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Job Name: BROXWOOD VIEW, 29 ST. EDMUND'S TERRACE LONDON NW8 7QH

Calc Title: Detailed Design – Temporary Propping Scheme to Laterally Restrain Secant Pile Retaining Wall & Segmental Underpinning Wall Rev. 00

BROXWOOD VIEW, 29. ST. EDMUND'S TERRACE

LONDON NW8 7QH

Report on Detailed Design for Temporary Propping Scheme to Laterally Restrain ∅450 Secant Pile Retaining Wall & Segmental Underpinning Wall **Rev. 00**

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BROXWOOD VIEW, 29. ST. EDMUND'S TERRACE LONDON NW8 7QH

REPORT ON DETAILED DESIGN FOR TEMPORARY PROPPING SCHEME TO LATERALLY RESTRAIN Ø450 SECANT PILE RETAINING WALL & SEGMENTAL UNDERPINNING WALL

1.0 INTRODUCTION

Deep Foundations Specialists (DFS) Limited have been appointed by Broxwood View Limited to carry out the detailed designs for the permanent perimeter secant pile retaining wall, associated temporary works and bearing piles for the proposed residential development on the above site in Northwest London.

The wider project is centred on the redevelopment of the site; this involves the complete demolition of the pre-existing 2 storey Porter's Lodge building on the site and the subsequent construction of a new 4 storey-extension adjacent to the northern wall of the existing Barrie House multi-storey block of residential apartments on the site, with an underlying single level-basement. The new 4 storey-structure would accommodate 9 No. residential apartments.

The approximate National Grid Reference for the approximately square-shaped 0.18 ha-site is 527495E, 183575N, while existing site topography generally slopes downwards from the northern boundary to the south, with an approximate gradient of 1:8. The site's reduced levels vary between (+48.600m OD) – (+42.000m OD). It is proposed to chiefly support the new structure on a 600mm thick reinforced concrete raft at lower ground floor level, while a number of bearing piles are also required as part of the proposed development.

A combination of secant bored pile retaining wall and segmental underpinning systems are required to support the deep excavation for the proposed subterranean components of the building, Maximum retained height is < 4.85m. The secant pile retaining wall and segmental underpinning systems would also function as permanent components of the new basement structure. In addition to lateral earth/groundwater retention, the secant bored pile retaining wall is also designed to support nominal service vertical compressive loading of up to 175 kN/m run and nominal service vertical tension loading of -70 kN/m run of wall.

The detailed designs for the secant pile retaining wall and segmental underpinning wall had already been completed and issued under separate covers by Deep Foundations Specialists (DFS) Limited and Richard Trant Associates Limited respectively. **This particular report chiefly focuses on the detailed design for the temporary props that are required to provide temporary lateral restraint to the retaining walls during bulk excavation and prior to the completion of the basement's reinforced concrete shell.**

The temporary propping systems are required to support service horizontal loading of up to 50 kN/m run of wall, as specified in Table 3 of Deep Foundations Specialists (DFS) Limited's Pile Wall Design Report No. DFS221011 Rev. 00 of 14/10/22.

The design calculations are presented under the following headings:

- INPUT DATA
- OUTLINE OF TEMPORARY WORKS DESIGN
- TYPICAL RETAINING WALL SECTION(S) CONSIDERED IN TEMPORARY WORKS DESIGN
- GROUND CONDITIONS
- TEMPORARY WORKS DESIGN
- PROPOSED STRUCTURAL MOVEMENT MONITORING SCHEME & CONTINGENCY MEASURES
- REFERENCES
- APPENDICES

2.0 INPUT DATA

Design is based on the following site-specific refence documents:

(i) PARMARBROOK's Document No. 1805 of May 2018 – Basement Impact Assessment: Barrie House, 29 St. Edmunds Terrace.

(ii) Card Geotechnics Limited's Geotechnical Report No. CG/28408 Rev. 2 of May 2018 – Barrie House Basement Impact Assessment Revision 2.

(iii) Soil Consultants Limited's Geotechnical Report No. 9241/OT/JRCB of 07 November 2012 – Ground Investigation Report for Proposed Construction at Barrie House, 29 St. Edmund's Terrace, London NW8 7QH.

