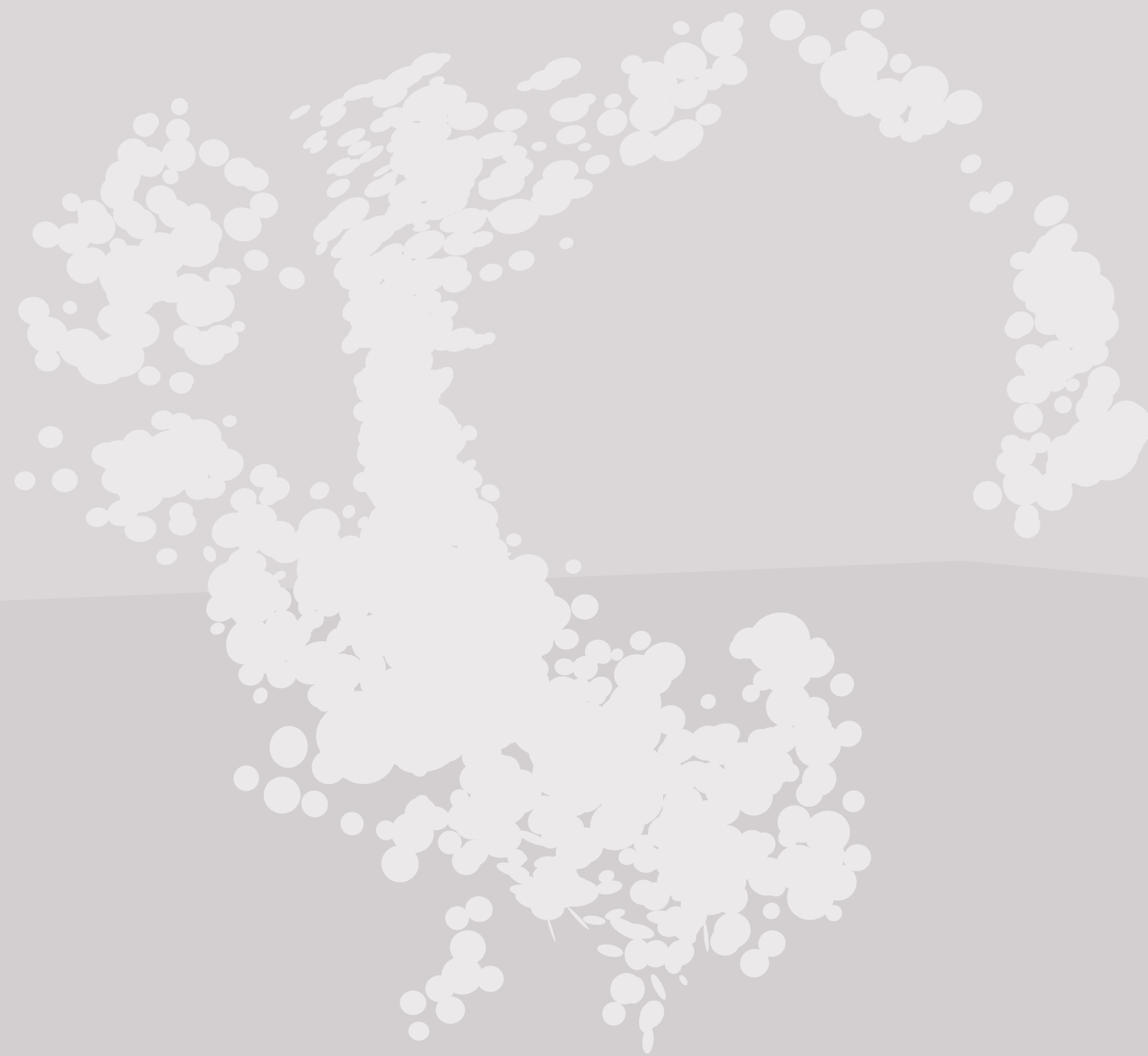


Appendix 11

Basement Retaining Wall Design



AKT 11 Ltd	Sheet No.
Program: WALLAP Version 6.06 Revision A52.B71.R56	Job No. 4259
Licensed from GEOSOLVE	Made by : BB
Data filename/Run ID: 4259_SecantWall[248]900_SLS	Rev 04
Belgrove House	Date: 4-12-2020
900@1400 CFA	Checked :

Units: kN,m

INPUT DATA

SOIL PROFILE

Stratum no.	Elevation of top of stratum	Soil types	
		Left side	Right side
1	17.00	1 Made Ground	1 Made Ground
2	12.00	2 LC1 - ST	2 LC1 - ST
3	3.00	6 LC2 - ST	6 LC2 - ST

SOIL PROPERTIES

-- Soil type --	Bulk density	Young's Modulus	At rest coeff.	Consol state.	Active limit	Passive limit	Cohesion
No. Description (Datum elev.)	kN/m3	Eh, kN/m2 (dEh/dy)	Ko (dKo/dy)	NC/OC (Nu)	Ka (Kac)	Kp (Kpc)	kN/m2 (dc/dy)
1 Made Ground	18.00	5000	0.500	OC (0.200)	0.273 (0.000)	5.026 (0.000)	
2 LC1 - ST (12.00)	20.00	48750 (6500)	1.000	OC (0.490)	1.000 (2.389)	1.000 (2.390)	75.00u (10.00)
3 LC1 - LT (12.00)	20.00	39000 (5200)	1.000	OC (0.200)	0.371 (1.482)	3.212 (5.212)	0.0d
4 Not defined							
5 Not defined							
6 LC2 - ST (3.00)	20.00	107250 (6500)	1.000	OC (0.490)	1.000 (2.389)	1.000 (2.390)	165.0u (10.00)
7 LC2 - LT (3.00)	20.00	103480 (5720)	1.000	OC (0.200)	0.355 (1.448)	3.411 (5.416)	5.000d

Additional soil parameters associated with Ka and Kp

		--- parameters for Ka ---			--- parameters for Kp ---		
		Soil friction	Wall adhesion	Back-fill	Soil friction	Wall adhesion	Back-fill
No. Description		angle	coeff.	angle	angle	coeff.	angle
1 Made Ground		30.00	1.000	0.00	30.00	1.000	0.00
2 LC1 - ST		0.00	0.500	0.00	0.00	0.500	0.00
3 LC1 - LT		23.00	1.000	0.00	23.00	1.000	0.00
4 Not defined							
5 Not defined							
6 LC2 - ST		0.00	0.500	0.00	0.00	0.500	0.00
7 LC2 - LT		24.00	1.000	0.00	24.00	1.000	0.00

GROUND WATER CONDITIONS

Density of water = 10.00 kN/m3

	Left side	Right side
Initial water table elevation	14.00	14.00

Automatic water pressure balancing at toe of wall : No

Water		Left side			Right side			
profile	Point	Elev.	Piezo	Water	Point	Elev.	Piezo	Water
no.	no.	m	elev. m	press. kN/m2	no.	m	elev. m	press. kN/m2
1	1	14.00	14.00	0.0	1	14.00	14.00	0.0 WC
2	1	14.00	14.00	0.0	1	11.00	11.00	0.0 MC
3	1	14.00	14.00	0.0	1	4.80	4.80	0.0 MC
4	1	14.00	14.00	0.0	1	4.80	4.80	0.0 MC
	2	14.00	14.00	0.0	2	4.80	14.00	92.0

