16	38.70	34.03	0.005	1.12E-03	22.6	-25.2		77684
17	38.50	38.38	0.005	1.22E-03	29.8	-20.0		41252
18	37.94	51.99	0.004	1.32E-03	55.1	3.0		41252
		-77.80	0.004	1.32E-03	55.1	3.0		
19	37.37	-47.43	0.003	1.14E-03	19.4	21.7		41252
20	36.80	-22.76	0.003	8.18E-04	-0.6	25.1		41252
21	36.00	-2.18	0.002	4.06E-04	-10.5	17.3		41252
22	35.20	5.15	0.002	1.62E-04	-9.4	8.2		41252

(continued)

Stage No.11 Change EI of wall to 77684 kN.m2/m run
From elevation 41.50 to 38.50
Yield moment not defined
No adjustments to wall displacements

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
23	34.40	5.32	0.002	6.57E-05	-5.2	2.3		41252
24	33.60	3.17	0.002	4.99E-05	-1.8	-0.2		41252
25	32.80	1.18	0.002	6.15E-05	-0.0	-0.6		41252
26	32.00	0.01	0.002	7.32E-05	0.5	-0.3		41252
27	31.40	-0.43	0.002	7.70E-05	0.3	-0.1		41252
28	30.80	-0.66	0.002	7.79E-05	0.0	0.0		---

At elev. 45.40 Strut force = 102.8 kN/strut = 13.7 kN/m run
At elev. 42.00 Strut force = 380.1 kN/strut = 50.7 kN/m run (horiz.)
= 58.5 kN/m run (inclined)
At elev. 38.70 The strut is slack

Node no.	Y coord	LEFT side Water press. kN/m2	Vertic -al kN/m2	Effective stresses Active limit kN/m2	Passive limit kN/m2	Earth pressure kN/m2	Total earth pressure kN/m2	Coeff. of subgrade reaction kN/m3
1	45.80	0.00	0.00	0.00	0.00	0.00	0.00	4583
2	45.69	0.00	1.98	0.54	9.95	1.70	1.70	4583
3	45.60	0.00	3.60	0.98	18.09	2.06	2.06	4583
4	45.40	0.00	7.20	1.97	36.20	2.86	2.86	4583
		Total>	7.20	2.00m	212.88	6.49	6.49	23239
5	44.85	Total>	18.30	4.75m	223.98	6.44	6.44	23239
6	44.50	Total>	25.56	6.50m	231.24	6.50	6.50a	23239
7	43.75	Total>	42.75	10.25m	248.43	10.25	10.25a	23239
8	43.00	Total>	61.63	14.00m	267.31	14.00	14.00a	13097
9	42.80	Total>	66.71	15.00m	272.39	15.00	15.00a	13097
10	42.00	Total>	86.49	19.00m	301.43	19.00	19.00a	14022
11	41.50	Total>	98.26	21.50m	318.98	24.42	24.42	14600
12	41.40	Total>	100.55	22.00m	322.43	25.72	25.72	14715
13	40.70	Total>	116.17	25.50m	346.15	34.78	34.78	15524
14	40.00	Total>	131.14	29.00m	369.21	45.60	45.60	16333
15	39.35	Total>	144.64	32.25m	390.24	59.15	59.15	17084
16	38.70	Total>	157.89	35.50m	411.00	77.03	77.03	11129
17	38.50	Total>	161.93	36.50m	417.36	83.38	83.38	11273
18	37.94	Total>	173.17	39.30m	435.07	102.59	102.59	11677
19	37.37	Total>	184.53	42.15m	453.03	122.54	122.54	12088
20	36.80	Total>	195.84	45.00m	470.94	140.87	140.87	12499
21	36.00	Total>	211.66	49.00m	496.01	162.62	162.62	13076
22	35.20	Total>	227.44	53.00m	521.05	180.65	180.65	13653
23	34.40	Total>	243.20	57.00m	546.06	196.69	196.69	14230
24	33.60	Total>	258.94	61.00m	571.06	212.09	212.09	14807
25	32.80	Total>	274.68	65.00m	596.05	227.57	227.57	15384
26	32.00	Total>	290.42	69.00m	621.05	243.32	243.32	15961
27	31.40	Total>	302.22	72.00m	639.79	255.29	255.29	16393
28	30.80	Total>	314.03	75.00m	658.54	267.35	267.35	16826

(continued)

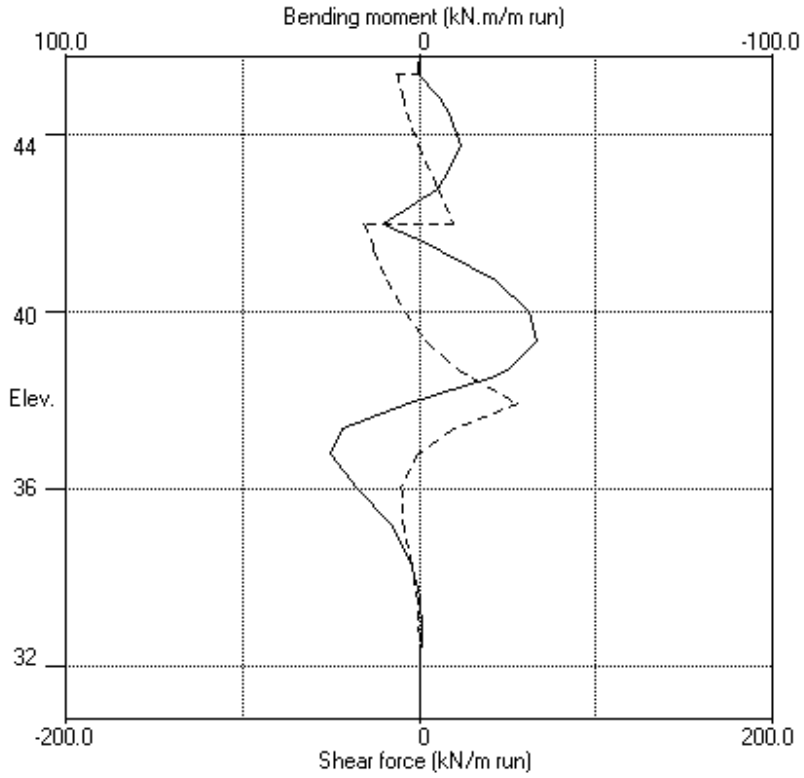
Stage No.11 Change EI of wall to 77684 kN.m2/m run
From elevation 41.50 to 38.50
Yield moment not defined
No adjustments to wall displacements

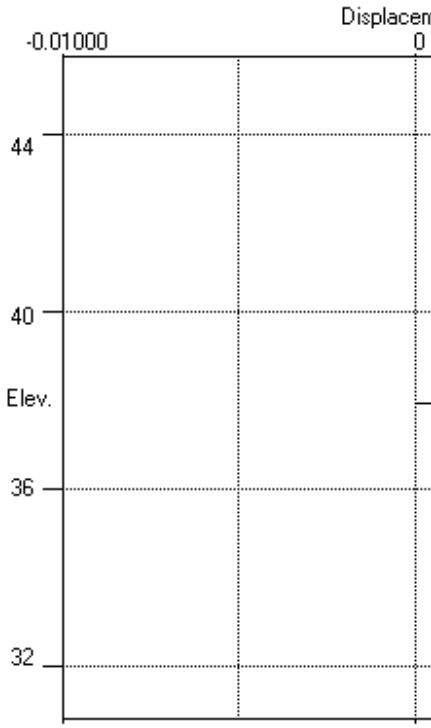
Node no.	Y coord	RIGHT side Water press. kN/m2	Effective stresses Vertic -al kN/m2	Active limit kN/m2	Passive limit kN/m2	Earth pressure kN/m2	Total earth pressure kN/m2	Coeff. of subgrade reaction kN/m3
1	45.80	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	45.69	0.00	0.00	0.00	0.00	0.00	0.00	0.0
3	45.60	0.00	0.00	0.00	0.00	0.00	0.00	0.0
4	45.40	0.00	0.00	0.00	0.00	0.00	0.00	0.0
5	44.85	0.00	0.00	0.00	0.00	0.00	0.00	0.0
6	44.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
7	43.75	0.00	0.00	0.00	0.00	0.00	0.00	0.0
8	43.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
9	42.80	2.00	0.00	0.00	0.00	0.00	2.00	0.0
10	42.00	10.00	0.00	0.00	0.00	0.00	10.00	0.0
11	41.50	15.00	0.00	0.00	0.00	0.00	15.00	0.0
12	41.40	16.00	0.00	0.00	0.00	0.00	16.00	0.0
13	40.70	23.00	0.00	0.00	0.00	0.00	23.00	0.0
14	40.00	30.00	0.00	0.00	0.00	0.00	30.00	0.0
15	39.35	36.50	0.00	0.00	0.00	0.00	36.50	0.0
16	38.70	43.00	0.00	0.00	0.00	0.00	43.00	0.0
17	38.50	45.00	0.00	0.00	0.00	0.00	45.00	0.0
18	37.94	50.60	0.00	0.00	0.00	0.00	50.60	0.0
		Total> 50.60	50.60w		312.51	180.40	180.40	11677
19	37.37	Total> 62.00	28.15m		330.50	169.97	169.97	12088
20	36.80	Total> 73.41	31.00m		348.51	163.62	163.62	12499
21	36.00	Total> 89.44	35.00m		373.79	164.80	164.80	13076
22	35.20	Total> 105.51	39.00m		399.12	175.50	175.50	13653
23	34.40	Total> 121.64	43.00m		424.50	191.37	191.37	14230
24	33.60	Total> 137.83	47.00m		449.95	208.92	208.92	14807
25	32.80	Total> 154.11	51.00m		475.48	226.39	226.39	15384
26	32.00	Total> 170.46	55.00m		501.09	243.31	243.31	15961
27	31.40	Total> 182.79	58.00m		520.36	255.72	255.72	16393
28	30.80	Total> 195.17	61.00m		539.68	268.01	268.01	16826

Note: 19.00a Soil pressure at active limit
123.45p Soil pressure at passive limit

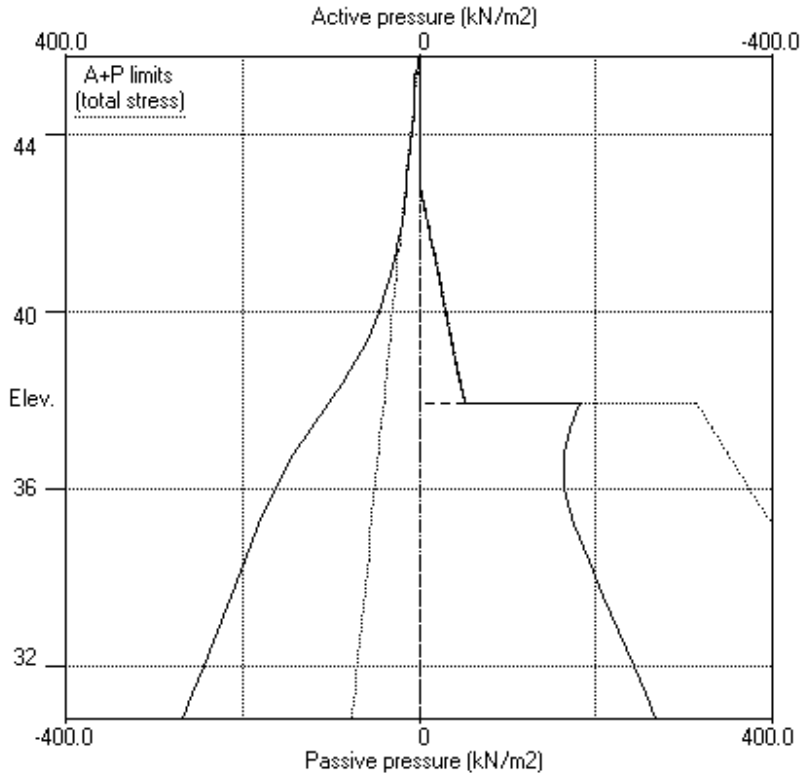
Units: kN,m

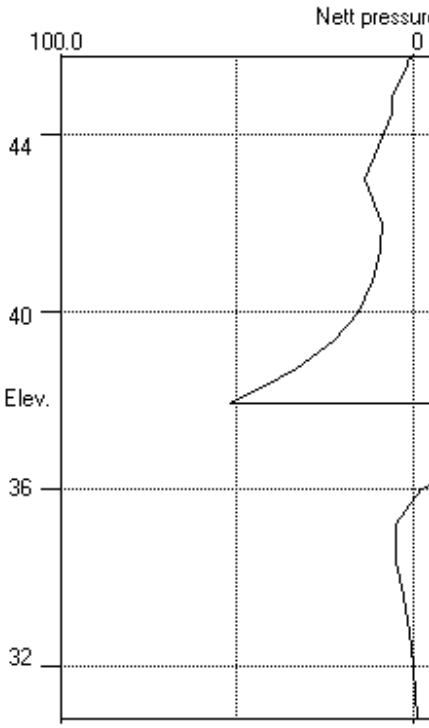
Stage No.11 Change EI of wall to 77684kN.m2/m run





Stage No.11 Change EI of wall to 77684kN.m2/m run





Units: kN,m

Stage No. 14 Change EI of wall to 77684 kN.m2/m run
From elevation 45.80 to 41.50
Yield moment not defined
No adjustments to wall displacements

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. = 30.80 Factor of Safety	Moment equilib. at elev.	Toe elev. for FoS = 1.000 Toe elev.	Wall Penetr -ation	Direction of failure
14	45.80	37.94		More than one strut. No FoS calc.				

BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall
Analysis options
Length of wall perpendicular to section = 15.00m
Subgrade reaction model - Boussinesq Influence coefficients
Soil deformations are elastic until the active or passive limit is reached
Open Tension Crack analysis - No

Rigid boundaries: Left side 30.00 from wall
Right side 30.00 from wall
Limit State: Serviceability Limit State
Calculated Bending Moments and Strut Forces are to be multiplied by a factor of 1.35 to obtain values for structural design. See summary for factored values.

*** Wall displacements reset to zero at stage 4

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	45.80	0.00	0.004	-8.95E-04	0.0	0.0		77684
2	45.69	1.83	0.004	-8.95E-04	0.1	-0.0		77684
3	45.60	2.02	0.004	-8.95E-04	0.3	0.0		77684
4	45.40	2.71	0.004	-8.95E-04	0.7	0.1	16.3	77684
		5.75	0.004	-8.95E-04	-15.6	0.1		
5	44.85	4.75	0.005	-8.42E-04	-12.7	-7.4		77684
6	44.50	6.50	0.005	-7.56E-04	-10.7	-11.4		77684
7	43.75	10.25	0.005	-4.86E-04	-4.4	-17.1		77684
8	43.00	14.00	0.006	-1.96E-04	4.7	-15.2		77684
9	42.80	13.00	0.006	-1.30E-04	7.4	-14.0		77684
10	42.00	9.00	0.006	-1.28E-05	16.2	-1.9		77684
11	41.50	8.00	0.006	-8.49E-05	20.4	8.2		77684
12	41.40	8.65	0.006	-9.88E-05	21.2	10.3	52.9	77684
		8.65	0.006	-9.88E-05	-31.7	10.3		
13	40.70	12.57	0.006	-4.50E-05	-24.3	-9.8		77684
14	40.00	17.28	0.006	2.63E-04	-13.8	-23.7		77684
15	39.35	24.49	0.005	6.80E-04	-0.2	-28.9		77684
16	38.70	35.61	0.005	1.08E-03	19.3	-23.5	-0.0	77684
17	38.50	39.82	0.005	1.18E-03	26.8	-18.9		41252
18	37.94	52.99	0.004	1.27E-03	52.8	2.6		41252
		-73.91	0.004	1.27E-03	52.8	2.6		
19	37.37	-45.31	0.003	1.10E-03	18.8	20.7		41252
20	36.80	-21.97	0.003	7.94E-04	-0.3	24.1		41252
21	36.00	-2.29	0.002	3.98E-04	-10.0	16.7		41252
22	35.20	4.89	0.002	1.62E-04	-9.0	8.0		41252

(continued)

Stage No.14 Change EI of wall to 77684 kN.m2/m run
From elevation 45.80 to 41.50
Yield moment not defined
No adjustments to wall displacements

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
23	34.40	5.11	0.002	6.80E-05	-5.0	2.3		41252
24	33.60	3.06	0.002	5.20E-05	-1.7	-0.1		41252
25	32.80	1.15	0.002	6.27E-05	-0.0	-0.6		41252
26	32.00	0.01	0.002	7.36E-05	0.4	-0.3		41252
27	31.40	-0.40	0.002	7.72E-05	0.3	-0.1		41252
28	30.80	-0.62	0.002	7.80E-05	0.0	0.0		---

At elev. 45.40 Strut force = 122.4 kN/strut = 16.3 kN/m run
At elev. 41.40 Strut force = 52.9 kN/strut = 52.9 kN/m run
At elev. 38.70 The strut is slack

Node no.	Y coord	LEFT side: Effective stresses: Water press. kN/m2	Vertic -al kN/m2	Active limit kN/m2	Passive limit kN/m2	Earth pressure kN/m2	Total earth pressure kN/m2	Coeff. of subgrade reaction kN/m3
1	45.80	0.00	0.00	0.00	0.00	0.00	0.00	2374
2	45.69	0.00	1.98	0.54	9.95	1.83	1.83	2374
3	45.60	0.00	3.60	0.98	18.09	2.02	2.02	2374
4	45.40	0.00	7.20	1.97	36.20	2.71	2.71	2374
		Total>	7.20	2.00m	212.88	5.75	5.75	12130
5	44.85	Total>	18.30	4.75m	223.98	4.75	4.75a	12130
6	44.50	Total>	25.56	6.50m	231.24	6.50	6.50a	12130
7	43.75	Total>	42.75	10.25m	248.43	10.25	10.25a	12130
8	43.00	Total>	61.63	14.00m	267.31	14.00	14.00a	12130
9	42.80	Total>	66.71	15.00m	272.39	15.00	15.00a	12130
10	42.00	Total>	86.49	19.00m	301.43	19.00	19.00a	12986
11	41.50	Total>	98.26	21.50m	318.98	23.00	23.00	13521
12	41.40	Total>	100.55	22.00m	322.43	24.65	24.65	13932
13	40.70	Total>	116.17	25.50m	346.15	35.57	35.57	14697
14	40.00	Total>	131.14	29.00m	369.21	47.28	47.28	15463
15	39.35	Total>	144.64	32.25m	390.24	60.99	60.99	16174
16	38.70	Total>	157.89	35.50m	411.00	78.61	78.61	16886
17	38.50	Total>	161.93	36.50m	417.36	84.82	84.82	17104
18	37.94	Total>	173.17	39.30m	435.07	103.59	103.59	17717
19	37.37	Total>	184.53	42.15m	453.03	123.09	123.09	18341
20	36.80	Total>	195.84	45.00m	470.94	141.07	141.07	18964
21	36.00	Total>	211.66	49.00m	496.01	162.56	162.56	19840
22	35.20	Total>	227.44	53.00m	521.05	180.52	180.52	26477
23	34.40	Total>	243.20	57.00m	546.06	196.58	196.58	27596
24	33.60	Total>	258.94	61.00m	571.06	212.04	212.04	28715
25	32.80	Total>	274.68	65.00m	596.05	227.56	227.56	29834
26	32.00	Total>	290.42	69.00m	621.05	243.32	243.32	30952
27	31.40	Total>	302.22	72.00m	639.79	255.30	255.30	105242
28	30.80	Total>	314.03	75.00m	658.54	267.37	267.37	108020

(continued)

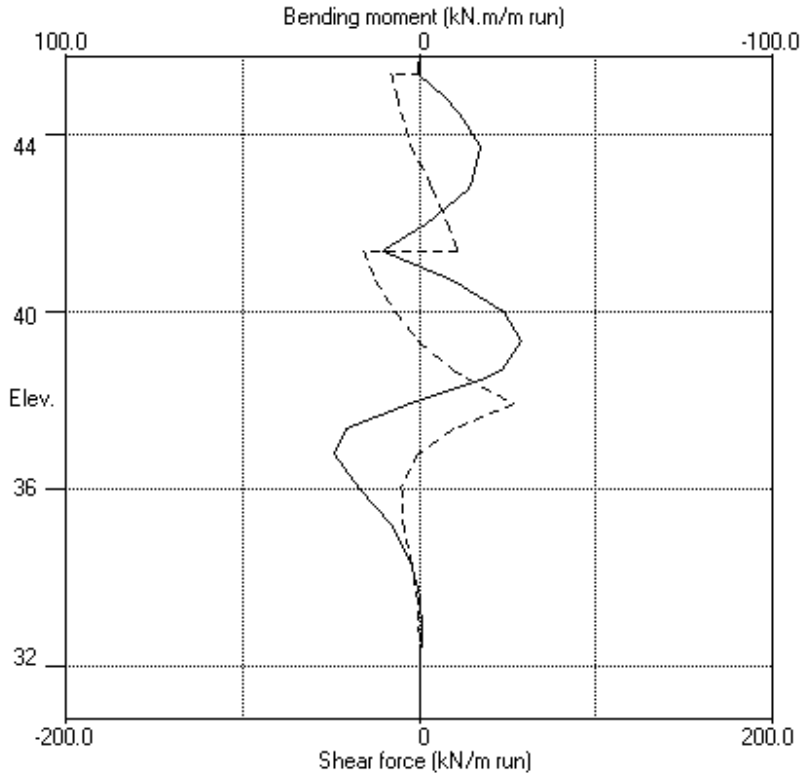
Stage No.14 Change EI of wall to 77684 kN.m2/m run
From elevation 45.80 to 41.50
Yield moment not defined
No adjustments to wall displacements

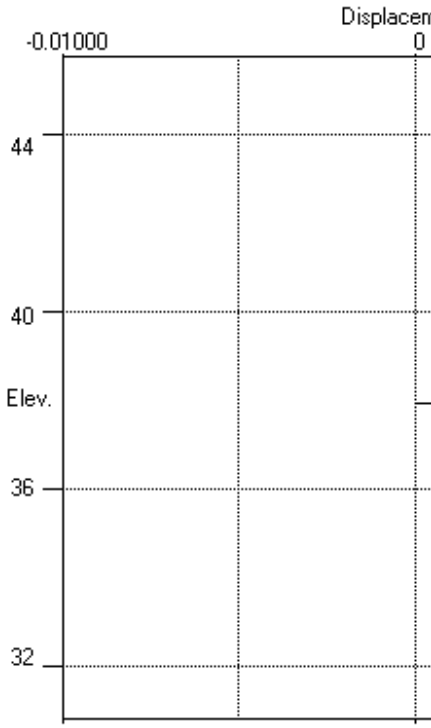
Node no.	Y coord	RIGHT side Water press. kN/m2	Effective stresses Vertic -al kN/m2	Active limit kN/m2	Passive limit kN/m2	Earth pressure kN/m2	Total earth pressure kN/m2	Coeff. of subgrade reaction kN/m3
1	45.80	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	45.69	0.00	0.00	0.00	0.00	0.00	0.00	0.0
3	45.60	0.00	0.00	0.00	0.00	0.00	0.00	0.0
4	45.40	0.00	0.00	0.00	0.00	0.00	0.00	0.0
5	44.85	0.00	0.00	0.00	0.00	0.00	0.00	0.0
6	44.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
7	43.75	0.00	0.00	0.00	0.00	0.00	0.00	0.0
8	43.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
9	42.80	2.00	0.00	0.00	0.00	0.00	2.00	0.0
10	42.00	10.00	0.00	0.00	0.00	0.00	10.00	0.0
11	41.50	15.00	0.00	0.00	0.00	0.00	15.00	0.0
12	41.40	16.00	0.00	0.00	0.00	0.00	16.00	0.0
13	40.70	23.00	0.00	0.00	0.00	0.00	23.00	0.0
14	40.00	30.00	0.00	0.00	0.00	0.00	30.00	0.0
15	39.35	36.50	0.00	0.00	0.00	0.00	36.50	0.0
16	38.70	43.00	0.00	0.00	0.00	0.00	43.00	0.0
17	38.50	45.00	0.00	0.00	0.00	0.00	45.00	0.0
18	37.94	50.60	0.00	0.00	0.00	0.00	50.60	0.0
		Total> 50.60	50.60w	312.51	177.50	177.50		42644
19	37.37	Total> 62.00	28.15m	330.50	168.40	168.40		44145
20	36.80	Total> 73.41	31.00m	348.51	163.04	163.04		45646
21	36.00	Total> 89.44	35.00m	373.79	164.85	164.85		47753
22	35.20	Total> 105.51	39.00m	399.12	175.63	175.63		26477
23	34.40	Total> 121.64	43.00m	424.50	191.47	191.47		27596
24	33.60	Total> 137.83	47.00m	449.95	208.97	208.97		28715
25	32.80	Total> 154.11	51.00m	475.48	226.41	226.41		29834
26	32.00	Total> 170.46	55.00m	501.09	243.31	243.31		30952
27	31.40	Total> 182.79	58.00m	520.36	255.71	255.71		105242
28	30.80	Total> 195.17	61.00m	539.68	267.99	267.99		108020

Note: 19.00a Soil pressure at active limit
123.45p Soil pressure at passive limit

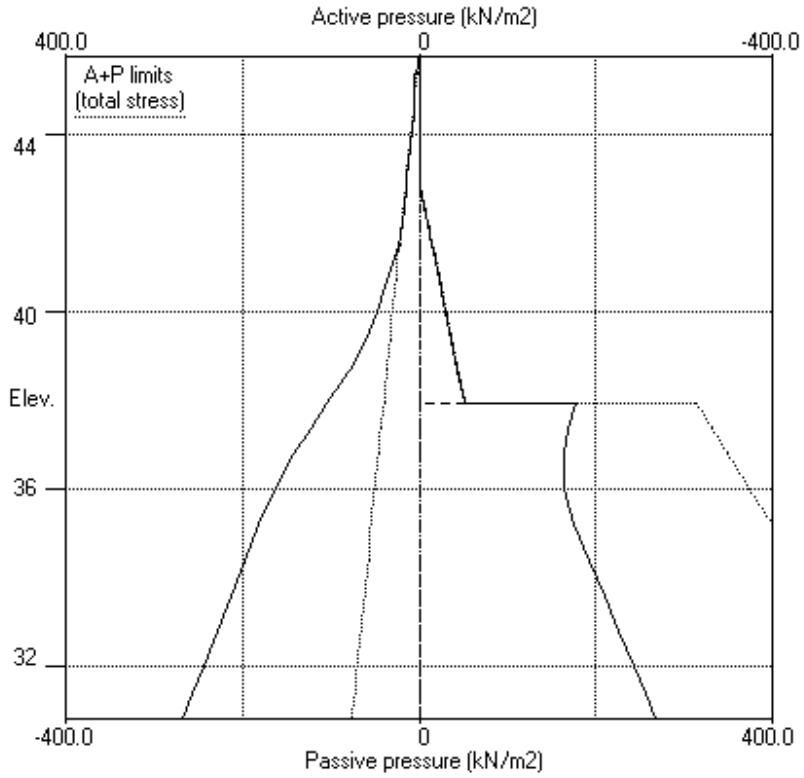
Units: kN,m

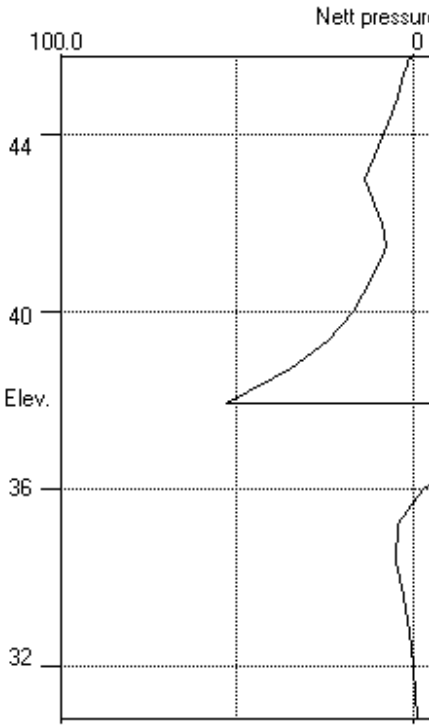
Stage No.14 Change EI of wall to 77684kN.m2/m run





Stage No.14 Change EI of wall to 77684kN.m2/m run





Units: kN,m

Stage No. 20 Change EI of wall to 38842 kN.m2/m run
From elevation 45.80 to 38.50
Yield moment not defined
No adjustments to wall displacements

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. = 30.80 Factor of Safety	Moment equilib. at elev.	Toe elev. for FoS = 1.000	Wall Penetr -ation	Direction of failure
20	45.80	37.94		More than one strut. No FoS calc.				

BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall
Analysis options
Length of wall perpendicular to section = 15.00m
Subgrade reaction model - Boussinesq Influence coefficients
Soil deformations are elastic until the active or passive limit is reached
Open Tension Crack analysis - No

Rigid boundaries: Left side 30.00 from wall
Right side 30.00 from wall
Limit State: Serviceability Limit State
Calculated Bending Moments and Strut Forces are to be multiplied by a factor of 1.35 to obtain values for structural design. See summary for factored values.

*** Wall displacements reset to zero at stage 4

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	45.80	0.00	0.004	-1.34E-03	0.0	0.0		38842
2	45.69	1.73	0.004	-1.34E-03	0.1	-0.0	19.2	38842
		1.73	0.004	-1.34E-03	-19.1	-0.0		
3	45.60	1.82	0.004	-1.34E-03	-19.0	-1.7		38842
4	45.40	2.30	0.004	-1.33E-03	-18.5	-5.5		38842
		3.71	0.004	-1.33E-03	-18.5	-5.5		
5	44.85	1.27	0.005	-1.21E-03	-17.2	-14.9		38842
6	44.50	3.00	0.005	-1.07E-03	-16.4	-20.8		38842
7	43.75	14.83	0.006	-6.05E-04	-9.7	-30.9		38842
8	43.00	27.32	0.006	-5.14E-05	6.1	-30.9		38842
9	42.80	30.66	0.006	8.95E-05	11.9	-29.1		38842
10	42.00	43.84	0.006	4.02E-04	41.7	-5.9		38842
11	41.50	51.85	0.006	2.92E-04	65.6	21.7		38842
12	41.40	53.43	0.006	2.46E-04	70.9	28.5	144.1	38842
		53.43	0.006	2.46E-04	-73.3	28.5		
13	40.70	64.30	0.006	1.51E-04	-32.1	-9.2		38842
14	40.00	74.93	0.006	3.64E-04	16.7	-15.3		38842
15	39.35	84.64	0.005	4.24E-04	68.5	11.7		38842
16	38.70	94.26	0.005	-9.01E-05	126.7	74.4	263.7	38842
		94.26	0.005	-9.01E-05	-137.0	74.4		
17	38.50	97.20	0.005	-3.21E-04	-117.9	48.9		41252
18	37.94	99.82	0.005	-6.55E-04	-62.7	-2.0		41252
		74.72	0.005	-6.55E-04	-62.7	-2.0		
19	37.37	56.63	0.006	-4.60E-04	-25.3	-27.6		41252
20	36.80	38.50	0.006	-3.48E-05	1.8	-34.6		41252

(continued)

Stage No.20 Change EI of wall to 38842 kN.m2/m run
From elevation 45.80 to 38.50
Yield moment not defined
No adjustments to wall displacements

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
21	36.00	12.94	0.006	5.39E-04	22.4	-24.7		41252
22	35.20	-12.81	0.005	8.37E-04	22.4	-5.6		41252
23	34.40	-19.09	0.004	7.94E-04	9.7	10.5		41252
24	33.60	-7.95	0.004	5.80E-04	-1.1	12.1		41252
25	32.80	-1.48	0.004	3.83E-04	-4.9	8.6		41252
26	32.00	1.71	0.003	2.62E-04	-4.8	4.1		41252
27	31.40	3.05	0.003	2.22E-04	-3.4	1.5		41252
28	30.80	8.20	0.003	2.11E-04	0.0	0.0		---
At elev. 45.69 Strut force = 19.2 kN/strut = 19.2 kN/m run								
At elev. 41.40 Strut force = 144.1 kN/strut = 144.1 kN/m run								
At elev. 38.70 Strut force = 263.7 kN/strut = 263.7 kN/m run								

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	45.80	0.00	0.00	0.00	0.00	0.00	0.00	69158
2	45.69	0.00	1.98	0.54	9.95	1.73	1.73	2466
3	45.60	0.00	3.60	0.98	18.09	1.82	1.82	2466
4	45.40	0.00	7.20	1.97	36.20	2.30	2.30	2466
		0.00	7.20	0.00	46.91	3.71	3.71	12091
5	44.85	0.00	19.40	0.00	83.85	1.27	1.27	12091
6	44.50	0.00	27.36	3.00	107.96	3.00	3.00a	12091
7	43.75	7.50	38.55	7.33	141.83	7.33	14.83a	12091
8	43.00	15.00	51.43	12.32	180.83	12.32	27.32a	12091
9	42.80	17.00	54.91	13.66	191.36	13.66	30.66a	12091
		17.00	54.91	13.66	191.36	13.66	30.66a	11380
10	42.00	25.00	68.29	18.84	231.88	18.84	43.84a	11892
11	41.50	30.00	76.06	21.85	255.40	21.85	51.85a	12212
12	41.40	31.00	77.55	22.43	259.93	22.43	53.43a	12276
13	40.70	38.00	87.57	26.30	290.26	26.30	64.30a	20196
14	40.00	45.00	96.94	29.93	318.63	29.93	74.93a	20907
15	39.35	51.50	105.24	33.14	343.77	33.14	84.64a	21567
16	38.70	58.00	113.29	36.26	368.13	36.26	94.26a	12956
17	38.50	60.00	115.73	37.20	375.52	37.20	97.20a	13074
18	37.94	65.60	122.49	39.82	395.99	39.82	105.42a	13406
19	37.37	71.30	129.29	42.45	416.60	42.45	113.75a	13743
20	36.80	77.00	136.04	45.06	437.04	45.06	122.06a	14081
21	36.00	85.00	145.46	48.71	465.56	48.71	133.71a	14555
22	35.20	93.00	154.84	52.34	493.95	52.34	145.34a	15028
23	34.40	101.00	164.20	55.96	522.28	64.97	165.97	15502
24	33.60	109.00	173.54	59.57	550.58	79.45	188.45	15976
25	32.80	117.00	182.88	63.19	578.86	91.62	208.62	16450
26	32.00	125.00	192.22	66.80	607.13	102.02	227.02	16923
27	31.40	131.00	199.22	69.51	628.34	109.24	240.24	17279
28	30.80	137.00	206.23	72.23	649.56	118.37	255.37	198881

(continued)

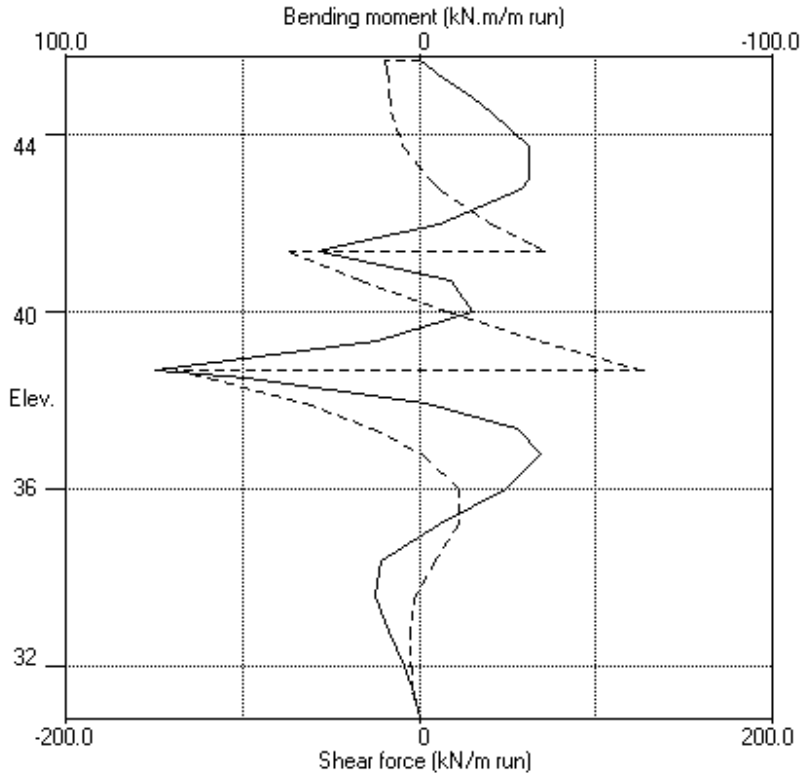
Stage No.20 Change EI of wall to 38842 kN.m2/m run
From elevation 45.80 to 38.50
Yield moment not defined
No adjustments to wall displacements

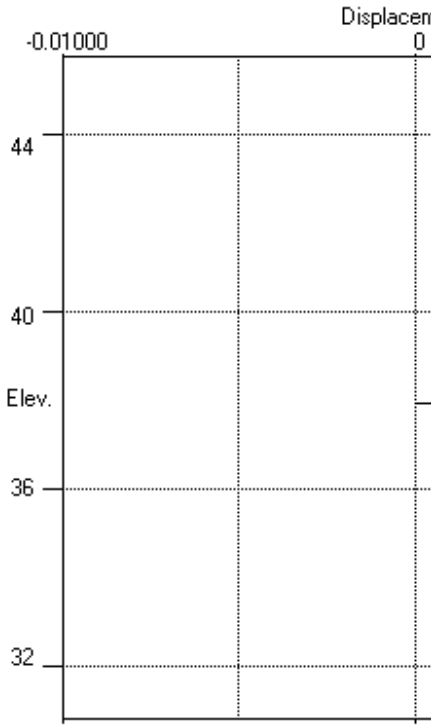
Node no.	Y coord	RIGHT side Water press. kN/m2	Effective stresses Vertic -al kN/m2	Active limit kN/m2	Passive limit kN/m2	Earth pressure kN/m2	Total earth pressure kN/m2	Coeff. of subgrade reaction kN/m3
1	45.80	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	45.69	0.00	0.00	0.00	0.00	0.00	0.00	0.0
3	45.60	0.00	0.00	0.00	0.00	0.00	0.00	0.0
4	45.40	0.00	0.00	0.00	0.00	0.00	0.00	0.0
5	44.85	0.00	0.00	0.00	0.00	0.00	0.00	0.0
6	44.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
7	43.75	0.00	0.00	0.00	0.00	0.00	0.00	0.0
8	43.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
9	42.80	0.00	0.00	0.00	0.00	0.00	0.00	0.0
10	42.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
11	41.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
12	41.40	0.00	0.00	0.00	0.00	0.00	0.00	0.0
13	40.70	0.00	0.00	0.00	0.00	0.00	0.00	0.0
14	40.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
15	39.35	0.00	0.00	0.00	0.00	0.00	0.00	0.0
16	38.70	0.00	0.00	0.00	0.00	0.00	0.00	0.0
17	38.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
18	37.94	5.60	0.00	0.00	0.00	0.00	5.60	0.0
		5.60	0.00	0.00	25.10	25.10	30.70p	13421
19	37.37	11.30	6.84	0.00	45.82	45.82	57.12p	13758
20	36.80	17.00	13.69	0.00	66.56	66.56	83.56p	14096
21	36.00	25.00	23.34	1.45	95.77	95.77	120.77p	14571
22	35.20	33.00	33.04	5.20	125.15	125.15	158.15p	15045
23	34.40	41.00	42.82	8.99	154.76	144.06	185.06	15519
24	33.60	49.00	52.70	12.81	184.67	147.40	196.40	15993
25	32.80	57.00	62.69	16.67	214.91	153.10	210.10	16468
26	32.00	65.00	72.79	20.59	245.52	160.30	225.30	16942
27	31.40	71.00	80.46	23.55	268.73	166.19	237.19	17298
28	30.80	77.00	88.20	26.55	292.17	170.18	247.18	198881

Note: 145.34a Soil pressure at active limit
158.15p Soil pressure at passive limit

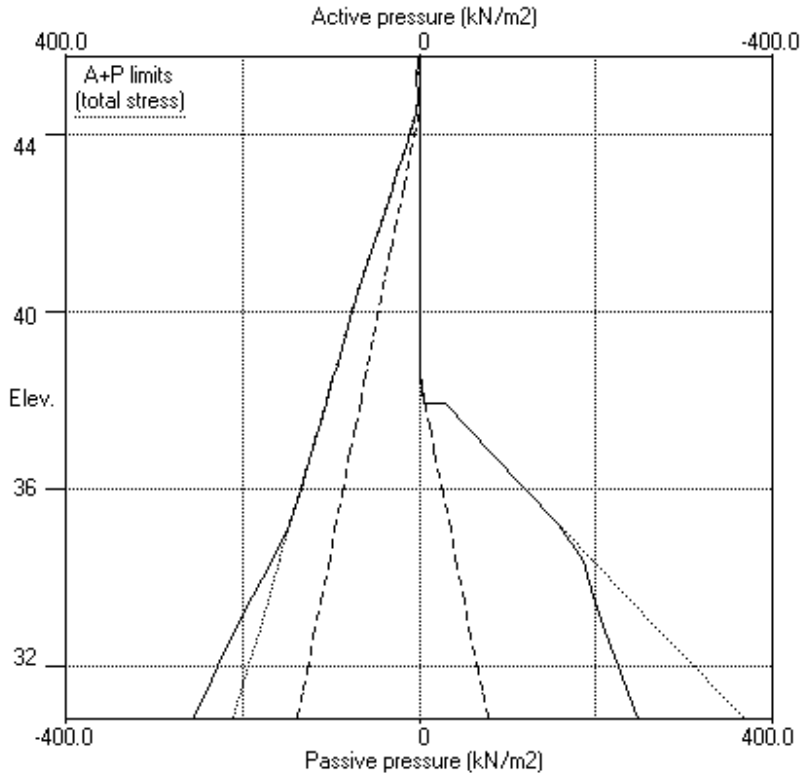
Units: kN,m

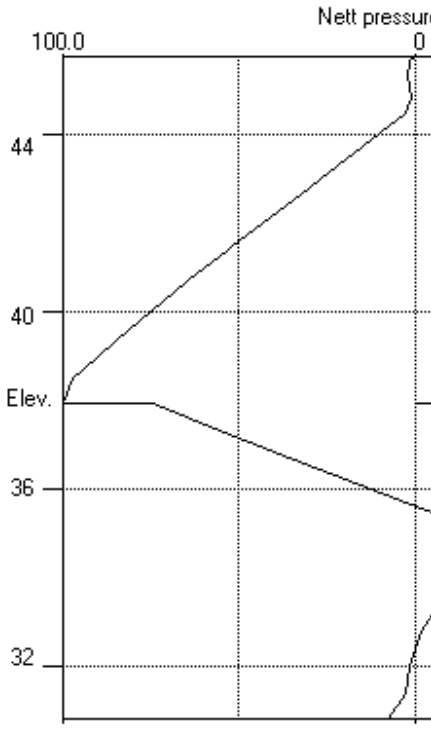
Stage No.20 Change EI of wall to 38842kN.m2/m run





Stage No.20 Change EI of wall to 38842kN.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. = 30.80 Factor of Safety	Moment equilib. at elev.	Toe elev. for FoS = 1.000	Wall Penetr -ation	Direction of failure
1	45.80	45.80	Cant.	Conditions not suitable for FoS calc.				
2	45.80	45.80		No analysis at this stage				
3	45.80	45.80	Cant.	Conditions not suitable for FoS calc.				
4	45.80	45.80		No analysis at this stage				
5	45.80	43.75	Cant.	8.747	31.36	43.59	0.16	L to R
6	45.80	43.75		No analysis at this stage				
7	45.80	41.50	45.40	6.754	n/a	41.41	0.09	L to R
8	45.80	41.50		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 = 15.00m
Subgrade reaction model - Boussinesq Influence coefficients
Soil deformations are elastic until the active or passive limit is reached
Open Tension Crack analysis - No

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

Limit State: Serviceability Limit State

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

Bending moment, shear force and displacement envelopes

Node no.	Y coord	Displacement		Bending moment 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	45.80	0.004	0.000	0	-0	0	-0	0	0	0	0
2	45.69	0.004	0.000	0	-0	0	-0	0	-19	0	-26
3	45.60	0.004	0.000	0	-2	0	-2	0	-19	0	-26
4	45.40	0.004	0.000	0	-5	0	-7	1	-19	1	-25
5	44.85	0.005	0.000	1	-15	1	-20	2	-17	3	-23
6	44.50	0.005	0.000	2	-21	3	-28	4	-16	6	-22
7	43.75	0.006	0.000	8	-31	10	-42	10	-10	14	-13
8	43.00	0.006	0.000	12	-31	16	-42	8	-2	11	-3
9	42.80	0.006	0.000	12	-29	16	-39	12	-4	16	-5
10	42.00	0.006	0.000	10	-15	13	-20	42	-31	56	-42
11	41.50	0.006	0.000	22	-4	29	-5	66	-26	89	-36
12	41.40	0.006	0.000	28	-6	38	-8	71	-73	96	-99
13	40.70	0.006	0.000	11	-22	15	-29	8	-32	11	-43
14	40.00	0.006	0.000	12	-31	17	-42	17	-14	23	-19
15	39.35	0.005	0.000	12	-33	16	-45	69	-5	93	-7
16	38.70	0.005	0.000	74	-25	100	-34	127	-137	171	-185
17	38.50	0.005	0.000	49	-20	66	-27	30	-118	40	-159
18	37.94	0.005	0.000	9	-2	13	-3	55	-63	74	-85
19	37.37	0.006	0.000	22	-28	29	-37	19	-25	26	-34
20	36.80	0.006	0.000	25	-35	34	-47	2	-6	2	-8
21	36.00	0.006	0.000	17	-25	23	-33	22	-11	30	-14
22	35.20	0.005	0.000	8	-6	11	-8	22	-9	30	-13
23	34.40	0.004	0.000	11	-2	14	-3	10	-5	13	-7
24	33.60	0.004	0.000	12	-2	16	-2	1	-2	1	-2
25	32.80	0.004	0.000	9	-1	12	-1	1	-5	1	-7
26	32.00	0.003	0.000	4	-0	6	-0	1	-5	1	-6
27	31.40	0.003	0.000	2	-0	2	-0	0	-3	0	-5
28	30.80	0.003	0.000	0	-0	0	-0	0	-0	0	-0

Summary of results (continued)

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

Maximum and minimum bending moment and shear force at each stage

Stage	Bending moment						Shear force					
no.	Calculated				Factored		Calculated				Factored	
	max.	elev.	min.	elev.	max.	min.	max.	elev.	min.	elev.	max.	min.
	kN.m/m		kN.m/m		kN.m/m		kN/m		kN/m		kN/m	kN/m
1	0	36.80	-0	42.00	0	-1	0	40.00	-0	43.75	0	-0
2	No calculation at this stage											
3	1	44.50	-3	40.70	1	-4	1	38.70	-2	42.80	1	-3
4	No calculation at this stage											
5	12	43.00	-2	39.35	16	-3	10	43.75	-6	42.00	14	-9
6	No calculation at this stage											
7	12	40.00	-25	43.00	17	-34	32	41.50	-19	45.40	43	-25
8	No calculation at this stage											
9	25	36.80	-33	39.35	34	-45	55	37.94	-31	42.00	74	-42
10	No calculation at this stage											
11	25	36.80	-33	39.35	34	-45	55	37.94	-31	42.00	74	-42
12	No calculation at this stage											
13	24	36.80	-29	39.35	32	-39	53	37.94	-32	41.40	71	-43
14	24	36.80	-29	39.35	32	-39	53	37.94	-32	41.40	71	-43
15	No calculation at this stage											
16	24	36.80	-29	39.35	32	-38	53	37.94	-32	41.40	71	-44
17	20	38.70	-25	40.00	27	-33	78	38.70	-52	41.40	106	-70
18	No calculation at this stage											
19	No calculation at this stage											
20	74	38.70	-35	36.80	100	-47	127	38.70	-137	38.70	171	-185

Maximum and minimum displacement at each stage

Stage	Displacement				Stage description
no.	maximum	elev.	minimum	elev.	
	m		m		
1	0.000	41.40	-0.000	45.80	Apply surcharge no.1 at elev. 44.85
2	No calculation at this stage				Apply surcharge no.2 at elev. 44.85
3	0.001	39.35	-0.000	45.80	Apply surcharge no.3 at elev. 45.60
4	Wall displacements reset to zero				Change EI of wall to 41252kN.m2/m run
5	0.004	45.80	0.000	45.80	Excav. to elev. 43.75 on RIGHT side
6	No calculation at this stage				Install strut no.4 at elev. 45.40
7	0.005	43.75	0.000	45.80	Excav. to elev. 41.50 on RIGHT side
8	No calculation at this stage				Install strut no.5 at elev. 42.00
9	0.006	40.70	0.000	45.80	Excav. to elev. 37.94 on RIGHT side
10	No calculation at this stage				Install strut no.3 at elev. 38.70
11	0.006	40.70	0.000	45.80	Change EI of wall to 77684kN.m2/m run
12	No calculation at this stage				Install strut no.2 at elev. 41.40
13	0.006	40.70	0.000	45.80	Remove strut no.5 at elev. 42.00
14	0.006	40.70	0.000	45.80	Change EI of wall to 77684kN.m2/m run
15	No calculation at this stage				Install strut no.1 at elev. 45.69
16	0.006	40.70	0.000	45.80	Remove strut no.4 at elev. 45.40
17	0.006	40.70	0.000	45.80	Apply water pressure profile no.1
18	No calculation at this stage				Change soil type 2 to soil type 4
19	No calculation at this stage				Change soil type 3 to soil type 5
20	0.006	43.00	0.000	45.80	Change EI of wall to 38842kN.m2/m run

Summary of results (continued)

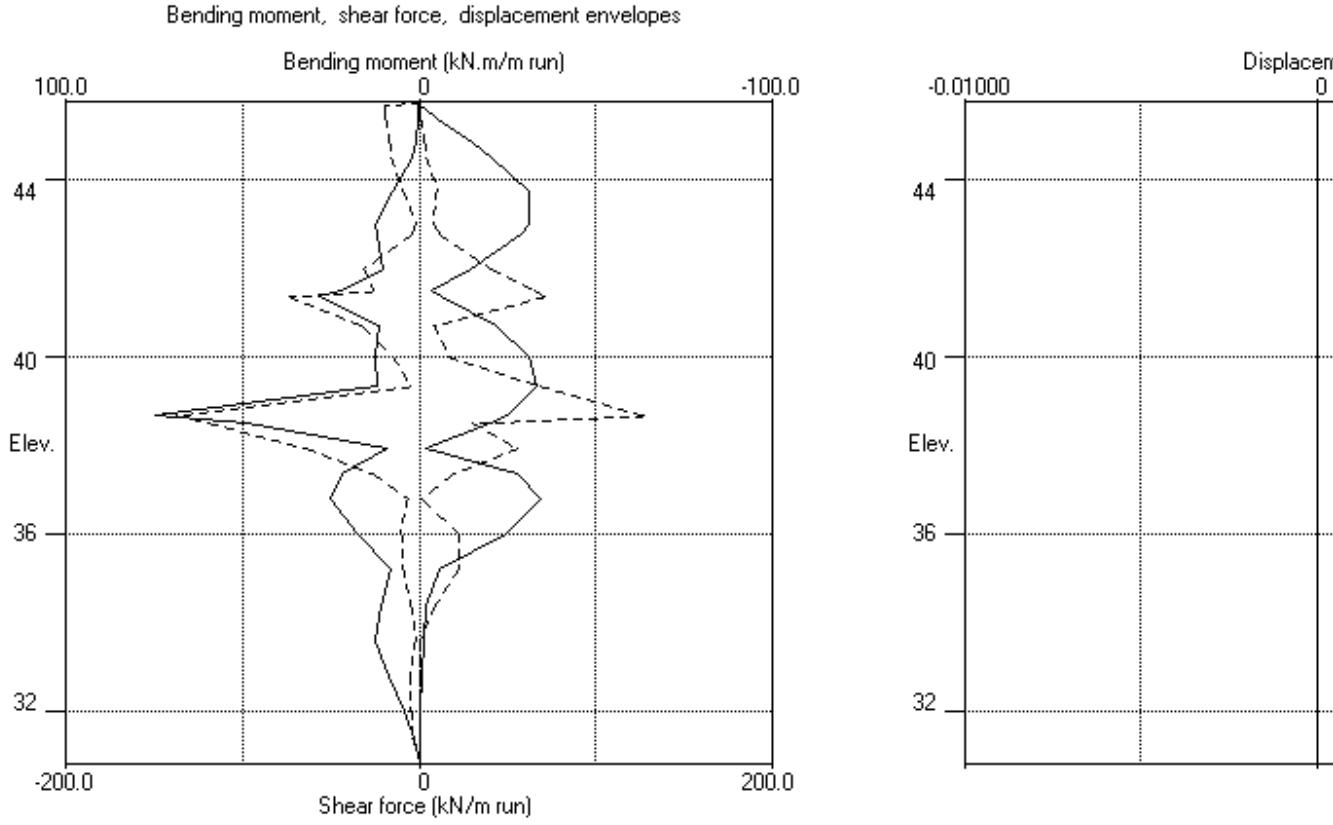
Calculated Bending Moments and Strut Forces have been multiplied by a factor of 1.35 to obtain values for structural design.

Strut forces at each stage (horizontal components)

Stage no.	Strut no. 1 at elev. 45.69			Strut no. 2 at elev. 41.40			Strut no. 3 at elev. 38.70		
	--Calculated-- kN per m run	kN per strut	Factored kN per strut	--Calculated-- kN per m run	kN per strut	Factored kN per strut	--Calculated-- kN per m run	kN per strut	Factored kN per strut
11	---	---	---	---	---	---	0	0	0
13	---	---	---	53	53	71	slack	slack	slack
14	---	---	---	53	53	71	slack	slack	slack
16	15	15	20	55	55	74	slack	slack	slack
17	15	15	20	88	88	118	124	124	167
20	19	19	26	144	144	195	264	264	356

Stage no.	Strut no. 4 at elev. 45.40			Strut no. 5 at elev. 42.00		
	--Calculated-- kN per m run	kN per strut	Factored kN per strut	--Calculated-- kN per m run	kN per strut	Factored kN per strut
7	19	144	194	---	---	---
9	14	103	139	51	380	513
11	14	103	139	51	380	513
13	16	122	165	---	---	---
14	16	122	165	---	---	---

Units: kN,m


Bending moment, shear force, displacement envelopes
Bending moment (kN.m/m run)
100.0
0
-100.0
44
40
Elev.
36
32
-200.0
0
200.0
Shear force (kN/m run)
-0.01000
0
Displacem

SECTION 1-1 ULS - COMBINATION 1

KNIGHT BUILD LTD | Sheet No.
Program: WALLAP Version 6.06 Revision A49.B68.R53 | Job No. 79AR
Licensed from GEOSOLVE | Made by : JRC
Data filename/Run ID: SECTION_1-1_ULS1 |
79 Avenue Road | Date:28-06-2021
SECTION 1-1 ANALYSIS | Checked :

Units: kN,m

INPUT DATA

SOIL PROFILE

Stratum no.	Elevation of top of stratum	Soil types Left side	Right side
1	45.80	1 Made Ground	1 Made Ground
2	45.40	2 Head	2 Head
3	42.80	3 London Clay	3 London Clay

SOIL PROPERTIES (Unfactored SLS soil strengths)

No.	Soil type -- Description (Datum elev.)	Bulk density kN/m3	Young's Modulus Eh,kN/m2 (dEh/dy)	At rest coeff. Ko (dKo/dy)	Consol state. NC/OC (Nu)	Active limit Ka (Kac)	Passive limit Kp (Kpc)	Cohesion kN/m2 (dc/dy)
1	Made Ground	18.00	13000	0.500	OC (0.200)	0.273 (0.000)	5.026 (0.000)	
2	Head	20.00	51000	1.000	OC (0.490)	1.000 (2.570)	1.000 (2.571)	80.00u
3	London Clay	20.00	51000	1.000	OC (0.490)	1.000 (2.570)	1.000 (2.571)	80.00u (4.500)
	(42.80)		(4500)					
4	Head (drained)	22.00	63750	0.625	OC (0.200)	0.387 (1.517)	3.028 (5.020)	5.000d
5	LC Drained	22.00	60000	0.625	OC (0.200)	0.387 (1.517)	3.028 (5.020)	5.000d
	(42.80)		(3375)					

Additional soil parameters associated with Ka and Kp

No.	Soil type Description	--- parameters for Ka --- Soil friction angle	Wall adhesion coeff.	Back-fill angle	--- parameters for Kp --- Soil friction angle	Wall adhesion coeff.	Back-fill angle
1	Made Ground	30.00	1.000	0.00	30.00	1.000	0.00
2	Head	0.00	1.000	0.00	0.00	0.995	0.00
3	London Clay	0.00	1.000	0.00	0.00	0.995	0.00
4	Head (drained)	22.01	1.000	0.00	22.00	1.000	0.00
5	LC Drained	22.01	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	43.00	43.00

Automatic water pressure balancing at toe of wall : No

Water press. profile no.	Left side Point no.	Elev. m	Piezo elev. m	Water press. kN/m2	Right side Point no.	Elev. m	Piezo elev. m	Water press. kN/m2	
1	1	44.50	44.50	0.0	1	38.50	38.50	0.0	MC+WC

WALL PROPERTIES

Type of structure = Fully Embedded Wall
Elevation of toe of wall = 30.80
Maximum finite element length = 0.80 m
Youngs modulus of wall E = 2.8000E+07 kN/m2
Moment of inertia of wall I = 1.4732E-03 m4/m run
E.I = 41251 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	45.69	1.00	0.250000	2.800E+07	15.00	0.00	0	No
2	41.40	1.00	0.250000	2.800E+07	10.00	0.00	0	No
3	38.70	1.00	0.450000	2.800E+07	10.00	0.00	0	No
4	45.40	7.50	0.016400	2.050E+08	10.00	0.00	0	No
5	42.00	7.50	0.016400	2.050E+08	10.00	30.00	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	44.85	1.60(L)	1000.00	0.60	10.00	=	N/A	1.00 -
2	44.85	2.70(L)	1000.00	0.80	85.00	=	N/A	1.00 -
3	45.60	2.70(L)	1000.00	20.00	12.50	=	N/A	1.00 -

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 44.85
	No analysis at this stage
2	Apply surcharge no.2 at elevation 44.85
	No analysis at this stage
3	Apply surcharge no.3 at elevation 45.60
4	Change EI of wall to 41252 kN.m2/m run
	Yield moment not defined
	Reset wall displacements to zero at this stage
5	Excavate to elevation 43.75 on RIGHT side
6	Install strut or anchor no.4 at elevation 45.40
7	Excavate to elevation 41.50 on RIGHT side
8	Install strut or anchor no.5 at elevation 42.00
9	Excavate to elevation 37.94 on RIGHT side
10	Fill to elevation 38.44 on RIGHT side with soil type 1
11	Install strut or anchor no.3 at elevation 38.70
12	Change EI of wall to 77684 kN.m2/m run
	From elevation 41.50 to 38.50
	Yield moment not defined
	No adjustments to wall displacements
13	Install strut or anchor no.2 at elevation 41.40
14	Remove strut or anchor no.5 at elevation 42.00
15	Change EI of wall to 77684 kN.m2/m run
	From elevation 45.80 to 41.50
	Yield moment not defined
	No adjustments to wall displacements
16	Install strut or anchor no.1 at elevation 45.69
17	Remove strut or anchor no.4 at elevation 45.40
18	Apply water pressure profile no.1 (Mod. Conserv.)
19	Change properties of soil type 2 to soil type 4
	No analysis at this stage
	Ko pressures will not be reset
20	Change properties of soil type 3 to soil type 5
	No analysis at this stage
	Ko pressures will not be reset
21	Change EI of wall to 20625 kN.m2/m run
	From elevation 38.50 to 30.80
	Yield moment not defined
	No adjustments to wall displacements
22	Change EI of wall to 38842 kN.m2/m run
	From elevation 45.80 to 38.50
	Yield moment not defined
	No adjustments to wall displacements

FACTORS OF SAFETY and ANALYSIS OPTIONS

Limit State options: ULS DA1 Combination 1
Water pressures : Moderately Conservative
Partial factor on C' = 1.000
Partial factor on Phi' = 1.000
Partial factor on Cu = 1.000
Partial factor on Soil Modulus = 1.000
Partial factor on Permanent Unfavourable loads = 1.000
Partial factor on Permanent Favourable loads = 1.000
Partial factor on Variable Unfavourable loads = 1.100
Design factor on calculated Bending Moments = 1.350

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

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

Boundary conditions:
Length of wall (normal to plane of analysis) = 15.00 m

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

Distance to rigid boundary on Left side = 30.00 m
Distance to rigid boundary on Right side = 30.00 m

OUTPUT OPTIONS

Stage no.	Stage description	Output options: Displacement, Bending mom., Shear force	Active, Passive pressures	Graph. output
1	Apply surcharge no.1 at elev. 44.85	Yes	Yes	Yes
2	Apply surcharge no.2 at elev. 44.85	No	No	No
3	Apply surcharge no.3 at elev. 45.60	Yes	Yes	Yes
4	Change EI of wall to 41252kN.m2/m run	No	No	No
5	Excav. to elev. 43.75 on RIGHT side	Yes	Yes	Yes
6	Install strut no.4 at elev. 45.40	No	No	No
7	Excav. to elev. 41.50 on RIGHT side	Yes	Yes	Yes
8	Install strut no.5 at elev. 42.00	No	No	No
9	Excav. to elev. 37.94 on RIGHT side	No	No	No
10	Fill to elev. 38.44 on RIGHT side	No	No	No
11	Install strut no.3 at elev. 38.70	Yes	Yes	Yes
12	Change EI of wall to 77684kN.m2/m run	No	No	No
13	Install strut no.2 at elev. 41.40	No	No	No
14	Remove strut no.5 at elev. 42.00	No	No	No
15	Change EI of wall to 77684kN.m2/m run	No	No	No
16	Install strut no.1 at elev. 45.69	No	No	No
17	Remove strut no.4 at elev. 45.40	No	No	No
18	Apply water pressure profile no.1	Yes	Yes	Yes
19	Change soil type 2 to soil type 4	No	No	No
20	Change soil type 3 to soil type 5	No	No	No
21	Change EI of wall to 20625kN.m2/m run	No	No	No
22	Change EI of wall to 38842kN.m2/m run	Yes	Yes	Yes
*	Summary output	Yes	-	Yes

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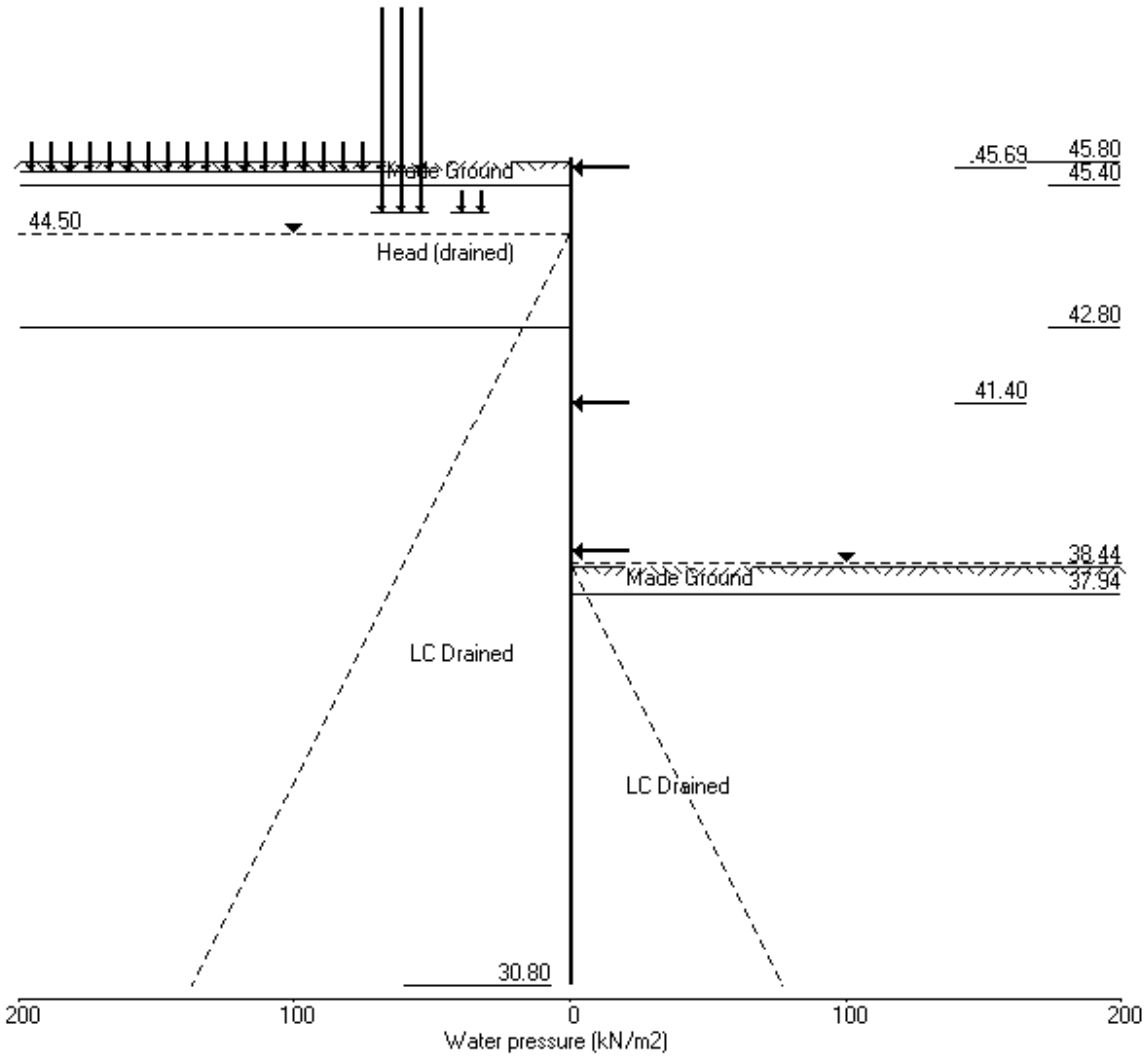
Units: kN,m

Stage No.22 Change EI of wall to 38842kN.m2/m run



Units: kN,m

Stage No. 5 Excavate to elevation 43.75 on RIGHT side

BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall

Analysis options

Length of wall perpendicular to section = 15.00m
Subgrade reaction model - Boussinesq Influence coefficients
Soil deformations are elastic until the active or passive limit is reached
Open Tension Crack analysis - No

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

Limit State: ULS DA1 Combination 1

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

*** Wall displacements reset to zero at stage 4

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	45.80	0.00	0.004	8.47E-04	0.0	0.0		41252
2	45.69	0.54	0.004	8.47E-04	0.0	-0.0		41252
3	45.60	0.98	0.004	8.47E-04	0.1	0.0		41252
4	45.40	1.97	0.004	8.47E-04	0.4	0.1		41252
		2.00	0.004	8.47E-04	0.4	0.1		
5	44.85	4.75	0.003	8.46E-04	2.2	0.9		41252
6	44.50	6.50	0.003	8.39E-04	4.2	2.0		41252
7	43.75	10.25	0.002	7.63E-04	10.5	7.5		41252
		-22.71	0.002	7.63E-04	10.5	7.5		
8	43.00	-10.25	0.002	5.81E-04	-1.9	12.2		41252
9	42.80	-6.87	0.002	5.18E-04	-3.6	11.6		41252
10	42.00	0.01	0.001	3.02E-04	-6.3	7.0		41252
11	41.50	2.17	0.001	2.03E-04	-5.8	3.9		41252
12	41.40	2.44	0.001	1.87E-04	-5.5	3.3		41252
13	40.70	3.14	0.001	1.03E-04	-3.6	0.2		41252
14	40.00	2.57	0.001	6.31E-05	-1.6	-1.5		41252
15	39.35	1.66	0.001	5.00E-05	-0.2	-2.0		41252
16	38.70	0.79	0.001	4.88E-05	0.6	-1.8		41252
17	38.50	0.56	0.001	4.96E-05	0.7	-1.6		41252
18	38.44	0.50	0.001	4.99E-05	0.7	-1.6		41252
19	37.94	0.08	0.001	5.27E-05	0.9	-1.1		41252
20	37.37	-0.21	0.001	5.53E-05	0.9	-0.6		41252
21	36.80	-0.33	0.001	5.66E-05	0.7	-0.2		41252
22	36.00	-0.33	0.001	5.60E-05	0.4	0.2		41252
23	35.20	-0.23	0.001	5.34E-05	0.2	0.4		41252
24	34.40	-0.14	0.001	4.99E-05	0.1	0.5		41252
25	33.60	-0.08	0.001	4.65E-05	-0.0	0.4		41252
26	32.80	-0.05	0.001	4.36E-05	-0.1	0.3		41252
27	32.00	-0.01	0.001	4.16E-05	-0.1	0.2		41252
28	31.40	0.07	0.001	4.08E-05	-0.1	0.1		41252
29	30.80	0.21	0.001	4.06E-05	-0.0	-0.0		---

(continued)

Stage No.5 Excavate to elevation 43.75 on RIGHT side

Node no.	Y coord	LEFT side ------- Effective stresses ------- Water press. kN/m2	Vertic -al kN/m2	Active limit kN/m2	Passive limit kN/m2	Earth pressure kN/m2	Total earth pressure kN/m2	Coeff. of subgrade reaction kN/m3
1	45.80	0.00	0.00	0.00	0.00	0.00	0.00	2728
2	45.69	0.00	1.98	0.54	9.95	0.54	0.54a	2728
3	45.60	0.00	3.60	0.98	18.09	0.98	0.98a	2728
4	45.40	0.00	7.20	1.97	36.20	1.97	1.97a	2728
		Total>	7.20	2.00m	212.88	2.00	2.00a	13912
5	44.85	Total>	18.30	4.75m	223.99	4.75	4.75a	13912
6	44.50	Total>	25.56	6.50m	231.25	6.50	6.50a	13912
7	43.75	Total>	42.75	10.25m	248.44	10.25	10.25a	13912
8	43.00	Total>	61.63	14.00m	267.33	32.44	32.44	13912
9	42.80	Total>	66.71	15.00m	272.40	38.73	38.73	13912
10	42.00	Total>	86.49	19.00m	301.44	60.16	60.16	14894
11	41.50	Total>	98.26	21.50m	319.00	72.15	72.15	15507
12	41.40	Total>	100.55	22.00m	322.45	74.44	74.44	15630
13	40.70	Total>	116.17	25.50m	346.17	89.61	89.61	16489
14	40.00	Total>	131.14	29.00m	369.24	103.82	103.82	17349
15	39.35	Total>	144.64	32.25m	390.26	116.62	116.62	18146
16	38.70	Total>	157.89	35.50m	411.03	129.33	129.33	18944
17	38.50	Total>	161.93	36.50m	417.39	133.24	133.24	19190
18	38.44	Total>	163.14	36.80m	419.29	134.42	134.42	19263
19	37.94	Total>	173.17	39.30m	435.11	144.26	144.26	19877
20	37.37	Total>	184.53	42.15m	453.07	155.55	155.55	20577
21	36.80	Total>	195.84	45.00m	470.97	166.91	166.91	21276
22	36.00	Total>	211.66	49.00m	496.05	182.93	182.93	22258
23	35.20	Total>	227.44	53.00m	521.09	199.00	199.00	23240
24	34.40	Total>	243.20	57.00m	546.10	215.07	215.07	24222
25	33.60	Total>	258.94	61.00m	571.10	231.14	231.14	25204
26	32.80	Total>	274.68	65.00m	596.10	247.21	247.21	26186
27	32.00	Total>	290.42	69.00m	621.09	263.30	263.30	27168
28	31.40	Total>	302.22	72.00m	639.84	275.39	275.39	27905
29	30.80	Total>	314.03	75.00m	658.59	287.53	287.53	28641

Node no.	Y coord	RIGHT side ------- Effective stresses ------- Water press. kN/m2	Vertic -al kN/m2	Active limit kN/m2	Passive limit kN/m2	Earth pressure kN/m2	Total earth pressure kN/m2	Coeff. of subgrade reaction kN/m3
1	45.80	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	45.69	0.00	0.00	0.00	0.00	0.00	0.00	0.0
3	45.60	0.00	0.00	0.00	0.00	0.00	0.00	0.0
4	45.40	0.00	0.00	0.00	0.00	0.00	0.00	0.0
5	44.85	0.00	0.00	0.00	0.00	0.00	0.00	0.0
6	44.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
7	43.75	0.00	0.00	0.00	0.00	0.00	0.00	0.0
		Total>	0.00	0.00	205.68	32.96	32.96	12379
8	43.00	Total>	15.00	3.75m	220.68	42.69	42.69	12379
9	42.80	Total>	19.00	4.75m	224.69	45.60	45.60	12379
10	42.00	Total>	35.01	8.75m	249.95	60.15	60.15	13252
11	41.50	Total>	45.02	11.25m	265.75	69.98	69.98	13799
12	41.40	Total>	47.03	11.75m	268.91	72.00	72.00	13908
13	40.70	Total>	61.06	15.25m	291.04	86.47	86.47	14672
14	40.00	Total>	75.11	18.75m	313.19	101.24	101.24	15437
15	39.35	Total>	88.17	22.00m	333.78	114.96	114.96	16147
16	38.70	Total>	101.25	25.25m	354.38	128.54	128.54	16857
17	38.50	Total>	105.28	26.25m	360.73	132.68	132.68	17075

(continued)

Stage No.5 Excavate to elevation 43.75 on RIGHT side

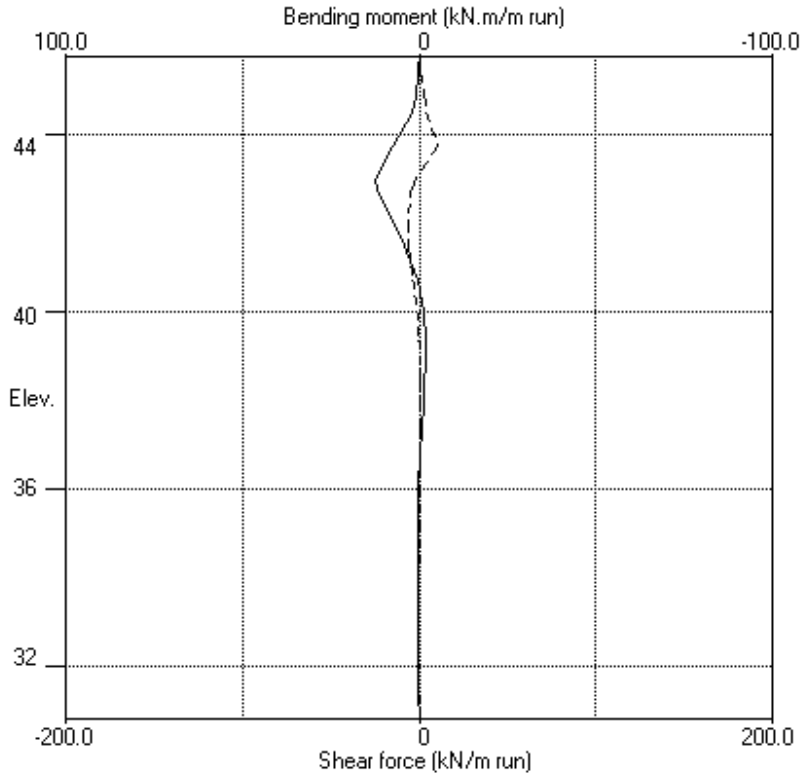
Node no.	Y coord	RIGHT side						
		Effective stresses					Total earth pressure	Coeff. of subgrade reaction
		Water press. kN/m2	Vertic -al kN/m2	Active limit kN/m2	Passive limit kN/m2	Earth pressure kN/m2		
18	38.44	Total>	106.49	26.55m	362.63	133.92	133.92	17141
19	37.94	Total>	116.58	29.05m	378.50	144.18	144.18	17687
20	37.37	Total>	128.09	31.90m	396.61	155.76	155.76	18309
21	36.80	Total>	139.62	34.75m	414.74	167.24	167.24	18932
22	36.00	Total>	155.84	38.75m	440.21	183.26	183.26	19806
23	35.20	Total>	172.09	42.75m	465.72	199.23	199.23	20680
24	34.40	Total>	188.37	46.75m	491.26	215.21	215.21	21553
25	33.60	Total>	204.69	50.75m	516.84	231.22	231.22	22427
26	32.80	Total>	221.04	54.75m	542.45	247.26	247.26	23301
27	32.00	Total>	237.42	58.75m	568.08	263.30	263.30	24175
28	31.40	Total>	249.72	61.75m	587.32	275.33	275.33	24830
29	30.80	Total>	262.03	64.75m	606.58	287.33	287.33	25485

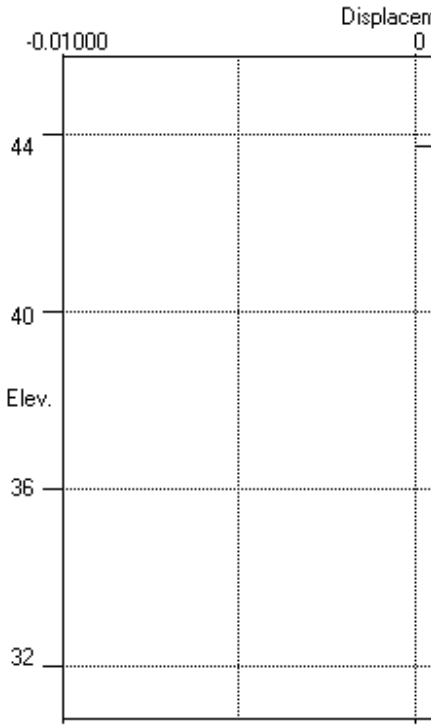
Note: 10.25a Soil pressure at active limit
123.45p Soil pressure at passive limit

KNIGHT BUILD LTD | Sheet No.
Program: WALLAP Version 6.06 Revision A49.B68.R53 | Job No. 79AR
Licensed from GEOSOLVE | Made by : JRC
Data filename/Run ID: SECTION_1-1_ULS1 |
79 Avenue Road | Date:28-06-2021
SECTION 1-1 ANALYSIS | Checked :

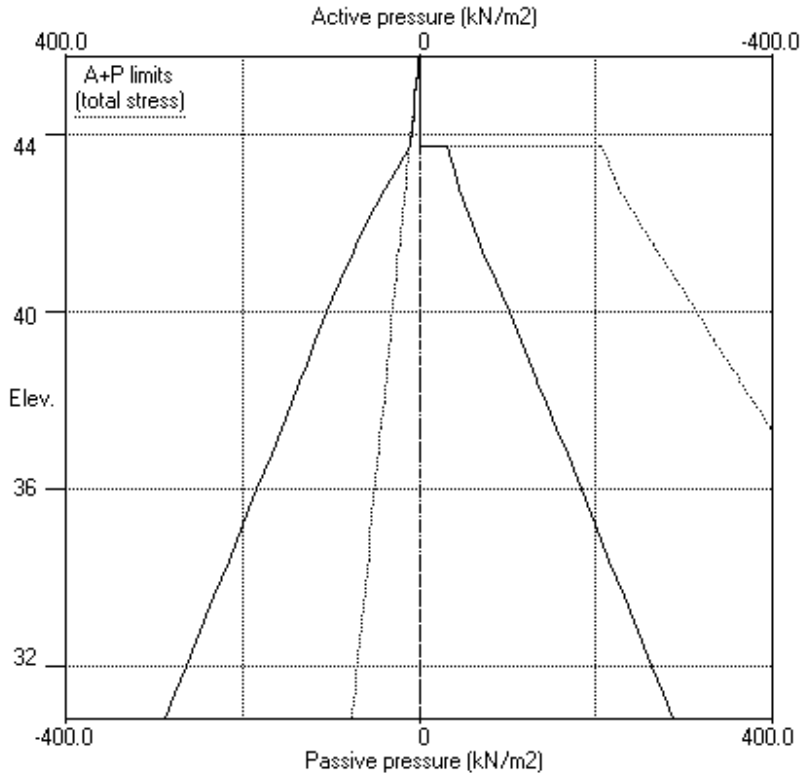
Units: kN,m

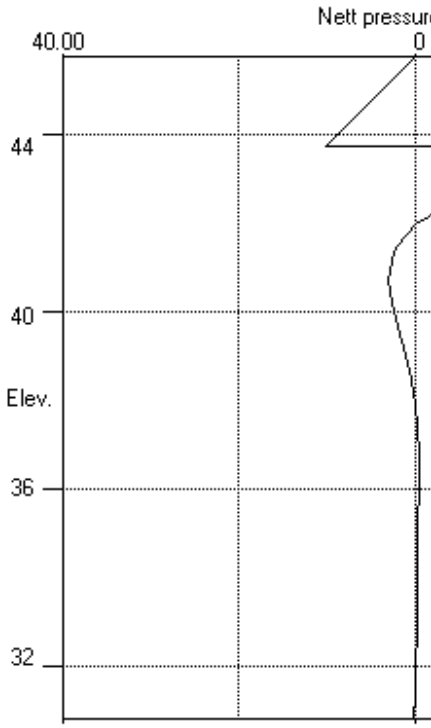
Stage No.5 Excav. to elev. 43.75 on RIGHT side





Stage No.5 Excav. to elev. 43.75 on RIGHT side





Units: kN,m

Stage No. 7 Excavate to elevation 41.50 on RIGHT side

BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall

Analysis options

Length of wall perpendicular to section = 15.00m
Subgrade reaction model - Boussinesq Influence coefficients
Soil deformations are elastic until the active or passive limit is reached
Open Tension Crack analysis - No

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

Limit State: ULS DA1 Combination 1

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

*** Wall displacements reset to zero at stage 4

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	45.80	0.00	0.004	-5.57E-04	0.0	0.0		41252
2	45.69	0.54	0.004	-5.57E-04	0.0	-0.0		41252
3	45.60	0.98	0.004	-5.57E-04	0.1	0.0		41252
4	45.40	1.97	0.004	-5.57E-04	0.4	0.1	19.1	41252
		2.00	0.004	-5.57E-04	-18.7	0.1		
5	44.85	4.75	0.004	-4.88E-04	-16.9	-9.7		41252
6	44.50	6.50	0.005	-3.77E-04	-14.9	-15.2		41252
7	43.75	10.25	0.005	-9.37E-06	-8.6	-24.0		41252
8	43.00	14.00	0.005	4.35E-04	0.5	-25.3		41252
9	42.80	13.00	0.004	5.52E-04	3.2	-24.9		41252
10	42.00	23.49	0.004	9.00E-04	17.7	-14.6		41252
11	41.50	33.29	0.003	9.71E-04	31.9	-2.5		41252
		-38.40	0.003	9.71E-04	31.9	-2.5		
12	41.40	-36.15	0.003	9.66E-04	28.2	0.5		41252
13	40.70	-20.67	0.003	8.11E-04	8.3	11.5		41252
14	40.00	-8.58	0.002	5.57E-04	-1.9	12.3		41252
15	39.35	-1.63	0.002	3.46E-04	-5.2	9.3		41252
16	38.70	1.74	0.002	1.98E-04	-5.2	5.6		41252
17	38.50	2.23	0.002	1.66E-04	-4.8	4.6		41252
18	38.44	2.34	0.002	1.58E-04	-4.7	4.3		41252
19	37.94	2.69	0.002	1.04E-04	-3.4	2.3		41252
20	37.37	2.31	0.002	7.41E-05	-2.0	0.8		41252
21	36.80	1.60	0.002	6.45E-05	-0.9	-0.0		41252
22	36.00	0.67	0.002	6.64E-05	0.0	-0.2		41252
23	35.20	0.08	0.001	7.23E-05	0.3	-0.0		41252
24	34.40	-0.17	0.001	7.53E-05	0.3	0.2		41252
25	33.60	-0.22	0.001	7.46E-05	0.2	0.4		41252
26	32.80	-0.17	0.001	7.19E-05	-0.0	0.3		41252
27	32.00	-0.07	0.001	6.91E-05	-0.1	0.2		41252
28	31.40	0.06	0.001	6.79E-05	-0.1	0.1		41252
29	30.80	0.28	0.001	6.75E-05	-0.0	-0.0		---

At elev. 45.40 Strut force = 143.6 kN/strut = 19.1 kN/m run

(continued)

Stage No.7 Excavate to elevation 41.50 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	45.80	0.00	0.00	0.00	0.00	0.00	0.00	62503
2	45.69	0.00	1.98	0.54	9.95	0.54	0.54a	6135
3	45.60	0.00	3.60	0.98	18.09	0.98	0.98a	1952
4	45.40	0.00	7.20	1.97	36.20	1.97	1.97a	1952
		Total>	7.20	2.00m	212.88	2.00	2.00a	10012
5	44.85	Total>	18.30	4.75m	223.99	4.75	4.75a	10012
6	44.50	Total>	25.56	6.50m	231.25	6.50	6.50a	10012
7	43.75	Total>	42.75	10.25m	248.44	10.25	10.25a	10012
8	43.00	Total>	61.63	14.00m	267.33	14.00	14.00a	10012
9	42.80	Total>	66.71	15.00m	272.40	15.00	15.00a	10012
10	42.00	Total>	86.49	19.00m	301.44	33.49	33.49	10719
11	41.50	Total>	98.26	21.50m	319.00	48.29	48.29	11161
12	41.40	Total>	100.55	22.00m	322.45	51.26	51.26	11249
13	40.70	Total>	116.17	25.50m	346.17	71.50	71.50	11868
14	40.00	Total>	131.14	29.00m	369.24	90.04	90.04	12486
15	39.35	Total>	144.64	32.25m	390.26	105.53	105.53	13060
16	38.70	Total>	157.89	35.50m	411.03	119.69	119.69	13635
17	38.50	Total>	161.93	36.50m	417.39	123.85	123.85	13811
18	38.44	Total>	163.14	36.80m	419.29	125.08	125.08	13864
19	37.94	Total>	173.17	39.30m	435.11	135.18	135.18	14306
20	37.37	Total>	184.53	42.15m	453.07	146.42	146.42	14809
21	36.80	Total>	195.84	45.00m	470.97	157.58	157.58	15313
22	36.00	Total>	211.66	49.00m	496.05	173.27	173.27	16020
23	35.20	Total>	227.44	53.00m	521.09	189.11	189.11	16727
24	34.40	Total>	243.20	57.00m	546.10	205.08	205.08	17433
25	33.60	Total>	258.94	61.00m	571.10	221.14	221.14	18140
26	32.80	Total>	274.68	65.00m	596.10	237.24	237.24	18847
27	32.00	Total>	290.42	69.00m	621.09	253.39	253.39	19554
28	31.40	Total>	302.22	72.00m	639.84	265.55	265.55	20084
29	30.80	Total>	314.03	75.00m	658.59	277.76	277.76	20614

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	45.80	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	45.69	0.00	0.00	0.00	0.00	0.00	0.00	0.0
3	45.60	0.00	0.00	0.00	0.00	0.00	0.00	0.0
4	45.40	0.00	0.00	0.00	0.00	0.00	0.00	0.0
5	44.85	0.00	0.00	0.00	0.00	0.00	0.00	0.0
6	44.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
7	43.75	0.00	0.00	0.00	0.00	0.00	0.00	0.0
8	43.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
9	42.80	2.00	0.00	0.00	0.00	0.00	2.00	0.0
10	42.00	10.00	0.00	0.00	0.00	0.00	10.00	0.0
11	41.50	15.00	0.00	0.00	0.00	0.00	15.00	0.0
		Total>	15.00	15.00w	235.72	86.69	86.69	21303
12	41.40	Total>	17.00	8.00m	238.88	87.40	87.40	21471
13	40.70	Total>	31.00	11.50m	260.98	92.17	92.17	22652
14	40.00	Total>	45.01	15.00m	283.09	98.62	98.62	23832
15	39.35	Total>	58.04	18.25m	303.64	107.16	107.16	24928
16	38.70	Total>	71.08	21.50m	324.20	117.95	117.95	26024
17	38.50	Total>	75.10	22.50m	330.53	121.62	121.62	26361

(continued)