(iv) PARMARBROOK's Drawing No. 1805-PAR-ZZ-LG-DR-S-0090-S2-P02 – General Arrangement Lower Ground Floor.

(v) PARMARBROOK's Drawing No. 1805-PAR-ZZ-00-DR-S-0100-S2-P02 – General Arrangement Ground Floor.

(vi) PARMARBROOK's Drawing No. 1805-PAR-ZZ-01-DR-S-0110-S2-P01 – General Arrangement First Floor.

(vii) PARMARBROOK's Drawing No. 1805-PAR-ZZ-02-DR-S-0120 – General Arrangement Second Floor.

(viii) PARMARBROOK's Drawing No. 1805-PAR-ZZ-03-DR-S-0130 – General Arrangement Third Floor.

(ix) PARMARBROOK's Drawing No. 1805-PAR-ZZ-04-DR-S-0140 – General Arrangement Roof Plan.

(x) Richard Tant Associates' Drawing No. 5295-P01 – Notes.

(xi) Richard Tant Associates' Drawing No. 5295-P02 – Proposed Basement Floor Sheet 1/2.

(xii) Richard Tant Associates' Drawing No. 5295-P03 – Proposed Basement Floor Sheet 2/2.

(xiii) Richard Tant Associates' Drawing No. 5295-P04 – Proposed Ground Floor Sheet 1/2.

(xiv) Richard Tant Associates' Drawing No. 5295-P05 – Proposed Ground Floor Sheet 2/2.

(xv) Richard Tant Associates' Drawing No. 5295-P10 – Section 1-1.

(xvi) Richard Tant Associates' Drawing No. 5295-P11 – Section 2-2.

(xvii) Richard Tant Associates' Drawing No. 5295-P12 – Section 3-3.

(xviii) Richard Tant Associates' Drawing No. 5295-P13 – Section 4-4.

(xix) Richard Tant Associates' Drawing No. 5295-P14 – Sections 5-5 & 6-6.

(xx) Richard Tant Associates' Drawing No. 5295-P15 – Sections 7-7 & 8-8.

(xxi) Richard Tant Associates' Drawing No. 5295-P16 – Sections 9-9, 10-10 & 11-11.

(xxii) Richard Tant Associates' Drawing No. 5295-P17 – Section 12-12.

(xxiii) Richard Tant Associates' Drawing No. 5295-P18 – Section 13-13.

(xxiv) Richard Tant Associates' Drawing No. 5295-P19 – Section 14-14.

(xxv) Richard Tant Associates' Drawing No. 5295-P20 – Section 15-15.

(xxvi) Richard Tant Associates' Drawing No. 5295-PSM01 – Suggested Method of Works 1.

(xxvii) Richard Tant Associates' Drawing No. 5295-PSM02 – Suggested Method of Works 2.

3.0 OUTLINE OF TEMPORARY WORKS DESIGN

- The detailed design for the temporary propping scheme has been carried out in accordance with the recommendations of the BS5975 (2019) – Code of Practice for Temporary Works Procedures, ICE Specification for Piling & Embedded Retaining Walls (2016), BS8002 (1994), BS5950-1 (2002), BS EN 1997-1:2004 Eurocode 7, BS EN 1992-1-1: 2004 Eurocode 2, PD6687:2006 and the CIRIA Report No. C760 (2017).
- Proposed development comprises of a 4 storey-block of residential apartments, with an underlying basement, as an extension adjacent to the northern wall of the existing Barrie House multi-storey block of residential flats.
- The proposed earth/groundwater retention system for the deep excavation for the new basement on the site shall comprise of a combination of segmental underpinning retaining wall adjacent to the northern wall of the existing Barrie House and ∅450 perimeter secant pile retaining wall on all other sections of the proposed basement; 450mm dia. interlocking male and female piles, with male piles spaced @ 600mm c/c intervals.
- **For serviceability reasons, whilst considering the existence of an underground Thames Water trunk outside the northern boundary of the proposed development, it is required to restrain all sections of the pile wall and segmental underpinning wall with a single row of temporary structural steel props in the temporary condition. The temporary props shall be fixed to the reinforced concrete capping beam on the pile wall and structural steel waling beam on the face of the segmental underpinning wall around crest level, such that there would be sufficient clearance above the props to allow for the safe construction of the reinforced concrete ground floor slab prior to the removal of the temporary props.**
- In essence, all temporary props shall remain in-place until both the basement slab and the ground floor slab achieve sufficient/design structural strength.
- **The above proposal would ensure that the pile wall lateral deflection at any section of the retaining walls and associated ground movements are restricted to tolerable levels during bulk excavation for new basement and therefore, it is expected that the serviceability of all underground assets (including the existing Thames Water trunk) and above-ground structures within the vicinity of the**