WALL PROPERTIES

Type of structure = Fully Embedded Wall
 Elevation of toe of wall = -0.50
 Maximum finite element length = 1.00 m
 Youngs modulus of wall E = 3.0000E+07 kN/m2
 Moment of inertia of wall I = 0.023000 m4/m run
 E.I = 690000 kN.m2/m run
 Yield Moment of wall = Not defined

STRUTS and ANCHORS

Prop no.	Elev.	Prop spacing m	Cross-section area sq.m	Youngs modulus kN/m2	Free length m	Inclin -ation (degs)	Pre-stress /prop kN	Strut or Anchor	Allow tension ?	L/R
1	17.00	1.00	1.000000	100000	1.00	0.00	0	Strut	No	R
2	16.00	1.00	1.000000	40000	1.00	0.00	0	Strut	No	R
3	13.00	1.00	1.000000	100000	1.00	0.00	0	Strut	No	R
4	12.00	1.00	1.000000	40000	1.00	0.00	0	Strut	No	R
5	5.80	1.00	1.000000	100000	1.00	0.00	0	Strut	No	R

SURCHARGE LOADS

Surch -arge no.	Elev.	Distance from wall	Length parallel to wall	Width perpend. to wall	Surcharge kN/m2		Equiv. soil type	Partial factor/ Category
					Near edge	Far edge		
1	17.00	0.00(L)	45.00	20.00	15.00	=	N/A	1.00 -
2	4.80	-0.00(R)	100.00	20.00	92.00	=	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 17.00
2	Change EI of wall to 483000 kN.m2/m run Yield moment not defined Reset wall displacements to zero at this stage
3	Excavate to elevation 15.00 on RIGHT side
4	Install strut or anchor no.2 at elevation 16.00
5	Apply water pressure profile no.2 (Mod. Conserv.)
6	Excavate to elevation 11.00 on RIGHT side
7	Install strut or anchor no.4 at elevation 12.00
8	Apply water pressure profile no.3 (Mod. Conserv.)
9	Excavate to elevation 4.80 on RIGHT side
10	Install strut or anchor no.5 at elevation 5.80
11	Install strut or anchor no.3 at elevation 13.00
12	Remove strut or anchor no.4 at elevation 12.00
13	Install strut or anchor no.1 at elevation 17.00
14	Remove strut or anchor no.2 at elevation 16.00
15	Change EI of wall to 345000 kN.m2/m run Yield moment not defined No adjustments to wall displacements
16	Change properties of soil type 2 to soil type 3 No analysis at this stage Ko pressures will not be reset
17	Change properties of soil type 6 to soil type 7 No analysis at this stage Ko pressures will not be reset
18	Apply surcharge no.2 at elevation 4.80 No analysis at this stage
19	Apply water pressure profile no.4 (Mod. Conserv.)

FACTORS OF SAFETY and ANALYSIS OPTIONS

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

Stability analysis:

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

Parameters for undrained strata:

Minimum equivalent fluid density = 5.00 kN/m³
 Maximum depth of water filled tension crack = 0.00 m

Bending moment and displacement calculation:

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

Boundary conditions:

Length of wall (normal to plane of analysis) = 45.00 m

Width of excavation on Left side of wall = 20.00 m

Width of excavation on Right side of wall = 20.00 m

Distance to rigid boundary on Left side = 20.00 m

Distance to rigid boundary on Right side = 20.00 m

OUTPUT OPTIONS

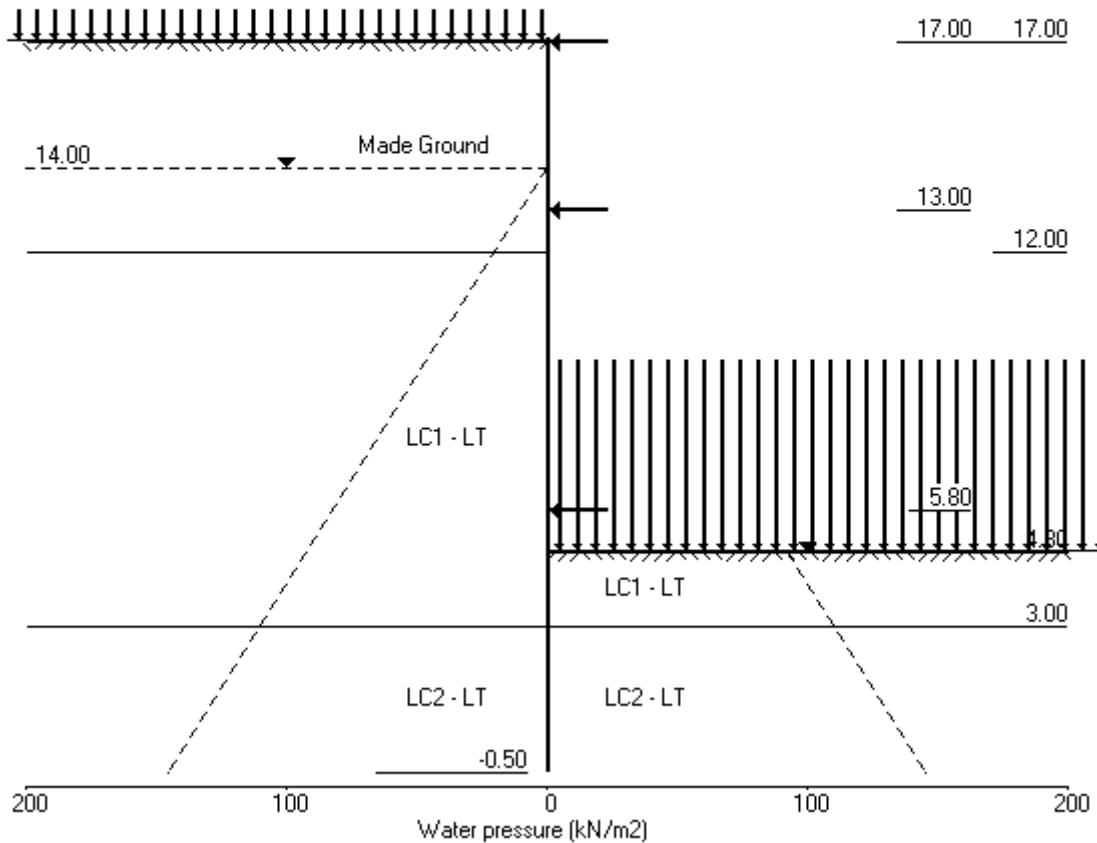
Stage no.	Stage description	Displacement Bending mom. Shear force	Active, Passive pressures	Graph. output
1	Apply surcharge no.1 at elev. 17.00	Yes	Yes	Yes
2	Change EI of wall to 483000kN.m ² /m run	Yes	Yes	Yes
3	Excav. to elev. 15.00 on RIGHT side	Yes	Yes	Yes
4	Install prop no.2 at elev. 16.00	Yes	Yes	Yes
5	Apply water pressure profile no.2	Yes	Yes	Yes
6	Excav. to elev. 11.00 on RIGHT side	Yes	Yes	Yes
7	Install prop no.4 at elev. 12.00	Yes	Yes	Yes
8	Apply water pressure profile no.3	Yes	Yes	Yes
9	Excav. to elev. 4.80 on RIGHT side	Yes	Yes	Yes
10	Install prop no.5 at elev. 5.80	Yes	Yes	Yes
11	Install prop no.3 at elev. 13.00	Yes	Yes	Yes
12	Remove prop no.4 at elev. 12.00	Yes	Yes	Yes
13	Install prop no.1 at elev. 17.00	Yes	Yes	Yes
14	Remove prop no.2 at elev. 16.00	Yes	Yes	Yes
15	Change EI of wall to 345000kN.m ² /m run	Yes	Yes	Yes
16	Change soil type 2 to soil type 3	No	No	No
17	Change soil type 6 to soil type 7	Yes	Yes	Yes
18	Apply surcharge no.2 at elev. 4.80	No	No	No
19	Apply water pressure profile no.4	Yes	Yes	Yes
*	Summary output	Yes	-	Yes