Stage No.7 Excavate to elevation 41.50 on RIGHT side

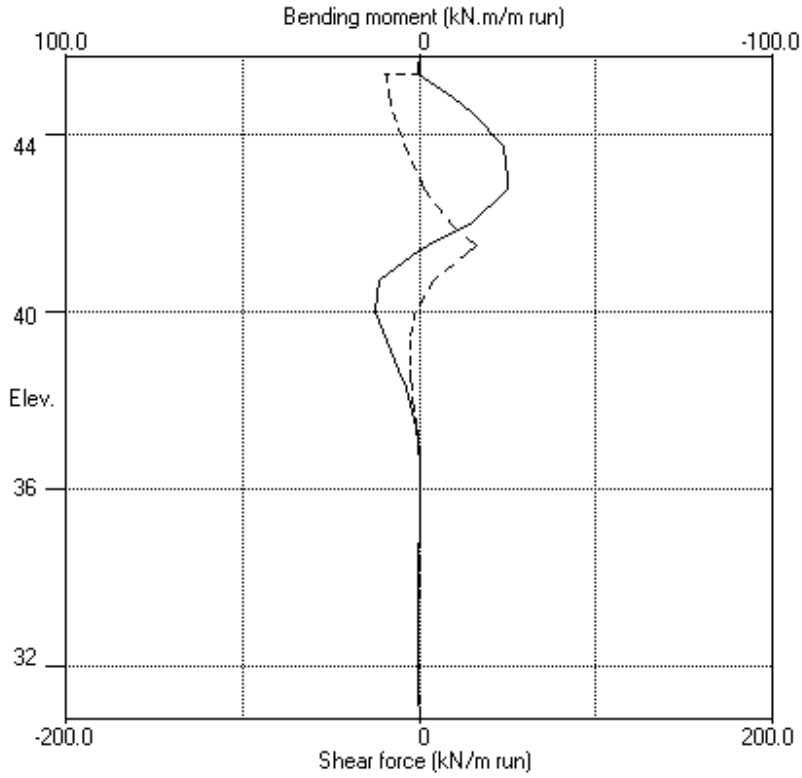
Node no.	Y coord	RIGHT side Water press. kN/m2	Effective stresses Vertic -al kN/m2	Active limit kN/m2	Passive limit kN/m2	Earth pressure kN/m2	Total earth pressure kN/m2	Coeff. of subgrade reaction kN/m3
18	38.44	Total>	76.30	22.80m	332.43	122.74	122.74	26463
19	37.94	Total>	86.36	25.30m	348.28	132.49	132.49	27306
20	37.37	Total>	97.85	28.15m	366.36	144.12	144.12	28267
21	36.80	Total>	109.36	31.00m	384.47	155.98	155.98	29228
22	36.00	Total>	125.57	35.00m	409.93	172.61	172.61	30577
23	35.20	Total>	141.83	39.00m	435.46	189.03	189.03	31926
24	34.40	Total>	158.16	43.00m	461.04	205.25	205.25	33275
25	33.60	Total>	174.54	47.00m	486.68	221.35	221.35	34624
26	32.80	Total>	190.99	51.00m	512.39	237.41	237.41	35973
27	32.00	Total>	207.50	55.00m	538.15	253.46	253.46	37322
28	31.40	Total>	219.92	58.00m	557.52	265.49	265.49	38334
29	30.80	Total>	232.37	61.00m	576.91	277.47	277.47	39345

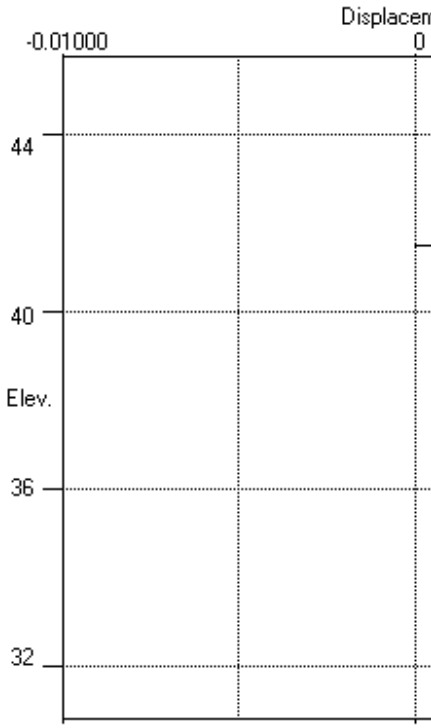
Note: 15.00a Soil pressure at active limit
123.45p Soil pressure at passive limit

KNIGHT BUILD LTD | Sheet No.
Program: WALLAP Version 6.06 Revision A49.B68.R53 | Job No. 79AR
Licensed from GEOSOLVE | Made by : JRC
Data filename/Run ID: SECTION_1-1_ULS1 |
79 Avenue Road | Date:28-06-2021
SECTION 1-1 ANALYSIS | Checked :

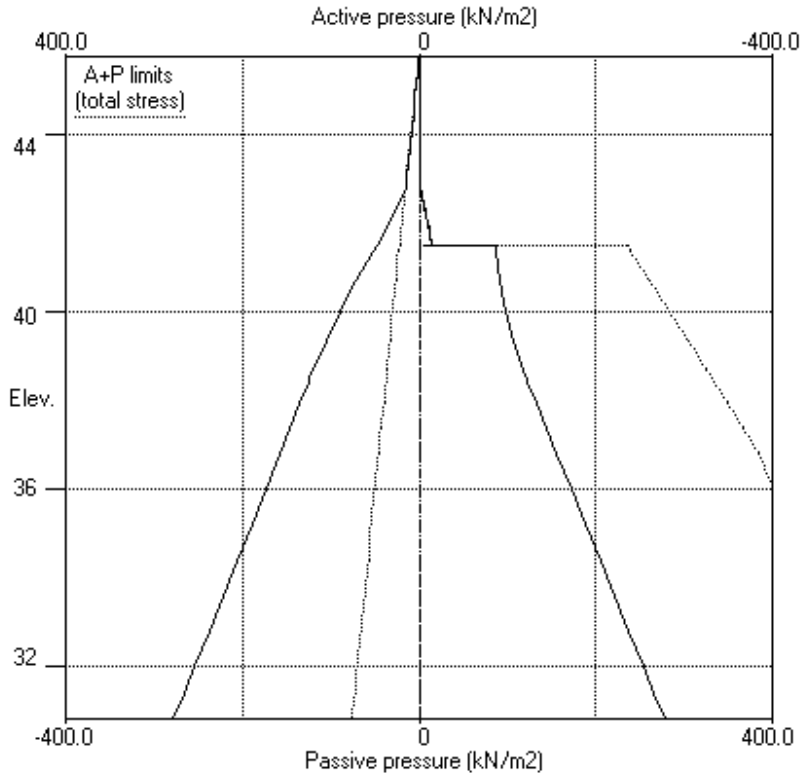
Units: kN,m

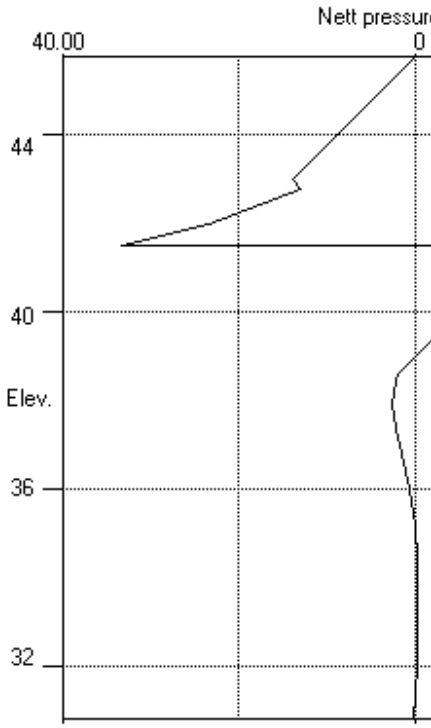
Stage No.7 Excav. to elev. 41.50 on RIGHT side





Stage No.7 Excav. to elev. 41.50 on RIGHT side





Units: kN,m

Stage No. 9 Excavate to elevation 37.94 on RIGHT side

BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall

Analysis options

Length of wall perpendicular to section = 15.00m
Subgrade reaction model - Boussinesq Influence coefficients
Soil deformations are elastic until the active or passive limit is reached
Open Tension Crack analysis - No

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

Limit State: ULS DA1 Combination 1

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

*** Wall displacements reset to zero at stage 4

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	45.80	0.00	0.004	-6.85E-04	0.0	0.0		41252
2	45.69	1.70	0.004	-6.85E-04	0.1	-0.0		41252
3	45.60	2.06	0.004	-6.85E-04	0.3	0.0		41252
4	45.40	2.86	0.004	-6.85E-04	0.8	0.1	13.7	41252
		6.49	0.004	-6.85E-04	-13.0	0.1		
5	44.85	6.44	0.004	-6.43E-04	-9.4	-5.7		41252
6	44.50	6.50	0.005	-5.77E-04	-7.1	-8.6		41252
7	43.75	10.25	0.005	-3.83E-04	-0.9	-11.6		41252
8	43.00	14.00	0.005	-2.18E-04	8.2	-6.9		41252
9	42.80	13.00	0.005	-1.93E-04	10.9	-5.0		41252
10	42.00	9.00	0.005	-2.77E-04	19.7	9.9	50.7	41252
		9.00	0.005	-2.77E-04	-30.9	9.9		
11	41.50	9.42	0.006	-3.49E-04	-26.3	-3.5		41252
12	41.40	9.72	0.006	-3.45E-04	-25.4	-6.1		41252
13	40.70	11.77	0.006	-1.65E-04	-17.8	-21.5		41252
14	40.00	15.59	0.006	2.29E-04	-8.3	-31.1		41252
15	39.35	22.64	0.005	6.94E-04	4.2	-33.0		41252
16	38.70	34.01	0.005	1.12E-03	22.6	-25.2		41252
17	38.50	38.36	0.005	1.22E-03	29.8	-20.0		41252
18	38.44	39.73	0.005	1.25E-03	32.2	-18.2		41252
19	37.94	51.99	0.004	1.32E-03	55.1	3.1		41252
		-77.88	0.004	1.32E-03	55.1	3.1		
20	37.37	-47.44	0.003	1.14E-03	19.4	21.8		41252
21	36.80	-22.73	0.003	8.18E-04	-0.6	25.2		41252
22	36.00	-2.14	0.002	4.05E-04	-10.6	17.4		41252
23	35.20	5.18	0.002	1.61E-04	-9.4	8.2		41252
24	34.40	5.33	0.002	6.54E-05	-5.2	2.3		41252
25	33.60	3.17	0.002	4.98E-05	-1.8	-0.2		41252
26	32.80	1.18	0.002	6.15E-05	-0.0	-0.6		41252
27	32.00	0.01	0.002	7.32E-05	0.5	-0.3		41252
28	31.40	-0.43	0.002	7.71E-05	0.3	-0.1		41252
29	30.80	-0.66	0.002	7.79E-05	-0.0	-0.0		---

At elev. 45.40 Strut force = 102.8 kN/strut = 13.7 kN/m run
At elev. 42.00 Strut force = 380.0 kN/strut = 50.7 kN/m run (horiz.)
= 58.5 kN/m run (inclined)

(continued)

Stage No.9 Excavate to elevation 37.94 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	45.80	0.00	0.00	0.00	0.00	0.00	0.00	7327
2	45.69	0.00	1.98	0.54	9.95	1.70	1.70	7327
3	45.60	0.00	3.60	0.98	18.09	2.06	2.06	7327
4	45.40	0.00	7.20	1.97	36.20	2.86	2.86	7327
		Total>	7.20	2.00m	212.88	6.49	6.49	37034
5	44.85	Total>	18.30	4.75m	223.99	6.44	6.44	37034
6	44.50	Total>	25.56	6.50m	231.25	6.50	6.50a	9983
7	43.75	Total>	42.75	10.25m	248.44	10.25	10.25a	9983
8	43.00	Total>	61.63	14.00m	267.33	14.00	14.00a	9983
9	42.80	Total>	66.71	15.00m	272.40	15.00	15.00a	9983
10	42.00	Total>	86.49	19.00m	301.44	19.00	19.00a	10688
11	41.50	Total>	98.26	21.50m	319.00	24.42	24.42	11128
12	41.40	Total>	100.55	22.00m	322.45	25.72	25.72	11216
13	40.70	Total>	116.17	25.50m	346.17	34.77	34.77	11833
14	40.00	Total>	131.14	29.00m	369.24	45.59	45.59	12449
15	39.35	Total>	144.64	32.25m	390.26	59.14	59.14	13022
16	38.70	Total>	157.89	35.50m	411.03	77.01	77.01	13595
17	38.50	Total>	161.93	36.50m	417.39	83.36	83.36	13771
18	38.44	Total>	163.14	36.80m	419.29	85.33	85.33	13824
19	37.94	Total>	173.17	39.30m	435.11	102.59	102.59	14264
20	37.37	Total>	184.53	42.15m	453.07	122.55	122.55	14766
21	36.80	Total>	195.84	45.00m	470.97	140.88	140.88	15268
22	36.00	Total>	211.66	49.00m	496.05	162.64	162.64	15973
23	35.20	Total>	227.44	53.00m	521.09	180.66	180.66	16678
24	34.40	Total>	243.20	57.00m	546.10	196.69	196.69	17382
25	33.60	Total>	258.94	61.00m	571.10	212.10	212.10	18087
26	32.80	Total>	274.68	65.00m	596.10	227.58	227.58	18792
27	32.00	Total>	290.42	69.00m	621.09	243.33	243.33	19496
28	31.40	Total>	302.22	72.00m	639.84	255.29	255.29	20025
29	30.80	Total>	314.03	75.00m	658.59	267.36	267.36	20553

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	45.80	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	45.69	0.00	0.00	0.00	0.00	0.00	0.00	0.0
3	45.60	0.00	0.00	0.00	0.00	0.00	0.00	0.0
4	45.40	0.00	0.00	0.00	0.00	0.00	0.00	0.0
5	44.85	0.00	0.00	0.00	0.00	0.00	0.00	0.0
6	44.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
7	43.75	0.00	0.00	0.00	0.00	0.00	0.00	0.0
8	43.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
9	42.80	2.00	0.00	0.00	0.00	0.00	2.00	0.0
10	42.00	10.00	0.00	0.00	0.00	0.00	10.00	0.0
11	41.50	15.00	0.00	0.00	0.00	0.00	15.00	0.0
12	41.40	16.00	0.00	0.00	0.00	0.00	16.00	0.0
13	40.70	23.00	0.00	0.00	0.00	0.00	23.00	0.0
14	40.00	30.00	0.00	0.00	0.00	0.00	30.00	0.0
15	39.35	36.50	0.00	0.00	0.00	0.00	36.50	0.0
16	38.70	43.00	0.00	0.00	0.00	0.00	43.00	0.0
17	38.50	45.00	0.00	0.00	0.00	0.00	45.00	0.0
18	38.44	45.60	0.00	0.00	0.00	0.00	45.60	0.0

(continued)

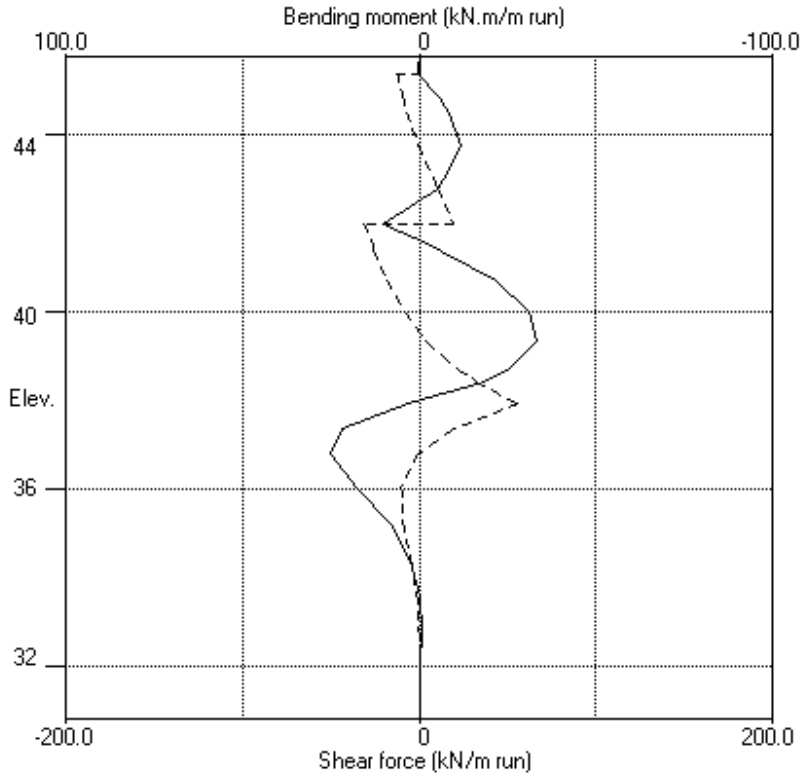
Stage No.9 Excavate to elevation 37.94 on RIGHT side

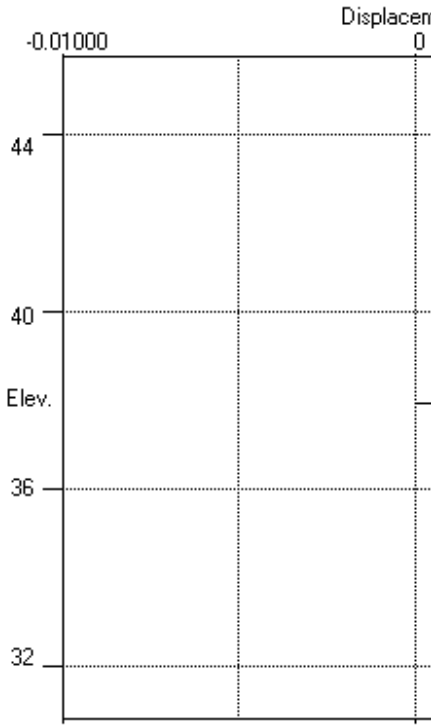
Node no.	Y coord	RIGHT side Water press. kN/m2	Effective stresses Vertic -al kN/m2	Active limit kN/m2	Passive limit kN/m2	Earth pressure kN/m2	Total earth pressure kN/m2	Coeff. of subgrade reaction kN/m3
19	37.94	50.60	0.00	0.00	0.00	0.00	50.60	0.0
		Total> 50.60	50.60w	312.51	180.47	180.47		36042
20	37.37	Total> 62.00	28.15m	330.50	169.99	169.99		37310
21	36.80	Total> 73.41	31.00m	348.51	163.61	163.61		38579
22	36.00	Total> 89.44	35.00m	373.80	164.78	164.78		40360
23	35.20	Total> 105.51	39.00m	399.13	175.49	175.49		42140
24	34.40	Total> 121.64	43.00m	424.51	191.36	191.36		43921
25	33.60	Total> 137.83	47.00m	449.96	208.92	208.92		45701
26	32.80	Total> 154.11	51.00m	475.49	226.40	226.40		47482
27	32.00	Total> 170.46	55.00m	501.11	243.32	243.32		49262
28	31.40	Total> 182.79	58.00m	520.38	255.73	255.73		50598
29	30.80	Total> 195.17	61.00m	539.70	268.02	268.02		51933

Note: 19.00a Soil pressure at active limit
123.45p Soil pressure at passive limit

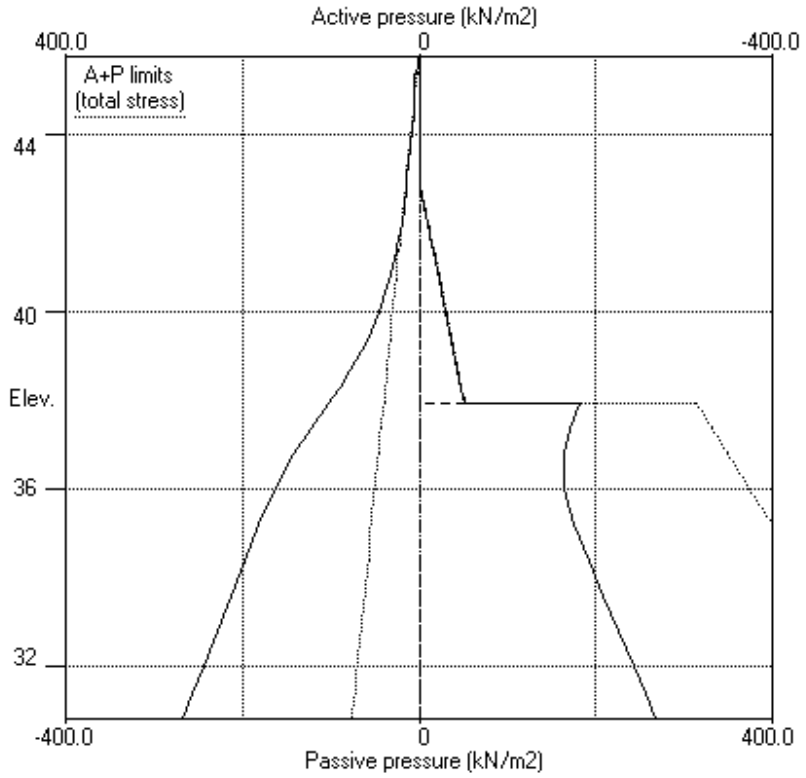
Units: kN,m

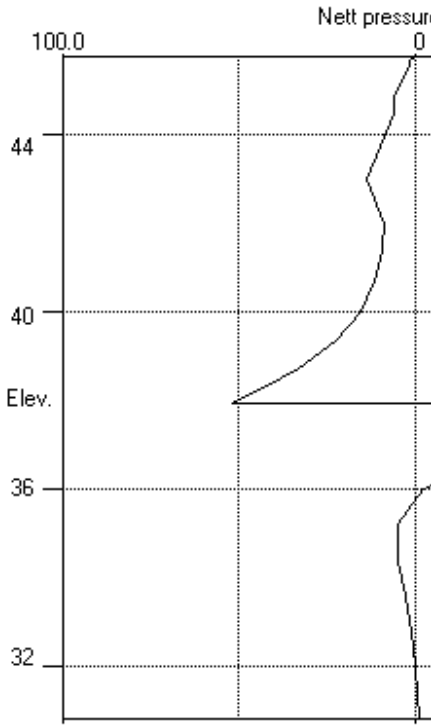
Stage No.9 Excav. to elev. 37.94 on RIGHT side





Stage No.9 Excav. to elev. 37.94 on RIGHT side





Units: kN,m

Stage No. 10 Fill to elevation 38.44 on RIGHT side with soil type 1

BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall

Analysis options

Length of wall perpendicular to section = 15.00m
Subgrade reaction model - Boussinesq Influence coefficients
Soil deformations are elastic until the active or passive limit is reached
Open Tension Crack analysis - No

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

Limit State: ULS DA1 Combination 1

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

*** Wall displacements reset to zero at stage 4

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	45.80	0.00	0.004	-6.89E-04	0.0	0.0		41252
2	45.69	1.70	0.004	-6.89E-04	0.1	-0.0		41252
3	45.60	2.06	0.004	-6.89E-04	0.3	0.0		41252
4	45.40	2.85	0.004	-6.89E-04	0.8	0.1	13.8	41252
		6.47	0.004	-6.89E-04	-13.0	0.1		
5	44.85	6.39	0.004	-6.47E-04	-9.5	-5.8		41252
6	44.50	6.50	0.005	-5.80E-04	-7.2	-8.6		41252
7	43.75	10.25	0.005	-3.85E-04	-0.9	-11.7		41252
8	43.00	14.00	0.005	-2.16E-04	8.2	-7.1		41252
9	42.80	13.00	0.005	-1.91E-04	10.9	-5.2		41252
10	42.00	9.00	0.005	-2.70E-04	19.7	9.7	50.8	41252
		9.00	0.005	-2.70E-04	-31.1	9.7		
11	41.50	9.43	0.006	-3.38E-04	-26.5	-3.9		41252
12	41.40	9.74	0.006	-3.33E-04	-25.6	-6.5		41252
13	40.70	11.89	0.006	-1.45E-04	-18.0	-22.1		41252
14	40.00	15.86	0.006	2.58E-04	-8.3	-31.7		41252
15	39.35	23.13	0.005	7.32E-04	4.4	-33.6		41252
16	38.70	34.78	0.005	1.16E-03	23.2	-25.5		41252
17	38.50	39.22	0.005	1.27E-03	30.6	-20.1		41252
18	38.44	40.62	0.004	1.29E-03	33.0	-18.2		41252
19	37.94	52.05	0.004	1.37E-03	56.2	3.5		41252
		-79.41	0.004	1.37E-03	56.2	3.5		
20	37.37	-48.42	0.003	1.18E-03	19.7	22.6		41252
21	36.80	-23.26	0.002	8.41E-04	-0.7	26.0		41252
22	36.00	-2.25	0.002	4.14E-04	-10.9	18.0		41252
23	35.20	5.27	0.002	1.60E-04	-9.7	8.5		41252
24	34.40	5.48	0.002	5.92E-05	-5.4	2.4		41252
25	33.60	3.30	0.002	4.19E-05	-1.9	-0.2		41252
26	32.80	1.26	0.002	5.37E-05	-0.0	-0.7		41252
27	32.00	0.03	0.002	6.59E-05	0.5	-0.4		41252
28	31.40	-0.45	0.002	7.00E-05	0.3	-0.1		41252
29	30.80	-0.72	0.002	7.09E-05	-0.0	-0.0		---

At elev. 45.40 Strut force = 103.3 kN/strut = 13.8 kN/m run
At elev. 42.00 Strut force = 380.8 kN/strut = 50.8 kN/m run (horiz.)
= 58.6 kN/m run (inclined)

(continued)

Stage No.10 Fill to elevation 38.44 on RIGHT side with soil type 1

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	45.80	0.00	0.00	0.00	0.00	0.00	0.00	43560
2	45.69	0.00	1.98	0.54	9.95	1.70	1.70	2578
3	45.60	0.00	3.60	0.98	18.09	2.06	2.06	2578
4	45.40	0.00	7.20	1.97	36.20	2.85	2.85	2578
		Total>	7.20	2.00m	212.88	6.47	6.47	13155
5	44.85	Total>	18.30	4.75m	223.99	6.39	6.39	13155
6	44.50	Total>	25.56	6.50m	231.25	6.50	6.50a	13155
7	43.75	Total>	42.75	10.25m	248.44	10.25	10.25a	13155
8	43.00	Total>	61.63	14.00m	267.33	14.00	14.00a	13155
9	42.80	Total>	66.71	15.00m	272.40	15.00	15.00a	13155
10	42.00	Total>	86.49	19.00m	301.44	19.00	19.00a	14084
11	41.50	Total>	98.26	21.50m	319.00	24.43	24.43	7991
12	41.40	Total>	100.55	22.00m	322.45	25.74	25.74	8054
13	40.70	Total>	116.17	25.50m	346.17	34.89	34.89	8497
14	40.00	Total>	131.14	29.00m	369.24	45.86	45.86	8940
15	39.35	Total>	144.64	32.25m	390.26	59.63	59.63	9351
16	38.70	Total>	157.89	35.50m	411.03	77.78	77.78	9762
17	38.50	Total>	161.93	36.50m	417.39	84.22	84.22	9889
18	38.44	Total>	163.14	36.80m	419.29	86.22	86.22	9927
19	37.94	Total>	173.17	39.30m	435.11	103.74	103.74	10243
20	37.37	Total>	184.53	42.15m	453.07	123.98	123.98	10603
21	36.80	Total>	195.84	45.00m	470.97	142.54	142.54	10964
22	36.00	Total>	211.66	49.00m	496.05	164.51	164.51	11470
23	35.20	Total>	227.44	53.00m	521.09	182.65	182.65	11976
24	34.40	Total>	243.20	57.00m	546.10	198.72	198.72	12482
25	33.60	Total>	258.94	61.00m	571.10	214.14	214.14	12988
26	32.80	Total>	274.68	65.00m	596.10	229.61	229.61	13494
27	32.00	Total>	290.42	69.00m	621.09	245.35	245.35	14000
28	31.40	Total>	302.22	72.00m	639.84	257.31	257.31	14380
29	30.80	Total>	314.03	75.00m	658.59	269.36	269.36	14759

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	45.80	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	45.69	0.00	0.00	0.00	0.00	0.00	0.00	0.0
3	45.60	0.00	0.00	0.00	0.00	0.00	0.00	0.0
4	45.40	0.00	0.00	0.00	0.00	0.00	0.00	0.0
5	44.85	0.00	0.00	0.00	0.00	0.00	0.00	0.0
6	44.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
7	43.75	0.00	0.00	0.00	0.00	0.00	0.00	0.0
8	43.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
9	42.80	2.00	0.00	0.00	0.00	0.00	2.00	0.0
10	42.00	10.00	0.00	0.00	0.00	0.00	10.00	0.0
11	41.50	15.00	0.00	0.00	0.00	0.00	15.00	0.0
12	41.40	16.00	0.00	0.00	0.00	0.00	16.00	0.0
13	40.70	23.00	0.00	0.00	0.00	0.00	23.00	0.0
14	40.00	30.00	0.00	0.00	0.00	0.00	30.00	0.0
15	39.35	36.50	0.00	0.00	0.00	0.00	36.50	0.0
16	38.70	43.00	0.00	0.00	0.00	0.00	43.00	0.0
17	38.50	45.00	0.00	0.00	0.00	0.00	45.00	0.0
18	38.44	45.60	0.00	0.00	0.00	0.00	45.60	0.0
		45.60	0.00	0.00	0.00	0.00	45.60	1398

(continued)

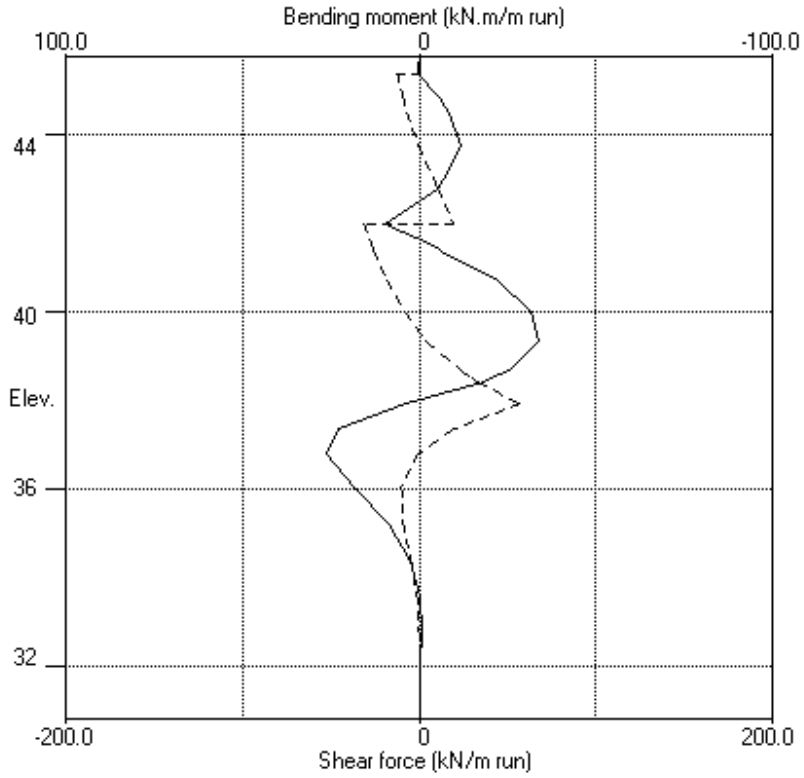
Stage No.10 Fill to elevation 38.44 on RIGHT side with soil type 1

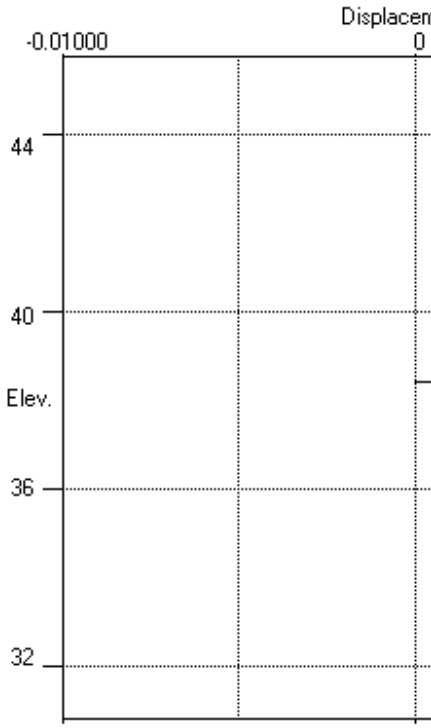
Node no.	Y coord	RIGHT side Water press. kN/m2	Effective stresses Vertic -al kN/m2	Active limit kN/m2	Passive limit kN/m2	Earth pressure kN/m2	Total earth pressure kN/m2	Coeff. of subgrade reaction kN/m3
19	37.94	50.60	4.00	1.09	20.11	1.09	51.69a	1398
		Total> 54.60	25.30m	316.51	183.15	183.15		10347
20	37.37	Total> 66.01	28.15m	334.51	172.40	172.40		10711
21	36.80	Total> 77.42	31.00m	352.52	165.80	165.80		11075
22	36.00	Total> 93.48	35.00m	377.83	166.76	166.76		11586
23	35.20	Total> 109.58	39.00m	403.19	177.38	177.38		12097
24	34.40	Total> 125.74	43.00m	428.61	193.25	193.25		12609
25	33.60	Total> 141.97	47.00m	454.10	210.84	210.84		13120
26	32.80	Total> 158.28	51.00m	479.66	228.35	228.35		13631
27	32.00	Total> 174.67	55.00m	505.32	245.31	245.31		14142
28	31.40	Total> 187.02	58.00m	524.61	257.76	257.76		14525
29	30.80	Total> 199.42	61.00m	543.96	270.08	270.08		14909

Note: 51.69a Soil pressure at active limit
123.45p Soil pressure at passive limit

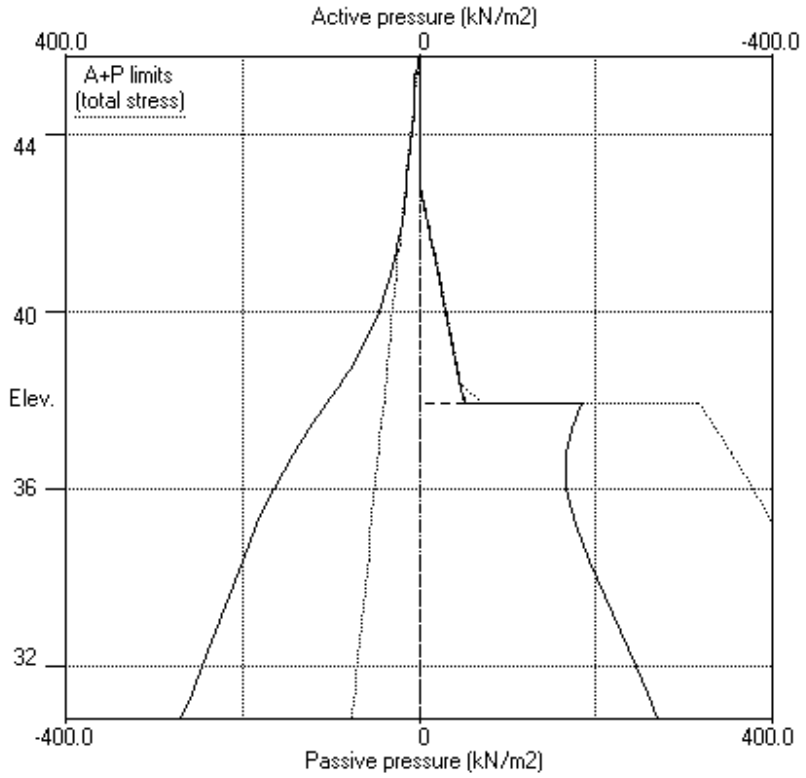
Units: kN,m

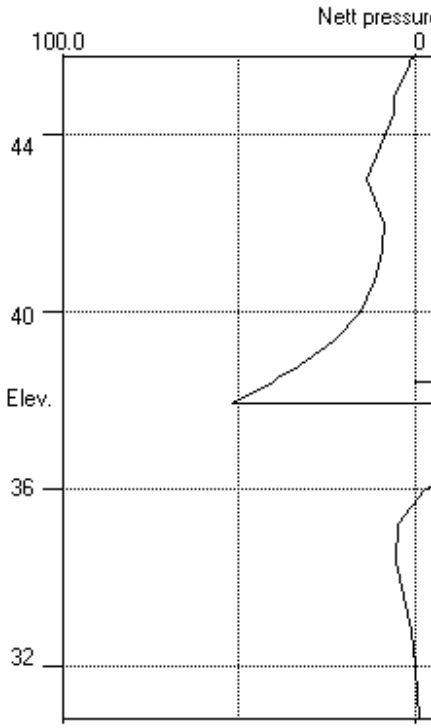
Stage No.10 Fill to elev. 38.44 on RIGHT side





Stage No.10 Fill to elev. 38.44 on RIGHT side





Units: kN,m

Stage No. 12 Change EI of wall to 77684 kN.m2/m run
From elevation 41.50 to 38.50
Yield moment not defined
No adjustments to wall displacements

BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall

Analysis options

Length of wall perpendicular to section = 15.00m
Subgrade reaction model - Boussinesq Influence coefficients
Soil deformations are elastic until the active or passive limit is reached
Open Tension Crack analysis - No

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

Limit State: ULS DA1 Combination 1

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

*** Wall displacements reset to zero at stage 4

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	45.80	0.00	0.004	-6.89E-04	0.0	0.0		41252
2	45.69	1.70	0.004	-6.89E-04	0.1	-0.0		41252
3	45.60	2.06	0.004	-6.89E-04	0.3	0.0		41252
4	45.40	2.85	0.004	-6.89E-04	0.8	0.1	13.8	41252
		6.47	0.004	-6.89E-04	-13.0	0.1		
5	44.85	6.39	0.004	-6.47E-04	-9.5	-5.8		41252
6	44.50	6.50	0.005	-5.80E-04	-7.2	-8.6		41252
7	43.75	10.25	0.005	-3.85E-04	-0.9	-11.7		41252
8	43.00	14.00	0.005	-2.16E-04	8.2	-7.1		41252
9	42.80	13.00	0.005	-1.91E-04	10.9	-5.2		41252
10	42.00	9.00	0.005	-2.70E-04	19.7	9.7	50.8	41252
		9.00	0.005	-2.70E-04	-31.1	9.7		
11	41.50	9.43	0.006	-3.38E-04	-26.5	-3.9		77684
12	41.40	9.74	0.006	-3.33E-04	-25.6	-6.5		77684
13	40.70	11.89	0.006	-1.45E-04	-18.0	-22.1		77684
14	40.00	15.86	0.006	2.58E-04	-8.3	-31.7		77684
15	39.35	23.13	0.005	7.32E-04	4.4	-33.6		77684
16	38.70	34.78	0.005	1.16E-03	23.2	-25.5		77684
17	38.50	39.22	0.005	1.27E-03	30.6	-20.1		41252
18	38.44	40.62	0.004	1.29E-03	33.0	-18.2		41252
19	37.94	52.05	0.004	1.37E-03	56.2	3.5		41252
		-79.41	0.004	1.37E-03	56.2	3.5		
20	37.37	-48.42	0.003	1.18E-03	19.7	22.6		41252
21	36.80	-23.26	0.002	8.41E-04	-0.7	26.0		41252
22	36.00	-2.25	0.002	4.14E-04	-10.9	18.0		41252
23	35.20	5.27	0.002	1.60E-04	-9.7	8.5		41252
24	34.40	5.48	0.002	5.92E-05	-5.4	2.4		41252
25	33.60	3.30	0.002	4.19E-05	-1.9	-0.2		41252
26	32.80	1.26	0.002	5.37E-05	-0.0	-0.7		41252
27	32.00	0.03	0.002	6.59E-05	0.5	-0.4		41252
28	31.40	-0.45	0.002	7.00E-05	0.3	-0.1		41252
29	30.80	-0.72	0.002	7.09E-05	-0.0	-0.0		---

At elev. 45.40 Strut force = 103.3 kN/strut = 13.8 kN/m run
At elev. 42.00 Strut force = 380.8 kN/strut = 50.8 kN/m run (horiz.)
= 58.6 kN/m run (inclined)
At elev. 38.70 The strut is slack

(continued)

Stage No.12 Change EI of wall to 77684 kN.m2/m run
From elevation 41.50 to 38.50
Yield moment not defined
No adjustments to wall displacements

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	45.80	0.00	0.00	0.00	0.00	0.00	0.00	7171
2	45.69	0.00	1.98	0.54	9.95	1.70	1.70	7171
3	45.60	0.00	3.60	0.98	18.09	2.06	2.06	7171
4	45.40	0.00	7.20	1.97	36.20	2.85	2.85	7171
		Total>	7.20	2.00m	212.88	6.47	6.47	36254
5	44.85	Total>	18.30	4.75m	223.99	6.39	6.39	36254
6	44.50	Total>	25.56	6.50m	231.25	6.50	6.50a	12738
7	43.75	Total>	42.75	10.25m	248.44	10.25	10.25a	12738
8	43.00	Total>	61.63	14.00m	267.33	14.00	14.00a	12738
9	42.80	Total>	66.71	15.00m	272.40	15.00	15.00a	12738
10	42.00	Total>	86.49	19.00m	301.44	19.00	19.00a	13637
11	41.50	Total>	98.26	21.50m	319.00	24.43	24.43	14199
12	41.40	Total>	100.55	22.00m	322.45	25.74	25.74	14311
13	40.70	Total>	116.17	25.50m	346.17	34.89	34.89	15098
14	40.00	Total>	131.14	29.00m	369.24	45.86	45.86	15885
15	39.35	Total>	144.64	32.25m	390.26	59.63	59.63	16615
16	38.70	Total>	157.89	35.50m	411.03	77.78	77.78	10537
17	38.50	Total>	161.93	36.50m	417.39	84.22	84.22	10674
18	38.44	Total>	163.14	36.80m	419.29	86.22	86.22	10715
19	37.94	Total>	173.17	39.30m	435.11	103.74	103.74	11056
20	37.37	Total>	184.53	42.15m	453.07	123.98	123.98	11445
21	36.80	Total>	195.84	45.00m	470.97	142.54	142.54	11834
22	36.00	Total>	211.66	49.00m	496.05	164.51	164.51	12381
23	35.20	Total>	227.44	53.00m	521.09	182.65	182.65	12927
24	34.40	Total>	243.20	57.00m	546.10	198.72	198.72	13473
25	33.60	Total>	258.94	61.00m	571.10	214.14	214.14	14019
26	32.80	Total>	274.68	65.00m	596.10	229.61	229.61	14565
27	32.00	Total>	290.42	69.00m	621.09	245.35	245.35	15112
28	31.40	Total>	302.22	72.00m	639.84	257.31	257.31	15521
29	30.80	Total>	314.03	75.00m	658.59	269.36	269.36	15931

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	45.80	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	45.69	0.00	0.00	0.00	0.00	0.00	0.00	0.0
3	45.60	0.00	0.00	0.00	0.00	0.00	0.00	0.0
4	45.40	0.00	0.00	0.00	0.00	0.00	0.00	0.0
5	44.85	0.00	0.00	0.00	0.00	0.00	0.00	0.0
6	44.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
7	43.75	0.00	0.00	0.00	0.00	0.00	0.00	0.0
8	43.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
9	42.80	2.00	0.00	0.00	0.00	0.00	2.00	0.0
10	42.00	10.00	0.00	0.00	0.00	0.00	10.00	0.0
11	41.50	15.00	0.00	0.00	0.00	0.00	15.00	0.0
12	41.40	16.00	0.00	0.00	0.00	0.00	16.00	0.0
13	40.70	23.00	0.00	0.00	0.00	0.00	23.00	0.0
14	40.00	30.00	0.00	0.00	0.00	0.00	30.00	0.0
15	39.35	36.50	0.00	0.00	0.00	0.00	36.50	0.0

(continued)

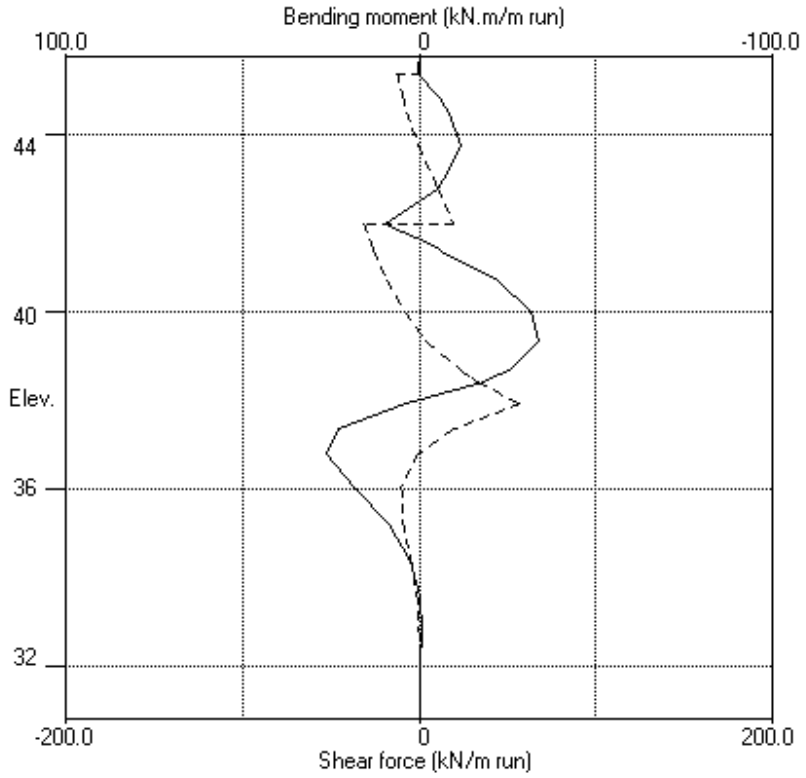
Stage No.12 Change EI of wall to 77684 kN.m2/m run
From elevation 41.50 to 38.50
Yield moment not defined
No adjustments to wall displacements

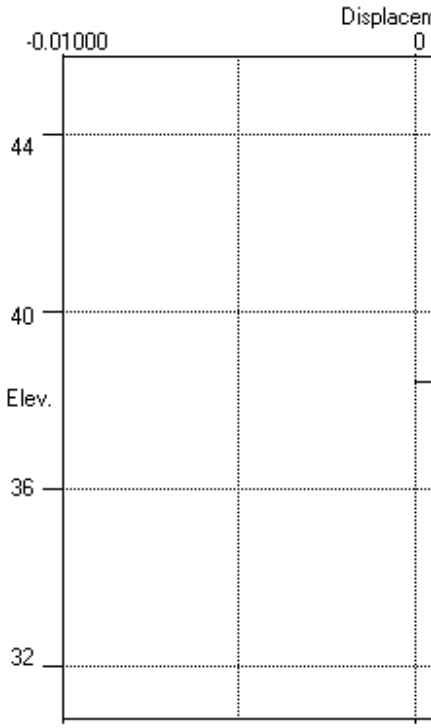
Node no.	Y coord	RIGHT side Water press. kN/m2	Effective stresses Vertic -al kN/m2	Active limit kN/m2	Passive limit kN/m2	Earth pressure kN/m2	Total earth pressure kN/m2	Coeff. of subgrade reaction kN/m3
16	38.70	43.00	0.00	0.00	0.00	0.00	43.00	0.0
17	38.50	45.00	0.00	0.00	0.00	0.00	45.00	0.0
18	38.44	45.60	0.00	0.00	0.00	0.00	45.60	0.0
		45.60	0.00	0.00	0.00	0.00	45.60	1498
19	37.94	50.60	4.00	1.09	20.11	1.09	51.69a	1498
		Total> 54.60	25.30m	316.51	183.15	183.15		11056
20	37.37	Total> 66.01	28.15m	334.51	172.40	172.40		11445
21	36.80	Total> 77.42	31.00m	352.52	165.80	165.80		11834
22	36.00	Total> 93.48	35.00m	377.83	166.76	166.76		12381
23	35.20	Total> 109.58	39.00m	403.19	177.38	177.38		12927
24	34.40	Total> 125.74	43.00m	428.61	193.25	193.25		13473
25	33.60	Total> 141.97	47.00m	454.10	210.84	210.84		14019
26	32.80	Total> 158.28	51.00m	479.66	228.35	228.35		14565
27	32.00	Total> 174.67	55.00m	505.32	245.31	245.31		15112
28	31.40	Total> 187.02	58.00m	524.61	257.76	257.76		15521
29	30.80	Total> 199.42	61.00m	543.96	270.08	270.08		15931

Note: 51.69a Soil pressure at active limit
123.45p Soil pressure at passive limit

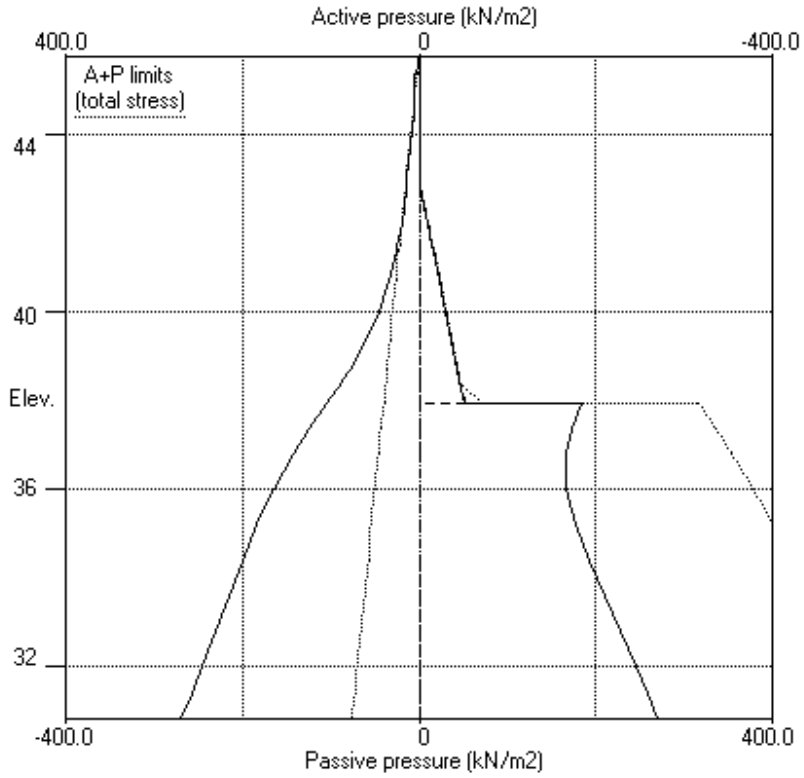
Units: kN,m

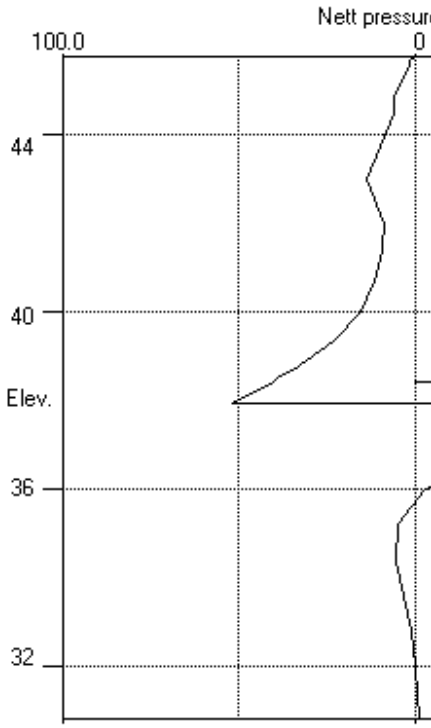
Stage No.12 Change EI of wall to 77684kN.m2/m run





Stage No.12 Change EI of wall to 77684kN.m2/m run





Units: kN,m

Stage No. 15 Change EI of wall to 77684 kN.m2/m run
From elevation 45.80 to 41.50
Yield moment not defined
No adjustments to wall displacements

BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall

Analysis options

Length of wall perpendicular to section = 15.00m
Subgrade reaction model - Boussinesq Influence coefficients
Soil deformations are elastic until the active or passive limit is reached
Open Tension Crack analysis - No

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

Limit State: ULS DA1 Combination 1

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

*** Wall displacements reset to zero at stage 4

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	45.80	0.00	0.004	-9.00E-04	0.0	0.0		77684
2	45.69	1.82	0.004	-9.00E-04	0.1	-0.0		77684
3	45.60	2.02	0.004	-9.00E-04	0.3	0.0		77684
4	45.40	2.71	0.004	-9.00E-04	0.7	0.1	16.4	77684
		5.73	0.004	-9.00E-04	-15.7	0.1		
5	44.85	4.75	0.005	-8.47E-04	-12.8	-7.4		77684
6	44.50	6.50	0.005	-7.60E-04	-10.8	-11.5		77684
7	43.75	10.25	0.005	-4.88E-04	-4.5	-17.2		77684
8	43.00	14.00	0.006	-1.95E-04	4.6	-15.4		77684
9	42.80	13.00	0.006	-1.28E-04	7.3	-14.2		77684
10	42.00	9.00	0.006	-4.65E-06	16.1	-2.2		77684
11	41.50	8.00	0.006	-7.25E-05	20.3	7.8		77684
12	41.40	8.67	0.006	-8.55E-05	21.1	9.9	53.0	77684
		8.67	0.006	-8.55E-05	-31.9	9.9		
13	40.70	12.68	0.006	-2.42E-05	-24.4	-10.3		77684
14	40.00	17.56	0.006	2.93E-04	-13.8	-24.3		77684
15	39.35	25.00	0.005	7.18E-04	0.0	-29.4		77684
16	38.70	36.41	0.005	1.12E-03	20.0	-23.7	-0.0	77684
17	38.50	40.72	0.004	1.22E-03	27.7	-19.0		41252
18	38.44	42.08	0.004	1.25E-03	30.2	-17.3		41252
19	37.94	53.11	0.004	1.32E-03	54.0	3.2		41252
		-75.93	0.004	1.32E-03	54.0	3.2		
20	37.37	-46.43	0.003	1.14E-03	19.1	21.6		41252
21	36.80	-22.42	0.002	8.15E-04	-0.5	25.0		41252
22	36.00	-2.29	0.002	4.04E-04	-10.4	17.4		41252
23	35.20	5.03	0.002	1.59E-04	-9.3	8.3		41252
24	34.40	5.26	0.002	6.12E-05	-5.2	2.4		41252
25	33.60	3.18	0.002	4.39E-05	-1.8	-0.1		41252
26	32.80	1.21	0.002	5.49E-05	-0.1	-0.6		41252
27	32.00	0.03	0.002	6.63E-05	0.4	-0.3		41252
28	31.40	-0.42	0.002	7.02E-05	0.3	-0.1		41252
29	30.80	-0.67	0.002	7.11E-05	0.0	-0.0		---

At elev. 45.40 Strut force = 123.1 kN/strut = 16.4 kN/m run
At elev. 41.40 Strut force = 53.0 kN/strut = 53.0 kN/m run
At elev. 38.70 The strut is slack

(continued)

Stage No.15 Change EI of wall to 77684 kN.m2/m run
From elevation 45.80 to 41.50
Yield moment not defined
No adjustments to wall displacements

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	45.80	0.00	0.00	0.00	0.00	0.00	0.00	2374
2	45.69	0.00	1.98	0.54	9.95	1.82	1.82	2374
3	45.60	0.00	3.60	0.98	18.09	2.02	2.02	2374
4	45.40	0.00	7.20	1.97	36.20	2.71	2.71	2374
		Total>	7.20	2.00m	212.88	5.73	5.73	12130
5	44.85	Total>	18.30	4.75m	223.99	4.75	4.75a	12130
6	44.50	Total>	25.56	6.50m	231.25	6.50	6.50a	12130
7	43.75	Total>	42.75	10.25m	248.44	10.25	10.25a	12130
8	43.00	Total>	61.63	14.00m	267.33	14.00	14.00a	12130
9	42.80	Total>	66.71	15.00m	272.40	15.00	15.00a	12130
10	42.00	Total>	86.49	19.00m	301.44	19.00	19.00a	12986
11	41.50	Total>	98.26	21.50m	319.00	23.00	23.00	13521
12	41.40	Total>	100.55	22.00m	322.45	24.67	24.67	13756
13	40.70	Total>	116.17	25.50m	346.17	35.68	35.68	14513
14	40.00	Total>	131.14	29.00m	369.24	47.56	47.56	15269
15	39.35	Total>	144.64	32.25m	390.26	61.50	61.50	15971
16	38.70	Total>	157.89	35.50m	411.03	79.41	79.41	16673
17	38.50	Total>	161.93	36.50m	417.39	85.72	85.72	16889
18	38.44	Total>	163.14	36.80m	419.29	87.68	87.68	16954
19	37.94	Total>	173.17	39.30m	435.11	104.80	104.80	17494
20	37.37	Total>	184.53	42.15m	453.07	124.59	124.59	18110
21	36.80	Total>	195.84	45.00m	470.97	142.80	142.80	18726
22	36.00	Total>	211.66	49.00m	496.05	164.49	164.49	19590
23	35.20	Total>	227.44	53.00m	521.09	182.53	182.53	26927
24	34.40	Total>	243.20	57.00m	546.10	198.62	198.62	28065
25	33.60	Total>	258.94	61.00m	571.10	214.08	214.08	29202
26	32.80	Total>	274.68	65.00m	596.10	229.59	229.59	30340
27	32.00	Total>	290.42	69.00m	621.09	245.35	245.35	31478
28	31.40	Total>	302.22	72.00m	639.84	257.32	257.32	115313
29	30.80	Total>	314.03	75.00m	658.59	269.39	269.39	118357

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	45.80	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	45.69	0.00	0.00	0.00	0.00	0.00	0.00	0.0
3	45.60	0.00	0.00	0.00	0.00	0.00	0.00	0.0
4	45.40	0.00	0.00	0.00	0.00	0.00	0.00	0.0
5	44.85	0.00	0.00	0.00	0.00	0.00	0.00	0.0
6	44.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
7	43.75	0.00	0.00	0.00	0.00	0.00	0.00	0.0
8	43.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
9	42.80	2.00	0.00	0.00	0.00	0.00	2.00	0.0
10	42.00	10.00	0.00	0.00	0.00	0.00	10.00	0.0
11	41.50	15.00	0.00	0.00	0.00	0.00	15.00	0.0
12	41.40	16.00	0.00	0.00	0.00	0.00	16.00	0.0
13	40.70	23.00	0.00	0.00	0.00	0.00	23.00	0.0
14	40.00	30.00	0.00	0.00	0.00	0.00	30.00	0.0
15	39.35	36.50	0.00	0.00	0.00	0.00	36.50	0.0

(continued)

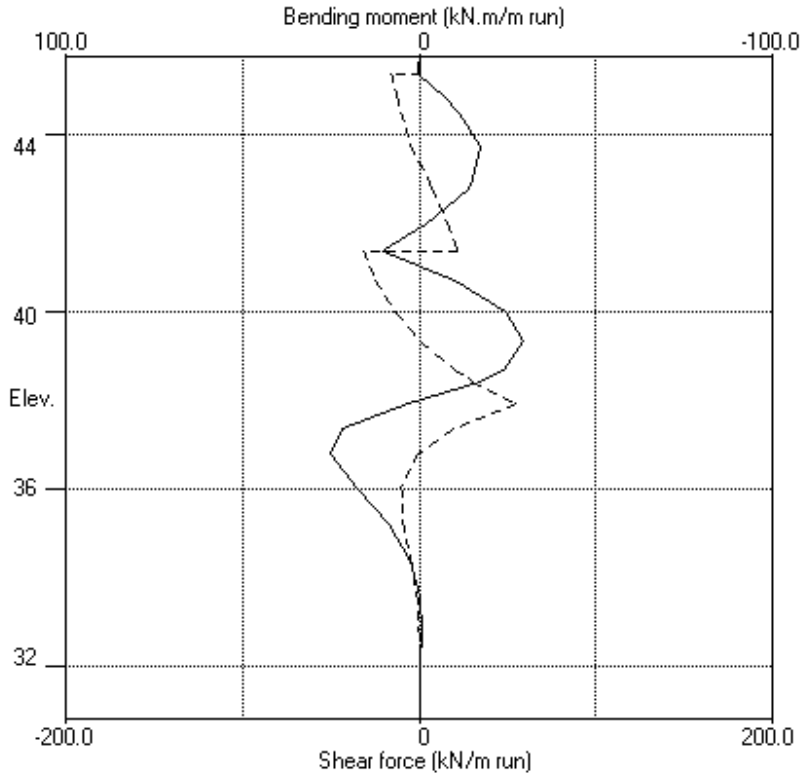
Stage No.15 Change EI of wall to 77684 kN.m2/m run
From elevation 45.80 to 41.50
Yield moment not defined
No adjustments to wall displacements

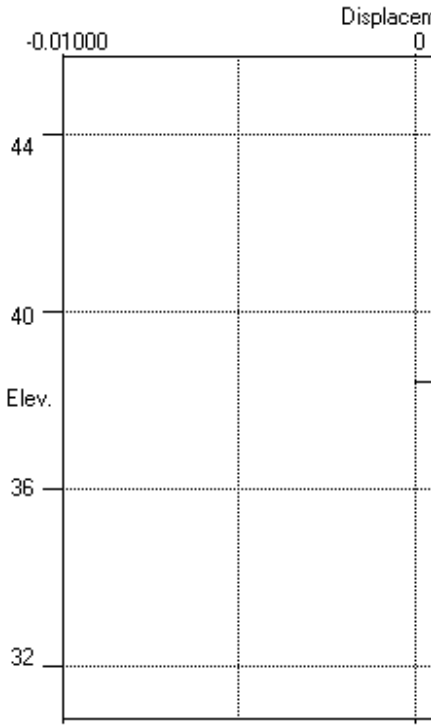
Node no.	Y coord	RIGHT side Water press. kN/m2	Effective stresses Vertic -al kN/m2	Active limit kN/m2	Passive limit kN/m2	Earth pressure kN/m2	Total earth pressure kN/m2	Coeff. of subgrade reaction kN/m3
16	38.70	43.00	0.00	0.00	0.00	0.00	43.00	0.0
17	38.50	45.00	0.00	0.00	0.00	0.00	45.00	0.0
18	38.44	45.60	0.00	0.00	0.00	0.00	45.60	0.0
		45.60	0.00	0.00	0.00	0.00	45.60	4483
19	37.94	50.60	4.00	1.09	20.11	1.09	51.69a	4483
		Total> 54.60	25.30m	316.51	180.74	180.74		32490
20	37.37	Total> 66.01	28.15m	334.51	171.02	171.02		33633
21	36.80	Total> 77.42	31.00m	352.52	165.21	165.21		34777
22	36.00	Total> 93.48	35.00m	377.83	166.78	166.78		36382
23	35.20	Total> 109.58	39.00m	403.19	177.50	177.50		26927
24	34.40	Total> 125.74	43.00m	428.61	193.35	193.35		28065
25	33.60	Total> 141.97	47.00m	454.10	210.89	210.89		29202
26	32.80	Total> 158.28	51.00m	479.66	228.37	228.37		30340
27	32.00	Total> 174.67	55.00m	505.32	245.31	245.31		31478
28	31.40	Total> 187.02	58.00m	524.61	257.74	257.74		115313
29	30.80	Total> 199.42	61.00m	543.96	270.06	270.06		118357

Note: 51.69a Soil pressure at active limit
123.45p Soil pressure at passive limit

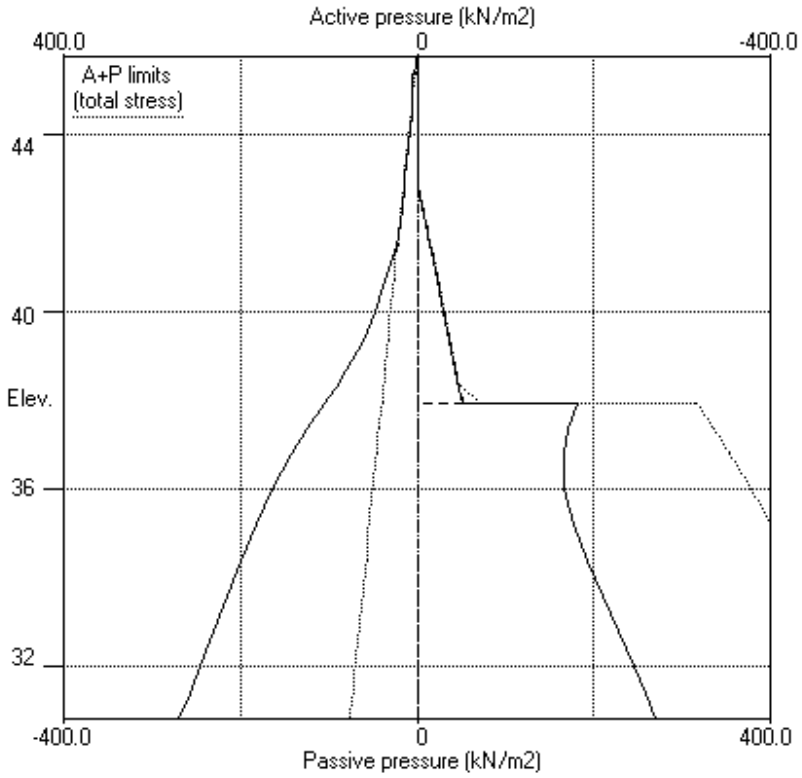
Units: kN,m

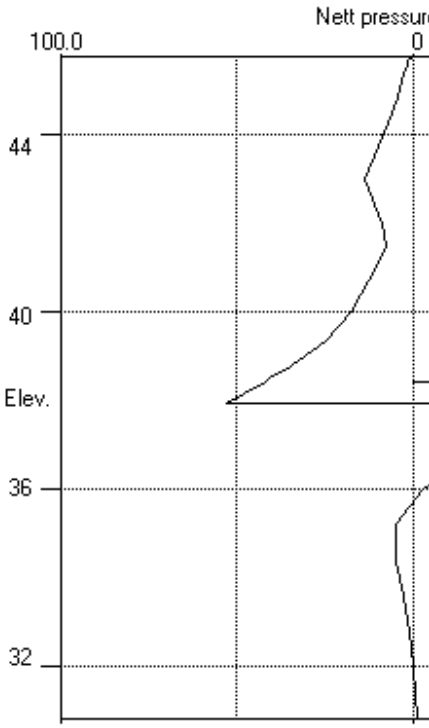
Stage No.15 Change EI of wall to 77684kN.m2/m run





Stage No.15 Change EI of wall to 77684kN.m2/m run





Units: kN,m

Stage No. 22 Change EI of wall to 38842 kN.m2/m run
From elevation 45.80 to 38.50
Yield moment not defined
No adjustments to wall displacements

BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall

Analysis options

Length of wall perpendicular to section = 15.00m
Subgrade reaction model - Boussinesq Influence coefficients
Soil deformations are elastic until the active or passive limit is reached
Open Tension Crack analysis - No

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

Limit State: ULS DA1 Combination 1

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

*** Wall displacements reset to zero at stage 4

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	45.80	0.00	0.004	-1.33E-03	0.0	0.0		38842
2	45.69	1.72	0.004	-1.33E-03	0.1	-0.0	19.1	38842
		1.72	0.004	-1.33E-03	-19.0	-0.0		
3	45.60	1.82	0.004	-1.33E-03	-18.8	-1.7		38842
4	45.40	2.31	0.004	-1.31E-03	-18.4	-5.4		38842
		3.76	0.004	-1.31E-03	-18.4	-5.4		
5	44.85	1.46	0.005	-1.20E-03	-17.0	-14.8		38842
6	44.50	3.01	0.005	-1.06E-03	-16.2	-20.6		38842
7	43.75	14.84	0.006	-6.00E-04	-9.5	-30.6		38842
8	43.00	27.32	0.006	-5.40E-05	6.3	-30.4		38842
9	42.80	30.67	0.006	8.42E-05	12.1	-28.6		38842
10	42.00	43.85	0.006	3.84E-04	41.9	-5.2		38842
11	41.50	51.85	0.006	2.64E-04	65.8	22.5		38842
12	41.40	53.43	0.006	2.16E-04	71.1	29.3	147.4	38842
		53.43	0.006	2.16E-04	-76.3	29.3		
13	40.70	64.31	0.006	1.25E-04	-35.1	-10.5		38842
14	40.00	74.93	0.006	3.80E-04	13.6	-18.8		38842
15	39.35	84.65	0.005	5.15E-04	65.5	6.2		38842
16	38.70	94.26	0.005	1.07E-04	123.6	67.0	241.9	38842
		94.26	0.005	1.07E-04	-118.3	67.0		
17	38.50	97.20	0.005	-9.49E-05	-99.1	45.2		20625
18	38.44	97.48	0.005	-2.02E-04	-93.3	39.4		20625
19	37.94	95.45	0.005	-6.26E-04	-45.0	4.9		20625
		62.61	0.005	-6.26E-04	-45.0	4.9		
20	37.37	44.50	0.006	-3.54E-04	-14.5	-12.7		20625
21	36.80	26.33	0.006	2.22E-04	5.7	-15.6		20625
22	36.00	0.67	0.005	8.21E-04	16.5	-6.5		20625
23	35.20	-20.26	0.004	8.84E-04	8.6	6.0		20625
24	34.40	-5.85	0.004	6.00E-04	-1.8	7.9		20625
25	33.60	0.98	0.003	3.31E-04	-3.8	4.5		20625
26	32.80	2.26	0.003	1.91E-04	-2.5	1.7		20625
27	32.00	1.50	0.003	1.44E-04	-0.9	0.4		20625
28	31.40	0.76	0.003	1.37E-04	-0.3	0.1		20625
29	30.80	0.15	0.003	1.37E-04	0.0	0.0		---

At elev. 45.69 Strut force = 19.1 kN/strut = 19.1 kN/m run
At elev. 41.40 Strut force = 147.4 kN/strut = 147.4 kN/m run
At elev. 38.70 Strut force = 241.9 kN/strut = 241.9 kN/m run

(continued)

Stage No.22 Change EI of wall to 38842 kN.m2/m run
From elevation 45.80 to 38.50
Yield moment not defined
No adjustments to wall displacements

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	45.80	0.00	0.00	0.00	0.00	0.00	0.00	69243
2	45.69	0.00	1.98	0.54	9.95	1.72	1.72	2463
3	45.60	0.00	3.60	0.98	18.09	1.82	1.82	2463
4	45.40	0.00	7.20	1.97	36.20	2.31	2.31	2463
		0.00	7.20	0.00	46.91	3.76	3.76	12077
5	44.85	0.00	19.40	0.00	83.85	1.46	1.46	12077
6	44.50	0.00	27.36	3.01	107.96	3.01	3.01a	12077
7	43.75	7.50	38.55	7.34	141.83	7.34	14.84a	12077
8	43.00	15.00	51.43	12.32	180.83	12.32	27.32a	12077
9	42.80	17.00	54.91	13.67	191.36	13.67	30.67a	12077
		17.00	54.91	13.67	191.36	13.67	30.67a	11367
10	42.00	25.00	68.29	18.85	231.88	18.85	43.85a	11878
11	41.50	30.00	76.06	21.85	255.39	21.85	51.85a	12198
12	41.40	31.00	77.55	22.43	259.93	22.43	53.43a	12262
13	40.70	38.00	87.57	26.31	290.26	26.31	64.31a	20781
14	40.00	45.00	96.94	29.93	318.63	29.93	74.93a	21513
15	39.35	51.50	105.24	33.15	343.77	33.15	84.65a	22192
16	38.70	58.00	113.29	36.26	368.13	36.26	94.26a	14765
17	38.50	60.00	115.73	37.20	375.51	37.20	97.20a	14900
18	38.44	60.60	116.46	37.48	377.72	37.48	98.08a	14941
19	37.94	65.60	122.49	39.82	395.99	39.82	105.42a	15278
20	37.37	71.30	129.29	42.45	416.59	42.45	113.75a	15663
21	36.80	77.00	136.04	45.07	437.03	45.07	122.07a	16048
22	36.00	85.00	145.46	48.71	465.55	48.71	133.71a	16588
23	35.20	93.00	154.84	52.34	493.95	57.28	150.28	17128
24	34.40	101.00	164.20	55.96	522.28	73.56	174.56	17667
25	33.60	109.00	173.54	59.58	550.57	85.93	194.93	18207
26	32.80	117.00	182.88	63.19	578.85	95.53	212.53	18747
27	32.00	125.00	192.22	66.80	607.13	103.98	228.98	19287
28	31.40	131.00	199.22	69.51	628.34	110.19	241.19	19692
29	30.80	137.00	206.23	72.23	649.55	116.46	253.46	20097

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	45.80	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	45.69	0.00	0.00	0.00	0.00	0.00	0.00	0.0
3	45.60	0.00	0.00	0.00	0.00	0.00	0.00	0.0
4	45.40	0.00	0.00	0.00	0.00	0.00	0.00	0.0
5	44.85	0.00	0.00	0.00	0.00	0.00	0.00	0.0
6	44.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
7	43.75	0.00	0.00	0.00	0.00	0.00	0.00	0.0
8	43.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
9	42.80	0.00	0.00	0.00	0.00	0.00	0.00	0.0
10	42.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
11	41.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
12	41.40	0.00	0.00	0.00	0.00	0.00	0.00	0.0
13	40.70	0.00	0.00	0.00	0.00	0.00	0.00	0.0
14	40.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0

(continued)

Stage No.22 Change EI of wall to 38842 kN.m2/m run
From elevation 45.80 to 38.50
Yield moment not defined
No adjustments to wall displacements

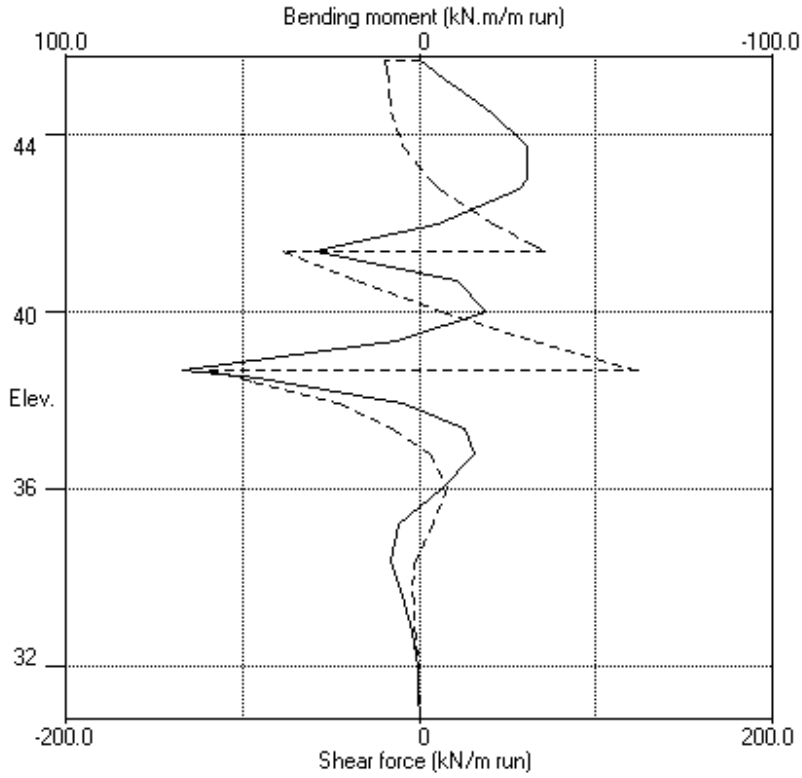
Node no.	Y coord	RIGHT side Water press. kN/m2	Effective stresses Vertic -al kN/m2	Active limit kN/m2	Passive limit kN/m2	Earth pressure kN/m2	Total earth pressure kN/m2	Coeff. of subgrade reaction kN/m3
15	39.35	0.00	0.00	0.00	0.00	0.00	0.00	0.0
16	38.70	0.00	0.00	0.00	0.00	0.00	0.00	0.0
17	38.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
18	38.44	0.60	0.00	0.00	0.00	0.00	0.60	0.0
		0.60	0.00	0.00	0.00	0.00	0.60	2600
19	37.94	5.60	4.00	1.09	20.11	4.37	9.97	2600
		5.60	4.00	0.00	37.21	37.21	42.81p	15278
20	37.37	11.30	10.85	0.00	57.95	57.95	69.25p	15663
21	36.80	17.00	17.71	0.00	78.74	78.74	95.74p	16048
22	36.00	25.00	27.39	3.02	108.04	108.04	133.04p	16588
23	35.20	33.00	37.14	6.79	137.54	137.54	170.54p	17128
24	34.40	41.00	46.97	10.59	167.31	139.41	180.41	17667
25	33.60	49.00	56.90	14.44	197.39	144.95	193.95	18207
26	32.80	57.00	66.95	18.33	227.81	153.26	210.26	18747
27	32.00	65.00	77.11	22.26	258.60	162.48	227.48	19287
28	31.40	71.00	84.82	25.24	281.95	169.43	240.43	19692
29	30.80	77.00	92.61	28.26	305.51	176.31	253.31	20097

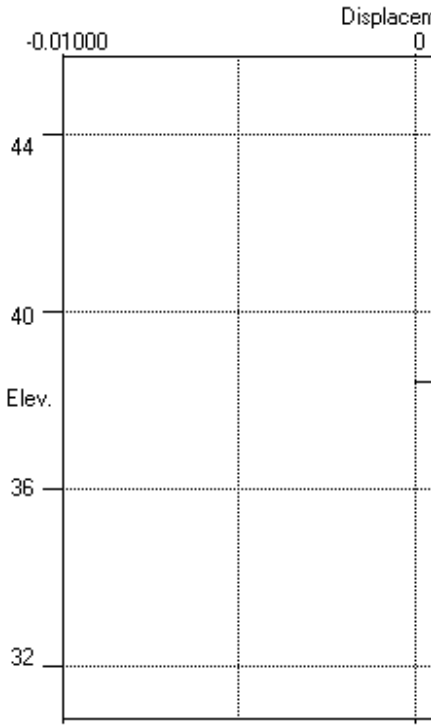
Note: 133.71a Soil pressure at active limit
170.54p Soil pressure at passive limit

KNIGHT BUILD LTD | Sheet No.
Program: WALLAP Version 6.06 Revision A49.B68.R53 | Job No. 79AR
Licensed from GEOSOLVE | Made by : JRC
Data filename/Run ID: SECTION_1-1_ULS1 |
79 Avenue Road | Date:28-06-2021
SECTION 1-1 ANALYSIS | Checked :

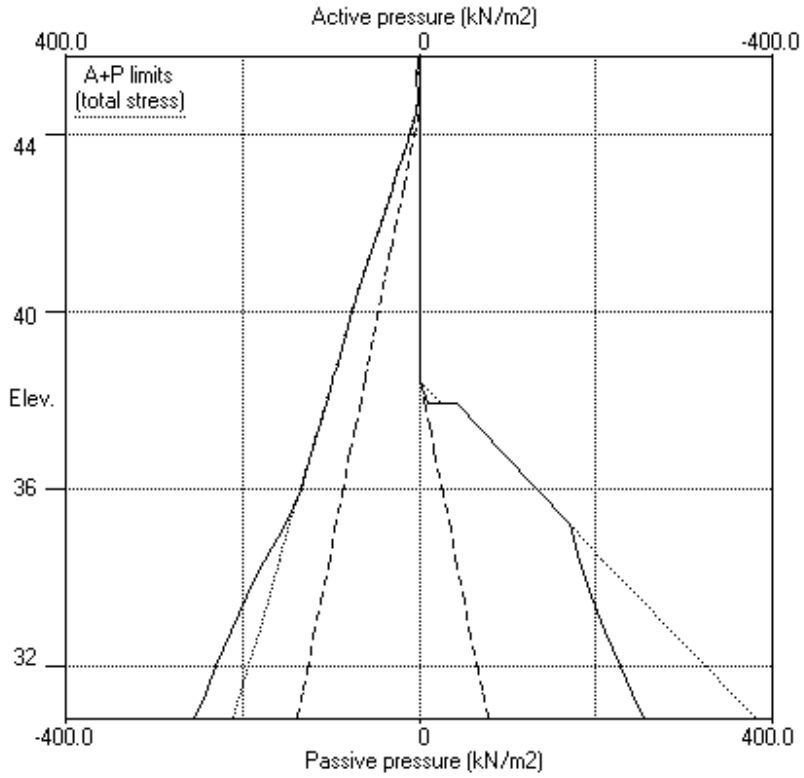
Units: kN,m

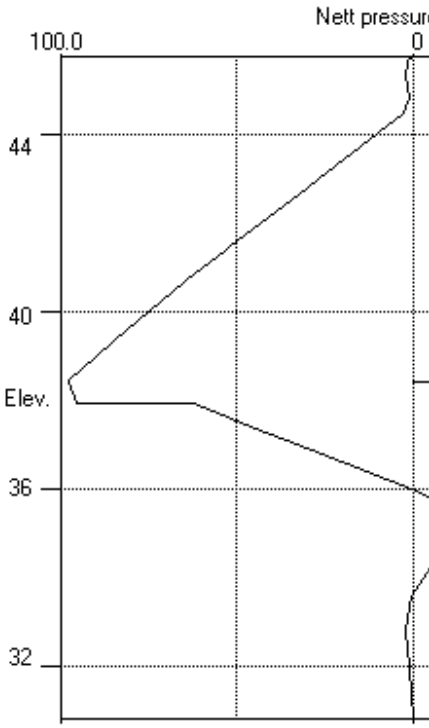
Stage No.22 Change EI of wall to 38842kN.m2/m run





Stage No.22 Change EI of wall to 38842kN.m2/m run





Units: kN,m

Summary of results

BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall

Analysis options

Length of wall perpendicular to section = 15.00m
Subgrade reaction model - Boussinesq Influence coefficients
Soil deformations are elastic until the active or passive limit is reached
Open Tension Crack analysis - No

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

Limit State: ULS DA1 Combination 1

Calculated Bending Moments and Strut Forces 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	45.80	0.004	0.000	0	-0	0	-0	0	0	0	0
2	45.69	0.004	0.000	0	-0	0	-0	0	-19	0	-26
3	45.60	0.004	0.000	0	-2	0	-2	0	-19	0	-25
4	45.40	0.004	0.000	0	-5	0	-7	1	-19	1	-25
5	44.85	0.005	0.000	1	-15	1	-20	2	-17	3	-23
6	44.50	0.005	0.000	2	-21	3	-28	4	-16	6	-22
7	43.75	0.006	0.000	8	-31	10	-41	10	-10	14	-13
8	43.00	0.006	0.000	12	-30	16	-41	8	-2	11	-3
9	42.80	0.006	0.000	12	-29	16	-39	12	-4	16	-5
10	42.00	0.006	0.000	10	-15	13	-20	42	-31	57	-42
11	41.50	0.006	0.000	22	-4	30	-5	66	-27	89	-36
12	41.40	0.006	0.000	29	-6	40	-9	71	-76	96	-103
13	40.70	0.006	0.000	11	-22	15	-30	8	-35	11	-47
14	40.00	0.006	0.000	12	-32	17	-43	14	-14	18	-19
15	39.35	0.005	0.000	9	-34	13	-45	65	-5	88	-7
16	38.70	0.005	0.000	67	-25	90	-34	124	-118	167	-160
17	38.50	0.005	0.000	45	-20	61	-27	31	-99	41	-134
18	38.44	0.005	0.000	39	-18	53	-25	33	-93	45	-126
19	37.94	0.005	0.000	10	-1	14	-2	56	-45	76	-61
20	37.37	0.006	0.000	23	-13	31	-17	20	-15	27	-20
21	36.80	0.006	0.000	26	-16	35	-21	6	-6	8	-8
22	36.00	0.005	0.000	18	-7	24	-9	16	-11	22	-15
23	35.20	0.004	0.000	9	-0	12	-0	9	-10	12	-13
24	34.40	0.004	0.000	8	-2	11	-3	0	-5	0	-7
25	33.60	0.003	0.000	5	-2	6	-2	1	-4	1	-5
26	32.80	0.003	0.000	2	-1	2	-1	1	-2	1	-3
27	32.00	0.003	0.000	0	-0	1	-0	1	-1	1	-1
28	31.40	0.003	0.000	0	-0	0	-0	0	-0	0	-0
29	30.80	0.003	0.000	0	-0	0	-0	0	-0	0	-0

Summary of results (continued)

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

Maximum and minimum bending moment and shear force at each stage

Stage	Bending moment						Shear force					
no.	Calculated				Factored		Calculated				Factored	
	max.	elev.	min.	elev.	max.	min.	max.	elev.	min.	elev.	max.	min.
	kN.m/m		kN.m/m		kN.m/m		kN/m		kN/m		kN/m	kN/m
1	0	36.80	-0	42.00	0	-1	0	40.00	-0	43.75	0	-0
2	No calculation at this stage											
3	1	44.50	-3	40.70	1	-4	1	38.70	-2	42.80	1	-3
4	No calculation at this stage											
5	12	43.00	-2	39.35	16	-3	10	43.75	-6	42.00	14	-9
6	No calculation at this stage											
7	12	40.00	-25	43.00	17	-34	32	41.50	-19	45.40	43	-25
8	No calculation at this stage											
9	25	36.80	-33	39.35	34	-45	55	37.94	-31	42.00	74	-42
10	26	36.80	-34	39.35	35	-45	56	37.94	-31	42.00	76	-42
11	No calculation at this stage											
12	26	36.80	-34	39.35	35	-45	56	37.94	-31	42.00	76	-42
13	No calculation at this stage											
14	25	36.80	-29	39.35	34	-40	54	37.94	-32	41.40	73	-43
15	25	36.80	-29	39.35	34	-40	54	37.94	-32	41.40	73	-43
16	No calculation at this stage											
17	25	36.80	-29	39.35	34	-39	54	37.94	-33	41.40	73	-44
18	20	38.70	-25	40.00	27	-34	79	38.70	-52	41.40	106	-70
19	No calculation at this stage											
20	No calculation at this stage											
21	No calculation at this stage											
22	67	38.70	-31	43.75	90	-41	124	38.70	-118	38.70	167	-160

Maximum and minimum displacement at each stage

Stage	Displacement				Stage description
no.	maximum	elev.	minimum	elev.	
	m		m		
1	0.000	41.40	-0.000	45.80	Apply surcharge no.1 at elev. 44.85
2	No calculation at this stage				Apply surcharge no.2 at elev. 44.85
3	0.001	39.35	-0.000	45.80	Apply surcharge no.3 at elev. 45.60
4	Wall displacements reset to zero				Change EI of wall to 41252kN.m2/m run
5	0.004	45.80	0.000	45.80	Excav. to elev. 43.75 on RIGHT side
6	No calculation at this stage				Install strut no.4 at elev. 45.40
7	0.005	43.75	0.000	45.80	Excav. to elev. 41.50 on RIGHT side
8	No calculation at this stage				Install strut no.5 at elev. 42.00
9	0.006	40.70	0.000	45.80	Excav. to elev. 37.94 on RIGHT side
10	0.006	40.70	0.000	45.80	Fill to elev. 38.44 on RIGHT side
11	No calculation at this stage				Install strut no.3 at elev. 38.70
12	0.006	40.70	0.000	45.80	Change EI of wall to 77684kN.m2/m run
13	No calculation at this stage				Install strut no.2 at elev. 41.40
14	0.006	40.70	0.000	45.80	Remove strut no.5 at elev. 42.00
15	0.006	40.70	0.000	45.80	Change EI of wall to 77684kN.m2/m run
16	No calculation at this stage				Install strut no.1 at elev. 45.69
17	0.006	40.70	0.000	45.80	Remove strut no.4 at elev. 45.40
18	0.006	40.70	0.000	45.80	Apply water pressure profile no.1
19	No calculation at this stage				Change soil type 2 to soil type 4
20	No calculation at this stage				Change soil type 3 to soil type 5
21	No calculation at this stage				Change EI of wall to 20625kN.m2/m run
22	0.006	43.00	0.000	45.80	Change EI of wall to 38842kN.m2/m run

Summary of results (continued)

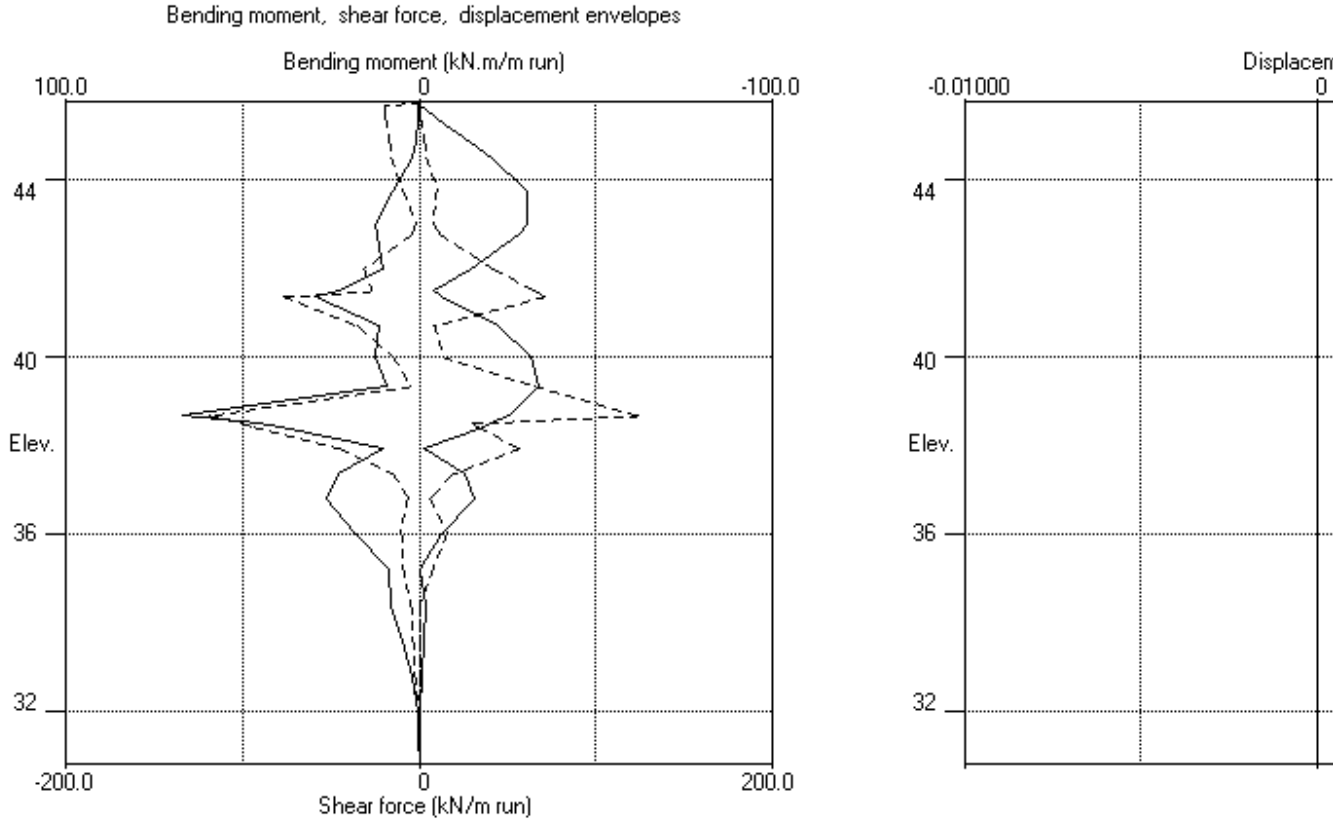
Calculated Bending Moments and Strut Forces have been multiplied by a factor of 1.35 to obtain values for structural design.