propped retaining walls will not be compromised during and after the bulk excavation for the newly proposed basement.

- Maximum wall retained height is < 4.85m.
- The temporary props are generally subject to service horizontal loading of up to 50 kN/m run of wall; see table 3 of Deep Foundations Specialists Limited's pile wall design report No. DFS221011 Rev. 00 of 14/10/22.
- **10 kPa nominal traffic & services surcharge, as well as 50 kPa estimated potential surcharge from fire engines/appliances have been accounted for in the analysis of the retaining wall sections and associated temporary propping system design.**
- The clay layers on the site are modelled as undrained materials, with total stress parameters in the temporary condition. All other soil layers are modelled with effective stress parameters.
- Anticipated perimeter pile wall lateral deflection in both temporary and permanent conditions is < 5.0mm.

4.0 TYPICAL RETAINING WALL SECTION(S) CONSIDERED IN TEMPORARY WORKS DESIGN

The typical retaining wall section considered in temporary works design is described below. A set of construction drawings, which illustrate the layout of the retaining wall-stabilising temporary works, typical sections, connection details and associated construction sequencing are attached to the appendices of this report.

TYPICAL RETAINING WALL SECTION (PROPPED): Piling Platform Level ≈ Existing Ground Level in the Area of Proposed Works = +45.500. Basement Formation Level ≈ -+40.650. Maximum Wall Retained Height < 4.85m. Wall Section is Designed to be Temporarily Restrained with a Row of Structural Steel Props at Capping Beam Level/Wall Crest Level in the Temporary Condition. In the Permanent Condition, the Retaining Wall shall be Restrained by the Lower Ground Floor Slab and the Ground Floor Slab. 10 kPa Nominal Traffic & Services Surcharge, as well as 50 kPa potential surcharge from fire engines/appliances are Accounted for in Wall Analysis & Design.

Proposed Sequence of Construction:

1. Install temporary guide wall prior to the commencement of secant pile wall construction.
2. Concurrently install ∅450 interlocking male and female piles, with male piles spaced @ 600mm c/c, from piling platform level (+45.500) to depths specified by DFS, to form secant pile wall, as we well as the ∅350 bearing piles required for the proposed underpinning works underneath the existing northern wall of Barrie House; see DFS' pile wall construction schedule and bearing pile construction schedule for more detailed information.
3. Break down piles to 75mm above proposed soffit level of RC capping beam.
4. Construct RC capping beam on piles.
5. Carry out segmental underpinning of the existing pad footings and strip footings underneath the northern wall of the existing Barrie House building, as detailed by the Project Structural Engineer (see Richard Tant Associates' Drawing No's 5295-P02, 5295-P04, 5295-P13, 5295-P15, 5295-P17, 5295-P18, 5295-P19, 5295-PSM01 & 5295-PSM02).
6. Install temporary structural steel waling beam along the face of segmental underpinning retaining wall around crest level.

7. Install temporary props at capping beam level/waling beam level of pile wall and underpinning wall.
8. Carry out bulk excavation down to basement formation level; 4.85m maximum dig.
9. Place blinding of 50mm minimum thickness at formation level.
10. Install/fix water-proof membrane on placed blinding, as well as face of pile retaining wall/segmental underpinning wall and around capping beam.
11. Construct 600mm thick reinforced concrete raft/lower ground floor slab with water-proof concrete and dowel into pile retaining wall/segmental underpinning wall, whilst making allowance for cavity drain in front of retaining walls.
12. Construct RC liner wall of 250mm minimum thickness with water-proof concrete, in front of pile retaining wall, from basement level, up to capping beam soffit level and connect same to capping beam.
13. Construct ground floor slab and connect same to capping beam.
14. Remove temporary props and structural steel walling beam.
15. Construct superstructure.