AKT 11 Ltd
 Program: WALLAP Version 6.06 Revision A52.B71.R56
 Licensed from GEOSOLVE
 Data filename/Run ID: 4259_SecantWall[248]900_SLS
 Belgrove House
 900@1400 CFA

Sheet No.
 Job No. 4259
 Made by : BB
 Date: 4-12-2020
 Checked :

Units: kN,m

Stage No.19 Apply water pressure profile no.4 (Mod. Conserv.)



AKT 11 Ltd	Sheet No.
Program: WALLAP Version 6.06 Revision A52.B71.R56	Job No. 4259
Licensed from GEOSOLVE	Made by : BB
Data filename/Run ID: 4259_SecantWall[248]900_SLS	
Belgrove House	Date: 4-12-2020
900@1400 CFA	Checked :

Units: kN,m

Stage No. 3 Excavate to elevation 15.00 on RIGHT side

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

Stage No.	Ground level Act.	level Pass.	Prop Elev.	FoS for toe elev. = -0.50	Toe elev. for FoS = 1.000	Direction of failure
				Factor of Safety	Moment at elev.	
3	17.00	15.00	Cant.	6.324	1.47	13.37 1.63 L to R

BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall

Analysis options

Length of wall perpendicular to section = 45.00m
Subgrade reaction model - Boussinesq Influence coefficients
Soil deformations are elastic until the active or passive limit is reached
Open Tension Crack analysis - No

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

Limit State: Serviceability Limit State

Calculated Bending Moments and Prop 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 2

Node no.	Y coord	Nett pressure kN/m2	Wall disp. m	Wall rotation rad.	Shear force kN/m	Bending moment kN.m/m	Prop forces kN/m	EI of wall kN.m2/m
1	17.00	4.10	0.008	1.12E-03	0.0	0.0		483000
2	16.00	9.01	0.007	1.12E-03	6.6	3.4		483000
3	15.00	15.77	0.006	1.11E-03	18.9	16.3		483000
4	14.00	2.26	0.005	1.06E-03	28.0	41.4		483000
5	13.00	4.41	0.004	9.76E-04	31.3	70.5		483000
6	12.00	6.31	0.003	8.32E-04	36.7	104.0		483000
		-38.09	0.003	8.32E-04	36.7	104.0		
7	11.00	-25.32	0.002	6.48E-04	5.0	121.6		483000
8	10.00	-13.47	0.001	4.60E-04	-14.4	113.8		483000
9	9.00	-4.22	0.001	2.98E-04	-23.3	92.6		483000
10	8.00	1.83	0.001	1.77E-04	-24.5	67.2		483000
11	7.00	4.92	0.001	9.70E-05	-21.1	43.5		483000
12	6.40	5.65	0.001	6.60E-05	-17.9	31.7		483000
13	5.80	5.75	0.001	4.52E-05	-14.5	22.0		483000
14	4.80	4.99	0.001	2.66E-05	-9.1	10.2		483000
15	3.90	3.80	0.001	2.14E-05	-5.2	3.9		483000
16	3.00	2.53	0.001	2.17E-05	-2.3	0.7		483000
17	2.00	1.28	0.001	2.40E-05	-0.4	-0.5		483000
18	1.00	0.29	0.001	2.59E-05	0.3	-0.4		483000
19	0.25	-0.27	0.001	2.65E-05	0.4	-0.1		483000
20	-0.50	-0.69	0.000	2.67E-05	0.0	0.0		---

Run ID. 4259_SecantWall[248] 900_SLS
 Belgrove House
 900@1400 CFA

| Sheet No.
 | Date: 4-12-2020
 | Checked :

(continued)

Stage No.3 Excavate to elevation 15.00 on RIGHT side

LEFT side								
Node no.	Y coord	Water press.	Vertic -al	Effective stresses			Total earth pressure	Coeff. of subgrade reaction
				Active limit	Passive limit	Earth pressure		
		kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m3
1	17.00	0.00	15.00	4.10	75.39	4.10	4.10a	804
2	16.00	0.00	33.00	9.01	165.86	9.01	9.01a	804
3	15.00	0.00	50.99	13.93	256.29	15.77	15.77	804
4	14.00	0.00	68.97	18.84	346.65	25.84	25.84	804
5	13.00	10.00	76.93	21.01	386.65	30.83	40.83	804
6	12.00	20.00	84.86	23.18	426.52	35.72	55.72	804
		Total>	104.86	25.00m	284.11	63.35	63.35	10952
7	11.00	Total>	124.77	30.00m	327.91	89.29	89.29	12412
8	10.00	Total>	144.64	35.00m	371.69	114.82	114.82	13872
9	9.00	Total>	164.48	40.00m	415.43	139.14	139.14	15332
10	8.00	Total>	184.30	45.00m	459.14	161.98	161.98	16793
11	7.00	Total>	204.08	50.00m	502.82	183.45	183.45	18253
12	6.40	Total>	215.94	53.00m	529.02	195.80	195.80	19129
13	5.80	Total>	227.78	56.00m	555.21	207.86	207.86	20005
14	4.80	Total>	247.51	61.00m	598.83	227.54	227.54	21465
15	3.90	Total>	265.25	65.50m	638.08	245.02	245.02	22780
16	3.00	Total>	282.97	70.00m	677.31	262.47	262.47	24094
17	2.00	Total>	302.64	75.00m	720.88	281.93	281.93	25554
18	1.00	Total>	311.02	80.00m	753.16	301.52	301.52	27014
19	0.25	Total>	337.05	83.75m	797.11	316.31	316.31	28110
20	-0.50	Total>	351.79	87.50m	829.78	331.16	331.16	29205