Strut forces at each stage (horizontal components)

Stage no.	Strut no. 1 at elev. 45.69			Strut no. 2 at elev. 41.40			Strut no. 3 at elev. 38.70		
	--Calculated-- kN per m run	kN per strut	Factored kN per strut	--Calculated-- kN per m run	kN per strut	Factored kN per strut	--Calculated-- kN per m run	kN per strut	Factored kN per strut
12	---	---	---	---	---	---	0	0	0
14	---	---	---	53	53	72	slack	slack	slack
15	---	---	---	53	53	72	slack	slack	slack
17	15	15	20	55	55	74	slack	slack	slack
18	15	15	20	88	88	118	123	123	166
22	19	19	26	147	147	199	242	242	327

Stage no.	Strut no. 4 at elev. 45.40			Strut no. 5 at elev. 42.00		
	--Calculated-- kN per m run	kN per strut	Factored kN per strut	--Calculated-- kN per m run	kN per strut	Factored kN per strut
7	19	144	194	---	---	---
9	14	103	139	51	380	513
10	14	103	139	51	381	514
12	14	103	139	51	381	514
14	16	123	166	---	---	---
15	16	123	166	---	---	---

Units: kN,m


Bending moment, shear force, displacement envelopes
Bending moment (kN.m/m run)
100.0
0
-100.0
44
40
Elev.
36
32
-200.0
0
200.0
Shear force (kN/m run)
-0.01000
0
Displacem

SECTION 1-1 ULS - COMBINATION 2

KNIGHT BUILD LTD | Sheet No.
Program: WALLAP Version 6.06 Revision A49.B68.R53 | Job No. 79AR
Licensed from GEOSOLVE | Made by : JRC
Data filename/Run ID: SECTION_1-1_ULS2 |
79 Avenue Road | Date:28-06-2021
SECTION 1-1 ANALYSIS | Checked :

Units: kN,m

INPUT DATA

SOIL PROFILE

Stratum no.	Elevation of top of stratum	Soil types Left side	Soil types Right side
1	45.80	1 Made Ground	1 Made Ground
2	45.40	2 Head	2 Head
3	42.80	3 London Clay	3 London Clay

SOIL PROPERTIES (Unfactored SLS soil strengths)

No.	Soil type -- Description (Datum elev.)	Bulk density kN/m3	Young's Modulus Eh,kN/m2 (dEh/dy)	At rest coeff. Ko (dKo/dy)	Consol state. NC/OC (Nu)	Active limit Ka (Kac)	Passive limit Kp (Kpc)	Cohesion kN/m2 (dc/dy)
1	Made Ground	18.00	13000	0.500	OC (0.200)	0.273 (0.000)	5.026 (0.000)	
2	Head	20.00	51000	1.000	OC (0.490)	1.000 (2.570)	1.000 (2.571)	80.00u
3	London Clay	20.00	51000	1.000	OC (0.490)	1.000 (2.570)	1.000 (2.571)	80.00u (4.500)
	(42.80)		(4500)					
4	Head (drained)	22.00	63750	0.625	OC (0.200)	0.387 (1.517)	3.028 (5.020)	5.000d
5	LC Drained	22.00	60000	0.625	OC (0.200)	0.387 (1.517)	3.028 (5.020)	5.000d
	(42.80)		(3375)					

Additional soil parameters associated with Ka and Kp

No.	Soil type Description	--- parameters for Ka --- Soil friction angle	Wall adhesion coeff.	Back-fill angle	--- parameters for Kp --- Soil friction angle	Wall adhesion coeff.	Back-fill angle
1	Made Ground	30.00	1.000	0.00	30.00	1.000	0.00
2	Head	0.00	1.000	0.00	0.00	0.995	0.00
3	London Clay	0.00	1.000	0.00	0.00	0.995	0.00
4	Head (drained)	22.01	1.000	0.00	22.00	1.000	0.00
5	LC Drained	22.01	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	43.00	43.00

Automatic water pressure balancing at toe of wall : No

Water press. profile no.	Left side Point no.	Elev. m	Piezo elev. m	Water press. kN/m2	Right side Point no.	Elev. m	Piezo elev. m	Water press. kN/m2	
1	1	44.50	44.50	0.0	1	38.50	38.50	0.0	MC+WC

WALL PROPERTIES

Type of structure = Fully Embedded Wall
Elevation of toe of wall = 30.80
Maximum finite element length = 0.80 m
Youngs modulus of wall E = 2.8000E+07 kN/m2
Moment of inertia of wall I = 1.4732E-03 m4/m run
E.I = 41251 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	45.69	1.00	0.250000	2.800E+07	15.00	0.00	0	No
2	41.40	1.00	0.250000	2.800E+07	10.00	0.00	0	No
3	38.70	1.00	0.450000	2.800E+07	10.00	0.00	0	No
4	45.40	7.50	0.016400	2.050E+08	10.00	0.00	0	No
5	42.00	7.50	0.016400	2.050E+08	10.00	30.00	0	No

SURCHARGE LOADS

Surch -arge no.	Elev.	Distance from wall	Length parallel to wall	Width perpend. to wall	Surcharge kN/m2 Near edge	Surcharge kN/m2 Far edge	Equiv. soil type	Partial factor/ Category
1	44.85	1.60(L)	1000.00	0.60	10.00	=	N/A	1.00 -
2	44.85	2.70(L)	1000.00	0.80	85.00	=	N/A	1.00 -
3	45.60	2.70(L)	1000.00	20.00	12.50	=	N/A	1.00 -

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 44.85
	No analysis at this stage
2	Apply surcharge no.2 at elevation 44.85
	No analysis at this stage
3	Apply surcharge no.3 at elevation 45.60
4	Change EI of wall to 41252 kN.m2/m run
	Yield moment not defined
	Reset wall displacements to zero at this stage
5	Excavate to elevation 43.75 on RIGHT side
6	Install strut or anchor no.4 at elevation 45.40
7	Excavate to elevation 41.50 on RIGHT side
8	Install strut or anchor no.5 at elevation 42.00
9	Excavate to elevation 37.94 on RIGHT side
10	Fill to elevation 38.44 on RIGHT side with soil type 1
11	Install strut or anchor no.3 at elevation 38.70
12	Change EI of wall to 77684 kN.m2/m run
	From elevation 41.50 to 38.50
	Yield moment not defined
	No adjustments to wall displacements
13	Install strut or anchor no.2 at elevation 41.40
14	Remove strut or anchor no.5 at elevation 42.00
15	Change EI of wall to 77684 kN.m2/m run
	From elevation 45.80 to 41.50
	Yield moment not defined
	No adjustments to wall displacements
16	Install strut or anchor no.1 at elevation 45.69
17	Remove strut or anchor no.4 at elevation 45.40
18	Apply water pressure profile no.1 (Worst Cred.)
19	Change properties of soil type 2 to soil type 4
	No analysis at this stage
	Ko pressures will not be reset
20	Change properties of soil type 3 to soil type 5
	No analysis at this stage
	Ko pressures will not be reset
21	Change EI of wall to 20625 kN.m2/m run
	From elevation 38.50 to 30.80
	Yield moment not defined
	No adjustments to wall displacements
22	Change EI of wall to 38842 kN.m2/m run
	From elevation 45.80 to 38.50
	Yield moment not defined
	No adjustments to wall displacements

FACTORS OF SAFETY and ANALYSIS OPTIONS

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

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

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

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

Boundary conditions:
Length of wall (normal to plane of analysis) = 15.00 m

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

Distance to rigid boundary on Left side = 30.00 m
Distance to rigid boundary on Right side = 30.00 m

OUTPUT OPTIONS

Stage no.	Stage description	Output options: Displacement, Bending mom., Shear force	Active, Passive pressures	Graph. output
1	Apply surcharge no.1 at elev. 44.85	Yes	Yes	Yes
2	Apply surcharge no.2 at elev. 44.85	No	No	No
3	Apply surcharge no.3 at elev. 45.60	Yes	Yes	Yes
4	Change EI of wall to 41252kN.m2/m run	No	No	No
5	Excav. to elev. 43.75 on RIGHT side	Yes	Yes	Yes
6	Install strut no.4 at elev. 45.40	No	No	No
7	Excav. to elev. 41.50 on RIGHT side	Yes	Yes	Yes
8	Install strut no.5 at elev. 42.00	No	No	No
9	Excav. to elev. 37.94 on RIGHT side	No	No	No
10	Fill to elev. 38.44 on RIGHT side	No	No	No
11	Install strut no.3 at elev. 38.70	Yes	Yes	Yes
12	Change EI of wall to 77684kN.m2/m run	No	No	No
13	Install strut no.2 at elev. 41.40	No	No	No
14	Remove strut no.5 at elev. 42.00	No	No	No
15	Change EI of wall to 77684kN.m2/m run	No	No	No
16	Install strut no.1 at elev. 45.69	No	No	No
17	Remove strut no.4 at elev. 45.40	No	No	No
18	Apply water pressure profile no.1	Yes	Yes	Yes
19	Change soil type 2 to soil type 4	No	No	No
20	Change soil type 3 to soil type 5	No	No	No
21	Change EI of wall to 20625kN.m2/m run	No	No	No
22	Change EI of wall to 38842kN.m2/m run	Yes	Yes	Yes
*	Summary output	Yes	-	Yes

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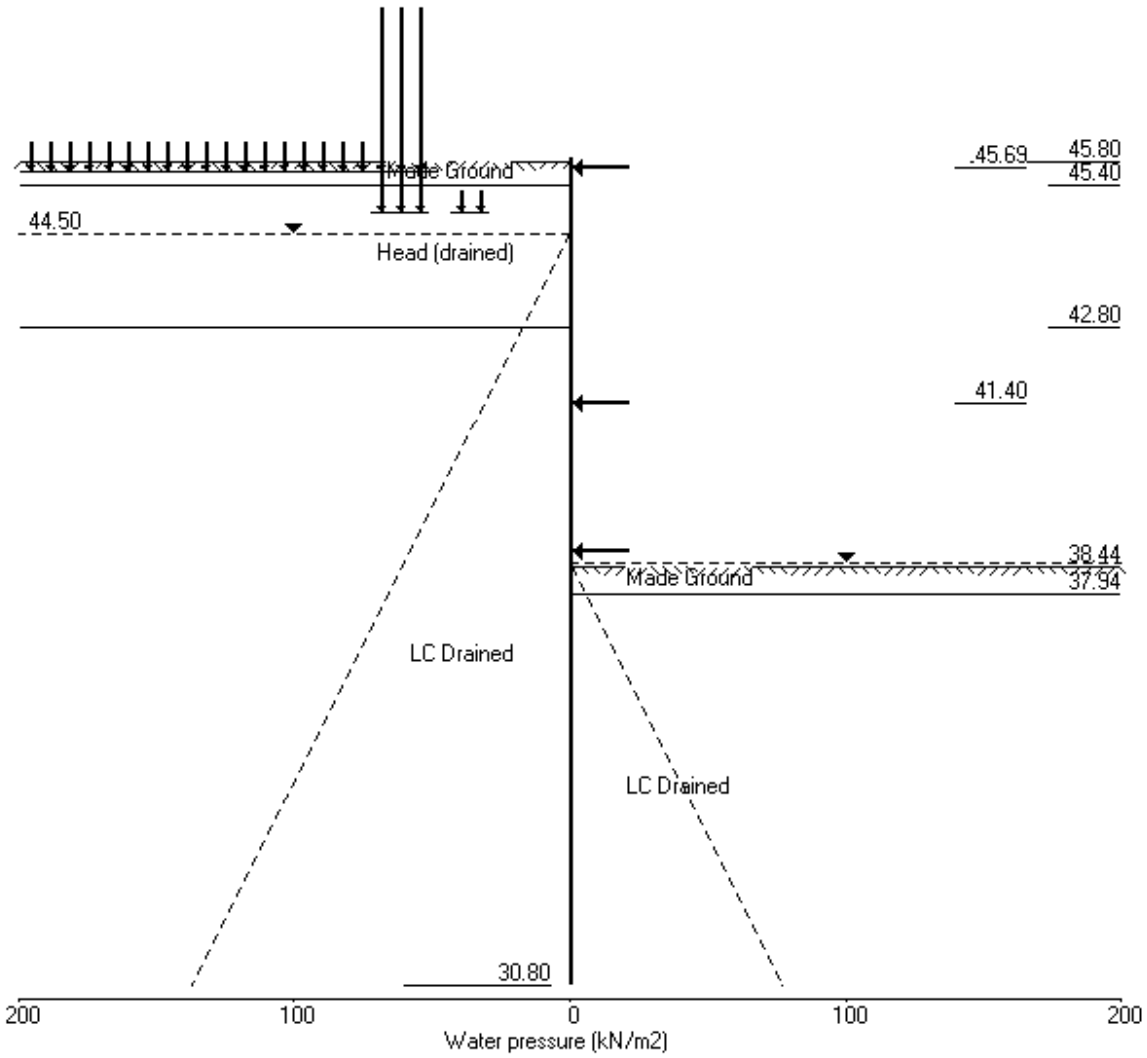
Units: kN,m

Stage No.22 Change EI of wall to 38842kN.m2/m run



Units: kN,m

Stage No. 5 Excavate to elevation 43.75 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.	Overall FoS for toe elev. = 30.80 Factor of Safety	Moment equilib. at elev.	Toe elev. for FoS = 1.000 Toe elev.	Wall Penetr -ation	Direction of failure
5	45.80	43.75	Cant.	6.248	31.36	43.50	0.25	L to R

BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall
Analysis options
Length of wall perpendicular to section = 15.00m
Subgrade reaction model - Boussinesq Influence coefficients
Soil deformations are elastic until the active or passive limit is reached
Open Tension Crack analysis - No

Rigid boundaries: Left side 30.00 from wall
Right side 30.00 from wall
Limit State: ULS DA1 Combination 2

*** Wall displacements reset to zero at stage 4

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	45.80	0.00	0.004	8.59E-04	0.0	0.0		41252
2	45.69	0.68	0.004	8.59E-04	0.0	-0.0		41252
3	45.60	1.24	0.004	8.59E-04	0.1	0.0		41252
4	45.40	2.47	0.004	8.59E-04	0.5	0.1		41252
		2.00	0.004	8.59E-04	0.5	0.1		
5	44.85	4.75	0.003	8.56E-04	2.4	0.9		41252
6	44.50	6.50	0.003	8.49E-04	4.3	2.1		41252
7	43.75	10.25	0.002	7.70E-04	10.6	7.7		41252
		-22.97	0.002	7.70E-04	10.6	7.7		
8	43.00	-10.38	0.002	5.84E-04	-1.9	12.4		41252
9	42.80	-6.96	0.002	5.21E-04	-3.6	11.8		41252
10	42.00	0.03	0.001	3.02E-04	-6.4	7.1		41252
11	41.50	2.21	0.001	2.02E-04	-5.9	3.9		41252
12	41.40	2.48	0.001	1.85E-04	-5.6	3.4		41252
13	40.70	3.19	0.001	1.01E-04	-3.6	0.2		41252
14	40.00	2.61	0.001	6.16E-05	-1.6	-1.5		41252
15	39.35	1.67	0.001	4.89E-05	-0.2	-2.0		41252
16	38.70	0.79	0.001	4.79E-05	0.6	-1.8		41252
17	38.50	0.57	0.001	4.88E-05	0.7	-1.6		41252
18	38.44	0.50	0.001	4.92E-05	0.8	-1.6		41252
19	37.94	0.08	0.001	5.20E-05	0.9	-1.2		41252
20	37.37	-0.21	0.001	5.48E-05	0.9	-0.6		41252
21	36.80	-0.34	0.001	5.61E-05	0.7	-0.2		41252
22	36.00	-0.33	0.001	5.55E-05	0.4	0.2		41252
23	35.20	-0.23	0.001	5.29E-05	0.2	0.4		41252
24	34.40	-0.14	0.001	4.95E-05	0.1	0.5		41252
25	33.60	-0.08	0.001	4.60E-05	-0.0	0.4		41252
26	32.80	-0.05	0.001	4.31E-05	-0.1	0.3		41252
27	32.00	-0.01	0.001	4.12E-05	-0.1	0.2		41252

(continued)

Stage No.5 Excavate to elevation 43.75 on RIGHT side

Node no.	Y coord	Nett pressure kN/m2	Wall disp. m	Wall rotation rad.	Shear force kN/m	Bending moment kN.m/m	Strut forces kN/m	EI of wall kN.m2/m
28	31.40	0.07	0.001	4.04E-05	-0.1	0.1		41252
29	30.80	0.20	0.001	4.02E-05	-0.0	-0.0		---

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	45.80	0.00	0.00	0.00	0.00	0.00	0.00	2747
2	45.69	0.00	1.98	0.68	7.09	0.68	0.68a	2747
3	45.60	0.00	3.60	1.24	12.89	1.24	1.24a	2747
4	45.40	0.00	7.20	2.47	25.79	2.47	2.47a	2747
		Total>	7.20	2.00m	154.12	2.00	2.00a	14005
5	44.85	Total>	18.30	4.75m	165.22	4.75	4.75a	14005
6	44.50	Total>	25.56	6.50m	172.49	6.50	6.50a	14005
7	43.75	Total>	42.75	10.25m	189.68	10.25	10.25a	14005
8	43.00	Total>	61.63	14.00m	208.56	32.44	32.44	14005
9	42.80	Total>	66.71	15.00m	213.64	38.75	38.75	14005
10	42.00	Total>	86.49	19.00m	240.03	60.23	60.23	14993
11	41.50	Total>	98.26	21.50m	255.93	72.24	72.24	15611
12	41.40	Total>	100.55	22.00m	259.06	74.52	74.52	15735
13	40.70	Total>	116.17	25.50m	280.46	89.70	89.70	16600
14	40.00	Total>	131.14	29.00m	301.22	103.89	103.89	17465
15	39.35	Total>	144.64	32.25m	320.09	116.68	116.68	18268
16	38.70	Total>	157.89	35.50m	338.71	129.39	129.39	19071
17	38.50	Total>	161.93	36.50m	344.41	133.30	133.30	19318
18	38.44	Total>	163.14	36.80m	346.11	134.48	134.48	19392
19	37.94	Total>	173.17	39.30m	360.28	144.32	144.32	20010
20	37.37	Total>	184.53	42.15m	376.35	155.60	155.60	20715
21	36.80	Total>	195.84	45.00m	392.38	166.96	166.96	21419
22	36.00	Total>	211.66	49.00m	414.81	182.99	182.99	22408
23	35.20	Total>	227.44	53.00m	437.20	199.06	199.06	23396
24	34.40	Total>	243.20	57.00m	459.57	215.13	215.13	24385
25	33.60	Total>	258.94	61.00m	481.92	231.20	231.20	25373
26	32.80	Total>	274.68	65.00m	504.28	247.27	247.27	26362
27	32.00	Total>	290.42	69.00m	526.63	263.35	263.35	27350
28	31.40	Total>	302.22	72.00m	543.39	275.45	275.45	28092
29	30.80	Total>	314.03	75.00m	560.16	287.58	287.58	28833

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	45.80	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	45.69	0.00	0.00	0.00	0.00	0.00	0.00	0.0
3	45.60	0.00	0.00	0.00	0.00	0.00	0.00	0.0
4	45.40	0.00	0.00	0.00	0.00	0.00	0.00	0.0
5	44.85	0.00	0.00	0.00	0.00	0.00	0.00	0.0
6	44.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
7	43.75	0.00	0.00	0.00	0.00	0.00	0.00	0.0
		Total>	0.00	0.00	146.91	33.22	33.22	12538
8	43.00	Total>	15.00	3.75m	161.92	42.82	42.82	12538
9	42.80	Total>	19.00	4.75m	165.92	45.71	45.71	12538
10	42.00	Total>	35.01	8.75m	188.54	60.20	60.20	13423
11	41.50	Total>	45.02	11.25m	202.69	70.02	70.02	13976

(continued)

Stage No.5 Excavate to elevation 43.75 on RIGHT side

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
12	41.40	Total>	47.03	11.75m	205.52	72.04	72.04	14087
13	40.70	Total>	61.06	15.25m	225.34	86.51	86.51	14861
14	40.00	Total>	75.11	18.75m	245.17	101.29	101.29	15636
15	39.35	Total>	88.17	22.00m	263.61	115.01	115.01	16355
16	38.70	Total>	101.25	25.25m	282.07	128.60	128.60	17074
17	38.50	Total>	105.28	26.25m	287.75	132.74	132.74	17295
18	38.44	Total>	106.49	26.55m	289.45	133.98	133.98	17362
19	37.94	Total>	116.58	29.05m	303.67	144.24	144.24	17915
20	37.37	Total>	128.09	31.90m	319.90	155.82	155.82	18545
21	36.80	Total>	139.62	34.75m	336.14	167.30	167.30	19176
22	36.00	Total>	155.84	38.75m	358.97	183.32	183.32	20061
23	35.20	Total>	172.09	42.75m	381.83	199.29	199.29	20946
24	34.40	Total>	188.37	46.75m	404.73	215.27	215.27	21831
25	33.60	Total>	204.69	50.75m	427.66	231.28	231.28	22716
26	32.80	Total>	221.04	54.75m	450.62	247.31	247.31	23601
27	32.00	Total>	237.42	58.75m	473.61	263.36	263.36	24486
28	31.40	Total>	249.72	61.75m	490.87	275.38	275.38	25150
29	30.80	Total>	262.03	64.75m	508.15	287.38	287.38	25814

Note: 10.25a Soil pressure at active limit
123.45p Soil pressure at passive limit

KNIGHT BUILD LTD | Sheet No.
Program: WALLAP Version 6.06 Revision A49.B68.R53 | Job No. 79AR
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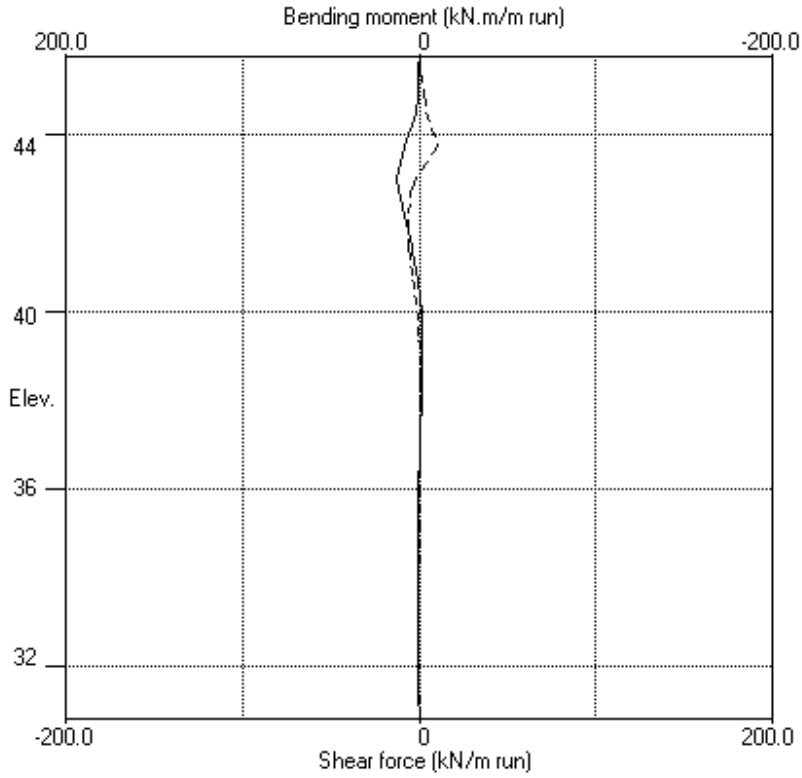
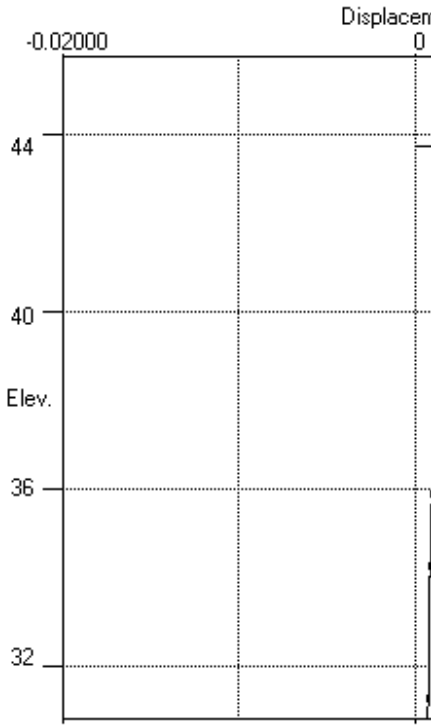
79 Avenue Road | Date:28-06-2021
SECTION 1-1 ANALYSIS | Checked :

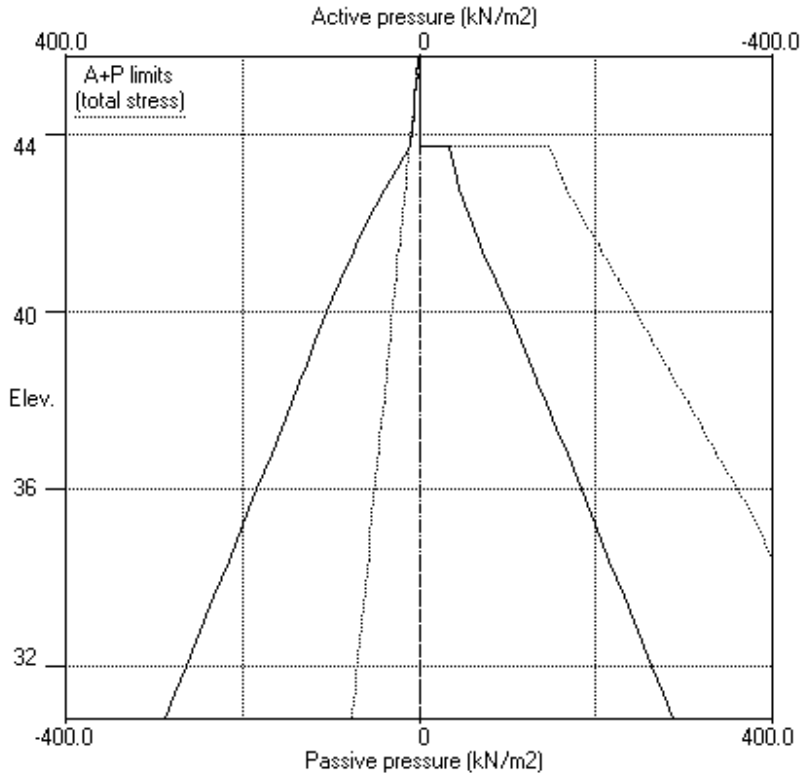
Units: kN,m

Stage No.5 Excav. to elev. 43.75 on RIGHT side





Stage No.5 Excav. to elev. 43.75 on RIGHT side



Units: kN,m

Stage No. 7 Excavate to elevation 41.50 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.	Overall FoS for toe elev. = 30.80 Factor of Safety	Moment equilib. at elev.	Toe elev. for FoS = 1.000 Toe elev.	Wall Penetr-ation	Direction of failure
7	45.80	41.50	45.40	4.824	n/a	41.38	0.12	L to R

BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall
Analysis options
Length of wall perpendicular to section = 15.00m
Subgrade reaction model - Boussinesq Influence coefficients
Soil deformations are elastic until the active or passive limit is reached
Open Tension Crack analysis - No

Rigid boundaries: Left side 30.00 from wall
Right side 30.00 from wall
Limit State: ULS DA1 Combination 2

*** Wall displacements reset to zero at stage 4

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	45.80	0.00	0.004	-5.54E-04	0.0	0.0		41252
2	45.69	0.68	0.004	-5.54E-04	0.0	-0.0		41252
3	45.60	1.24	0.004	-5.54E-04	0.1	0.0		41252
4	45.40	2.47	0.004	-5.54E-04	0.5	0.1	19.2	41252
		2.00	0.004	-5.54E-04	-18.8	0.1		
5	44.85	4.75	0.004	-4.86E-04	-16.9	-9.6		41252
6	44.50	6.50	0.005	-3.75E-04	-14.9	-15.2		41252
7	43.75	10.25	0.005	-8.00E-06	-8.6	-24.0		41252
8	43.00	14.00	0.005	4.37E-04	0.4	-25.3		41252
9	42.80	13.00	0.005	5.54E-04	3.1	-24.9		41252
10	42.00	23.46	0.004	9.02E-04	17.7	-14.7		41252
11	41.50	33.26	0.003	9.73E-04	31.9	-2.6		41252
		-38.26	0.003	9.73E-04	31.9	-2.6		
12	41.40	-36.02	0.003	9.68E-04	28.2	0.4		41252
13	40.70	-20.63	0.003	8.13E-04	8.4	11.5		41252
14	40.00	-8.60	0.002	5.59E-04	-1.9	12.3		41252
15	39.35	-1.67	0.002	3.48E-04	-5.2	9.3		41252
16	38.70	1.71	0.002	1.99E-04	-5.2	5.6		41252
17	38.50	2.20	0.002	1.67E-04	-4.8	4.6		41252
18	38.44	2.31	0.002	1.59E-04	-4.7	4.3		41252
19	37.94	2.67	0.002	1.05E-04	-3.4	2.3		41252
20	37.37	2.30	0.002	7.42E-05	-2.0	0.8		41252
21	36.80	1.61	0.002	6.43E-05	-0.9	0.0		41252
22	36.00	0.68	0.002	6.59E-05	0.0	-0.2		41252
23	35.20	0.09	0.001	7.18E-05	0.3	-0.0		41252
24	34.40	-0.17	0.001	7.49E-05	0.3	0.2		41252
25	33.60	-0.21	0.001	7.44E-05	0.2	0.3		41252
26	32.80	-0.17	0.001	7.17E-05	-0.0	0.3		41252
27	32.00	-0.07	0.001	6.90E-05	-0.1	0.2		41252

(continued)

Stage No.7 Excavate to elevation 41.50 on RIGHT side

Node no.	Y coord	Nett pressure kN/m2	Wall disp. m	Wall rotation rad.	Shear force kN/m	Bending moment kN.m/m	Strut forces kN/m	EI of wall kN.m2/m
28	31.40	0.06	0.001	6.78E-05	-0.1	0.1		41252
29	30.80	0.28	0.001	6.74E-05	-0.0	0.0		---
At elev. 45.40 Strut force = 144.4 kN/strut = 19.2 kN/m run								

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	45.80	0.00	0.00	0.00	0.00	0.00	0.00	61664
2	45.69	0.00	1.98	0.68	7.09	0.68	0.68a	13085
3	45.60	0.00	3.60	1.24	12.89	1.24	1.24a	3315
4	45.40	0.00	7.20	2.47	25.79	2.47	2.47a	1945
		Total>	7.20	2.00m	154.12	2.00	2.00a	9977
5	44.85	Total>	18.30	4.75m	165.22	4.75	4.75a	9977
6	44.50	Total>	25.56	6.50m	172.49	6.50	6.50a	9977
7	43.75	Total>	42.75	10.25m	189.68	10.25	10.25a	9977
8	43.00	Total>	61.63	14.00m	208.56	14.00	14.00a	9977
9	42.80	Total>	66.71	15.00m	213.64	15.00	15.00a	9977
10	42.00	Total>	86.49	19.00m	240.03	33.46	33.46	10681
11	41.50	Total>	98.26	21.50m	255.93	48.26	48.26	11121
12	41.40	Total>	100.55	22.00m	259.06	51.23	51.23	11209
13	40.70	Total>	116.17	25.50m	280.46	71.47	71.47	11825
14	40.00	Total>	131.14	29.00m	301.22	90.02	90.02	12441
15	39.35	Total>	144.64	32.25m	320.09	105.51	105.51	13014
16	38.70	Total>	157.89	35.50m	338.71	119.68	119.68	13586
17	38.50	Total>	161.93	36.50m	344.41	123.84	123.84	13762
18	38.44	Total>	163.14	36.80m	346.11	125.07	125.07	13815
19	37.94	Total>	173.17	39.30m	360.28	135.17	135.17	14255
20	37.37	Total>	184.53	42.15m	376.35	146.43	146.43	14757
21	36.80	Total>	195.84	45.00m	392.38	157.58	157.58	15258
22	36.00	Total>	211.66	49.00m	414.81	173.28	173.28	15963
23	35.20	Total>	227.44	53.00m	437.20	189.11	189.11	16667
24	34.40	Total>	243.20	57.00m	459.57	205.08	205.08	17371
25	33.60	Total>	258.94	61.00m	481.92	221.13	221.13	18075
26	32.80	Total>	274.68	65.00m	504.28	237.24	237.24	18779
27	32.00	Total>	290.42	69.00m	526.63	253.39	253.39	19484
28	31.40	Total>	302.22	72.00m	543.39	265.54	265.54	20012
29	30.80	Total>	314.03	75.00m	560.16	277.76	277.76	20540

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	45.80	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	45.69	0.00	0.00	0.00	0.00	0.00	0.00	0.0
3	45.60	0.00	0.00	0.00	0.00	0.00	0.00	0.0
4	45.40	0.00	0.00	0.00	0.00	0.00	0.00	0.0
5	44.85	0.00	0.00	0.00	0.00	0.00	0.00	0.0
6	44.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
7	43.75	0.00	0.00	0.00	0.00	0.00	0.00	0.0
8	43.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
9	42.80	2.00	0.00	0.00	0.00	0.00	2.00	0.0
10	42.00	10.00	0.00	0.00	0.00	0.00	10.00	0.0
11	41.50	15.00	0.00	0.00	0.00	0.00	15.00	0.0
		Total>	15.00	15.00w	172.66	86.52	86.52	21034

(continued)

Stage No.7 Excavate to elevation 41.50 on RIGHT side

Node no.	Y coord	RIGHT side Effective stresses Water press. kN/m2	Vertic -al kN/m2	Active limit kN/m2	Passive limit kN/m2	Earth pressure kN/m2	Total earth pressure kN/m2	Coeff. of subgrade reaction kN/m3
12	41.40	Total>	17.00	8.00m	175.48	87.25	87.25	21201
13	40.70	Total>	31.00	11.50m	195.27	92.10	92.10	22366
14	40.00	Total>	45.01	15.00m	215.07	98.61	98.61	23532
15	39.35	Total>	58.04	18.25m	233.47	107.18	107.18	24614
16	38.70	Total>	71.08	21.50m	251.88	117.97	117.97	25696
17	38.50	Total>	75.10	22.50m	257.55	121.64	121.64	26029
18	38.44	Total>	76.30	22.80m	259.26	122.76	122.76	26129
19	37.94	Total>	86.36	25.30m	273.45	132.50	132.50	26961
20	37.37	Total>	97.85	28.15m	289.65	144.12	144.12	27911
21	36.80	Total>	109.36	31.00m	305.87	155.97	155.97	28860
22	36.00	Total>	125.57	35.00m	328.69	172.60	172.60	30192
23	35.20	Total>	141.83	39.00m	351.57	189.03	189.03	31524
24	34.40	Total>	158.16	43.00m	374.51	205.25	205.25	32855
25	33.60	Total>	174.54	47.00m	397.50	221.35	221.35	34187
26	32.80	Total>	190.99	51.00m	420.57	237.41	237.41	35519
27	32.00	Total>	207.50	55.00m	443.69	253.46	253.46	36851
28	31.40	Total>	219.92	58.00m	461.07	265.48	265.48	37850
29	30.80	Total>	232.37	61.00m	478.48	277.47	277.47	38849

Note: 15.00a Soil pressure at active limit
123.45p Soil pressure at passive limit

KNIGHT BUILD LTD | Sheet No.
Program: WALLAP Version 6.06 Revision A49.B68.R53 | Job No. 79AR
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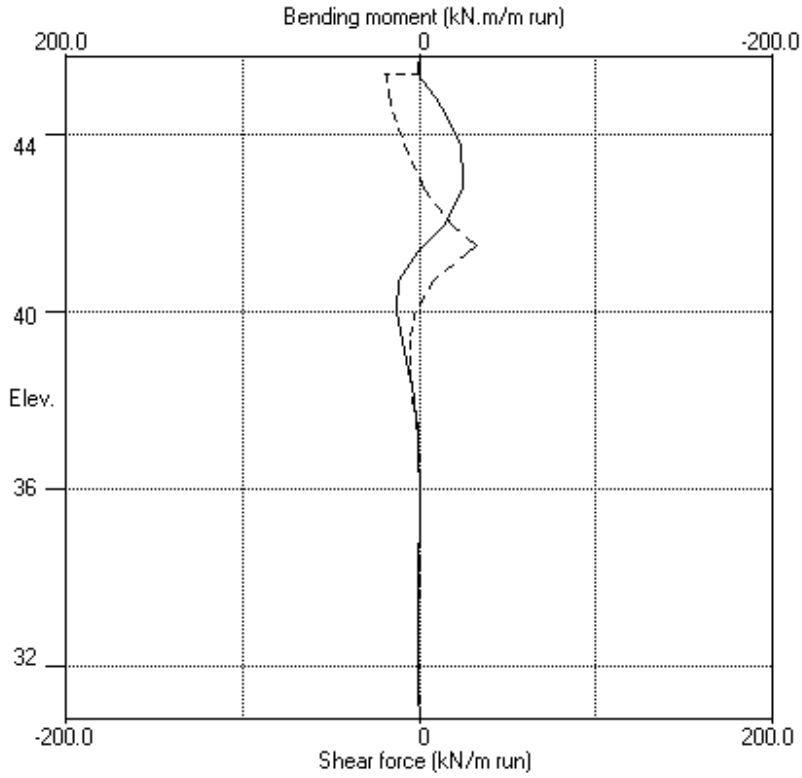
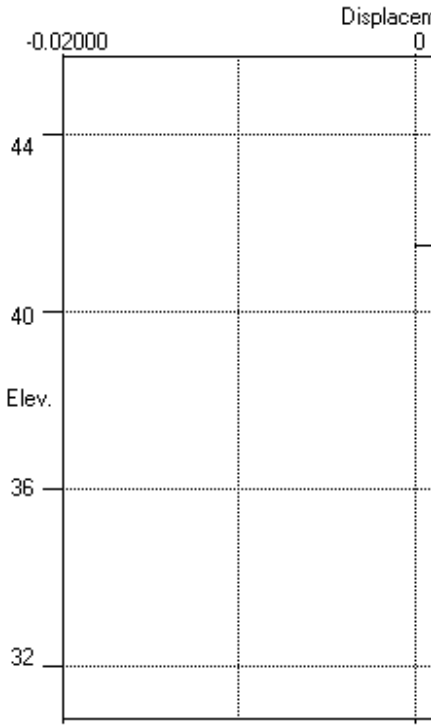
Data filename/Run ID: SECTION_1-1_ULS2 |
79 Avenue Road | Date:28-06-2021
SECTION 1-1 ANALYSIS | Checked :

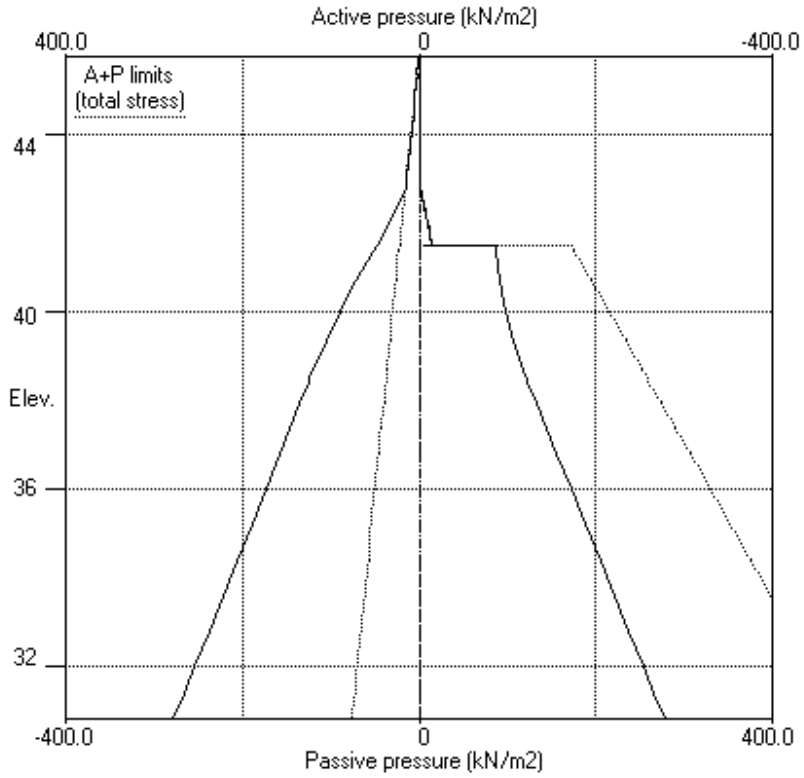
Units: kN,m

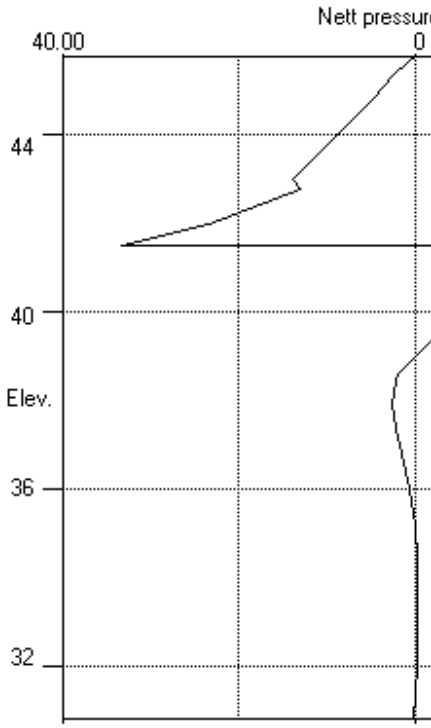
Stage No.7 Excav. to elev. 41.50 on RIGHT side





Stage No.7 Excav. to elev. 41.50 on RIGHT side





Units: kN,m

Stage No. 9 Excavate to elevation 37.94 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.	Overall FoS for toe elev. = 30.80 Factor of Safety	Moment equilib. at elev.	Toe elev. for FoS = 1.000 Toe elev.	Wall Penetr -ation	Direction of failure
9	45.80	37.94		More than one strut. No FoS calc.				

BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall
Analysis options
Length of wall perpendicular to section = 15.00m
Subgrade reaction model - Boussinesq Influence coefficients
Soil deformations are elastic until the active or passive limit is reached
Open Tension Crack analysis - No

Rigid boundaries: Left side 30.00 from wall
Right side 30.00 from wall
Limit State: ULS DA1 Combination 2

*** Wall displacements reset to zero at stage 4

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	45.80	0.00	0.004	-6.82E-04	0.0	0.0		41252
2	45.69	1.84	0.004	-6.82E-04	0.1	-0.0		41252
3	45.60	2.31	0.004	-6.82E-04	0.3	0.0		41252
4	45.40	3.36	0.004	-6.83E-04	0.9	0.1	13.8	41252
		6.48	0.004	-6.83E-04	-13.0	0.1		
5	44.85	6.44	0.004	-6.41E-04	-9.4	-5.7		41252
6	44.50	6.50	0.005	-5.75E-04	-7.1	-8.6		41252
7	43.75	10.25	0.005	-3.81E-04	-0.9	-11.5		41252
8	43.00	14.00	0.005	-2.16E-04	8.2	-7.0		41252
9	42.80	13.00	0.005	-1.92E-04	10.9	-5.1		41252
10	42.00	9.00	0.005	-2.75E-04	19.7	9.9	50.6	41252
		9.00	0.005	-2.75E-04	-30.9	9.9		
11	41.50	9.41	0.006	-3.47E-04	-26.3	-3.5		41252
12	41.40	9.71	0.006	-3.43E-04	-25.3	-6.1		41252
13	40.70	11.76	0.006	-1.62E-04	-17.8	-21.5		41252
14	40.00	15.58	0.006	2.31E-04	-8.3	-31.1		41252
15	39.35	22.63	0.005	6.96E-04	4.2	-33.0		41252
16	38.70	34.01	0.005	1.12E-03	22.6	-25.2		41252
17	38.50	38.35	0.005	1.22E-03	29.8	-20.0		41252
18	38.44	39.72	0.005	1.25E-03	32.1	-18.1		41252
19	37.94	51.99	0.004	1.32E-03	55.1	3.1		41252
		-77.89	0.004	1.32E-03	55.1	3.1		
20	37.37	-47.44	0.003	1.14E-03	19.4	21.8		41252
21	36.80	-22.73	0.003	8.17E-04	-0.6	25.2		41252
22	36.00	-2.14	0.002	4.05E-04	-10.6	17.4		41252
23	35.20	5.18	0.002	1.61E-04	-9.4	8.2		41252
24	34.40	5.33	0.002	6.51E-05	-5.2	2.3		41252
25	33.60	3.18	0.002	4.96E-05	-1.8	-0.2		41252
26	32.80	1.18	0.002	6.13E-05	-0.0	-0.6		41252

(continued)

Stage No.9 Excavate to elevation 37.94 on RIGHT side

Node no.	Y coord	Nett pressure kN/m2	Wall disp. m	Wall rotation rad.	Shear force kN/m	Bending moment kN.m/m	Strut forces kN/m	EI of wall kN.m2/m
27	32.00	0.01	0.002	7.31E-05	0.5	-0.3		41252
28	31.40	-0.43	0.002	7.69E-05	0.3	-0.1		41252
29	30.80	-0.66	0.002	7.78E-05	0.0	0.0		---
At elev. 45.40 Strut force =			103.6 kN/strut =			13.8 kN/m run		
At elev. 42.00 Strut force =			379.8 kN/strut =			50.6 kN/m run (horiz.)		
						58.5 kN/m run (inclined)		

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	45.80	0.00	0.00	0.00	0.00	0.00	0.00	7321
2	45.69	0.00	1.98	0.68	7.09	1.84	1.84	7321
3	45.60	0.00	3.60	1.24	12.89	2.31	2.31	7321
4	45.40	0.00	7.20	2.47	25.79	3.36	3.36	7321
		Total>	7.20	2.00m	154.12	6.48	6.48	37004
5	44.85	Total>	18.30	4.75m	165.22	6.44	6.44	37004
6	44.50	Total>	25.56	6.50m	172.49	6.50	6.50a	9983
7	43.75	Total>	42.75	10.25m	189.68	10.25	10.25a	9983
8	43.00	Total>	61.63	14.00m	208.56	14.00	14.00a	9983
9	42.80	Total>	66.71	15.00m	213.64	15.00	15.00a	9983
10	42.00	Total>	86.49	19.00m	240.03	19.00	19.00a	10688
11	41.50	Total>	98.26	21.50m	255.93	24.41	24.41	11128
12	41.40	Total>	100.55	22.00m	259.06	25.71	25.71	11216
13	40.70	Total>	116.17	25.50m	280.46	34.76	34.76	11833
14	40.00	Total>	131.14	29.00m	301.22	45.58	45.58	12449
15	39.35	Total>	144.64	32.25m	320.09	59.13	59.13	13022
16	38.70	Total>	157.89	35.50m	338.71	77.01	77.01	13594
17	38.50	Total>	161.93	36.50m	344.41	83.35	83.35	13771
18	38.44	Total>	163.14	36.80m	346.11	85.32	85.32	13823
19	37.94	Total>	173.17	39.30m	360.28	102.59	102.59	14264
20	37.37	Total>	184.53	42.15m	376.35	122.55	122.55	14766
21	36.80	Total>	195.84	45.00m	392.38	140.88	140.88	15268
22	36.00	Total>	211.66	49.00m	414.81	162.64	162.64	15973
23	35.20	Total>	227.44	53.00m	437.20	180.66	180.66	16677
24	34.40	Total>	243.20	57.00m	459.57	196.69	196.69	17382
25	33.60	Total>	258.94	61.00m	481.92	212.09	212.09	18087
26	32.80	Total>	274.68	65.00m	504.28	227.57	227.57	18791
27	32.00	Total>	290.42	69.00m	526.63	243.32	243.32	19496
28	31.40	Total>	302.22	72.00m	543.39	255.29	255.29	20025
29	30.80	Total>	314.03	75.00m	560.16	267.35	267.35	20553

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	45.80	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	45.69	0.00	0.00	0.00	0.00	0.00	0.00	0.0
3	45.60	0.00	0.00	0.00	0.00	0.00	0.00	0.0
4	45.40	0.00	0.00	0.00	0.00	0.00	0.00	0.0
5	44.85	0.00	0.00	0.00	0.00	0.00	0.00	0.0
6	44.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
7	43.75	0.00	0.00	0.00	0.00	0.00	0.00	0.0
8	43.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0

(continued)

Stage No.9 Excavate to elevation 37.94 on RIGHT side

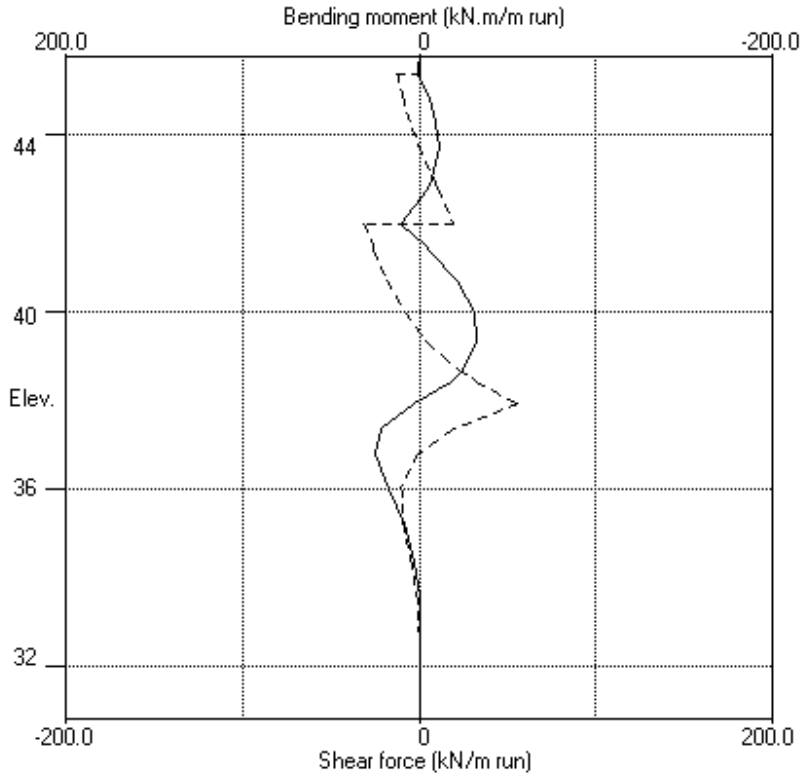
Node no.	Y coord	RIGHT side Effective stresses Water press. kN/m2	Vertic -al kN/m2	Active limit kN/m2	Passive limit kN/m2	Earth pressure kN/m2	Total earth pressure kN/m2	Coeff. of subgrade reaction kN/m3
9	42.80	2.00	0.00	0.00	0.00	0.00	2.00	0.0
10	42.00	10.00	0.00	0.00	0.00	0.00	10.00	0.0
11	41.50	15.00	0.00	0.00	0.00	0.00	15.00	0.0
12	41.40	16.00	0.00	0.00	0.00	0.00	16.00	0.0
13	40.70	23.00	0.00	0.00	0.00	0.00	23.00	0.0
14	40.00	30.00	0.00	0.00	0.00	0.00	30.00	0.0
15	39.35	36.50	0.00	0.00	0.00	0.00	36.50	0.0
16	38.70	43.00	0.00	0.00	0.00	0.00	43.00	0.0
17	38.50	45.00	0.00	0.00	0.00	0.00	45.00	0.0
18	38.44	45.60	0.00	0.00	0.00	0.00	45.60	0.0
19	37.94	50.60	0.00	0.00	0.00	0.00	50.60	0.0
		Total> 50.60	50.60w		237.68	180.47	180.47	36038
20	37.37	Total> 62.00	28.15m		253.79	170.00	170.00	37306
21	36.80	Total> 73.41	31.00m		269.91	163.61	163.61	38575
22	36.00	Total> 89.44	35.00m		292.55	164.77	164.77	40355
23	35.20	Total> 105.51	39.00m		315.24	175.48	175.48	42135
24	34.40	Total> 121.64	43.00m		337.98	191.36	191.36	43916
25	33.60	Total> 137.83	47.00m		360.79	208.92	208.92	45696
26	32.80	Total> 154.11	51.00m		383.67	226.39	226.39	47477
27	32.00	Total> 170.46	55.00m		406.64	243.31	243.31	49257
28	31.40	Total> 182.79	58.00m		423.93	255.72	255.72	50592
29	30.80	Total> 195.17	61.00m		441.27	268.01	268.01	51928

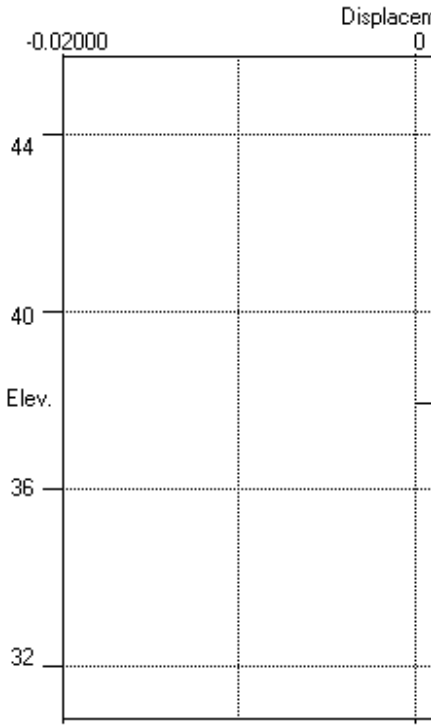
Note: 19.00a Soil pressure at active limit
123.45p Soil pressure at passive limit

KNIGHT BUILD LTD | Sheet No.
Program: WALLAP Version 6.06 Revision A49.B68.R53 | Job No. 79AR
Licensed from GEOSOLVE | Made by : JRC
Data filename/Run ID: SECTION_1-1_ULS2 |
79 Avenue Road | Date:28-06-2021
SECTION 1-1 ANALYSIS | Checked :

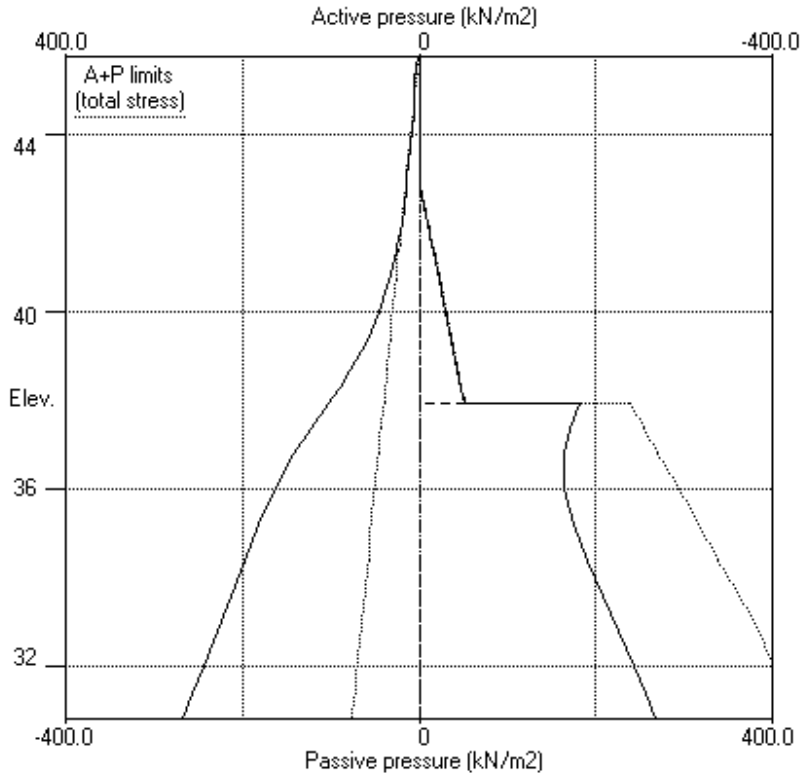
Units: kN,m

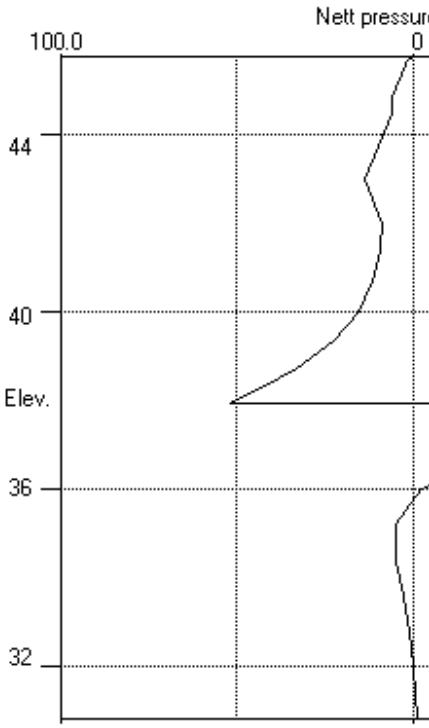
Stage No.9 Excav. to elev. 37.94 on RIGHT side





Stage No.9 Excav. to elev. 37.94 on RIGHT side





Units: kN,m

Stage No. 10 Fill to elevation 38.44 on RIGHT side with soil type 1

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

Stage No.	G.L. Act.	G.L. Pass.	Strut Elev.	Overall FoS for toe elev. = 30.80 Factor of Safety	Moment equilib. at elev.	Toe elev. for FoS = 1.000 Toe elev.	Wall Penetr -ation	Direction of failure
10	45.80	38.44		More than one strut. No FoS calc.				

BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall
Analysis options
Length of wall perpendicular to section = 15.00m
Subgrade reaction model - Boussinesq Influence coefficients
Soil deformations are elastic until the active or passive limit is reached
Open Tension Crack analysis - No

Rigid boundaries: Left side 30.00 from wall
Right side 30.00 from wall
Limit State: ULS DA1 Combination 2

*** Wall displacements reset to zero at stage 4

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	45.80	0.00	0.004	-6.87E-04	0.0	0.0		41252
2	45.69	1.84	0.004	-6.87E-04	0.1	-0.0		41252
3	45.60	2.31	0.004	-6.87E-04	0.3	0.0		41252
4	45.40	3.36	0.004	-6.87E-04	0.9	0.1	13.9	41252
		6.47	0.004	-6.87E-04	-13.0	0.1		
5	44.85	6.39	0.004	-6.45E-04	-9.5	-5.8		41252
6	44.50	6.50	0.005	-5.78E-04	-7.2	-8.6		41252
7	43.75	10.25	0.005	-3.83E-04	-1.0	-11.7		41252
8	43.00	14.00	0.005	-2.15E-04	8.1	-7.2		41252
9	42.80	13.00	0.005	-1.89E-04	10.8	-5.3		41252
10	42.00	9.00	0.005	-2.68E-04	19.6	9.6	50.7	41252
		9.00	0.005	-2.68E-04	-31.1	9.6		
11	41.50	9.42	0.006	-3.36E-04	-26.5	-3.9		41252
12	41.40	9.73	0.006	-3.31E-04	-25.5	-6.5		41252
13	40.70	11.88	0.006	-1.43E-04	-18.0	-22.0		41252
14	40.00	15.86	0.006	2.60E-04	-8.3	-31.7		41252
15	39.35	23.13	0.005	7.34E-04	4.4	-33.5		41252
16	38.70	34.78	0.005	1.16E-03	23.2	-25.4		41252
17	38.50	39.23	0.005	1.27E-03	30.6	-20.1		41252
18	38.44	40.63	0.004	1.29E-03	33.0	-18.2		41252
19	37.94	51.77	0.004	1.37E-03	56.1	3.6		41252
		-79.39	0.004	1.37E-03	56.1	3.6		
20	37.37	-48.40	0.003	1.18E-03	19.7	22.6		41252
21	36.80	-23.24	0.002	8.40E-04	-0.7	26.0		41252
22	36.00	-2.24	0.002	4.13E-04	-10.9	18.0		41252
23	35.20	5.28	0.002	1.60E-04	-9.7	8.5		41252
24	34.40	5.48	0.002	5.88E-05	-5.4	2.4		41252
25	33.60	3.30	0.002	4.17E-05	-1.9	-0.2		41252
26	32.80	1.25	0.002	5.35E-05	-0.0	-0.7		41252

(continued)

Stage No.10 Fill to elevation 38.44 on RIGHT side with soil type 1

Node no.	Y coord	Nett pressure kN/m2	Wall disp. m	Wall rotation rad.	Shear force kN/m	Bending moment kN.m/m	Strut forces kN/m	EI of wall kN.m2/m
27	32.00	0.03	0.002	6.57E-05	0.5	-0.4		41252
28	31.40	-0.45	0.002	6.98E-05	0.3	-0.1		41252
29	30.80	-0.72	0.002	7.08E-05	0.0	0.0		---

At elev. 45.40 Strut force = 104.1 kN/strut = 13.9 kN/m run
At elev. 42.00 Strut force = 380.5 kN/strut = 50.7 kN/m run (horiz.)
= 58.6 kN/m run (inclined)

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	45.80	0.00	0.00	0.00	0.00	0.00	0.00	43560
2	45.69	0.00	1.98	0.68	7.09	1.84	1.84	2588
3	45.60	0.00	3.60	1.24	12.89	2.31	2.31	2588
4	45.40	0.00	7.20	2.47	25.79	3.36	3.36	2588
		Total>	7.20	2.00m	154.12	6.47	6.47	13206
5	44.85	Total>	18.30	4.75m	165.22	6.39	6.39	13206
6	44.50	Total>	25.56	6.50m	172.49	6.50	6.50a	13206
7	43.75	Total>	42.75	10.25m	189.68	10.25	10.25a	13206
8	43.00	Total>	61.63	14.00m	208.56	14.00	14.00a	13206
9	42.80	Total>	66.71	15.00m	213.64	15.00	15.00a	13206
10	42.00	Total>	86.49	19.00m	240.03	19.00	19.00a	14138
11	41.50	Total>	98.26	21.50m	255.93	24.42	24.42	7977
12	41.40	Total>	100.55	22.00m	259.06	25.73	25.73	8040
13	40.70	Total>	116.17	25.50m	280.46	34.88	34.88	8482
14	40.00	Total>	131.14	29.00m	301.22	45.86	45.86	8924
15	39.35	Total>	144.64	32.25m	320.09	59.63	59.63	9334
16	38.70	Total>	157.89	35.50m	338.71	77.78	77.78	9745
17	38.50	Total>	161.93	36.50m	344.41	84.23	84.23	9871
18	38.44	Total>	163.14	36.80m	346.11	86.23	86.23	9909
19	37.94	Total>	173.17	39.30m	360.28	103.75	103.75	10225
20	37.37	Total>	184.53	42.15m	376.35	123.99	123.99	10585
21	36.80	Total>	195.84	45.00m	392.38	142.55	142.55	10944
22	36.00	Total>	211.66	49.00m	414.81	164.51	164.51	11450
23	35.20	Total>	227.44	53.00m	437.20	182.65	182.65	11955
24	34.40	Total>	243.20	57.00m	459.57	198.72	198.72	12460
25	33.60	Total>	258.94	61.00m	481.92	214.13	214.13	12965
26	32.80	Total>	274.68	65.00m	504.28	229.60	229.60	13470
27	32.00	Total>	290.42	69.00m	526.63	245.34	245.34	13975
28	31.40	Total>	302.22	72.00m	543.39	257.30	257.30	14354
29	30.80	Total>	314.03	75.00m	560.16	269.36	269.36	14733

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	45.80	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	45.69	0.00	0.00	0.00	0.00	0.00	0.00	0.0
3	45.60	0.00	0.00	0.00	0.00	0.00	0.00	0.0
4	45.40	0.00	0.00	0.00	0.00	0.00	0.00	0.0
5	44.85	0.00	0.00	0.00	0.00	0.00	0.00	0.0
6	44.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
7	43.75	0.00	0.00	0.00	0.00	0.00	0.00	0.0
8	43.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0

(continued)

Stage No.10 Fill to elevation 38.44 on RIGHT side with soil type 1

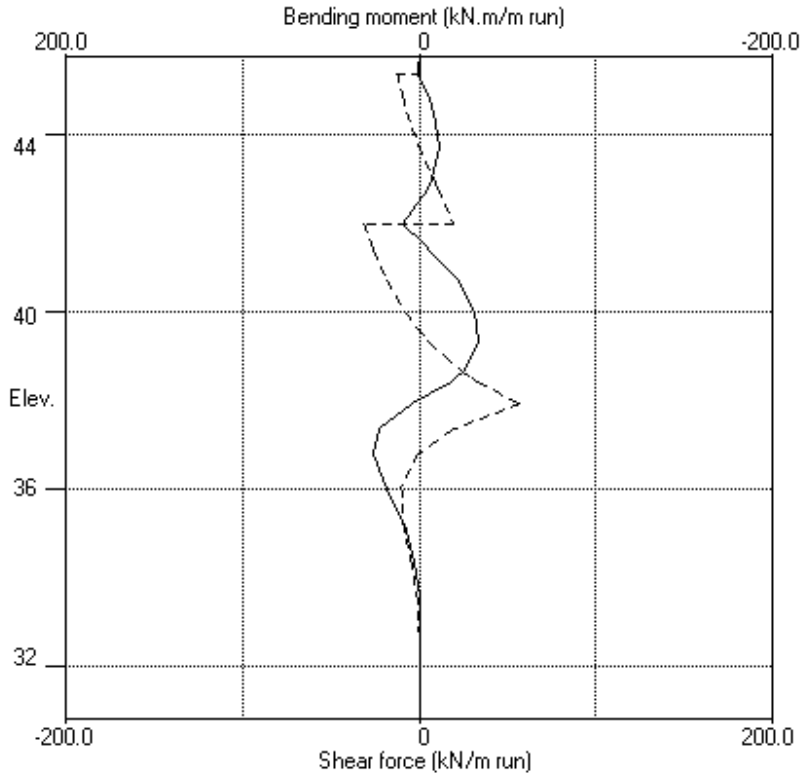
Node no.	Y coord	RIGHT side Effective stresses Water press. kN/m2	Vertic -al kN/m2	Active limit kN/m2	Passive limit kN/m2	Earth pressure kN/m2	Total earth pressure kN/m2	Coeff. of subgrade reaction kN/m3
9	42.80	2.00	0.00	0.00	0.00	0.00	2.00	0.0
10	42.00	10.00	0.00	0.00	0.00	0.00	10.00	0.0
11	41.50	15.00	0.00	0.00	0.00	0.00	15.00	0.0
12	41.40	16.00	0.00	0.00	0.00	0.00	16.00	0.0
13	40.70	23.00	0.00	0.00	0.00	0.00	23.00	0.0
14	40.00	30.00	0.00	0.00	0.00	0.00	30.00	0.0
15	39.35	36.50	0.00	0.00	0.00	0.00	36.50	0.0
16	38.70	43.00	0.00	0.00	0.00	0.00	43.00	0.0
17	38.50	45.00	0.00	0.00	0.00	0.00	45.00	0.0
18	38.44	45.60	0.00	0.00	0.00	0.00	45.60	0.0
		45.60	0.00	0.00	0.00	0.00	45.60	1398
19	37.94	50.60	4.00	1.37	14.33	1.37	51.97a	1398
		Total> 54.60	25.30m	241.68	183.14	183.14		10347
20	37.37	Total> 66.01	28.15m	257.80	172.39	172.39		10711
21	36.80	Total> 77.42	31.00m	273.93	165.79	165.79		11075
22	36.00	Total> 93.48	35.00m	296.59	166.75	166.75		11586
23	35.20	Total> 109.58	39.00m	319.30	177.37	177.37		12097
24	34.40	Total> 125.74	43.00m	342.08	193.24	193.24		12609
25	33.60	Total> 141.97	47.00m	364.92	210.83	210.83		13120
26	32.80	Total> 158.28	51.00m	387.84	228.35	228.35		13631
27	32.00	Total> 174.67	55.00m	410.85	245.31	245.31		14142
28	31.40	Total> 187.02	58.00m	428.16	257.75	257.75		14525
29	30.80	Total> 199.42	61.00m	445.53	270.07	270.07		14909

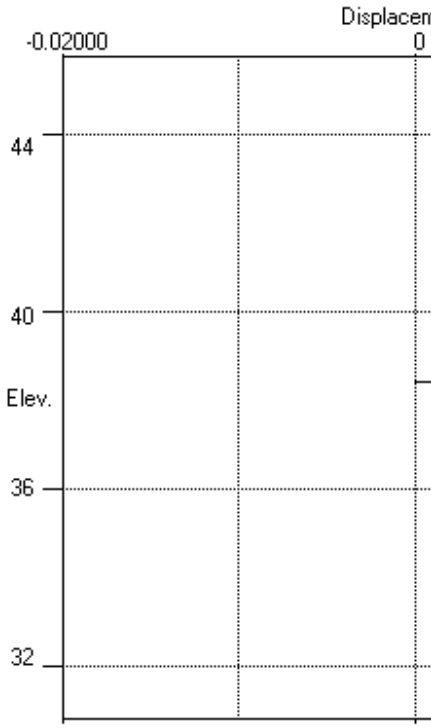
Note: 51.97a Soil pressure at active limit
123.45p Soil pressure at passive limit

KNIGHT BUILD LTD | Sheet No.
Program: WALLAP Version 6.06 Revision A49.B68.R53 | Job No. 79AR
Licensed from GEOSOLVE | Made by : JRC
Data filename/Run ID: SECTION_1-1_ULS2 |
79 Avenue Road | Date:28-06-2021
SECTION 1-1 ANALYSIS | Checked :

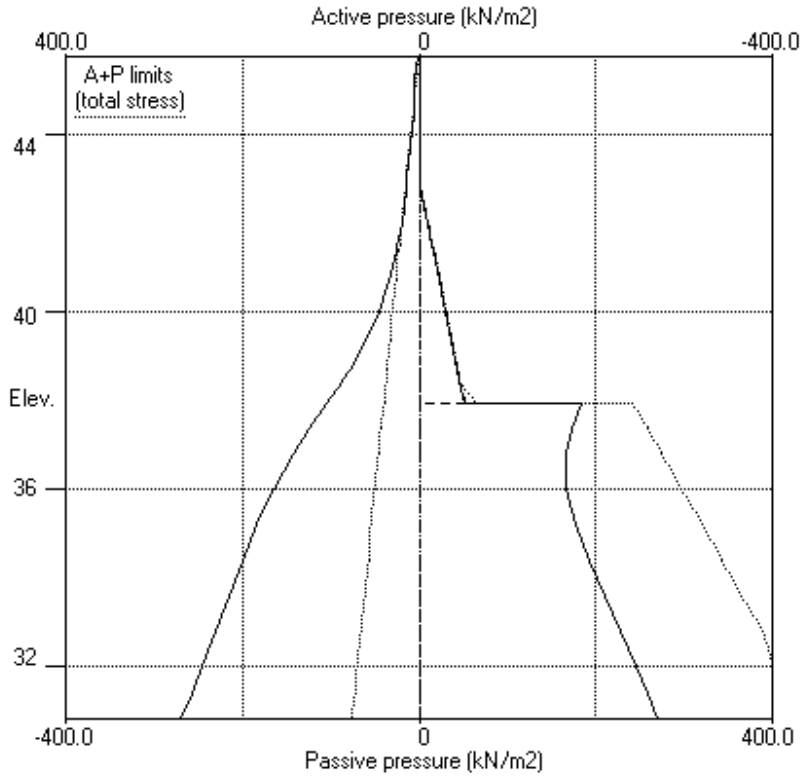
Units: kN,m

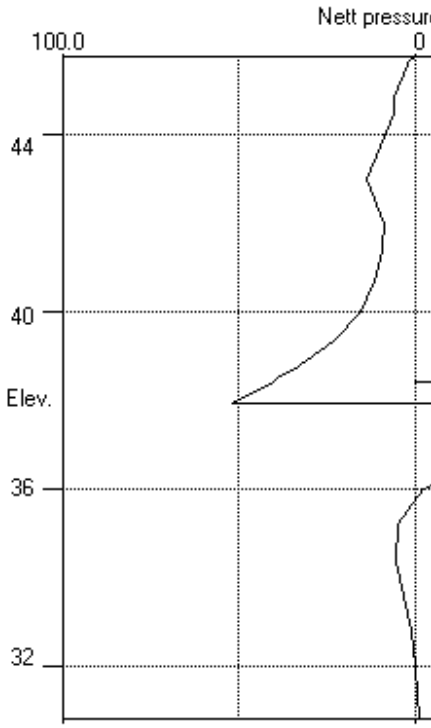
Stage No.10 Fill to elev. 38.44 on RIGHT side





Stage No.10 Fill to elev. 38.44 on RIGHT side





Units: kN,m

Stage No. 12 Change EI of wall to 77684 kN.m2/m run
From elevation 41.50 to 38.50
Yield moment not defined
No adjustments to wall displacements

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

Stage No.	--- G.L. --- Act.	Pass.	Strut Elev.	Overall FoS for toe elev. = 30.80 Factor of Safety	Moment equilib. at elev.	Toe elev. for FoS = 1.000 Toe elev.	Wall Penetr -ation	Direction of failure
12	45.80	38.44		More than one strut. No FoS calc.				

BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall
Analysis options
Length of wall perpendicular to section = 15.00m
Subgrade reaction model - Boussinesq Influence coefficients
Soil deformations are elastic until the active or passive limit is reached
Open Tension Crack analysis - No

Rigid boundaries: Left side 30.00 from wall
Right side 30.00 from wall
Limit State: ULS DA1 Combination 2

*** Wall displacements reset to zero at stage 4

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	45.80	0.00	0.004	-6.87E-04	0.0	0.0		41252
2	45.69	1.84	0.004	-6.87E-04	0.1	-0.0		41252
3	45.60	2.31	0.004	-6.87E-04	0.3	0.0		41252
4	45.40	3.36	0.004	-6.87E-04	0.9	0.1	13.9	41252
		6.47	0.004	-6.87E-04	-13.0	0.1		
5	44.85	6.39	0.004	-6.45E-04	-9.5	-5.8		41252
6	44.50	6.50	0.005	-5.78E-04	-7.2	-8.6		41252
7	43.75	10.25	0.005	-3.83E-04	-1.0	-11.7		41252
8	43.00	14.00	0.005	-2.15E-04	8.1	-7.2		41252
9	42.80	13.00	0.005	-1.89E-04	10.8	-5.3		41252
10	42.00	9.00	0.005	-2.68E-04	19.6	9.6	50.7	41252
		9.00	0.005	-2.68E-04	-31.1	9.6		
11	41.50	9.42	0.006	-3.36E-04	-26.5	-3.9		77684
12	41.40	9.73	0.006	-3.31E-04	-25.5	-6.5		77684
13	40.70	11.88	0.006	-1.43E-04	-18.0	-22.0		77684
14	40.00	15.86	0.006	2.60E-04	-8.3	-31.7		77684
15	39.35	23.13	0.005	7.34E-04	4.4	-33.5		77684
16	38.70	34.78	0.005	1.16E-03	23.2	-25.4		77684
17	38.50	39.23	0.005	1.27E-03	30.6	-20.1		41252
18	38.44	40.63	0.004	1.29E-03	33.0	-18.2		41252
19	37.94	51.77	0.004	1.37E-03	56.1	3.6		41252
		-79.39	0.004	1.37E-03	56.1	3.6		
20	37.37	-48.40	0.003	1.18E-03	19.7	22.6		41252
21	36.80	-23.24	0.002	8.40E-04	-0.7	26.0		41252
22	36.00	-2.24	0.002	4.13E-04	-10.9	18.0		41252
23	35.20	5.28	0.002	1.60E-04	-9.7	8.5		41252

(continued)

Stage No.12 Change EI of wall to 77684 kN.m2/m run
From elevation 41.50 to 38.50
Yield moment not defined
No adjustments to wall displacements

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
24	34.40	5.48	0.002	5.88E-05	-5.4	2.4		41252
25	33.60	3.30	0.002	4.17E-05	-1.9	-0.2		41252
26	32.80	1.25	0.002	5.35E-05	-0.0	-0.7		41252
27	32.00	0.03	0.002	6.57E-05	0.5	-0.4		41252
28	31.40	-0.45	0.002	6.98E-05	0.3	-0.1		41252
29	30.80	-0.72	0.002	7.08E-05	0.0	0.0		---

At elev. 45.40 Strut force = 104.1 kN/strut = 13.9 kN/m run
At elev. 42.00 Strut force = 380.5 kN/strut = 50.7 kN/m run (horiz.)
= 58.6 kN/m run (inclined)
At elev. 38.70 The strut is slack

Node no.	Y coord	LEFT side Water press. kN/m2	Vertic -al kN/m2	Effective stresses Active limit kN/m2	Passive limit kN/m2	Earth pressure kN/m2	Total earth pressure kN/m2	Coeff. of subgrade reaction kN/m3
1	45.80	0.00	0.00	0.00	0.00	0.00	0.00	3932
2	45.69	0.00	1.98	0.68	7.09	1.84	1.84	3932
3	45.60	0.00	3.60	1.24	12.89	2.31	2.31	3932
4	45.40	0.00	7.20	2.47	25.79	3.36	3.36	3932
		Total>	7.20	2.00m	154.12	6.47	6.47	19968
5	44.85	Total>	18.30	4.75m	165.22	6.39	6.39	19968
6	44.50	Total>	25.56	6.50m	172.49	6.50	6.50a	19968
7	43.75	Total>	42.75	10.25m	189.68	10.25	10.25a	13764
8	43.00	Total>	61.63	14.00m	208.56	14.00	14.00a	13764
9	42.80	Total>	66.71	15.00m	213.64	15.00	15.00a	13764
10	42.00	Total>	86.49	19.00m	240.03	19.00	19.00a	14736
11	41.50	Total>	98.26	21.50m	255.93	24.42	24.42	15343
12	41.40	Total>	100.55	22.00m	259.06	25.73	25.73	15464
13	40.70	Total>	116.17	25.50m	280.46	34.88	34.88	16315
14	40.00	Total>	131.14	29.00m	301.22	45.86	45.86	17165
15	39.35	Total>	144.64	32.25m	320.09	59.63	59.63	17954
16	38.70	Total>	157.89	35.50m	338.71	77.78	77.78	10841
17	38.50	Total>	161.93	36.50m	344.41	84.23	84.23	10981
18	38.44	Total>	163.14	36.80m	346.11	86.23	86.23	11024
19	37.94	Total>	173.17	39.30m	360.28	103.75	103.75	11375
20	37.37	Total>	184.53	42.15m	376.35	123.99	123.99	11775
21	36.80	Total>	195.84	45.00m	392.38	142.55	142.55	12175
22	36.00	Total>	211.66	49.00m	414.81	164.51	164.51	12737
23	35.20	Total>	227.44	53.00m	437.20	182.65	182.65	13299
24	34.40	Total>	243.20	57.00m	459.57	198.72	198.72	13861
25	33.60	Total>	258.94	61.00m	481.92	214.13	214.13	14423
26	32.80	Total>	274.68	65.00m	504.28	229.60	229.60	14985
27	32.00	Total>	290.42	69.00m	526.63	245.34	245.34	15547
28	31.40	Total>	302.22	72.00m	543.39	257.30	257.30	15969
29	30.80	Total>	314.03	75.00m	560.16	269.36	269.36	16390

(continued)

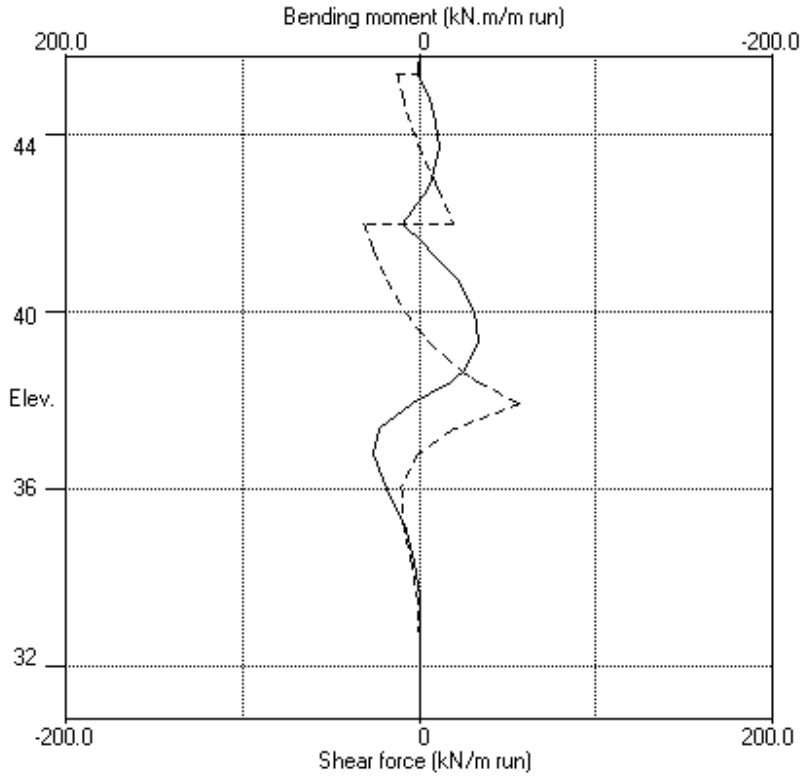
Stage No.12 Change EI of wall to 77684 kN.m2/m run
From elevation 41.50 to 38.50
Yield moment not defined
No adjustments to wall displacements

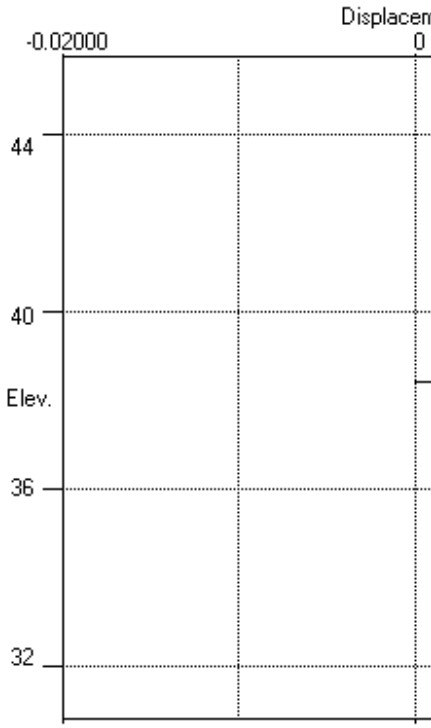
Node no.	Y coord	RIGHT side Water press. kN/m2	Effective stresses Vertic -al kN/m2	Active limit kN/m2	Passive limit kN/m2	Earth pressure kN/m2	Total earth pressure kN/m2	Coeff. of subgrade reaction kN/m3
1	45.80	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	45.69	0.00	0.00	0.00	0.00	0.00	0.00	0.0
3	45.60	0.00	0.00	0.00	0.00	0.00	0.00	0.0
4	45.40	0.00	0.00	0.00	0.00	0.00	0.00	0.0
5	44.85	0.00	0.00	0.00	0.00	0.00	0.00	0.0
6	44.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
7	43.75	0.00	0.00	0.00	0.00	0.00	0.00	0.0
8	43.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
9	42.80	2.00	0.00	0.00	0.00	0.00	2.00	0.0
10	42.00	10.00	0.00	0.00	0.00	0.00	10.00	0.0
11	41.50	15.00	0.00	0.00	0.00	0.00	15.00	0.0
12	41.40	16.00	0.00	0.00	0.00	0.00	16.00	0.0
13	40.70	23.00	0.00	0.00	0.00	0.00	23.00	0.0
14	40.00	30.00	0.00	0.00	0.00	0.00	30.00	0.0
15	39.35	36.50	0.00	0.00	0.00	0.00	36.50	0.0
16	38.70	43.00	0.00	0.00	0.00	0.00	43.00	0.0
17	38.50	45.00	0.00	0.00	0.00	0.00	45.00	0.0
18	38.44	45.60	0.00	0.00	0.00	0.00	45.60	0.0
		45.60	0.00	0.00	0.00	0.00	45.60	1543
19	37.94	50.60	4.00	1.37	14.33	1.37	51.97a	1543
		Total> 54.60	25.30m	241.68	183.14	183.14		11375
20	37.37	Total> 66.01	28.15m	257.80	172.39	172.39		11775
21	36.80	Total> 77.42	31.00m	273.93	165.79	165.79		12175
22	36.00	Total> 93.48	35.00m	296.59	166.75	166.75		12737
23	35.20	Total> 109.58	39.00m	319.30	177.37	177.37		13299
24	34.40	Total> 125.74	43.00m	342.08	193.24	193.24		13861
25	33.60	Total> 141.97	47.00m	364.92	210.83	210.83		14423
26	32.80	Total> 158.28	51.00m	387.84	228.35	228.35		14985
27	32.00	Total> 174.67	55.00m	410.85	245.31	245.31		15547
28	31.40	Total> 187.02	58.00m	428.16	257.75	257.75		15969
29	30.80	Total> 199.42	61.00m	445.53	270.07	270.07		16390

Note: 51.97a Soil pressure at active limit
123.45p Soil pressure at passive limit

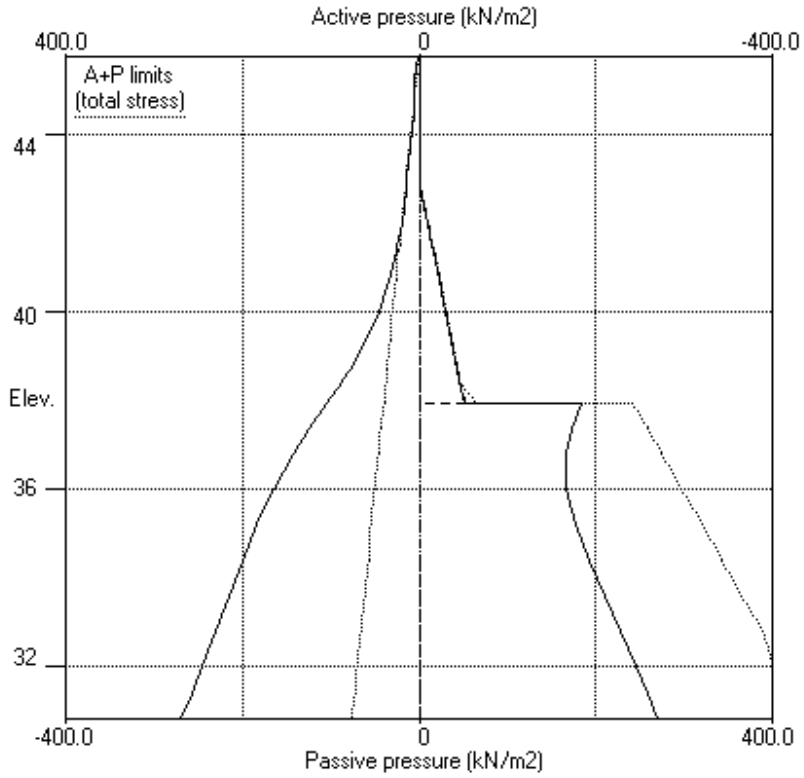
Units: kN,m

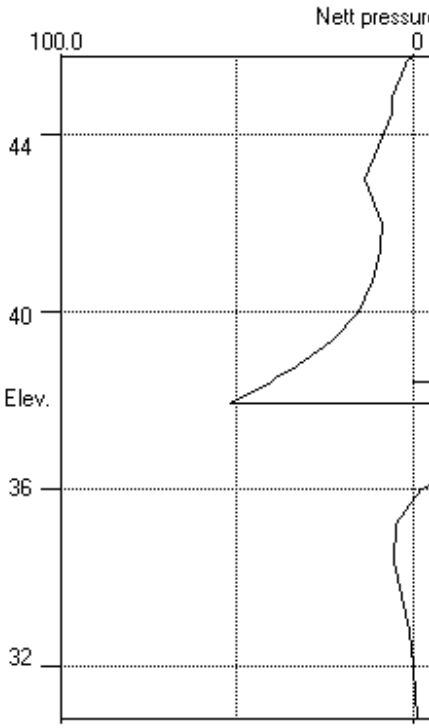
Stage No.12 Change EI of wall to 77684kN.m2/m run





Stage No.12 Change EI of wall to 77684kN.m2/m run





Units: kN,m

Stage No. 15 Change EI of wall to 77684 kN.m2/m run
From elevation 45.80 to 41.50
Yield moment not defined
No adjustments to wall displacements

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

Stage No.	--- G.L. --- Act.	Pass.	Strut Elev.	Overall FoS for toe elev. = 30.80 Factor of Safety	Moment equilib. at elev.	Toe elev. for FoS = 1.000 Toe elev.	Wall Penetr -ation	Direction of failure
15	45.80	38.44		More than one strut. No FoS calc.				

BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall
Analysis options
Length of wall perpendicular to section = 15.00m
Subgrade reaction model - Boussinesq Influence coefficients
Soil deformations are elastic until the active or passive limit is reached
Open Tension Crack analysis - No

Rigid boundaries: Left side 30.00 from wall
Right side 30.00 from wall
Limit State: ULS DA1 Combination 2

*** Wall displacements reset to zero at stage 4

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	45.80	0.00	0.004	-8.97E-04	0.0	0.0		77684
2	45.69	1.95	0.004	-8.97E-04	0.1	-0.0		77684
3	45.60	2.27	0.004	-8.97E-04	0.3	0.0		77684
4	45.40	3.21	0.004	-8.97E-04	0.8	0.1	16.5	77684
		5.72	0.004	-8.97E-04	-15.7	0.1		
5	44.85	4.75	0.005	-8.44E-04	-12.8	-7.4		77684
6	44.50	6.50	0.005	-7.58E-04	-10.8	-11.5		77684
7	43.75	10.25	0.005	-4.86E-04	-4.5	-17.2		77684
8	43.00	14.00	0.006	-1.93E-04	4.6	-15.4		77684
9	42.80	13.00	0.006	-1.26E-04	7.3	-14.2		77684
10	42.00	9.00	0.006	-2.64E-06	16.1	-2.2		77684
11	41.50	7.99	0.006	-7.02E-05	20.3	7.8		77684
12	41.40	8.66	0.006	-8.32E-05	21.1	9.9	53.0	77684
		8.66	0.006	-8.32E-05	-31.8	9.9		
13	40.70	12.68	0.006	-2.17E-05	-24.4	-10.3		77684
14	40.00	17.56	0.006	2.95E-04	-13.8	-24.2		77684
15	39.35	24.99	0.005	7.20E-04	0.0	-29.3		77684
16	38.70	36.41	0.005	1.12E-03	20.0	-23.7	-0.0	77684
17	38.50	40.73	0.004	1.22E-03	27.7	-19.0		41252
18	38.44	42.09	0.004	1.25E-03	30.2	-17.2		41252
19	37.94	52.84	0.004	1.32E-03	53.9	3.3		41252
		-75.92	0.004	1.32E-03	53.9	3.3		
20	37.37	-46.41	0.003	1.14E-03	19.1	21.7		41252
21	36.80	-22.40	0.002	8.15E-04	-0.5	25.0		41252
22	36.00	-2.27	0.002	4.04E-04	-10.4	17.4		41252
23	35.20	5.04	0.002	1.59E-04	-9.3	8.3		41252

(continued)

Stage No.15 Change EI of wall to 77684 kN.m2/m run
From elevation 45.80 to 41.50
Yield moment not defined
No adjustments to wall displacements

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
24	34.40	5.27	0.002	6.07E-05	-5.2	2.4		41252
25	33.60	3.18	0.002	4.37E-05	-1.8	-0.1		41252
26	32.80	1.21	0.002	5.47E-05	-0.0	-0.6		41252
27	32.00	0.03	0.002	6.62E-05	0.4	-0.3		41252
28	31.40	-0.42	0.002	7.01E-05	0.3	-0.1		41252
29	30.80	-0.67	0.002	7.10E-05	0.0	0.0		---

At elev. 45.40 Strut force = 123.9 kN/strut = 16.5 kN/m run
At elev. 41.40 Strut force = 53.0 kN/strut = 53.0 kN/m run
At elev. 38.70 The strut is slack

Node no.	Y coord	LEFT side: Water press. kN/m2	Vertic -al kN/m2	Effective stresses: Active limit kN/m2	Passive limit kN/m2	Earth pressure kN/m2	Total earth pressure kN/m2	Coeff. of subgrade reaction kN/m3
1	45.80	0.00	0.00	0.00	0.00	0.00	0.00	2374
2	45.69	0.00	1.98	0.68	7.09	1.95	1.95	2374
3	45.60	0.00	3.60	1.24	12.89	2.27	2.27	2374
4	45.40	0.00	7.20	2.47	25.79	3.21	3.21	2374
		Total>	7.20	2.00m	154.12	5.72	5.72	12130
5	44.85	Total>	18.30	4.75m	165.22	4.75	4.75a	12130
6	44.50	Total>	25.56	6.50m	172.49	6.50	6.50a	12130
7	43.75	Total>	42.75	10.25m	189.68	10.25	10.25a	12130
8	43.00	Total>	61.63	14.00m	208.56	14.00	14.00a	12130
9	42.80	Total>	66.71	15.00m	213.64	15.00	15.00a	12130
10	42.00	Total>	86.49	19.00m	240.03	19.00	19.00a	12986
11	41.50	Total>	98.26	21.50m	255.93	22.99	22.99	13521
12	41.40	Total>	100.55	22.00m	259.06	24.66	24.66	13756
13	40.70	Total>	116.17	25.50m	280.46	35.68	35.68	14513
14	40.00	Total>	131.14	29.00m	301.22	47.56	47.56	15269
15	39.35	Total>	144.64	32.25m	320.09	61.49	61.49	15971
16	38.70	Total>	157.89	35.50m	338.71	79.41	79.41	16673
17	38.50	Total>	161.93	36.50m	344.41	85.73	85.73	16889
18	38.44	Total>	163.14	36.80m	346.11	87.69	87.69	16954
19	37.94	Total>	173.17	39.30m	360.28	104.81	104.81	17494
20	37.37	Total>	184.53	42.15m	376.35	124.60	124.60	18110
21	36.80	Total>	195.84	45.00m	392.38	142.80	142.80	18726
22	36.00	Total>	211.66	49.00m	414.81	164.50	164.50	19590
23	35.20	Total>	227.44	53.00m	437.20	182.53	182.53	26927
24	34.40	Total>	243.20	57.00m	459.57	198.61	198.61	28065
25	33.60	Total>	258.94	61.00m	481.92	214.07	214.07	29202
26	32.80	Total>	274.68	65.00m	504.28	229.58	229.58	30340
27	32.00	Total>	290.42	69.00m	526.63	245.34	245.34	31478
28	31.40	Total>	302.22	72.00m	543.39	257.31	257.31	115313
29	30.80	Total>	314.03	75.00m	560.16	269.38	269.38	118357

(continued)

Stage No.15 Change EI of wall to 77684 kN.m2/m run
From elevation 45.80 to 41.50
Yield moment not defined
No adjustments to wall displacements

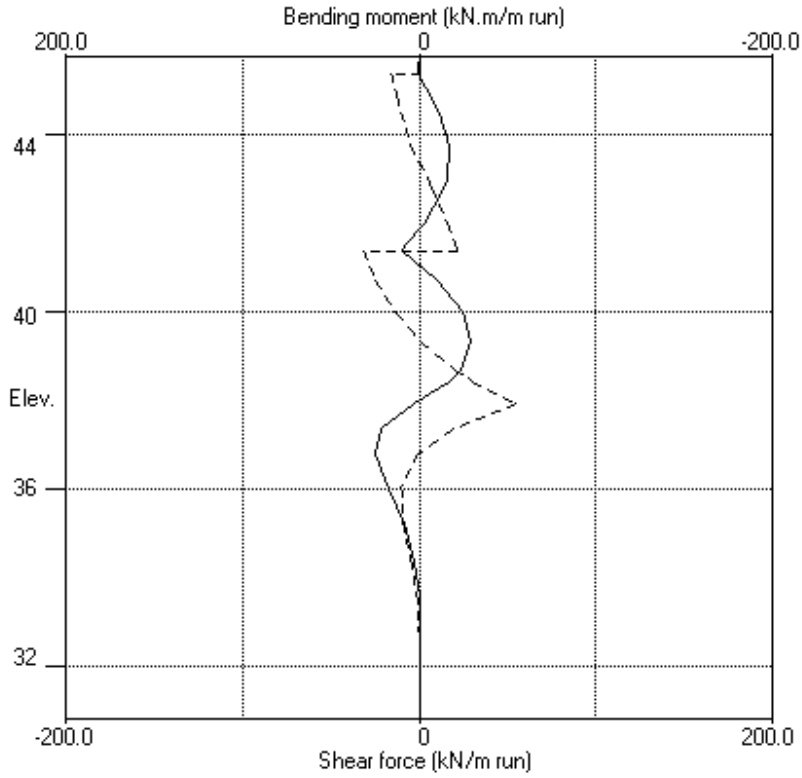
Node no.	Y coord	RIGHT side Water press. kN/m2	Effective stresses Vertic -al kN/m2	Active limit kN/m2	Passive limit kN/m2	Earth pressure kN/m2	Total earth pressure kN/m2	Coeff. of subgrade reaction kN/m3
1	45.80	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	45.69	0.00	0.00	0.00	0.00	0.00	0.00	0.0
3	45.60	0.00	0.00	0.00	0.00	0.00	0.00	0.0
4	45.40	0.00	0.00	0.00	0.00	0.00	0.00	0.0
5	44.85	0.00	0.00	0.00	0.00	0.00	0.00	0.0
6	44.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
7	43.75	0.00	0.00	0.00	0.00	0.00	0.00	0.0
8	43.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
9	42.80	2.00	0.00	0.00	0.00	0.00	2.00	0.0
10	42.00	10.00	0.00	0.00	0.00	0.00	10.00	0.0
11	41.50	15.00	0.00	0.00	0.00	0.00	15.00	0.0
12	41.40	16.00	0.00	0.00	0.00	0.00	16.00	0.0
13	40.70	23.00	0.00	0.00	0.00	0.00	23.00	0.0
14	40.00	30.00	0.00	0.00	0.00	0.00	30.00	0.0
15	39.35	36.50	0.00	0.00	0.00	0.00	36.50	0.0
16	38.70	43.00	0.00	0.00	0.00	0.00	43.00	0.0
17	38.50	45.00	0.00	0.00	0.00	0.00	45.00	0.0
18	38.44	45.60	0.00	0.00	0.00	0.00	45.60	0.0
		45.60	0.00	0.00	0.00	0.00	45.60	4483
19	37.94	50.60	4.00	1.37	14.33	1.37	51.97a	4483
		Total> 54.60	25.30m	241.68	180.73	180.73		32490
20	37.37	Total> 66.01	28.15m	257.80	171.01	171.01		33633
21	36.80	Total> 77.42	31.00m	273.93	165.20	165.20		34777
22	36.00	Total> 93.48	35.00m	296.59	166.77	166.77		36382
23	35.20	Total> 109.58	39.00m	319.30	177.49	177.49		26927
24	34.40	Total> 125.74	43.00m	342.08	193.35	193.35		28065
25	33.60	Total> 141.97	47.00m	364.92	210.89	210.89		29202
26	32.80	Total> 158.28	51.00m	387.84	228.37	228.37		30340
27	32.00	Total> 174.67	55.00m	410.85	245.31	245.31		31478
28	31.40	Total> 187.02	58.00m	428.16	257.74	257.74		115313
29	30.80	Total> 199.42	61.00m	445.53	270.05	270.05		118357

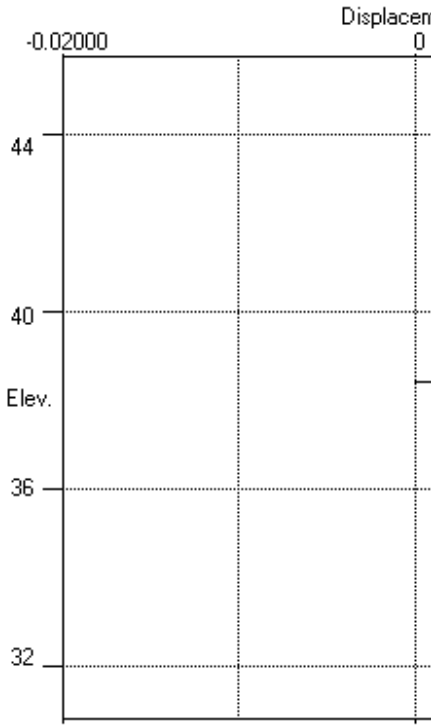
Note: 51.97a Soil pressure at active limit
123.45p Soil pressure at passive limit

KNIGHT BUILD LTD | Sheet No.
Program: WALLAP Version 6.06 Revision A49.B68.R53 | Job No. 79AR
Licensed from GEOSOLVE | Made by : JRC
Data filename/Run ID: SECTION_1-1_ULS2 |
79 Avenue Road | Date:28-06-2021
SECTION 1-1 ANALYSIS | Checked :

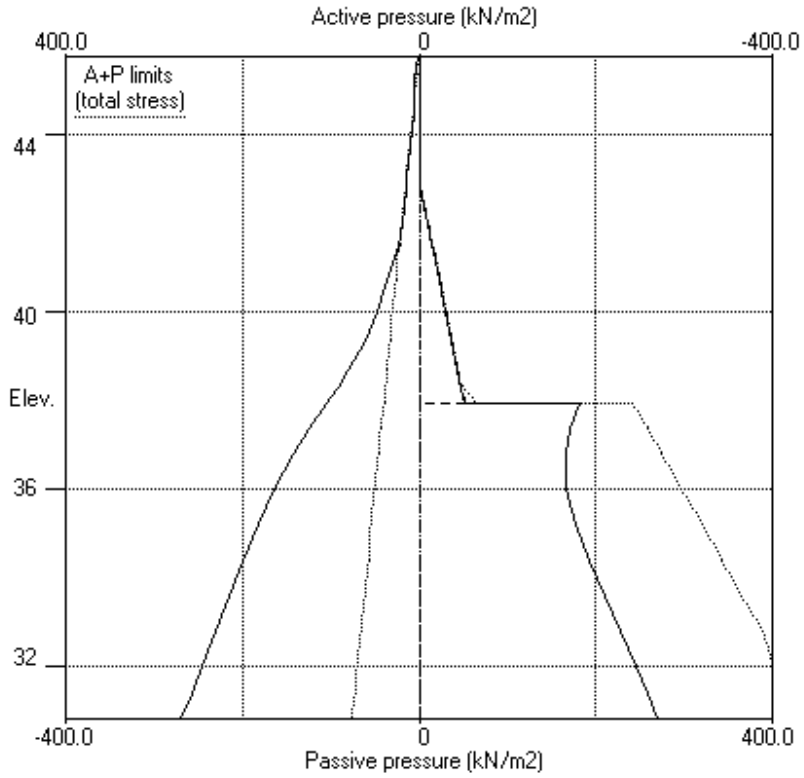
Units: kN,m

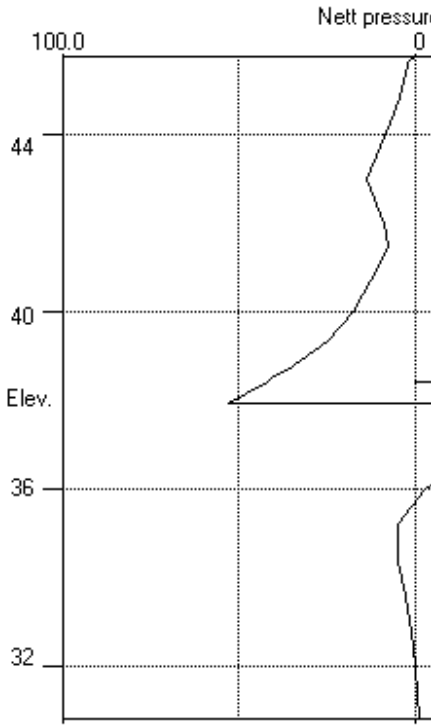
Stage No.15 Change EI of wall to 77684kN.m2/m run





Stage No.15 Change EI of wall to 77684kN.m2/m run





Units: kN,m

Stage No. 22 Change EI of wall to 38842 kN.m2/m run
From elevation 45.80 to 38.50
Yield moment not defined
No adjustments to wall displacements

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

Stage No.	--- G.L. --- Act.	Pass.	Strut Elev.	Overall FoS for toe elev. = 30.80 Factor of Safety	Moment equilib. at elev.	Toe elev. for FoS = 1.000 Toe elev.	Wall Penetr -ation	Direction of failure
22	45.80	38.44		More than one strut. No FoS calc.				

BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall
Analysis options
Length of wall perpendicular to section = 15.00m
Subgrade reaction model - Boussinesq Influence coefficients
Soil deformations are elastic until the active or passive limit is reached
Open Tension Crack analysis - No

Rigid boundaries: Left side 30.00 from wall
Right side 30.00 from wall
Limit State: ULS DA1 Combination 2

*** Wall displacements reset to zero at stage 4

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	45.80	0.00	0.004	-1.72E-03	0.0	0.0		38842
2	45.69	1.82	0.004	-1.72E-03	0.1	-0.0	25.3	38842
		1.82	0.004	-1.72E-03	-25.2	-0.0		
3	45.60	1.96	0.004	-1.71E-03	-25.1	-2.3		38842
4	45.40	2.50	0.004	-1.70E-03	-24.6	-7.2		38842
		2.22	0.004	-1.70E-03	-24.6	-7.2		
5	44.85	2.28	0.005	-1.53E-03	-23.4	-20.3		38842
6	44.50	5.94	0.006	-1.33E-03	-21.9	-28.2		38842
7	43.75	18.60	0.007	-6.90E-04	-12.7	-41.6		38842
8	43.00	32.04	0.007	7.98E-05	6.3	-42.7		38842
9	42.80	35.64	0.007	2.81E-04	13.0	-40.8		38842
10	42.00	49.81	0.006	8.07E-04	47.2	-14.9		38842
11	41.50	58.39	0.006	7.90E-04	74.3	16.2		38842
12	41.40	60.08	0.006	7.57E-04	80.2	23.9	137.2	38842
		60.08	0.006	7.57E-04	-57.0	23.9		
13	40.70	71.69	0.005	6.27E-04	-10.9	-0.7		38842
14	40.00	83.01	0.005	5.37E-04	43.2	9.8		38842
15	39.35	93.34	0.005	1.87E-05	100.5	55.8		38842
16	38.70	103.55	0.005	-1.42E-03	164.5	141.2	352.9	38842
		103.55	0.005	-1.42E-03	-188.3	141.2		
17	38.50	106.67	0.005	-1.97E-03	-167.3	105.6		20625
18	38.44	107.01	0.006	-2.25E-03	-160.9	95.7		20625
19	37.94	101.71	0.007	-3.64E-03	-108.7	28.6		20625
		82.80	0.007	-3.64E-03	-108.7	28.6		
20	37.37	69.48	0.009	-3.57E-03	-65.3	-21.8		20625
21	36.80	56.09	0.011	-2.40E-03	-29.5	-49.3		20625

(continued)

Stage No.22 Change EI of wall to 38842 kN.m2/m run
From elevation 45.80 to 38.50
Yield moment not defined
No adjustments to wall displacements

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
22	36.00	37.18	0.012	-1.52E-04	7.8	-58.1		20625
23	35.20	18.08	0.011	1.84E-03	29.9	-42.3		20625
24	34.40	-1.24	0.009	2.93E-03	36.6	-14.5		20625
25	33.60	-20.80	0.007	2.94E-03	27.8	12.5		20625
26	32.80	-38.93	0.005	2.12E-03	3.9	28.8		20625
27	32.00	-10.24	0.004	1.14E-03	-15.8	21.3		20625
28	31.40	3.76	0.003	6.90E-04	-17.7	10.0		20625
29	30.80	55.25	0.003	5.45E-04	0.0	-0.0		---
At elev. 45.69 Strut force = 25.3 kN/strut = 25.3 kN/m run								
At elev. 41.40 Strut force = 137.2 kN/strut = 137.2 kN/m run								
At elev. 38.70 Strut force = 352.9 kN/strut = 352.9 kN/m run								

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	45.80	0.00	0.00	0.00	0.00	0.00	0.00	72936
2	45.69	0.00	1.98	0.68	7.09	1.82	1.82	2468
3	45.60	0.00	3.60	1.24	12.89	1.96	1.96	2468
4	45.40	0.00	7.20	2.47	25.79	2.50	2.50	2468
		0.00	7.20	0.00	34.68	2.22	2.22	12104
5	44.85	0.00	19.40	2.28	64.00	2.28	2.28a	12104
6	44.50	0.00	27.36	5.94	83.14	5.94	5.94a	12104
7	43.75	7.50	38.55	11.10	110.02	11.10	18.60a	12104
8	43.00	15.00	51.43	17.04	140.98	17.04	32.04a	12104
9	42.80	17.00	54.91	18.64	149.33	18.64	35.64a	12104
		17.00	54.91	18.64	149.33	18.64	35.64a	11392
10	42.00	25.00	68.29	24.81	181.49	24.81	49.81a	11904
11	41.50	30.00	76.06	28.39	200.16	28.39	58.39a	12225
12	41.40	31.00	77.55	29.08	203.76	29.08	60.08a	12289
13	40.70	38.00	87.57	33.69	227.83	33.69	71.69a	18979
14	40.00	45.00	96.94	38.01	250.35	38.01	83.01a	19647
15	39.35	51.50	105.24	41.84	270.30	41.84	93.34a	20268
16	38.70	58.00	113.29	45.55	289.64	45.55	103.55a	11943
17	38.50	60.00	115.73	46.67	295.50	46.67	106.67a	12052
18	38.44	60.60	116.46	47.01	297.26	47.01	107.61a	12085
19	37.94	65.60	122.49	49.79	311.75	49.79	115.39a	12358
20	37.37	71.30	129.29	52.92	328.11	52.92	124.22a	12669
21	36.80	77.00	136.04	56.03	344.33	56.03	133.03a	12981
22	36.00	85.00	145.46	60.37	366.97	60.37	145.37a	13417
23	35.20	93.00	154.84	64.70	389.51	64.70	157.70a	13854
24	34.40	101.00	164.20	69.01	411.99	69.01	170.01a	14291
25	33.60	109.00	173.54	73.32	434.45	73.32	182.32a	14727
26	32.80	117.00	182.88	77.62	456.90	77.62	194.62a	15164
27	32.00	125.00	192.22	81.92	479.34	98.11	223.11	15601
28	31.40	131.00	199.22	85.15	496.17	111.68	242.68	100913
29	30.80	137.00	206.23	88.38	513.01	144.01	281.01	102989

(continued)

Stage No.22 Change EI of wall to 38842 kN.m2/m run
From elevation 45.80 to 38.50
Yield moment not defined
No adjustments to wall displacements

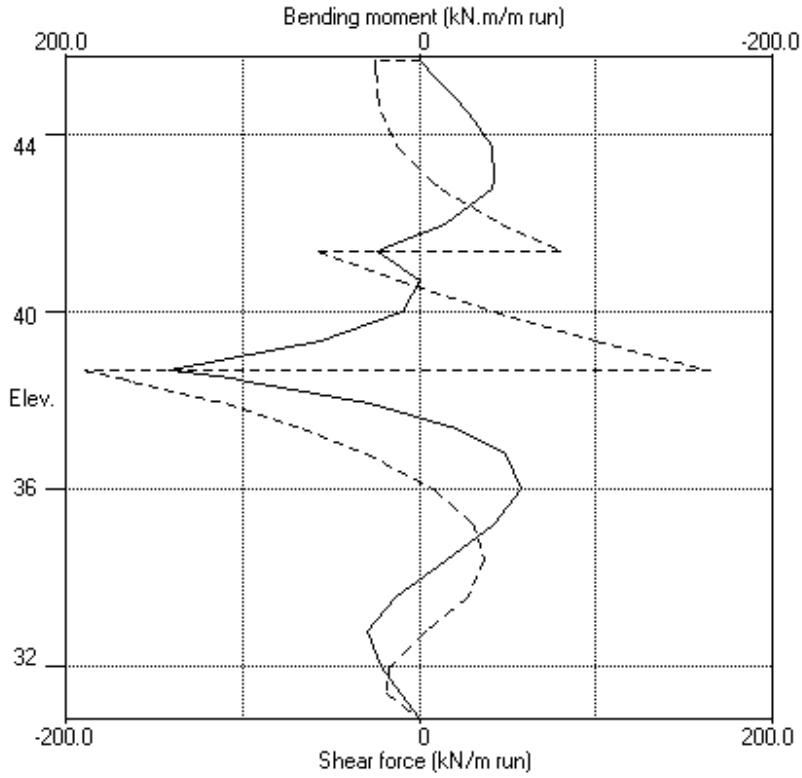
Node no.	Y coord	RIGHT side Water press. kN/m2	Effective stresses Vertic -al kN/m2	Active limit kN/m2	Passive limit kN/m2	Earth pressure kN/m2	Total earth pressure kN/m2	Coeff. of subgrade reaction kN/m3
1	45.80	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	45.69	0.00	0.00	0.00	0.00	0.00	0.00	0.0
3	45.60	0.00	0.00	0.00	0.00	0.00	0.00	0.0
4	45.40	0.00	0.00	0.00	0.00	0.00	0.00	0.0
5	44.85	0.00	0.00	0.00	0.00	0.00	0.00	0.0
6	44.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
7	43.75	0.00	0.00	0.00	0.00	0.00	0.00	0.0
8	43.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
9	42.80	0.00	0.00	0.00	0.00	0.00	0.00	0.0
10	42.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
11	41.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
12	41.40	0.00	0.00	0.00	0.00	0.00	0.00	0.0
13	40.70	0.00	0.00	0.00	0.00	0.00	0.00	0.0
14	40.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
15	39.35	0.00	0.00	0.00	0.00	0.00	0.00	0.0
16	38.70	0.00	0.00	0.00	0.00	0.00	0.00	0.0
17	38.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
18	38.44	0.60	0.00	0.00	0.00	0.00	0.60	0.0
		0.60	0.00	0.00	0.00	0.00	0.60	2103
19	37.94	5.60	4.00	1.37	14.33	8.08	13.68	2103
		5.60	4.00	0.00	26.98	26.98	32.58p	12358
20	37.37	11.30	10.85	0.00	43.44	43.44	54.74p	12669
21	36.80	17.00	17.71	1.50	59.94	59.94	76.94p	12981
22	36.00	25.00	27.39	5.96	83.20	83.20	108.20p	13417
23	35.20	33.00	37.14	10.45	106.62	106.62	139.62p	13854
24	34.40	41.00	46.97	14.98	130.25	130.25	171.25p	14291
25	33.60	49.00	56.90	19.56	154.12	154.12	203.12p	14727
26	32.80	57.00	66.95	24.19	178.26	176.55	233.55	15164
27	32.00	65.00	77.11	28.87	202.70	168.35	233.35	15601
28	31.40	71.00	84.82	32.43	221.23	167.92	238.92	100913
29	30.80	77.00	92.61	36.01	239.94	148.75	225.75	102989

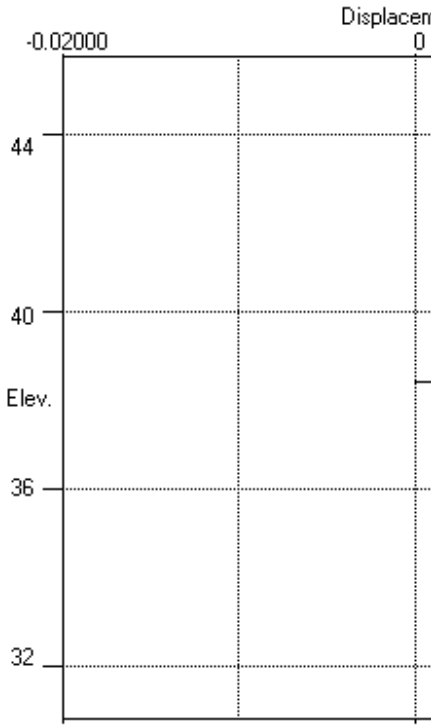
Note: 194.62a Soil pressure at active limit
203.12p Soil pressure at passive limit

KNIGHT BUILD LTD | Sheet No.
Program: WALLAP Version 6.06 Revision A49.B68.R53 | Job No. 79AR
Licensed from GEOSOLVE | Made by : JRC
Data filename/Run ID: SECTION_1-1_ULS2 |
79 Avenue Road | Date:28-06-2021
SECTION 1-1 ANALYSIS | Checked :

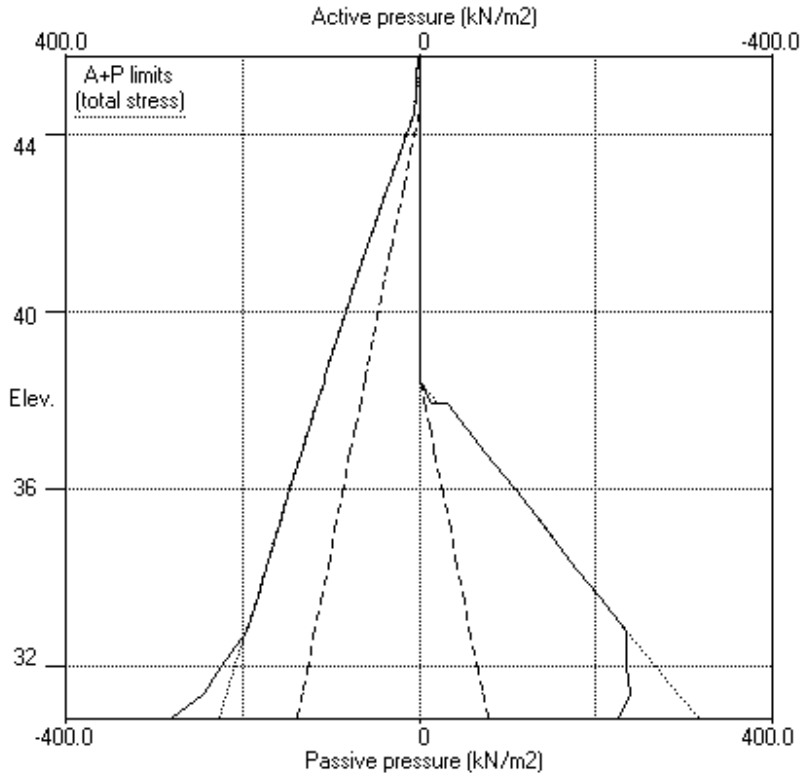
Units: kN,m

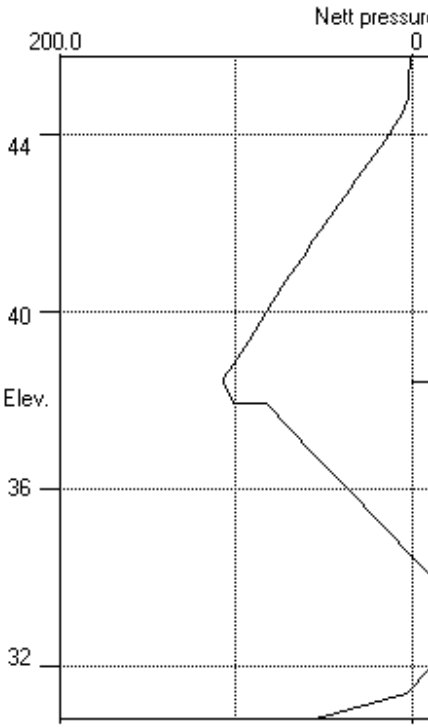
Stage No.22 Change EI of wall to 38842kN.m2/m run





Stage No.22 Change EI of wall to 38842kN.m2/m run





Units: kN,m

Summary of results

LIMIT STATE PARAMETERS

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

STABILITY ANALYSIS of Fully Embedded Wall according to Strength Factor method

Factor of safety on soil strength

Stage No.	--- G.L. --- Act.	Pass.	Strut Elev.	Overall FoS for toe elev. = 30.80 Factor of Safety	Moment equilib. at elev.	Toe elev. for FoS = 1.000 Toe elev.	Wall Penetr -ation	Direction of failure
1	45.80	45.80	Cant.	Conditions not suitable for FoS calc.				
2	45.80	45.80		No analysis at this stage				
3	45.80	45.80	Cant.	Conditions not suitable for FoS calc.				
4	45.80	45.80		No analysis at this stage				
5	45.80	43.75	Cant.	6.248	31.36	43.50	0.25	L to R
6	45.80	43.75		No analysis at this stage				
7	45.80	41.50	45.40	4.824	n/a	41.38	0.12	L to R
8	45.80	41.50		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 = 15.00m
Subgrade reaction model - Boussinesq Influence coefficients
Soil deformations are elastic until the active or passive limit is reached
Open Tension Crack analysis - No

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

Limit State: ULS DA1 Combination 2

Bending moment, shear force and displacement envelopes

Node no.	Y coord	Displacement maximum m	Displacement minimum m	Bending moment maximum kN.m/m	Bending moment minimum kN.m/m	Shear force maximum kN/m	Shear force minimum kN/m
1	45.80	0.004	0.000	0.0	-0.0	0.0	0.0
2	45.69	0.004	0.000	0.0	-0.0	0.1	-25.2
3	45.60	0.004	0.000	0.0	-2.3	0.3	-25.1
4	45.40	0.004	0.000	0.1	-7.2	0.9	-24.6
5	44.85	0.005	0.000	0.9	-20.3	2.4	-23.4
6	44.50	0.006	0.000	2.1	-28.2	4.3	-21.9
7	43.75	0.007	0.000	7.7	-41.6	10.6	-12.7
8	43.00	0.007	0.000	12.4	-42.7	8.2	-2.2
9	42.80	0.007	0.000	11.8	-40.8	13.0	-3.6
10	42.00	0.006	0.000	9.9	-14.9	47.2	-31.1
11	41.50	0.006	0.000	16.2	-3.9	74.3	-26.5
12	41.40	0.006	0.000	23.9	-6.5	80.2	-57.0
13	40.70	0.006	0.000	11.5	-22.0	8.4	-31.0
14	40.00	0.006	0.000	12.3	-31.7	43.2	-14.3
15	39.35	0.005	0.000	55.8	-33.5	100.5	-5.2
16	38.70	0.005	0.000	141.2	-25.4	164.5	-188.3
17	38.50	0.005	0.000	105.6	-20.1	30.6	-167.3
18	38.44	0.006	0.000	95.7	-18.2	33.0	-160.9
19	37.94	0.007	0.000	28.6	-1.2	56.1	-108.7
20	37.37	0.009	0.000	22.6	-21.8	19.7	-65.3
21	36.80	0.011	0.000	26.0	-49.3	0.7	-29.5
22	36.00	0.012	0.000	18.0	-58.1	7.8	-10.9
23	35.20	0.011	0.000	8.5	-42.3	29.9	-9.7
24	34.40	0.009	0.000	2.4	-14.5	36.6	-5.4
25	33.60	0.007	0.000	12.5	-1.6	27.8	-1.9
26	32.80	0.005	0.000	28.8	-0.7	3.9	-0.1
27	32.00	0.004	0.000	21.3	-0.4	0.6	-15.8
28	31.40	0.003	0.000	10.0	-0.1	0.3	-17.7
29	30.80	0.003	0.000	0.0	-0.0	0.0	-0.0

Summary of results (continued)

Maximum and minimum bending moment and shear force at each stage

Stage	Bending moment				Shear force			
no.	maximum kN.m/m	elev.	minimum kN.m/m	elev.	maximum kN/m	elev.	minimum kN/m	elev.
1	0.1	36.80	-0.4	42.00	0.2	40.00	-0.3	43.75
2	No calculation at this stage							
3	0.7	44.50	-3.2	40.70	1.0	38.70	-2.2	42.80
4	No calculation at this stage							
5	12.4	43.00	-2.0	39.35	10.6	43.75	-6.4	42.00
6	No calculation at this stage							
7	12.3	40.00	-25.3	43.00	31.9	41.50	-18.8	45.40
8	No calculation at this stage							
9	25.2	36.80	-33.0	39.35	55.1	37.94	-30.9	42.00
10	26.0	36.80	-33.5	39.35	56.1	37.94	-31.1	42.00
11	No calculation at this stage							
12	26.0	36.80	-33.5	39.35	56.1	37.94	-31.1	42.00
13	No calculation at this stage							
14	25.0	36.80	-29.3	39.35	53.9	37.94	-31.8	41.40
15	25.0	36.80	-29.3	39.35	53.9	37.94	-31.8	41.40
16	No calculation at this stage							
17	24.9	36.80	-29.0	39.35	53.7	37.94	-32.5	41.40
18	19.9	38.70	-25.1	40.00	78.8	38.70	-52.2	41.40
19	No calculation at this stage							
20	No calculation at this stage							
21	No calculation at this stage							
22	141.2	38.70	-58.1	36.00	164.5	38.70	-188.3	38.70

Maximum and minimum displacement at each stage

Stage	Displacement				Stage description
no.	maximum m	elev.	minimum m	elev.	
1	0.000	41.40	-0.000	45.80	Apply surcharge no.1 at elev. 44.85
2	No calculation at this stage				Apply surcharge no.2 at elev. 44.85
3	0.001	39.35	-0.000	45.80	Apply surcharge no.3 at elev. 45.60
4	Wall displacements reset to zero				Change EI of wall to 41252kN.m2/m run
5	0.004	45.80	0.000	45.80	Excav. to elev. 43.75 on RIGHT side
6	No calculation at this stage				Install strut no.4 at elev. 45.40
7	0.005	43.75	0.000	45.80	Excav. to elev. 41.50 on RIGHT side
8	No calculation at this stage				Install strut no.5 at elev. 42.00
9	0.006	40.70	0.000	45.80	Excav. to elev. 37.94 on RIGHT side
10	0.006	40.70	0.000	45.80	Fill to elev. 38.44 on RIGHT side
11	No calculation at this stage				Install strut no.3 at elev. 38.70
12	0.006	40.70	0.000	45.80	Change EI of wall to 77684kN.m2/m run
13	No calculation at this stage				Install strut no.2 at elev. 41.40
14	0.006	40.70	0.000	45.80	Remove strut no.5 at elev. 42.00
15	0.006	40.70	0.000	45.80	Change EI of wall to 77684kN.m2/m run
16	No calculation at this stage				Install strut no.1 at elev. 45.69
17	0.006	40.70	0.000	45.80	Remove strut no.4 at elev. 45.40
18	0.006	40.70	0.000	45.80	Apply water pressure profile no.1
19	No calculation at this stage				Change soil type 2 to soil type 4
20	No calculation at this stage				Change soil type 3 to soil type 5
21	No calculation at this stage				Change EI of wall to 20625kN.m2/m run
22	0.012	36.00	0.000	45.80	Change EI of wall to 38842kN.m2/m run

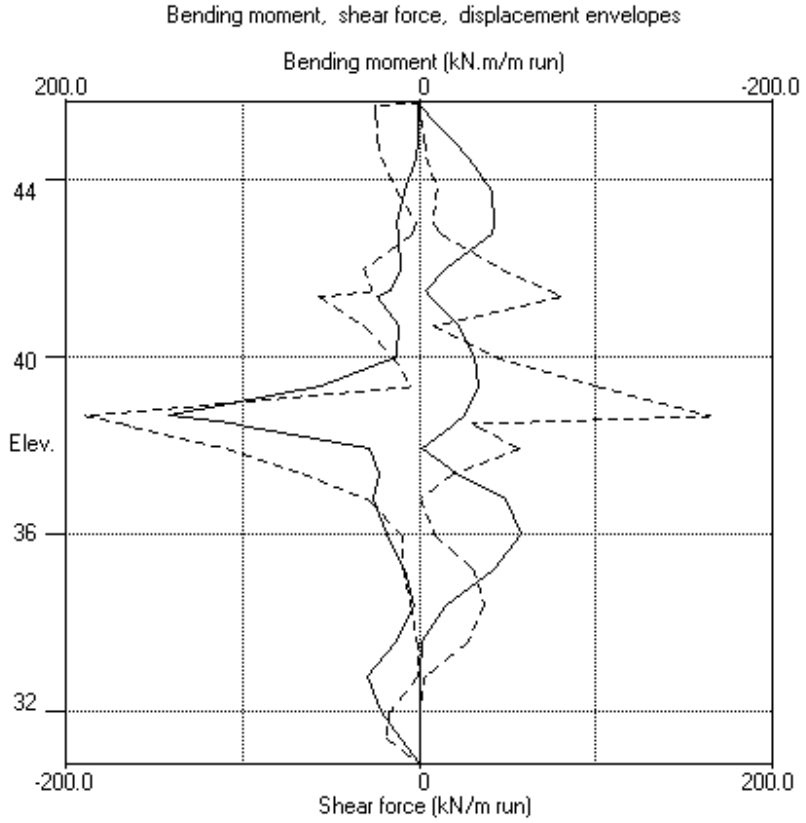
Summary of results (continued)

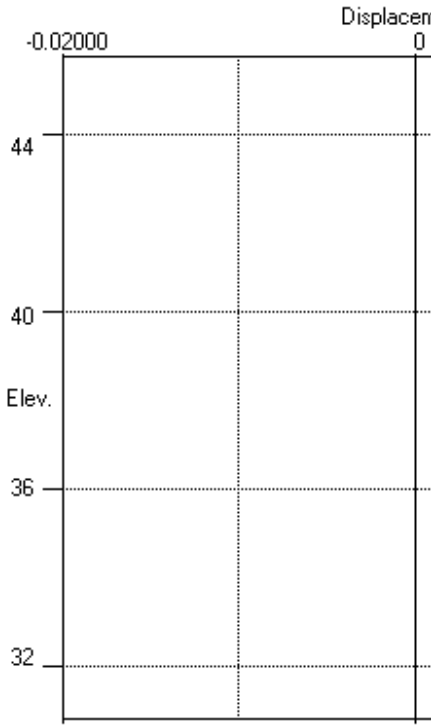
Strut forces at each stage (horizontal components)

Stage no.	Strut no. 1 at elev. 45.69		Strut no. 2 at elev. 41.40		Strut no. 3 at elev. 38.70	
	kN/m run	kN/strut	kN/m run	kN/strut	kN/m run	kN/strut
12	---	---	---	---	0.00	0.00
14	---	---	52.97	52.97	slack	slack
15	---	---	52.97	52.97	slack	slack
17	14.86	14.86	55.08	55.08	slack	slack
18	15.23	15.23	87.64	87.64	123.32	123.32
22	25.33	25.33	137.21	137.21	352.85	352.85

Stage no.	Strut no. 4 at elev. 45.40		Strut no. 5 at elev. 42.00	
	kN/m run	kN/strut	kN/m run	kN/strut
7	19.25	144.37	---	---
9	13.82	103.64	50.63	379.75
10	13.88	104.10	50.73	380.50
12	13.88	104.10	50.73	380.50
14	16.52	123.86	---	---
15	16.52	123.86	---	---

Units: kN,m


Bending moment, shear force, displacement envelopes
Bending moment (kN.m/m run)
200.0
0
-200.0
44
40
Elev.
36
32
-200.0
0
200.0
Shear force (kN/m run)


Displacem
-0.02000
0
44
40
Elev.
36
32

SECTION 2-2 SLS

KNIGHT BUILD LTD | Sheet No.
Program: WALLAP Version 6.06 Revision A49.B68.R53 | Job No. 79AR
Licensed from GEOSOLVE | Made by : JRC
Data filename/Run ID: SECTION_2-2_SLS |
79 Avenue Road | Date:28-06-2021
SECTION 2-2 ANALYSIS | Checked :

Units: kN,m

INPUT DATA

SOIL PROFILE

Stratum no.	Elevation of top of stratum	Soil types Left side	Right side
1	45.80	1 Made Ground	1 Made Ground
2	45.40	2 Head	2 Head
3	42.80	3 London Clay	3 London Clay

SOIL PROPERTIES

No.	Soil type -- Description (Datum elev.)	Bulk density kN/m3	Young's Modulus Eh,kN/m2 (dEh/dy)	At rest coeff. Ko (dKo/dy)	Consol state. NC/OC (Nu)	Active limit Ka (Kac)	Passive limit Kp (Kpc)	Cohesion kN/m2 (dc/dy)
1	Made Ground	18.00	13000	0.500	OC (0.200)	0.273 (0.000)	5.026 (0.000)	
2	Head	20.00	51000	1.000	OC (0.490)	1.000 (2.570)	1.000 (2.571)	80.00u
3	London Clay	20.00	51000	1.000	OC (0.490)	1.000 (2.570)	1.000 (2.571)	80.00u
	(42.80)		(4500)				(4.500)	
4	Head (drained)	22.00	63750	0.625	OC (0.200)	0.387 (1.517)	3.028 (5.020)	5.000d
5	LC Drained	22.00	60000	0.625	OC (0.200)	0.387 (1.517)	3.028 (5.020)	5.000d
	(42.80)		(3375)					

Additional soil parameters associated with Ka and Kp

No.	Soil type Description	--- parameters for Ka --- Soil friction angle	Wall adhesion coeff.	Back-fill angle	--- parameters for Kp --- Soil friction angle	Wall adhesion coeff.	Back-fill angle
1	Made Ground	30.00	1.000	0.00	30.00	1.000	0.00
2	Head	0.00	1.000	0.00	0.00	0.995	0.00
3	London Clay	0.00	1.000	0.00	0.00	0.995	0.00
4	Head (drained)	22.01	1.000	0.00	22.00	1.000	0.00
5	LC Drained	22.01	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	43.00	43.00

Automatic water pressure balancing at toe of wall : No

Water press. profile no.	Left side Point no.	Elev. m	Piezo elev. m	Water press. kN/m2	Right side Point no.	Elev. m	Piezo elev. m	Water press. kN/m2	
1	1	44.50	44.50	0.0	1	38.50	38.50	0.0	MC+WC

WALL PROPERTIES

Type of structure = Fully Embedded Wall
Elevation of toe of wall = 30.80
Maximum finite element length = 0.80 m
Youngs modulus of wall E = 2.8000E+07 kN/m2
Moment of inertia of wall I = 3.3547E-03 m4/m run
E.I = 93931 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	45.69	1.00	0.250000	2.800E+07	15.00	0.00	0	No
2	41.40	1.00	0.250000	2.800E+07	10.00	0.00	0	No
3	38.70	1.00	0.450000	2.800E+07	10.00	0.00	0	No
4	45.40	7.50	0.016400	2.050E+08	10.00	0.00	0	No
5	42.00	7.50	0.016400	2.050E+08	10.00	30.00	0	No

SURCHARGE LOADS

Surch -arge no.	Elev.	Distance from wall	Length parallel to wall	Width perpend. to wall	Surcharge kN/m2 Near edge	Surcharge kN/m2 Far edge	Equiv. soil type	Partial factor/ Category
1	44.85	1.00(L)	1000.00	0.60	10.00	=	N/A	1.00 -
2	44.85	2.60(L)	1000.00	0.80	85.00	=	N/A	1.00 -
3	45.60	2.60(L)	1000.00	20.00	12.50	=	N/A	1.00 -

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 44.85
	No analysis at this stage
2	Apply surcharge no.2 at elevation 44.85
	No analysis at this stage
3	Apply surcharge no.3 at elevation 45.60
4	Change EI of wall to 93950 kN.m2/m run
	Yield moment not defined
	Reset wall displacements to zero at this stage
5	Excavate to elevation 43.75 on RIGHT side
6	Install strut or anchor no.4 at elevation 45.40
7	Excavate to elevation 41.50 on RIGHT side
8	Install strut or anchor no.5 at elevation 42.00
9	Excavate to elevation 37.94 on RIGHT side
10	Fill to elevation 38.50 on RIGHT side with soil type 1
11	Install strut or anchor no.3 at elevation 38.70
12	Change EI of wall to 290309 kN.m2/m run
	From elevation 41.50 to 38.50
	Yield moment not defined
	No adjustments to wall displacements
13	Remove strut or anchor no.5 at elevation 42.00
14	Change EI of wall to 290309 kN.m2/m run
	From elevation 45.80 to 41.50
	Yield moment not defined
	No adjustments to wall displacements
15	Install strut or anchor no.1 at elevation 45.69
16	Remove strut or anchor no.4 at elevation 45.40
17	Apply water pressure profile no.1 (Mod. Conserv.)
18	Change properties of soil type 2 to soil type 4
	No analysis at this stage
	Ko pressures will not be reset
19	Change properties of soil type 3 to soil type 5
	No analysis at this stage
	Ko pressures will not be reset
20	Change EI of wall to 46965 kN.m2/m run
	From elevation 38.50 to 30.80
	Yield moment not defined
	No adjustments to wall displacements
21	Change EI of wall to 145154 kN.m2/m run
	From elevation 45.80 to 38.50
	Yield moment not defined
	No adjustments to wall displacements

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) = 15.00 m

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

Distance to rigid boundary on Left side = 30.00 m
Distance to rigid boundary on Right side = 30.00 m

OUTPUT OPTIONS

Stage no.	Stage description	Output options: Displacement, Bending mom., Shear force	Active, Passive pressures	Graph. output
1	Apply surcharge no.1 at elev. 44.85	Yes	Yes	Yes
2	Apply surcharge no.2 at elev. 44.85	No	No	No
3	Apply surcharge no.3 at elev. 45.60	Yes	Yes	Yes
4	Change EI of wall to 93950kN.m2/m run	No	No	No
5	Excav. to elev. 43.75 on RIGHT side	Yes	Yes	Yes
6	Install strut no.4 at elev. 45.40	No	No	No
7	Excav. to elev. 41.50 on RIGHT side	Yes	Yes	Yes
8	Install strut no.5 at elev. 42.00	No	No	No
9	Excav. to elev. 37.94 on RIGHT side	No	No	No
10	Fill to elev. 38.50 on RIGHT side	No	No	No
11	Install strut no.3 at elev. 38.70	Yes	Yes	Yes
12	Change EI of wall to 290309kN.m2/m run	No	No	No
13	Remove strut no.5 at elev. 42.00	No	No	No
14	Change EI of wall to 290309kN.m2/m run	No	No	No
15	Install strut no.1 at elev. 45.69	No	No	No
16	Remove strut no.4 at elev. 45.40	No	No	No
17	Apply water pressure profile no.1	Yes	Yes	Yes
18	Change soil type 2 to soil type 4	No	No	No
19	Change soil type 3 to soil type 5	No	No	No
20	Change EI of wall to 46965kN.m2/m run	No	No	No
21	Change EI of wall to 145154kN.m2/m run	Yes	Yes	Yes
*	Summary output	Yes	-	Yes

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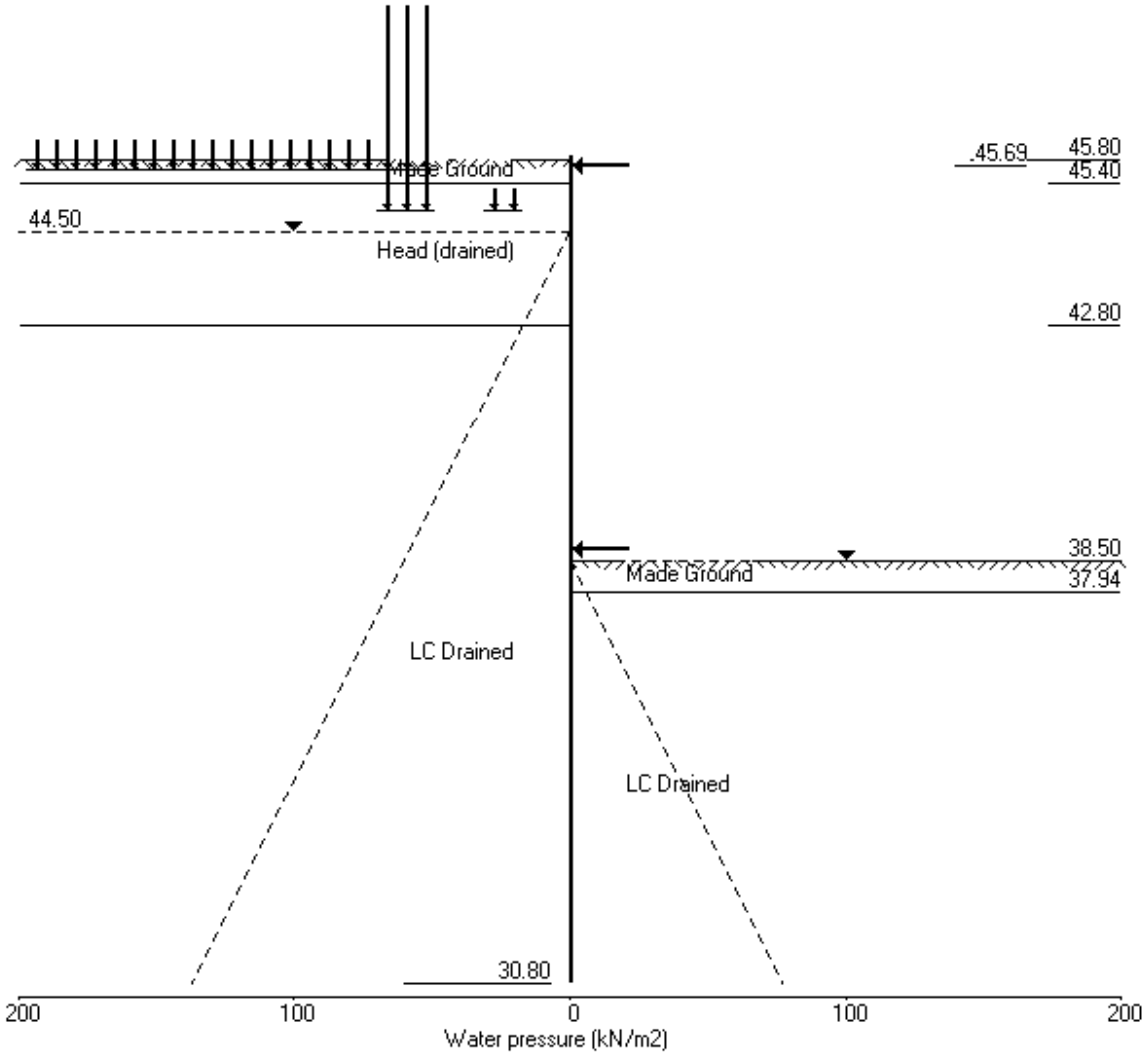
Units: kN,m

Stage No.21 Change EI of wall to 145154kN.m2/m run



Units: kN,m

Stage No. 5 Excavate to elevation 43.75 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. = 30.80 Factor of Safety	Moment equilib. at elev.	Toe elev. for FoS = 1.000 Toe elev.	Wall Penetr -ation	Direction of failure
5	45.80	43.75	Cant.	8.619	31.39	43.59	0.16	L to R

BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall

Analysis options

Length of wall perpendicular to section = 15.00m

Subgrade reaction model - Boussinesq Influence coefficients

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

Open Tension Crack analysis - No

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

Limit State: Serviceability Limit State

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

*** Wall displacements reset to zero at stage 4

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	45.80	0.00	0.004	6.78E-04	0.0	0.0		93950
2	45.69	0.54	0.004	6.78E-04	0.0	-0.0		93950
3	45.60	0.98	0.004	6.78E-04	0.1	0.0		93950
4	45.40	1.97	0.004	6.78E-04	0.4	0.1		93950
		2.00	0.004	6.78E-04	0.4	0.1		
5	44.85	4.75	0.003	6.76E-04	2.2	0.8		93950
6	44.50	6.50	0.003	6.72E-04	4.2	1.9		93950
7	43.75	10.34	0.003	6.19E-04	10.5	10.4		93950
		-20.32	0.003	6.19E-04	10.5	10.4		
8	43.00	-9.22	0.002	5.08E-04	-0.5	12.9		93950
9	42.80	-6.59	0.002	4.74E-04	-2.1	12.6		93950
10	42.00	-1.40	0.002	3.41E-04	-5.3	9.2		93950
11	41.50	0.62	0.002	2.68E-04	-5.5	6.4		93950
12	40.75	2.14	0.001	1.81E-04	-4.5	2.6		93950
13	40.00	2.37	0.001	1.22E-04	-2.8	-0.1		93950
14	39.35	2.00	0.001	9.13E-05	-1.4	-1.3		93950
15	38.70	1.42	0.001	7.33E-05	-0.3	-1.8		93950
16	38.50	1.23	0.001	6.98E-05	0.0	-1.8		93950
17	37.94	0.72	0.001	6.36E-05	0.6	-1.6		93950
18	37.37	0.30	0.001	6.08E-05	0.8	-1.2		93950
19	36.80	-0.02	0.001	6.01E-05	0.9	-0.7		93950
20	36.00	-0.28	0.001	6.00E-05	0.8	0.0		93950
21	35.20	-0.38	0.001	5.96E-05	0.5	0.5		93950
22	34.40	-0.37	0.001	5.83E-05	0.2	0.8		93950
23	33.60	-0.29	0.001	5.65E-05	-0.0	0.8		93950
24	32.80	-0.18	0.001	5.45E-05	-0.2	0.6		93950
25	32.00	0.00	0.001	5.31E-05	-0.3	0.3		93950
26	31.40	0.21	0.001	5.25E-05	-0.2	0.1		93950

(continued)

Stage No.5 Excavate to elevation 43.75 on RIGHT side

Node no.	Y coord	Nett pressure kN/m2	Wall disp. m	Wall rotation rad.	Shear force kN/m	Bending moment kN.m/m	Strut forces kN/m	EI of wall kN.m2/m
27	30.80	0.50	0.001	5.23E-05	-0.0	0.0		---

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	45.80	0.00	0.00	0.00	0.00	0.00	0.00	2253
2	45.69	0.00	1.98	0.54	9.95	0.54	0.54a	2253
3	45.60	0.00	3.60	0.98	18.09	0.98	0.98a	2253
4	45.40	0.00	7.20	1.97	36.20	1.97	1.97a	2253
		Total>	7.20	2.00m	212.88	2.00	2.00a	11521
5	44.85	Total>	18.32	4.75m	224.00	4.75	4.75a	11521
6	44.50	Total>	25.69	6.50m	231.37	6.50	6.50a	11521
7	43.75	Total>	43.79	10.25m	249.47	10.34	10.34	11521
8	43.00	Total>	62.99	14.00m	268.67	33.25	33.25	11521
9	42.80	Total>	68.06	15.00m	273.74	39.16	39.16	11521
10	42.00	Total>	87.69	19.00m	302.63	59.66	59.66	12334
11	41.50	Total>	99.32	21.50m	320.04	71.53	71.53	12843
12	40.75	Total>	115.95	25.25m	345.35	88.15	88.15	13605
13	40.00	Total>	131.85	29.00m	369.93	103.76	103.76	14368
14	39.35	Total>	145.24	32.25m	390.84	116.80	116.80	15028
15	38.70	Total>	158.40	35.50m	411.51	129.62	129.62	15689
16	38.50	Total>	162.41	36.50m	417.84	133.55	133.55	15893
17	37.94	Total>	173.59	39.30m	435.50	144.52	144.52	16462
18	37.37	Total>	184.91	42.15m	453.41	155.72	155.72	17041
19	36.80	Total>	196.18	45.00m	471.27	166.95	166.95	17621
20	36.00	Total>	211.95	49.00m	496.30	182.81	182.81	18434
21	35.20	Total>	227.69	53.00m	521.30	198.76	198.76	19247
22	34.40	Total>	243.41	57.00m	546.28	214.78	214.78	20060
23	33.60	Total>	259.13	61.00m	571.25	230.84	230.84	20874
24	32.80	Total>	274.85	65.00m	596.23	246.95	246.95	21687
25	32.00	Total>	290.57	69.00m	621.20	263.10	263.10	22500
26	31.40	Total>	302.37	72.00m	639.94	275.26	275.26	23110
27	30.80	Total>	314.16	75.00m	658.68	287.47	287.47	23720

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	45.80	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	45.69	0.00	0.00	0.00	0.00	0.00	0.00	0.0
3	45.60	0.00	0.00	0.00	0.00	0.00	0.00	0.0
4	45.40	0.00	0.00	0.00	0.00	0.00	0.00	0.0
5	44.85	0.00	0.00	0.00	0.00	0.00	0.00	0.0
6	44.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
7	43.75	0.00	0.00	0.00	0.00	0.00	0.00	0.0
		Total>	0.00	0.00	205.68	30.67	30.67	9942
8	43.00	Total>	15.00	3.75m	220.68	42.47	42.47	9942
9	42.80	Total>	19.00	4.75m	224.68	45.75	45.75	9942
10	42.00	Total>	35.01	8.75m	249.95	61.06	61.06	10644
11	41.50	Total>	45.02	11.25m	265.74	70.91	70.91	11083
12	40.75	Total>	60.06	15.00m	289.45	86.02	86.02	11740
13	40.00	Total>	75.11	18.75m	313.18	101.39	101.39	12398
14	39.35	Total>	88.17	22.00m	333.77	114.80	114.80	12969

(continued)

Stage No.5 Excavate to elevation 43.75 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	kN/m2	kN/m3
15	38.70	Total>	101.25	25.25m	354.37	128.20	128.20	13539
16	38.50	Total>	105.28	26.25m	360.71	132.32	132.32	13714
17	37.94	Total>	116.58	29.05m	378.49	143.80	143.80	14206
18	37.37	Total>	128.09	31.90m	396.60	155.42	155.42	14706
19	36.80	Total>	139.62	34.75m	414.72	166.97	166.97	15206
20	36.00	Total>	155.84	38.75m	440.19	183.09	183.09	15907
21	35.20	Total>	172.09	42.75m	465.70	199.14	199.14	16609
22	34.40	Total>	188.37	46.75m	491.24	215.14	215.14	17311
23	33.60	Total>	204.69	50.75m	516.81	231.14	231.14	18013
24	32.80	Total>	221.04	54.75m	542.41	247.12	247.12	18715
25	32.00	Total>	237.42	58.75m	568.05	263.10	263.10	19416
26	31.40	Total>	249.72	61.75m	587.29	275.05	275.05	19943
27	30.80	Total>	262.03	64.75m	606.54	286.98	286.98	20469

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

KNIGHT BUILD LTD | Sheet No.
Program: WALLAP Version 6.06 Revision A49.B68.R53 | Job No. 79AR
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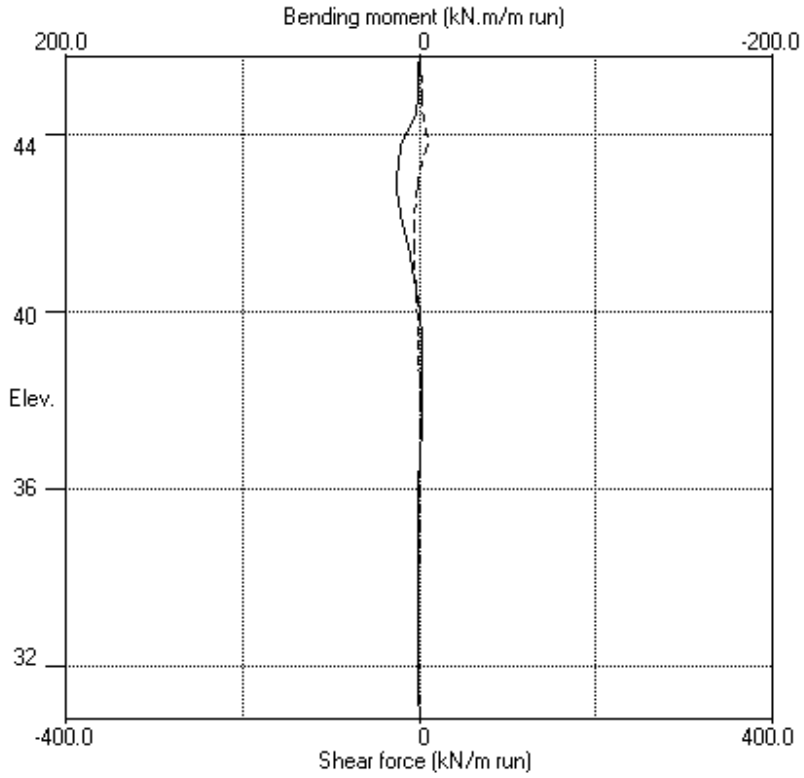
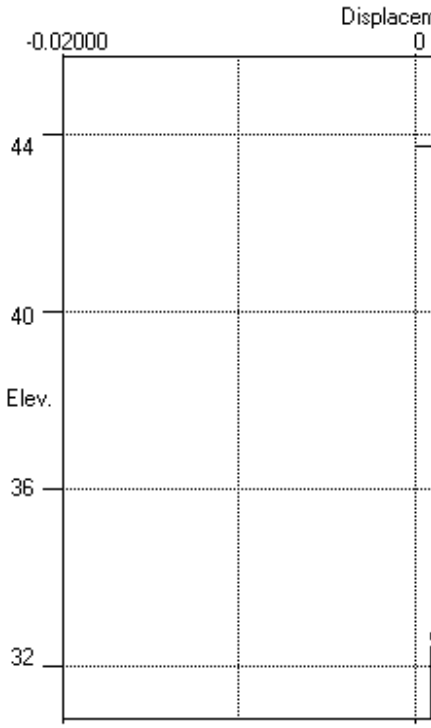
79 Avenue Road | Date:28-06-2021
SECTION 2-2 ANALYSIS | Checked :

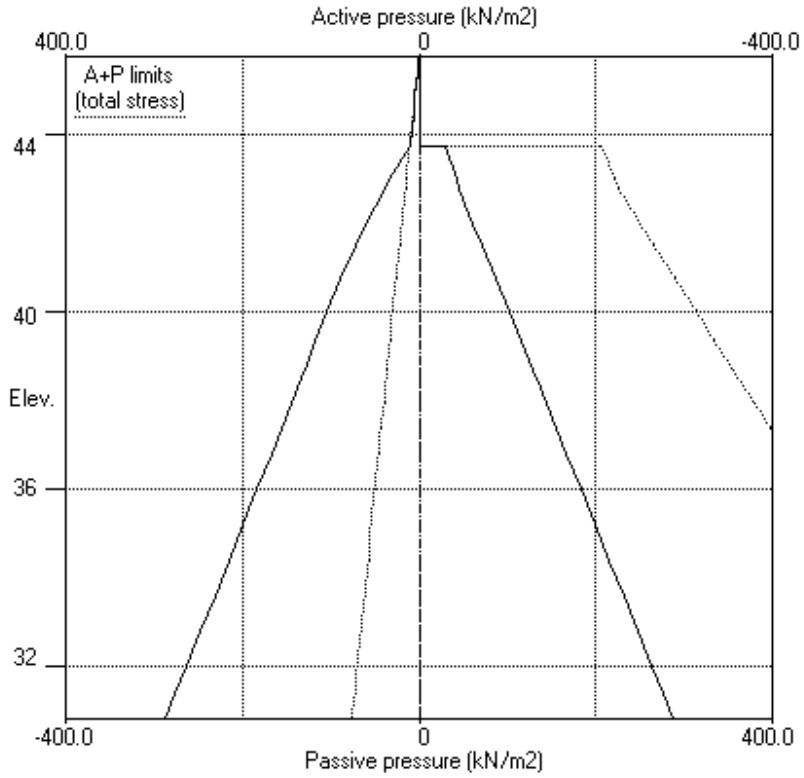
Units: kN,m

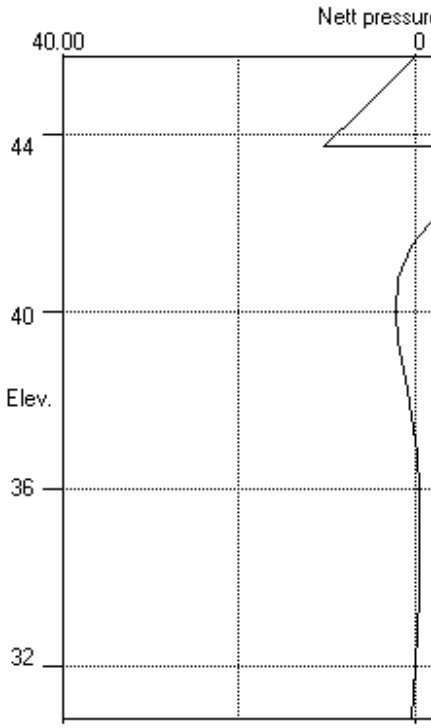
Stage No.5 Excav. to elev. 43.75 on RIGHT side





Stage No.5 Excav. to elev. 43.75 on RIGHT side





Units: kN,m

Stage No. 7 Excavate to elevation 41.50 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. = 30.80 Factor of Safety	Moment equilib. at elev.	Toe elev. for FoS = 1.000 Toe elev.	Wall Penetr -ation	Direction of failure
7	45.80	41.50	45.40	6.725	n/a	41.42	0.08	L to R

BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall

Analysis options

Length of wall perpendicular to section = 15.00m

Subgrade reaction model - Boussinesq Influence coefficients

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

Open Tension Crack analysis - No

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

Limit State: Serviceability Limit State

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

*** Wall displacements reset to zero at stage 4

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	45.80	0.00	0.004	-3.24E-04	0.0	0.0		93950
2	45.69	0.54	0.004	-3.24E-04	0.0	-0.0		93950
3	45.60	0.98	0.004	-3.24E-04	0.1	0.0		93950
4	45.40	1.97	0.004	-3.24E-04	0.4	0.1	23.7	93950
		2.00	0.004	-3.24E-04	-23.3	0.1		
5	44.85	4.75	0.004	-2.88E-04	-21.4	-12.2		93950
6	44.50	6.50	0.005	-2.28E-04	-19.5	-19.4		93950
7	43.75	10.25	0.005	-4.11E-05	-13.2	-28.7		93950
8	43.00	14.00	0.005	2.00E-04	-4.1	-36.0		93950
9	42.80	17.22	0.005	2.69E-04	-1.0	-36.4		93950
10	42.00	28.25	0.004	5.15E-04	17.2	-30.5		93950
11	41.50	35.47	0.004	6.13E-04	33.2	-18.1		93950
		-23.42	0.004	6.13E-04	33.2	-18.1		
12	40.75	-17.43	0.003	6.33E-04	17.8	0.3		93950
13	40.00	-11.22	0.003	5.48E-04	7.1	8.9		93950
14	39.35	-6.64	0.003	4.43E-04	1.3	11.1		93950
15	38.70	-3.17	0.002	3.39E-04	-1.9	10.6		93950
16	38.50	-2.34	0.002	3.09E-04	-2.4	10.1		93950
17	37.94	-0.56	0.002	2.37E-04	-3.3	8.4		93950
18	37.37	0.53	0.002	1.81E-04	-3.3	6.4		93950
19	36.80	1.06	0.002	1.41E-04	-2.8	4.6		93950
20	36.00	1.17	0.002	1.07E-04	-1.9	2.7		93950
21	35.20	0.91	0.002	9.12E-05	-1.1	1.5		93950
22	34.40	0.53	0.002	8.53E-05	-0.5	0.8		93950
23	33.60	0.21	0.002	8.41E-05	-0.2	0.5		93950
24	32.80	0.02	0.002	8.41E-05	-0.1	0.4		93950
25	32.00	-0.02	0.002	8.41E-05	-0.1	0.2		93950
26	31.40	0.07	0.002	8.40E-05	-0.1	0.1		93950

(continued)

Stage No.7 Excavate to elevation 41.50 on RIGHT side

Node no.	Y coord	Nett pressure kN/m2	Wall disp. m	Wall rotation rad.	Shear force kN/m	Bending moment kN.m/m	Strut forces kN/m	EI of wall kN.m2/m
27	30.80	0.28	0.001	8.39E-05	-0.0	0.0		---

At elev. 45.40 Strut force = 177.6 kN/strut = 23.7 kN/m run

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	45.80	0.00	0.00	0.00	0.00	0.00	0.00	3823
2	45.69	0.00	1.98	0.54	9.95	0.54	0.54a	1602
3	45.60	0.00	3.60	0.98	18.09	0.98	0.98a	1602
4	45.40	0.00	7.20	1.97	36.20	1.97	1.97a	1602
		Total>	7.20	2.00m	212.88	2.00	2.00a	8257
5	44.85	Total>	18.32	4.75m	224.00	4.75	4.75a	8257
6	44.50	Total>	25.69	6.50m	231.37	6.50	6.50a	8257
7	43.75	Total>	43.79	10.25m	249.47	10.25	10.25a	8257
8	43.00	Total>	62.99	14.00m	268.67	14.00	14.00a	8257
9	42.80	Total>	68.06	15.00m	273.74	19.22	19.22	8257
10	42.00	Total>	87.69	19.00m	302.63	38.25	38.25	8840
11	41.50	Total>	99.32	21.50m	320.04	50.47	50.47	9204
12	40.75	Total>	115.95	25.25m	345.35	68.86	68.86	9750
13	40.00	Total>	131.85	29.00m	369.93	86.83	86.83	10297
14	39.35	Total>	145.24	32.25m	390.84	101.83	101.83	10770
15	38.70	Total>	158.40	35.50m	411.51	116.25	116.25	11244
16	38.50	Total>	162.41	36.50m	417.84	120.58	120.58	11390
17	37.94	Total>	173.59	39.30m	435.50	132.45	132.45	11798
18	37.37	Total>	184.91	42.15m	453.41	144.24	144.24	12213
19	36.80	Total>	196.18	45.00m	471.27	155.80	155.80	12628
20	36.00	Total>	211.95	49.00m	496.30	171.81	171.81	13211
21	35.20	Total>	227.69	53.00m	521.30	187.69	187.69	13794
22	34.40	Total>	243.41	57.00m	546.28	203.57	203.57	14377
23	33.60	Total>	259.13	61.00m	571.25	219.51	219.51	14960
24	32.80	Total>	274.85	65.00m	596.23	235.53	235.53	15542
25	32.00	Total>	290.57	69.00m	621.20	251.64	251.64	16125
26	31.40	Total>	302.37	72.00m	639.94	263.80	263.80	16562
27	30.80	Total>	314.16	75.00m	658.68	276.04	276.04	17000

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	45.80	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	45.69	0.00	0.00	0.00	0.00	0.00	0.00	0.0
3	45.60	0.00	0.00	0.00	0.00	0.00	0.00	0.0
4	45.40	0.00	0.00	0.00	0.00	0.00	0.00	0.0
5	44.85	0.00	0.00	0.00	0.00	0.00	0.00	0.0
6	44.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
7	43.75	0.00	0.00	0.00	0.00	0.00	0.00	0.0
8	43.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
9	42.80	2.00	0.00	0.00	0.00	0.00	2.00	0.0
10	42.00	10.00	0.00	0.00	0.00	0.00	10.00	0.0
11	41.50	15.00	0.00	0.00	0.00	0.00	15.00	0.0
		Total>	15.00	15.00w	235.72	73.89	73.89	13907
12	40.75	Total>	30.00	11.25m	259.40	86.29	86.29	14733
13	40.00	Total>	45.01	15.00m	283.09	98.05	98.05	15558

(continued)

Stage No.7 Excavate to elevation 41.50 on RIGHT side

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
14	39.35	Total>	58.04	18.25m	303.63	108.47	108.47	16274
15	38.70	Total>	71.08	21.50m	324.19	119.42	119.42	16990
16	38.50	Total>	75.10	22.50m	330.53	122.91	122.91	17210
17	37.94	Total>	86.36	25.30m	348.27	133.01	133.01	17826
18	37.37	Total>	97.85	28.15m	366.35	143.70	143.70	18454
19	36.80	Total>	109.36	31.00m	384.46	154.74	154.74	19081
20	36.00	Total>	125.57	35.00m	409.92	170.63	170.63	19962
21	35.20	Total>	141.83	39.00m	435.44	186.79	186.79	20842
22	34.40	Total>	158.16	43.00m	461.02	203.04	203.04	21723
23	33.60	Total>	174.54	47.00m	486.66	219.30	219.30	22604
24	32.80	Total>	190.99	51.00m	512.36	235.51	235.51	23484
25	32.00	Total>	207.50	55.00m	538.13	251.66	251.66	24365
26	31.40	Total>	219.92	58.00m	557.49	263.73	263.73	25026
27	30.80	Total>	232.37	61.00m	576.88	275.76	275.76	25686

Note: 14.00a Soil pressure at active limit
123.45p Soil pressure at passive limit

KNIGHT BUILD LTD | Sheet No.
Program: WALLAP Version 6.06 Revision A49.B68.R53 | Job No. 79AR
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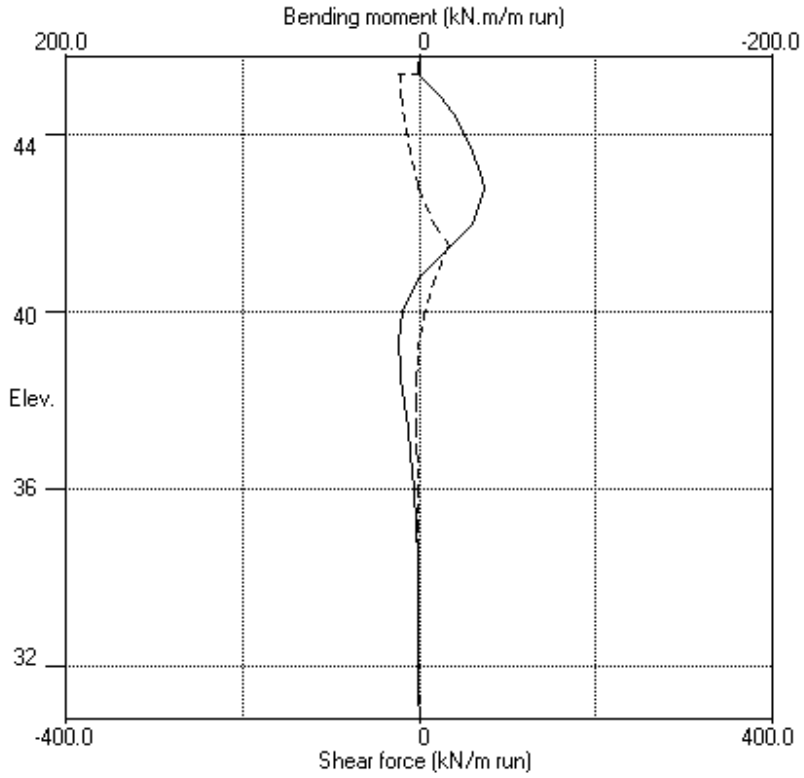
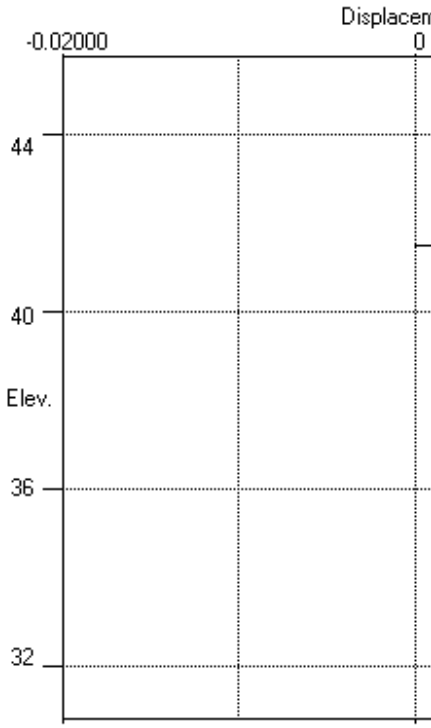
Data filename/Run ID: SECTION_2-2_SLS |
79 Avenue Road | Date:28-06-2021
SECTION 2-2 ANALYSIS | Checked :

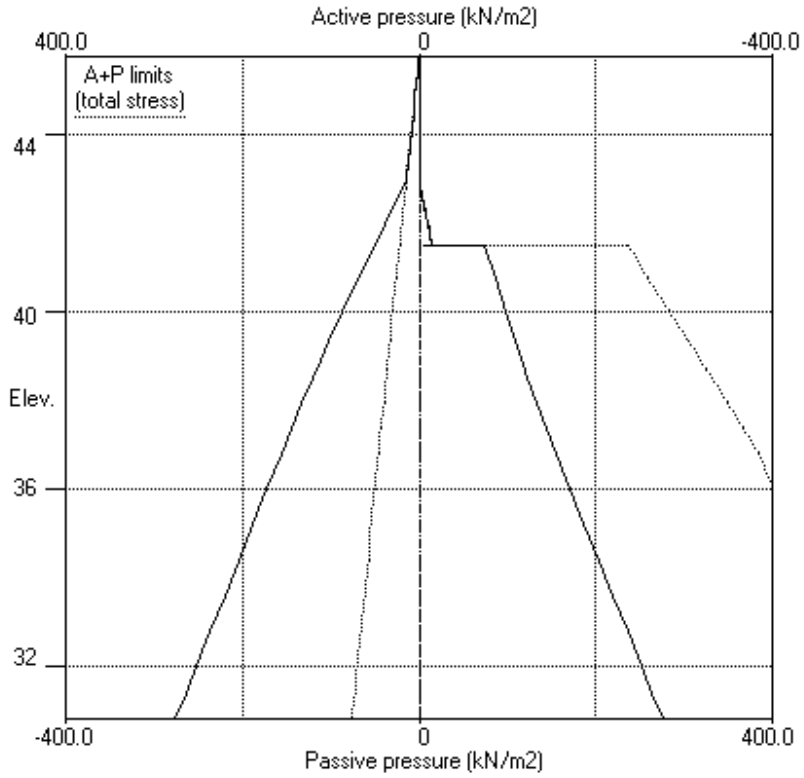
Units: kN,m

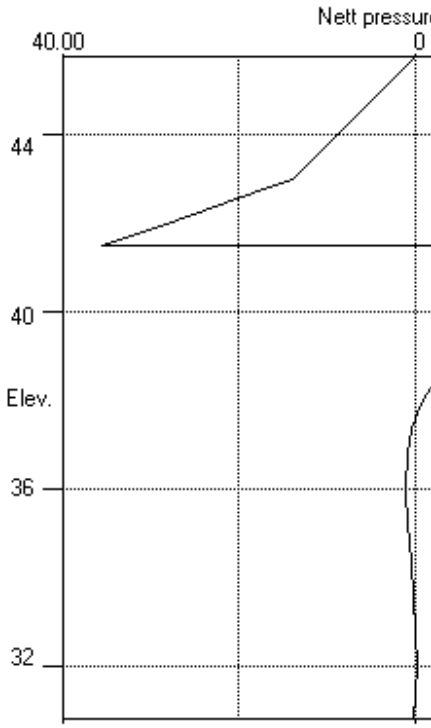
Stage No.7 Excav. to elev. 41.50 on RIGHT side





Stage No.7 Excav. to elev. 41.50 on RIGHT side





Units: kN,m

Stage No. 9 Excavate to elevation 37.94 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. = 30.80 Factor of Safety	Moment equilib. at elev.	Toe elev. for FoS = 1.000 Toe elev.	Wall Penetr -ation	Direction of failure
9	45.80	37.94		More than one strut. No FoS calc.				

BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall

Analysis options

Length of wall perpendicular to section = 15.00m

Subgrade reaction model - Boussinesq Influence coefficients

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

Open Tension Crack analysis - No

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

Limit State: Serviceability Limit State

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

*** Wall displacements reset to zero at stage 4

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	45.80	0.00	0.004	-6.89E-04	0.0	0.0		93950
2	45.69	3.17	0.004	-6.89E-04	0.2	-0.0		93950
3	45.60	3.23	0.004	-6.89E-04	0.5	0.0		93950
4	45.40	3.37	0.004	-6.90E-04	1.1	0.2	18.3	93950
		9.05	0.004	-6.90E-04	-17.2	0.2		
5	44.85	4.75	0.005	-6.67E-04	-13.4	-7.6		93950
6	44.50	6.50	0.005	-6.30E-04	-11.4	-12.0		93950
7	43.75	10.25	0.005	-5.25E-04	-5.1	-15.3		93950
8	43.00	14.00	0.006	-4.16E-04	4.0	-16.5		93950
9	42.80	13.00	0.006	-3.89E-04	6.7	-15.3		93950
10	42.00	12.24	0.006	-3.46E-04	16.8	-4.2	56.8	93950
		12.24	0.006	-3.46E-04	-40.1	-4.2		
11	41.50	14.33	0.006	-3.06E-04	-33.4	-22.4		93950
12	40.75	17.31	0.006	-9.65E-05	-21.6	-42.9		93950
13	40.00	21.75	0.006	2.40E-04	-6.9	-53.7		93950
14	39.35	27.96	0.006	5.74E-04	9.2	-53.3		93950
15	38.70	36.89	0.005	8.71E-04	30.3	-41.1		93950
16	38.50	40.18	0.005	9.44E-04	38.0	-34.2		93950
17	37.94	50.41	0.005	1.04E-03	63.4	-6.4		93950
		-61.91	0.005	1.04E-03	63.4	-6.4		
18	37.37	-45.31	0.004	9.97E-04	32.8	19.6		93950
19	36.80	-29.51	0.004	8.37E-04	11.5	31.0		93950
20	36.00	-12.18	0.003	5.71E-04	-5.2	30.7		93950
21	35.20	-1.61	0.003	3.46E-04	-10.7	22.7		93950
22	34.40	3.27	0.002	1.96E-04	-10.0	13.5		93950
23	33.60	4.42	0.002	1.15E-04	-6.9	6.5		93950
24	32.80	3.66	0.002	8.17E-05	-3.7	2.3		93950
25	32.00	2.23	0.002	7.22E-05	-1.3	0.5		93950

(continued)

Stage No.9 Excavate to elevation 37.94 on RIGHT side

Node no.	Y coord	Nett pressure kN/m2	Wall disp. m	Wall rotation rad.	Shear force kN/m	Bending moment kN.m/m	Strut forces kN/m	EI of wall kN.m2/m
26	31.40	1.11	0.002	7.13E-05	-0.3	0.0		93950
27	30.80	0.05	0.002	7.14E-05	-0.0	0.0		---

At elev. 45.40 Strut force = 137.1 kN/strut = 18.3 kN/m run
At elev. 42.00 Strut force = 426.3 kN/strut = 56.8 kN/m run (horiz.)
= 65.6 kN/m run (inclined)

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	45.80	0.00	0.00	0.00	0.00	0.00	0.00	11604
2	45.69	0.00	1.98	0.54	9.95	3.17	3.17	11604
3	45.60	0.00	3.60	0.98	18.09	3.23	3.23	11604
4	45.40	0.00	7.20	1.97	36.20	3.37	3.37	11604
		Total>	7.20	2.00m	212.88	9.05	9.05	58516
5	44.85	Total>	18.32	4.75m	224.00	4.75	4.75a	8847
6	44.50	Total>	25.69	6.50m	231.37	6.50	6.50a	8847
7	43.75	Total>	43.79	10.25m	249.47	10.25	10.25a	8847
8	43.00	Total>	62.99	14.00m	268.67	14.00	14.00a	8847
9	42.80	Total>	68.06	15.00m	273.74	15.00	15.00a	8847
10	42.00	Total>	87.69	19.00m	302.63	22.24	22.24	9472
11	41.50	Total>	99.32	21.50m	320.04	29.33	29.33	9862
12	40.75	Total>	115.95	25.25m	345.35	39.81	39.81	10448
13	40.00	Total>	131.85	29.00m	369.93	51.75	51.75	11033
14	39.35	Total>	145.24	32.25m	390.84	64.46	64.46	11541
15	38.70	Total>	158.40	35.50m	411.51	79.89	79.89	12048
16	38.50	Total>	162.41	36.50m	417.84	85.18	85.18	12204
17	37.94	Total>	173.59	39.30m	435.50	101.01	101.01	12641
18	37.37	Total>	184.91	42.15m	453.41	117.86	117.86	13086
19	36.80	Total>	196.18	45.00m	471.27	134.41	134.41	13531
20	36.00	Total>	211.95	49.00m	496.30	156.02	156.02	14156
21	35.20	Total>	227.69	53.00m	521.30	175.41	175.41	14780
22	34.40	Total>	243.41	57.00m	546.28	192.95	192.95	15405
23	33.60	Total>	259.13	61.00m	571.25	209.31	209.31	16029
24	32.80	Total>	274.85	65.00m	596.23	225.08	225.08	16654
25	32.00	Total>	290.57	69.00m	621.20	240.69	240.69	17278
26	31.40	Total>	302.37	72.00m	639.94	252.42	252.42	17747
27	30.80	Total>	314.16	75.00m	658.68	264.22	264.22	18215

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	45.80	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	45.69	0.00	0.00	0.00	0.00	0.00	0.00	0.0
3	45.60	0.00	0.00	0.00	0.00	0.00	0.00	0.0
4	45.40	0.00	0.00	0.00	0.00	0.00	0.00	0.0
5	44.85	0.00	0.00	0.00	0.00	0.00	0.00	0.0
6	44.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
7	43.75	0.00	0.00	0.00	0.00	0.00	0.00	0.0
8	43.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
9	42.80	2.00	0.00	0.00	0.00	0.00	2.00	0.0
10	42.00	10.00	0.00	0.00	0.00	0.00	10.00	0.0
11	41.50	15.00	0.00	0.00	0.00	0.00	15.00	0.0

(continued)

Stage No.9 Excavate to elevation 37.94 on RIGHT side

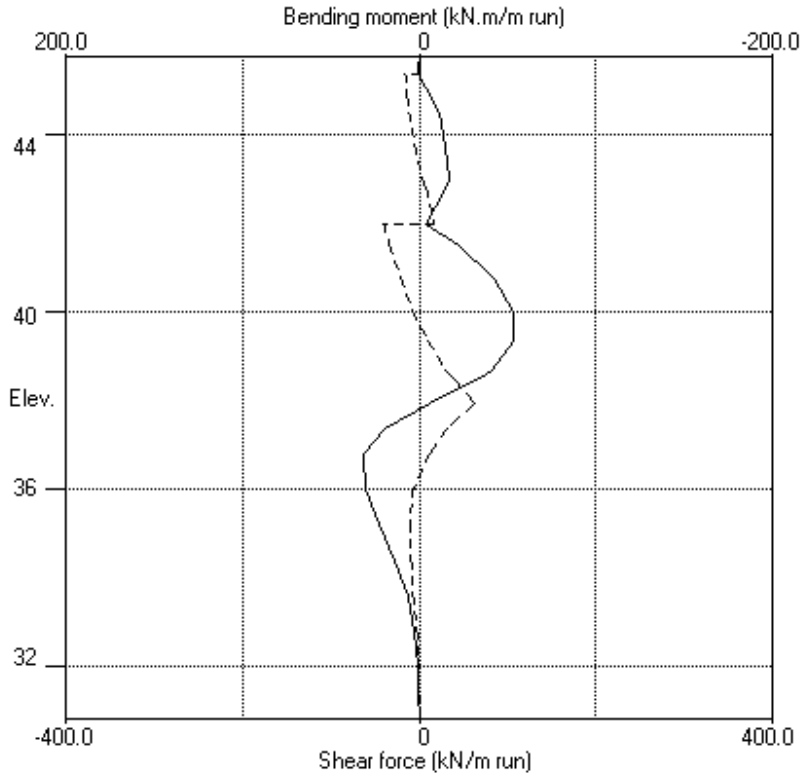
Node no.	Y coord	RIGHT side Water press. kN/m2	Effective stresses Vertic -al kN/m2	Active limit kN/m2	Passive limit kN/m2	Earth pressure kN/m2	Total earth pressure kN/m2	Coeff. of subgrade reaction kN/m3
12	40.75	22.50	0.00	0.00	0.00	0.00	22.50	0.0
13	40.00	30.00	0.00	0.00	0.00	0.00	30.00	0.0
14	39.35	36.50	0.00	0.00	0.00	0.00	36.50	0.0
15	38.70	43.00	0.00	0.00	0.00	0.00	43.00	0.0
16	38.50	45.00	0.00	0.00	0.00	0.00	45.00	0.0
17	37.94	50.60	0.00	0.00	0.00	0.00	50.60	0.0
		Total> 50.60	50.60w	312.51	162.92	162.92		25838
18	37.37	Total> 62.00	28.15m	330.50	163.17	163.17		26748
19	36.80	Total> 73.41	31.00m	348.51	163.92	163.92		27657
20	36.00	Total> 89.44	35.00m	373.79	168.20	168.20		28934
21	35.20	Total> 105.51	39.00m	399.12	177.01	177.01		30210
22	34.40	Total> 121.64	43.00m	424.50	189.68	189.68		31487
23	33.60	Total> 137.83	47.00m	449.95	204.88	204.88		32763
24	32.80	Total> 154.11	51.00m	475.48	221.42	221.42		34040
25	32.00	Total> 170.46	55.00m	501.09	238.46	238.46		35316
26	31.40	Total> 182.79	58.00m	520.36	251.32	251.32		36274
27	30.80	Total> 195.17	61.00m	539.68	264.17	264.17		37231

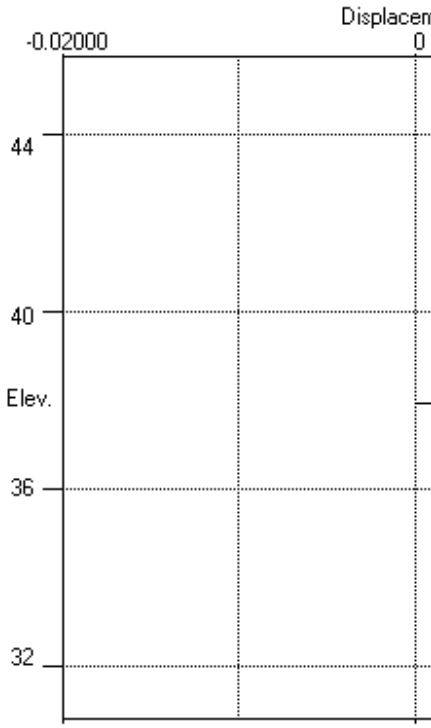
Note: 15.00a Soil pressure at active limit
123.45p Soil pressure at passive limit

KNIGHT BUILD LTD | Sheet No.
Program: WALLAP Version 6.06 Revision A49.B68.R53 | Job No. 79AR
Licensed from GEOSOLVE | Made by : JRC
Data filename/Run ID: SECTION_2-2_SLS |
79 Avenue Road | Date:28-06-2021
SECTION 2-2 ANALYSIS | Checked :

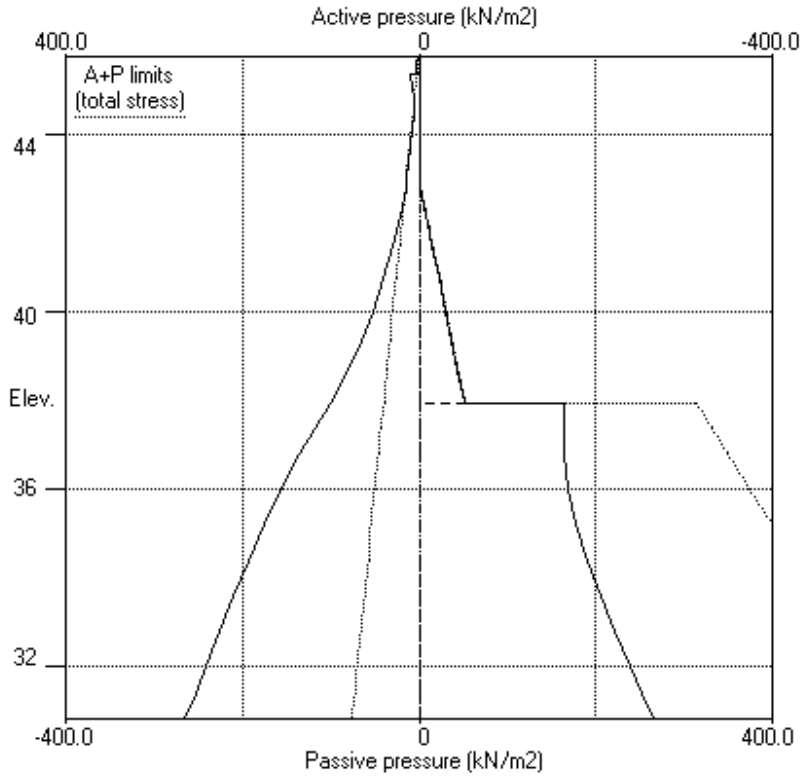
Units: kN,m

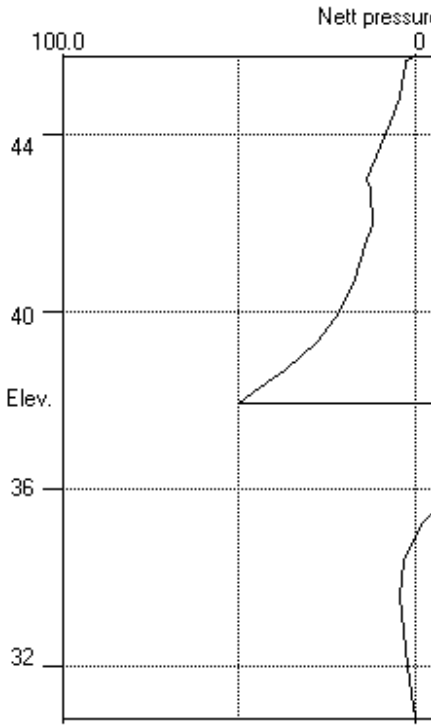
Stage No.9 Excav. to elev. 37.94 on RIGHT side





Stage No.9 Excav. to elev. 37.94 on RIGHT side





Units: kN,m

Stage No. 10 Fill to elevation 38.50 on RIGHT side with soil type 1

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

Stage No.	G.L. Act.	G.L. Pass.	Strut Elev.	FoS for toe elev. = 30.80 Factor of Safety	Moment equilib. at elev.	Toe elev. for FoS = 1.000 Toe elev.	Wall Penetr -ation	Direction of failure
10	45.80	38.50		More than one strut. No FoS calc.				

BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall
Analysis options
Length of wall perpendicular to section = 15.00m
Subgrade reaction model - Boussinesq Influence coefficients
Soil deformations are elastic until the active or passive limit is reached
Open Tension Crack analysis - No

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

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

*** Wall displacements reset to zero at stage 4

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	45.80	0.00	0.004	-6.92E-04	0.0	0.0		93950
2	45.69	3.16	0.004	-6.92E-04	0.2	-0.0		93950
3	45.60	3.22	0.004	-6.92E-04	0.5	0.0		93950
4	45.40	3.35	0.004	-6.92E-04	1.1	0.2	18.5	93950
		8.99	0.004	-6.92E-04	-17.4	0.2		
5	44.85	4.75	0.005	-6.69E-04	-13.6	-7.8		93950
6	44.50	6.50	0.005	-6.31E-04	-11.6	-12.2		93950
7	43.75	10.25	0.005	-5.25E-04	-5.3	-15.6		93950
8	43.00	14.00	0.006	-4.11E-04	3.7	-17.1		93950
9	42.80	13.00	0.006	-3.83E-04	6.4	-15.9		93950
10	42.00	12.25	0.006	-3.34E-04	16.5	-5.0	56.8	93950
		12.25	0.006	-3.34E-04	-40.2	-5.0		
11	41.50	14.41	0.006	-2.90E-04	-33.6	-23.3		93950
12	40.75	17.51	0.006	-7.24E-05	-21.6	-43.9		93950
13	40.00	22.15	0.006	2.72E-04	-6.7	-54.6		93950
14	39.35	28.59	0.006	6.11E-04	9.8	-54.0		93950
15	38.70	37.80	0.005	9.12E-04	31.3	-41.3		93950
16	38.50	41.17	0.005	9.85E-04	39.2	-34.3		93950
17	37.94	50.45	0.005	1.08E-03	64.9	-5.7		93950
		-63.67	0.005	1.08E-03	64.9	-5.7		
18	37.37	-46.54	0.004	1.03E-03	33.5	21.0		93950
19	36.80	-30.28	0.003	8.62E-04	11.6	32.5		93950
20	36.00	-12.48	0.003	5.84E-04	-5.5	32.0		93950
21	35.20	-1.61	0.002	3.49E-04	-11.2	23.6		93950
22	34.40	3.41	0.002	1.93E-04	-10.4	14.1		93950
23	33.60	4.60	0.002	1.08E-04	-7.2	6.8		93950
24	32.80	3.82	0.002	7.35E-05	-3.9	2.4		93950
25	32.00	2.33	0.002	6.35E-05	-1.4	0.5		93950

(continued)

Stage No.10 Fill to elevation 38.50 on RIGHT side with soil type 1

Node no.	Y coord	Nett pressure kN/m2	Wall disp. m	Wall rotation rad.	Shear force kN/m	Bending moment kN.m/m	Strut forces kN/m	EI of wall kN.m2/m
26	31.40	1.15	0.002	6.26E-05	-0.4	0.0		93950
27	30.80	0.03	0.002	6.27E-05	-0.0	0.0		---

At elev. 45.40 Strut force = 138.7 kN/strut = 18.5 kN/m run
At elev. 42.00 Strut force = 425.8 kN/strut = 56.8 kN/m run (horiz.)
= 65.6 kN/m run (inclined)

LEFT side

Node no.	Y coord	Water press. kN/m2	Vertic -al kN/m2	Effective stresses Active limit kN/m2	Passive limit kN/m2	Earth pressure kN/m2	Total earth pressure kN/m2	Coeff. of subgrade reaction kN/m3
1	45.80	0.00	0.00	0.00	0.00	0.00	0.00	2396
2	45.69	0.00	1.98	0.54	9.95	3.16	3.16	2396
3	45.60	0.00	3.60	0.98	18.09	3.22	3.22	2396
4	45.40	0.00	7.20	1.97	36.20	3.35	3.35	2396
		Total>	7.20	2.00m	212.88	8.99	8.99	12239
5	44.85	Total>	18.32	4.75m	224.00	4.75	4.75a	12239
6	44.50	Total>	25.69	6.50m	231.37	6.50	6.50a	12239
7	43.75	Total>	43.79	10.25m	249.47	10.25	10.25a	12239
8	43.00	Total>	62.99	14.00m	268.67	14.00	14.00a	12239
9	42.80	Total>	68.06	15.00m	273.74	15.00	15.00a	12239
10	42.00	Total>	87.69	19.00m	302.63	22.25	22.25	7598
11	41.50	Total>	99.32	21.50m	320.04	29.41	29.41	7911
12	40.75	Total>	115.95	25.25m	345.35	40.01	40.01	8380
13	40.00	Total>	131.85	29.00m	369.93	52.15	52.15	8850
14	39.35	Total>	145.24	32.25m	390.84	65.09	65.09	9257
15	38.70	Total>	158.40	35.50m	411.51	80.80	80.80	9664
16	38.50	Total>	162.41	36.50m	417.84	86.17	86.17	9789
17	37.94	Total>	173.59	39.30m	435.50	102.27	102.27	10140
18	37.37	Total>	184.91	42.15m	453.41	119.39	119.39	10497
19	36.80	Total>	196.18	45.00m	471.27	136.17	136.17	10854
20	36.00	Total>	211.95	49.00m	496.30	158.02	158.02	11355
21	35.20	Total>	227.69	53.00m	521.30	177.57	177.57	11855
22	34.40	Total>	243.41	57.00m	546.28	195.20	195.20	12356
23	33.60	Total>	259.13	61.00m	571.25	211.60	211.60	12857
24	32.80	Total>	274.85	65.00m	596.23	227.38	227.38	13358
25	32.00	Total>	290.57	69.00m	621.20	242.99	242.99	13859
26	31.40	Total>	302.37	72.00m	639.94	254.71	254.71	14235
27	30.80	Total>	314.16	75.00m	658.68	266.48	266.48	14611

RIGHT side

Node no.	Y coord	Water press. kN/m2	Vertic -al kN/m2	Effective stresses Active limit kN/m2	Passive limit kN/m2	Earth pressure kN/m2	Total earth pressure kN/m2	Coeff. of subgrade reaction kN/m3
1	45.80	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	45.69	0.00	0.00	0.00	0.00	0.00	0.00	0.0
3	45.60	0.00	0.00	0.00	0.00	0.00	0.00	0.0
4	45.40	0.00	0.00	0.00	0.00	0.00	0.00	0.0
5	44.85	0.00	0.00	0.00	0.00	0.00	0.00	0.0
6	44.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
7	43.75	0.00	0.00	0.00	0.00	0.00	0.00	0.0
8	43.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
9	42.80	2.00	0.00	0.00	0.00	0.00	2.00	0.0
10	42.00	10.00	0.00	0.00	0.00	0.00	10.00	0.0
11	41.50	15.00	0.00	0.00	0.00	0.00	15.00	0.0

(continued)

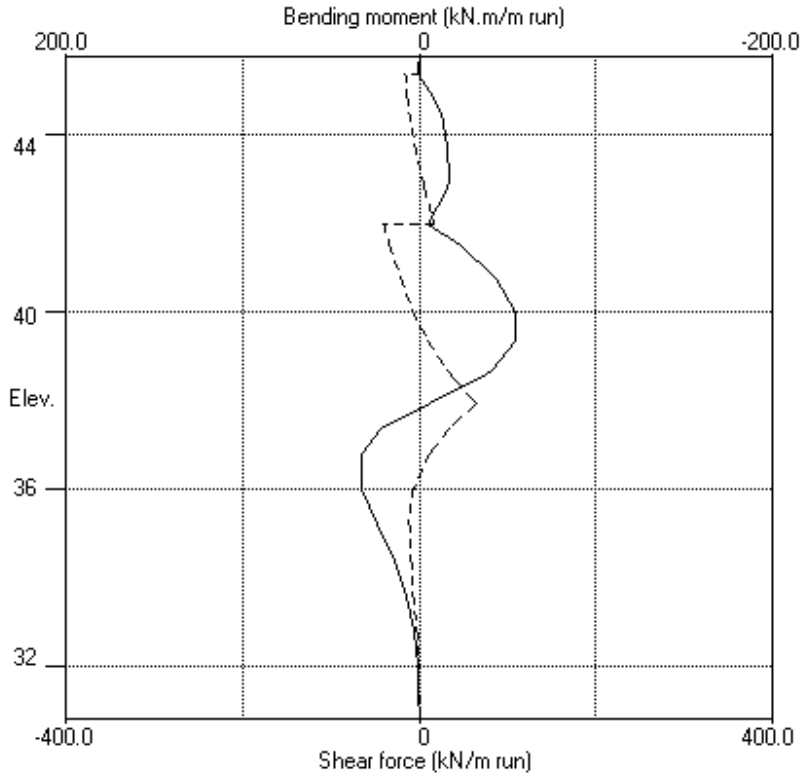
Stage No.10 Fill to elevation 38.50 on RIGHT side with soil type 1

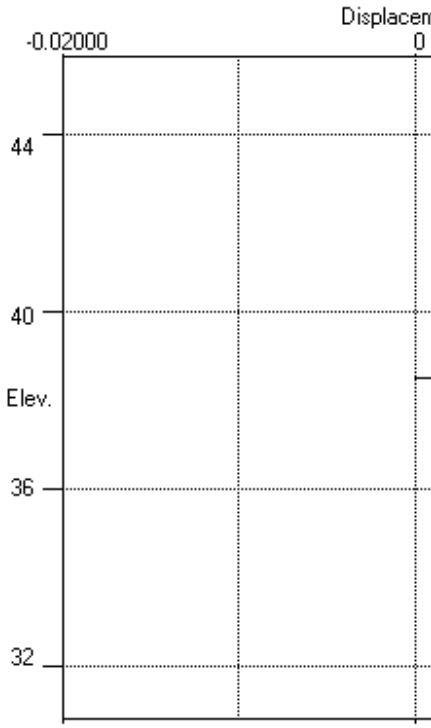
Node no.	Y coord	RIGHT side Water press. kN/m2	Effective stresses Vertic -al kN/m2	Active limit kN/m2	Passive limit kN/m2	Earth pressure kN/m2	Total earth pressure kN/m2	Coeff. of subgrade reaction kN/m3
12	40.75	22.50	0.00	0.00	0.00	0.00	22.50	0.0
13	40.00	30.00	0.00	0.00	0.00	0.00	30.00	0.0
14	39.35	36.50	0.00	0.00	0.00	0.00	36.50	0.0
15	38.70	43.00	0.00	0.00	0.00	0.00	43.00	0.0
16	38.50	45.00	0.00	0.00	0.00	0.00	45.00	0.0
		45.00	0.00	0.00	0.00	0.00	45.00	1393
17	37.94	50.60	4.48	1.22	22.52	1.22	51.82a	1393
		Total>	55.08	25.30m	316.99	165.94	165.94	10306
18	37.37	Total>	66.49	28.15m	334.99	165.93	165.93	10669
19	36.80	Total>	77.91	31.00m	353.00	166.45	166.45	11032
20	36.00	Total>	93.96	35.00m	378.31	170.51	170.51	11541
21	35.20	Total>	110.06	39.00m	403.67	179.18	179.18	12050
22	34.40	Total>	126.23	43.00m	429.09	191.79	191.79	12560
23	33.60	Total>	142.46	47.00m	454.58	207.00	207.00	13069
24	32.80	Total>	158.78	51.00m	480.15	223.57	223.57	13578
25	32.00	Total>	175.17	55.00m	505.80	240.66	240.66	14087
26	31.40	Total>	187.53	58.00m	525.10	253.55	253.55	14469
27	30.80	Total>	199.93	61.00m	544.45	266.45	266.45	14851

Note: 51.82a Soil pressure at active limit
123.45p Soil pressure at passive limit

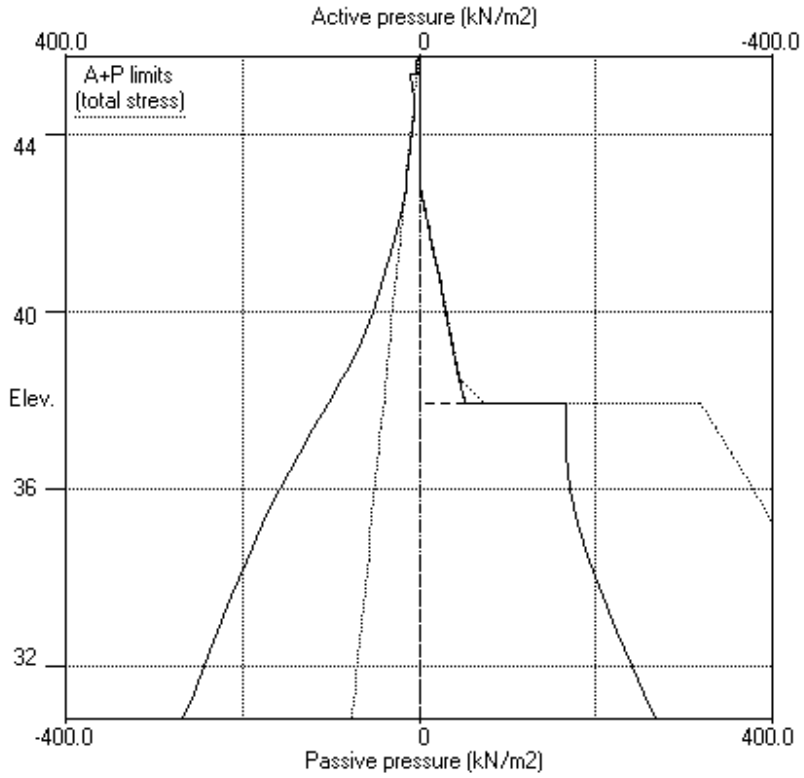
Units: kN,m

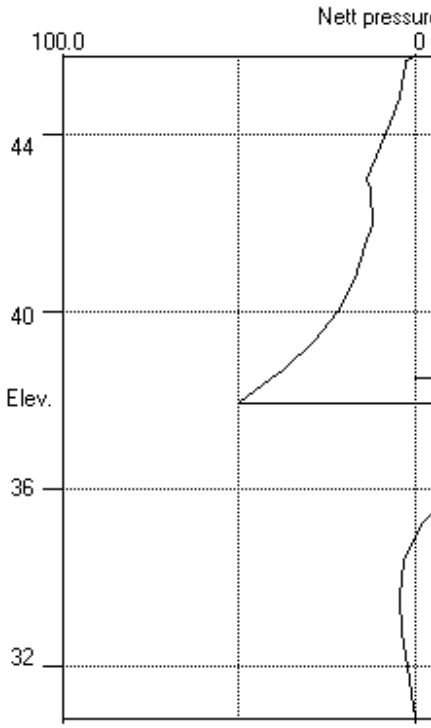
Stage No.10 Fill to elev. 38.50 on RIGHT side





Stage No.10 Fill to elev. 38.50 on RIGHT side





Units: kN,m

Stage No. 14 Change EI of wall to 290309 kN.m2/m run
From elevation 45.80 to 41.50
Yield moment not defined
No adjustments to wall displacements

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. = 30.80 Factor of Safety	Moment equilib. at elev.	Toe elev. for FoS = 1.000 Toe elev.	Wall Penetr -ation	Direction of failure
14	45.80	38.50		More than one strut. No FoS calc.				

BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall
Analysis options
Length of wall perpendicular to section = 15.00m
Subgrade reaction model - Boussinesq Influence coefficients
Soil deformations are elastic until the active or passive limit is reached
Open Tension Crack analysis - No

Rigid boundaries: Left side 30.00 from wall
Right side 30.00 from wall
Limit State: Serviceability Limit State
Calculated Bending Moments and Strut Forces are to be multiplied by a factor of 1.35 to obtain values for structural design. See summary for factored values.

*** Wall displacements reset to zero at stage 4

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	45.80	0.00	0.004	-1.35E-03	0.0	0.0		290309
2	45.69	2.93	0.004	-1.35E-03	0.2	-0.0		290309
3	45.60	2.88	0.004	-1.35E-03	0.4	0.0		290309
4	45.40	2.76	0.004	-1.35E-03	1.0	0.2	32.3	290309
		5.94	0.004	-1.35E-03	-31.3	0.2		
5	44.85	4.75	0.005	-1.30E-03	-28.3	-15.9		290309
6	44.50	6.50	0.006	-1.22E-03	-26.4	-25.5		290309
7	43.75	10.25	0.006	-9.72E-04	-20.1	-40.0		290309
8	43.00	14.00	0.007	-6.20E-04	-11.0	-52.5		290309
9	42.80	13.00	0.007	-5.14E-04	-8.3	-54.3		290309
10	42.00	9.00	0.007	-8.68E-05	0.5	-55.5		290309
11	41.50	6.50	0.007	1.73E-04	4.4	-54.0		290309
12	40.75	6.04	0.007	4.35E-04	9.1	-47.6		290309
13	40.00	14.73	0.007	7.63E-04	16.9	-38.6		290309
14	39.35	24.78	0.006	1.05E-03	29.7	-24.2		290309
15	38.70	37.37	0.005	1.27E-03	49.9	0.7	40.2	290309
		37.37	0.005	1.27E-03	9.8	0.7		
16	38.50	41.85	0.005	1.31E-03	17.7	3.4		93950
17	37.94	53.61	0.004	1.23E-03	44.4	20.0		93950
		-57.35	0.004	1.23E-03	44.4	20.0		
18	37.37	-38.31	0.004	1.05E-03	17.1	36.0		93950
19	36.80	-22.18	0.003	8.14E-04	-0.1	39.6		93950
20	36.00	-6.32	0.003	5.05E-04	-11.5	32.3		93950
21	35.20	2.12	0.002	2.79E-04	-13.2	21.1		93950
22	34.40	5.14	0.002	1.46E-04	-10.3	11.2		93950

(continued)

Stage No.14 Change EI of wall to 290309 kN.m2/m run
From elevation 45.80 to 41.50
Yield moment not defined
No adjustments to wall displacements

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
23	33.60	5.04	0.002	8.40E-05	-6.2	4.6		93950
24	32.80	3.55	0.002	6.36E-05	-2.8	1.2		93950
25	32.00	1.75	0.002	6.10E-05	-0.6	0.0		93950
26	31.40	0.50	0.002	6.20E-05	0.0	-0.1		93950
27	30.80	-0.64	0.002	6.25E-05	-0.0	0.0		---
At elev. 45.40 Strut force = 241.9 kN/strut = 32.3 kN/m run								
At elev. 38.70 Strut force = 40.2 kN/strut = 40.2 kN/m run								

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	45.80	0.00	0.00	0.00	0.00	0.00	0.00	1903
2	45.69	0.00	1.98	0.54	9.95	2.93	2.93	1903
3	45.60	0.00	3.60	0.98	18.09	2.88	2.88	1903
4	45.40	0.00	7.20	1.97	36.20	2.76	2.76	1903
		Total>	7.20	2.00m	212.88	5.94	5.94	9765
5	44.85	Total>	18.32	4.75m	224.00	4.75	4.75a	9765
6	44.50	Total>	25.69	6.50m	231.37	6.50	6.50a	9765
7	43.75	Total>	43.79	10.25m	249.47	10.25	10.25a	9765
8	43.00	Total>	62.99	14.00m	268.67	14.00	14.00a	9765
9	42.80	Total>	68.06	15.00m	273.74	15.00	15.00a	9765
10	42.00	Total>	87.69	19.00m	302.63	19.00	19.00a	10455
11	41.50	Total>	99.32	21.50m	320.04	21.50	21.50a	10886
12	40.75	Total>	115.95	25.25m	345.35	28.54	28.54	11532
13	40.00	Total>	131.85	29.00m	369.93	44.73	44.73	12178
14	39.35	Total>	145.24	32.25m	390.84	61.28	61.28	12738
15	38.70	Total>	158.40	35.50m	411.51	80.37	80.37	24582
16	38.50	Total>	162.41	36.50m	417.84	86.85	86.85	24901
17	37.94	Total>	173.59	39.30m	435.50	105.43	105.43	25793
18	37.37	Total>	184.91	42.15m	453.41	123.51	123.51	26701
19	36.80	Total>	196.18	45.00m	471.27	140.22	140.22	27609
20	36.00	Total>	211.95	49.00m	496.30	161.11	161.11	28883
21	35.20	Total>	227.69	53.00m	521.30	179.44	179.44	30157
22	34.40	Total>	243.41	57.00m	546.28	196.07	196.07	31431
23	33.60	Total>	259.13	61.00m	571.25	211.82	211.82	32706
24	32.80	Total>	274.85	65.00m	596.23	227.25	227.25	33980
25	32.00	Total>	290.57	69.00m	621.20	242.70	242.70	35254
26	31.40	Total>	302.37	72.00m	639.94	254.38	254.38	36210
27	30.80	Total>	314.16	75.00m	658.68	266.14	266.14	37166

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	45.80	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	45.69	0.00	0.00	0.00	0.00	0.00	0.00	0.0
3	45.60	0.00	0.00	0.00	0.00	0.00	0.00	0.0
4	45.40	0.00	0.00	0.00	0.00	0.00	0.00	0.0
5	44.85	0.00	0.00	0.00	0.00	0.00	0.00	0.0
6	44.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0

(continued)

Stage No.14 Change EI of wall to 290309 kN.m2/m run
From elevation 45.80 to 41.50
Yield moment not defined
No adjustments to wall displacements

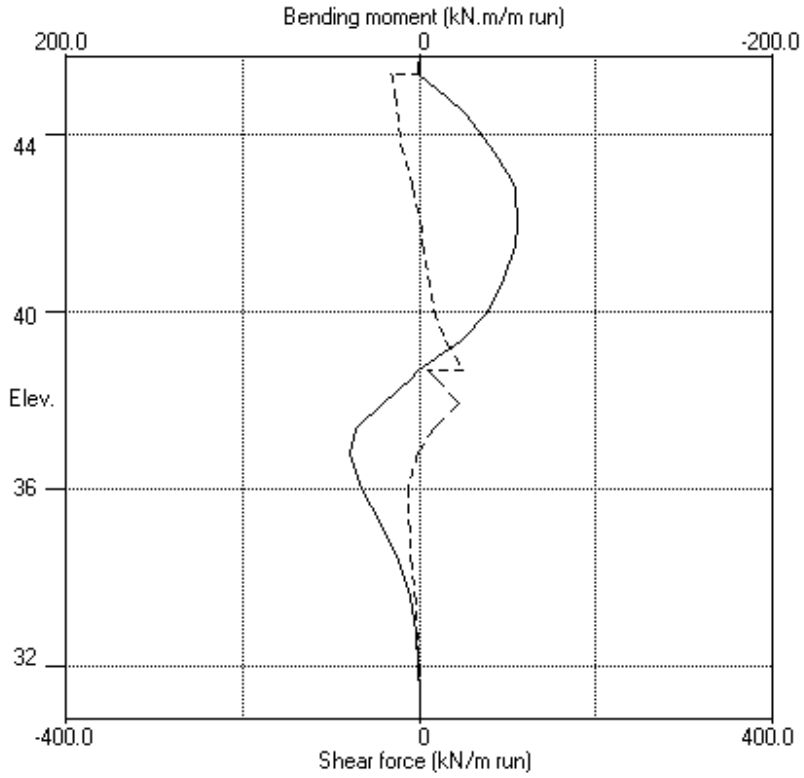
Node no.	Y coord	RIGHT side Water press. kN/m2	Effective stresses Vertic -al kN/m2	Active limit kN/m2	Passive limit kN/m2	Earth pressure kN/m2	Total earth pressure kN/m2	Coeff. of subgrade reaction kN/m3
7	43.75	0.00	0.00	0.00	0.00	0.00	0.00	0.0
8	43.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
9	42.80	2.00	0.00	0.00	0.00	0.00	2.00	0.0
10	42.00	10.00	0.00	0.00	0.00	0.00	10.00	0.0
11	41.50	15.00	0.00	0.00	0.00	0.00	15.00	0.0
12	40.75	22.50	0.00	0.00	0.00	0.00	22.50	0.0
13	40.00	30.00	0.00	0.00	0.00	0.00	30.00	0.0
14	39.35	36.50	0.00	0.00	0.00	0.00	36.50	0.0
15	38.70	43.00	0.00	0.00	0.00	0.00	43.00	0.0
16	38.50	45.00	0.00	0.00	0.00	0.00	45.00	0.0
		45.00	0.00	0.00	0.00	0.00	45.00	3551
17	37.94	50.60	4.48	1.22	22.52	1.22	51.82a	3551
		Total> 55.08	25.30m	316.99	162.78	162.78		25793
18	37.37	Total> 66.49	28.15m	334.99	161.81	161.81		26701
19	36.80	Total> 77.91	31.00m	353.00	162.40	162.40		27609
20	36.00	Total> 93.96	35.00m	378.31	167.42	167.42		28883
21	35.20	Total> 110.06	39.00m	403.67	177.32	177.32		30157
22	34.40	Total> 126.23	43.00m	429.09	190.93	190.93		31431
23	33.60	Total> 142.46	47.00m	454.58	206.78	206.78		32706
24	32.80	Total> 158.78	51.00m	480.15	223.70	223.70		33980
25	32.00	Total> 175.17	55.00m	505.80	240.94	240.94		35254
26	31.40	Total> 187.53	58.00m	525.10	253.88	253.88		36210
27	30.80	Total> 199.93	61.00m	544.45	266.79	266.79		37166

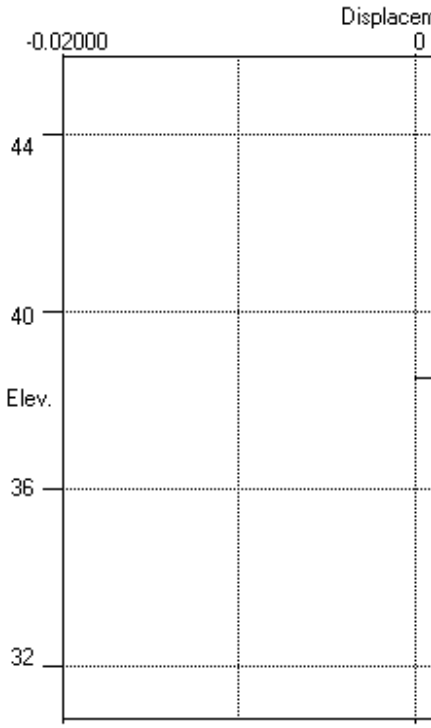
Note: 51.82a Soil pressure at active limit
123.45p Soil pressure at passive limit

KNIGHT BUILD LTD | Sheet No.
Program: WALLAP Version 6.06 Revision A49.B68.R53 | Job No. 79AR
Licensed from GEOSOLVE | Made by : JRC
Data filename/Run ID: SECTION_2-2_SLS |
79 Avenue Road | Date:28-06-2021
SECTION 2-2 ANALYSIS | Checked :

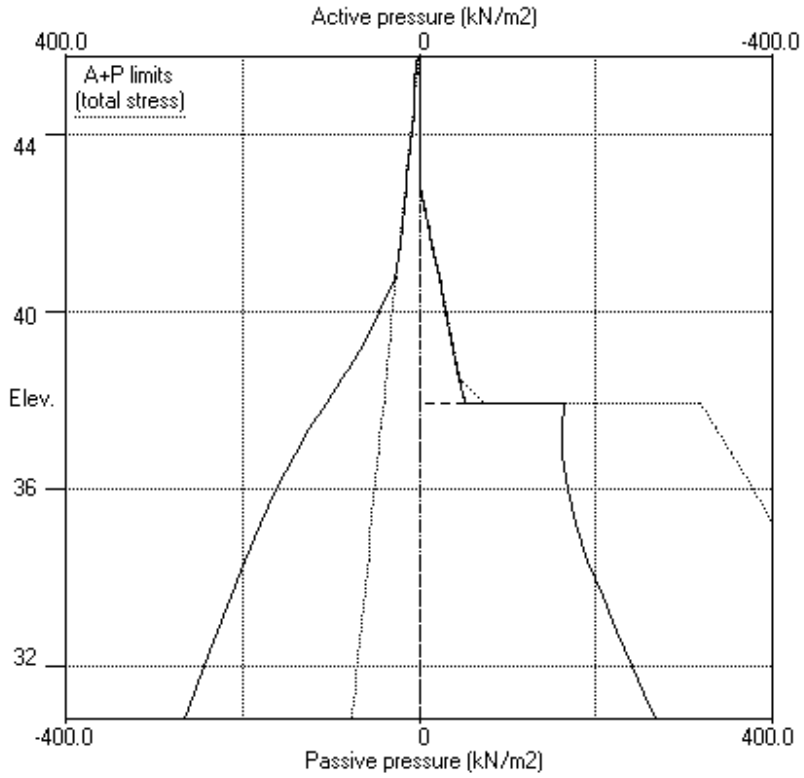
Units: kN,m

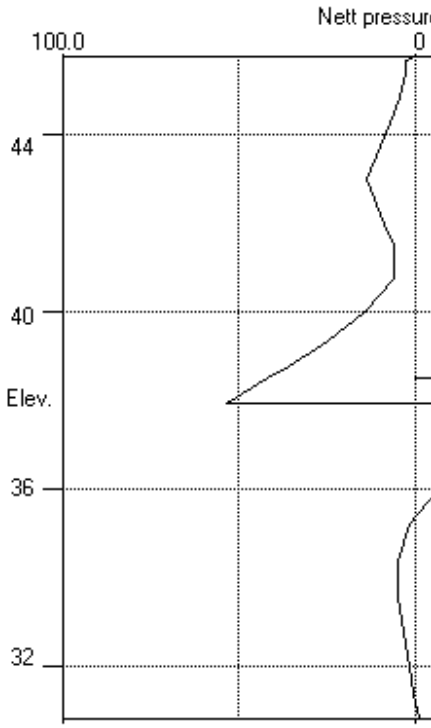
Stage No.14 Change EI of wall to 290309kN.m2/m run





Stage No.14 Change EI of wall to 290309kN.m2/m run





Units: kN,m

Stage No. 21 Change EI of wall to 145154 kN.m2/m run
From elevation 45.80 to 38.50
Yield moment not defined
No adjustments to wall displacements

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. = 30.80 Factor of Safety	Moment equilib. at elev.	Toe elev. for FoS = 1.000	Wall Penetr -ation	Direction of failure
21	45.80	38.50		More than one strut. No FoS calc.				

BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall
Analysis options
Length of wall perpendicular to section = 15.00m
Subgrade reaction model - Boussinesq Influence coefficients
Soil deformations are elastic until the active or passive limit is reached
Open Tension Crack analysis - No

Rigid boundaries: Left side 30.00 from wall
Right side 30.00 from wall
Limit State: Serviceability Limit State
Calculated Bending Moments and Strut Forces are to be multiplied by a factor of 1.35 to obtain values for structural design. See summary for factored values.

*** Wall displacements reset to zero at stage 4

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	45.80	0.00	0.004	-2.58E-03	0.0	0.0		145154
2	45.69	2.70	0.004	-2.58E-03	0.1	-0.0	60.4	145154
		2.70	0.004	-2.58E-03	-60.2	-0.0		
3	45.60	2.45	0.004	-2.58E-03	-60.0	-5.4		145154
4	45.40	1.97	0.005	-2.57E-03	-59.6	-17.4		145154
		1.55	0.005	-2.57E-03	-59.6	-17.4		
5	44.85	0.00	0.006	-2.45E-03	-59.1	-49.9		145154
6	44.50	3.05	0.007	-2.29E-03	-58.6	-70.5		145154
7	43.75	15.24	0.009	-1.78E-03	-51.8	-109.4		145154
8	43.00	27.84	0.010	-1.07E-03	-35.6	-143.4		145154
9	42.80	31.19	0.010	-8.50E-04	-29.7	-149.8		145154
10	42.00	44.31	0.010	6.40E-05	0.5	-160.5		145154
11	41.50	52.26	0.010	6.36E-04	24.6	-154.2		145154
12	40.75	63.88	0.009	1.29E-03	68.2	-118.3		145154
13	40.00	75.21	0.008	1.82E-03	120.4	-48.5		145154
14	39.35	84.88	0.007	2.02E-03	172.4	45.9		145154
15	38.70	94.45	0.006	1.83E-03	230.7	175.9	392.8	145154
		94.45	0.006	1.83E-03	-162.2	175.9		
16	38.50	97.39	0.005	1.71E-03	-143.0	145.4		46965
17	37.94	103.99	0.005	7.21E-04	-86.6	80.4		46965
		71.15	0.005	7.21E-04	-86.6	80.4		
18	37.37	49.73	0.004	2.48E-04	-52.2	41.3		46965
19	36.80	34.45	0.004	9.13E-05	-28.2	18.4		46965
20	36.00	11.82	0.004	7.80E-05	-9.7	4.0		46965
21	35.20	3.34	0.004	1.19E-04	-3.6	-0.4		46965

(continued)

Stage No.21 Change EI of wall to 145154 kN.m2/m run
From elevation 45.80 to 38.50
Yield moment not defined
No adjustments to wall displacements

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
22	34.40	2.67	0.004	1.49E-04	-1.2	-2.3		46965
23	33.60	1.51	0.004	1.68E-04	0.5	-2.5		46965
24	32.80	0.32	0.004	1.79E-04	1.2	-1.7		46965
25	32.00	-0.58	0.004	1.84E-04	1.1	-0.7		46965
26	31.40	-0.97	0.004	1.85E-04	0.6	-0.2		46965
27	30.80	-1.17	0.003	1.85E-04	-0.0	0.0		---
At elev. 45.69 Strut force =			60.4 kN/strut =			60.4 kN/m run		
At elev. 38.70 Strut force =			392.8 kN/strut =			392.8 kN/m run		

Node no.	Y coord	LEFT side ------- Effective stresses ------- Water press. kN/m2	Vertic -al kN/m2	Active limit kN/m2	Passive limit kN/m2	Earth pressure kN/m2	Total earth pressure kN/m2	Coeff. of subgrade reaction kN/m3
1	45.80	0.00	0.00	0.00	0.00	0.00	0.00	92853
2	45.69	0.00	1.98	0.54	9.95	2.70	2.70	1870
3	45.60	0.00	3.60	0.98	18.09	2.45	2.45	1870
4	45.40	0.00	7.20	1.97	36.20	1.97	1.97a	1870
		0.00	7.20	0.00	46.91	1.55	1.55	9170
5	44.85	0.00	19.42	0.00	83.89	0.00	0.00a	9170
6	44.50	0.00	27.49	3.05	108.35	3.05	3.05a	9170
7	43.75	7.50	39.59	7.74	144.97	7.74	15.24a	9170
8	43.00	15.00	52.79	12.84	184.95	12.84	27.84a	9170
9	42.80	17.00	56.26	14.19	195.46	14.19	31.19a	9170
		17.00	56.26	14.19	195.46	14.19	31.19a	8630
10	42.00	25.00	69.49	19.31	235.51	19.31	44.31a	9019
11	41.50	30.00	77.12	22.26	258.63	22.26	52.26a	9261
12	40.75	37.50	87.75	26.38	290.82	26.38	63.88a	9626
13	40.00	45.00	97.65	30.21	320.80	30.21	75.21a	9990
14	39.35	51.50	105.84	33.38	345.59	33.38	84.88a	10305
15	38.70	58.00	113.80	36.45	369.68	36.45	94.45a	10621
16	38.50	60.00	116.21	37.39	376.99	37.39	97.39a	10718
17	37.94	65.60	122.91	39.98	397.28	45.22	110.82	74039
18	37.37	71.30	129.67	42.60	417.73	49.14	120.44	12146
19	36.80	77.00	136.38	45.19	438.05	54.65	131.65	12444
20	36.00	85.00	145.75	48.82	466.42	61.33	146.33	12863
21	35.20	93.00	155.09	52.43	494.71	68.12	161.12	13282
22	34.40	101.00	164.41	56.04	522.94	75.34	176.34	13700
23	33.60	109.00	173.73	59.65	551.16	83.01	192.01	14119
24	32.80	117.00	183.05	63.26	579.38	91.06	208.06	14538
25	32.00	125.00	192.37	66.86	607.60	99.44	224.44	14956
26	31.40	131.00	199.37	69.57	628.78	105.93	236.93	15270
27	30.80	137.00	206.36	72.28	649.96	112.55	249.55	15584

Node no.	Y coord	RIGHT side ------- Effective stresses ------- Water press. kN/m2	Vertic -al kN/m2	Active limit kN/m2	Passive limit kN/m2	Earth pressure kN/m2	Total earth pressure kN/m2	Coeff. of subgrade reaction kN/m3
1	45.80	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	45.69	0.00	0.00	0.00	0.00	0.00	0.00	0.0
3	45.60	0.00	0.00	0.00	0.00	0.00	0.00	0.0
4	45.40	0.00	0.00	0.00	0.00	0.00	0.00	0.0

(continued)

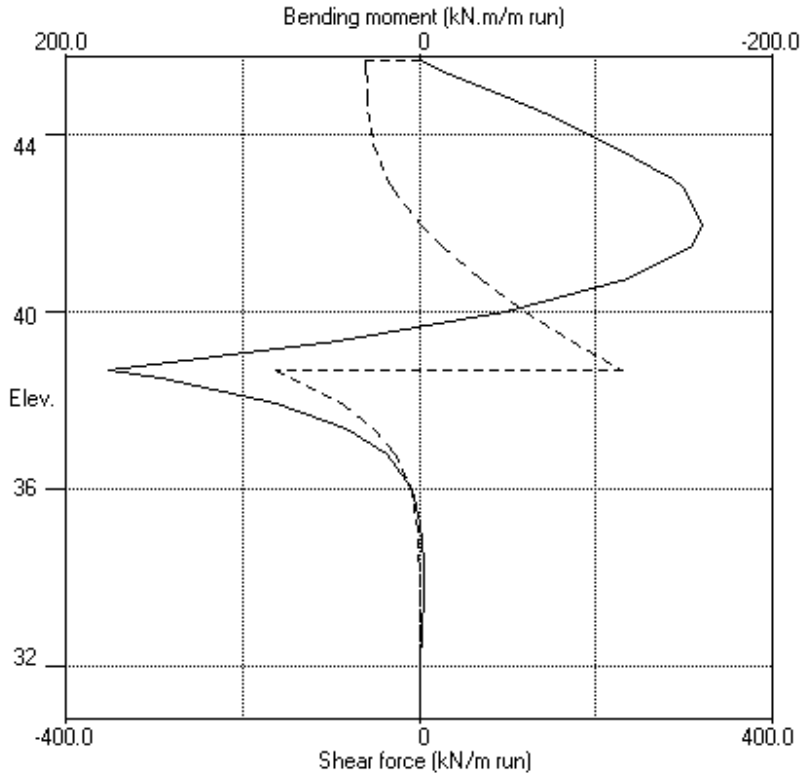
Stage No.21 Change EI of wall to 145154 kN.m2/m run
From elevation 45.80 to 38.50
Yield moment not defined
No adjustments to wall displacements

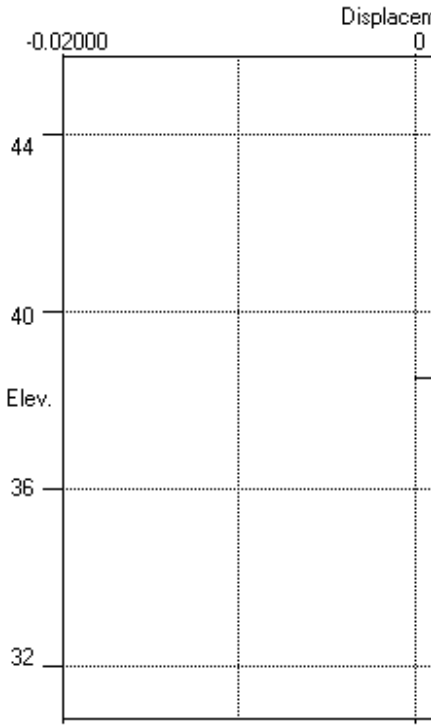
Node no.	Y coord	RIGHT side Water press. kN/m2	Effective stresses Vertic -al kN/m2	Active limit kN/m2	Passive limit kN/m2	Earth pressure kN/m2	Total earth pressure kN/m2	Coeff. of subgrade reaction kN/m3
5	44.85	0.00	0.00	0.00	0.00	0.00	0.00	0.0
6	44.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
7	43.75	0.00	0.00	0.00	0.00	0.00	0.00	0.0
8	43.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
9	42.80	0.00	0.00	0.00	0.00	0.00	0.00	0.0
10	42.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
11	41.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
12	40.75	0.00	0.00	0.00	0.00	0.00	0.00	0.0
13	40.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
14	39.35	0.00	0.00	0.00	0.00	0.00	0.00	0.0
15	38.70	0.00	0.00	0.00	0.00	0.00	0.00	0.0
16	38.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
		0.00	0.00	0.00	0.00	0.00	0.00	31953
17	37.94	5.60	4.48	1.22	22.52	1.22	6.82a	12598
		5.60	4.48	0.00	38.67	34.07	39.67	74039
18	37.37	11.30	11.33	0.00	59.41	59.41	70.71p	12146
19	36.80	17.00	18.20	0.00	80.20	80.20	97.20p	12444
20	36.00	25.00	27.88	3.20	109.52	109.52	134.52p	12863
21	35.20	33.00	37.63	6.98	139.04	124.78	157.78	13282
22	34.40	41.00	47.47	10.78	168.82	132.67	173.67	13700
23	33.60	49.00	57.40	14.63	198.92	141.50	190.50	14119
24	32.80	57.00	67.46	18.52	229.36	150.74	207.74	14538
25	32.00	65.00	77.63	22.46	260.18	160.02	225.02	14956
26	31.40	71.00	85.35	25.45	283.54	166.90	237.90	15270
27	30.80	77.00	93.14	28.46	307.12	173.73	250.73	15584

Note: 6.82a Soil pressure at active limit
134.52p Soil pressure at passive limit

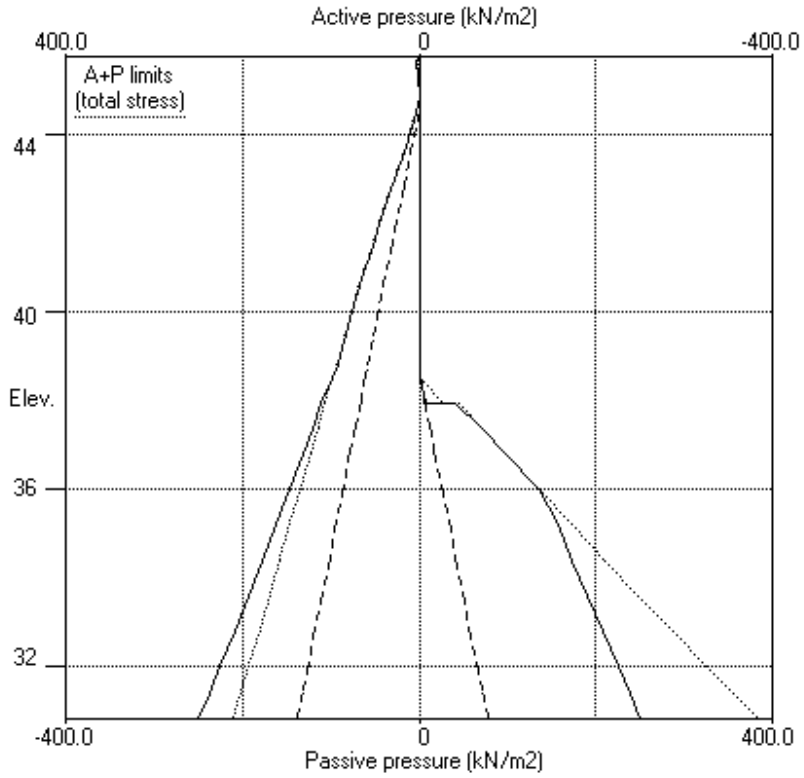
Units: kN,m

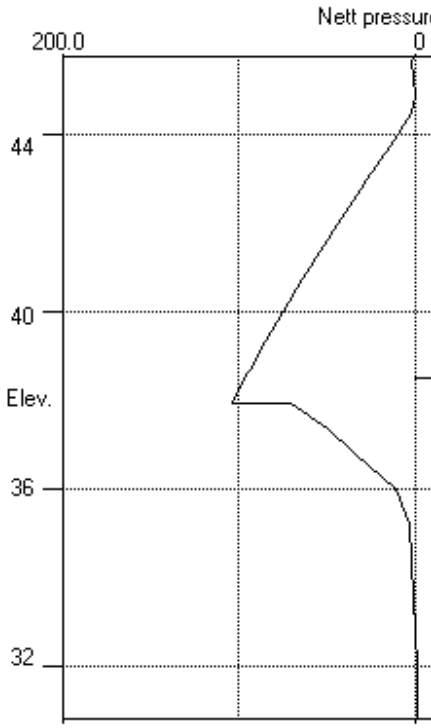
Stage No.21 Change EI of wall to 145154kN.m2/m run





Stage No.21 Change EI of wall to 145154kN.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. = 30.80: Factor of Safety	Moment equilib. at elev.	Toe elev. for FoS = 1.000	Wall Penetr-ation	Direction of failure
1	45.80	45.80	Cant.	Conditions not suitable for FoS calc.				
2	45.80	45.80		No analysis at this stage				
3	45.80	45.80	Cant.	Conditions not suitable for FoS calc.				
4	45.80	45.80		No analysis at this stage				
5	45.80	43.75	Cant.	8.619	31.39	43.59	0.16	L to R
6	45.80	43.75		No analysis at this stage				
7	45.80	41.50	45.40	6.725	n/a	41.42	0.08	L to R
8	45.80	41.50		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 = 15.00m
Subgrade reaction model - Boussinesq Influence coefficients
Soil deformations are elastic until the active or passive limit is reached
Open Tension Crack analysis - No

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

Limit State: Serviceability Limit State

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

Bending moment, shear force and displacement envelopes

Node no.	Y coord	Displacement		Bending moment 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	45.80	0.004	0.000	0	-0	0	-0	0	0	0	0
2	45.69	0.004	0.000	0	-0	0	-0	0	-60	0	-81
3	45.60	0.004	0.000	0	-5	0	-7	0	-60	1	-81
4	45.40	0.005	0.000	0	-17	0	-23	1	-60	2	-80
5	44.85	0.006	0.000	1	-50	1	-67	2	-59	3	-80
6	44.50	0.007	0.000	2	-71	3	-95	4	-59	6	-79
7	43.75	0.009	0.000	10	-109	14	-148	11	-52	14	-70
8	43.00	0.010	0.000	13	-143	17	-194	4	-36	5	-48
9	42.80	0.010	0.000	13	-150	17	-202	7	-30	9	-40
10	42.00	0.010	0.000	9	-161	12	-217	17	-40	23	-54
11	41.50	0.010	0.000	6	-154	9	-208	33	-34	45	-45
12	40.75	0.009	0.000	3	-118	4	-160	68	-22	92	-29
13	40.00	0.008	0.000	9	-55	12	-74	120	-7	162	-9
14	39.35	0.007	0.000	46	-54	62	-73	172	-1	233	-2
15	38.70	0.006	0.000	176	-41	238	-56	231	-162	311	-219
16	38.50	0.005	0.000	145	-34	196	-46	39	-143	53	-193
17	37.94	0.005	0.000	80	-6	108	-9	65	-87	88	-117
18	37.37	0.004	0.000	41	-1	56	-2	33	-52	45	-70
19	36.80	0.004	0.000	40	-1	54	-1	12	-28	16	-38
20	36.00	0.004	0.000	32	0	44	0	1	-16	1	-22
21	35.20	0.004	0.000	24	-0	32	-1	1	-13	1	-18
22	34.40	0.004	0.000	14	-2	19	-3	0	-10	0	-14
23	33.60	0.004	0.000	7	-4	9	-5	0	-7	1	-10
24	32.80	0.004	0.000	2	-3	3	-4	2	-4	2	-5
25	32.00	0.004	0.000	0	-1	1	-2	2	-1	2	-2
26	31.40	0.004	0.000	0	-0	0	-0	1	-0	2	-0
27	30.80	0.003	0.000	0	-0	0	-0	0	-0	0	-0

Summary of results (continued)

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

Maximum and minimum bending moment and shear force at each stage

Stage	Bending moment						Shear force					
no.	Calculated				Factored		Calculated				Factored	
	max.	elev.	min.	elev.	max.	min.	max.	elev.	min.	elev.	max.	min.
	kN.m/m		kN.m/m		kN.m/m		kN/m		kN/m		kN/m	kN/m
1	0	36.80	-1	42.80	0	-1	0	40.75	-1	43.75	1	-1
2	No calculation at this stage											
3	1	34.40	-6	40.75	1	-9	2	38.70	-3	43.00	2	-4
4	No calculation at this stage											
5	13	43.00	-2	38.50	17	-2	11	43.75	-6	41.50	14	-7
6	No calculation at this stage											
7	11	39.35	-36	42.80	15	-49	33	41.50	-23	45.40	45	-31
8	No calculation at this stage											
9	31	36.80	-54	40.00	42	-72	63	37.94	-40	42.00	86	-54
10	32	36.80	-55	40.00	44	-74	65	37.94	-40	42.00	88	-54
11	No calculation at this stage											
12	No calculation at this stage											
13	40	36.80	-55	42.00	53	-75	50	38.70	-31	45.40	67	-42
14	40	36.80	-55	42.00	53	-75	50	38.70	-31	45.40	67	-42
15	No calculation at this stage											
16	40	36.80	-58	42.80	54	-79	51	38.70	-30	45.69	69	-41
17	86	38.70	-80	42.00	116	-108	134	38.70	-79	38.70	181	-106
18	No calculation at this stage											
19	No calculation at this stage											
20	No calculation at this stage											
21	176	38.70	-161	42.00	238	-217	231	38.70	-162	38.70	311	-219

Maximum and minimum displacement at each stage

Stage	Displacement				Stage description
no.	maximum	elev.	minimum	elev.	
	m		m		
1	0.000	41.50	0.000	45.80	Apply surcharge no.1 at elev. 44.85
2	No calculation at this stage				Apply surcharge no.2 at elev. 44.85
3	0.001	39.35	-0.000	45.80	Apply surcharge no.3 at elev. 45.60
4	Wall displacements reset to zero				Change EI of wall to 93950kN.m2/m run
5	0.004	45.80	0.000	45.80	Excav. to elev. 43.75 on RIGHT side
6	No calculation at this stage				Install strut no.4 at elev. 45.40
7	0.005	43.75	0.000	45.80	Excav. to elev. 41.50 on RIGHT side
8	No calculation at this stage				Install strut no.5 at elev. 42.00
9	0.006	40.75	0.000	45.80	Excav. to elev. 37.94 on RIGHT side
10	0.006	40.75	0.000	45.80	Fill to elev. 38.50 on RIGHT side
11	No calculation at this stage				Install strut no.3 at elev. 38.70
12	No calculation at this stage				Change EI of wall to 290309kN.m2/m run
13	0.007	42.00	0.000	45.80	Remove strut no.5 at elev. 42.00
14	0.007	42.00	0.000	45.80	Change EI of wall to 290309kN.m2/m run
15	No calculation at this stage				Install strut no.1 at elev. 45.69
16	0.008	42.00	0.000	45.80	Remove strut no.4 at elev. 45.40
17	0.008	42.00	0.000	45.80	Apply water pressure profile no.1
18	No calculation at this stage				Change soil type 2 to soil type 4
19	No calculation at this stage				Change soil type 3 to soil type 5
20	No calculation at this stage				Change EI of wall to 46965kN.m2/m run
21	0.010	42.00	0.000	45.80	Change EI of wall to 145154kN.m2/m run

Summary of results (continued)

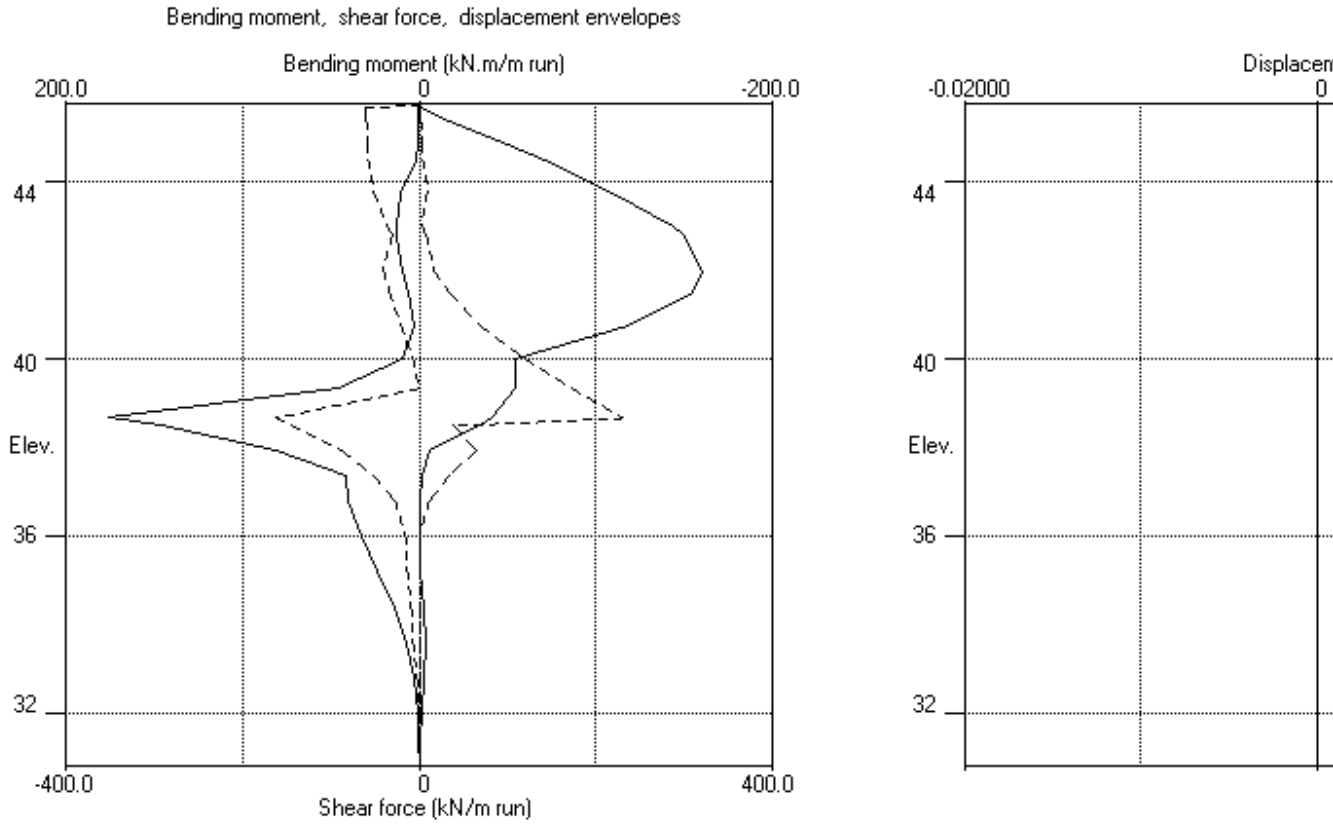
Calculated Bending Moments and Strut Forces have been multiplied by a factor of 1.35 to obtain values for structural design.

Strut forces at each stage (horizontal components)

Stage no.	Strut no. 1 at elev. 45.69			Strut no. 3 at elev. 38.70			Strut no. 4 at elev. 45.40		
	--Calculated-- kN per m run	kN per strut	Factored kN per strut	--Calculated-- kN per m run	kN per strut	Factored kN per strut	--Calculated-- kN per m run	kN per strut	Factored kN per strut
7	---	---	---	---	---	---	24	178	240
9	---	---	---	---	---	---	18	137	185
10	---	---	---	---	---	---	18	139	187
13	---	---	---	40	40	54	32	242	327
14	---	---	---	40	40	54	32	242	327
16	30	30	41	42	42	57	---	---	---
17	37	37	49	212	212	287	---	---	---
21	60	60	82	393	393	530	---	---	---

Stage no.	Strut no. 5 at elev. 42.00 --Calculated-- kN per m run	kN per strut	Factored kN per strut
9	57	426	576
10	57	426	575

Units: kN,m


Bending moment, shear force, displacement envelopes
Bending moment (kN.m/m run)
200.0
0
-200.0
44
40
Elev.
36
32
-400.0
0
400.0
Shear force (kN/m run)
-0.02000
0
Displacem

SECTION 2-2 ULS - COMBINATION 1

KNIGHT BUILD LTD | Sheet No.
Program: WALLAP Version 6.06 Revision A49.B68.R53 | Job No. 79AR
Licensed from GEOSOLVE | Made by : JRC
Data filename/Run ID: SECTION_2-2_ULS1 |
79 Avenue Road | Date:28-06-2021
SECTION 2-2 ANALYSIS | Checked :

Units: kN,m

INPUT DATA

SOIL PROFILE

Stratum no.	Elevation of top of stratum	Soil types Left side	Right side
1	45.80	1 Made Ground	1 Made Ground
2	45.40	2 Head	2 Head
3	42.80	3 London Clay	3 London Clay

SOIL PROPERTIES (Unfactored SLS soil strengths)

No.	Soil type -- Description (Datum elev.)	Bulk density kN/m3	Young's Modulus Eh,kN/m2 (dEh/dy)	At rest coeff. Ko (dKo/dy)	Consol state. NC/OC (Nu)	Active limit Ka (Kac)	Passive limit Kp (Kpc)	Cohesion kN/m2 (dc/dy)
1	Made Ground	18.00	13000	0.500	OC (0.200)	0.273 (0.000)	5.026 (0.000)	
2	Head	20.00	51000	1.000	OC (0.490)	1.000 (2.570)	1.000 (2.571)	80.00u
3	London Clay (42.80)	20.00	51000 (4500)	1.000	OC (0.490)	1.000 (2.570)	1.000 (2.571)	80.00u (4.500)
4	Head (drained)	22.00	63750	0.625	OC (0.200)	0.387 (1.517)	3.028 (5.020)	5.000d
5	LC Drained (42.80)	22.00	60000 (3375)	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	Made Ground	30.00	1.000	0.00	30.00	1.000	0.00
2	Head	0.00	1.000	0.00	0.00	0.995	0.00
3	London Clay	0.00	1.000	0.00	0.00	0.995	0.00
4	Head (drained)	22.01	1.000	0.00	22.00	1.000	0.00
5	LC Drained	22.01	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	43.00	43.00

Automatic water pressure balancing at toe of wall : No

Water press. profile no.	Left side Point no.	Elev. m	Piezo elev. m	Water press. kN/m2	Right side Point no.	Elev. m	Piezo elev. m	Water press. kN/m2	
1	1	44.50	44.50	0.0	1	38.50	38.50	0.0	MC+WC

WALL PROPERTIES

Type of structure = Fully Embedded Wall
Elevation of toe of wall = 30.80
Maximum finite element length = 0.80 m
Youngs modulus of wall E = 2.8000E+07 kN/m2
Moment of inertia of wall I = 3.3547E-03 m4/m run
E.I = 93931 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	45.69	1.00	0.250000	2.800E+07	15.00	0.00	0	No
2	41.40	1.00	0.250000	2.800E+07	10.00	0.00	0	No
3	38.70	1.00	0.450000	2.800E+07	10.00	0.00	0	No
4	45.40	7.50	0.016400	2.050E+08	10.00	0.00	0	No
5	42.00	7.50	0.016400	2.050E+08	10.00	30.00	0	No

SURCHARGE LOADS

Surch -arge no.	Elev.	Distance from wall	Length parallel to wall	Width perpend. to wall	Surcharge kN/m2 Near edge	Surcharge kN/m2 Far edge	Equiv. soil type	Partial factor/ Category
1	44.85	1.00(L)	1000.00	0.60	10.00	=	N/A	1.00 -
2	44.85	2.60(L)	1000.00	0.80	85.00	=	N/A	1.00 -
3	45.60	2.60(L)	1000.00	20.00	12.50	=	N/A	1.00 -

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 44.85
	No analysis at this stage
2	Apply surcharge no.2 at elevation 44.85
	No analysis at this stage
3	Apply surcharge no.3 at elevation 45.60
4	Change EI of wall to 93950 kN.m2/m run
	Yield moment not defined
	Reset wall displacements to zero at this stage
5	Excavate to elevation 43.75 on RIGHT side
6	Install strut or anchor no.4 at elevation 45.40
7	Excavate to elevation 41.50 on RIGHT side
8	Install strut or anchor no.5 at elevation 42.00
9	Excavate to elevation 37.94 on RIGHT side
10	Fill to elevation 38.50 on RIGHT side with soil type 1
11	Install strut or anchor no.3 at elevation 38.70
12	Change EI of wall to 290309 kN.m2/m run
	From elevation 41.50 to 38.50
	Yield moment not defined
	No adjustments to wall displacements
13	Remove strut or anchor no.5 at elevation 42.00
14	Change EI of wall to 290309 kN.m2/m run
	From elevation 45.80 to 41.50
	Yield moment not defined
	No adjustments to wall displacements
15	Install strut or anchor no.1 at elevation 45.69
16	Remove strut or anchor no.4 at elevation 45.40
17	Apply water pressure profile no.1 (Mod. Conserv.)
18	Change properties of soil type 2 to soil type 4
	No analysis at this stage
	Ko pressures will not be reset
19	Change properties of soil type 3 to soil type 5
	No analysis at this stage
	Ko pressures will not be reset
20	Change EI of wall to 46965 kN.m2/m run
	From elevation 38.50 to 30.80
	Yield moment not defined
	No adjustments to wall displacements
21	Change EI of wall to 145154 kN.m2/m run
	From elevation 45.80 to 38.50
	Yield moment not defined
	No adjustments to wall displacements

FACTORS OF SAFETY and ANALYSIS OPTIONS

Limit State options: ULS DA1 Combination 1
Water pressures : Moderately Conservative
Partial factor on C' = 1.000
Partial factor on Phi' = 1.000
Partial factor on Cu = 1.000
Partial factor on Soil Modulus = 1.000
Partial factor on Permanent Unfavourable loads = 1.000
Partial factor on Permanent Favourable loads = 1.000
Partial factor on Variable Unfavourable loads = 1.100
Design factor on calculated Bending Moments = 1.350

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

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

Boundary conditions:
Length of wall (normal to plane of analysis) = 15.00 m

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

Distance to rigid boundary on Left side = 30.00 m
Distance to rigid boundary on Right side = 30.00 m

OUTPUT OPTIONS

Stage no.	Stage description	Output options: Displacement, Bending mom., Shear force	Active, Passive pressures	Graph. output
1	Apply surcharge no.1 at elev. 44.85	Yes	Yes	Yes
2	Apply surcharge no.2 at elev. 44.85	No	No	No
3	Apply surcharge no.3 at elev. 45.60	Yes	Yes	Yes
4	Change EI of wall to 93950kN.m2/m run	No	No	No
5	Excav. to elev. 43.75 on RIGHT side	Yes	Yes	Yes
6	Install strut no.4 at elev. 45.40	No	No	No
7	Excav. to elev. 41.50 on RIGHT side	Yes	Yes	Yes
8	Install strut no.5 at elev. 42.00	No	No	No
9	Excav. to elev. 37.94 on RIGHT side	No	No	No
10	Fill to elev. 38.50 on RIGHT side	No	No	No
11	Install strut no.3 at elev. 38.70	Yes	Yes	Yes
12	Change EI of wall to 290309kN.m2/m run	No	No	No
13	Remove strut no.5 at elev. 42.00	No	No	No
14	Change EI of wall to 290309kN.m2/m run	No	No	No
15	Install strut no.1 at elev. 45.69	No	No	No
16	Remove strut no.4 at elev. 45.40	No	No	No
17	Apply water pressure profile no.1	Yes	Yes	Yes
18	Change soil type 2 to soil type 4	No	No	No
19	Change soil type 3 to soil type 5	No	No	No
20	Change EI of wall to 46965kN.m2/m run	No	No	No
21	Change EI of wall to 145154kN.m2/m run	Yes	Yes	Yes
*	Summary output	Yes	-	Yes

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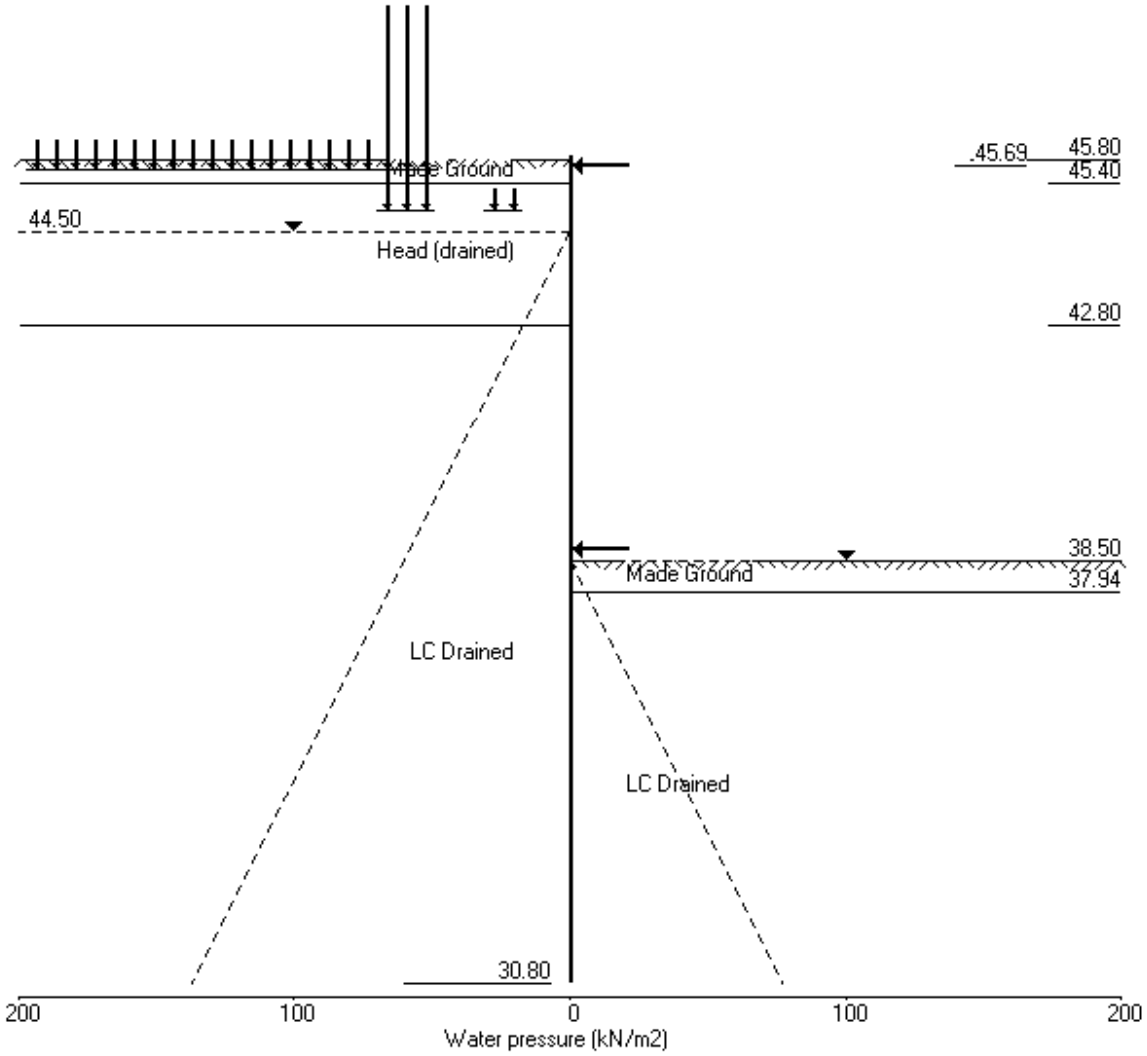
Units: kN,m

Stage No.21 Change EI of wall to 145154kN.m2/m run



Units: kN,m

Stage No. 5 Excavate to elevation 43.75 on RIGHT side

BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall

Analysis options

Length of wall perpendicular to section = 15.00m
Subgrade reaction model - Boussinesq Influence coefficients
Soil deformations are elastic until the active or passive limit is reached
Open Tension Crack analysis - No

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

Limit State: ULS DA1 Combination 1

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

*** Wall displacements reset to zero at stage 4

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	45.80	0.00	0.004	6.78E-04	0.0	0.0		93950
2	45.69	0.54	0.004	6.78E-04	0.0	-0.0		93950
3	45.60	0.98	0.004	6.78E-04	0.1	0.0		93950
4	45.40	1.97	0.004	6.78E-04	0.4	0.1		93950
		2.00	0.004	6.78E-04	0.4	0.1		
5	44.85	4.75	0.003	6.76E-04	2.2	0.8		93950
6	44.50	6.50	0.003	6.72E-04	4.2	1.9		93950
7	43.75	10.34	0.003	6.19E-04	10.5	10.4		93950
		-20.32	0.003	6.19E-04	10.5	10.4		
8	43.00	-9.22	0.002	5.08E-04	-0.5	12.9		93950
9	42.80	-6.59	0.002	4.74E-04	-2.1	12.6		93950
10	42.00	-1.40	0.002	3.41E-04	-5.3	9.2		93950
11	41.50	0.62	0.002	2.68E-04	-5.5	6.4		93950
12	40.75	2.14	0.001	1.81E-04	-4.5	2.6		93950
13	40.00	2.37	0.001	1.22E-04	-2.8	-0.1		93950
14	39.35	2.00	0.001	9.13E-05	-1.4	-1.3		93950
15	38.70	1.42	0.001	7.33E-05	-0.3	-1.8		93950
16	38.50	1.23	0.001	6.98E-05	0.0	-1.8		93950
17	37.94	0.72	0.001	6.36E-05	0.6	-1.6		93950
18	37.37	0.30	0.001	6.08E-05	0.8	-1.2		93950
19	36.80	-0.02	0.001	6.01E-05	0.9	-0.7		93950
20	36.00	-0.28	0.001	6.00E-05	0.8	0.0		93950
21	35.20	-0.38	0.001	5.96E-05	0.5	0.5		93950
22	34.40	-0.37	0.001	5.83E-05	0.2	0.8		93950
23	33.60	-0.29	0.001	5.65E-05	-0.0	0.8		93950
24	32.80	-0.18	0.001	5.45E-05	-0.2	0.6		93950
25	32.00	0.00	0.001	5.31E-05	-0.3	0.3		93950
26	31.40	0.21	0.001	5.25E-05	-0.2	0.1		93950
27	30.80	0.50	0.001	5.23E-05	-0.0	-0.0		---

Node no.	Y coord	LEFT side: Water press. kN/m2	Vertic -al kN/m2	Effective stresses: Active limit kN/m2	Passive limit kN/m2	Earth pressure kN/m2	Total earth pressure kN/m2	Coeff. of subgrade reaction kN/m3
1	45.80	0.00	0.00	0.00	0.00	0.00	0.00	2253
2	45.69	0.00	1.98	0.54	9.95	0.54	0.54a	2253
3	45.60	0.00	3.60	0.98	18.09	0.98	0.98a	2253
4	45.40	0.00	7.20	1.97	36.20	1.97	1.97a	2253
		Total> 7.20	2.00m	212.88	2.00	2.00a	11521	

(continued)

Stage No.5 Excavate to elevation 43.75 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
5	44.85	Total>	18.32	4.75m	224.00	4.75	4.75a	11521
6	44.50	Total>	25.69	6.50m	231.38	6.50	6.50a	11521
7	43.75	Total>	43.79	10.25m	249.48	10.34	10.34	11521
8	43.00	Total>	62.99	14.00m	268.69	33.25	33.25	11521
9	42.80	Total>	68.06	15.00m	273.76	39.16	39.16	11521
10	42.00	Total>	87.69	19.00m	302.65	59.66	59.66	12334
11	41.50	Total>	99.32	21.50m	320.07	71.53	71.53	12843
12	40.75	Total>	115.95	25.25m	345.38	88.15	88.15	13605
13	40.00	Total>	131.85	29.00m	369.95	103.76	103.76	14368
14	39.35	Total>	145.24	32.25m	390.86	116.80	116.80	15028
15	38.70	Total>	158.40	35.50m	411.54	129.62	129.62	15689
16	38.50	Total>	162.41	36.50m	417.87	133.55	133.55	15893
17	37.94	Total>	173.59	39.30m	435.53	144.52	144.52	16462
18	37.37	Total>	184.91	42.15m	453.44	155.72	155.72	17041
19	36.80	Total>	196.18	45.00m	471.31	166.95	166.95	17621
20	36.00	Total>	211.95	49.00m	496.34	182.81	182.81	18434
21	35.20	Total>	227.69	53.00m	521.33	198.76	198.76	19247
22	34.40	Total>	243.41	57.00m	546.32	214.78	214.78	20060
23	33.60	Total>	259.13	61.00m	571.29	230.84	230.84	20874
24	32.80	Total>	274.85	65.00m	596.27	246.95	246.95	21687
25	32.00	Total>	290.57	69.00m	621.25	263.10	263.10	22500
26	31.40	Total>	302.37	72.00m	639.99	275.26	275.26	23110
27	30.80	Total>	314.16	75.00m	658.73	287.47	287.47	23720

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	45.80	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	45.69	0.00	0.00	0.00	0.00	0.00	0.00	0.0
3	45.60	0.00	0.00	0.00	0.00	0.00	0.00	0.0
4	45.40	0.00	0.00	0.00	0.00	0.00	0.00	0.0
5	44.85	0.00	0.00	0.00	0.00	0.00	0.00	0.0
6	44.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
7	43.75	0.00	0.00	0.00	0.00	0.00	0.00	0.0
		Total>	0.00	0.00	205.68	30.67	30.67	9942
8	43.00	Total>	15.00	3.75m	220.68	42.47	42.47	9942
9	42.80	Total>	19.00	4.75m	224.69	45.75	45.75	9942
10	42.00	Total>	35.01	8.75m	249.95	61.06	61.06	10644
11	41.50	Total>	45.02	11.25m	265.75	70.91	70.91	11083
12	40.75	Total>	60.06	15.00m	289.46	86.02	86.02	11740
13	40.00	Total>	75.11	18.75m	313.19	101.39	101.39	12398
14	39.35	Total>	88.17	22.00m	333.78	114.80	114.80	12969
15	38.70	Total>	101.25	25.25m	354.38	128.20	128.20	13539
16	38.50	Total>	105.28	26.25m	360.73	132.32	132.32	13714
17	37.94	Total>	116.58	29.05m	378.50	143.80	143.80	14206
18	37.37	Total>	128.09	31.90m	396.61	155.42	155.42	14706
19	36.80	Total>	139.62	34.75m	414.74	166.97	166.97	15206
20	36.00	Total>	155.84	38.75m	440.21	183.09	183.09	15907
21	35.20	Total>	172.09	42.75m	465.72	199.14	199.14	16609
22	34.40	Total>	188.37	46.75m	491.26	215.14	215.14	17311
23	33.60	Total>	204.69	50.75m	516.84	231.14	231.14	18013
24	32.80	Total>	221.04	54.75m	542.45	247.12	247.12	18715

(continued)

Stage No.5 Excavate to elevation 43.75 on RIGHT side

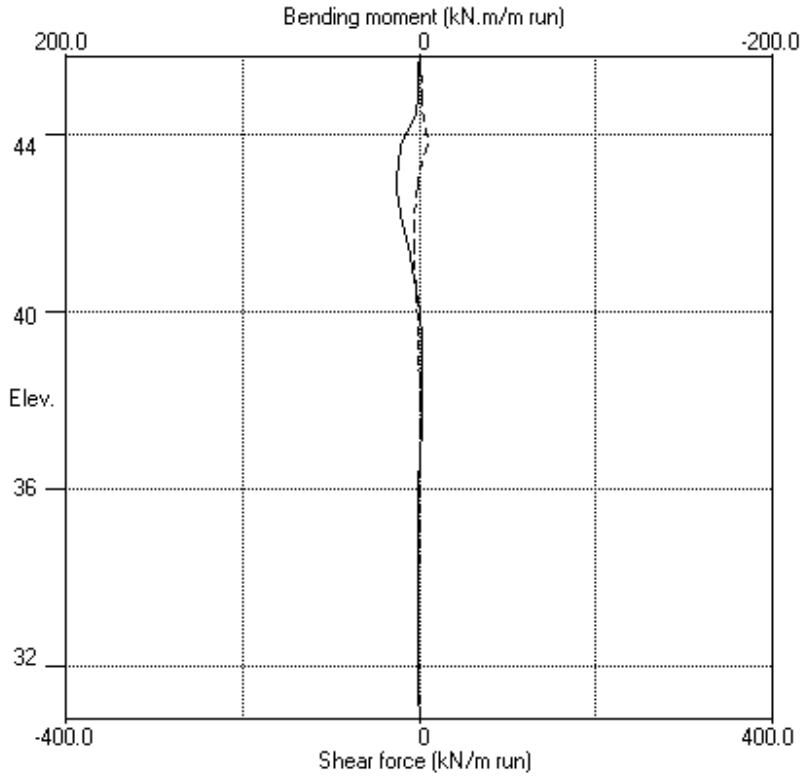
Node no.	Y coord	RIGHT side Water press. kN/m2	Effective stresses Vertic -al kN/m2	Active limit kN/m2	Passive limit kN/m2	Earth pressure kN/m2	Total earth pressure kN/m2	Coeff. of subgrade reaction kN/m3
25	32.00	Total>	237.42	58.75m	568.08	263.10	263.10	19416
26	31.40	Total>	249.72	61.75m	587.32	275.05	275.05	19943
27	30.80	Total>	262.03	64.75m	606.58	286.98	286.98	20469