5.0 GROUND CONDITIONS

Site stratigraphy at Broxwood View, 29 St. Edmund's Terrace London NW8 7QH may be generalised as shown in table 1 below:

DEPTH (m bgl)	DESCRIPTION	Representative N_{spt} Value
0.0 – 2.5	Made Ground	-
Below 2.5m bgl	Soft to Firm to Stiff to Very Stiff London Clay	6 - 16

* - Static groundwater level was observed to be approx. 0.8m bgl during site-specific monitoring.

Table 1 – Generalised Site Stratigraphy

Soil parameters used in design are presented in table 2 overleaf. In table 2;

ϕ' values for the cohesionless layers/made ground have been deduced from N_{spt} values (after Peck, Hanson & Thorburn (1974)).

ϕ' values for the cohesive layers are deduced from plasticity indices (after CIRIA Report No. 104, 1984 & CIRIA Report No. C580, 2003).

E' values for cohesionless materials/made ground are estimated with the correlation: $E' = 2000 – 3000 * N_{spt}$ in kPa (after CIRIA Report No. 143, 1995 & CIRIA Report No. C580, 2003).

E' values for cohesive layers are deduced from the expression $E' = 0.8 * E_u$, where $E_u = 800 * C_u$. (after Borin, 2012).

SOIL LAYER	N_{spt}	γ (kN/m^3)	ϕ' (°)	C' (kPa)	C_u (kPa)	E_u	E' (kPa)
Made Ground	-	18.0	28.0	0.0	-	-	15000
Soft to Firm to Stiff to Very Stiff London Clay	6 - 16	19.0	23.0	5.0	30 + 12z	24000 + 9600z	19200 + 7680z

Table 2 – Input soil parameters

6.0 TEMPORARY WORKS DESIGN

(i) Structural Design

It is proposed to temporarily restrain the proposed secant bored pile retaining wall and segmental underpinning wall for the site at Broxwood View, 29 St. Edmund's Terrace London NW8 7QH with a single row of structural steel struts at capping beam level/crest level, in the temporary condition. The temporary struts shall remain in-place until both the basement slab and ground floor slab achieve sufficient/design structural strength.

The structural steel struts shall be fixed to the reinforced concrete capping beam on the pile wall and a structural steel waling beam around the crest level of the segmental underpinning wall, before bulk excavation for the proposed basement progresses below 1m depth. Copies of Deep Foundations Specialists (DFS) Limited's temporary works drawings are attached to the appendices of this report; these provide detailed technical information on perimeter retaining wall layout, struts, capping beam, waling beam, as well as all associated connection details.

Based on retaining wall serviceability analysis results, estimated maximum service prop load (perpendicular to wall line) = 50 kN/m run of wall (see CADS PWS 6.09 computer output files attached to the appendices of this report). In addition, based on the CADS PWS 6.09 computer output files, anticipated maximum wall lateral deflection < 5.0mm.

Prop Type A – RMD Kwikform Tubeshor 320 Hydraulic Corner Braces (45° Inclination Angle to Wall Centrelines)

Estimated service prop load at right angle to wall < 50 kN/m (see CADS PWS 6.09 computer output files attached to the appendices of this report). However, 50 kN/m service prop load is conservatively adopted in the current structural analysis & design calculations for the propping system.

The behaviour of these corner braces and capping beam under 50 kN/m service loading has been analysed with GoBeam Version 2015.1 structural modelling programme. Copies of the relevant computer output files are attached to the appendices of this report.

The main highlights of the analysis are outlined below:

Maximum Service Bending Moment on Capping Beam/Waling Beam = 181.0 kNm

Maximum Service Shear Force on Capping Beam/Waling Beam = 167.0 KN

Maximum Capping Beam/Waling Beam Deflection = 0.5mm

Maximum Corner Brace Reaction = 306.0 KN (conservatively adopt 350 KN for design purpose)

Maximum effective length l of corner braces < 6.0m (conservatively adopt 8.0m for design purpose)

As corner braces are inclined at 45° angle to pile wall centreline, maximum service axial load P_s in any corner brace = 350 / (sin 45°) = 495 KN/Corner Brace.