RIGHT side								
Node no.	Y coord	Water press.	Vertic -al	Effective stresses			Total earth pressure	Coeff. of subgrade reaction
				Active limit	Passive limit	Earth pressure		
		kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m3
1	17.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	16.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
3	15.00	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	945
4	14.00	0.00	18.00	4.92	90.48	23.57	23.57	945
5	13.00	10.00	26.02	7.11	130.76	26.42	36.42	945
6	12.00	20.00	34.05	9.30	171.14	29.40	49.40	945
		Total>	54.05	15.00m	233.30	101.44	101.44	12767
7	11.00	Total>	74.12	20.00m	277.26	114.61	114.61	14469
8	10.00	Total>	94.22	25.00m	321.27	128.29	128.29	16172
9	9.00	Total>	114.37	30.00m	365.32	143.37	143.37	17874
10	8.00	Total>	134.57	35.00m	409.41	160.15	160.15	19576
11	7.00	Total>	154.82	40.00m	453.56	178.52	178.52	21278
12	6.40	Total>	166.99	43.00m	480.07	190.15	190.15	22300
13	5.80	Total>	179.18	46.00m	506.60	202.12	202.12	23321
14	4.80	Total>	199.53	51.00m	550.86	222.55	222.55	25023
15	3.90	Total>	217.89	55.50m	590.72	241.22	241.22	26555
16	3.00	Total>	236.27	60.00m	630.62	259.93	259.93	28087
17	2.00	Total>	256.74	65.00m	674.98	280.65	280.65	29790
18	1.00	Total>	277.23	70.00m	719.37	301.23	301.23	31492
19	0.25	Total>	292.62	73.75m	752.68	316.57	316.57	32769
20	-0.50	Total>	308.01	77.50m	786.00	331.85	331.85	34045

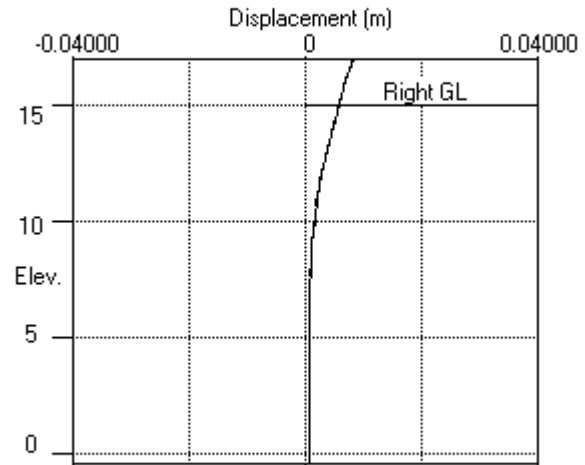
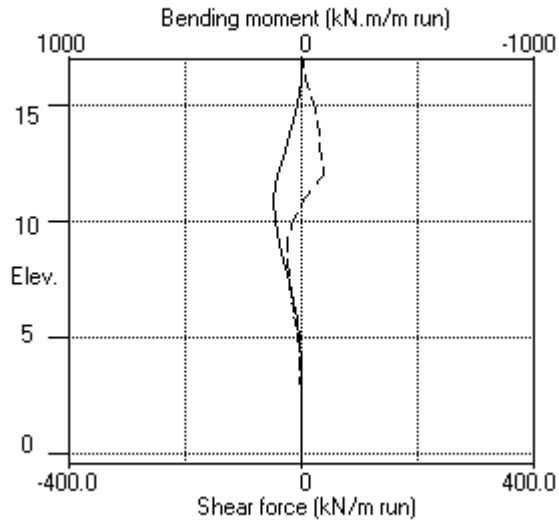
Note: 9.01a Soil pressure at active limit
 123.45p Soil pressure at passive limit

AKT 11 Ltd
 Program: WALLAP Version 6.06 Revision A52.B71.R56
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 Data filename/Run ID: 4259_SecantWall[248] 900_SLS
 Belgrove House
 900@1400 CFA

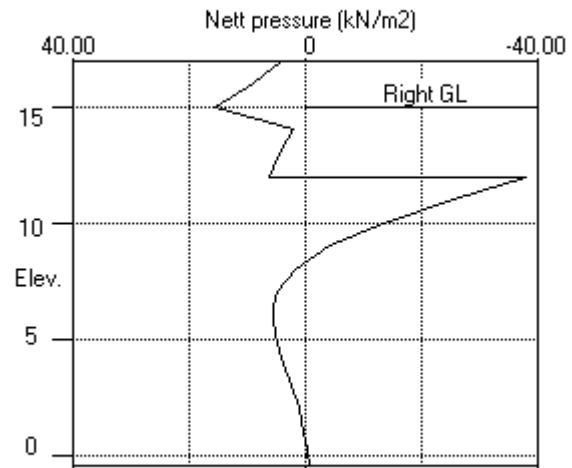
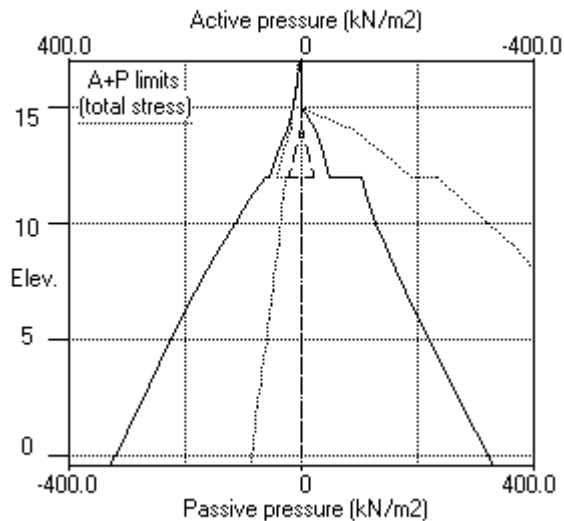
Sheet No.
 Job No. 4259
 Made by : BB
 Date: 4-12-2020
 Checked :

Units: kN,m

Stage No.3 Excav. to elev. 15.00 on RIGHT side



Stage No.3 Excav. to elev. 15.00 on RIGHT side



AKT 11 Ltd
Program: WALLAP Version 6.06 Revision A52.B71.R56
Data filename/Run ID: 4259_SecantWall[248] 900_SLS
Belgrove House
900@1400 CFA

Sheet No.
Job No. 4259
Made by : BB
Date: 4-12-2020
Checked :

Units: kN,m

Stage No. 6 Excavate to elevation 11.00 on RIGHT side

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

Stage No.	Ground Act.	level Pass.	Prop Elev.	FoS for toe elev. = -0.50	Moment of equilib. at elev.	Toe elev. for FoS = 1.000	Wall Penetr -ation	Direction of failure
				Factor of Safety		Toe elev.		
6	17.00	11.00	16.00	5.757	n/a	10.67	0.33	L to R

BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall

Analysis options

Length of wall perpendicular to section = 45.00m
Subgrade reaction model - Boussinesq Influence coefficients
Soil deformations are elastic until the active or passive limit is reached
Open Tension Crack analysis - No

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

Limit State: Serviceability Limit State

Calculated Bending Moments and Prop 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 2