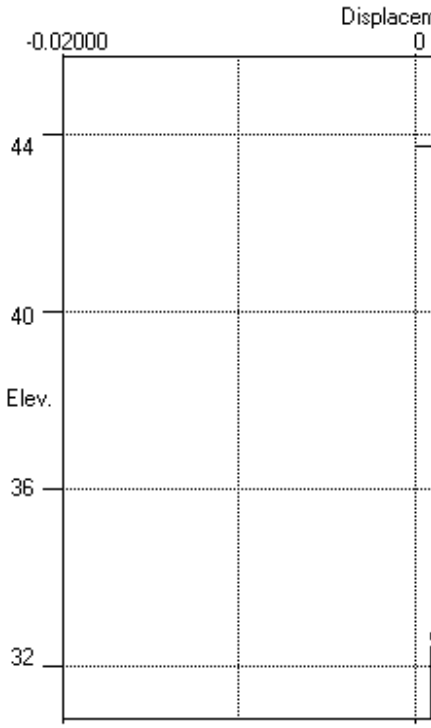
Note: 6.50a Soil pressure at active limit
123.45p Soil pressure at passive limit

KNIGHT BUILD LTD | Sheet No.
Program: WALLAP Version 6.06 Revision A49.B68.R53 | Job No. 79AR
Licensed from GEOSOLVE | Made by : JRC
Data filename/Run ID: SECTION_2-2_ULS1 |
79 Avenue Road | Date:28-06-2021
SECTION 2-2 ANALYSIS | Checked :

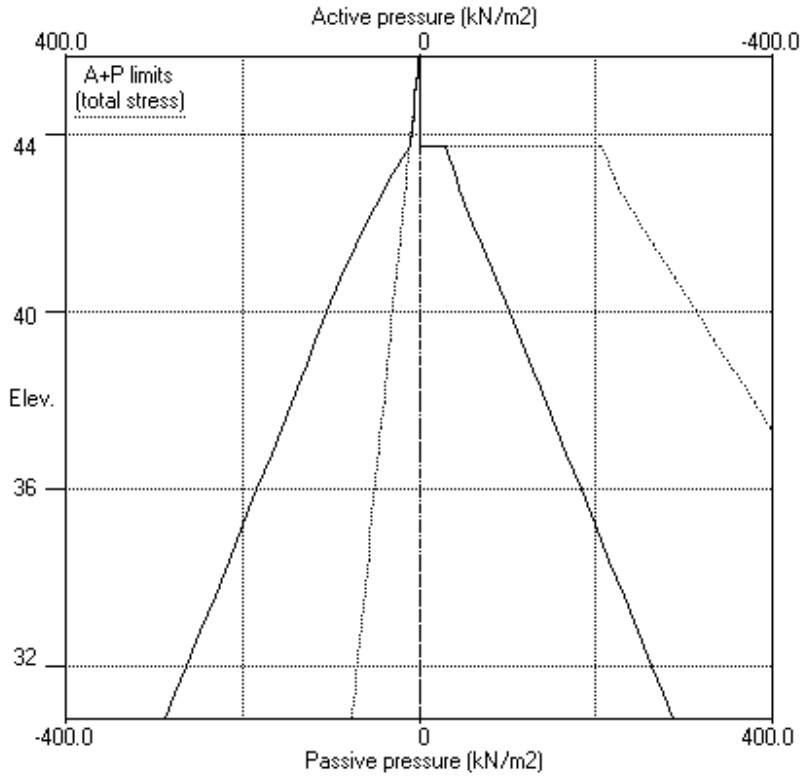
Units: kN,m

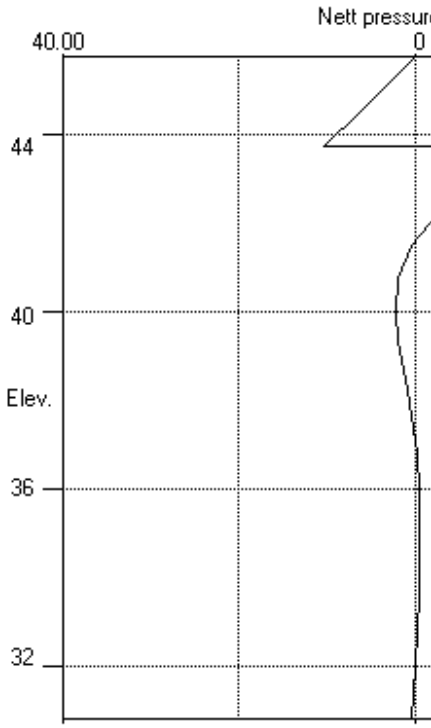
Stage No.5 Excav. to elev. 43.75 on RIGHT side





Stage No.5 Excav. to elev. 43.75 on RIGHT side





Units: kN,m

Stage No. 7 Excavate to elevation 41.50 on RIGHT side

BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall

Analysis options

Length of wall perpendicular to section = 15.00m
Subgrade reaction model - Boussinesq Influence coefficients
Soil deformations are elastic until the active or passive limit is reached
Open Tension Crack analysis - No

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

Limit State: ULS DA1 Combination 1

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

*** Wall displacements reset to zero at stage 4

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	45.80	0.00	0.004	-3.24E-04	0.0	0.0		93950
2	45.69	0.54	0.004	-3.24E-04	0.0	-0.0		93950
3	45.60	0.98	0.004	-3.24E-04	0.1	0.0		93950
4	45.40	1.97	0.004	-3.24E-04	0.4	0.1	23.7	93950
		2.00	0.004	-3.24E-04	-23.3	0.1		
5	44.85	4.75	0.004	-2.88E-04	-21.4	-12.2		93950
6	44.50	6.50	0.005	-2.28E-04	-19.5	-19.4		93950
7	43.75	10.25	0.005	-4.11E-05	-13.2	-28.7		93950
8	43.00	14.00	0.005	2.00E-04	-4.1	-36.0		93950
9	42.80	17.22	0.005	2.69E-04	-1.0	-36.4		93950
10	42.00	28.25	0.004	5.15E-04	17.2	-30.5		93950
11	41.50	35.47	0.004	6.13E-04	33.2	-18.1		93950
		-23.42	0.004	6.13E-04	33.2	-18.1		
12	40.75	-17.43	0.003	6.33E-04	17.8	0.3		93950
13	40.00	-11.22	0.003	5.48E-04	7.1	8.9		93950
14	39.35	-6.64	0.003	4.43E-04	1.3	11.1		93950
15	38.70	-3.17	0.002	3.39E-04	-1.9	10.6		93950
16	38.50	-2.34	0.002	3.09E-04	-2.4	10.1		93950
17	37.94	-0.56	0.002	2.37E-04	-3.3	8.4		93950
18	37.37	0.53	0.002	1.81E-04	-3.3	6.4		93950
19	36.80	1.06	0.002	1.41E-04	-2.8	4.6		93950
20	36.00	1.17	0.002	1.07E-04	-1.9	2.7		93950
21	35.20	0.91	0.002	9.12E-05	-1.1	1.5		93950
22	34.40	0.53	0.002	8.53E-05	-0.5	0.8		93950
23	33.60	0.21	0.002	8.41E-05	-0.2	0.5		93950
24	32.80	0.02	0.002	8.41E-05	-0.1	0.4		93950
25	32.00	-0.02	0.002	8.41E-05	-0.1	0.2		93950
26	31.40	0.07	0.002	8.40E-05	-0.1	0.1		93950
27	30.80	0.28	0.001	8.39E-05	-0.0	0.0		---

At elev. 45.40 Strut force = 177.6 kN/strut = 23.7 kN/m run

(continued)

Stage No.7 Excavate to elevation 41.50 on RIGHT side

Node no.	Y coord	LEFT side ------- Effective stresses ------- Water press. kN/m2	Vertic -al kN/m2	Active limit kN/m2	Passive limit kN/m2	Earth pressure kN/m2	Total earth pressure kN/m2	Coeff. of subgrade reaction kN/m3
1	45.80	0.00	0.00	0.00	0.00	0.00	0.00	3823
2	45.69	0.00	1.98	0.54	9.95	0.54	0.54a	1602
3	45.60	0.00	3.60	0.98	18.09	0.98	0.98a	1602
4	45.40	0.00	7.20	1.97	36.20	1.97	1.97a	1602
		Total> 7.20	2.00m	212.88	2.00	2.00a		8257
5	44.85	Total> 18.32	4.75m	224.00	4.75	4.75a		8257
6	44.50	Total> 25.69	6.50m	231.38	6.50	6.50a		8257
7	43.75	Total> 43.79	10.25m	249.48	10.25	10.25a		8257
8	43.00	Total> 62.99	14.00m	268.69	14.00	14.00a		8257
9	42.80	Total> 68.06	15.00m	273.76	19.22	19.22		8257
10	42.00	Total> 87.69	19.00m	302.65	38.25	38.25		8840
11	41.50	Total> 99.32	21.50m	320.07	50.47	50.47		9204
12	40.75	Total> 115.95	25.25m	345.38	68.86	68.86		9750
13	40.00	Total> 131.85	29.00m	369.95	86.83	86.83		10297
14	39.35	Total> 145.24	32.25m	390.86	101.83	101.83		10770
15	38.70	Total> 158.40	35.50m	411.54	116.25	116.25		11244
16	38.50	Total> 162.41	36.50m	417.87	120.58	120.58		11390
17	37.94	Total> 173.59	39.30m	435.53	132.45	132.45		11798
18	37.37	Total> 184.91	42.15m	453.44	144.24	144.24		12213
19	36.80	Total> 196.18	45.00m	471.31	155.80	155.80		12628
20	36.00	Total> 211.95	49.00m	496.34	171.81	171.81		13211
21	35.20	Total> 227.69	53.00m	521.33	187.69	187.69		13794
22	34.40	Total> 243.41	57.00m	546.32	203.57	203.57		14377
23	33.60	Total> 259.13	61.00m	571.29	219.51	219.51		14960
24	32.80	Total> 274.85	65.00m	596.27	235.53	235.53		15542
25	32.00	Total> 290.57	69.00m	621.25	251.64	251.64		16125
26	31.40	Total> 302.37	72.00m	639.99	263.80	263.80		16562
27	30.80	Total> 314.16	75.00m	658.73	276.04	276.04		17000

Node no.	Y coord	RIGHT side ------- Effective stresses ------- Water press. kN/m2	Vertic -al kN/m2	Active limit kN/m2	Passive limit kN/m2	Earth pressure kN/m2	Total earth pressure kN/m2	Coeff. of subgrade reaction kN/m3
1	45.80	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	45.69	0.00	0.00	0.00	0.00	0.00	0.00	0.0
3	45.60	0.00	0.00	0.00	0.00	0.00	0.00	0.0
4	45.40	0.00	0.00	0.00	0.00	0.00	0.00	0.0
5	44.85	0.00	0.00	0.00	0.00	0.00	0.00	0.0
6	44.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
7	43.75	0.00	0.00	0.00	0.00	0.00	0.00	0.0
8	43.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
9	42.80	2.00	0.00	0.00	0.00	0.00	2.00	0.0
10	42.00	10.00	0.00	0.00	0.00	0.00	10.00	0.0
11	41.50	15.00	0.00	0.00	0.00	0.00	15.00	0.0
		Total> 15.00	15.00w	235.72	73.89	73.89		13907
12	40.75	Total> 30.00	11.25m	259.40	86.29	86.29		14733
13	40.00	Total> 45.01	15.00m	283.09	98.05	98.05		15558
14	39.35	Total> 58.04	18.25m	303.64	108.47	108.47		16274
15	38.70	Total> 71.08	21.50m	324.20	119.42	119.42		16990
16	38.50	Total> 75.10	22.50m	330.53	122.91	122.91		17210
17	37.94	Total> 86.36	25.30m	348.28	133.01	133.01		17826
18	37.37	Total> 97.85	28.15m	366.36	143.70	143.70		18454
19	36.80	Total> 109.36	31.00m	384.47	154.74	154.74		19081

(continued)

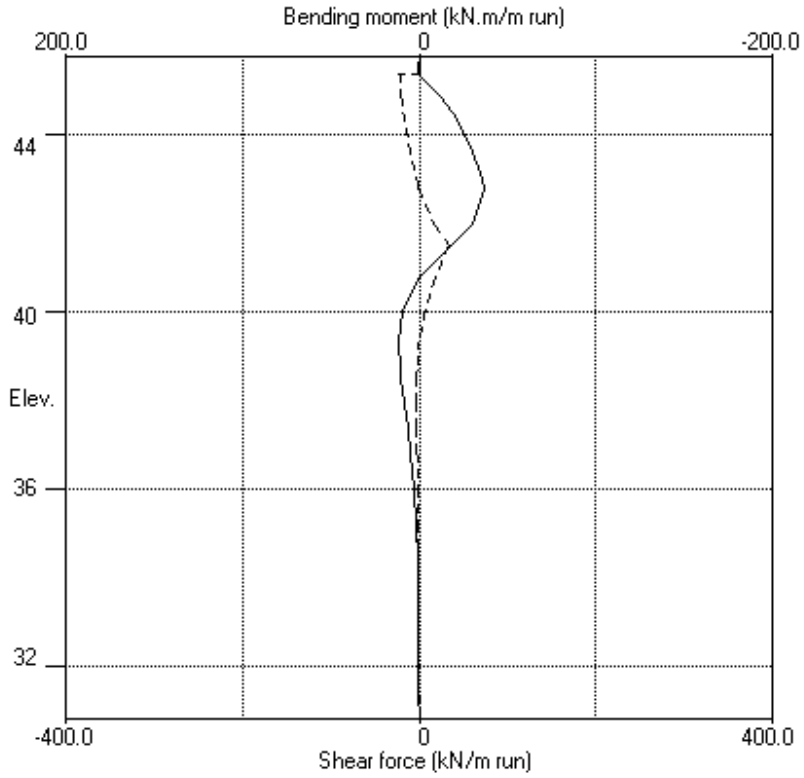
Stage No.7 Excavate to elevation 41.50 on RIGHT side

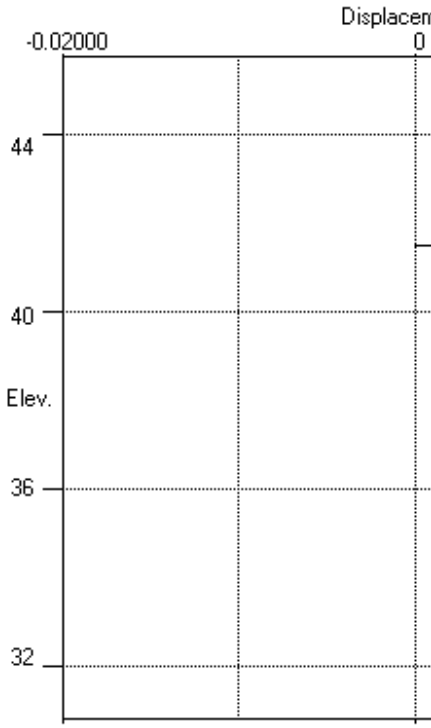
Node no.	Y coord	RIGHT side Water press. kN/m2	Effective stresses Vertic -al kN/m2	Active limit kN/m2	Passive limit kN/m2	Earth pressure kN/m2	Total earth pressure kN/m2	Coeff. of subgrade reaction kN/m3
20	36.00	Total>	125.57	35.00m	409.93	170.63	170.63	19962
21	35.20	Total>	141.83	39.00m	435.46	186.79	186.79	20842
22	34.40	Total>	158.16	43.00m	461.04	203.04	203.04	21723
23	33.60	Total>	174.54	47.00m	486.68	219.30	219.30	22604
24	32.80	Total>	190.99	51.00m	512.39	235.51	235.51	23484
25	32.00	Total>	207.50	55.00m	538.15	251.66	251.66	24365
26	31.40	Total>	219.92	58.00m	557.52	263.73	263.73	25026
27	30.80	Total>	232.37	61.00m	576.91	275.76	275.76	25686

Note: 14.00a Soil pressure at active limit
123.45p Soil pressure at passive limit

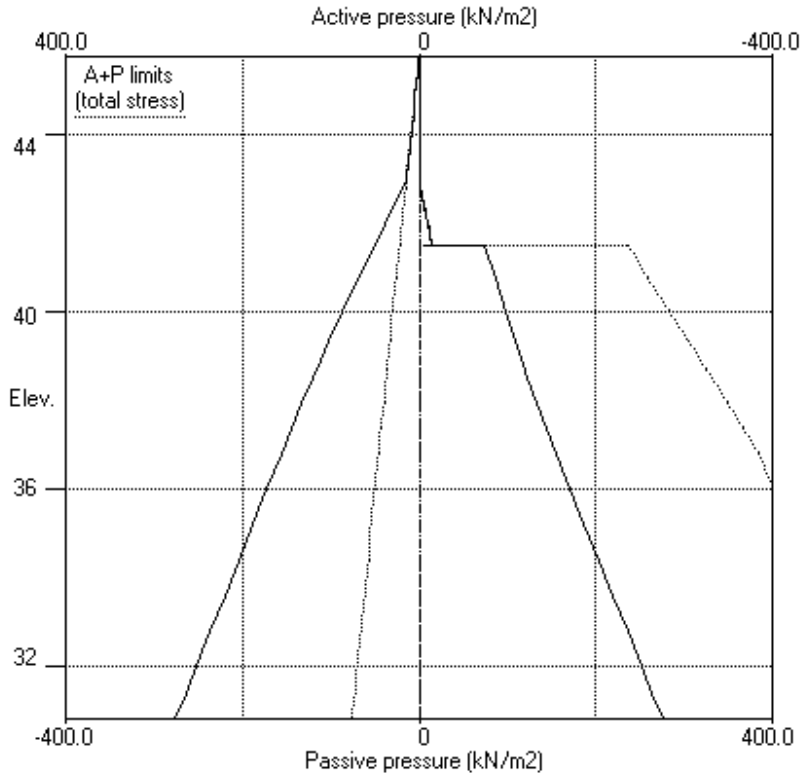
Units: kN,m

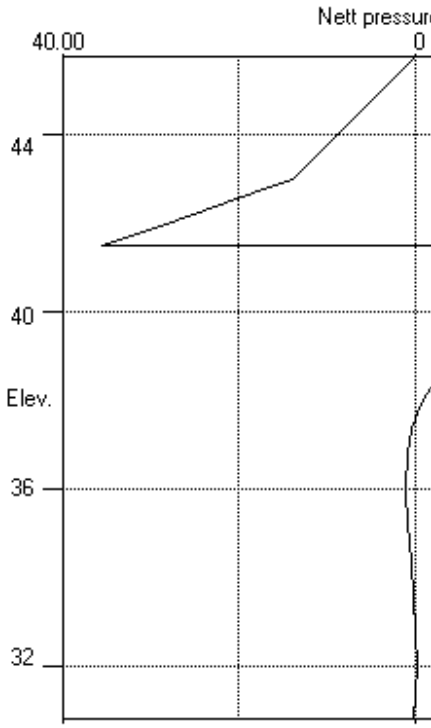
Stage No.7 Excav. to elev. 41.50 on RIGHT side





Stage No.7 Excav. to elev. 41.50 on RIGHT side





Units: kN,m

Stage No. 9 Excavate to elevation 37.94 on RIGHT side

BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall

Analysis options

Length of wall perpendicular to section = 15.00m
Subgrade reaction model - Boussinesq Influence coefficients
Soil deformations are elastic until the active or passive limit is reached
Open Tension Crack analysis - No

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

Limit State: ULS DA1 Combination 1

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

*** Wall displacements reset to zero at stage 4

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	45.80	0.00	0.004	-6.89E-04	0.0	0.0		93950
2	45.69	3.17	0.004	-6.89E-04	0.2	-0.0		93950
3	45.60	3.23	0.004	-6.89E-04	0.5	0.0		93950
4	45.40	3.37	0.004	-6.90E-04	1.1	0.2	18.3	93950
		9.05	0.004	-6.90E-04	-17.2	0.2		
5	44.85	4.75	0.005	-6.67E-04	-13.4	-7.6		93950
6	44.50	6.50	0.005	-6.30E-04	-11.4	-12.0		93950
7	43.75	10.25	0.005	-5.25E-04	-5.1	-15.3		93950
8	43.00	14.00	0.006	-4.16E-04	4.0	-16.5		93950
9	42.80	13.00	0.006	-3.89E-04	6.7	-15.3		93950
10	42.00	12.24	0.006	-3.46E-04	16.8	-4.2	56.8	93950
		12.24	0.006	-3.46E-04	-40.1	-4.2		
11	41.50	14.33	0.006	-3.06E-04	-33.4	-22.4		93950
12	40.75	17.31	0.006	-9.65E-05	-21.6	-42.9		93950
13	40.00	21.75	0.006	2.40E-04	-6.9	-53.7		93950
14	39.35	27.96	0.006	5.74E-04	9.2	-53.3		93950
15	38.70	36.89	0.005	8.71E-04	30.3	-41.1		93950
16	38.50	40.18	0.005	9.44E-04	38.0	-34.2		93950
17	37.94	50.41	0.005	1.04E-03	63.4	-6.4		93950
		-61.91	0.005	1.04E-03	63.4	-6.4		
18	37.37	-45.31	0.004	9.97E-04	32.8	19.6		93950
19	36.80	-29.51	0.004	8.37E-04	11.5	31.0		93950
20	36.00	-12.18	0.003	5.71E-04	-5.2	30.7		93950
21	35.20	-1.61	0.003	3.46E-04	-10.7	22.7		93950
22	34.40	3.27	0.002	1.96E-04	-10.0	13.5		93950
23	33.60	4.42	0.002	1.15E-04	-6.9	6.5		93950
24	32.80	3.66	0.002	8.17E-05	-3.7	2.3		93950
25	32.00	2.23	0.002	7.22E-05	-1.3	0.5		93950
26	31.40	1.11	0.002	7.13E-05	-0.3	0.0		93950
27	30.80	0.05	0.002	7.14E-05	-0.0	-0.0		---

At elev. 45.40 Strut force = 137.1 kN/strut = 18.3 kN/m run
At elev. 42.00 Strut force = 426.3 kN/strut = 56.8 kN/m run (horiz.)
= 65.6 kN/m run (inclined)

(continued)

Stage No.9 Excavate to elevation 37.94 on RIGHT side

Node no.	Y coord	LEFT side ------- Effective stresses ------- Water press. kN/m2	Vertic -al kN/m2	Active limit kN/m2	Passive limit kN/m2	Earth pressure kN/m2	Total earth pressure kN/m2	Coeff. of subgrade reaction kN/m3
1	45.80	0.00	0.00	0.00	0.00	0.00	0.00	11604
2	45.69	0.00	1.98	0.54	9.95	3.17	3.17	11604
3	45.60	0.00	3.60	0.98	18.09	3.23	3.23	11604
4	45.40	0.00	7.20	1.97	36.20	3.37	3.37	11604
		Total> 7.20	2.00m	212.88	9.05	9.05		58516
5	44.85	Total> 18.32	4.75m	224.00	4.75	4.75a		8847
6	44.50	Total> 25.69	6.50m	231.38	6.50	6.50a		8847
7	43.75	Total> 43.79	10.25m	249.48	10.25	10.25a		8847
8	43.00	Total> 62.99	14.00m	268.69	14.00	14.00a		8847
9	42.80	Total> 68.06	15.00m	273.76	15.00	15.00a		8847
10	42.00	Total> 87.69	19.00m	302.65	22.24	22.24		9472
11	41.50	Total> 99.32	21.50m	320.07	29.33	29.33		9862
12	40.75	Total> 115.95	25.25m	345.38	39.81	39.81		10448
13	40.00	Total> 131.85	29.00m	369.95	51.75	51.75		11033
14	39.35	Total> 145.24	32.25m	390.86	64.46	64.46		11541
15	38.70	Total> 158.40	35.50m	411.54	79.89	79.89		12048
16	38.50	Total> 162.41	36.50m	417.87	85.18	85.18		12204
17	37.94	Total> 173.59	39.30m	435.53	101.01	101.01		12641
18	37.37	Total> 184.91	42.15m	453.44	117.86	117.86		13086
19	36.80	Total> 196.18	45.00m	471.31	134.41	134.41		13531
20	36.00	Total> 211.95	49.00m	496.34	156.02	156.02		14156
21	35.20	Total> 227.69	53.00m	521.33	175.41	175.41		14780
22	34.40	Total> 243.41	57.00m	546.32	192.95	192.95		15405
23	33.60	Total> 259.13	61.00m	571.29	209.31	209.31		16029
24	32.80	Total> 274.85	65.00m	596.27	225.08	225.08		16654
25	32.00	Total> 290.57	69.00m	621.25	240.69	240.69		17278
26	31.40	Total> 302.37	72.00m	639.99	252.42	252.42		17747
27	30.80	Total> 314.16	75.00m	658.73	264.22	264.22		18215

Node no.	Y coord	RIGHT side ------- Effective stresses ------- Water press. kN/m2	Vertic -al kN/m2	Active limit kN/m2	Passive limit kN/m2	Earth pressure kN/m2	Total earth pressure kN/m2	Coeff. of subgrade reaction kN/m3
1	45.80	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	45.69	0.00	0.00	0.00	0.00	0.00	0.00	0.0
3	45.60	0.00	0.00	0.00	0.00	0.00	0.00	0.0
4	45.40	0.00	0.00	0.00	0.00	0.00	0.00	0.0
5	44.85	0.00	0.00	0.00	0.00	0.00	0.00	0.0
6	44.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
7	43.75	0.00	0.00	0.00	0.00	0.00	0.00	0.0
8	43.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
9	42.80	2.00	0.00	0.00	0.00	0.00	2.00	0.0
10	42.00	10.00	0.00	0.00	0.00	0.00	10.00	0.0
11	41.50	15.00	0.00	0.00	0.00	0.00	15.00	0.0
12	40.75	22.50	0.00	0.00	0.00	0.00	22.50	0.0
13	40.00	30.00	0.00	0.00	0.00	0.00	30.00	0.0
14	39.35	36.50	0.00	0.00	0.00	0.00	36.50	0.0
15	38.70	43.00	0.00	0.00	0.00	0.00	43.00	0.0
16	38.50	45.00	0.00	0.00	0.00	0.00	45.00	0.0
17	37.94	50.60	0.00	0.00	0.00	0.00	50.60	0.0
		Total> 50.60	50.60w	312.51	162.92	162.92		25838
18	37.37	Total> 62.00	28.15m	330.50	163.17	163.17		26748
19	36.80	Total> 73.41	31.00m	348.51	163.92	163.92		27657

(continued)

Stage No.9 Excavate to elevation 37.94 on RIGHT side

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	36.00	Total>	89.44	35.00m	373.80	168.20	168.20	28934
21	35.20	Total>	105.51	39.00m	399.13	177.01	177.01	30210
22	34.40	Total>	121.64	43.00m	424.51	189.68	189.68	31487
23	33.60	Total>	137.83	47.00m	449.96	204.88	204.88	32763
24	32.80	Total>	154.11	51.00m	475.49	221.42	221.42	34040
25	32.00	Total>	170.46	55.00m	501.11	238.46	238.46	35316
26	31.40	Total>	182.79	58.00m	520.38	251.32	251.32	36274
27	30.80	Total>	195.17	61.00m	539.70	264.17	264.17	37231

Note: 15.00a Soil pressure at active limit
123.45p Soil pressure at passive limit

KNIGHT BUILD LTD | Sheet No.
Program: WALLAP Version 6.06 Revision A49.B68.R53 | Job No. 79AR
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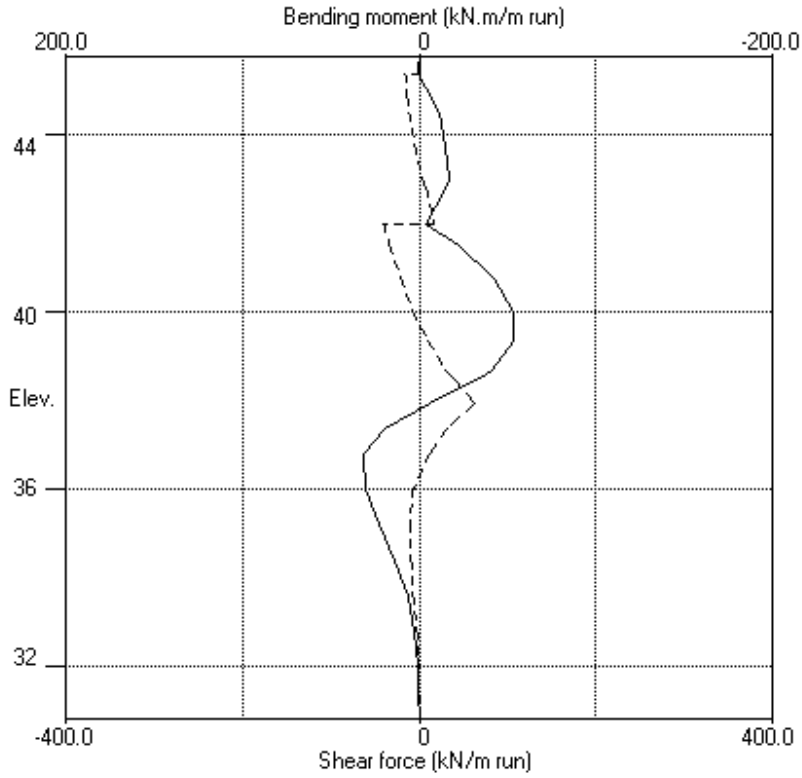
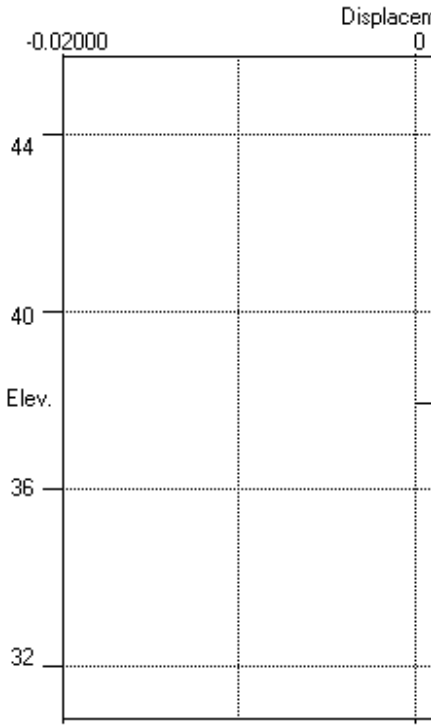
Data filename/Run ID: SECTION_2-2_ULS1 |
79 Avenue Road | Date:28-06-2021
SECTION 2-2 ANALYSIS | Checked :

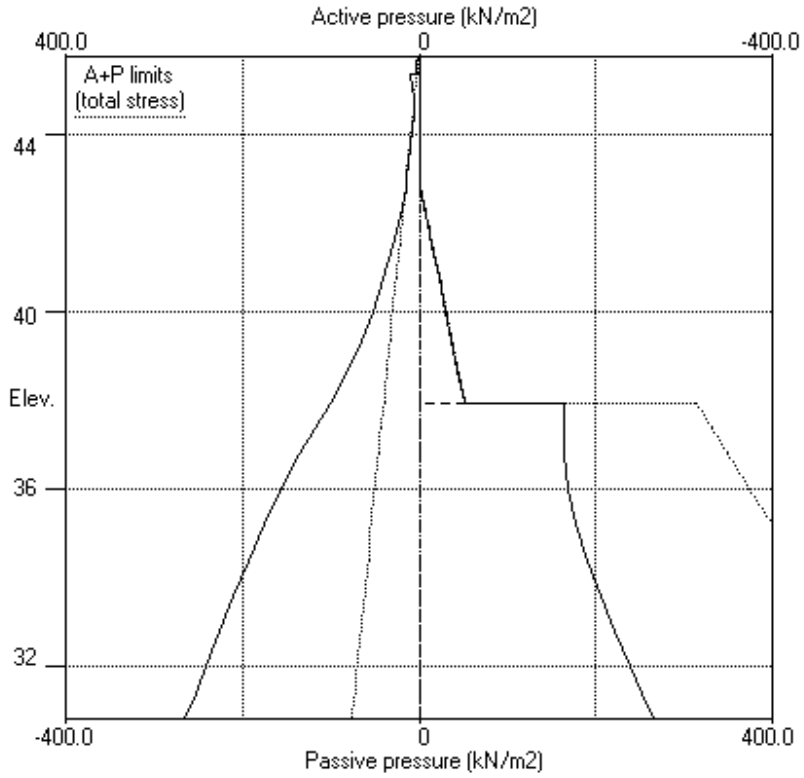
Units: kN,m

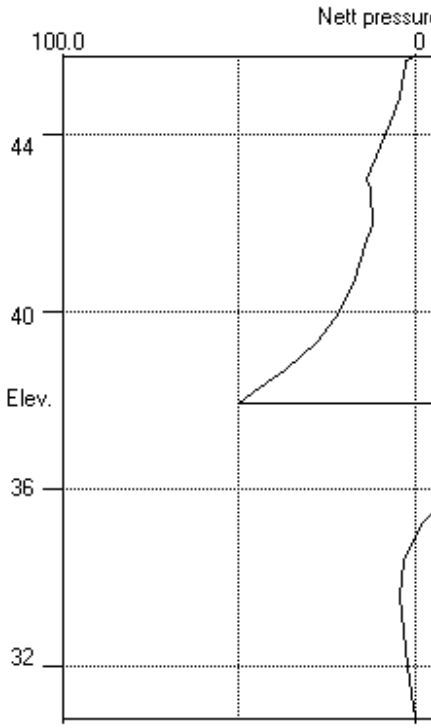
Stage No.9 Excav. to elev. 37.94 on RIGHT side





Stage No.9 Excav. to elev. 37.94 on RIGHT side





Units: kN,m

Stage No. 10 Fill to elevation 38.50 on RIGHT side with soil type 1

BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall

Analysis options

Length of wall perpendicular to section = 15.00m
Subgrade reaction model - Boussinesq Influence coefficients
Soil deformations are elastic until the active or passive limit is reached
Open Tension Crack analysis - No

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

Limit State: ULS DA1 Combination 1

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

*** Wall displacements reset to zero at stage 4

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	45.80	0.00	0.004	-6.92E-04	0.0	0.0		93950
2	45.69	3.16	0.004	-6.92E-04	0.2	-0.0		93950
3	45.60	3.22	0.004	-6.92E-04	0.5	0.0		93950
4	45.40	3.35	0.004	-6.92E-04	1.1	0.2	18.5	93950
		8.99	0.004	-6.92E-04	-17.4	0.2		
5	44.85	4.75	0.005	-6.69E-04	-13.6	-7.8		93950
6	44.50	6.50	0.005	-6.31E-04	-11.6	-12.2		93950
7	43.75	10.25	0.005	-5.25E-04	-5.3	-15.6		93950
8	43.00	14.00	0.006	-4.11E-04	3.7	-17.1		93950
9	42.80	13.00	0.006	-3.83E-04	6.4	-15.9		93950
10	42.00	12.25	0.006	-3.34E-04	16.5	-5.0	56.8	93950
		12.25	0.006	-3.34E-04	-40.2	-5.0		
11	41.50	14.41	0.006	-2.90E-04	-33.6	-23.3		93950
12	40.75	17.51	0.006	-7.24E-05	-21.6	-43.9		93950
13	40.00	22.15	0.006	2.72E-04	-6.7	-54.6		93950
14	39.35	28.59	0.006	6.11E-04	9.8	-54.0		93950
15	38.70	37.80	0.005	9.12E-04	31.3	-41.3		93950
16	38.50	41.17	0.005	9.85E-04	39.2	-34.3		93950
17	37.94	50.45	0.005	1.08E-03	64.9	-5.7		93950
		-63.67	0.005	1.08E-03	64.9	-5.7		
18	37.37	-46.54	0.004	1.03E-03	33.5	21.0		93950
19	36.80	-30.28	0.003	8.62E-04	11.6	32.5		93950
20	36.00	-12.48	0.003	5.84E-04	-5.5	32.0		93950
21	35.20	-1.61	0.002	3.49E-04	-11.2	23.6		93950
22	34.40	3.41	0.002	1.93E-04	-10.4	14.1		93950
23	33.60	4.60	0.002	1.08E-04	-7.2	6.8		93950
24	32.80	3.82	0.002	7.35E-05	-3.9	2.4		93950
25	32.00	2.33	0.002	6.35E-05	-1.4	0.5		93950
26	31.40	1.15	0.002	6.26E-05	-0.4	0.0		93950
27	30.80	0.03	0.002	6.27E-05	-0.0	-0.0		---

At elev. 45.40 Strut force = 138.7 kN/strut = 18.5 kN/m run
At elev. 42.00 Strut force = 425.8 kN/strut = 56.8 kN/m run (horiz.)
= 65.6 kN/m run (inclined)

(continued)

Stage No.10 Fill to elevation 38.50 on RIGHT side with soil type 1

Node no.	Y coord	LEFT side ------- Effective stresses ------- Water press. kN/m2	Vertic -al kN/m2	Active limit kN/m2	Passive limit kN/m2	Earth pressure kN/m2	Total earth pressure kN/m2	Coeff. of subgrade reaction kN/m3
1	45.80	0.00	0.00	0.00	0.00	0.00	0.00	2396
2	45.69	0.00	1.98	0.54	9.95	3.16	3.16	2396
3	45.60	0.00	3.60	0.98	18.09	3.22	3.22	2396
4	45.40	0.00	7.20	1.97	36.20	3.35	3.35	2396
		Total>	7.20	2.00m	212.88	8.99	8.99	12239
5	44.85	Total>	18.32	4.75m	224.00	4.75	4.75a	12239
6	44.50	Total>	25.69	6.50m	231.38	6.50	6.50a	12239
7	43.75	Total>	43.79	10.25m	249.48	10.25	10.25a	12239
8	43.00	Total>	62.99	14.00m	268.69	14.00	14.00a	12239
9	42.80	Total>	68.06	15.00m	273.76	15.00	15.00a	12239
10	42.00	Total>	87.69	19.00m	302.65	22.25	22.25	7598
11	41.50	Total>	99.32	21.50m	320.07	29.41	29.41	7911
12	40.75	Total>	115.95	25.25m	345.38	40.01	40.01	8380
13	40.00	Total>	131.85	29.00m	369.95	52.15	52.15	8850
14	39.35	Total>	145.24	32.25m	390.86	65.09	65.09	9257
15	38.70	Total>	158.40	35.50m	411.54	80.80	80.80	9664
16	38.50	Total>	162.41	36.50m	417.87	86.17	86.17	9789
17	37.94	Total>	173.59	39.30m	435.53	102.27	102.27	10140
18	37.37	Total>	184.91	42.15m	453.44	119.39	119.39	10497
19	36.80	Total>	196.18	45.00m	471.31	136.17	136.17	10854
20	36.00	Total>	211.95	49.00m	496.34	158.02	158.02	11355
21	35.20	Total>	227.69	53.00m	521.33	177.57	177.57	11855
22	34.40	Total>	243.41	57.00m	546.32	195.20	195.20	12356
23	33.60	Total>	259.13	61.00m	571.29	211.60	211.60	12857
24	32.80	Total>	274.85	65.00m	596.27	227.38	227.38	13358
25	32.00	Total>	290.57	69.00m	621.25	242.99	242.99	13859
26	31.40	Total>	302.37	72.00m	639.99	254.71	254.71	14235
27	30.80	Total>	314.16	75.00m	658.73	266.48	266.48	14611

Node no.	Y coord	RIGHT side ------- Effective stresses ------- Water press. kN/m2	Vertic -al kN/m2	Active limit kN/m2	Passive limit kN/m2	Earth pressure kN/m2	Total earth pressure kN/m2	Coeff. of subgrade reaction kN/m3
1	45.80	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	45.69	0.00	0.00	0.00	0.00	0.00	0.00	0.0
3	45.60	0.00	0.00	0.00	0.00	0.00	0.00	0.0
4	45.40	0.00	0.00	0.00	0.00	0.00	0.00	0.0
5	44.85	0.00	0.00	0.00	0.00	0.00	0.00	0.0
6	44.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
7	43.75	0.00	0.00	0.00	0.00	0.00	0.00	0.0
8	43.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
9	42.80	2.00	0.00	0.00	0.00	0.00	2.00	0.0
10	42.00	10.00	0.00	0.00	0.00	0.00	10.00	0.0
11	41.50	15.00	0.00	0.00	0.00	0.00	15.00	0.0
12	40.75	22.50	0.00	0.00	0.00	0.00	22.50	0.0
13	40.00	30.00	0.00	0.00	0.00	0.00	30.00	0.0
14	39.35	36.50	0.00	0.00	0.00	0.00	36.50	0.0
15	38.70	43.00	0.00	0.00	0.00	0.00	43.00	0.0
16	38.50	45.00	0.00	0.00	0.00	0.00	45.00	0.0
		45.00	0.00	0.00	0.00	0.00	45.00	1393
17	37.94	50.60	4.48	1.22	22.52	1.22	51.82a	1393
		Total>	55.08	25.30m	316.99	165.94	165.94	10306
18	37.37	Total>	66.49	28.15m	334.99	165.93	165.93	10669

(continued)

Stage No.10 Fill to elevation 38.50 on RIGHT side with soil type 1

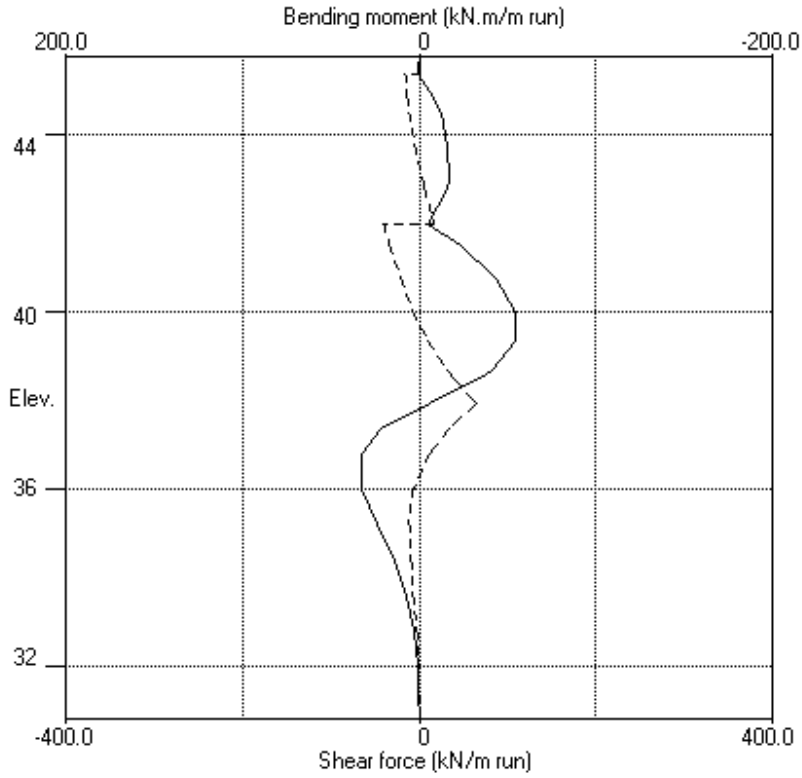
Node no.	Y coord	RIGHT side Water press. kN/m2	Effective stresses Vertic -al kN/m2	Active limit kN/m2	Passive limit kN/m2	Earth pressure kN/m2	Total earth pressure kN/m2	Coeff. of subgrade reaction kN/m3
19	36.80	Total>	77.91	31.00m	353.01	166.45	166.45	11032
20	36.00	Total>	93.96	35.00m	378.32	170.51	170.51	11541
21	35.20	Total>	110.06	39.00m	403.68	179.18	179.18	12050
22	34.40	Total>	126.23	43.00m	429.10	191.79	191.79	12560
23	33.60	Total>	142.46	47.00m	454.59	207.00	207.00	13069
24	32.80	Total>	158.78	51.00m	480.17	223.57	223.57	13578
25	32.00	Total>	175.17	55.00m	505.82	240.66	240.66	14087
26	31.40	Total>	187.53	58.00m	525.12	253.55	253.55	14469
27	30.80	Total>	199.93	61.00m	544.47	266.45	266.45	14851

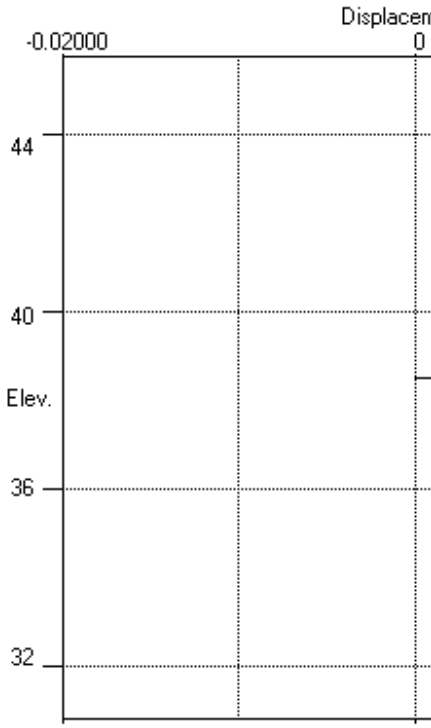
Note: 51.82a Soil pressure at active limit
123.45p Soil pressure at passive limit

KNIGHT BUILD LTD | Sheet No.
Program: WALLAP Version 6.06 Revision A49.B68.R53 | Job No. 79AR
Licensed from GEOSOLVE | Made by : JRC
Data filename/Run ID: SECTION_2-2_ULS1 |
79 Avenue Road | Date:28-06-2021
SECTION 2-2 ANALYSIS | Checked :

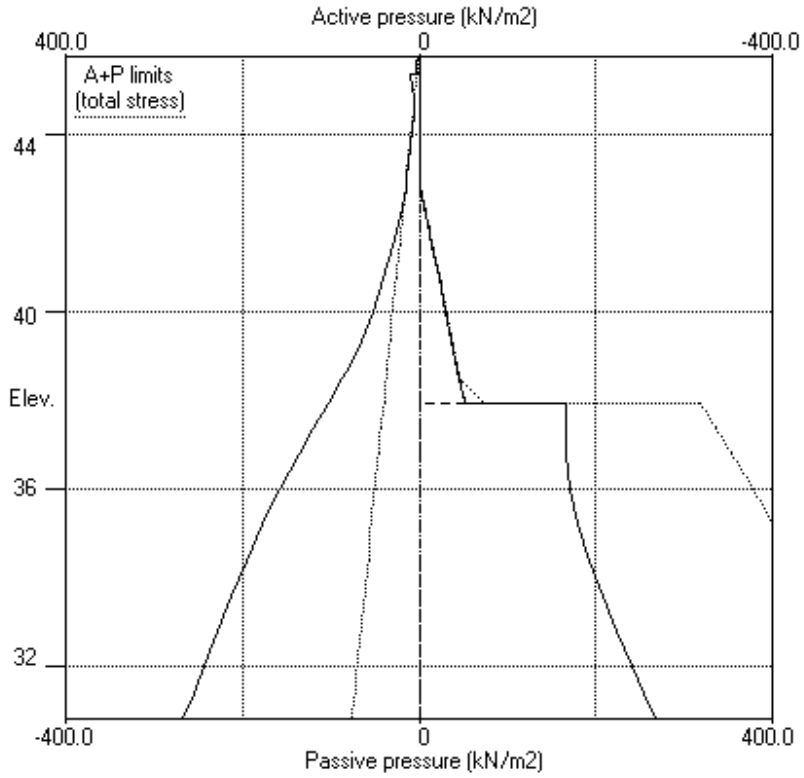
Units: kN,m

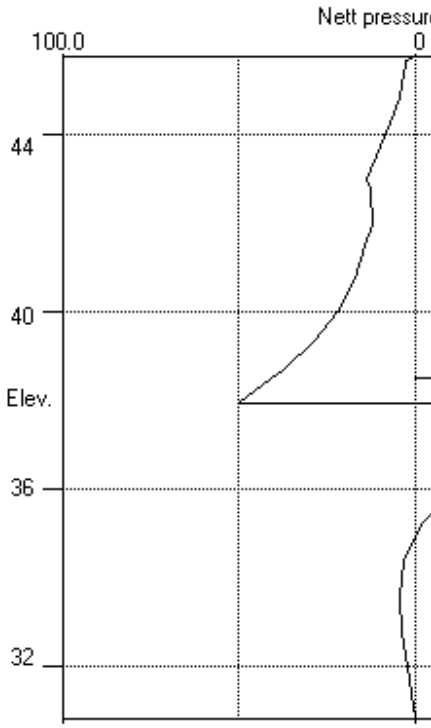
Stage No.10 Fill to elev. 38.50 on RIGHT side





Stage No.10 Fill to elev. 38.50 on RIGHT side





Units: kN,m

Stage No. 14 Change EI of wall to 290309 kN.m2/m run
From elevation 45.80 to 41.50
Yield moment not defined
No adjustments to wall displacements

BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall

Analysis options

Length of wall perpendicular to section = 15.00m
Subgrade reaction model - Boussinesq Influence coefficients
Soil deformations are elastic until the active or passive limit is reached
Open Tension Crack analysis - No

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

Limit State: ULS DA1 Combination 1

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

*** Wall displacements reset to zero at stage 4

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	45.80	0.00	0.004	-1.35E-03	0.0	0.0		290309
2	45.69	2.93	0.004	-1.35E-03	0.2	-0.0		290309
3	45.60	2.88	0.004	-1.35E-03	0.4	0.0		290309
4	45.40	2.76	0.004	-1.35E-03	1.0	0.2	32.3	290309
		5.94	0.004	-1.35E-03	-31.3	0.2		
5	44.85	4.75	0.005	-1.30E-03	-28.3	-15.9		290309
6	44.50	6.50	0.006	-1.22E-03	-26.4	-25.5		290309
7	43.75	10.25	0.006	-9.72E-04	-20.1	-40.0		290309
8	43.00	14.00	0.007	-6.20E-04	-11.0	-52.5		290309
9	42.80	13.00	0.007	-5.14E-04	-8.3	-54.3		290309
10	42.00	9.00	0.007	-8.68E-05	0.5	-55.5		290309
11	41.50	6.50	0.007	1.73E-04	4.4	-54.0		290309
12	40.75	6.04	0.007	4.35E-04	9.1	-47.6		290309
13	40.00	14.73	0.007	7.63E-04	16.9	-38.6		290309
14	39.35	24.78	0.006	1.05E-03	29.7	-24.2		290309
15	38.70	37.37	0.005	1.27E-03	49.9	0.7	40.2	290309
		37.37	0.005	1.27E-03	9.8	0.7		
16	38.50	41.85	0.005	1.31E-03	17.7	3.4		93950
17	37.94	53.61	0.004	1.23E-03	44.4	20.0		93950
		-57.35	0.004	1.23E-03	44.4	20.0		
18	37.37	-38.31	0.004	1.05E-03	17.1	36.0		93950
19	36.80	-22.18	0.003	8.14E-04	-0.1	39.6		93950
20	36.00	-6.32	0.003	5.05E-04	-11.5	32.3		93950
21	35.20	2.12	0.002	2.79E-04	-13.2	21.1		93950
22	34.40	5.14	0.002	1.46E-04	-10.3	11.2		93950
23	33.60	5.04	0.002	8.40E-05	-6.2	4.6		93950
24	32.80	3.55	0.002	6.36E-05	-2.8	1.2		93950
25	32.00	1.75	0.002	6.10E-05	-0.6	0.0		93950
26	31.40	0.50	0.002	6.20E-05	0.0	-0.1		93950
27	30.80	-0.64	0.002	6.25E-05	-0.0	-0.0		---

At elev. 45.40 Strut force = 241.9 kN/strut = 32.3 kN/m run
At elev. 38.70 Strut force = 40.2 kN/strut = 40.2 kN/m run

(continued)

Stage No.14 Change EI of wall to 290309 kN.m2/m run
From elevation 45.80 to 41.50
Yield moment not defined
No adjustments to wall displacements

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	45.80	0.00	0.00	0.00	0.00	0.00	0.00	1875
2	45.69	0.00	1.98	0.54	9.95	2.93	2.93	1875
3	45.60	0.00	3.60	0.98	18.09	2.88	2.88	1875
4	45.40	0.00	7.20	1.97	36.20	2.76	2.76	1875
		Total>	7.20	2.00m	212.88	5.94	5.94	9623
5	44.85	Total>	18.32	4.75m	224.00	4.75	4.75a	9623
6	44.50	Total>	25.69	6.50m	231.38	6.50	6.50a	9623
7	43.75	Total>	43.79	10.25m	249.48	10.25	10.25a	9623
8	43.00	Total>	62.99	14.00m	268.69	14.00	14.00a	9623
9	42.80	Total>	68.06	15.00m	273.76	15.00	15.00a	9623
10	42.00	Total>	87.69	19.00m	302.65	19.00	19.00a	10302
11	41.50	Total>	99.32	21.50m	320.07	21.50	21.50a	10726
12	40.75	Total>	115.95	25.25m	345.38	28.54	28.54	11363
13	40.00	Total>	131.85	29.00m	369.95	44.73	44.73	12000
14	39.35	Total>	145.24	32.25m	390.86	61.28	61.28	12552
15	38.70	Total>	158.40	35.50m	411.54	80.37	80.37	11214
16	38.50	Total>	162.41	36.50m	417.87	86.85	86.85	11360
17	37.94	Total>	173.59	39.30m	435.53	105.43	105.43	11767
18	37.37	Total>	184.91	42.15m	453.44	123.51	123.51	12181
19	36.80	Total>	196.18	45.00m	471.31	140.22	140.22	12595
20	36.00	Total>	211.95	49.00m	496.34	161.11	161.11	13176
21	35.20	Total>	227.69	53.00m	521.33	179.44	179.44	13758
22	34.40	Total>	243.41	57.00m	546.32	196.07	196.07	14339
23	33.60	Total>	259.13	61.00m	571.29	211.82	211.82	14920
24	32.80	Total>	274.85	65.00m	596.27	227.25	227.25	15502
25	32.00	Total>	290.57	69.00m	621.25	242.70	242.70	16083
26	31.40	Total>	302.37	72.00m	639.99	254.38	254.38	16519
27	30.80	Total>	314.16	75.00m	658.73	266.14	266.14	16955

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	45.80	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	45.69	0.00	0.00	0.00	0.00	0.00	0.00	0.0
3	45.60	0.00	0.00	0.00	0.00	0.00	0.00	0.0
4	45.40	0.00	0.00	0.00	0.00	0.00	0.00	0.0
5	44.85	0.00	0.00	0.00	0.00	0.00	0.00	0.0
6	44.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
7	43.75	0.00	0.00	0.00	0.00	0.00	0.00	0.0
8	43.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
9	42.80	2.00	0.00	0.00	0.00	0.00	2.00	0.0
10	42.00	10.00	0.00	0.00	0.00	0.00	10.00	0.0
11	41.50	15.00	0.00	0.00	0.00	0.00	15.00	0.0
12	40.75	22.50	0.00	0.00	0.00	0.00	22.50	0.0
13	40.00	30.00	0.00	0.00	0.00	0.00	30.00	0.0
14	39.35	36.50	0.00	0.00	0.00	0.00	36.50	0.0
15	38.70	43.00	0.00	0.00	0.00	0.00	43.00	0.0
16	38.50	45.00	0.00	0.00	0.00	0.00	45.00	0.0
		45.00	0.00	0.00	0.00	0.00	45.00	1598

(continued)

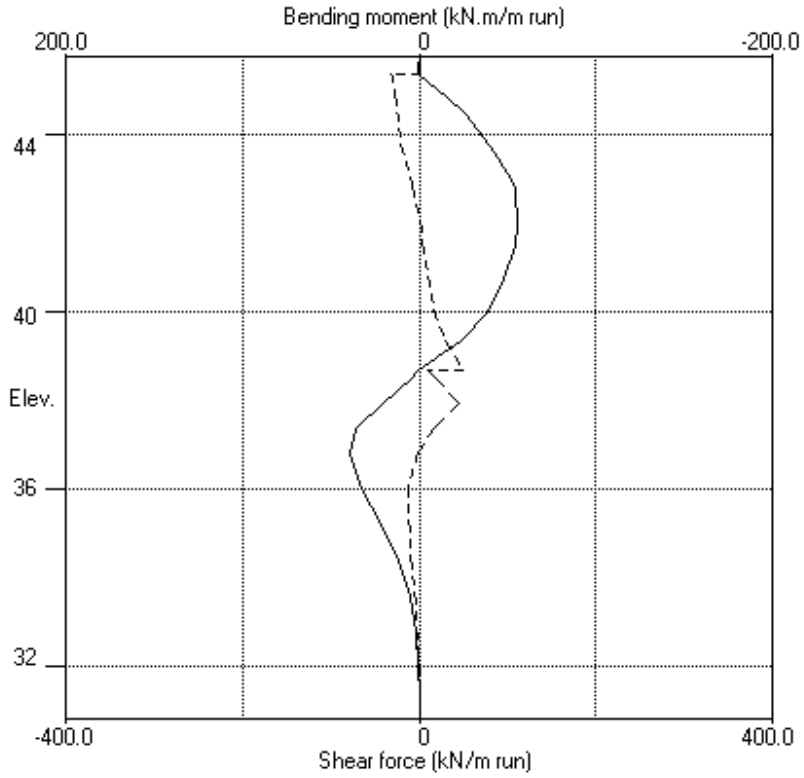
Stage No.14 Change EI of wall to 290309 kN.m2/m run
From elevation 45.80 to 41.50
Yield moment not defined
No adjustments to wall displacements

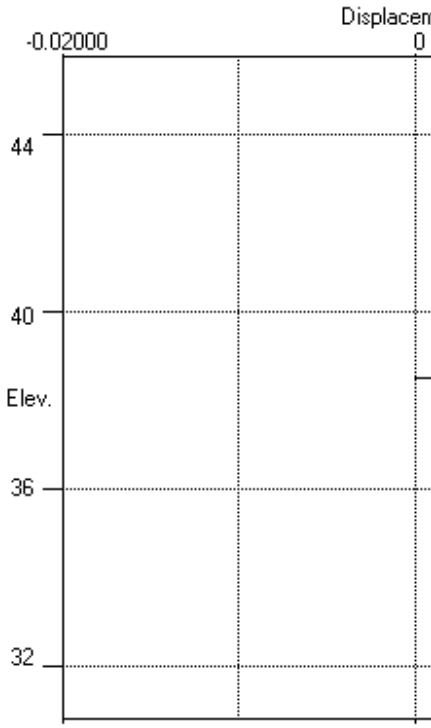
Node no.	Y coord	RIGHT side Water press. kN/m2	Effective stresses Vertic -al kN/m2	Active limit kN/m2	Passive limit kN/m2	Earth pressure kN/m2	Total earth pressure kN/m2	Coeff. of subgrade reaction kN/m3
17	37.94	50.60	4.48	1.22	22.52	1.22	51.82a	1598
		Total> 55.08	25.30m	316.99	162.78	162.78		11767
18	37.37	Total> 66.49	28.15m	334.99	161.81	161.81		12181
19	36.80	Total> 77.91	31.00m	353.01	162.40	162.40		12595
20	36.00	Total> 93.96	35.00m	378.32	167.42	167.42		13176
21	35.20	Total> 110.06	39.00m	403.68	177.32	177.32		13758
22	34.40	Total> 126.23	43.00m	429.10	190.93	190.93		14339
23	33.60	Total> 142.46	47.00m	454.59	206.78	206.78		14920
24	32.80	Total> 158.78	51.00m	480.17	223.70	223.70		15502
25	32.00	Total> 175.17	55.00m	505.82	240.94	240.94		16083
26	31.40	Total> 187.53	58.00m	525.12	253.88	253.88		16519
27	30.80	Total> 199.93	61.00m	544.47	266.79	266.79		16955

Note: 51.82a Soil pressure at active limit
123.45p Soil pressure at passive limit

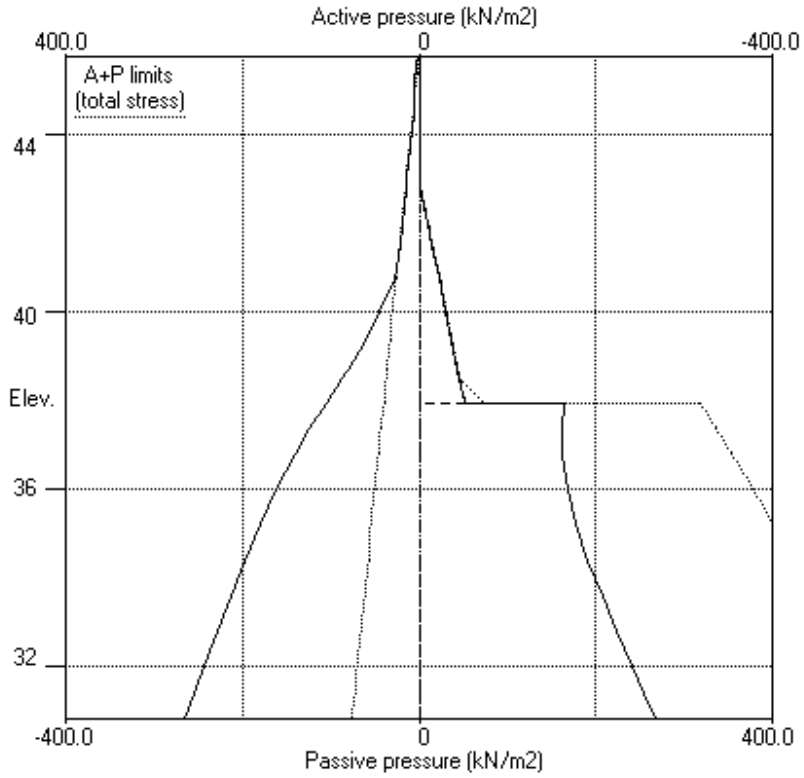
Units: kN,m

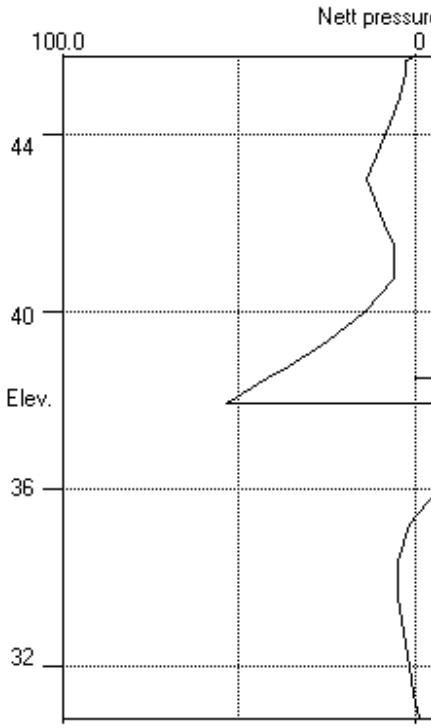
Stage No.14 Change EI of wall to 290309kN.m2/m run





Stage No.14 Change EI of wall to 290309kN.m2/m run





Units: kN,m

Stage No. 21 Change EI of wall to 145154 kN.m2/m run
From elevation 45.80 to 38.50
Yield moment not defined
No adjustments to wall displacements

BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall

Analysis options

Length of wall perpendicular to section = 15.00m
Subgrade reaction model - Boussinesq Influence coefficients
Soil deformations are elastic until the active or passive limit is reached
Open Tension Crack analysis - No

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

Limit State: ULS DA1 Combination 1

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

*** Wall displacements reset to zero at stage 4

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	45.80	0.00	0.004	-2.58E-03	0.0	0.0		145154
2	45.69	2.70	0.004	-2.58E-03	0.1	-0.0	60.4	145154
		2.70	0.004	-2.58E-03	-60.2	-0.0		
3	45.60	2.45	0.004	-2.58E-03	-60.0	-5.4		145154
4	45.40	1.97	0.005	-2.57E-03	-59.6	-17.4		145154
		1.55	0.005	-2.57E-03	-59.6	-17.4		
5	44.85	0.00	0.006	-2.45E-03	-59.1	-49.9		145154
6	44.50	3.06	0.007	-2.29E-03	-58.6	-70.5		145154
7	43.75	15.24	0.009	-1.78E-03	-51.8	-109.4		145154
8	43.00	27.85	0.010	-1.07E-03	-35.6	-143.4		145154
9	42.80	31.19	0.010	-8.50E-04	-29.7	-149.8		145154
10	42.00	44.31	0.010	6.41E-05	0.5	-160.5		145154
11	41.50	52.26	0.010	6.36E-04	24.7	-154.2		145154
12	40.75	63.88	0.009	1.29E-03	68.2	-118.3		145154
13	40.00	75.21	0.008	1.82E-03	120.4	-48.5		145154
14	39.35	84.88	0.007	2.02E-03	172.4	45.9		145154
15	38.70	94.46	0.006	1.83E-03	230.7	175.9	392.9	145154
		94.46	0.006	1.83E-03	-162.2	175.9		
16	38.50	97.39	0.005	1.71E-03	-143.0	145.4		46965
17	37.94	103.99	0.005	7.21E-04	-86.6	80.4		46965
		71.15	0.005	7.21E-04	-86.6	80.4		
18	37.37	49.73	0.004	2.48E-04	-52.2	41.3		46965
19	36.80	34.45	0.004	9.12E-05	-28.2	18.4		46965
20	36.00	11.82	0.004	7.80E-05	-9.7	4.0		46965
21	35.20	3.34	0.004	1.19E-04	-3.6	-0.4		46965
22	34.40	2.67	0.004	1.49E-04	-1.2	-2.3		46965
23	33.60	1.51	0.004	1.68E-04	0.5	-2.5		46965
24	32.80	0.32	0.004	1.79E-04	1.2	-1.7		46965
25	32.00	-0.58	0.004	1.84E-04	1.1	-0.7		46965
26	31.40	-0.97	0.004	1.85E-04	0.6	-0.2		46965
27	30.80	-1.17	0.003	1.85E-04	-0.0	-0.0		---

At elev. 45.69 Strut force = 60.4 kN/strut = 60.4 kN/m run
At elev. 38.70 Strut force = 392.9 kN/strut = 392.9 kN/m run

(continued)

Stage No.21 Change EI of wall to 145154 kN.m2/m run
From elevation 45.80 to 38.50
Yield moment not defined
No adjustments to wall displacements

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	45.80	0.00	0.00	0.00	0.00	0.00	0.00	92857
2	45.69	0.00	1.98	0.54	9.95	2.70	2.70	1870
3	45.60	0.00	3.60	0.98	18.09	2.45	2.45	1870
4	45.40	0.00	7.20	1.97	36.20	1.97	1.97a	1870
		0.00	7.20	0.00	46.91	1.55	1.55	9170
5	44.85	0.00	19.42	0.00	83.89	0.00	0.00a	9170
6	44.50	0.00	27.49	3.06	108.34	3.06	3.06a	9170
7	43.75	7.50	39.59	7.74	144.97	7.74	15.24a	9170
8	43.00	15.00	52.79	12.85	184.95	12.85	27.85a	9170
9	42.80	17.00	56.26	14.19	195.46	14.19	31.19a	9170
		17.00	56.26	14.19	195.46	14.19	31.19a	8630
10	42.00	25.00	69.49	19.31	235.51	19.31	44.31a	9019
11	41.50	30.00	77.12	22.26	258.63	22.26	52.26a	9261
12	40.75	37.50	87.75	26.38	290.82	26.38	63.88a	9625
13	40.00	45.00	97.65	30.21	320.79	30.21	75.21a	9990
14	39.35	51.50	105.84	33.38	345.59	33.38	84.88a	10305
15	38.70	58.00	113.80	36.46	369.67	36.46	94.46a	10621
16	38.50	60.00	116.21	37.39	376.98	37.39	97.39a	10718
17	37.94	65.60	122.91	39.98	397.27	45.22	110.82	74024
18	37.37	71.30	129.67	42.60	417.73	49.14	120.44	12146
19	36.80	77.00	136.38	45.19	438.04	54.65	131.65	12444
20	36.00	85.00	145.75	48.82	466.42	61.33	146.33	12863
21	35.20	93.00	155.09	52.44	494.70	68.12	161.12	13282
22	34.40	101.00	164.41	56.04	522.94	75.34	176.34	13700
23	33.60	109.00	173.73	59.65	551.16	83.01	192.01	14119
24	32.80	117.00	183.05	63.26	579.37	91.06	208.06	14538
25	32.00	125.00	192.37	66.86	607.60	99.44	224.44	14957
26	31.40	131.00	199.37	69.57	628.77	105.93	236.93	15271
27	30.80	137.00	206.36	72.28	649.96	112.55	249.55	15585

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	45.80	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	45.69	0.00	0.00	0.00	0.00	0.00	0.00	0.0
3	45.60	0.00	0.00	0.00	0.00	0.00	0.00	0.0
4	45.40	0.00	0.00	0.00	0.00	0.00	0.00	0.0
5	44.85	0.00	0.00	0.00	0.00	0.00	0.00	0.0
6	44.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
7	43.75	0.00	0.00	0.00	0.00	0.00	0.00	0.0
8	43.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
9	42.80	0.00	0.00	0.00	0.00	0.00	0.00	0.0
10	42.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
11	41.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
12	40.75	0.00	0.00	0.00	0.00	0.00	0.00	0.0
13	40.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
14	39.35	0.00	0.00	0.00	0.00	0.00	0.00	0.0
15	38.70	0.00	0.00	0.00	0.00	0.00	0.00	0.0
16	38.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
		0.00	0.00	0.00	0.00	0.00	0.00	31953

(continued)

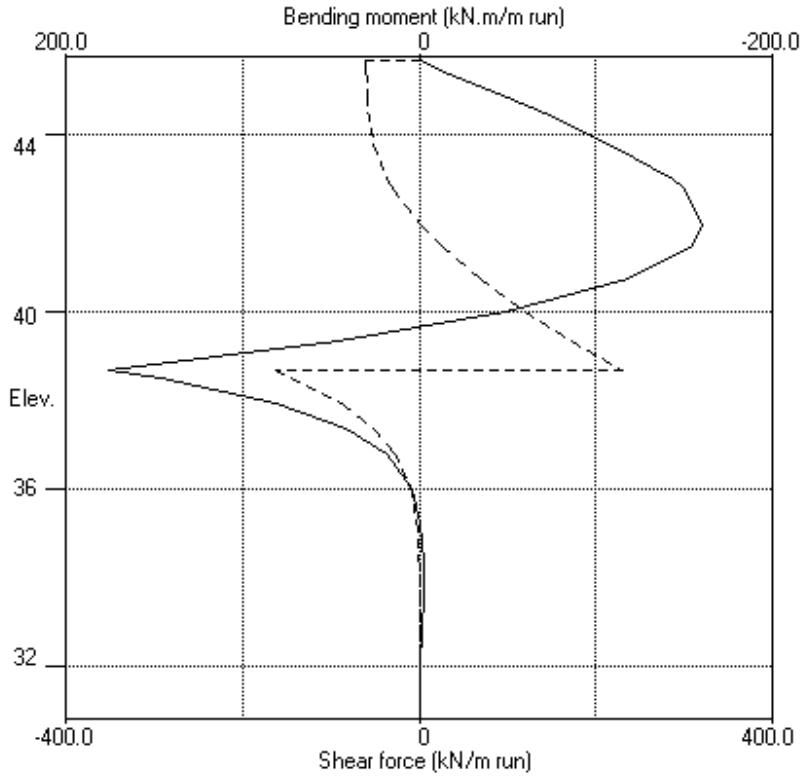
Stage No.21 Change EI of wall to 145154 kN.m2/m run
From elevation 45.80 to 38.50
Yield moment not defined
No adjustments to wall displacements

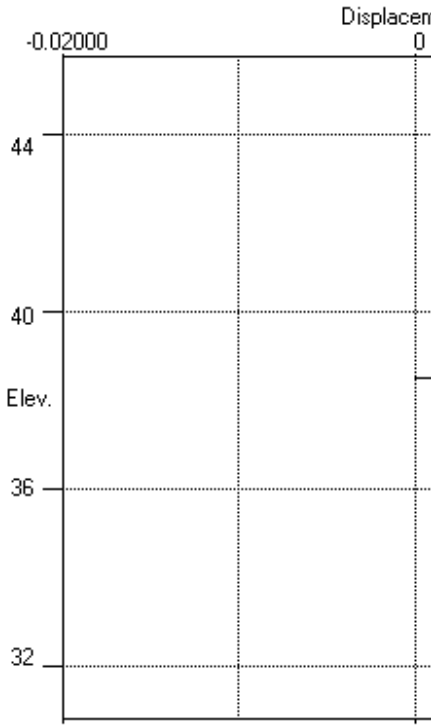
Node no.	Y coord	RIGHT side Water press. kN/m2	Effective stresses Vertic -al kN/m2	Active limit kN/m2	Passive limit kN/m2	Earth pressure kN/m2	Total earth pressure kN/m2	Coeff. of subgrade reaction kN/m3
17	37.94	5.60	4.48	1.22	22.52	1.22	6.82a	12595
		5.60	4.48	0.00	38.67	34.07	39.67	74024
18	37.37	11.30	11.33	0.00	59.41	59.41	70.71p	12146
19	36.80	17.00	18.20	0.00	80.20	80.20	97.20p	12444
20	36.00	25.00	27.88	3.21	109.51	109.51	134.51p	12863
21	35.20	33.00	37.63	6.98	139.03	124.78	157.78	13282
22	34.40	41.00	47.47	10.79	168.82	132.67	173.67	13700
23	33.60	49.00	57.40	14.63	198.92	141.50	190.50	14119
24	32.80	57.00	67.46	18.52	229.36	150.74	207.74	14538
25	32.00	65.00	77.63	22.46	260.17	160.02	225.02	14957
26	31.40	71.00	85.35	25.45	283.54	166.90	237.90	15271
27	30.80	77.00	93.14	28.46	307.12	173.73	250.73	15585

Note: 6.82a Soil pressure at active limit
134.51p Soil pressure at passive limit

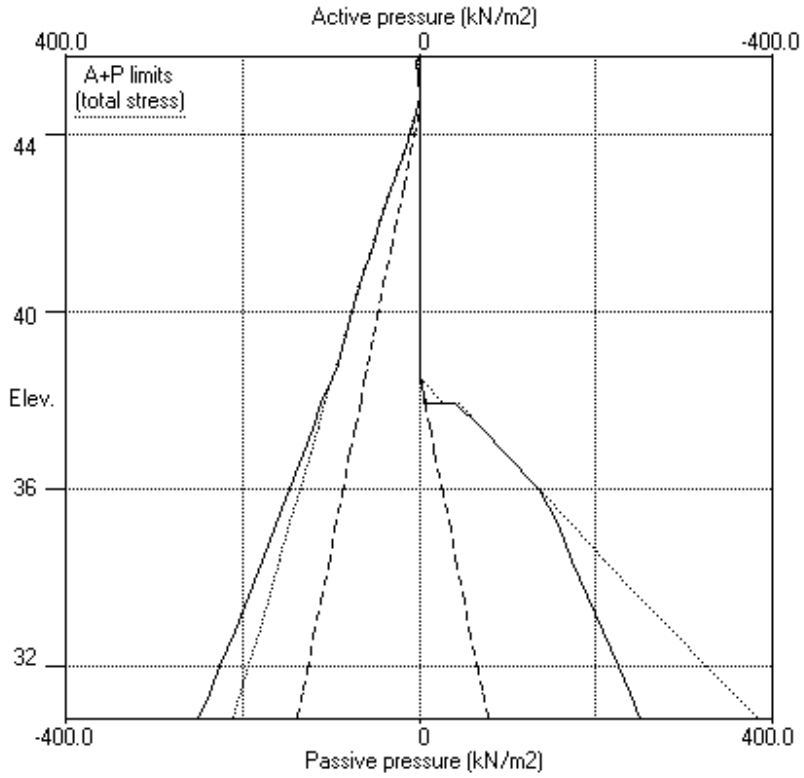
Units: kN,m

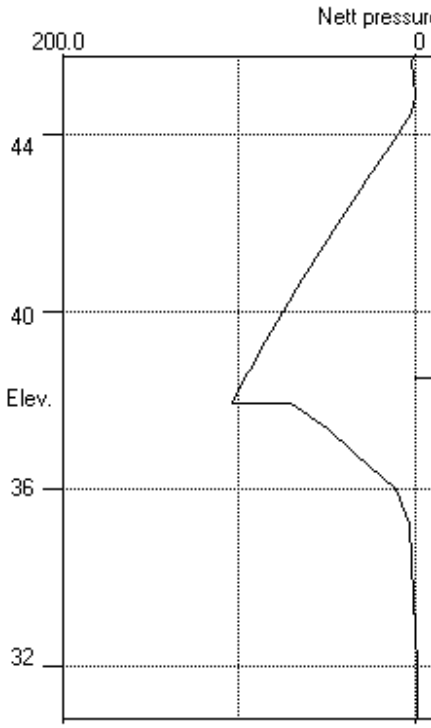
Stage No.21 Change EI of wall to 145154kN.m2/m run





Stage No.21 Change EI of wall to 145154kN.m2/m run





Units: kN,m

Summary of results

BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall

Analysis options

Length of wall perpendicular to section = 15.00m
Subgrade reaction model - Boussinesq Influence coefficients
Soil deformations are elastic until the active or passive limit is reached
Open Tension Crack analysis - No

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

Limit State: ULS DA1 Combination 1

Calculated Bending Moments and Strut Forces 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	45.80	0.004	0.000	0	-0	0	-0	0	0	0	0
2	45.69	0.004	0.000	0	-0	0	-0	0	-60	0	-81
3	45.60	0.004	0.000	0	-5	0	-7	0	-60	1	-81
4	45.40	0.005	0.000	0	-17	0	-23	1	-60	2	-80
5	44.85	0.006	0.000	1	-50	1	-67	2	-59	3	-80
6	44.50	0.007	0.000	2	-71	3	-95	4	-59	6	-79
7	43.75	0.009	0.000	10	-109	14	-148	11	-52	14	-70
8	43.00	0.010	0.000	13	-143	17	-194	4	-36	5	-48
9	42.80	0.010	0.000	13	-150	17	-202	7	-30	9	-40
10	42.00	0.010	0.000	9	-161	12	-217	17	-40	23	-54
11	41.50	0.010	0.000	6	-154	9	-208	33	-34	45	-45
12	40.75	0.009	0.000	3	-118	4	-160	68	-22	92	-29
13	40.00	0.008	0.000	9	-55	12	-74	120	-7	162	-9
14	39.35	0.007	0.000	46	-54	62	-73	172	-1	233	-2
15	38.70	0.006	0.000	176	-41	238	-56	231	-162	311	-219
16	38.50	0.005	0.000	145	-34	196	-46	39	-143	53	-193
17	37.94	0.005	0.000	80	-6	108	-9	65	-87	88	-117
18	37.37	0.004	0.000	41	-1	56	-2	33	-52	45	-70
19	36.80	0.004	0.000	40	-1	54	-1	12	-28	16	-38
20	36.00	0.004	0.000	32	0	44	0	1	-16	1	-22
21	35.20	0.004	0.000	24	-0	32	-1	1	-13	1	-18
22	34.40	0.004	0.000	14	-2	19	-3	0	-10	0	-14
23	33.60	0.004	0.000	7	-4	9	-5	0	-7	1	-10
24	32.80	0.004	0.000	2	-3	3	-4	2	-4	2	-5
25	32.00	0.004	0.000	0	-1	1	-2	2	-1	2	-2
26	31.40	0.004	0.000	0	-0	0	-0	1	-0	2	-0
27	30.80	0.003	0.000	0	-0	0	-0	0	-0	0	-0

Summary of results (continued)

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

Maximum and minimum bending moment and shear force at each stage

Stage	Bending moment						Shear force					
no.	Calculated				Factored		Calculated				Factored	
	max.	elev.	min.	elev.	max.	min.	max.	elev.	min.	elev.	max.	min.
	kN.m/m		kN.m/m		kN.m/m		kN/m		kN/m		kN/m	kN/m
1	0	36.80	-1	42.80	0	-1	0	40.75	-1	43.75	1	-1
2	No calculation at this stage											
3	1	34.40	-6	40.75	1	-9	2	38.70	-3	43.00	2	-4
4	No calculation at this stage											
5	13	43.00	-2	38.50	17	-2	11	43.75	-6	41.50	14	-7
6	No calculation at this stage											
7	11	39.35	-36	42.80	15	-49	33	41.50	-23	45.40	45	-31
8	No calculation at this stage											
9	31	36.80	-54	40.00	42	-72	63	37.94	-40	42.00	86	-54
10	32	36.80	-55	40.00	44	-74	65	37.94	-40	42.00	88	-54
11	No calculation at this stage											
12	No calculation at this stage											
13	40	36.80	-55	42.00	53	-75	50	38.70	-31	45.40	67	-42
14	40	36.80	-55	42.00	53	-75	50	38.70	-31	45.40	67	-42
15	No calculation at this stage											
16	40	36.80	-58	42.80	54	-79	51	38.70	-30	45.69	69	-41
17	86	38.70	-80	42.00	116	-108	134	38.70	-79	38.70	181	-106
18	No calculation at this stage											
19	No calculation at this stage											
20	No calculation at this stage											
21	176	38.70	-161	42.00	238	-217	231	38.70	-162	38.70	311	-219

Maximum and minimum displacement at each stage

Stage	Displacement				Stage description
no.	maximum	elev.	minimum	elev.	
	m		m		
1	0.000	41.50	0.000	45.80	Apply surcharge no.1 at elev. 44.85
2	No calculation at this stage				Apply surcharge no.2 at elev. 44.85
3	0.001	39.35	-0.000	45.80	Apply surcharge no.3 at elev. 45.60
4	Wall displacements reset to zero				Change EI of wall to 93950kN.m2/m run
5	0.004	45.80	0.000	45.80	Excav. to elev. 43.75 on RIGHT side
6	No calculation at this stage				Install strut no.4 at elev. 45.40
7	0.005	43.75	0.000	45.80	Excav. to elev. 41.50 on RIGHT side
8	No calculation at this stage				Install strut no.5 at elev. 42.00
9	0.006	40.75	0.000	45.80	Excav. to elev. 37.94 on RIGHT side
10	0.006	40.75	0.000	45.80	Fill to elev. 38.50 on RIGHT side
11	No calculation at this stage				Install strut no.3 at elev. 38.70
12	No calculation at this stage				Change EI of wall to 290309kN.m2/m run
13	0.007	42.00	0.000	45.80	Remove strut no.5 at elev. 42.00
14	0.007	42.00	0.000	45.80	Change EI of wall to 290309kN.m2/m run
15	No calculation at this stage				Install strut no.1 at elev. 45.69
16	0.008	42.00	0.000	45.80	Remove strut no.4 at elev. 45.40
17	0.008	42.00	0.000	45.80	Apply water pressure profile no.1
18	No calculation at this stage				Change soil type 2 to soil type 4
19	No calculation at this stage				Change soil type 3 to soil type 5
20	No calculation at this stage				Change EI of wall to 46965kN.m2/m run
21	0.010	42.00	0.000	45.80	Change EI of wall to 145154kN.m2/m run

Summary of results (continued)

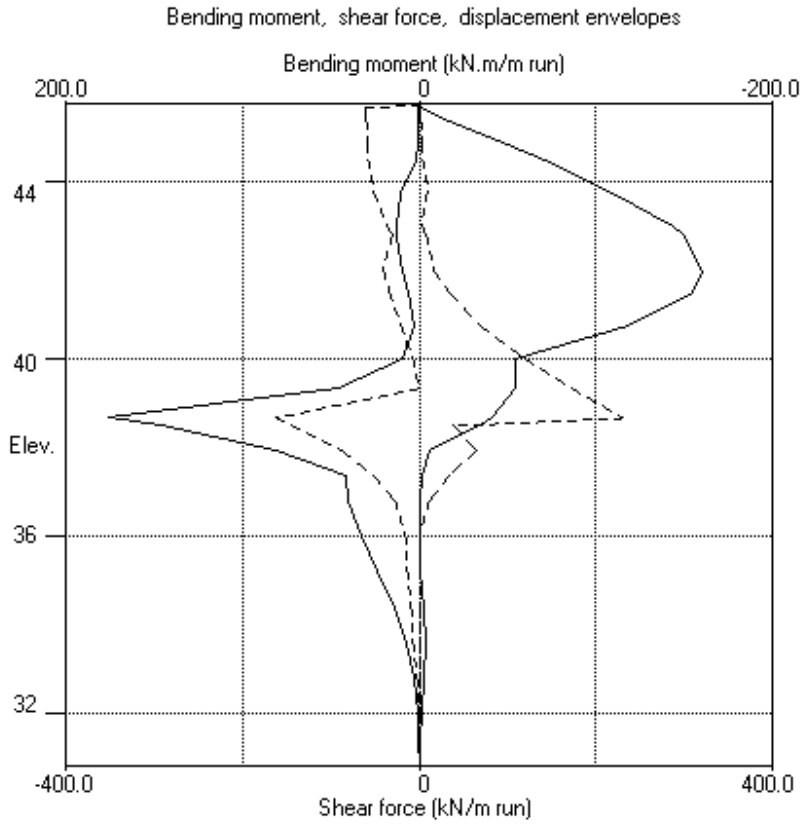
Calculated Bending Moments and Strut Forces have been multiplied by a factor of 1.35 to obtain values for structural design.