∴ P_s = 495 KN/Corner Brace

∴ **Provide RMD Kwikform Tubeshor 320 Hydraulic Struts as Corner Braces**

Allowable Compressive Resistance P_c = 500 KN > 495 KN **(O.K.).; see copies of manufacturer's datasheets attached to the appendices of this report.**

The above specification duly accounts for potential load eccentricities and accidental lateral impact loading of up to 10 KN on the struts.

Load Eccentricity Check for Corner Braces:

N/A

Prop Type B – RMD Kwikform Tubeshor 320 Hydraulic Flying Struts

Estimated service prop load at right angle to wall < 50 kN/m (see CADS PWS 6.09 computer output files attached to the appendices of this report). However, 50 kN/m service prop load is conservatively adopted in the current structural analysis & design calculations for the propping system.

The behaviour of these flying struts and capping beam under 50 kN/m service loading has been analysed with GoBeam Version 2015.1 structural modelling programme. Copies of the relevant computer output files are attached to the appendices of this report.

The main highlights of the analysis are outlined below:

Maximum Service Bending Moment on Capping Beam/Waling Beam = 181.0 kNm

Maximum Service Shear Force on Capping Beam/Waling Beam = 167.0 KN

Maximum Capping Beam/Waling Beam Deflection = 0.5mm

Maximum Flying Strut Reaction = 329.0 KN (conservatively adopt 400 KN for design purpose)

Maximum effective length l of flying struts < 11m (adopt 11m for design purpose)

Individual Service Prop Load P_s = 400 KN/flying strut (as already confirmed above)

∴ **Provide RMD Kwikform Tubeshor 320 Hydraulic Struts as Flying Struts.**

Allowable Compressive Resistance P_c = 410 KN > 400 KN **(O.K.).; see copies of manufacturer's datasheets attached to the appendices of this report.**

Allowance for Accidental Impact Loading on Struts during Construction:

Accidental loading of up to 10 KN is accounted for in manufacturer's datasheets for the RMD Kwikform Tubeshor 320 hydraulic struts. Copies are attached to the appendices of this report.

Capping Beam Design (7m Maximum Effective Span under 50 kN/m Service Horizontal Loading in the Temporary Condition):

To be completed and issued by the Project Structural Engineer under separate cover.

Structural Steel Waling Beam Design (7m Maximum Effective Span under 50 kN/m Service Horizontal Loading in the Temporary Condition):

Maximum Service Bending Moment M_s on Waling Beam/Capping Beam = 181.0 kNm (shown earlier).

∴ Provide RMD Kwikform GeoBrace 254

Allowable Service Bending Moment $M_{allowable}$ = 404 kNm > 181.0 kNm **(O.K.).; see copies of manufacturer's datasheets attached to the appendices of this report.**

End Plates for Struts:

Provide end plates to manufacturer's standard details; 320mm x 290mm x 20mm thk. MSX10052 MEGASHOR Push Pull Prop Pivot or 490mm x 300mm x 20mm thk. GBX25404 GeoBrace 254 Inclined Prop Connector. See manufacturer's datasheets attached to the appendices of this report.

Bolt Connections:

(i) *Shear Capacity:*

Shear loading from flying struts would be negligible.

Ultimate horizontal shear from corner braces on end plates = $P_u \cos \theta$, where P_u is the ultimate axial load in strut and θ is the angle of inclination of strut to wall line.

∴ Ultimate horizontal shear on end plate = (495 * 1.6) * cos 45° = 560 KN

Additional vertical shear on bolts due to self-weight of struts (70 kg/m, 11m worst-case length) < 10 KN

∴ Resultant shear load on a bearing plate = $\sqrt{[560^2 + 10^2]}$ KN ≅ 570 KN

Assuming 8 No. M20 DEWALT SC-PRO Carbon Steel Threaded Rod (strength class 8.8) in S275 ply;