Node no.	Y coord	Nett pressure kN/m2	Wall disp. m	Wall rotation rad.	Shear force kN/m	Bending moment kN.m/m	Prop forces kN/m	EI of wall kN.m2/m
1	17.00	4.10	0.009	-1.17E-04	0.0	0.0		483000
2	16.00	9.01	0.009	-1.19E-04	6.6	3.4	-70.1	483000
		9.01	0.009	-1.19E-04	-63.5	3.4		
3	15.00	14.45	0.009	-5.99E-05	-51.8	-53.8		483000
4	14.00	24.04	0.009	1.09E-04	-32.5	-96.1		483000
5	13.00	38.68	0.009	3.50E-04	-1.2	-114.5		483000
6	12.00	53.38	0.008	6.03E-04	44.8	-94.2		483000
		29.45	0.008	6.03E-04	44.8	-94.2		
7	11.00	50.64	0.007	7.84E-04	84.9	-32.5		483000
		-38.64	0.007	7.84E-04	84.9	-32.5		
8	10.00	-31.85	0.007	8.39E-04	49.6	33.1		483000
9	9.00	-23.18	0.006	7.88E-04	22.1	66.8		483000
10	8.00	-14.73	0.005	6.83E-04	3.2	77.3		483000
11	7.00	-7.75	0.004	5.62E-04	-8.1	73.0		483000
12	6.40	-4.49	0.004	4.91E-04	-11.7	66.8		483000
13	5.80	-1.94	0.004	4.25E-04	-13.7	58.9		483000
14	4.80	0.85	0.003	3.33E-04	-14.2	44.1		483000
15	3.90	2.14	0.003	2.71E-04	-12.9	31.6		483000
16	3.00	2.66	0.003	2.26E-04	-10.7	20.7		483000
17	2.00	2.81	0.003	1.96E-04	-8.0	11.1		483000
18	1.00	2.96	0.002	1.81E-04	-5.1	4.3		483000
19	0.25	3.32	0.002	1.77E-04	-2.7	1.2		483000
20	-0.50	4.01	0.002	1.76E-04	0.0	-0.0		---
At elev. 16.00					Prop force = 70.1 kN/m run			

(continued)

Stage No.6 Excavate to elevation 11.00 on RIGHT side

LEFT side								
Node no.	Y coord	Water press.	Vertic -al	Effective stresses			Total earth pressure	Coeff. of subgrade reaction
				Active limit	Passive limit	Earth pressure		
		kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m3
1	17.00	0.00	15.00	4.10	75.39	4.10	4.10a	438
2	16.00	0.00	33.00	9.01	165.86	9.01	9.01a	438
3	15.00	0.00	50.99	13.93	256.29	14.45	14.45	438
4	14.00	0.00	68.97	18.84	346.65	24.04	24.04	438
5	13.00	10.00	76.93	21.01	386.65	28.68	38.68	438
6	12.00	20.00	84.86	23.18	426.52	33.38	53.38	438
		Total>	104.86	25.00m	284.11	29.45	29.45	6364
7	11.00	Total>	124.77	30.00m	327.91	50.64	50.64	7212
8	10.00	Total>	144.64	35.00m	371.69	73.86	73.86	8060
9	9.00	Total>	164.48	40.00m	415.43	97.89	97.89	8909
10	8.00	Total>	184.30	45.00m	459.14	121.79	121.79	9757
11	7.00	Total>	204.08	50.00m	502.82	144.99	144.99	10606
12	6.40	Total>	215.94	53.00m	529.02	158.50	158.50	11115
13	5.80	Total>	227.78	56.00m	555.21	171.68	171.68	11624
14	4.80	Total>	247.51	61.00m	598.83	193.02	193.02	12472
15	3.90	Total>	265.25	65.50m	638.08	211.71	211.71	13236
16	3.00	Total>	282.97	70.00m	677.31	230.09	230.09	14000
17	2.00	Total>	302.64	75.00m	720.88	250.37	250.37	14848
18	1.00	Total>	311.02	80.00m	753.16	270.72	270.72	15697
19	0.25	Total>	337.05	83.75m	797.11	286.13	286.13	16333
20	-0.50	Total>	351.79	87.50m	829.78	301.72	301.72	16969

RIGHT side								
Node no.	Y coord	Water press.	Vertic -al	Effective stresses			Total earth pressure	Coeff. of subgrade reaction
				Active limit	Passive limit	Earth pressure		
		kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m3
1	17.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	16.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
3	15.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
4	14.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
5	13.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
6	12.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
7	11.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
		Total>	0.00	0.00	203.15	89.28	89.28	8826
8	10.00	Total>	20.01	5.00m	247.05	105.71	105.71	9864
9	9.00	Total>	40.05	10.00m	290.99	121.07	121.07	10903
10	8.00	Total>	60.15	15.00m	335.00	136.52	136.52	11941
11	7.00	Total>	80.36	20.00m	379.10	152.75	152.75	12980
12	6.40	Total>	92.53	23.00m	405.62	162.99	162.99	13603
13	5.80	Total>	104.76	26.00m	432.18	173.63	173.63	14226
14	4.80	Total>	125.25	31.00m	476.57	192.17	192.17	15264
15	3.90	Total>	143.81	35.50m	516.64	209.57	209.57	16198
16	3.00	Total>	162.50	40.00m	556.84	227.43	227.43	17133
17	2.00	Total>	183.41	45.00m	601.65	247.57	247.57	18171
18	1.00	Total>	204.46	50.00m	646.60	267.76	267.76	19210
19	0.25	Total>	220.33	53.75m	680.40	282.81	282.81	19989
20	-0.50	Total>	236.28	57.50m	714.27	297.71	297.71	20767

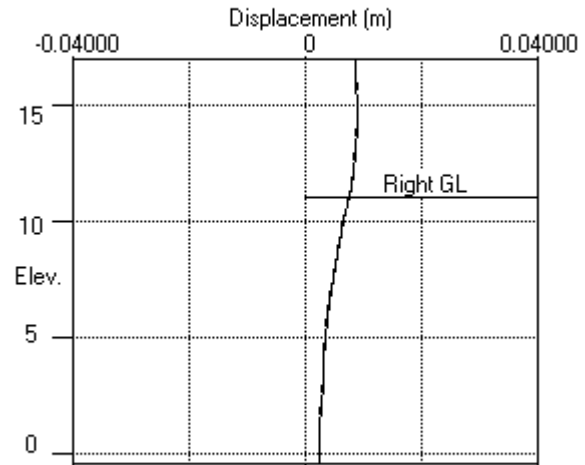
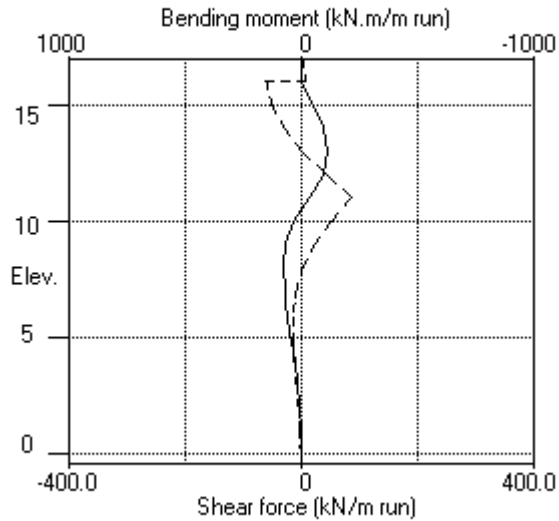
Note: 9.01a Soil pressure at active limit
 123.45p Soil pressure at passive limit