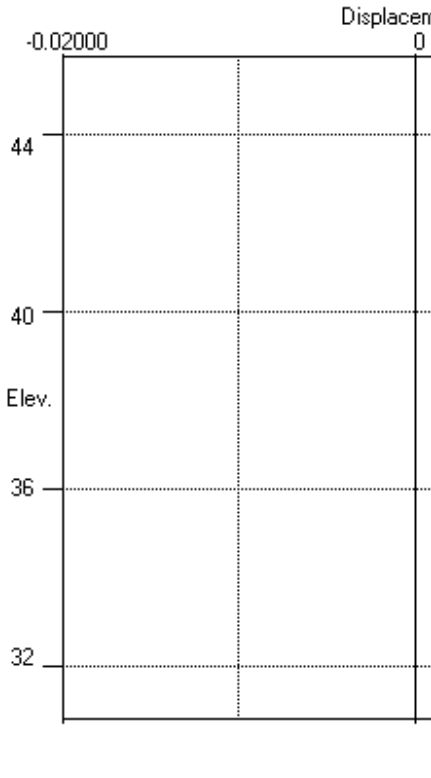
Strut forces at each stage (horizontal components)

Stage no.	Strut no. 1 at elev. 45.69			Strut no. 3 at elev. 38.70			Strut no. 4 at elev. 45.40		
	--Calculated-- kN per m run	kN per strut	Factored kN per strut	--Calculated-- kN per m run	kN per strut	Factored kN per strut	--Calculated-- kN per m run	kN per strut	Factored kN per strut
7	---	---	---	---	---	---	24	178	240
9	---	---	---	---	---	---	18	137	185
10	---	---	---	---	---	---	18	139	187
13	---	---	---	40	40	54	32	242	327
14	---	---	---	40	40	54	32	242	327
16	30	30	41	42	42	57	---	---	---
17	37	37	49	212	212	287	---	---	---
21	60	60	82	393	393	530	---	---	---

Stage no.	Strut no. 5 at elev. 42.00 --Calculated-- kN per m run	kN per strut	Factored kN per strut
9	57	426	576
10	57	426	575

Units: kN,m


Bending moment, shear force, displacement envelopes
Bending moment (kN.m/m run)
200.0
0
-200.0
44
40
Elev.
36
32
-400.0
0
400.0
Shear force (kN/m run)


Displacem
-0.02000
0
44
40
Elev.
36
32

SECTION 2-2 ULS - COMBINATION 2

KNIGHT BUILD LTD | Sheet No.
Program: WALLAP Version 6.06 Revision A49.B68.R53 | Job No. 79AR
Licensed from GEOSOLVE | Made by : JRC
Data filename/Run ID: SECTION_2-2_ULS2 |
79 Avenue Road | Date:28-06-2021
SECTION 2-2 ANALYSIS | Checked :

Units: kN,m

INPUT DATA

SOIL PROFILE

Stratum no.	Elevation of top of stratum	Soil types Left side	Soil types Right side
1	45.80	1 Made Ground	1 Made Ground
2	45.40	2 Head	2 Head
3	42.80	3 London Clay	3 London Clay

SOIL PROPERTIES (Unfactored SLS soil strengths)

No.	Soil type -- Description (Datum elev.)	Bulk density kN/m3	Young's Modulus Eh,kN/m2 (dEh/dy)	At rest coeff. Ko (dKo/dy)	Consol state. NC/OC (Nu)	Active limit Ka (Kac)	Passive limit Kp (Kpc)	Cohesion kN/m2 (dc/dy)
1	Made Ground	18.00	13000	0.500	OC (0.200)	0.273 (0.000)	5.026 (0.000)	
2	Head	20.00	51000	1.000	OC (0.490)	1.000 (2.570)	1.000 (2.571)	80.00u
3	London Clay	20.00	51000	1.000	OC (0.490)	1.000 (2.570)	1.000 (2.571)	80.00u (4.500)
	(42.80)		(4500)					
4	Head (drained)	22.00	63750	0.625	OC (0.200)	0.387 (1.517)	3.028 (5.020)	5.000d
5	LC Drained	22.00	60000	0.625	OC (0.200)	0.387 (1.517)	3.028 (5.020)	5.000d
	(42.80)		(3375)					

Additional soil parameters associated with Ka and Kp

No.	Soil type Description	--- parameters for Ka --- Soil friction angle	Wall adhesion coeff.	Back-fill angle	--- parameters for Kp --- Soil friction angle	Wall adhesion coeff.	Back-fill angle
1	Made Ground	30.00	1.000	0.00	30.00	1.000	0.00
2	Head	0.00	1.000	0.00	0.00	0.995	0.00
3	London Clay	0.00	1.000	0.00	0.00	0.995	0.00
4	Head (drained)	22.01	1.000	0.00	22.00	1.000	0.00
5	LC Drained	22.01	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	43.00	43.00

Automatic water pressure balancing at toe of wall : No

Water press. profile no.	Left side Point no.	Elev. m	Piezo elev. m	Water press. kN/m2	Right side Point no.	Elev. m	Piezo elev. m	Water press. kN/m2	
1	1	44.50	44.50	0.0	1	38.50	38.50	0.0	MC+WC

WALL PROPERTIES

Type of structure = Fully Embedded Wall
Elevation of toe of wall = 30.80
Maximum finite element length = 0.80 m
Youngs modulus of wall E = 2.8000E+07 kN/m2
Moment of inertia of wall I = 3.3547E-03 m4/m run
E.I = 93931 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	45.69	1.00	0.250000	2.800E+07	15.00	0.00	0	No
2	41.40	1.00	0.250000	2.800E+07	10.00	0.00	0	No
3	38.70	1.00	0.450000	2.800E+07	10.00	0.00	0	No
4	45.40	7.50	0.016400	2.050E+08	10.00	0.00	0	No
5	42.00	7.50	0.016400	2.050E+08	10.00	30.00	0	No

SURCHARGE LOADS

Surch -arge no.	Elev.	Distance from wall	Length parallel to wall	Width perpend. to wall	Surcharge kN/m2 Near edge	Surcharge kN/m2 Far edge	Equiv. soil type	Partial factor/ Category
1	44.85	1.00(L)	1000.00	0.60	10.00	=	N/A	1.00 -
2	44.85	2.60(L)	1000.00	0.80	85.00	=	N/A	1.00 -
3	45.60	2.60(L)	1000.00	20.00	12.50	=	N/A	1.00 -

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 44.85
	No analysis at this stage
2	Apply surcharge no.2 at elevation 44.85
	No analysis at this stage
3	Apply surcharge no.3 at elevation 45.60
4	Change EI of wall to 93950 kN.m2/m run
	Yield moment not defined
	Reset wall displacements to zero at this stage
5	Excavate to elevation 43.75 on RIGHT side
6	Install strut or anchor no.4 at elevation 45.40
7	Excavate to elevation 41.50 on RIGHT side
8	Install strut or anchor no.5 at elevation 42.00
9	Excavate to elevation 37.94 on RIGHT side
10	Fill to elevation 38.50 on RIGHT side with soil type 1
11	Install strut or anchor no.3 at elevation 38.70
12	Change EI of wall to 290309 kN.m2/m run
	From elevation 41.50 to 38.50
	Yield moment not defined
	No adjustments to wall displacements
13	Remove strut or anchor no.5 at elevation 42.00
14	Change EI of wall to 290309 kN.m2/m run
	From elevation 45.80 to 41.50
	Yield moment not defined
	No adjustments to wall displacements
15	Install strut or anchor no.1 at elevation 45.69
16	Remove strut or anchor no.4 at elevation 45.40
17	Apply water pressure profile no.1 (Worst Cred.)
18	Change properties of soil type 2 to soil type 4
	No analysis at this stage
	Ko pressures will not be reset
19	Change properties of soil type 3 to soil type 5
	No analysis at this stage
	Ko pressures will not be reset
20	Change EI of wall to 46965 kN.m2/m run
	From elevation 38.50 to 30.80
	Yield moment not defined
	No adjustments to wall displacements
21	Change EI of wall to 145154 kN.m2/m run
	From elevation 45.80 to 38.50
	Yield moment not defined
	No adjustments to wall displacements

FACTORS OF SAFETY and ANALYSIS OPTIONS

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

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

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

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

Boundary conditions:
Length of wall (normal to plane of analysis) = 15.00 m

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

Distance to rigid boundary on Left side = 30.00 m
Distance to rigid boundary on Right side = 30.00 m

OUTPUT OPTIONS

Stage no.	Stage description	Output options: Displacement, Bending mom., Shear force	Active, Passive pressures	Graph. output
1	Apply surcharge no.1 at elev. 44.85	Yes	Yes	Yes
2	Apply surcharge no.2 at elev. 44.85	No	No	No
3	Apply surcharge no.3 at elev. 45.60	Yes	Yes	Yes
4	Change EI of wall to 93950kN.m2/m run	No	No	No
5	Excav. to elev. 43.75 on RIGHT side	Yes	Yes	Yes
6	Install strut no.4 at elev. 45.40	No	No	No
7	Excav. to elev. 41.50 on RIGHT side	Yes	Yes	Yes
8	Install strut no.5 at elev. 42.00	No	No	No
9	Excav. to elev. 37.94 on RIGHT side	No	No	No
10	Fill to elev. 38.50 on RIGHT side	No	No	No
11	Install strut no.3 at elev. 38.70	Yes	Yes	Yes
12	Change EI of wall to 290309kN.m2/m run	No	No	No
13	Remove strut no.5 at elev. 42.00	No	No	No
14	Change EI of wall to 290309kN.m2/m run	No	No	No
15	Install strut no.1 at elev. 45.69	No	No	No
16	Remove strut no.4 at elev. 45.40	No	No	No
17	Apply water pressure profile no.1	Yes	Yes	Yes
18	Change soil type 2 to soil type 4	No	No	No
19	Change soil type 3 to soil type 5	No	No	No
20	Change EI of wall to 46965kN.m2/m run	No	No	No
21	Change EI of wall to 145154kN.m2/m run	Yes	Yes	Yes
*	Summary output	Yes	-	Yes

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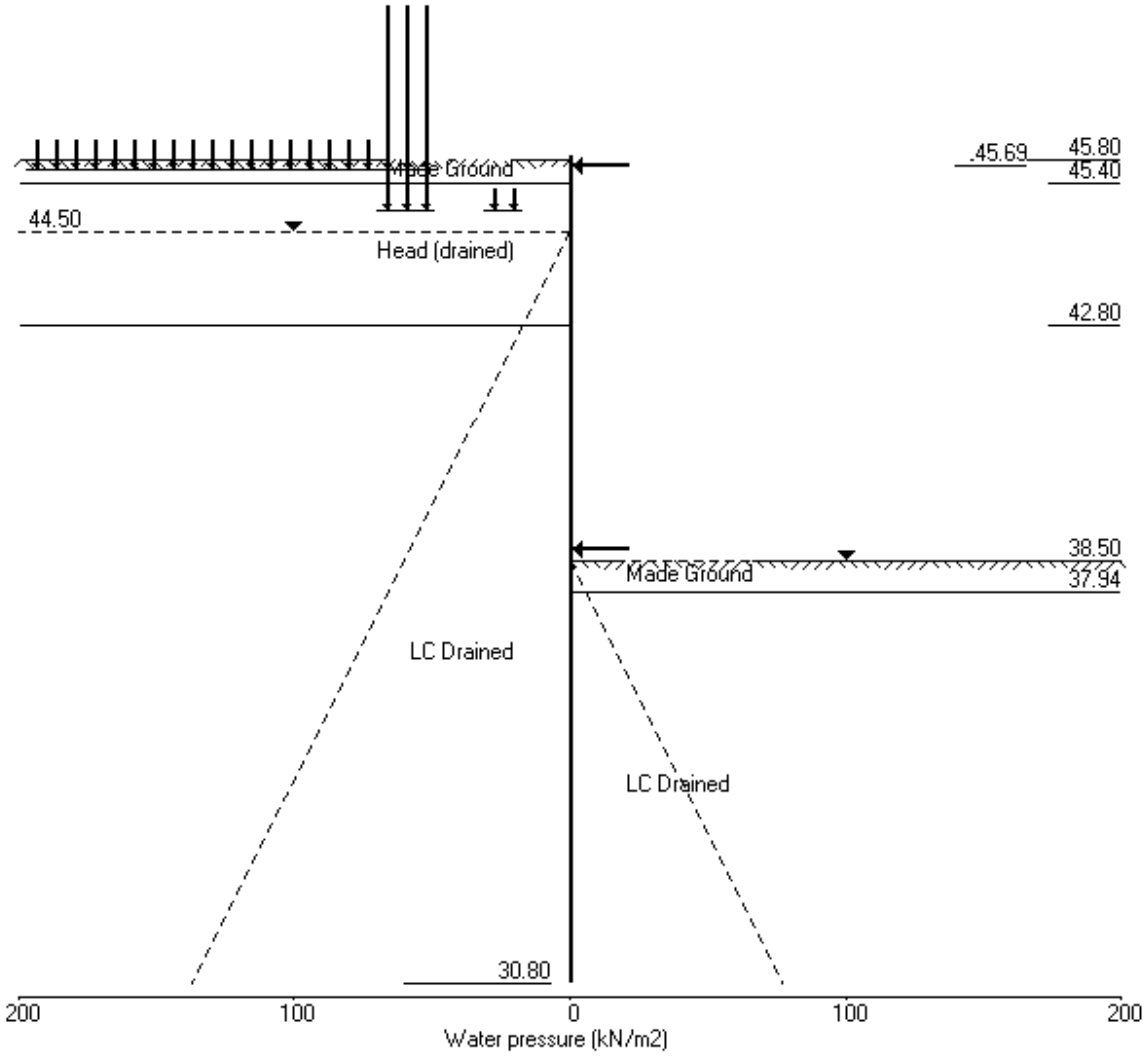
Units: kN,m

Stage No.21 Change EI of wall to 145154kN.m2/m run



Units: kN,m

Stage No. 5 Excavate to elevation 43.75 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.	Overall FoS for toe elev. = 30.80 Factor of Safety	Moment equilib. at elev.	Toe elev. for FoS = 1.000 Toe elev.	Wall Penetr -ation	Direction of failure
5	45.80	43.75	Cant.	6.157	31.38	43.50	0.25	L to R

BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall
Analysis options
Length of wall perpendicular to section = 15.00m
Subgrade reaction model - Boussinesq Influence coefficients
Soil deformations are elastic until the active or passive limit is reached
Open Tension Crack analysis - No

Rigid boundaries: Left side 30.00 from wall
Right side 30.00 from wall
Limit State: ULS DA1 Combination 2

*** Wall displacements reset to zero at stage 4

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	45.80	0.00	0.004	6.83E-04	0.0	-0.0		93950
2	45.69	0.68	0.004	6.83E-04	0.0	-0.0		93950
3	45.60	1.24	0.004	6.83E-04	0.1	0.0		93950
4	45.40	2.47	0.004	6.83E-04	0.5	0.1		93950
		2.00	0.004	6.83E-04	0.5	0.1		
5	44.85	4.75	0.003	6.81E-04	2.4	0.9		93950
6	44.50	6.50	0.003	6.76E-04	4.3	2.0		93950
7	43.75	10.28	0.003	6.22E-04	10.6	10.6		93950
		-20.52	0.003	6.22E-04	10.6	10.6		
8	43.00	-9.31	0.002	5.10E-04	-0.6	13.1		93950
9	42.80	-6.66	0.002	4.75E-04	-2.2	12.8		93950
10	42.00	-1.40	0.002	3.41E-04	-5.4	9.3		93950
11	41.50	0.64	0.002	2.67E-04	-5.6	6.5		93950
12	40.75	2.17	0.001	1.80E-04	-4.5	2.7		93950
13	40.00	2.40	0.001	1.21E-04	-2.8	-0.1		93950
14	39.35	2.02	0.001	9.02E-05	-1.4	-1.4		93950
15	38.70	1.43	0.001	7.22E-05	-0.3	-1.8		93950
16	38.50	1.24	0.001	6.89E-05	0.0	-1.8		93950
17	37.94	0.73	0.001	6.27E-05	0.6	-1.7		93950
18	37.37	0.30	0.001	6.02E-05	0.9	-1.2		93950
19	36.80	-0.02	0.001	5.95E-05	0.9	-0.7		93950
20	36.00	-0.29	0.001	5.95E-05	0.8	-0.0		93950
21	35.20	-0.38	0.001	5.92E-05	0.5	0.5		93950
22	34.40	-0.37	0.001	5.79E-05	0.2	0.8		93950
23	33.60	-0.29	0.001	5.61E-05	-0.0	0.8		93950
24	32.80	-0.18	0.001	5.41E-05	-0.2	0.6		93950
25	32.00	0.00	0.001	5.27E-05	-0.3	0.3		93950
26	31.40	0.21	0.001	5.21E-05	-0.2	0.1		93950
27	30.80	0.50	0.001	5.19E-05	-0.0	0.0		---

(continued)

Stage No.5 Excavate to elevation 43.75 on RIGHT side

Node no.	Y coord	LEFT side ------- Effective stresses ------- Water press. kN/m2	Vertic -al kN/m2	Active limit kN/m2	Passive limit kN/m2	Earth pressure kN/m2	Total earth pressure kN/m2	Coeff. of subgrade reaction kN/m3
1	45.80	0.00	0.00	0.00	0.00	0.00	0.00	2267
2	45.69	0.00	1.98	0.68	7.09	0.68	0.68a	2267
3	45.60	0.00	3.60	1.24	12.89	1.24	1.24a	2267
4	45.40	0.00	7.20	2.47	25.79	2.47	2.47a	2267
		Total>	7.20	2.00m	154.12	2.00	2.00a	11594
5	44.85	Total>	18.32	4.75m	165.23	4.75	4.75a	11594
6	44.50	Total>	25.69	6.50m	172.61	6.50	6.50a	11594
7	43.75	Total>	43.79	10.25m	190.71	10.28	10.28	11594
8	43.00	Total>	62.99	14.00m	209.92	33.24	33.24	11594
9	42.80	Total>	68.06	15.00m	214.99	39.15	39.15	11594
10	42.00	Total>	87.69	19.00m	241.23	59.68	59.68	12412
11	41.50	Total>	99.32	21.50m	257.00	71.57	71.57	12924
12	40.75	Total>	115.95	25.25m	279.83	88.20	88.20	13691
13	40.00	Total>	131.85	29.00m	301.93	103.80	103.80	14458
14	39.35	Total>	145.24	32.25m	320.69	116.84	116.84	15123
15	38.70	Total>	158.40	35.50m	339.22	129.65	129.65	15788
16	38.50	Total>	162.41	36.50m	344.89	133.58	133.58	15993
17	37.94	Total>	173.59	39.30m	360.70	144.55	144.55	16565
18	37.37	Total>	184.91	42.15m	376.73	155.74	155.74	17149
19	36.80	Total>	196.18	45.00m	392.71	166.98	166.98	17732
20	36.00	Total>	211.95	49.00m	415.09	182.84	182.84	18550
21	35.20	Total>	227.69	53.00m	437.45	198.78	198.78	19368
22	34.40	Total>	243.41	57.00m	459.78	214.80	214.80	20187
23	33.60	Total>	259.13	61.00m	482.12	230.87	230.87	21005
24	32.80	Total>	274.85	65.00m	504.45	246.97	246.97	21824
25	32.00	Total>	290.57	69.00m	526.78	263.12	263.12	22642
26	31.40	Total>	302.37	72.00m	543.54	275.28	275.28	23256
27	30.80	Total>	314.16	75.00m	560.29	287.50	287.50	23870

Node no.	Y coord	RIGHT side ------- Effective stresses ------- Water press. kN/m2	Vertic -al kN/m2	Active limit kN/m2	Passive limit kN/m2	Earth pressure kN/m2	Total earth pressure kN/m2	Coeff. of subgrade reaction kN/m3
1	45.80	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	45.69	0.00	0.00	0.00	0.00	0.00	0.00	0.0
3	45.60	0.00	0.00	0.00	0.00	0.00	0.00	0.0
4	45.40	0.00	0.00	0.00	0.00	0.00	0.00	0.0
5	44.85	0.00	0.00	0.00	0.00	0.00	0.00	0.0
6	44.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
7	43.75	0.00	0.00	0.00	0.00	0.00	0.00	0.0
		Total>	0.00	0.00	146.91	30.80	30.80	10032
8	43.00	Total>	15.00	3.75m	161.92	42.54	42.54	10032
9	42.80	Total>	19.00	4.75m	165.92	45.81	45.81	10032
10	42.00	Total>	35.01	8.75m	188.54	61.09	61.09	10740
11	41.50	Total>	45.02	11.25m	202.69	70.93	70.93	11182
12	40.75	Total>	60.06	15.00m	223.92	86.03	86.03	11846
13	40.00	Total>	75.11	18.75m	245.17	101.40	101.40	12510
14	39.35	Total>	88.17	22.00m	263.61	114.81	114.81	13085
15	38.70	Total>	101.25	25.25m	282.07	128.22	128.22	13661
16	38.50	Total>	105.28	26.25m	287.75	132.34	132.34	13838
17	37.94	Total>	116.58	29.05m	303.67	143.82	143.82	14333
18	37.37	Total>	128.09	31.90m	319.90	155.44	155.44	14838
19	36.80	Total>	139.62	34.75m	336.14	167.00	167.00	15343

(continued)

Stage No.5 Excavate to elevation 43.75 on RIGHT side

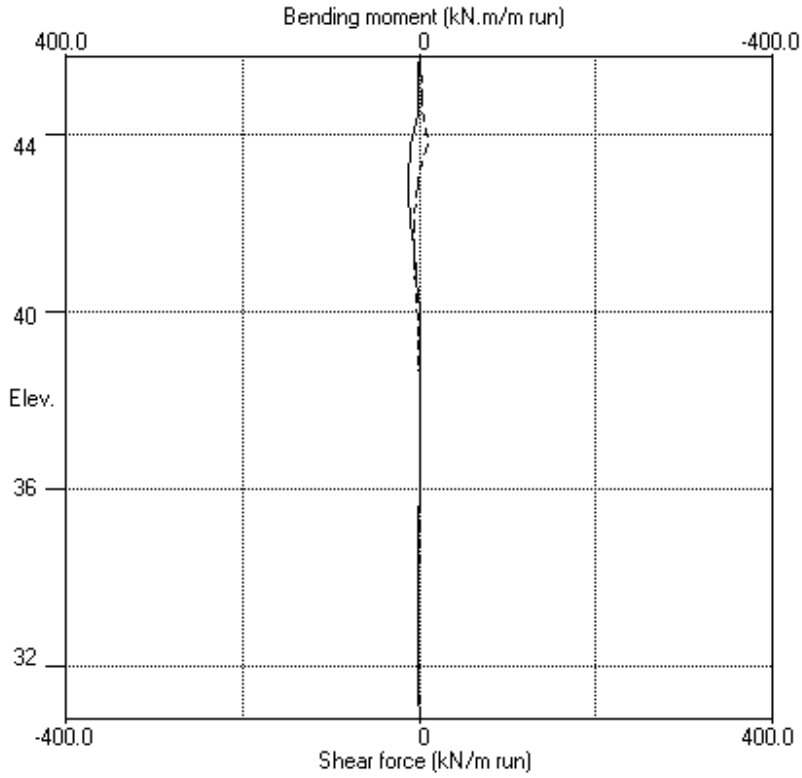
Node no.	Y coord	RIGHT side						
		Effective stresses					Total earth pressure	Coeff. of subgrade reaction
		Water press. kN/m2	Vertic -al kN/m2	Active limit kN/m2	Passive limit kN/m2	Earth pressure kN/m2		
20	36.00	Total>	155.84	38.75m	358.97	183.12	183.12	16051
21	35.20	Total>	172.09	42.75m	381.83	199.17	199.17	16759
22	34.40	Total>	188.37	46.75m	404.73	215.17	215.17	17467
23	33.60	Total>	204.69	50.75m	427.66	231.16	231.16	18175
24	32.80	Total>	221.04	54.75m	450.62	247.15	247.15	18883
25	32.00	Total>	237.42	58.75m	473.61	263.12	263.12	19591
26	31.40	Total>	249.72	61.75m	490.87	275.08	275.08	20122
27	30.80	Total>	262.03	64.75m	508.15	287.00	287.00	20653

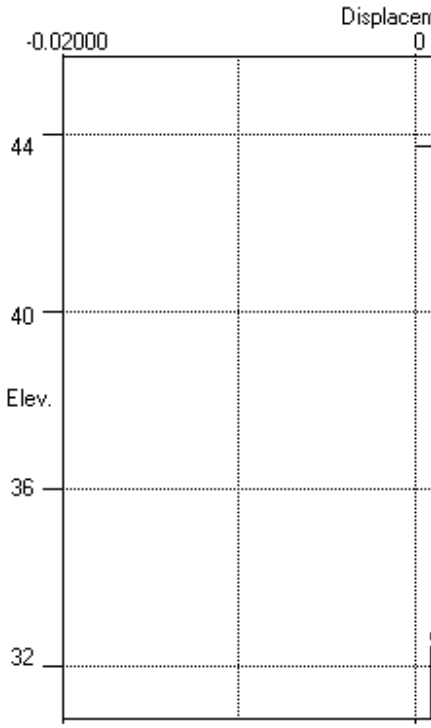
Note: 6.50a Soil pressure at active limit
123.45p Soil pressure at passive limit

KNIGHT BUILD LTD | Sheet No.
Program: WALLAP Version 6.06 Revision A49.B68.R53 | Job No. 79AR
Licensed from GEOSOLVE | Made by : JRC
Data filename/Run ID: SECTION_2-2_ULS2 |
79 Avenue Road | Date:28-06-2021
SECTION 2-2 ANALYSIS | Checked :

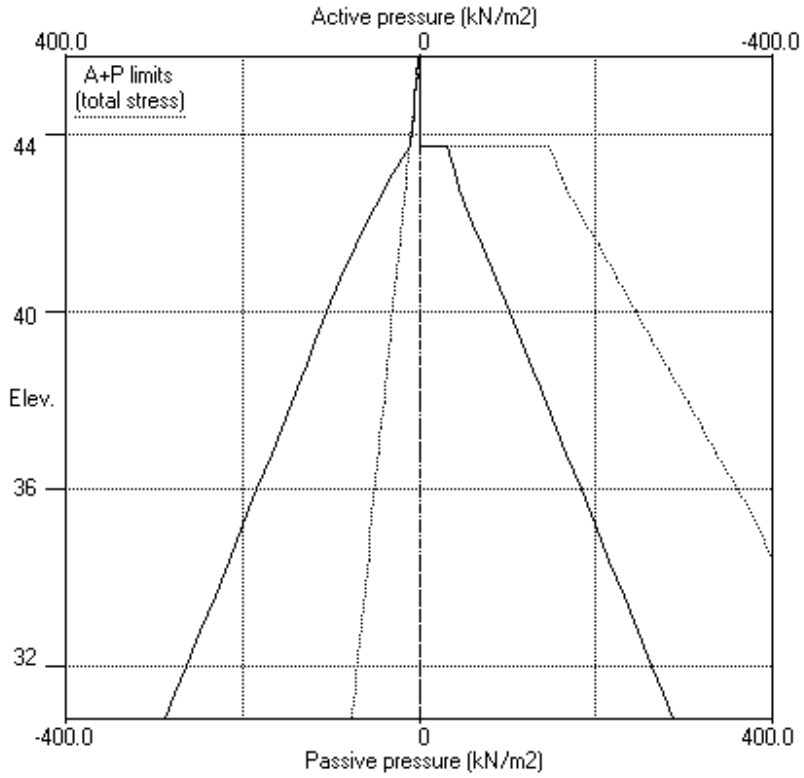
Units: kN,m

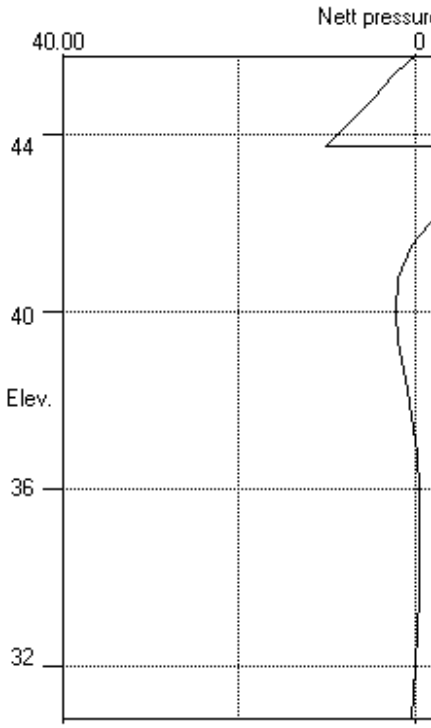
Stage No.5 Excav. to elev. 43.75 on RIGHT side





Stage No.5 Excav. to elev. 43.75 on RIGHT side





Units: kN,m

Stage No. 7 Excavate to elevation 41.50 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.	Overall FoS for toe elev. = 30.80 Factor of Safety	Moment equilib. at elev.	Toe elev. for FoS = 1.000 Toe elev.	Wall Penetr -ation	Direction of failure
7	45.80	41.50	45.40	4.803	n/a	41.39	0.11	L to R

BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall
Analysis options
Length of wall perpendicular to section = 15.00m
Subgrade reaction model - Boussinesq Influence coefficients
Soil deformations are elastic until the active or passive limit is reached
Open Tension Crack analysis - No

Rigid boundaries: Left side 30.00 from wall
Right side 30.00 from wall
Limit State: ULS DA1 Combination 2

*** Wall displacements reset to zero at stage 4

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	45.80	0.00	0.004	-3.20E-04	0.0	-0.0		93950
2	45.69	0.68	0.004	-3.20E-04	0.0	-0.0		93950
3	45.60	1.24	0.004	-3.20E-04	0.1	0.0		93950
4	45.40	2.47	0.004	-3.20E-04	0.5	0.1	23.8	93950
		2.00	0.004	-3.20E-04	-23.3	0.1		
5	44.85	4.75	0.004	-2.84E-04	-21.4	-12.2		93950
6	44.50	6.50	0.005	-2.25E-04	-19.4	-19.3		93950
7	43.75	10.25	0.005	-3.81E-05	-13.2	-28.6		93950
8	43.00	14.00	0.005	2.02E-04	-4.1	-35.9		93950
9	42.80	17.18	0.005	2.72E-04	-0.9	-36.3		93950
10	42.00	28.25	0.004	5.16E-04	17.2	-30.4		93950
11	41.50	35.48	0.004	6.13E-04	33.2	-18.0		93950
		-23.49	0.004	6.13E-04	33.2	-18.0		
12	40.75	-17.46	0.003	6.33E-04	17.8	0.4		93950
13	40.00	-11.22	0.003	5.48E-04	7.1	8.9		93950
14	39.35	-6.62	0.003	4.42E-04	1.3	11.2		93950
15	38.70	-3.15	0.002	3.38E-04	-1.9	10.6		93950
16	38.50	-2.32	0.002	3.08E-04	-2.5	10.1		93950
17	37.94	-0.54	0.002	2.37E-04	-3.3	8.4		93950
18	37.37	0.54	0.002	1.80E-04	-3.3	6.4		93950
19	36.80	1.07	0.002	1.40E-04	-2.8	4.6		93950
20	36.00	1.18	0.002	1.06E-04	-1.9	2.7		93950
21	35.20	0.91	0.002	9.06E-05	-1.1	1.5		93950
22	34.40	0.53	0.002	8.49E-05	-0.5	0.8		93950
23	33.60	0.21	0.002	8.36E-05	-0.2	0.5		93950
24	32.80	0.02	0.002	8.36E-05	-0.1	0.4		93950
25	32.00	-0.02	0.002	8.37E-05	-0.1	0.2		93950
26	31.40	0.07	0.002	8.36E-05	-0.1	0.1		93950
27	30.80	0.28	0.001	8.35E-05	-0.0	0.0		---

At elev. 45.40 Strut force = 178.1 kN/strut = 23.8 kN/m run

(continued)

Stage No.7 Excavate to elevation 41.50 on RIGHT side

Node no.	Y coord	LEFT side ------- Effective stresses ------- Water press. kN/m2	Vertic -al kN/m2	Active limit kN/m2	Passive limit kN/m2	Earth pressure kN/m2	Total earth pressure kN/m2	Coeff. of subgrade reaction kN/m3
1	45.80	0.00	0.00	0.00	0.00	0.00	0.00	3834
2	45.69	0.00	1.98	0.68	7.09	0.68	0.68a	1603
3	45.60	0.00	3.60	1.24	12.89	1.24	1.24a	1603
4	45.40	0.00	7.20	2.47	25.79	2.47	2.47a	1603
		Total> 7.20	2.00m	154.12	2.00	2.00a		8262
5	44.85	Total> 18.32	4.75m	165.23	4.75	4.75a		8262
6	44.50	Total> 25.69	6.50m	172.61	6.50	6.50a		8262
7	43.75	Total> 43.79	10.25m	190.71	10.25	10.25a		8262
8	43.00	Total> 62.99	14.00m	209.92	14.00	14.00a		8262
9	42.80	Total> 68.06	15.00m	214.99	19.18	19.18		8262
10	42.00	Total> 87.69	19.00m	241.23	38.25	38.25		8845
11	41.50	Total> 99.32	21.50m	257.00	50.48	50.48		9209
12	40.75	Total> 115.95	25.25m	279.83	68.89	68.89		9756
13	40.00	Total> 131.85	29.00m	301.93	86.87	86.87		10303
14	39.35	Total> 145.24	32.25m	320.69	101.87	101.87		10776
15	38.70	Total> 158.40	35.50m	339.22	116.29	116.29		11250
16	38.50	Total> 162.41	36.50m	344.89	120.62	120.62		11396
17	37.94	Total> 173.59	39.30m	360.70	132.49	132.49		11804
18	37.37	Total> 184.91	42.15m	376.73	144.28	144.28		12220
19	36.80	Total> 196.18	45.00m	392.71	155.84	155.84		12635
20	36.00	Total> 211.95	49.00m	415.09	171.84	171.84		13219
21	35.20	Total> 227.69	53.00m	437.45	187.73	187.73		13802
22	34.40	Total> 243.41	57.00m	459.78	203.61	203.61		14385
23	33.60	Total> 259.13	61.00m	482.12	219.54	219.54		14968
24	32.80	Total> 274.85	65.00m	504.45	235.56	235.56		15551
25	32.00	Total> 290.57	69.00m	526.78	251.67	251.67		16134
26	31.40	Total> 302.37	72.00m	543.54	263.84	263.84		16572
27	30.80	Total> 314.16	75.00m	560.29	276.07	276.07		17009

Node no.	Y coord	RIGHT side ------- Effective stresses ------- Water press. kN/m2	Vertic -al kN/m2	Active limit kN/m2	Passive limit kN/m2	Earth pressure kN/m2	Total earth pressure kN/m2	Coeff. of subgrade reaction kN/m3
1	45.80	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	45.69	0.00	0.00	0.00	0.00	0.00	0.00	0.0
3	45.60	0.00	0.00	0.00	0.00	0.00	0.00	0.0
4	45.40	0.00	0.00	0.00	0.00	0.00	0.00	0.0
5	44.85	0.00	0.00	0.00	0.00	0.00	0.00	0.0
6	44.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
7	43.75	0.00	0.00	0.00	0.00	0.00	0.00	0.0
8	43.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
9	42.80	2.00	0.00	0.00	0.00	0.00	2.00	0.0
10	42.00	10.00	0.00	0.00	0.00	0.00	10.00	0.0
11	41.50	15.00	0.00	0.00	0.00	0.00	15.00	0.0
		Total> 15.00	15.00w	172.66	73.98	73.98		13932
12	40.75	Total> 30.00	11.25m	193.86	86.35	86.35		14759
13	40.00	Total> 45.01	15.00m	215.07	98.09	98.09		15586
14	39.35	Total> 58.04	18.25m	233.47	108.50	108.50		16303
15	38.70	Total> 71.08	21.50m	251.88	119.44	119.44		17020
16	38.50	Total> 75.10	22.50m	257.55	122.94	122.94		17240
17	37.94	Total> 86.36	25.30m	273.45	133.03	133.03		17858
18	37.37	Total> 97.85	28.15m	289.65	143.73	143.73		18487
19	36.80	Total> 109.36	31.00m	305.87	154.77	154.77		19115

(continued)

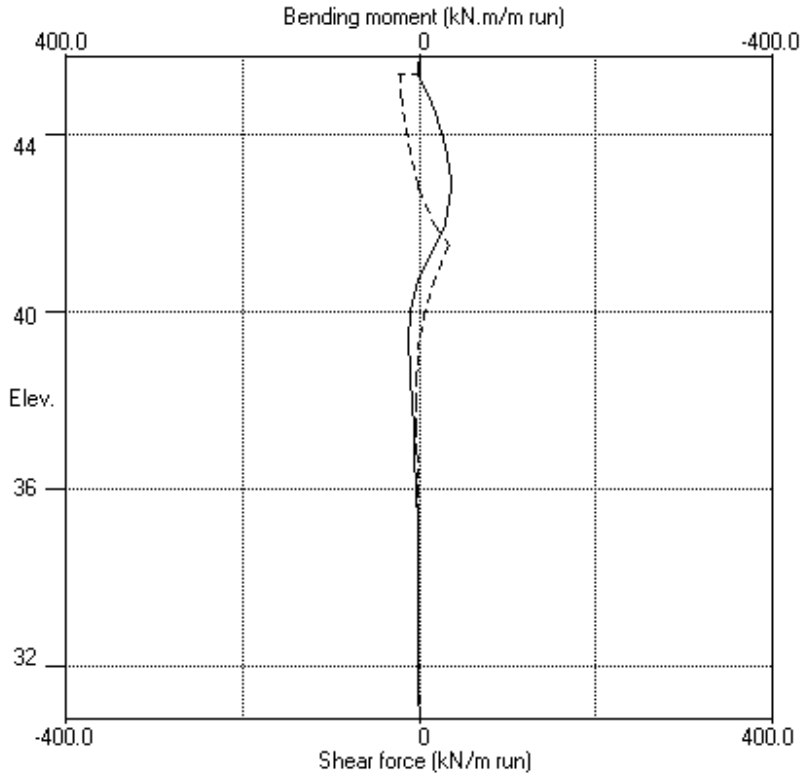
Stage No.7 Excavate to elevation 41.50 on RIGHT side

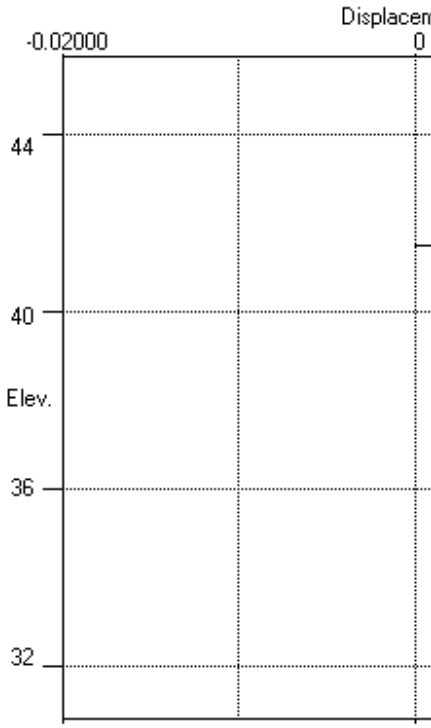
Node no.	Y coord	RIGHT side Water press. kN/m2	Effective stresses Vertic -al kN/m2	Active limit kN/m2	Passive limit kN/m2	Earth pressure kN/m2	Total earth pressure kN/m2	Coeff. of subgrade reaction kN/m3
20	36.00	Total>	125.57	35.00m	328.69	170.67	170.67	19997
21	35.20	Total>	141.83	39.00m	351.57	186.82	186.82	20880
22	34.40	Total>	158.16	43.00m	374.51	203.08	203.08	21762
23	33.60	Total>	174.54	47.00m	397.50	219.33	219.33	22644
24	32.80	Total>	190.99	51.00m	420.57	235.54	235.54	23526
25	32.00	Total>	207.50	55.00m	443.69	251.70	251.70	24409
26	31.40	Total>	219.92	58.00m	461.07	263.76	263.76	25070
27	30.80	Total>	232.37	61.00m	478.48	275.79	275.79	25732

Note: 14.00a Soil pressure at active limit
123.45p Soil pressure at passive limit

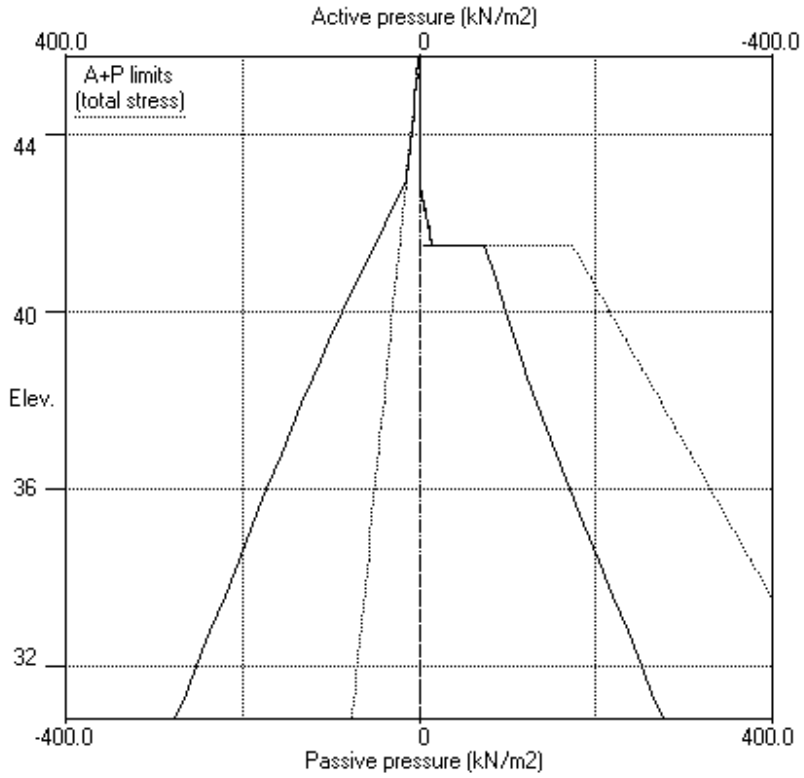
Units: kN,m

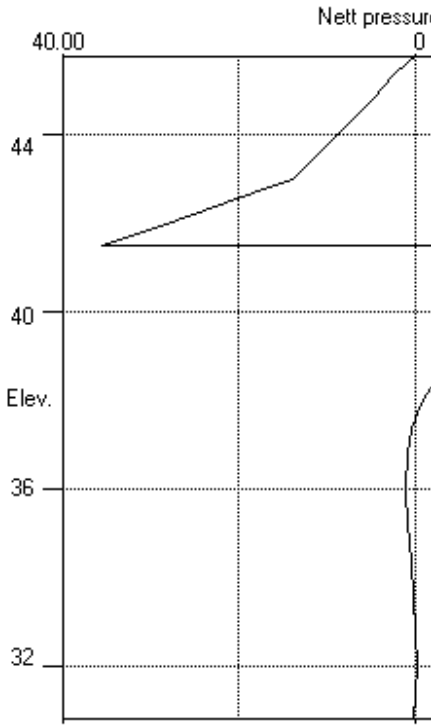
Stage No.7 Excav. to elev. 41.50 on RIGHT side





Stage No.7 Excav. to elev. 41.50 on RIGHT side





Units: kN,m

Stage No. 9 Excavate to elevation 37.94 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.	Overall FoS for toe elev. = 30.80 Factor of Safety	Moment equilib. at elev.	Toe elev. for FoS = 1.000 Toe elev.	Wall Penetr -ation	Direction of failure
9	45.80	37.94		More than one strut. No FoS calc.				

BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall
Analysis options
Length of wall perpendicular to section = 15.00m
Subgrade reaction model - Boussinesq Influence coefficients
Soil deformations are elastic until the active or passive limit is reached
Open Tension Crack analysis - No

Rigid boundaries: Left side 30.00 from wall
Right side 30.00 from wall
Limit State: ULS DA1 Combination 2

*** Wall displacements reset to zero at stage 4

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	45.80	0.00	0.004	-6.86E-04	0.0	-0.0		93950
2	45.69	3.31	0.004	-6.86E-04	0.2	-0.0		93950
3	45.60	3.48	0.004	-6.86E-04	0.5	0.0		93950
4	45.40	3.87	0.004	-6.86E-04	1.2	0.2	18.4	93950
		9.05	0.004	-6.86E-04	-17.1	0.2		
5	44.85	4.75	0.005	-6.64E-04	-13.3	-7.6		93950
6	44.50	6.50	0.005	-6.27E-04	-11.4	-11.9		93950
7	43.75	10.25	0.005	-5.23E-04	-5.1	-15.2		93950
8	43.00	14.00	0.006	-4.14E-04	4.0	-16.4		93950
9	42.80	13.00	0.006	-3.87E-04	6.7	-15.2		93950
10	42.00	12.22	0.006	-3.45E-04	16.8	-4.1	56.9	93950
		12.22	0.006	-3.45E-04	-40.1	-4.1		
11	41.50	14.33	0.006	-3.06E-04	-33.5	-22.4		93950
12	40.75	17.32	0.006	-9.65E-05	-21.6	-42.8		93950
13	40.00	21.77	0.006	2.40E-04	-6.9	-53.7		93950
14	39.35	27.98	0.006	5.74E-04	9.2	-53.3		93950
15	38.70	36.92	0.005	8.71E-04	30.3	-41.1		93950
16	38.50	40.20	0.005	9.44E-04	38.0	-34.3		93950
17	37.94	50.44	0.005	1.04E-03	63.4	-6.4		93950
		-61.95	0.005	1.04E-03	63.4	-6.4		
18	37.37	-45.34	0.004	9.97E-04	32.8	19.7		93950
19	36.80	-29.52	0.004	8.37E-04	11.5	31.0		93950
20	36.00	-12.19	0.003	5.71E-04	-5.2	30.7		93950
21	35.20	-1.61	0.003	3.45E-04	-10.7	22.7		93950
22	34.40	3.28	0.002	1.95E-04	-10.0	13.5		93950
23	33.60	4.43	0.002	1.15E-04	-6.9	6.5		93950
24	32.80	3.67	0.002	8.13E-05	-3.7	2.3		93950
25	32.00	2.23	0.002	7.17E-05	-1.3	0.5		93950
26	31.40	1.10	0.002	7.09E-05	-0.3	0.0		93950

(continued)

Stage No.9 Excavate to elevation 37.94 on RIGHT side

Node no.	Y coord	Nett pressure kN/m2	Wall disp. m	Wall rotation rad.	Shear force kN/m	Bending moment kN.m/m	Strut forces kN/m	EI of wall kN.m2/m
27	30.80	0.04	0.002	7.10E-05	-0.0	-0.0		---

At elev. 45.40 Strut force = 137.6 kN/strut = 18.4 kN/m run
At elev. 42.00 Strut force = 426.8 kN/strut = 56.9 kN/m run (horiz.)
= 65.7 kN/m run (inclined)

LEFT side

Node no.	Y coord	Water press. kN/m2	Vertic -al kN/m2	Effective stresses Active limit kN/m2	Passive limit kN/m2	Earth pressure kN/m2	Total earth pressure kN/m2	Coeff. of subgrade reaction kN/m3
1	45.80	0.00	0.00	0.00	0.00	0.00	0.00	11612
2	45.69	0.00	1.98	0.68	7.09	3.31	3.31	11612
3	45.60	0.00	3.60	1.24	12.89	3.48	3.48	11612
4	45.40	0.00	7.20	2.47	25.79	3.87	3.87	11612
		Total>	7.20	2.00m	154.12	9.05	9.05	58558
5	44.85	Total>	18.32	4.75m	165.23	4.75	4.75a	8847
6	44.50	Total>	25.69	6.50m	172.61	6.50	6.50a	8847
7	43.75	Total>	43.79	10.25m	190.71	10.25	10.25a	8847
8	43.00	Total>	62.99	14.00m	209.92	14.00	14.00a	8847
9	42.80	Total>	68.06	15.00m	214.99	15.00	15.00a	8847
10	42.00	Total>	87.69	19.00m	241.23	22.22	22.22	9472
11	41.50	Total>	99.32	21.50m	257.00	29.33	29.33	9862
12	40.75	Total>	115.95	25.25m	279.83	39.82	39.82	10448
13	40.00	Total>	131.85	29.00m	301.93	51.77	51.77	11033
14	39.35	Total>	145.24	32.25m	320.69	64.48	64.48	11540
15	38.70	Total>	158.40	35.50m	339.22	79.92	79.92	12048
16	38.50	Total>	162.41	36.50m	344.89	85.20	85.20	12204
17	37.94	Total>	173.59	39.30m	360.70	101.04	101.04	12641
18	37.37	Total>	184.91	42.15m	376.73	117.89	117.89	13086
19	36.80	Total>	196.18	45.00m	392.71	134.45	134.45	13531
20	36.00	Total>	211.95	49.00m	415.09	156.05	156.05	14156
21	35.20	Total>	227.69	53.00m	437.45	175.44	175.44	14780
22	34.40	Total>	243.41	57.00m	459.78	192.99	192.99	15405
23	33.60	Total>	259.13	61.00m	482.12	209.34	209.34	16029
24	32.80	Total>	274.85	65.00m	504.45	225.12	225.12	16654
25	32.00	Total>	290.57	69.00m	526.78	240.73	240.73	17278
26	31.40	Total>	302.37	72.00m	543.54	252.46	252.46	17747
27	30.80	Total>	314.16	75.00m	560.29	264.25	264.25	18215

RIGHT side

Node no.	Y coord	Water press. kN/m2	Vertic -al kN/m2	Effective stresses Active limit kN/m2	Passive limit kN/m2	Earth pressure kN/m2	Total earth pressure kN/m2	Coeff. of subgrade reaction kN/m3
1	45.80	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	45.69	0.00	0.00	0.00	0.00	0.00	0.00	0.0
3	45.60	0.00	0.00	0.00	0.00	0.00	0.00	0.0
4	45.40	0.00	0.00	0.00	0.00	0.00	0.00	0.0
5	44.85	0.00	0.00	0.00	0.00	0.00	0.00	0.0
6	44.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
7	43.75	0.00	0.00	0.00	0.00	0.00	0.00	0.0
8	43.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
9	42.80	2.00	0.00	0.00	0.00	0.00	2.00	0.0
10	42.00	10.00	0.00	0.00	0.00	0.00	10.00	0.0
11	41.50	15.00	0.00	0.00	0.00	0.00	15.00	0.0
12	40.75	22.50	0.00	0.00	0.00	0.00	22.50	0.0

(continued)

Stage No.9 Excavate to elevation 37.94 on RIGHT side

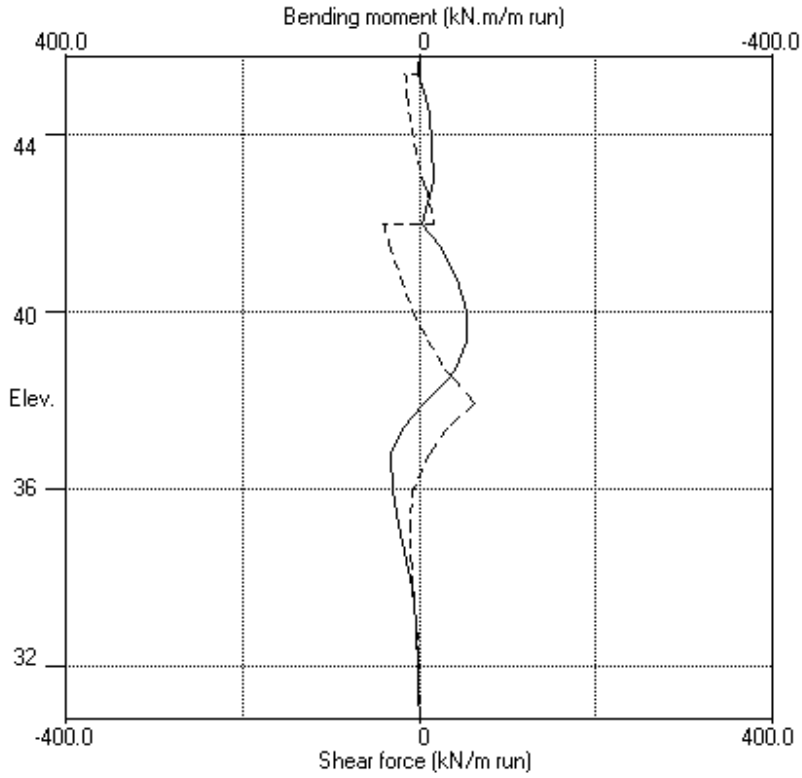
Node no.	Y coord	RIGHT side Water press. kN/m2	Effective stresses Vertic -al kN/m2	Active limit kN/m2	Passive limit kN/m2	Earth pressure kN/m2	Total earth pressure kN/m2	Coeff. of subgrade reaction kN/m3
13	40.00	30.00	0.00	0.00	0.00	0.00	30.00	0.0
14	39.35	36.50	0.00	0.00	0.00	0.00	36.50	0.0
15	38.70	43.00	0.00	0.00	0.00	0.00	43.00	0.0
16	38.50	45.00	0.00	0.00	0.00	0.00	45.00	0.0
17	37.94	50.60	0.00	0.00	0.00	0.00	50.60	0.0
		Total> 50.60	50.60w	237.68	162.99	162.99		25846
18	37.37	Total> 62.00	28.15m	253.79	163.23	163.23		26756
19	36.80	Total> 73.41	31.00m	269.91	163.97	163.97		27666
20	36.00	Total> 89.44	35.00m	292.55	168.24	168.24		28943
21	35.20	Total> 105.51	39.00m	315.24	177.05	177.05		30220
22	34.40	Total> 121.64	43.00m	337.98	189.71	189.71		31497
23	33.60	Total> 137.83	47.00m	360.79	204.91	204.91		32773
24	32.80	Total> 154.11	51.00m	383.67	221.45	221.45		34050
25	32.00	Total> 170.46	55.00m	406.64	238.49	238.49		35327
26	31.40	Total> 182.79	58.00m	423.93	251.35	251.35		36285
27	30.80	Total> 195.17	61.00m	441.27	264.21	264.21		37243

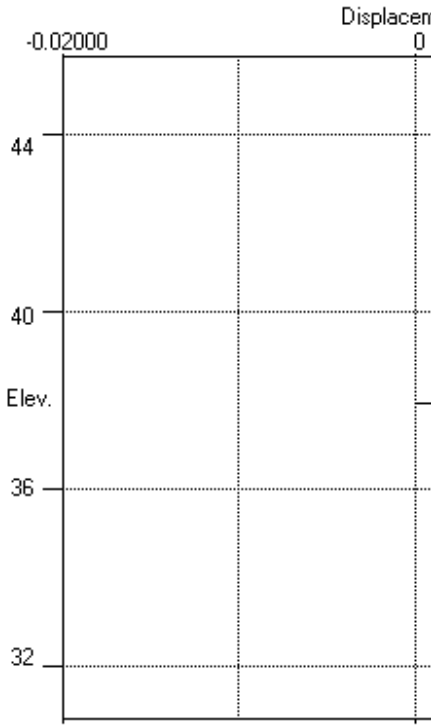
Note: 15.00a Soil pressure at active limit
123.45p Soil pressure at passive limit

KNIGHT BUILD LTD | Sheet No.
Program: WALLAP Version 6.06 Revision A49.B68.R53 | Job No. 79AR
Licensed from GEOSOLVE | Made by : JRC
Data filename/Run ID: SECTION_2-2_ULS2 |
79 Avenue Road | Date:28-06-2021
SECTION 2-2 ANALYSIS | Checked :

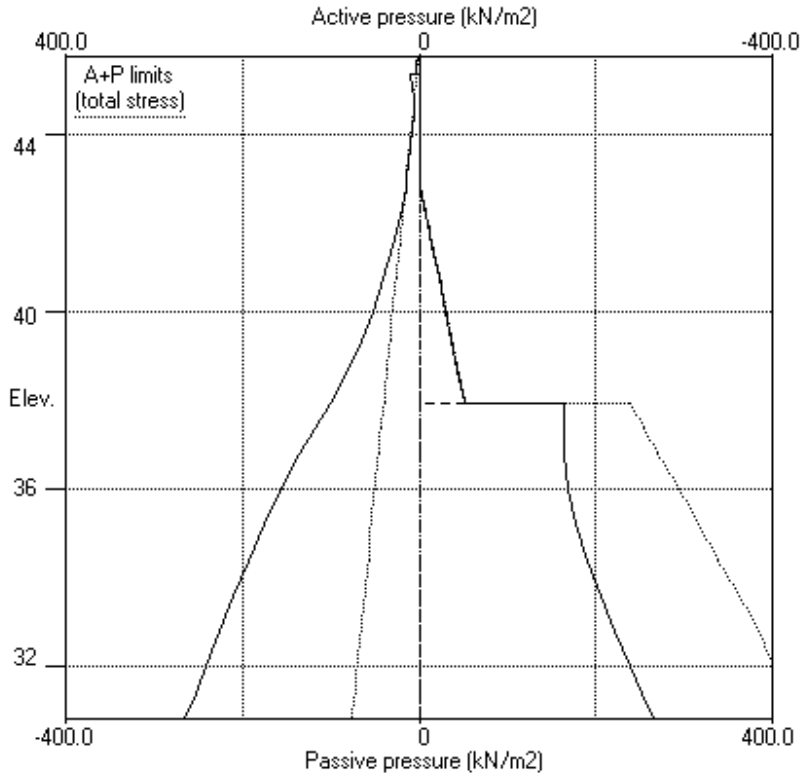
Units: kN,m

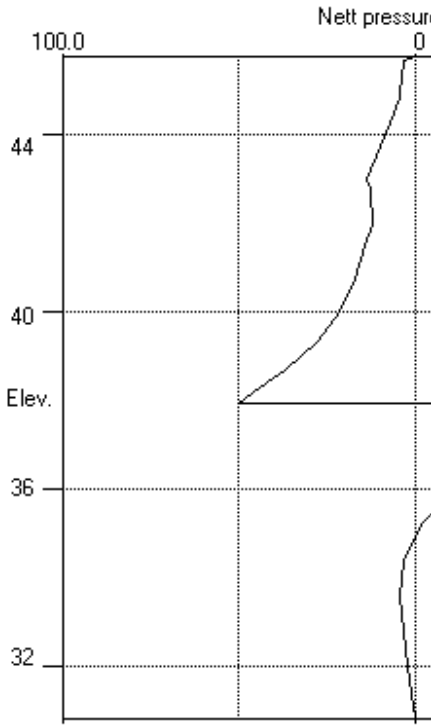
Stage No.9 Excav. to elev. 37.94 on RIGHT side





Stage No.9 Excav. to elev. 37.94 on RIGHT side





Units: kN,m

Stage No. 10 Fill to elevation 38.50 on RIGHT side with soil type 1

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

Stage No.	G.L. Act.	G.L. Pass.	Strut Elev.	Overall FoS for toe elev. = 30.80 Factor of Safety	Moment equilib. at elev.	Toe elev. for FoS = 1.000 Toe elev.	Wall Penetr -ation	Direction of failure
10	45.80	38.50		More than one strut. No FoS calc.				

BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall
Analysis options
Length of wall perpendicular to section = 15.00m
Subgrade reaction model - Boussinesq Influence coefficients
Soil deformations are elastic until the active or passive limit is reached
Open Tension Crack analysis - No

Rigid boundaries: Left side 30.00 from wall
Right side 30.00 from wall
Limit State: ULS DA1 Combination 2

*** Wall displacements reset to zero at stage 4

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	45.80	0.00	0.004	-6.89E-04	0.0	-0.0		93950
2	45.69	3.30	0.004	-6.89E-04	0.2	-0.0		93950
3	45.60	3.47	0.004	-6.89E-04	0.5	0.0		93950
4	45.40	3.86	0.004	-6.89E-04	1.2	0.2	18.6	93950
		8.99	0.004	-6.89E-04	-17.4	0.2		
5	44.85	4.75	0.005	-6.66E-04	-13.6	-7.7		93950
6	44.50	6.50	0.005	-6.28E-04	-11.6	-12.2		93950
7	43.75	10.25	0.005	-5.22E-04	-5.3	-15.6		93950
8	43.00	14.00	0.006	-4.09E-04	3.8	-17.0		93950
9	42.80	13.00	0.006	-3.81E-04	6.5	-15.9		93950
10	42.00	12.24	0.006	-3.32E-04	16.6	-4.9	56.8	93950
		12.24	0.006	-3.32E-04	-40.3	-4.9		
11	41.50	14.41	0.006	-2.89E-04	-33.6	-23.3		93950
12	40.75	17.53	0.006	-7.20E-05	-21.6	-43.8		93950
13	40.00	22.18	0.006	2.72E-04	-6.7	-54.6		93950
14	39.35	28.62	0.006	6.11E-04	9.8	-54.0		93950
15	38.70	37.84	0.005	9.12E-04	31.4	-41.3		93950
16	38.50	41.21	0.005	9.85E-04	39.3	-34.3		93950
17	37.94	50.17	0.005	1.08E-03	64.9	-5.6		93950
		-63.68	0.005	1.08E-03	64.9	-5.6		
18	37.37	-46.54	0.004	1.03E-03	33.5	21.0		93950
19	36.80	-30.28	0.003	8.61E-04	11.6	32.5		93950
20	36.00	-12.47	0.003	5.83E-04	-5.5	32.0		93950
21	35.20	-1.60	0.002	3.48E-04	-11.2	23.6		93950
22	34.40	3.42	0.002	1.92E-04	-10.4	14.1		93950
23	33.60	4.60	0.002	1.08E-04	-7.2	6.8		93950
24	32.80	3.82	0.002	7.30E-05	-3.9	2.4		93950
25	32.00	2.33	0.002	6.30E-05	-1.4	0.5		93950
26	31.40	1.15	0.002	6.21E-05	-0.4	0.0		93950

(continued)

Stage No.10 Fill to elevation 38.50 on RIGHT side with soil type 1

Node no.	Y coord	Nett pressure kN/m2	Wall disp. m	Wall rotation rad.	Shear force kN/m	Bending moment kN.m/m	Strut forces kN/m	EI of wall kN.m2/m
27	30.80	0.03	0.002	6.22E-05	-0.0	-0.0		---

At elev. 45.40 Strut force = 139.3 kN/strut = 18.6 kN/m run
At elev. 42.00 Strut force = 426.1 kN/strut = 56.8 kN/m run (horiz.)
= 65.6 kN/m run (inclined)

LEFT side

Node no.	Y coord	Water press. kN/m2	Vertic -al kN/m2	Effective stresses Active limit kN/m2	Passive limit kN/m2	Earth pressure kN/m2	Total earth pressure kN/m2	Coeff. of subgrade reaction kN/m3
1	45.80	0.00	0.00	0.00	0.00	0.00	0.00	2389
2	45.69	0.00	1.98	0.68	7.09	3.30	3.30	2389
3	45.60	0.00	3.60	1.24	12.89	3.47	3.47	2389
4	45.40	0.00	7.20	2.47	25.79	3.86	3.86	2389
		Total>	7.20	2.00m	154.12	8.99	8.99	12205
5	44.85	Total>	18.32	4.75m	165.23	4.75	4.75a	12205
6	44.50	Total>	25.69	6.50m	172.61	6.50	6.50a	12205
7	43.75	Total>	43.79	10.25m	190.71	10.25	10.25a	12205
8	43.00	Total>	62.99	14.00m	209.92	14.00	14.00a	12205
9	42.80	Total>	68.06	15.00m	214.99	15.00	15.00a	12205
10	42.00	Total>	87.69	19.00m	241.23	22.24	22.24	7584
11	41.50	Total>	99.32	21.50m	257.00	29.41	29.41	7896
12	40.75	Total>	115.95	25.25m	279.83	40.03	40.03	8365
13	40.00	Total>	131.85	29.00m	301.93	52.18	52.18	8834
14	39.35	Total>	145.24	32.25m	320.69	65.12	65.12	9240
15	38.70	Total>	158.40	35.50m	339.22	80.84	80.84	9646
16	38.50	Total>	162.41	36.50m	344.89	86.21	86.21	9771
17	37.94	Total>	173.59	39.30m	360.70	102.31	102.31	10121
18	37.37	Total>	184.91	42.15m	376.73	119.43	119.43	10478
19	36.80	Total>	196.18	45.00m	392.71	136.21	136.21	10834
20	36.00	Total>	211.95	49.00m	415.09	158.06	158.06	11334
21	35.20	Total>	227.69	53.00m	437.45	177.61	177.61	11834
22	34.40	Total>	243.41	57.00m	459.78	195.24	195.24	12334
23	33.60	Total>	259.13	61.00m	482.12	211.63	211.63	12834
24	32.80	Total>	274.85	65.00m	504.45	227.42	227.42	13334
25	32.00	Total>	290.57	69.00m	526.78	243.02	243.02	13834
26	31.40	Total>	302.37	72.00m	543.54	254.74	254.74	14209
27	30.80	Total>	314.16	75.00m	560.29	266.51	266.51	14584

RIGHT side

Node no.	Y coord	Water press. kN/m2	Vertic -al kN/m2	Effective stresses Active limit kN/m2	Passive limit kN/m2	Earth pressure kN/m2	Total earth pressure kN/m2	Coeff. of subgrade reaction kN/m3
1	45.80	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	45.69	0.00	0.00	0.00	0.00	0.00	0.00	0.0
3	45.60	0.00	0.00	0.00	0.00	0.00	0.00	0.0
4	45.40	0.00	0.00	0.00	0.00	0.00	0.00	0.0
5	44.85	0.00	0.00	0.00	0.00	0.00	0.00	0.0
6	44.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
7	43.75	0.00	0.00	0.00	0.00	0.00	0.00	0.0
8	43.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
9	42.80	2.00	0.00	0.00	0.00	0.00	2.00	0.0
10	42.00	10.00	0.00	0.00	0.00	0.00	10.00	0.0
11	41.50	15.00	0.00	0.00	0.00	0.00	15.00	0.0
12	40.75	22.50	0.00	0.00	0.00	0.00	22.50	0.0

(continued)

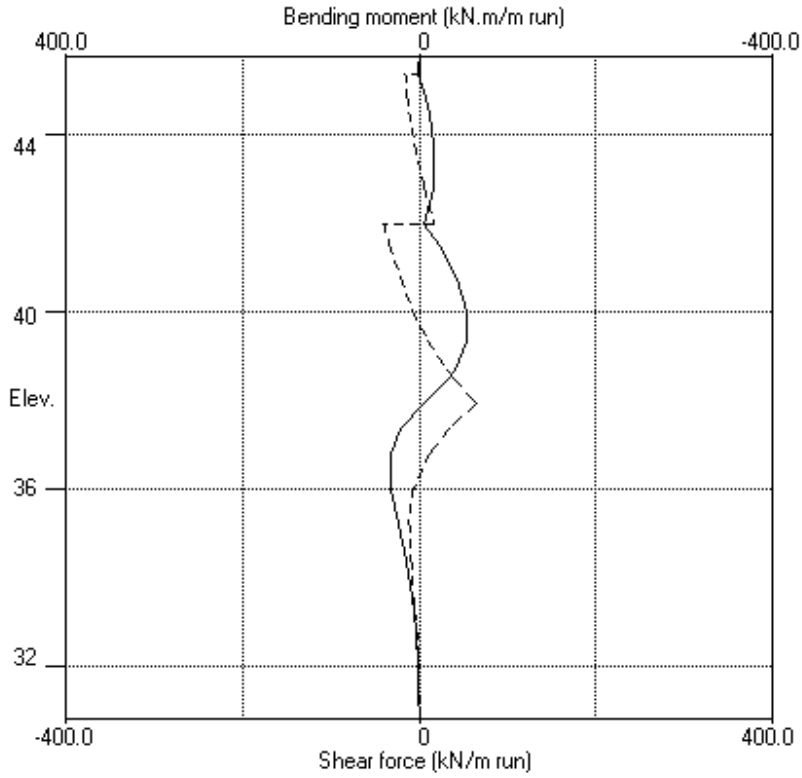
Stage No.10 Fill to elevation 38.50 on RIGHT side with soil type 1

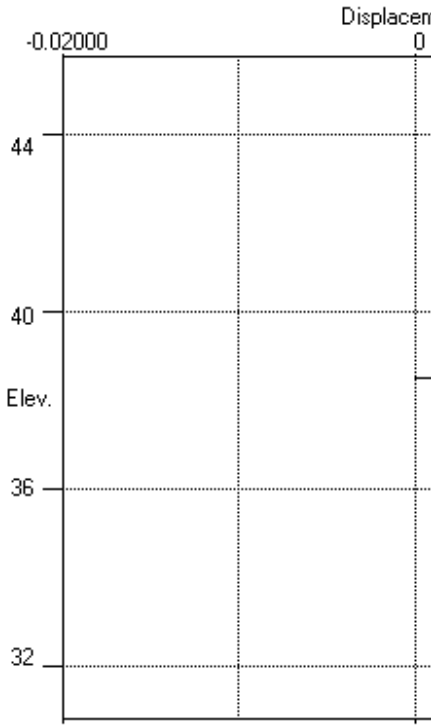
Node no.	Y coord	RIGHT side Water press. kN/m2	Effective stresses Vertic -al kN/m2	Active limit kN/m2	Passive limit kN/m2	Earth pressure kN/m2	Total earth pressure kN/m2	Coeff. of subgrade reaction kN/m3
13	40.00	30.00	0.00	0.00	0.00	0.00	30.00	0.0
14	39.35	36.50	0.00	0.00	0.00	0.00	36.50	0.0
15	38.70	43.00	0.00	0.00	0.00	0.00	43.00	0.0
16	38.50	45.00	0.00	0.00	0.00	0.00	45.00	0.0
		45.00	0.00	0.00	0.00	0.00	45.00	1393
17	37.94	50.60	4.48	1.54	16.04	1.54	52.14a	1393
		Total> 55.08	25.30m	242.16	165.99	165.99		10306
18	37.37	Total> 66.49	28.15m	258.28	165.98	165.98		10669
19	36.80	Total> 77.91	31.00m	274.41	166.49	166.49		11032
20	36.00	Total> 93.96	35.00m	297.08	170.53	170.53		11541
21	35.20	Total> 110.06	39.00m	319.79	179.21	179.21		12050
22	34.40	Total> 126.23	43.00m	342.57	191.82	191.82		12560
23	33.60	Total> 142.46	47.00m	365.42	207.03	207.03		13069
24	32.80	Total> 158.78	51.00m	388.34	223.60	223.60		13578
25	32.00	Total> 175.17	55.00m	411.36	240.69	240.69		14087
26	31.40	Total> 187.53	58.00m	428.67	253.59	253.59		14469
27	30.80	Total> 199.93	61.00m	446.04	266.48	266.48		14851

Note: 52.14a Soil pressure at active limit
123.45p Soil pressure at passive limit

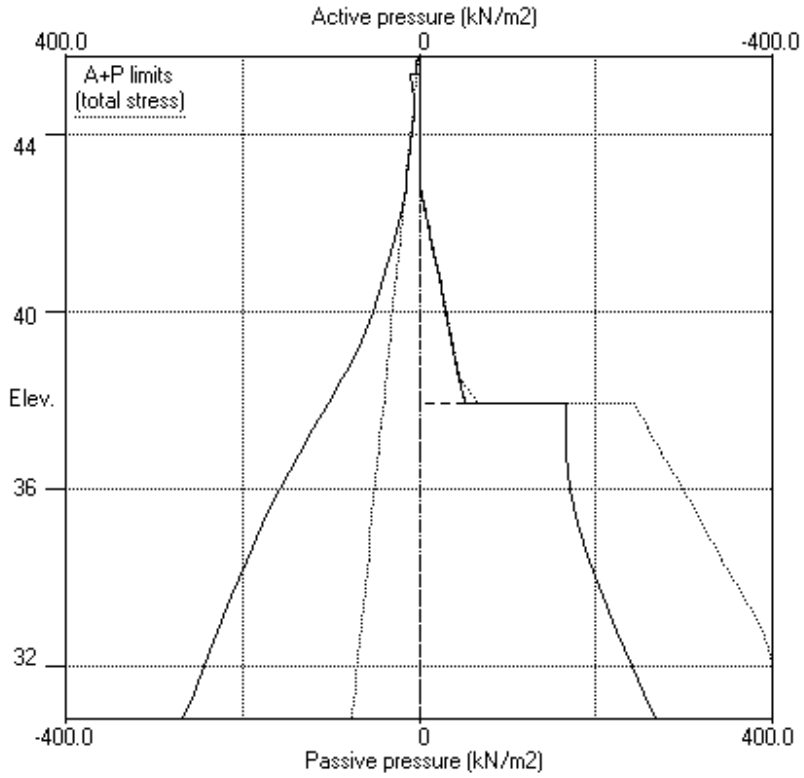
Units: kN,m

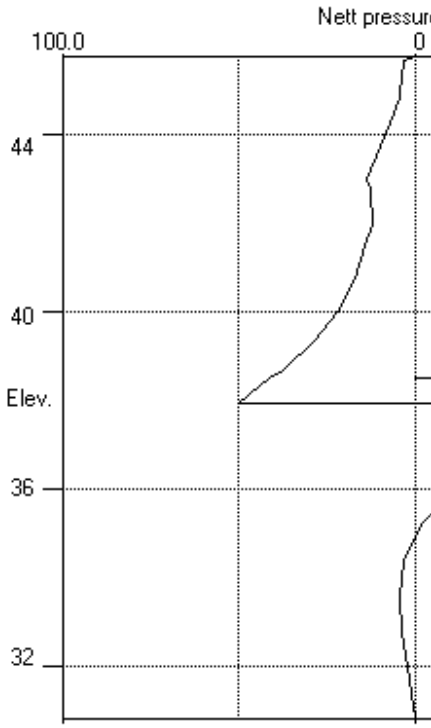
Stage No.10 Fill to elev. 38.50 on RIGHT side





Stage No.10 Fill to elev. 38.50 on RIGHT side





Units: kN,m

Stage No. 14 Change EI of wall to 290309 kN.m2/m run
From elevation 45.80 to 41.50
Yield moment not defined
No adjustments to wall displacements

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

Stage No.	--- G.L. --- Act.	Pass.	Strut Elev.	Overall FoS for toe elev. = 30.80 Factor of Safety	Moment equilib. at elev.	Toe elev. for FoS = 1.000 Toe elev.	Wall Penetr -ation	Direction of failure
14	45.80	38.50		More than one strut. No FoS calc.				

BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall
Analysis options
Length of wall perpendicular to section = 15.00m
Subgrade reaction model - Boussinesq Influence coefficients
Soil deformations are elastic until the active or passive limit is reached
Open Tension Crack analysis - No

Rigid boundaries: Left side 30.00 from wall
Right side 30.00 from wall
Limit State: ULS DA1 Combination 2

*** Wall displacements reset to zero at stage 4

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	45.80	0.00	0.004	-1.35E-03	0.0	-0.0		290309
2	45.69	3.08	0.004	-1.35E-03	0.2	-0.0		290309
3	45.60	3.13	0.004	-1.35E-03	0.4	0.0		290309
4	45.40	3.26	0.004	-1.35E-03	1.1	0.2	32.4	290309
		5.93	0.004	-1.35E-03	-31.3	0.2		
5	44.85	4.75	0.005	-1.30E-03	-28.3	-15.9		290309
6	44.50	6.50	0.006	-1.22E-03	-26.4	-25.4		290309
7	43.75	10.25	0.006	-9.70E-04	-20.1	-39.9		290309
8	43.00	14.00	0.007	-6.18E-04	-11.0	-52.4		290309
9	42.80	13.00	0.007	-5.12E-04	-8.3	-54.2		290309
10	42.00	9.00	0.007	-8.53E-05	0.5	-55.5		290309
11	41.50	6.50	0.007	1.74E-04	4.4	-54.0		290309
12	40.75	6.05	0.007	4.36E-04	9.1	-47.5		290309
13	40.00	14.75	0.007	7.64E-04	16.9	-38.5		290309
14	39.35	24.81	0.006	1.05E-03	29.8	-24.1		290309
15	38.70	37.40	0.005	1.27E-03	50.0	0.8	40.2	290309
		37.40	0.005	1.27E-03	9.8	0.8		
16	38.50	41.89	0.005	1.31E-03	17.7	3.5		93950
17	37.94	53.34	0.004	1.23E-03	44.4	20.1		93950
		-57.35	0.004	1.23E-03	44.4	20.1		
18	37.37	-38.30	0.004	1.04E-03	17.1	36.1		93950
19	36.80	-22.17	0.003	8.13E-04	-0.1	39.6		93950
20	36.00	-6.30	0.003	5.04E-04	-11.5	32.4		93950
21	35.20	2.14	0.002	2.78E-04	-13.2	21.1		93950
22	34.40	5.15	0.002	1.45E-04	-10.3	11.2		93950
23	33.60	5.05	0.002	8.34E-05	-6.2	4.5		93950

(continued)

Stage No.14 Change EI of wall to 290309 kN.m2/m run
From elevation 45.80 to 41.50
Yield moment not defined
No adjustments to wall displacements

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
24	32.80	3.55	0.002	6.30E-05	-2.8	1.1		93950
25	32.00	1.75	0.002	6.05E-05	-0.6	0.0		93950
26	31.40	0.50	0.002	6.15E-05	0.0	-0.1		93950
27	30.80	-0.65	0.002	6.20E-05	-0.0	-0.0		---

At elev. 45.40 Strut force = 242.6 kN/strut = 32.4 kN/m run
At elev. 38.70 Strut force = 40.2 kN/strut = 40.2 kN/m run

Node no.	Y coord	LEFT side: Effective stresses Water press. kN/m2	Vertic -al kN/m2	Active limit kN/m2	Passive limit kN/m2	Earth pressure kN/m2	Total earth pressure kN/m2	Coeff. of subgrade reaction kN/m3
1	45.80	0.00	0.00	0.00	0.00	0.00	0.00	14790
2	45.69	0.00	1.98	0.68	7.09	3.08	3.08	14790
3	45.60	0.00	3.60	1.24	12.89	3.13	3.13	14790
4	45.40	0.00	7.20	2.47	25.79	3.26	3.26	2080
		Total>	7.20	2.00m	154.12	5.93	5.93	10654
5	44.85	Total>	18.32	4.75m	165.23	4.75	4.75a	10654
6	44.50	Total>	25.69	6.50m	172.61	6.50	6.50a	10654
7	43.75	Total>	43.79	10.25m	190.71	10.25	10.25a	10654
8	43.00	Total>	62.99	14.00m	209.92	14.00	14.00a	10654
9	42.80	Total>	68.06	15.00m	214.99	15.00	15.00a	10654
10	42.00	Total>	87.69	19.00m	241.23	19.00	19.00a	11406
11	41.50	Total>	99.32	21.50m	257.00	21.50	21.50a	11876
12	40.75	Total>	115.95	25.25m	279.83	28.55	28.55	12581
13	40.00	Total>	131.85	29.00m	301.93	44.75	44.75	13286
14	39.35	Total>	145.24	32.25m	320.69	61.31	61.31	13897
15	38.70	Total>	158.40	35.50m	339.22	80.40	80.40	14508
16	38.50	Total>	162.41	36.50m	344.89	86.89	86.89	14696
17	37.94	Total>	173.59	39.30m	360.70	105.48	105.48	15223
18	37.37	Total>	184.91	42.15m	376.73	123.55	123.55	15758
19	36.80	Total>	196.18	45.00m	392.71	140.27	140.27	16294
20	36.00	Total>	211.95	49.00m	415.09	161.15	161.15	17046
21	35.20	Total>	227.69	53.00m	437.45	179.48	179.48	17798
22	34.40	Total>	243.41	57.00m	459.78	196.11	196.11	18550
23	33.60	Total>	259.13	61.00m	482.12	211.85	211.85	19302
24	32.80	Total>	274.85	65.00m	504.45	227.28	227.28	20054
25	32.00	Total>	290.57	69.00m	526.78	242.73	242.73	20807
26	31.40	Total>	302.37	72.00m	543.54	254.41	254.41	21371
27	30.80	Total>	314.16	75.00m	560.29	266.17	266.17	21935

Node no.	Y coord	RIGHT side: Effective stresses Water press. kN/m2	Vertic -al kN/m2	Active limit kN/m2	Passive limit kN/m2	Earth pressure kN/m2	Total earth pressure kN/m2	Coeff. of subgrade reaction kN/m3
1	45.80	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	45.69	0.00	0.00	0.00	0.00	0.00	0.00	0.0
3	45.60	0.00	0.00	0.00	0.00	0.00	0.00	0.0
4	45.40	0.00	0.00	0.00	0.00	0.00	0.00	0.0
5	44.85	0.00	0.00	0.00	0.00	0.00	0.00	0.0
6	44.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
7	43.75	0.00	0.00	0.00	0.00	0.00	0.00	0.0

(continued)

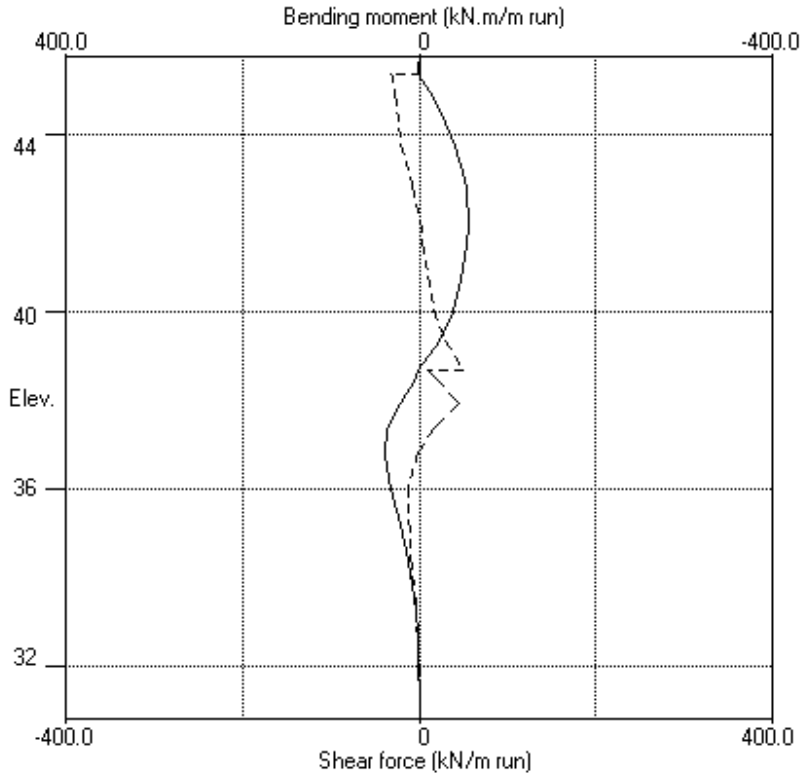
Stage No.14 Change EI of wall to 290309 kN.m2/m run
From elevation 45.80 to 41.50
Yield moment not defined
No adjustments to wall displacements

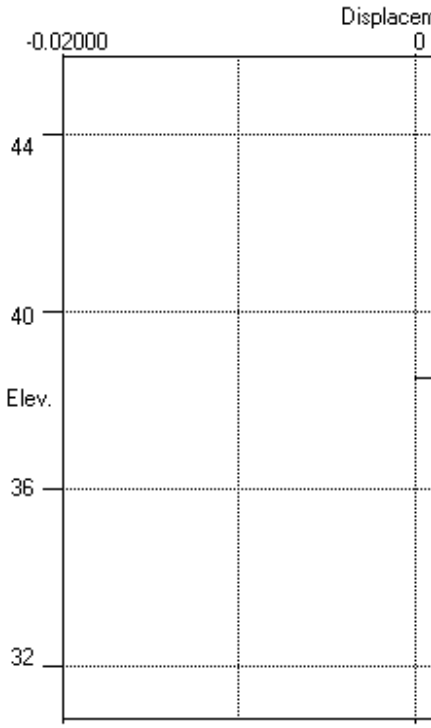
Node no.	Y coord	RIGHT side Water press. kN/m2	Effective stresses Vertic -al kN/m2	Active limit kN/m2	Passive limit kN/m2	Earth pressure kN/m2	Total earth pressure kN/m2	Coeff. of subgrade reaction kN/m3
8	43.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
9	42.80	2.00	0.00	0.00	0.00	0.00	2.00	0.0
10	42.00	10.00	0.00	0.00	0.00	0.00	10.00	0.0
11	41.50	15.00	0.00	0.00	0.00	0.00	15.00	0.0
12	40.75	22.50	0.00	0.00	0.00	0.00	22.50	0.0
13	40.00	30.00	0.00	0.00	0.00	0.00	30.00	0.0
14	39.35	36.50	0.00	0.00	0.00	0.00	36.50	0.0
15	38.70	43.00	0.00	0.00	0.00	0.00	43.00	0.0
16	38.50	45.00	0.00	0.00	0.00	0.00	45.00	0.0
		45.00	0.00	0.00	0.00	0.00	45.00	2080
17	37.94	50.60	4.48	1.54	16.04	1.54	52.14a	2080
		Total> 55.08	25.30m	242.16	162.83	162.83		15223
18	37.37	Total> 66.49	28.15m	258.28	161.85	161.85		15758
19	36.80	Total> 77.91	31.00m	274.41	162.43	162.43		16294
20	36.00	Total> 93.96	35.00m	297.08	167.45	167.45		17046
21	35.20	Total> 110.06	39.00m	319.79	177.34	177.34		17798
22	34.40	Total> 126.23	43.00m	342.57	190.95	190.95		18550
23	33.60	Total> 142.46	47.00m	365.42	206.81	206.81		19302
24	32.80	Total> 158.78	51.00m	388.34	223.73	223.73		20054
25	32.00	Total> 175.17	55.00m	411.36	240.98	240.98		20807
26	31.40	Total> 187.53	58.00m	428.67	253.91	253.91		21371
27	30.80	Total> 199.93	61.00m	446.04	266.82	266.82		21935

Note: 52.14a Soil pressure at active limit
123.45p Soil pressure at passive limit

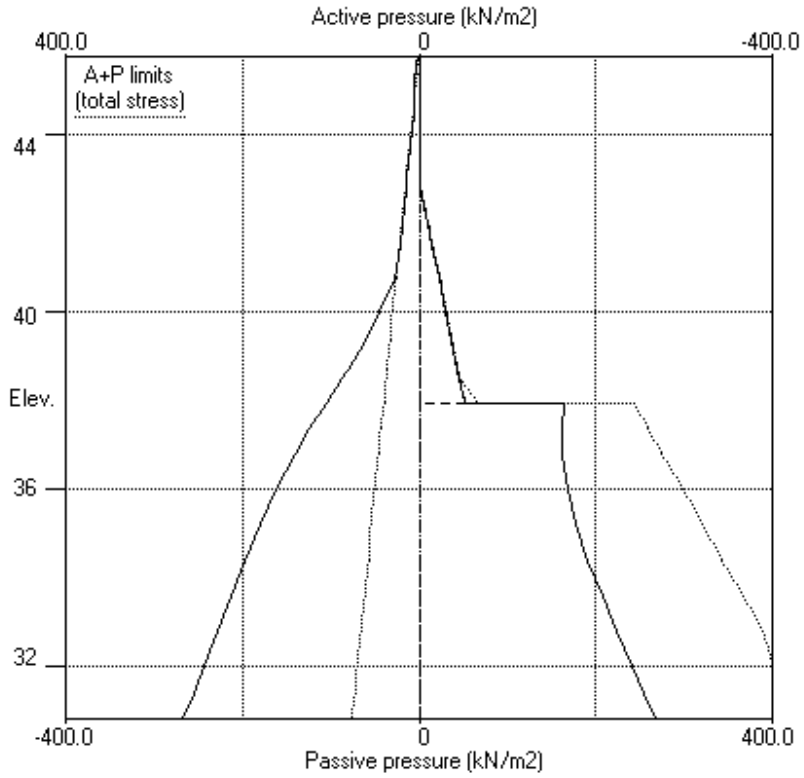
Units: kN,m

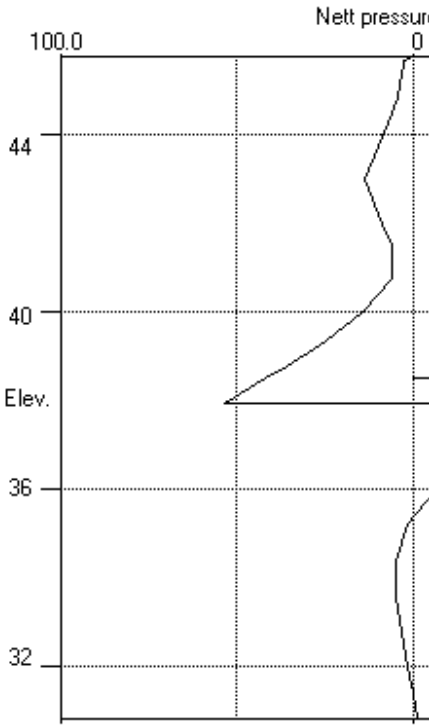
Stage No.14 Change EI of wall to 290309kN.m2/m run





Stage No.14 Change EI of wall to 290309kN.m2/m run





Units: kN,m

Stage No. 21 Change EI of wall to 145154 kN.m2/m run
From elevation 45.80 to 38.50
Yield moment not defined
No adjustments to wall displacements

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

Stage No.	--- G.L. --- Act.	Pass.	Strut Elev.	Overall FoS for toe elev. = 30.80 Factor of Safety	Moment equilib. at elev.	Toe elev. for FoS = 1.000 Toe elev.	Wall Penetr -ation	Direction of failure
21	45.80	38.50		More than one strut. No FoS calc.				

BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall
Analysis options
Length of wall perpendicular to section = 15.00m
Subgrade reaction model - Boussinesq Influence coefficients
Soil deformations are elastic until the active or passive limit is reached
Open Tension Crack analysis - No

Rigid boundaries: Left side 30.00 from wall
Right side 30.00 from wall
Limit State: ULS DA1 Combination 2

*** Wall displacements reset to zero at stage 4

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	45.80	0.00	0.004	-2.72E-03	0.0	-0.0		145154
2	45.69	2.84	0.004	-2.72E-03	0.2	-0.0	67.9	145154
		2.84	0.004	-2.72E-03	-67.7	-0.0		
3	45.60	2.72	0.004	-2.72E-03	-67.4	-6.1		145154
4	45.40	2.54	0.005	-2.71E-03	-66.9	-19.5		145154
		2.35	0.005	-2.71E-03	-66.9	-19.5		
5	44.85	2.28	0.006	-2.57E-03	-65.6	-55.8		145154
6	44.50	6.00	0.007	-2.40E-03	-64.2	-78.6		145154
7	43.75	19.08	0.009	-1.84E-03	-54.8	-120.7		145154
8	43.00	32.66	0.010	-1.06E-03	-35.4	-155.9		145154
9	42.80	36.26	0.010	-8.29E-04	-28.5	-162.1		145154
10	42.00	50.36	0.011	1.46E-04	6.2	-170.1		145154
11	41.50	58.88	0.010	7.45E-04	33.5	-160.2		145154
12	40.75	71.28	0.009	1.41E-03	82.3	-115.7		145154
13	40.00	83.34	0.008	1.89E-03	140.3	-33.3		145154
14	39.35	93.61	0.007	2.00E-03	197.8	75.8		145154
15	38.70	103.78	0.006	1.63E-03	261.9	224.2	468.5	145154
		103.78	0.006	1.63E-03	-206.6	224.2		
16	38.50	106.89	0.005	1.45E-03	-185.5	185.0		46965
17	37.94	107.31	0.005	1.18E-04	-125.5	97.6		46965
		81.84	0.005	1.18E-04	-125.5	97.6		
18	37.37	68.49	0.005	-4.38E-04	-82.7	37.9		46965
19	36.80	55.08	0.005	-4.67E-04	-47.5	0.7		46965
20	36.00	36.14	0.006	-1.05E-04	-11.0	-22.3		46965
21	35.20	17.01	0.006	3.40E-04	10.3	-21.7		46965
22	34.40	-2.34	0.005	6.16E-04	16.1	-9.9		46965

(continued)

Stage No.21 Change EI of wall to 145154 kN.m2/m run
From elevation 45.80 to 38.50
Yield moment not defined
No adjustments to wall displacements

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
23	33.60	-13.78	0.005	6.49E-04	9.7	3.5		46965
24	32.80	-7.59	0.004	5.37E-04	1.1	6.8		46965
25	32.00	-3.12	0.004	4.19E-04	-3.1	5.2		46965
26	31.40	-0.59	0.004	3.65E-04	-4.2	2.7		46965
27	30.80	14.74	0.003	3.47E-04	-0.0	-0.0		---
At elev. 45.69 Strut force = 67.9 kN/strut = 67.9 kN/m run								
At elev. 38.70 Strut force = 468.5 kN/strut = 468.5 kN/m run								

Node no.	Y coord	LEFT side ------- Effective stresses ------- Water press. kN/m2	Vertic -al kN/m2	Active limit kN/m2	Passive limit kN/m2	Earth pressure kN/m2	Total earth pressure kN/m2	Coeff. of subgrade reaction kN/m3
1	45.80	0.00	0.00	0.00	0.00	0.00	0.00	103693
2	45.69	0.00	1.98	0.68	7.09	2.84	2.84	1451
3	45.60	0.00	3.60	1.24	12.89	2.72	2.72	1451
4	45.40	0.00	7.20	2.47	25.79	2.54	2.54	1212
		0.00	7.20	0.00	34.68	2.35	2.35	5941
5	44.85	0.00	19.42	2.28	64.03	2.28	2.28a	5941
6	44.50	0.00	27.49	6.00	83.44	6.00	6.00a	5941
7	43.75	7.50	39.59	11.58	112.51	11.58	19.08a	5941
8	43.00	15.00	52.79	17.66	144.24	17.66	32.66a	5941
9	42.80	17.00	56.26	19.26	152.59	19.26	36.26a	5941
		17.00	56.26	19.26	152.59	19.26	36.26a	5592
10	42.00	25.00	69.49	25.36	184.38	25.36	50.36a	5844
11	41.50	30.00	77.12	28.88	202.73	28.88	58.88a	6001
12	40.75	37.50	87.75	33.78	228.28	33.78	71.28a	6237
13	40.00	45.00	97.65	38.34	252.07	38.34	83.34a	6473
14	39.35	51.50	105.84	42.11	271.75	42.11	93.61a	6677
15	38.70	58.00	113.80	45.78	290.87	45.78	103.78a	6882
16	38.50	60.00	116.21	46.89	296.67	46.89	106.89a	6944
17	37.94	65.60	122.91	49.98	312.77	49.98	115.58a	7121
18	37.37	71.30	129.67	53.09	329.01	53.09	124.39a	7300
19	36.80	77.00	136.38	56.19	345.13	56.19	133.19a	7479
20	36.00	85.00	145.75	60.51	367.66	60.51	145.51a	7731
21	35.20	93.00	155.09	64.81	390.10	64.81	157.81a	7982
22	34.40	101.00	164.41	69.11	412.52	69.11	170.11a	8234
23	33.60	109.00	173.73	73.40	434.92	78.23	187.23	8486
24	32.80	117.00	183.05	77.70	457.31	88.81	205.81	8737
25	32.00	125.00	192.37	82.00	479.71	99.03	224.03	8989
26	31.40	131.00	199.37	85.22	496.52	106.52	237.52	9178
27	30.80	137.00	206.36	88.44	513.34	120.54	257.54	762245

Node no.	Y coord	RIGHT side ------- Effective stresses ------- Water press. kN/m2	Vertic -al kN/m2	Active limit kN/m2	Passive limit kN/m2	Earth pressure kN/m2	Total earth pressure kN/m2	Coeff. of subgrade reaction kN/m3
1	45.80	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	45.69	0.00	0.00	0.00	0.00	0.00	0.00	0.0
3	45.60	0.00	0.00	0.00	0.00	0.00	0.00	0.0
4	45.40	0.00	0.00	0.00	0.00	0.00	0.00	0.0
5	44.85	0.00	0.00	0.00	0.00	0.00	0.00	0.0

(continued)

Stage No.21 Change EI of wall to 145154 kN.m2/m run
From elevation 45.80 to 38.50
Yield moment not defined
No adjustments to wall displacements

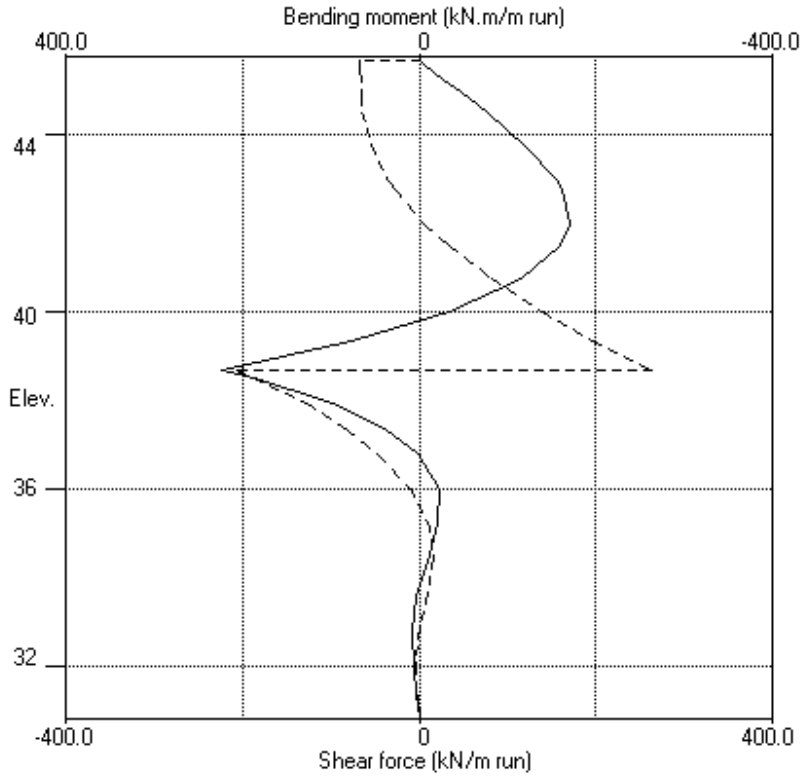
Node no.	Y coord	RIGHT side						
			Effective stresses				Total	Coeff. of
		Water press.	Vertic -al	Active limit	Passive limit	Earth pressure	earth pressure	subgrade reaction
		kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m3
6	44.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
7	43.75	0.00	0.00	0.00	0.00	0.00	0.00	0.0
8	43.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
9	42.80	0.00	0.00	0.00	0.00	0.00	0.00	0.0
10	42.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
11	41.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
12	40.75	0.00	0.00	0.00	0.00	0.00	0.00	0.0
13	40.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
14	39.35	0.00	0.00	0.00	0.00	0.00	0.00	0.0
15	38.70	0.00	0.00	0.00	0.00	0.00	0.00	0.0
16	38.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
		0.00	0.00	0.00	0.00	0.00	0.00	2104
17	37.94	5.60	4.48	1.54	16.05	2.67	8.27	2104
		5.60	4.48	0.00	28.14	28.14	33.74p	12363
18	37.37	11.30	11.33	0.00	44.60	44.60	55.90p	12674
19	36.80	17.00	18.20	1.72	61.10	61.10	78.10p	12985
20	36.00	25.00	27.88	6.18	84.37	84.37	109.37p	13422
21	35.20	33.00	37.63	10.67	107.80	107.80	140.80p	13859
22	34.40	41.00	47.47	15.21	131.45	131.45	172.45p	14296
23	33.60	49.00	57.40	19.79	155.33	152.00	201.00	14733
24	32.80	57.00	67.46	24.42	179.50	156.39	213.39	15170
25	32.00	65.00	77.63	29.11	203.95	162.15	227.15	15607
26	31.40	71.00	85.35	32.67	222.50	167.11	238.11	15934
27	30.80	77.00	93.14	36.26	241.21	165.80	242.80	762245

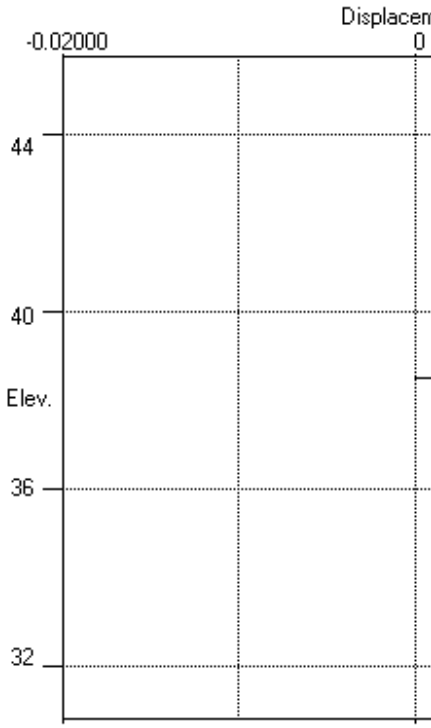
Note: 170.11a Soil pressure at active limit
172.45p Soil pressure at passive limit

KNIGHT BUILD LTD | Sheet No.
Program: WALLAP Version 6.06 Revision A49.B68.R53 | Job No. 79AR
Licensed from GEOSOLVE | Made by : JRC
Data filename/Run ID: SECTION_2-2_ULS2 |
79 Avenue Road | Date:28-06-2021
SECTION 2-2 ANALYSIS | Checked :

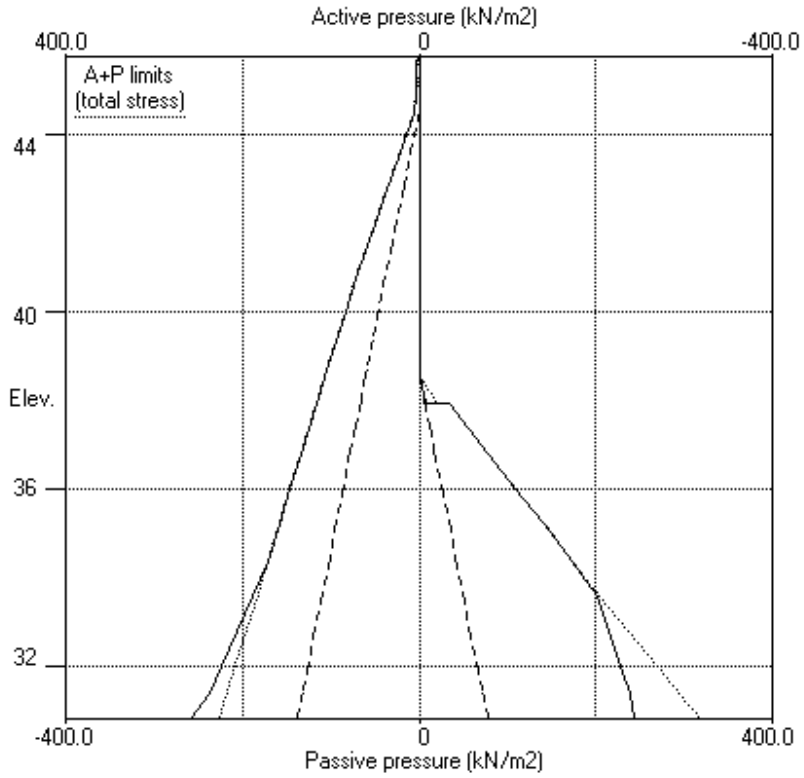
Units: kN,m

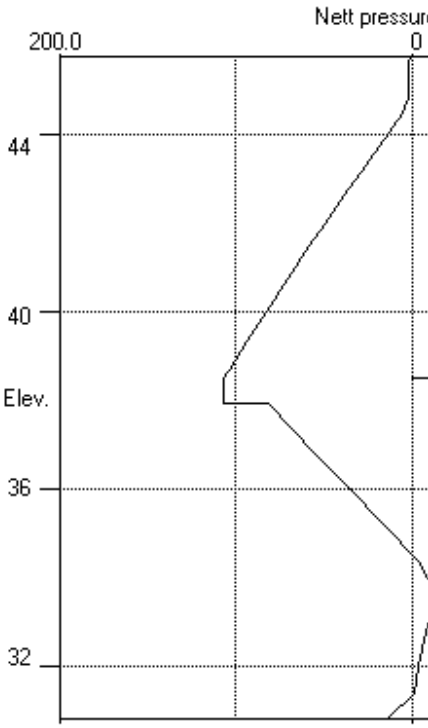
Stage No.21 Change EI of wall to 145154kN.m2/m run





Stage No.21 Change EI of wall to 145154kN.m2/m run





Units: kN,m

Summary of results

LIMIT STATE PARAMETERS

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

STABILITY ANALYSIS of Fully Embedded Wall according to Strength Factor method

Factor of safety on soil strength

Stage No.	G.L. Act.	G.L. Pass.	Strut Elev.	Overall FoS for toe elev. = 30.80 Factor of Safety	Moment equilib. at elev.	Toe elev. for FoS = 1.000 Toe elev.	Wall Penetr -ation	Direction of failure
1	45.80	45.80	Cant.	Conditions not suitable for FoS calc.				
2	45.80	45.80		No analysis at this stage				
3	45.80	45.80	Cant.	Conditions not suitable for FoS calc.				
4	45.80	45.80		No analysis at this stage				
5	45.80	43.75	Cant.	6.157	31.38	43.50	0.25	L to R
6	45.80	43.75		No analysis at this stage				
7	45.80	41.50	45.40	4.803	n/a	41.39	0.11	L to R
8	45.80	41.50		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 = 15.00m
Subgrade reaction model - Boussinesq Influence coefficients
Soil deformations are elastic until the active or passive limit is reached
Open Tension Crack analysis - No

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

Limit State: ULS DA1 Combination 2

Bending moment, shear force and displacement envelopes

Node no.	Y coord	Displacement maximum m	Displacement minimum m	Bending moment maximum kN.m/m	Bending moment minimum kN.m/m	Shear force maximum kN/m	Shear force minimum kN/m
1	45.80	0.004	0.000	0.0	-0.0	0.0	0.0
2	45.69	0.004	0.000	0.0	-0.0	0.2	-67.7
3	45.60	0.004	0.000	0.0	-6.1	0.5	-67.4
4	45.40	0.005	0.000	0.2	-19.5	1.2	-66.9
5	44.85	0.006	0.000	0.9	-55.8	2.4	-65.6
6	44.50	0.007	0.000	2.0	-78.6	4.3	-64.2
7	43.75	0.009	0.000	10.6	-120.7	10.6	-54.8
8	43.00	0.010	0.000	13.1	-155.9	4.0	-35.4
9	42.80	0.010	0.000	12.8	-162.1	6.7	-28.5
10	42.00	0.011	0.000	9.3	-170.1	17.2	-40.3
11	41.50	0.010	0.000	6.5	-160.2	33.5	-33.6
12	40.75	0.009	0.000	2.7	-115.7	82.3	-21.6
13	40.00	0.008	0.000	8.9	-54.6	140.3	-6.9
14	39.35	0.007	0.000	75.8	-54.0	197.8	-1.4
15	38.70	0.006	0.000	224.2	-41.3	261.9	-206.6
16	38.50	0.005	0.000	185.0	-34.3	39.3	-185.5
17	37.94	0.005	0.000	97.6	-6.4	64.9	-125.5
18	37.37	0.005	0.000	40.8	-1.4	33.5	-82.7
19	36.80	0.005	0.000	40.0	-0.7	11.6	-47.5
20	36.00	0.006	0.000	32.4	-22.3	0.8	-16.3
21	35.20	0.006	0.000	23.6	-21.7	10.3	-13.3
22	34.40	0.005	0.000	14.1	-9.9	16.1	-10.4
23	33.60	0.005	0.000	6.8	-3.8	9.7	-7.2
24	32.80	0.004	0.000	6.8	-2.9	1.6	-3.9
25	32.00	0.004	0.000	5.2	-1.3	1.8	-3.1
26	31.40	0.004	0.000	2.7	-0.4	1.1	-4.2
27	30.80	0.003	0.000	0.0	-0.0	0.0	-0.0

Summary of results (continued)

Maximum and minimum bending moment and shear force at each stage

Stage	Bending moment				Shear force			
no.	maximum kN.m/m	elev.	minimum kN.m/m	elev.	maximum kN/m	elev.	minimum kN/m	elev.
1	0.2	36.80	-1.1	42.80	0.4	40.75	-0.6	43.75
2	No calculation at this stage							
3	0.6	34.40	-6.4	40.75	1.8	38.70	-3.1	43.00
4	No calculation at this stage							
5	13.1	43.00	-1.8	38.50	10.6	43.75	-5.6	41.50
6	No calculation at this stage							
7	11.2	39.35	-36.3	42.80	33.2	41.50	-23.3	45.40
8	No calculation at this stage							
9	31.0	36.80	-53.7	40.00	63.4	37.94	-40.1	42.00
10	32.5	36.80	-54.6	40.00	64.9	37.94	-40.3	42.00
11	No calculation at this stage							
12	No calculation at this stage							
13	39.6	36.80	-55.5	42.00	50.0	38.70	-31.3	45.40
14	39.6	36.80	-55.5	42.00	50.0	38.70	-31.3	45.40
15	No calculation at this stage							
16	40.0	36.80	-58.2	42.80	51.0	38.70	-30.1	45.69
17	85.8	38.70	-80.2	42.00	133.8	38.70	-78.7	38.70
18	No calculation at this stage							
19	No calculation at this stage							
20	No calculation at this stage							
21	224.2	38.70	-170.1	42.00	261.9	38.70	-206.6	38.70

Maximum and minimum displacement at each stage

Stage	Displacement				Stage description
no.	maximum m	elev.	minimum m	elev.	
1	0.000	41.50	0.000	45.80	Apply surcharge no.1 at elev. 44.85
2	No calculation at this stage				Apply surcharge no.2 at elev. 44.85
3	0.001	39.35	-0.000	45.80	Apply surcharge no.3 at elev. 45.60
4	Wall displacements reset to zero				Change EI of wall to 93950kN.m2/m run
5	0.004	45.80	0.000	45.80	Excav. to elev. 43.75 on RIGHT side
6	No calculation at this stage				Install strut no.4 at elev. 45.40
7	0.005	43.75	0.000	45.80	Excav. to elev. 41.50 on RIGHT side
8	No calculation at this stage				Install strut no.5 at elev. 42.00
9	0.006	40.75	0.000	45.80	Excav. to elev. 37.94 on RIGHT side
10	0.006	40.75	0.000	45.80	Fill to elev. 38.50 on RIGHT side
11	No calculation at this stage				Install strut no.3 at elev. 38.70
12	No calculation at this stage				Change EI of wall to 290309kN.m2/m run
13	0.007	42.00	0.000	45.80	Remove strut no.5 at elev. 42.00
14	0.007	42.00	0.000	45.80	Change EI of wall to 290309kN.m2/m run
15	No calculation at this stage				Install strut no.1 at elev. 45.69
16	0.008	42.00	0.000	45.80	Remove strut no.4 at elev. 45.40
17	0.008	42.00	0.000	45.80	Apply water pressure profile no.1
18	No calculation at this stage				Change soil type 2 to soil type 4
19	No calculation at this stage				Change soil type 3 to soil type 5
20	No calculation at this stage				Change EI of wall to 46965kN.m2/m run
21	0.011	42.00	0.000	45.80	Change EI of wall to 145154kN.m2/m run

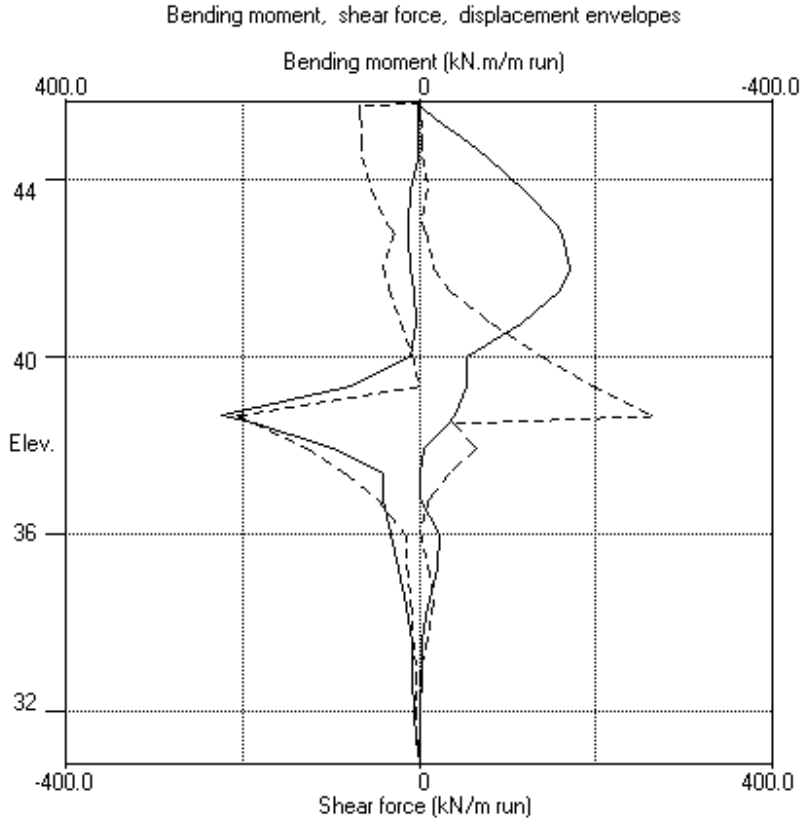
Summary of results (continued)

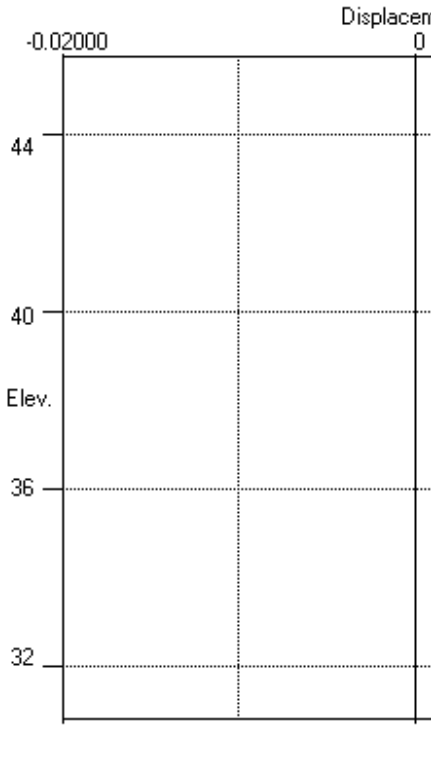
Strut forces at each stage (horizontal components)

Stage no.	Strut no. 1 at elev. 45.69		Strut no. 3 at elev. 38.70		Strut no. 4 at elev. 45.40	
	kN/m run	kN/strut	kN/m run	kN/strut	kN/m run	kN/strut
7	---	---	---	---	23.75	178.14
9	---	---	---	---	18.35	137.64
10	---	---	---	---	18.58	139.32
13	---	---	40.21	40.21	32.35	242.64
14	---	---	40.21	40.21	32.35	242.64
16	30.25	30.25	42.45	42.45	---	---
17	36.62	36.62	212.51	212.51	---	---
21	67.85	67.85	468.50	468.50	---	---

Stage no.	--- Strut no. 5 --- at elev. 42.00 kN/m run	kN/strut
9	56.90	426.76
10	56.82	426.14

Units: kN,m

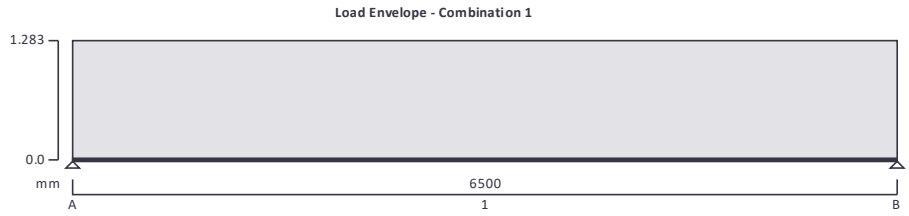

Bending moment, shear force, displacement envelopes
Bending moment (kN.m/m run)
400.0
0
-400.0
44
40
Elev.
36
32
-400.0
0
400.0
Shear force (kN/m run)

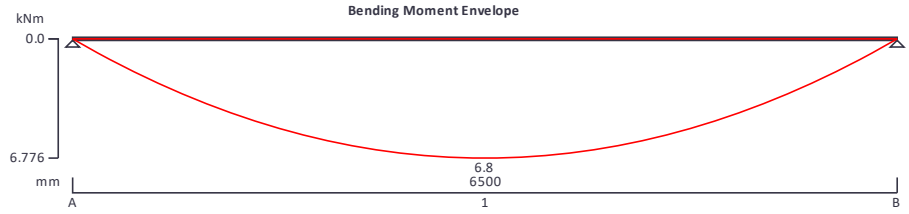

Displacem
-0.02000
0
44
40
Elev.
36
32

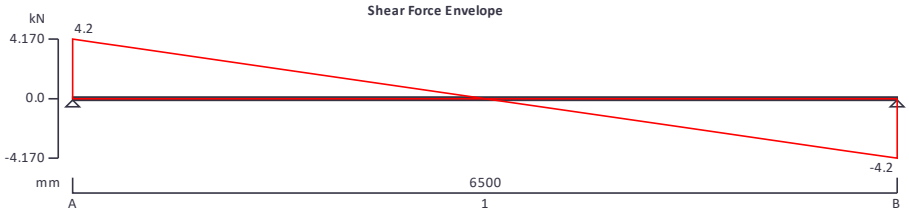
STEEL BEAM ANALYSIS & DESIGN (EN1993-1-1:2005)

In accordance with EN1993-1-1:2005 incorporating Corrigenda February 2006 and April 2009 and the UK national annex

TEDDS calculation version 3.0.14







Support conditions

Support A	Vertically restrained
	Rotationally free
Support B	Vertically restrained
	Rotationally free

Applied loading

Beam loads	Permanent self weight of beam * 1

Load combinations

Load combination 1	Support A	Permanent * 1.35
		Variable * 1.50
		Permanent * 1.35
		Variable * 1.50
	Support B	Permanent * 1.35
		Variable * 1.50

Analysis results

Maximum moment	M_{max} = **6.8** kNm	M_{min} = **0** kNm

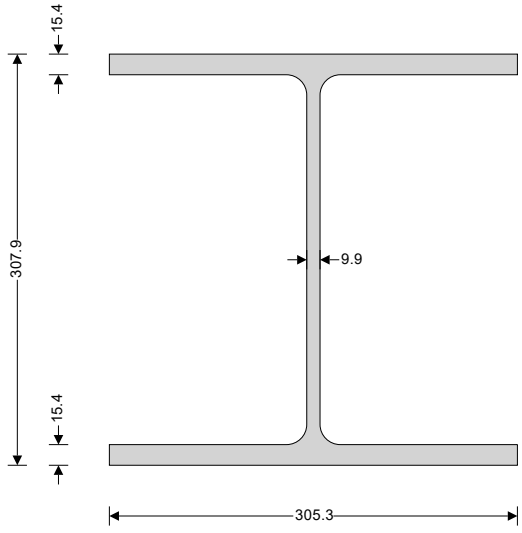
Maximum shear	V_{max} = **4.2** kN	V_{min} = **-4.2** kN
Deflection	δ_{max} = **0** mm	δ_{min} = **0** mm
Maximum reaction at support A	R_{A_max} = **4.2** kN	R_{A_min} = **4.2** kN
Unfactored permanent load reaction at support A	$R_{A\_Permanent}$ = **3.1** kN	
Maximum reaction at support B	R_{B_max} = **4.2** kN	R_{B_min} = **4.2** kN
Unfactored permanent load reaction at support B	$R_{B\_Permanent}$ = **3.1** kN	

Section details

Section type	**UKC 305x305x97 (Tata Steel Advance)**
Steel grade	**S355**

EN 10025-2:2004 - Hot rolled products of structural steels

Nominal thickness of element	t = max(t_f, t_w) = **15.4** mm
Nominal yield strength	f_y = **355** N/mm^2
Nominal ultimate tensile strength	f_u = **470** N/mm^2
Modulus of elasticity	E = **210000** N/mm^2



Partial factors - Section 6.1

Resistance of cross-sections	γ_{M0} = **1.00**
Resistance of members to instability	γ_{M1} = **1.00**
Resistance of tensile members to fracture	γ_{M2} = **1.10**

Lateral restraint

Span 1 has lateral restraint at supports only

Effective length factors

Effective length factor in major axis	K_y = **1.000**
Effective length factor in minor axis	K_z = **1.000**
Effective length factor for torsion	$K_{LT.A}$ = **1.000**
	$K_{LT.B}$ = **1.000**

Classification of cross sections - Section 5.5

$\varepsilon = \sqrt{[235\ N/mm^2 / f_y]}$ = **0.81**

Internal compression parts subject to bending and compression - Table 5.2 (sheet 1 of 3)

Width of section	c = d = **246.7** mm
	α = min([h / 2 + N_{Ed} / (2 * t_w * f_y) - (t_f+ r)] / c, 1) = **0.673**

$c / t_w = 30.6 * \varepsilon <= 396 * \varepsilon / (13 * \alpha - 1)$ Class 1

Outstand flanges - Table 5.2 (sheet 2 of 3)

Width of section $c = (b - t_w - 2 * r) / 2 =$ **132.5** mm

$c / t_f = 10.6 * \varepsilon <= 14 * \varepsilon$ Class 3

Section is class 3

Check shear - Section 6.2.6

Height of web $h_w = h - 2 * t_f =$ **277.1** mm

Shear area factor $\eta =$ **1.000**

$h_w / t_w < 72 * \varepsilon / \eta$

Shear buckling resistance can be ignored

Design shear force $V_{Ed} = \max(\text{abs}(V_{max}), \text{abs}(V_{min})) =$ **4.2** kN

Shear area - cl 6.2.6(3) $A_v = \max(A - 2 * b * t_f + (t_w + 2 * r) * t_f, \eta * h_w * t_w) =$ **3562** mm^2

Design shear resistance - cl 6.2.6(2) $V_{pl,Rd} = A_v * (f_y / \sqrt{[3]}) / \gamma_{M0} =$ **730.1** kN

PASS - Design shear resistance exceeds design shear force

Check bending moment major (y-y) axis - Section 6.2.5

Design bending moment $M_{Ed} = \max(\text{abs}(M_{s1\_max}), \text{abs}(M_{s1\_min})) =$ **6.8** kNm

Design bending resistance moment - eq 6.14 $M_{c,Rd} = M_{el,Rd} = W_{el,y} * f_y / \gamma_{M0} =$ **513** kNm

Slenderness ratio for lateral torsional buckling

Correction factor - Table 6.6 $k_c =$ **0.94**

$C_1 = 1 / k_c^2 =$ **1.132**

Curvature factor $g = \sqrt{[1 - (I_z / I_y)]} =$ **0.819**

Poissons ratio $\nu =$ **0.3**

Shear modulus $G = E / [2 \times (1 + \nu)] =$ **80769** N/mm^2

Unrestrained length $L = 1.0 * L_{s1} =$ **6500** mm

Elastic critical buckling moment $M_{cr} = C_1 * \pi^2 * E * I_z / (L^2 * g) * \sqrt{[I_w / I_z + L^2 * G * I_t / (\pi^2 * E * I_z)]} =$ **1013.9** kNm

Slenderness ratio for lateral torsional buckling $\bar{\lambda}_{LT} = \sqrt{(W_{el,y} * f_y / M_{cr})} =$ **0.711**

Limiting slenderness ratio $\bar{\lambda}_{LT,0} =$ **0.4**

$\bar{\lambda}_{LT} > \bar{\lambda}_{LT,0}$ - Lateral torsional buckling cannot be ignored

Design resistance for buckling - Section 6.3.2.1

Buckling curve - Table 6.5 b

Imperfection factor - Table 6.3 $\alpha_{LT} =$ **0.34**

Correction factor for rolled sections $\beta =$ **0.75**

LTB reduction determination factor $\phi_{LT} = 0.5 \times [1 + \alpha_{LT} \times (\bar{\lambda}_{LT} - \bar{\lambda}_{LT,0}) + \beta \times \bar{\lambda}_{LT}^2] =$ **0.743**

LTB reduction factor - eq 6.57 $\chi_{LT} = \min(1 / [\phi_{LT} + \sqrt{(\phi_{LT}^2 - \beta \times \bar{\lambda}_{LT}^2)}], 1, 1 / \bar{\lambda}_{LT}^2) =$ **0.864**

Modification factor $f = \min(1 - 0.5 * (1 - k_c) * [1 - 2 * (\bar{\lambda}_{LT} - 0.8)^2], 1) =$ **0.970**

Modified LTB reduction factor - eq 6.58 $\chi_{LT,mod} = \min(\chi_{LT} / f, 1) =$ **0.890**

Design buckling resistance moment - eq 6.55 $M_{b,Rd} = \chi_{LT,mod} * W_{el,y} * f_y / \gamma_{M1} =$ **456.7** kNm

PASS - Design buckling resistance moment exceeds design bending moment

Check compression - Section 6.2.4

Design compression force $N_{Ed} =$ **300** kN

Design resistance of section - eq 6.10 $N_{c,Rd} = N_{pl,Rd} = A * f_y / \gamma_{M0} =$ **4382.4** kN

Slenderness ratio for major (y-y) axis buckling

Critical buckling length $L_{cr,y} = L_{s1} * K_y =$ **6500** mm

Critical buckling force	$N_{cr,y} = \pi^2 * E_{SEC3} * I_y / L_{cr,y}^2 =$ **10914.5** kN
Slenderness ratio for buckling - eq 6.50	$\bar{\lambda}_y = \sqrt{[A * f_y / N_{cr,y}]} =$ **0.634**

Design resistance for buckling - Section 6.3.1.1

Buckling curve - Table 6.2	b
Imperfection factor - Table 6.1	$\alpha_y =$ **0.34**
Buckling reduction determination factor	$\phi_y = 0.5 * [1 + \alpha_y * (\bar{\lambda}_y - 0.2) + \bar{\lambda}_y^2] =$ **0.774**
Buckling reduction factor - eq 6.49	$\chi_y = \min(1 / [\phi_y + \sqrt{(\phi_y^2 - \bar{\lambda}_y^2)}], 1) =$ **0.820**
Design buckling resistance - eq 6.47	$N_{b,y,Rd} = \chi_y * A * f_y / \gamma_{M1} =$ **3592.8** kN

PASS - Design buckling resistance exceeds design compression force

Slenderness ratio for minor (z-z) axis buckling

Critical buckling length	$L_{cr,z} = L_{s1\_seg1} * K_z =$ **6500** mm
Critical buckling force	$N_{cr,z} = \pi^2 * E_{SEC3} * I_z / L_{cr,z}^2 =$ **3584.8** kN
Slenderness ratio for buckling - eq 6.50	$\bar{\lambda}_z = \sqrt{[A * f_y / N_{cr,z}]} =$ **1.106**

Design resistance for buckling - Section 6.3.1.1

Buckling curve - Table 6.2	c
Imperfection factor - Table 6.1	$\alpha_z =$ **0.49**
Buckling reduction determination factor	$\phi_z = 0.5 * [1 + \alpha_z * (\bar{\lambda}_z - 0.2) + \bar{\lambda}_z^2] =$ **1.333**
Buckling reduction factor - eq 6.49	$\chi_z = \min(1 / [\phi_z + \sqrt{(\phi_z^2 - \bar{\lambda}_z^2)}], 1) =$ **0.481**
Design buckling resistance - eq 6.47	$N_{b,z,Rd} = \chi_z * A * f_y / \gamma_{M1} =$ **2109** kN

PASS - Design buckling resistance exceeds design compression force

Check torsional and torsional-flexural buckling - Section 6.3.1.4

Torsional buckling length factor	$K_T =$ **1.00**
Torsional buckling length	$L_{cr,T} = \max(L_{s1}, L_{s1\_seg1}) * K_T =$ **6500** mm
Distance from shear centre to centroid in y axis	$y_0 =$ **0.0** mm
Distance from shear centre to centroid in z axis	$z_0 =$ **0.0** mm
Radius of gyration	$i_0 = \sqrt{[i_y^2 + i_z^2]} =$ **154.7** mm
Elastic critical torsional buckling force	$N_{cr,T} = 1 / i_0^2 * [G * I_t + \pi^2 * E_{SEC3} * I_w / L_{cr,T}^2] =$ **6280.4** kN
Torsion factor	$\beta_T = 1 - (y_0 / i_0)^2 =$ **1.000**
Elastic critical torsional-flexural buckling force	$N_{cr,TF} = N_{cr,y} / (2 \times \beta_T) \times [1 + N_{cr,T} / N_{cr,y} - \sqrt{[(1 - N_{cr,T} / N_{cr,y})^2 + 4 \times (y_0 / i_0)^2 \times N_{cr,T} / N_{cr,y}]}] =$ **6280.4** kN
Elastic critical buckling force	$N_{cr} = \min(N_{cr,T}, N_{cr,TF}) =$ **6280.4** kN
Slenderness ratio for torsional buckling - eq 6.52	$\bar{\lambda}_T = \sqrt{[A \times f_y / N_{cr}]} =$ **0.835**

Design resistance for buckling - Section 6.3.1.1

Buckling curve - Table 6.2	c
Imperfection factor - Table 6.1	$\alpha_T =$ **0.49**
Buckling reduction determination factor	$\phi_T = 0.5 * [1 + \alpha_T * (\bar{\lambda}_T - 0.2) + \bar{\lambda}_T^2] =$ **1.005**
Buckling reduction factor - eq 6.49	$\chi_T = \min(1 / [\phi_T + \sqrt{(\phi_T^2 - \bar{\lambda}_T^2)}], 1) =$ **0.640**
Design buckling resistance - eq 6.47	$N_{b,T,Rd} = \chi_T * A * f_y / \gamma_{M1} =$ **2804.7** kN

PASS - Design buckling resistance exceeds design compression force

Bending and axial force (class 3 section) – Section 6.2.9.2

Maximum longitudinal stress	$\sigma_{x,Ed} = M_{Ed} / W_{el,y} + N_{Ed} / A =$ **29.0** N/mm^2

PASS - Maximum longitudinal stress is less than or equal to f_y / γ_{M0}

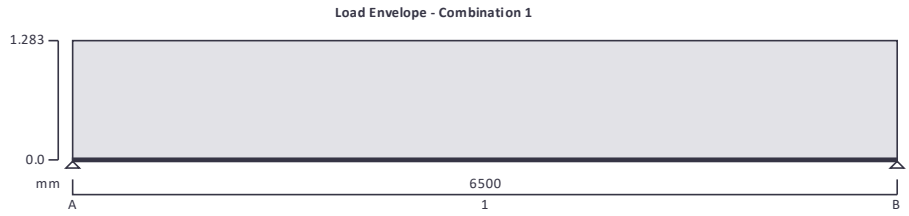
Check combined bending and compression - Section 6.3.3

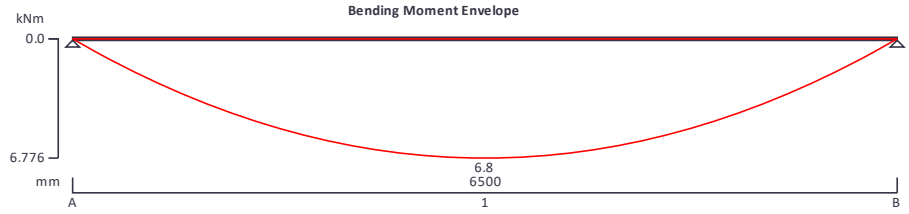
Equivalent uniform moment factors - Table B.3	$M_{hy} =$ **0** kNm

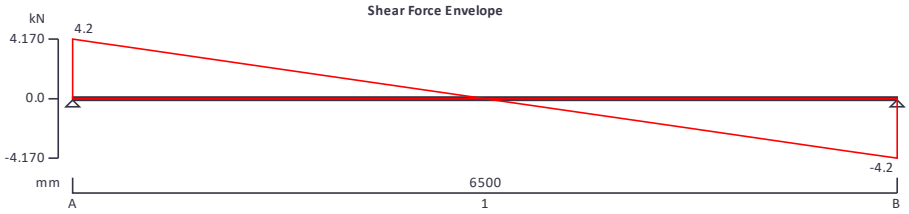
STEEL BEAM ANALYSIS & DESIGN (EN1993-1-1:2005)

In accordance with EN1993-1-1:2005 incorporating Corrigenda February 2006 and April 2009 and the UK national annex

TEDDS calculation version 3.0.14







Support conditions

Support A	Vertically restrained
	Rotationally free
Support B	Vertically restrained
	Rotationally free

Applied loading

Beam loads	Permanent self weight of beam * 1

Load combinations

Load combination 1	Support A	Permanent * 1.35
		Variable * 1.50
		Permanent * 1.35
		Variable * 1.50
	Support B	Permanent * 1.35
		Variable * 1.50

Analysis results

Maximum moment	M_{max} = **6.8** kNm	M_{min} = **0** kNm

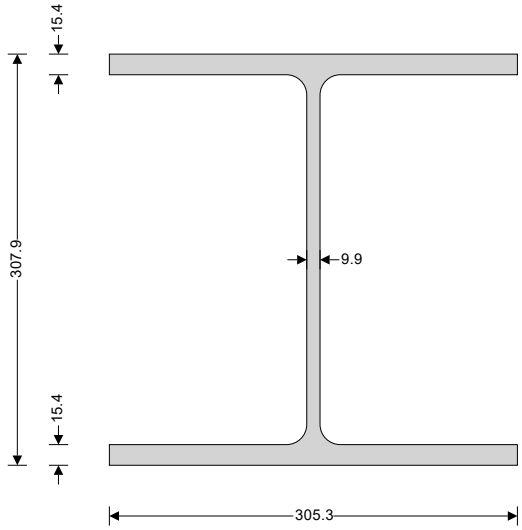
Maximum shear	V_{max} = **4.2** kN	V_{min} = **-4.2** kN
Deflection	δ_{max} = **0** mm	δ_{min} = **0** mm
Maximum reaction at support A	R_{A_max} = **4.2** kN	R_{A_min} = **4.2** kN
Unfactored permanent load reaction at support A	$R_{A\_Permanent}$ = **3.1** kN	
Maximum reaction at support B	R_{B_max} = **4.2** kN	R_{B_min} = **4.2** kN
Unfactored permanent load reaction at support B	$R_{B\_Permanent}$ = **3.1** kN	

Section details

Section type	**UKC 305x305x97 (Tata Steel Advance)**
Steel grade	**S355**

EN 10025-2:2004 - Hot rolled products of structural steels

Nominal thickness of element	t = max(t_f, t_w) = **15.4** mm
Nominal yield strength	f_y = **355** N/mm^2
Nominal ultimate tensile strength	f_u = **470** N/mm^2
Modulus of elasticity	E = **210000** N/mm^2



Partial factors - Section 6.1

Resistance of cross-sections	γ_{M0} = **1.00**
Resistance of members to instability	γ_{M1} = **1.00**
Resistance of tensile members to fracture	γ_{M2} = **1.10**

Lateral restraint

Span 1 has lateral restraint at supports only

Effective length factors

Effective length factor in major axis	K_y = **1.000**
Effective length factor in minor axis	K_z = **1.000**
Effective length factor for torsion	$K_{LT.A}$ = **1.000**
	$K_{LT.B}$ = **1.000**

Classification of cross sections - Section 5.5

$\varepsilon = \sqrt{[235\ N/mm^2 / f_y]}$ = **0.81**

Internal compression parts subject to bending and compression - Table 5.2 (sheet 1 of 3)

Width of section	c = d = **246.7** mm
	α = min([h / 2 + N_{Ed} / (2 * t_w * f_y) - (t_f+ r)] / c, 1) = **1.000**

$c / t_w = 30.6 * \varepsilon <= 396 * \varepsilon / (13 * \alpha - 1)$ Class 1

Outstand flanges - Table 5.2 (sheet 2 of 3)

Width of section $c = (b - t_w - 2 * r) / 2 =$ **132.5** mm

$c / t_f = 10.6 * \varepsilon <= 14 * \varepsilon$ Class 3

Section is class 3

Check shear - Section 6.2.6

Height of web $h_w = h - 2 * t_f =$ **277.1** mm

Shear area factor $\eta =$ **1.000**

$h_w / t_w < 72 * \varepsilon / \eta$

Shear buckling resistance can be ignored

Design shear force $V_{Ed} = \max(\text{abs}(V_{max}), \text{abs}(V_{min})) =$ **4.2** kN

Shear area - cl 6.2.6(3) $A_v = \max(A - 2 * b * t_f + (t_w + 2 * r) * t_f, \eta * h_w * t_w) =$ **3562** mm^2

Design shear resistance - cl 6.2.6(2) $V_{pl,Rd} = A_v * (f_y / \sqrt{[3]}) / \gamma_{M0} =$ **730.1** kN

PASS - Design shear resistance exceeds design shear force

Check bending moment major (y-y) axis - Section 6.2.5

Design bending moment $M_{Ed} = \max(\text{abs}(M_{s1\_max}), \text{abs}(M_{s1\_min})) =$ **6.8** kNm

Design bending resistance moment - eq 6.14 $M_{c,Rd} = M_{el,Rd} = W_{el.y} * f_y / \gamma_{M0} =$ **513** kNm

Slenderness ratio for lateral torsional buckling

Correction factor - Table 6.6 $k_c =$ **0.94**

$C_1 = 1 / k_c^2 =$ **1.132**

Curvature factor $g = \sqrt{[1 - (I_z / I_y)]} =$ **0.819**

Poissons ratio $\nu =$ **0.3**

Shear modulus $G = E / [2 \times (1 + \nu)] =$ **80769** N/mm^2

Unrestrained length $L = 1.0 * L_{s1} =$ **6500** mm

Elastic critical buckling moment $M_{cr} = C_1 * \pi^2 * E * I_z / (L^2 * g) * \sqrt{[I_w / I_z + L^2 * G * I_t / (\pi^2 * E * I_z)]} =$ **1013.9** kNm

Slenderness ratio for lateral torsional buckling $\bar{\lambda}_{LT} = \sqrt{(W_{el.y} * f_y / M_{cr})} =$ **0.711**

Limiting slenderness ratio $\bar{\lambda}_{LT,0} =$ **0.4**

$\bar{\lambda}_{LT} > \bar{\lambda}_{LT,0}$ - Lateral torsional buckling cannot be ignored

Design resistance for buckling - Section 6.3.2.1

Buckling curve - Table 6.5 b

Imperfection factor - Table 6.3 $\alpha_{LT} =$ **0.34**

Correction factor for rolled sections $\beta =$ **0.75**

LTB reduction determination factor $\phi_{LT} = 0.5 \times [1 + \alpha_{LT} \times (\bar{\lambda}_{LT} - \bar{\lambda}_{LT,0}) + \beta \times \bar{\lambda}_{LT}^2] =$ **0.743**

LTB reduction factor - eq 6.57 $\chi_{LT} = \min(1 / [\phi_{LT} + \sqrt{(\phi_{LT}^2 - \beta \times \bar{\lambda}_{LT}^2)}], 1, 1 / \bar{\lambda}_{LT}^2) =$ **0.864**

Modification factor $f = \min(1 - 0.5 * (1 - k_c) * [1 - 2 * (\bar{\lambda}_{LT} - 0.8)^2], 1) =$ **0.970**

Modified LTB reduction factor - eq 6.58 $\chi_{LT,mod} = \min(\chi_{LT} / f, 1) =$ **0.890**

Design buckling resistance moment - eq 6.55 $M_{b,Rd} = \chi_{LT,mod} * W_{el.y} * f_y / \gamma_{M1} =$ **456.7** kNm

PASS - Design buckling resistance moment exceeds design bending moment

Check compression - Section 6.2.4

Design compression force $N_{Ed} =$ **900** kN

Design resistance of section - eq 6.10 $N_{c,Rd} = N_{pl,Rd} = A * f_y / \gamma_{M0} =$ **4382.4** kN

Slenderness ratio for major (y-y) axis buckling

Critical buckling length $L_{cr,y} = L_{s1} * K_y =$ **6500** mm

Critical buckling force	$N_{cr,y} = \pi^2 * E_{SEC3} * I_y / L_{cr,y}^2$ = **10914.5** kN
Slenderness ratio for buckling - eq 6.50	$\bar{\lambda}_y = \sqrt{[A * f_y / N_{cr,y}]}$ = **0.634**

Design resistance for buckling - Section 6.3.1.1

Buckling curve - Table 6.2	b
Imperfection factor - Table 6.1	α_y = **0.34**
Buckling reduction determination factor	$\phi_y = 0.5 * [1 + \alpha_y * (\bar{\lambda}_y - 0.2) + \bar{\lambda}_y^2]$ = **0.774**
Buckling reduction factor - eq 6.49	$\chi_y = \min(1 / [\phi_y + \sqrt{(\phi_y^2 - \bar{\lambda}_y^2)}], 1)$ = **0.820**
Design buckling resistance - eq 6.47	$N_{b,y,Rd} = \chi_y * A * f_y / \gamma_{M1}$ = **3592.8** kN

PASS - Design buckling resistance exceeds design compression force

Slenderness ratio for minor (z-z) axis buckling

Critical buckling length	$L_{cr,z} = L_{s1\_seg1} * K_z$ = **6500** mm
Critical buckling force	$N_{cr,z} = \pi^2 * E_{SEC3} * I_z / L_{cr,z}^2$ = **3584.8** kN
Slenderness ratio for buckling - eq 6.50	$\bar{\lambda}_z = \sqrt{[A * f_y / N_{cr,z}]}$ = **1.106**

Design resistance for buckling - Section 6.3.1.1

Buckling curve - Table 6.2	c
Imperfection factor - Table 6.1	α_z = **0.49**
Buckling reduction determination factor	$\phi_z = 0.5 * [1 + \alpha_z * (\bar{\lambda}_z - 0.2) + \bar{\lambda}_z^2]$ = **1.333**
Buckling reduction factor - eq 6.49	$\chi_z = \min(1 / [\phi_z + \sqrt{(\phi_z^2 - \bar{\lambda}_z^2)}], 1)$ = **0.481**
Design buckling resistance - eq 6.47	$N_{b,z,Rd} = \chi_z * A * f_y / \gamma_{M1}$ = **2109** kN

PASS - Design buckling resistance exceeds design compression force

Check torsional and torsional-flexural buckling - Section 6.3.1.4

Torsional buckling length factor	K_T = **1.00**
Torsional buckling length	$L_{cr,T} = \max(L_{s1}, L_{s1\_seg1}) * K_T$ = **6500** mm
Distance from shear centre to centroid in y axis	y_0 = **0.0** mm
Distance from shear centre to centroid in z axis	z_0 = **0.0** mm
Radius of gyration	$i_0 = \sqrt{[i_y^2 + i_z^2]}$ = **154.7** mm
Elastic critical torsional buckling force	$N_{cr,T} = 1 / i_0^2 * [G * I_t + \pi^2 * E_{SEC3} * I_w / L_{cr,T}^2]$ = **6280.4** kN
Torsion factor	$\beta_T = 1 - (y_0 / i_0)^2$ = **1.000**
Elastic critical torsional-flexural buckling force	$N_{cr,TF} = N_{cr,y} / (2 \times \beta_T) \times [1 + N_{cr,T} / N_{cr,y} - \sqrt{[(1 - N_{cr,T} / N_{cr,y})^2 + 4 \times (y_0 / i_0)^2 \times N_{cr,T} / N_{cr,y}]}]$ = **6280.4** kN
Elastic critical buckling force	$N_{cr} = \min(N_{cr,T}, N_{cr,TF})$ = **6280.4** kN
Slenderness ratio for torsional buckling - eq 6.52	$\bar{\lambda}_T = \sqrt{[A \times f_y / N_{cr}]}$ = **0.835**

Design resistance for buckling - Section 6.3.1.1

Buckling curve - Table 6.2	c
Imperfection factor - Table 6.1	α_T = **0.49**
Buckling reduction determination factor	$\phi_T = 0.5 * [1 + \alpha_T * (\bar{\lambda}_T - 0.2) + \bar{\lambda}_T^2]$ = **1.005**
Buckling reduction factor - eq 6.49	$\chi_T = \min(1 / [\phi_T + \sqrt{(\phi_T^2 - \bar{\lambda}_T^2)}], 1)$ = **0.640**
Design buckling resistance - eq 6.47	$N_{b,T,Rd} = \chi_T * A * f_y / \gamma_{M1}$ = **2804.7** kN

PASS - Design buckling resistance exceeds design compression force

Bending and axial force (class 3 section) – Section 6.2.9.2

Maximum longitudinal stress	$\sigma_{x,Ed} = M_{Ed} / W_{el,y} + N_{Ed} / A$ = **77.6** N/mm^2

PASS - Maximum longitudinal stress is less than or equal to f_y / γ_{M0}

Check combined bending and compression - Section 6.3.3

Equivalent uniform moment factors - Table B.3	M_{hy} = **0** kNm

M_{sy} = **7** kNm

ψ_y = **1.000**

$\alpha_{hy} = M_{hy} / M_{sy}$ = **0.000**

$C_{my} = 0.95 + 0.05 * \alpha_{hy}$ = **0.950**

M_{hz} = **0** kNm

M_{sz} = **0** kNm

ψ_z = **1.000**

$C_{mz} = 0.6 + 0.4 * \psi_z$ = **1.000**

M_{hLT} = **0** kNm

M_{sLT} = **7** kNm

ψ_{LT} = **1.000**

$\alpha_{hLT} = M_{hLT} / M_{sLT}$ = **0.000**

$C_{mLT} = 0.95 + 0.05 * \alpha_{hLT}$ = **0.950**

Interaction factors k_{ij} for members not susceptible to torsional deformations - Table B.1

Characteristic moment resistance — $M_{Rk} = W_{el.y} * f_y$ = **513** kNm

Characteristic resistance to normal force — $N_{Rk} = A * f_y$ = **4382.4** kN

Interaction factors — $k_{yy} = C_{my} * [1 + \min(0.6 * \bar{\lambda}_y, 0.6) * N_{Ed} / (\chi_y * N_{Rk} / \gamma_{M1})]$ = **1.040**

$k_{zy} = 0.8 * k_{yy}$ = **0.832**

Interaction formulae - eq 6.61 & eq 6.62 — $N_{Ed} / (\chi_y * N_{Rk} / \gamma_{M1}) + k_{yy} * M_{Ed} / (\chi_{LT} * M_{Rk} / \gamma_{M1})$ = **0.266**

$N_{Ed} / (\chi_z * N_{Rk} / \gamma_{M1}) + k_{zy} * M_{Ed} / (\chi_{LT} * M_{Rk} / \gamma_{M1})$ = **0.439**

PASS - Combined bending and compression checks are satisfied

Check vertical deflection - Section 7.2.1

Consider deflection due to variable loads

Limiting deflection — $\delta_{lim} = L_{s1} / 360$ = **18.1** mm

Maximum deflection span 1 — $\delta = \max(\text{abs}(\delta_{max}), \text{abs}(\delta_{min}))$ = **0** mm

PASS - Maximum deflection does not exceed deflection limit

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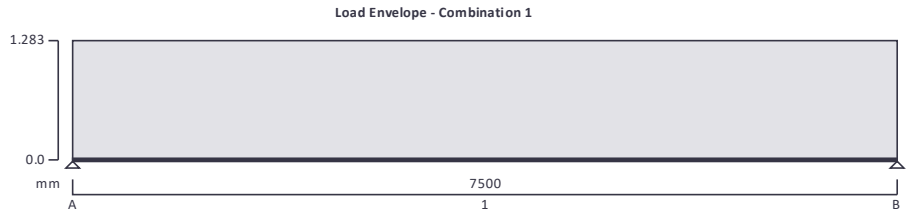
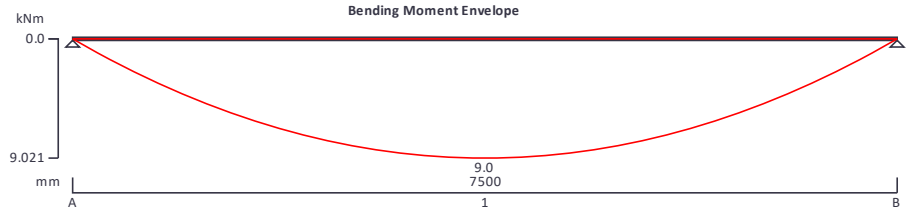
	Calcs for FLYING SHORE 2-1			Start page no./Revision 1	
	Calcs by JRC	Calcs date 28/06/2021	Checked by	Checked date	Approved by	Approved date

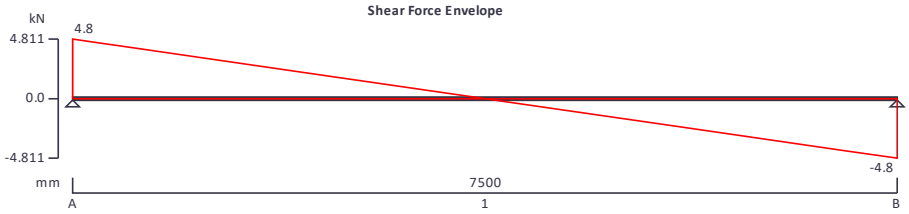
STEEL BEAM ANALYSIS & DESIGN (EN1993-1-1:2005)

In accordance with EN1993-1-1:2005 incorporating Corrigenda February 2006 and April 2009 and the UK national annex

TEDDS calculation version 3.0.14







Support conditions

Support A	Vertically restrained
	Rotationally free
Support B	Vertically restrained
	Rotationally free

Applied loading

Beam loads — Permanent self weight of beam * 1

Load combinations

Load combination 1	Support A	Permanent * 1.35
		Variable * 1.50
		Permanent * 1.35
		Variable * 1.50
	Support B	Permanent * 1.35
		Variable * 1.50

Analysis results

Maximum moment — M_{max} = **9** kNm — M_{min} = **0** kNm

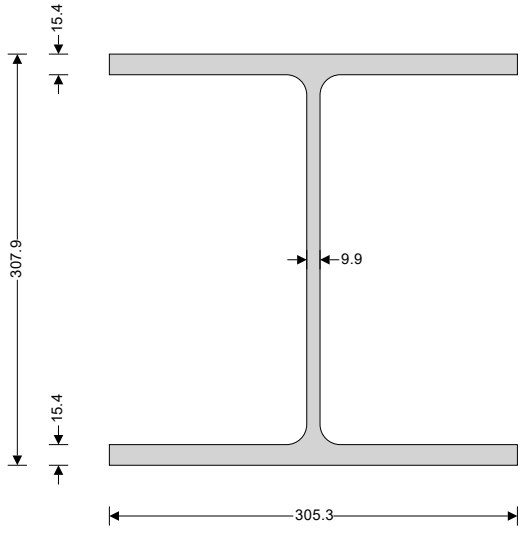
Maximum shear	V_{max} = **4.8** kN	V_{min} = **-4.8** kN
Deflection	δ_{max} = **0** mm	δ_{min} = **0** mm
Maximum reaction at support A	R_{A_max} = **4.8** kN	R_{A_min} = **4.8** kN
Unfactored permanent load reaction at support A	$R_{A\_Permanent}$ = **3.6** kN	
Maximum reaction at support B	R_{B_max} = **4.8** kN	R_{B_min} = **4.8** kN
Unfactored permanent load reaction at support B	$R_{B\_Permanent}$ = **3.6** kN	

Section details

Section type	**UKC 305x305x97 (Tata Steel Advance)**
Steel grade	**S355**

EN 10025-2:2004 - Hot rolled products of structural steels

Nominal thickness of element	t = max(t_f, t_w) = **15.4** mm
Nominal yield strength	f_y = **355** N/mm^2
Nominal ultimate tensile strength	f_u = **470** N/mm^2
Modulus of elasticity	E = **210000** N/mm^2



Partial factors - Section 6.1

Resistance of cross-sections	γ_{M0} = **1.00**
Resistance of members to instability	γ_{M1} = **1.00**
Resistance of tensile members to fracture	γ_{M2} = **1.10**

Lateral restraint

Span 1 has lateral restraint at supports only

Effective length factors

Effective length factor in major axis	K_y = **1.000**
Effective length factor in minor axis	K_z = **1.000**
Effective length factor for torsion	$K_{LT.A}$ = **1.000**
	$K_{LT.B}$ = **1.000**

Classification of cross sections - Section 5.5

$\varepsilon = \sqrt{[235\ N/mm^2 / f_y]}$ = **0.81**

Internal compression parts subject to bending and compression - Table 5.2 (sheet 1 of 3)

Width of section	c = d = **246.7** mm
	α = min([h / 2 + N_{Ed} / (2 * t_w * f_y) - (t_f+ r)] / c, 1) = **0.886**

$c / t_w = 30.6 * \varepsilon <= 396 * \varepsilon / (13 * \alpha - 1)$ Class 1

Outstand flanges - Table 5.2 (sheet 2 of 3)

Width of section $c = (b - t_w - 2 * r) / 2 =$ **132.5** mm

$c / t_f = 10.6 * \varepsilon <= 14 * \varepsilon$ Class 3

Section is class 3

Check shear - Section 6.2.6

Height of web $h_w = h - 2 * t_f =$ **277.1** mm

Shear area factor $\eta =$ **1.000**

$h_w / t_w < 72 * \varepsilon / \eta$

Shear buckling resistance can be ignored

Design shear force $V_{Ed} = \max(\text{abs}(V_{max}), \text{abs}(V_{min})) =$ **4.8** kN

Shear area - cl 6.2.6(3) $A_v = \max(A - 2 * b * t_f + (t_w + 2 * r) * t_f, \eta * h_w * t_w) =$ **3562** mm^2

Design shear resistance - cl 6.2.6(2) $V_{pl,Rd} = A_v * (f_y / \sqrt{[3]}) / \gamma_{M0} =$ **730.1** kN

PASS - Design shear resistance exceeds design shear force

Check bending moment major (y-y) axis - Section 6.2.5

Design bending moment $M_{Ed} = \max(\text{abs}(M_{s1\_max}), \text{abs}(M_{s1\_min})) =$ **9** kNm

Design bending resistance moment - eq 6.14 $M_{c,Rd} = M_{el,Rd} = W_{el,y} * f_y / \gamma_{M0} =$ **513** kNm

Slenderness ratio for lateral torsional buckling

Correction factor - Table 6.6 $k_c =$ **0.94**

$C_1 = 1 / k_c^2 =$ **1.132**

Curvature factor $g = \sqrt{[1 - (I_z / I_y)]} =$ **0.819**

Poissons ratio $\nu =$ **0.3**

Shear modulus $G = E / [2 \times (1 + \nu)] =$ **80769** N/mm^2

Unrestrained length $L = 1.0 * L_{s1} =$ **7500** mm

Elastic critical buckling moment $M_{cr} = C_1 * \pi^2 * E * I_z / (L^2 * g) * \sqrt{[I_w / I_z + L^2 * G * I_t / (\pi^2 * E * I_z)]} =$ **821.1** kNm

Slenderness ratio for lateral torsional buckling $\bar{\lambda}_{LT} = \sqrt{(W_{el,y} * f_y / M_{cr})} =$ **0.79**

Limiting slenderness ratio $\bar{\lambda}_{LT,0} =$ **0.4**

$\bar{\lambda}_{LT} > \bar{\lambda}_{LT,0}$ - Lateral torsional buckling cannot be ignored

Design resistance for buckling - Section 6.3.2.1

Buckling curve - Table 6.5 b

Imperfection factor - Table 6.3 $\alpha_{LT} =$ **0.34**

Correction factor for rolled sections $\beta =$ **0.75**

LTB reduction determination factor $\phi_{LT} = 0.5 \times [1 + \alpha_{LT} \times (\bar{\lambda}_{LT} - \bar{\lambda}_{LT,0}) + \beta \times \bar{\lambda}_{LT}^2] =$ **0.801**

LTB reduction factor - eq 6.57 $\chi_{LT} = \min(1 / [\phi_{LT} + \sqrt{(\phi_{LT}^2 - \beta \times \bar{\lambda}_{LT}^2)}], 1, 1 / \bar{\lambda}_{LT}^2) =$ **0.822**

Modification factor $f = \min(1 - 0.5 * (1 - k_c) * [1 - 2 * (\bar{\lambda}_{LT} - 0.8)^2], 1) =$ **0.970**

Modified LTB reduction factor - eq 6.58 $\chi_{LT,mod} = \min(\chi_{LT} / f, 1) =$ **0.848**

Design buckling resistance moment - eq 6.55 $M_{b,Rd} = \chi_{LT,mod} * W_{el,y} * f_y / \gamma_{M1} =$ **435** kNm

PASS - Design buckling resistance moment exceeds design bending moment

Check compression - Section 6.2.4

Design compression force $N_{Ed} =$ **670** kN

Design resistance of section - eq 6.10 $N_{c,Rd} = N_{pl,Rd} = A * f_y / \gamma_{M0} =$ **4382.4** kN

Slenderness ratio for major (y-y) axis buckling

Critical buckling length $L_{cr,y} = L_{s1} * K_y =$ **7500** mm

Critical buckling force	$N_{cr,y} = \pi^2 * E_{SEC3} * I_y / L_{cr,y}^2 =$ **8198** kN
Slenderness ratio for buckling - eq 6.50	$\bar{\lambda}_y = \sqrt{[A * f_y / N_{cr,y}]} =$ **0.731**

Design resistance for buckling - Section 6.3.1.1

Buckling curve - Table 6.2	b
Imperfection factor - Table 6.1	$\alpha_y =$ **0.34**
Buckling reduction determination factor	$\phi_y = 0.5 * [1 + \alpha_y * (\bar{\lambda}_y - 0.2) + \bar{\lambda}_y^2] =$ **0.858**
Buckling reduction factor - eq 6.49	$\chi_y = \min(1 / [\phi_y + \sqrt{(\phi_y^2 - \bar{\lambda}_y^2)}], 1) =$ **0.766**
Design buckling resistance - eq 6.47	$N_{b,y,Rd} = \chi_y * A * f_y / \gamma_{M1} =$ **3356.2** kN

PASS - Design buckling resistance exceeds design compression force

Slenderness ratio for minor (z-z) axis buckling

Critical buckling length	$L_{cr,z} = L_{s1\_seg1} * K_z =$ **7500** mm
Critical buckling force	$N_{cr,z} = \pi^2 * E_{SEC3} * I_z / L_{cr,z}^2 =$ **2692.6** kN
Slenderness ratio for buckling - eq 6.50	$\bar{\lambda}_z = \sqrt{[A * f_y / N_{cr,z}]} =$ **1.276**

Design resistance for buckling - Section 6.3.1.1

Buckling curve - Table 6.2	c
Imperfection factor - Table 6.1	$\alpha_z =$ **0.49**
Buckling reduction determination factor	$\phi_z = 0.5 * [1 + \alpha_z * (\bar{\lambda}_z - 0.2) + \bar{\lambda}_z^2] =$ **1.577**
Buckling reduction factor - eq 6.49	$\chi_z = \min(1 / [\phi_z + \sqrt{(\phi_z^2 - \bar{\lambda}_z^2)}], 1) =$ **0.399**
Design buckling resistance - eq 6.47	$N_{b,z,Rd} = \chi_z * A * f_y / \gamma_{M1} =$ **1749.5** kN

PASS - Design buckling resistance exceeds design compression force

Check torsional and torsional-flexural buckling - Section 6.3.1.4

Torsional buckling length factor	$K_T =$ **1.00**
Torsional buckling length	$L_{cr,T} = \max(L_{s1}, L_{s1\_seg1}) * K_T =$ **7500** mm
Distance from shear centre to centroid in y axis	$y_0 =$ **0.0** mm
Distance from shear centre to centroid in z axis	$z_0 =$ **0.0** mm
Radius of gyration	$i_0 = \sqrt{[i_y^2 + i_z^2]} =$ **154.7** mm
Elastic critical torsional buckling force	$N_{cr,T} = 1 / i_0^2 * [G * I_t + \pi^2 * E_{SEC3} * I_w / L_{cr,T}^2] =$ **5483.3** kN
Torsion factor	$\beta_T = 1 - (y_0 / i_0)^2 =$ **1.000**
Elastic critical torsional-flexural buckling force	$N_{cr,TF} = N_{cr,y} / (2 \times \beta_T) \times [1 + N_{cr,T} / N_{cr,y} - \sqrt{[(1 - N_{cr,T} / N_{cr,y})^2 + 4 \times (y_0 / i_0)^2 \times N_{cr,T} / N_{cr,y}]}] =$ **5483.3** kN
Elastic critical buckling force	$N_{cr} = \min(N_{cr,T}, N_{cr,TF}) =$ **5483.3** kN
Slenderness ratio for torsional buckling - eq 6.52	$\bar{\lambda}_T = \sqrt{[A \times f_y / N_{cr}]} =$ **0.894**

Design resistance for buckling - Section 6.3.1.1

Buckling curve - Table 6.2	c
Imperfection factor - Table 6.1	$\alpha_T =$ **0.49**
Buckling reduction determination factor	$\phi_T = 0.5 * [1 + \alpha_T * (\bar{\lambda}_T - 0.2) + \bar{\lambda}_T^2] =$ **1.070**
Buckling reduction factor - eq 6.49	$\chi_T = \min(1 / [\phi_T + \sqrt{(\phi_T^2 - \bar{\lambda}_T^2)}], 1) =$ **0.604**
Design buckling resistance - eq 6.47	$N_{b,T,Rd} = \chi_T * A * f_y / \gamma_{M1} =$ **2644.9** kN

PASS - Design buckling resistance exceeds design compression force

Bending and axial force (class 3 section) – Section 6.2.9.2

Maximum longitudinal stress	$\sigma_{x,Ed} = M_{Ed} / W_{el,y} + N_{Ed} / A =$ **60.5** N/mm^2

PASS - Maximum longitudinal stress is less than or equal to f_y / γ_{M0}

Check combined bending and compression - Section 6.3.3

Equivalent uniform moment factors - Table B.3	$M_{hy} =$ **0** kNm

M_{sy} = **9** kNm

ψ_y = **1.000**

$\alpha_{hy} = M_{hy} / M_{sy}$ = **0.000**

$C_{my} = 0.95 + 0.05 * \alpha_{hy}$ = **0.950**

M_{hz} = **0** kNm

M_{sz} = **0** kNm

ψ_z = **1.000**

$C_{mz} = 0.6 + 0.4 * \psi_z$ = **1.000**

M_{hLT} = **0** kNm

M_{sLT} = **9** kNm

ψ_{LT} = **1.000**

$\alpha_{hLT} = M_{hLT} / M_{sLT}$ = **0.000**

$C_{mLT} = 0.95 + 0.05 * \alpha_{hLT}$ = **0.950**

Interaction factors k_{ij} for members not susceptible to torsional deformations - Table B.1

Characteristic moment resistance — $M_{Rk} = W_{el.y} * f_y$ = **513** kNm

Characteristic resistance to normal force — $N_{Rk} = A * f_y$ = **4382.4** kN

Interaction factors — $k_{yy} = C_{my} * [1 + \min(0.6 * \bar{\lambda}_y, 0.6) * N_{Ed} / (\chi_y * N_{Rk} / \gamma_{M1})]$ = **1.033**

$k_{zy} = 0.8 * k_{yy}$ = **0.827**

Interaction formulae - eq 6.61 & eq 6.62 — $N_{Ed} / (\chi_y * N_{Rk} / \gamma_{M1}) + k_{yy} * M_{Ed} / (\chi_{LT} * M_{Rk} / \gamma_{M1})$ = **0.222**

$N_{Ed} / (\chi_z * N_{Rk} / \gamma_{M1}) + k_{zy} * M_{Ed} / (\chi_{LT} * M_{Rk} / \gamma_{M1})$ = **0.401**

PASS - Combined bending and compression checks are satisfied

Check vertical deflection - Section 7.2.1

Consider deflection due to variable loads

Limiting deflection — $\delta_{lim} = L_{s1} / 360$ = **20.8** mm

Maximum deflection span 1 — $\delta = \max(\text{abs}(\delta_{max}), \text{abs}(\delta_{min}))$ = **0** mm

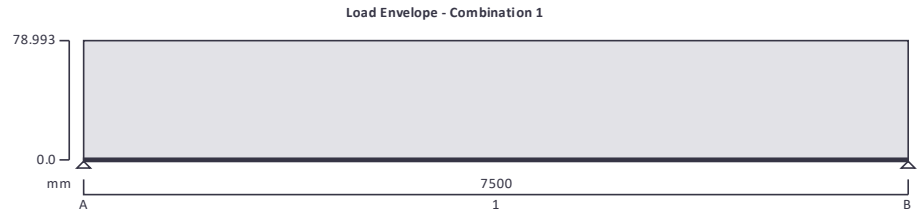
PASS - Maximum deflection does not exceed deflection limit

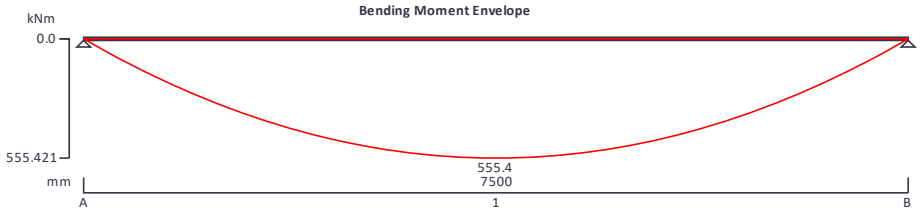
KNIGHTBUILD Knight Build Ltd engineering@knightbuild.co.uk	Project 79 AVENUE ROAD			Job no. 79AR	
	Calcs for WALER 1			Start page no./Revision 1	
	Calcs by JRC	Calcs date 28/06/2021	Checked by	Checked date	Approved by	Approved date

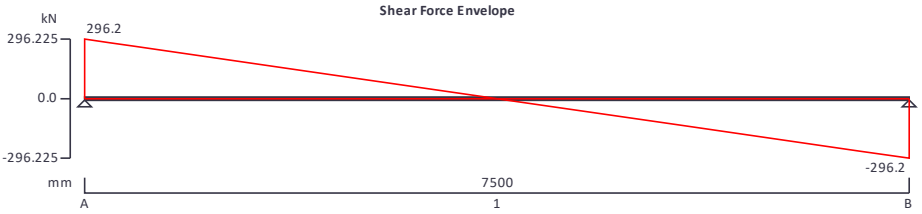
STEEL BEAM ANALYSIS & DESIGN (EN1993-1-1:2005)

In accordance with EN1993-1-1:2005 incorporating Corrigenda February 2006 and April 2009 and the UK national annex

TEDDS calculation version 3.0.14







Support conditions

Support A	Vertically restrained
	Rotationally free
Support B	Vertically restrained
	Rotationally free

Applied loading

Beam loads	ULS LINE LOAD - Other full UDL 77 kN/m
	Permanent self weight of beam * 1

Load combinations

Load combination 1	Support A	Permanent * 1.35
		Variable * 1.50
		Other * 1.00
		Permanent * 1.35
		Variable * 1.50
		Other * 1.00
	Support B	Permanent * 1.35
		Variable * 1.50

Other * 1.00

Analysis results

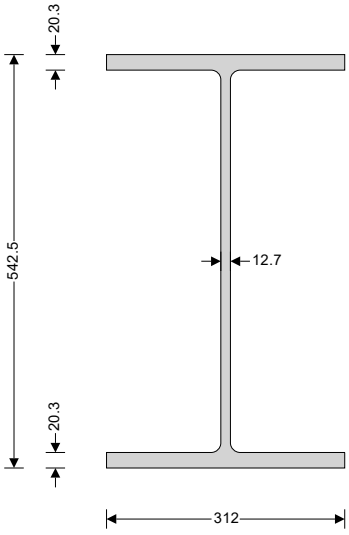
Maximum moment	M_{max} = **555.4** kNm	M_{min} = **0** kNm
Maximum shear	V_{max} = **296.2** kN	V_{min} = **-296.2** kN
Deflection	δ_{max} = **15** mm	δ_{min} = **0** mm
Maximum reaction at support A	R_{A_max} = **296.2** kN	R_{A_min} = **296.2** kN
Unfactored permanent load reaction at support A	$R_{A\_Permanent}$ = **5.5** kN	
Unfactored other load reaction at support A	R_{A_Other} = **288.8** kN	
Maximum reaction at support B	R_{B_max} = **296.2** kN	R_{B_min} = **296.2** kN
Unfactored permanent load reaction at support B	$R_{B\_Permanent}$ = **5.5** kN	
Unfactored other load reaction at support B	R_{B_Other} = **288.8** kN	

Section details

Section type	**UKB 533x312x150 (Tata Steel Advance)**
Steel grade	**S355**

EN 10025-2:2004 - Hot rolled products of structural steels

Nominal thickness of element	t = max(t_f, t_w) = **20.3** mm
Nominal yield strength	f_y = **345** N/mm^2
Nominal ultimate tensile strength	f_u = **470** N/mm^2
Modulus of elasticity	E = **210000** N/mm^2



Partial factors - Section 6.1

Resistance of cross-sections	γ_{M0} = **1.00**
Resistance of members to instability	γ_{M1} = **1.00**
Resistance of tensile members to fracture	γ_{M2} = **1.10**

Lateral restraint

Span 1 has full lateral restraint

Effective length factors

Effective length factor in major axis	K_y = **1.000**
Effective length factor in minor axis	K_z = **1.000**
Effective length factor for torsion	$K_{LT.A}$ = **1.000**
	$K_{LT.B}$ = **1.000**

Classification of cross sections - Section 5.5

$\varepsilon = \sqrt{[235\ N/mm^2 / f_y]} =$ **0.83**

Internal compression parts subject to bending and compression - Table 5.2 (sheet 1 of 3)

Width of section — $c = d =$ **476.5** mm

$\alpha = \min([h / 2 + N_{Ed} / (2 * t_w * f_y) - (t_f + r)] / c, 1) =$ **0.500**

$c / t_w = 45.5 * \varepsilon <= 36 * \varepsilon / \alpha)$ Class 1

Outstand flanges - Table 5.2 (sheet 2 of 3)

Width of section — $c = (b - t_w - 2 * r) / 2 =$ **137** mm

$c / t_f = 8.2 * \varepsilon <= 9 * \varepsilon$ Class 1

Section is class 1

Check shear - Section 6.2.6

Height of web — $h_w = h - 2 * t_f =$ **501.9** mm

Shear area factor — $\eta =$ **1.000**

$h_w / t_w < 72 * \varepsilon / \eta$

Shear buckling resistance can be ignored

Design shear force — $V_{Ed} = \max(abs(V_{max}), abs(V_{min})) =$ **296.2** kN

Shear area - cl 6.2.6(3) — $A_v = \max(A - 2 * b * t_f + (t_w + 2 * r) * t_f, \eta * h_w * t_w) =$ **7286** mm^2

Design shear resistance - cl 6.2.6(2) — $V_{c,Rd} = V_{pl,Rd} = A_v * (f_y / \sqrt{[3]}) / \gamma_{M0} =$ **1451.3** kN

PASS - Design shear resistance exceeds design shear force

Check bending moment major (y-y) axis - Section 6.2.5

Design bending moment — $M_{Ed} = \max(abs(M_{s1\_max}), abs(M_{s1\_min})) =$ **555.4** kNm

Design bending resistance moment - eq 6.13 — $M_{c,Rd} = M_{pl,Rd} = W_{pl,y} * f_y / \gamma_{M0} =$ **1428.8** kNm

PASS - Design bending resistance moment exceeds design bending moment

Check compression - Section 6.2.4

Design compression force — $N_{Ed} =$ **0** kN

Design resistance of section - eq 6.10 — $N_{c,Rd} = N_{pl,Rd} = A * f_y / \gamma_{M0} =$ **6617** kN

Slenderness ratio for major (y-y) axis buckling

Critical buckling length — $L_{cr,y} = L_{s1} * K_y =$ **7500** mm

Critical buckling force — $N_{cr,y} = \pi^2 * E_{SEC3} * I_y / L_{cr,y}^2 =$ **37079.7** kN

Slenderness ratio for buckling - eq 6.50 — $\bar{\lambda}_y = \sqrt{[A * f_y / N_{cr,y}]} =$ **0.422**

Design resistance for buckling - Section 6.3.1.1

Buckling curve - Table 6.2 — a

Imperfection factor - Table 6.1 — $\alpha_y =$ **0.21**

Buckling reduction determination factor — $\phi_y = 0.5 * [1 + \alpha_y * (\bar{\lambda}_y - 0.2) + \bar{\lambda}_y^2] =$ **0.613**

Buckling reduction factor - eq 6.49 — $\chi_y = \min(1 / [\phi_y + \sqrt{(\phi_y^2 - \bar{\lambda}_y^2)}], 1) =$ **0.947**

Design buckling resistance - eq 6.47 — $N_{b,y,Rd} = \chi_y * A * f_y / \gamma_{M1} =$ **6264.9** kN

PASS - Design buckling resistance exceeds design compression force

Check torsional and torsional-flexural buckling - Section 6.3.1.4

Torsional buckling length factor — $K_T =$ **1.00**

Torsional buckling length — $L_{cr,T} = \max(L_{s1}, L_{s1\_seg1}) * K_T =$ **7500** mm

Distance from shear centre to centroid in y axis — $y_0 =$ **0.0** mm

Distance from shear centre to centroid in z axis — $z_0 =$ **0.0** mm

Radius of gyration — $i_0 = \sqrt{[i_y^2 + i_z^2]} =$ **240.5** mm

Elastic critical torsional buckling force — $N_{cr,T} = 1 / i_0^2 * [G * I_t + \pi^2 * E_{SEC3} * I_w / L_{cr,T}^2] =$ **7487.2** kN

Torsion factor $\beta_T = 1 - (y_0 / i_0)^2 =$ **1.000**

Elastic critical torsional-flexural buckling force

$N_{cr,TF} = N_{cr,y} / (2 \times \beta_T) \times [1 + N_{cr,T} / N_{cr,y} - \sqrt{[(1 - N_{cr,T} / N_{cr,y})^2 + 4 \times (y_0 / i_0)^2 \times N_{cr,T} / N_{cr,y}]} =$ **7487.2** kN

Elastic critical buckling force $N_{cr} = \min(N_{cr,T}, N_{cr,TF}) =$ **7487.2** kN

Slenderness ratio for torsional buckling - eq 6.52 $\bar{\lambda}_T = \sqrt{[A \times f_y / N_{cr}]} =$ **0.940**

Design resistance for buckling - Section 6.3.1.1

Buckling curve - Table 6.2 b

Imperfection factor - Table 6.1 $\alpha_T =$ **0.34**

Buckling reduction determination factor $\phi_T = 0.5 * [1 + \alpha_T * (\bar{\lambda}_T - 0.2) + \bar{\lambda}_T^2] =$ **1.068**

Buckling reduction factor - eq 6.49 $\chi_T = \min(1 / [\phi_T + \sqrt{(\phi_T^2 - \bar{\lambda}_T^2)}], 1) =$ **0.635**

Design buckling resistance - eq 6.47 $N_{b,T,Rd} = \chi_T * A * f_y / \gamma_{M1} =$ **4204.3** kN

PASS - Design buckling resistance exceeds design compression force

Combined bending and axial force - Section 6.2.9

Bending and axial force check - eq 6.33 & 6.34 $N_{Ed} <= \min(0.25 * N_{pl,Rd}, 0.5 * h_w * t_w * f_y / \gamma_{M0})$

No allowance on the plastic moment need to be accounted for due to the effect of axial force

Check combined bending and compression - Section 6.3.3

Equivalent uniform moment factors - Table B.3

$M_{hy} =$ **0** kNm

$M_{sy} =$ **555** kNm

$\psi_y =$ **1.000**

$\alpha_{hy} = M_{hy} / M_{sy} =$ **0.000**

$C_{my} = 0.95 + 0.05 * \alpha_{hy} =$ **0.950**

$M_{hz} =$ **0** kNm

$M_{sz} =$ **0** kNm

$\psi_z =$ **1.000**

$C_{mz} = 0.6 + 0.4 * \psi_z =$ **1.000**

$M_{hLT} =$ **0** kNm

$M_{sLT} =$ **555** kNm

$\psi_{LT} =$ **1.000**

$\alpha_{hLT} = M_{hLT} / M_{sLT} =$ **0.000**

$C_{mLT} = 0.95 + 0.05 * \alpha_{hLT} =$ **0.950**

Interaction factors k_{ij} for members not susceptible to torsional deformations - Table B.1

Characteristic moment resistance $M_{Rk} = W_{pl,y} * f_y =$ **1428.8** kNm

Characteristic resistance to normal force $N_{Rk} = A * f_y =$ **6617** kN

Interaction factors $k_{yy} = C_{my} * [1 + \min(\bar{\lambda}_y - 0.2, 0.8) * N_{Ed} / (\chi_y * N_{Rk} / \gamma_{M1})] =$ **0.950**

$k_{zy} = 0.6 * k_{yy} =$ **0.570**

Interaction formulae - eq 6.61 & eq 6.62 $N_{Ed} / (\chi_y * N_{Rk} / \gamma_{M1}) + k_{yy} * M_{Ed} / (\chi_{LT} * M_{Rk} / \gamma_{M1}) =$ **0.369**

$N_{Ed} / (\chi_z * N_{Rk} / \gamma_{M1}) + k_{zy} * M_{Ed} / (\chi_{LT} * M_{Rk} / \gamma_{M1}) =$ **0.222**

PASS - Combined bending and compression checks are satisfied

Check vertical deflection - Section 7.2.1

Consider deflection due to variable and other loads

Limiting deflection $\delta_{lim} = L_{s1} / 360 =$ **20.8** mm

Maximum deflection span 1 $\delta = \max(\text{abs}(\delta_{max}), \text{abs}(\delta_{min})) =$ **15.011** mm

PASS - Maximum deflection does not exceed deflection limit

M_{sy} = **7** kNm

ψ_y = **1.000**

$\alpha_{hy} = M_{hy} / M_{sy}$ = **0.000**

$C_{my} = 0.95 + 0.05 * \alpha_{hy}$ = **0.950**

M_{hz} = **0** kNm

M_{sz} = **0** kNm

ψ_z = **1.000**

$C_{mz} = 0.6 + 0.4 * \psi_z$ = **1.000**

M_{hLT} = **0** kNm

M_{sLT} = **7** kNm

ψ_{LT} = **1.000**

$\alpha_{hLT} = M_{hLT} / M_{sLT}$ = **0.000**

$C_{mLT} = 0.95 + 0.05 * \alpha_{hLT}$ = **0.950**

Interaction factors k_{ij} for members not susceptible to torsional deformations - Table B.1

Characteristic moment resistance — $M_{Rk} = W_{el.y} * f_y$ = **513** kNm

Characteristic resistance to normal force — $N_{Rk} = A * f_y$ = **4382.4** kN

Interaction factors — $k_{yy} = C_{my} * [1 + \min(0.6 * \bar{\lambda}_y, 0.6) * N_{Ed} / (\chi_y * N_{Rk} / \gamma_{M1})]$ = **0.980**

$k_{zy} = 0.8 * k_{yy}$ = **0.784**

Interaction formulae - eq 6.61 & eq 6.62 — $N_{Ed} / (\chi_y * N_{Rk} / \gamma_{M1}) + k_{yy} * M_{Ed} / (\chi_{LT} * M_{Rk} / \gamma_{M1})$ = **0.098**

$N_{Ed} / (\chi_z * N_{Rk} / \gamma_{M1}) + k_{zy} * M_{Ed} / (\chi_{LT} * M_{Rk} / \gamma_{M1})$ = **0.154**

PASS - Combined bending and compression checks are satisfied

Check vertical deflection - Section 7.2.1

Consider deflection due to variable loads

Limiting deflection — $\delta_{lim} = L_{s1} / 360$ = **18.1** mm

Maximum deflection span 1 — $\delta = \max(\text{abs}(\delta_{max}), \text{abs}(\delta_{min}))$ = **0** mm

PASS - Maximum deflection does not exceed deflection limit