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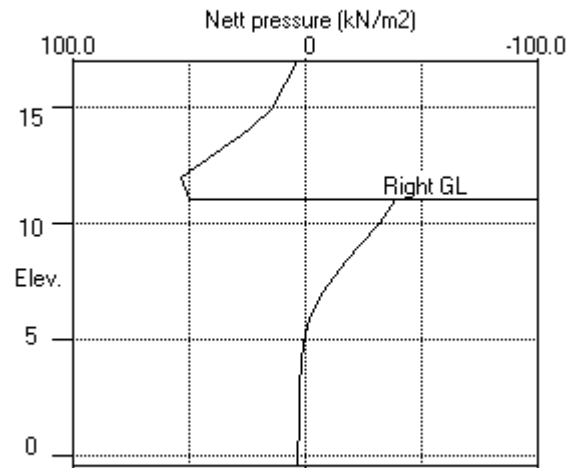
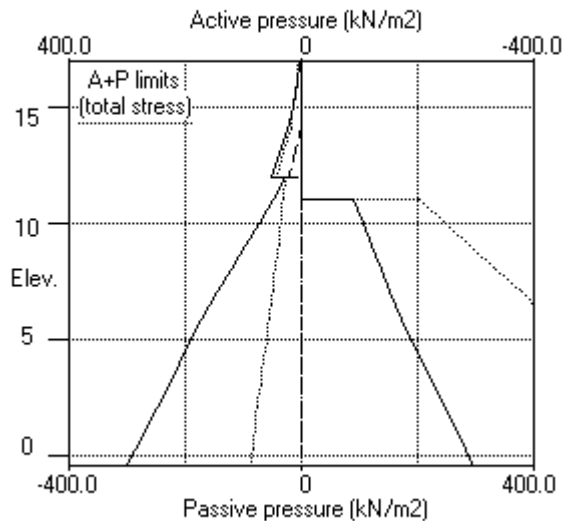
Sheet No.
 Job No. 4259
 Made by : BB
 Date: 4-12-2020
 Checked :

Units: kN,m

Stage No.6 Excav. to elev. 11.00 on RIGHT side



Stage No.6 Excav. to elev. 11.00 on RIGHT side



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Data filename/Run ID: 4259_SecantWall[248] 900_SLS
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Job No. 4259
Made by : BB
Date: 4-12-2020
Checked :

Units: kN,m

Stage No. 9 Excavate to elevation 4.80 on RIGHT side

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

				FoS for toe elev. = -0.50	Toe elev. for FoS = 1.000	
<u>Stage</u>	<u>Ground level</u>	<u>Prop</u>	<u>Factor</u>	<u>Moment</u>	<u>Toe</u>	<u>Wall</u>
<u>No.</u>	<u>Act.</u>	<u>Pass.</u>	<u>of</u>	<u>at equilib.</u>	<u>elev.</u>	<u>Penetr</u>
			<u>Safety</u>	<u>More than one prop.</u>	<u>No</u>	<u>FoS calc.</u>
9	17.00	4.80				

BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall

Analysis options

Length of wall perpendicular to section = 45.00m
Subgrade reaction model - Boussinesq Influence coefficients
Soil deformations are elastic until the active or passive limit is reached
Open Tension Crack analysis - No

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

Limit State: Serviceability Limit State

Calculated Bending Moments and Prop 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 2

<u>Node</u>	<u>Y</u>	<u>Nett</u>	<u>Wall</u>	<u>Wall</u>	<u>Shear</u>	<u>Bending</u>	<u>Prop</u>	<u>EI of</u>
<u>no.</u>	<u>coord</u>	<u>pressure</u>	<u>disp.</u>	<u>rotation</u>	<u>force</u>	<u>moment</u>	<u>forces</u>	<u>wall</u>
		kN/m2	m	rad.	kN/m	kN.m/m	kN/m	kN.m2/m
1	17.00	8.71	0.007	-1.35E-03	0.0	0.0		483000
2	16.00	10.44	0.008	-1.35E-03	9.6	5.7	-47.8	483000
		10.44	0.008	-1.35E-03	-38.2	5.7		
3	15.00	14.11	0.009	-1.33E-03	-25.9	-25.5		483000
4	14.00	23.05	0.011	-1.24E-03	-7.4	-42.1		483000
5	13.00	37.00	0.012	-1.14E-03	22.7	-35.8		483000
6	12.00	50.91	0.013	-1.07E-03	66.6	7.5	-200.1	483000
		25.00	0.013	-1.07E-03	-133.5	7.5		
7	11.00	30.00	0.014	-9.15E-04	-106.0	-114.0		483000
8	10.00	35.00	0.015	-5.29E-04	-73.5	-205.3		483000
9	9.00	40.00	0.015	6.25E-06	-36.0	-261.9		483000
10	8.00	45.00	0.015	6.09E-04	6.5	-278.4		483000
11	7.00	50.00	0.014	1.19E-03	54.0	-249.8		483000
12	6.40	53.00	0.013	1.49E-03	84.9	-208.4		483000
13	5.80	64.82	0.012	1.72E-03	120.3	-141.0		483000
14	4.80	98.22	0.010	1.86E-03	201.8	14.7		483000
		-156.95	0.010	1.86E-03	201.8	14.7		
15	3.90	-112.99	0.009	1.73E-03	80.3	132.7		483000
16	3.00	-69.50	0.007	1.46E-03	-1.8	159.1		483000
17	2.00	-26.67	0.006	1.18E-03	-49.9	122.5		483000
18	1.00	10.94	0.005	9.93E-04	-57.8	59.2		483000
19	0.25	38.17	0.004	9.33E-04	-39.3	18.8		483000
20	-0.50	66.73	0.003	9.18E-04	0.0	-0.0		---
At elev. 16.00			Prop force =		47.8 kN/m run			
At elev. 12.00			Prop force =		200.1 kN/m run			

(continued)

Stage No.9 Excavate to elevation 4.80 on RIGHT side

LEFT side								
Node no.	Y coord	Water press.	Vertic -al	Effective stresses			Total earth pressure	Coeff. of subgrade reaction
				Active limit	Passive limit	Earth pressure		
		kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m3
1	17.00	0.00	15.00	4.10	75.39	8.71	8.71	2576
2	16.00	0.00	33.00	9.01	165.86	10.44	10.44	2576
3	15.00	0.00	50.99	13.93	256.29	14.11	14.11	493
4	14.00	0.00	68.97	18.84	346.65	23.05	23.05	493
5	13.00	10.00	76.93	21.01	386.65	27.00	37.00	493
6	12.00	20.00	84.86	23.18	426.52	30.91	50.91	493
		Total>	104.86	25.00m	284.11	25.00	25.00a	7016
7	11.00	Total>	124.77	30.00m	327.91	30.00	30.00a	7952
8	10.00	Total>	144.64	35.00m	371.69	35.00	35.00a	8887
9	9.00	Total>	164.48	40.00m	415.43	40.00	40.00a	9823
10	8.00	Total>	184.30	45.00m	459.14	45.00	45.00a	10758
11	7.00	Total>	204.08	50.00m	502.82	50.00	50.00a	11694
12	6.40	Total>	215.94	53.00m	529.02	53.00	53.00a	12255
13	5.80	Total>	227.78	56.00m	555.21	64.82	64.82	12817
14	4.80	Total>	247.51	61.00m	598.83	98.22	98.22	13752
15	3.90	Total>	265.25	65.50m	638.08	131.06	131.06	14594
16	3.00	Total>	282.97	70.00m	677.31	163.68	163.68	15436
17	2.00	Total>	302.64	75.00m	720.88	198.09	198.09	16371
18	1.00	Total>	311.02	80.00m	753.16	230.83	230.83	17307
19	0.25	Total>	337.05	83.75m	797.11	255.14	255.14	18009
20	-0.50	Total>	351.79	87.50m	829.78	280.00	280.00	18710

RIGHT side								
Node no.	Y coord	Water press.	Vertic -al	Effective stresses			Total earth pressure	Coeff. of subgrade reaction
				Active limit	Passive limit	Earth pressure		
		kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m3
1	17.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	16.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
3	15.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
4	14.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
5	13.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
6	12.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
7	11.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
8	10.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
9	9.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
10	8.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
11	7.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
12	6.40	0.00	0.00	0.00	0.00	0.00	0.00	0.0
13	5.80	0.00	0.00	0.00	0.00	0.00	0.00	0.0
14	4.80	0.00	0.00	0.00	0.00	0.00	0.00	0.0
		Total>	0.00	0.00	351.32	255.16	255.16	27091
15	3.90	Total>	18.01	4.50m	390.84	244.05	244.05	28750
16	3.00	Total>	36.07	9.00m	430.41	233.18	233.18	30409
17	2.00	Total>	56.27	14.00m	474.51	224.76	224.76	32252
18	1.00	Total>	76.65	19.00m	518.79	219.88	219.88	34095
19	0.25	Total>	92.10	22.75m	552.17	216.97	216.97	35477
20	-0.50	Total>	107.70	26.50m	585.69	213.26	213.26	36859

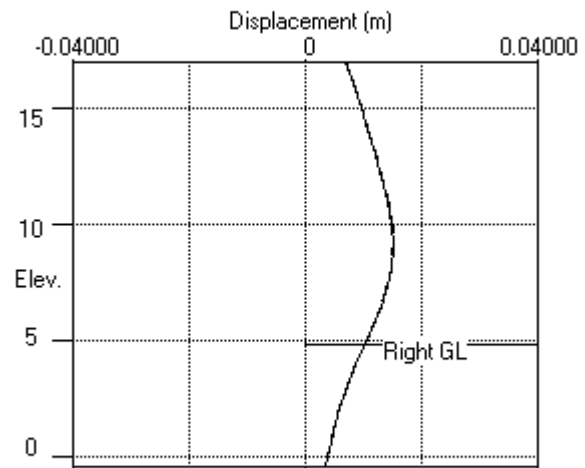
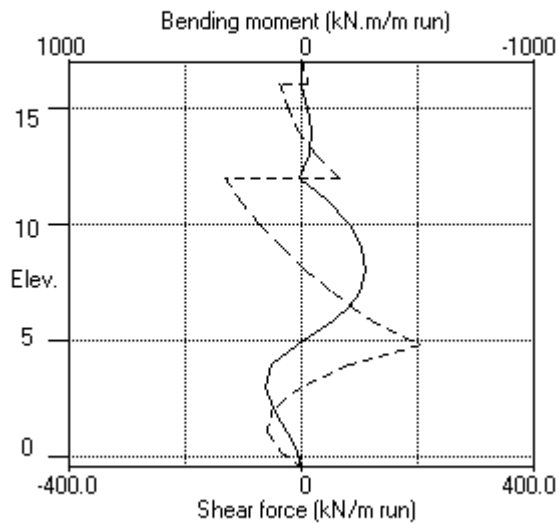
Note: 53.00a Soil pressure at active limit
 123.45p Soil pressure at passive limit

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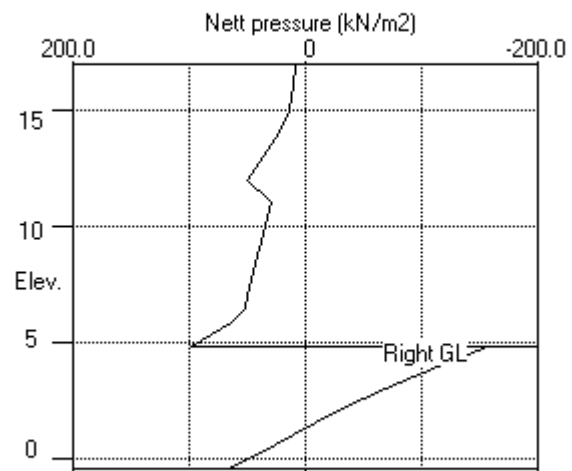
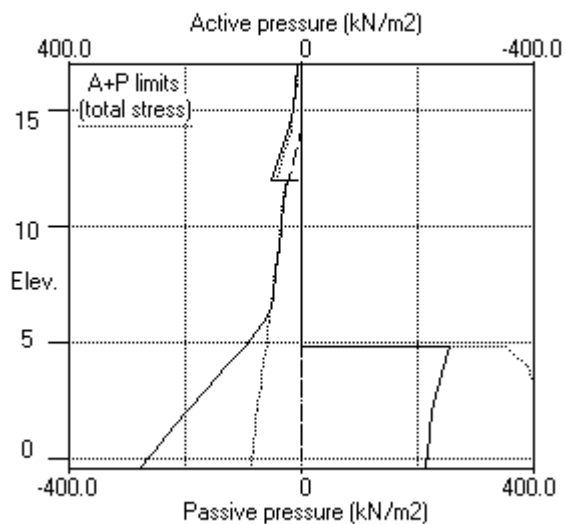
Sheet No.
 Job No. 4259
 Made by : BB
 Date: 4-12-2020
 Checked :

Units: kN,m

Stage No.9 Excav. to elev. 4.80 on RIGHT side



Stage No.9 Excav. to elev. 4.80 on RIGHT side



Units: kN, m

Stage No.	Ground Act.	level Pass.	Prop Elev.	FoS for toe elev. = -0.50		Toe elev. for FoS = 1.000		Direction of failure
				Factor of Safety	Moment equilib. at elev.	Toe elev.	Wall Penetr -ation	
1	17.00	17.00	Cant.	<u>Conditions not suitable for FoS calc.</u>				
2	17.00	17.00		No analysis at this stage				
3	17.00	15.00	Cant.	6.324	1.47	13.37	1.63	L to R
4	17.00	15.00		No analysis at this stage				
5	17.00	15.00	16.00	14.762	n/a	14.94	0.06	L to R
6	17.00	11.00	16.00	5.757	n/a	10.67	0.33	L to R
7	17.00	11.00		No analysis at this stage				
All remaining stages have more than one prop - FoS calculation n/a								

AKT 11 Ltd	Sheet No.
Program: WALLAP Version 6.06 Revision A52.B71.R56	Job No. 4259
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Data filename/Run ID: 4259_SecantWall[248] 900_SLS	
Belgrove House	Date: 4-12-2020
900@1400 CFA	Checked :

Units: kN,m

Summary of results

BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall

Analysis options

Length of wall perpendicular to section = 45.00m
 Subgrade reaction model - Boussinesq Influence coefficients
 Soil deformations are elastic until the active or passive limit is reached
 Open Tension Crack analysis - No

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

Limit State: Serviceability Limit State

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

Bending moment, shear force and displacement envelopes

Node no.	Y coord	Displacement		Bending moment				Shear force			
		max.	min.	Calculated		Factored		Calculated		Factored	
				max.	min.	max.	min.	max.	min.	max.	min.
		m	m	kN.m/m		kN.m/m		kN/m	kN/m	kN/m	kN/m
1	17.00	0.009	0.000	0	0	0	0	0	-35	0	-47
2	16.00	0.009	0.000	7	-28	9	-38	10	-64	14	-86
3	15.00	0.011	0.000	24	-54	32	-73	23	-52	30	-70
4	14.00	0.013	0.000	56	-96	75	-130	40	-33	55	-44
5	13.00	0.015	0.000	109	-115	147	-155	69	-259	93	-350
6	12.00	0.018	0.000	104	-160	140	-216	67	-217	90	-293
7	11.00	0.020	0.000	122	-321	164	-433	85	-159	115	-215
8	10.00	0.022	0.000	114	-446	154	-602	50	-87	67	-118
9	9.00	0.022	0.000	96	-493	129	-666	22	-36	30	-49
10	8.00	0.022	0.000	77	-448	104	-604	98	-24	132	-33
11	7.00	0.020	0.000	73	-296	99	-399	211	-22	284	-29
12	6.40	0.019	0.000	67	-208	90	-281	285	-19	385	-25
13	5.80	0.017	0.000	59	-141	79	-190	364	-129	492	-175
14	4.80	0.015	0.000	72	-9	97	-11	202	-14	272	-19
15	3.90	0.012	0.000	175	0	236	0	80	-13	108	-17
16	3.00	0.010	0.000	186	0	252	0	71	-17	96	-23
17	2.00	0.008	0.000	136	-0	184	-1	23	-61	31	-83
18	1.00	0.005	0.000	96	-0	129	-1	0	-64	0	-87
19	0.25	0.004	0.000	47	-0	64	-0	0	-62	0	-84
20	-0.50	0.003	0.000	0	-0	0	-0	0	-0	0	-0

Run ID. 4259_SecantWall[248]900_SLS
 Belgrove House
 900@1400 CFA

| Sheet No.
 | Date: 4-12-2020
 | Checked :

Summary of results (continued)

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

Maximum and minimum bending moment and shear force at each stage

Stage no.	Bending moment						Shear force					
	Calculated				Factored		Calculated				Factored	
	max. elev.	min. elev.	max. elev.	min. elev.	max. min.		max. elev.	min. elev.	max. elev.	min. elev.	max. min.	
	kN.m/m		kN.m/m		kN.m/m		kN/m		kN/m		kN/m	
1	27	10.00	0	17.00	36	0	8	12.00	-5	8.00	11	-6
2	No calculation at this stage											
3	122	11.00	-0	2.00	164	-1	37	12.00	-24	8.00	49	-33
4	No calculation at this stage											
5	117	11.00	-0	1.00	158	-0	46	12.00	-24	8.00	62	-32
6	77	8.00	-115	13.00	104	-155	85	11.00	-64	16.00	115	-86
7	No calculation at this stage											
8	77	8.00	-114	13.00	104	-153	85	11.00	-63	16.00	114	-85
9	159	3.00	-278	8.00	215	-376	202	4.80	-133	12.00	272	-180
10	No calculation at this stage											
11	No calculation at this stage											
12	186	3.00	-316	9.00	252	-427	192	4.80	-139	13.00	259	-187
13	No calculation at this stage											
14	186	3.00	-312	9.00	251	-421	192	4.80	-140	13.00	259	-189
15	No calculation at this stage											
16	No calculation at this stage											
17	No calculation at this stage											
18	No calculation at this stage											
19	112	2.00	-493	9.00	151	-666	364	5.80	-259	13.00	492	-350

Maximum and minimum displacement at each stage

Stage no.	Displacement				Stage description
	maximum	elev.	minimum	elev.	
	m		m		
1	0.002	17.00	0.000	17.00	Apply surcharge no.1 at elev. 17.00
2	Wall displacements reset to zero				Change EI of wall to 483000kN.m2/m run
3	0.008	17.00	0.000	17.00	Excav. to elev. 15.00 on RIGHT side
4	No calculation at this stage				Install prop no.2 at elev. 16.00
5	0.008	17.00	0.000	17.00	Apply water pressure profile no.2
6	0.009	15.00	0.000	17.00	Excav. to elev. 11.00 on RIGHT side
7	No calculation at this stage				Install prop no.4 at elev. 12.00
8	0.009	15.00	0.000	17.00	Apply water pressure profile no.3
9	0.015	9.00	0.000	17.00	Excav. to elev. 4.80 on RIGHT side
10	No calculation at this stage				Install prop no.5 at elev. 5.80
11	No calculation at this stage				Install prop no.3 at elev. 13.00
12	0.017	10.00	0.000	17.00	Remove prop no.4 at elev. 12.00
13	No calculation at this stage				Install prop no.1 at elev. 17.00
14	0.017	10.00	0.000	17.00	Remove prop no.2 at elev. 16.00
15	No calculation at this stage				Change EI of wall to 345000kN.m2/m run
16	No calculation at this stage				Change soil type 2 to soil type 3
17	No calculation at this stage				Change soil type 6 to soil type 7
18	No calculation at this stage				Apply surcharge no.2 at elev. 4.80
19	0.022	9.00	0.000	17.00	Apply water pressure profile no.4

Run ID. 4259_SecantWall[248]900_SLS
 Belgrove House
 900@1400 CFA

| Sheet No.
 | Date: 4-12-2020
 | Checked :

Summary of results (continued)

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

Prop forces at each stage (horizontal components)

Stage no.	----- Prop no. 1 ----- at elev. 17.00			----- Prop no. 2 ----- at elev. 16.00			----- Prop no. 3 ----- at elev. 13.00		
	--Calculated-- kN per m run	Factored kN per prop	Factored kN per prop	--Calculated-- kN per m run	Factored kN per prop	Factored kN per prop	--Calculated-- kN per m run	Factored kN per prop	Factored kN per prop
5	---	---	---	5	5	7	---	---	---
6	---	---	---	70	70	95	---	---	---
8	---	---	---	70	70	94	---	---	---
9	---	---	---	48	48	65	---	---	---
12	---	---	---	50	50	68	158	158	214
14	35	35	47	---	---	---	175	175	236
19	0	0	0	---	---	---	328	328	443

Stage no.	----- Prop no. 4 ----- at elev. 12.00			----- Prop no. 5 ----- at elev. 5.80		
	--Calculated-- kN per m run	Factored kN per prop	Factored kN per prop	--Calculated-- kN per m run	Factored kN per prop	Factored kN per prop
8	0	0	1	---	---	---
9	200	200	270	---	---	---
12	---	---	---	41	41	56
14	---	---	---	41	41	55
19	---	---	---	494	494	666

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Belgrove House
900@1400 CFA

| Sheet No.
| Job No. 4259
| Made by : BB
|
| Date: 4-12-2020
Checked :

Units: kN,m

Bending moment, shear force, displacement envelopes