Ultimate shear capacity of 1 No. rod = 98 KN

Ultimate shear capacity of 8 No. bolts = 98 * 8 = 784 KN > 570 KN **(O.K.).**

(ii) *Bearing Capacity:*

Ultimate compressive loading on end plate 400 KN * 1.6 = 640 KN

Assuming 20mm minimum ply/plate thickness, for a M20 DEWALT SC-PRO Carbon Steel Threaded Rod (strength class 8.8), ultimate bearing capacity = 196 KN/bolt

Estimated ultimate bearing load on each bolt = 640/8 = 80 KN < 196 KN **(O.K.).**

∴ **Provide 8 No's M20 DEWALT SC-PRO Carbon Steel Threaded Anchor Rods (strength class 8.8) between End Plates and RC Capping Beam at Every Strut Position. Provide Same between Waling Beam and Underpinning Wall at Every Struct Position.**

Every M20 DEWALT SC-PRO Carbon Steel Threaded Anchor Rod shall be Vinylester-Fixed.

170mm Minimum Anchor Bolt Embedment

Provide 8 No's M20 Grade 4.6 Non-Preloaded Ordinary Bolts between End Plates and Steel Waling Beams.

7.0 PROPOSED STRUCTURAL MOVEMENT MONITORING SCHEME & CONTIGENCY MEASURES

In order to maintain an adequate level of safety and serviceability during the bulk excavation phase, it is imperative that the movement of the retaining walls, as well as the external walls of neighbouring structures be regularly monitored, while a suitable contingency scheme needs to be put in-place, in anticipation of measured wall deflections potentially exceeding the maximum threshold. The instrumentation and monitoring process shall generally follow the recommendations of the Project Structural Engineer; see Richard Trant Associates' drawing No. 5295-PM01 for detailed information.

Essentially, the structural movement monitoring scheme shall involve the following procedure:

- Carry out initial monitoring works 2 months before commencement of site operations in order to establish baseline readings and pre-construction movements, whilst following the reading frequencies stipulated in Richard Trant Associates' drawing No. 5295-PM01.
- At piling/groundworks stage, monitoring data recording shall be done on a weekly basis, until 1 month after ground floor slab construction, as specified in Richard Trant Associates' drawing No. 5295-PM01. However, during underpinning works, readings shall be taken on a daily basis until 1 week after the curing of the final dry pack.
- After the completion of ground floor construction, reading frequency may be limited to 1 No. reading per calendar month until structural works are completed on the site.

The monitoring process shall be based on a 'traffic light' system with green, amber and red response zones. Descriptions of the response zones are given below:

Green – continue site operations and monitoring as normal

Amber – continue site operations with caution, whilst preparing to implement contingency measures/action plan, as detailed in Richard Trant Associates' drawing No. 5295-PM01. Increase monitoring frequency.

Red – stop site operations, do everything possible to slow down deflection and implement contingency/red level action plan, as detailed in Richard Trant Associates' drawing No. 5295-PM01. Install additional temporary works and increase monitoring frequency.

In the unlikely event of measured deflections reaching the amber zone/red zone threshold, the following contingency procedure shall be followed:

- Immediate back-filling of the excavation area up to ground level/capping beam level and immediate notification of project team members.
- Placed back-fill shall be left in place until such a time that monitoring results show no further wall movement.
- No further works shall be carried out on site until stabilisation/remedial works proposals are agreed with project team members.

At this stage, the following contingency/stabilisation measures are envisaged:

- Inspect the already installed temporary struts at capping beam level to confirm that there are no visible signs of distress, distortion, rotation, cracks, deflections or any other serviceability issues on the struts. If any serviceability issues are observed on the props, affected props shall be removed and replaced accordingly before bulk excavation resumes.
- Resume bulk excavation down to 3.0m depth.
- Install 2nd level of props at 2.5m depth, with associated steel waling beams.
- Complete bulk excavation down to basement formation level (4.85m depth).
- Construct basement slab
- Construct ground floor slab
- Remove 2nd level of temporary struts and waling beam at 2.5m depth
- Remove 1st level of temporary struts at capping beam level.

An illustration of the proposed trigger levels is presented in figure 1 below:

Figure 1 – Set Trigger Limits for Structural Movements within the Vicinity of Proposed Basement

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APPENDICES

DFS' Temporary Prop Layout, Typical Sections & Connection Details

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SUMMARY OF TEMPORARY PROPPING SCHEME

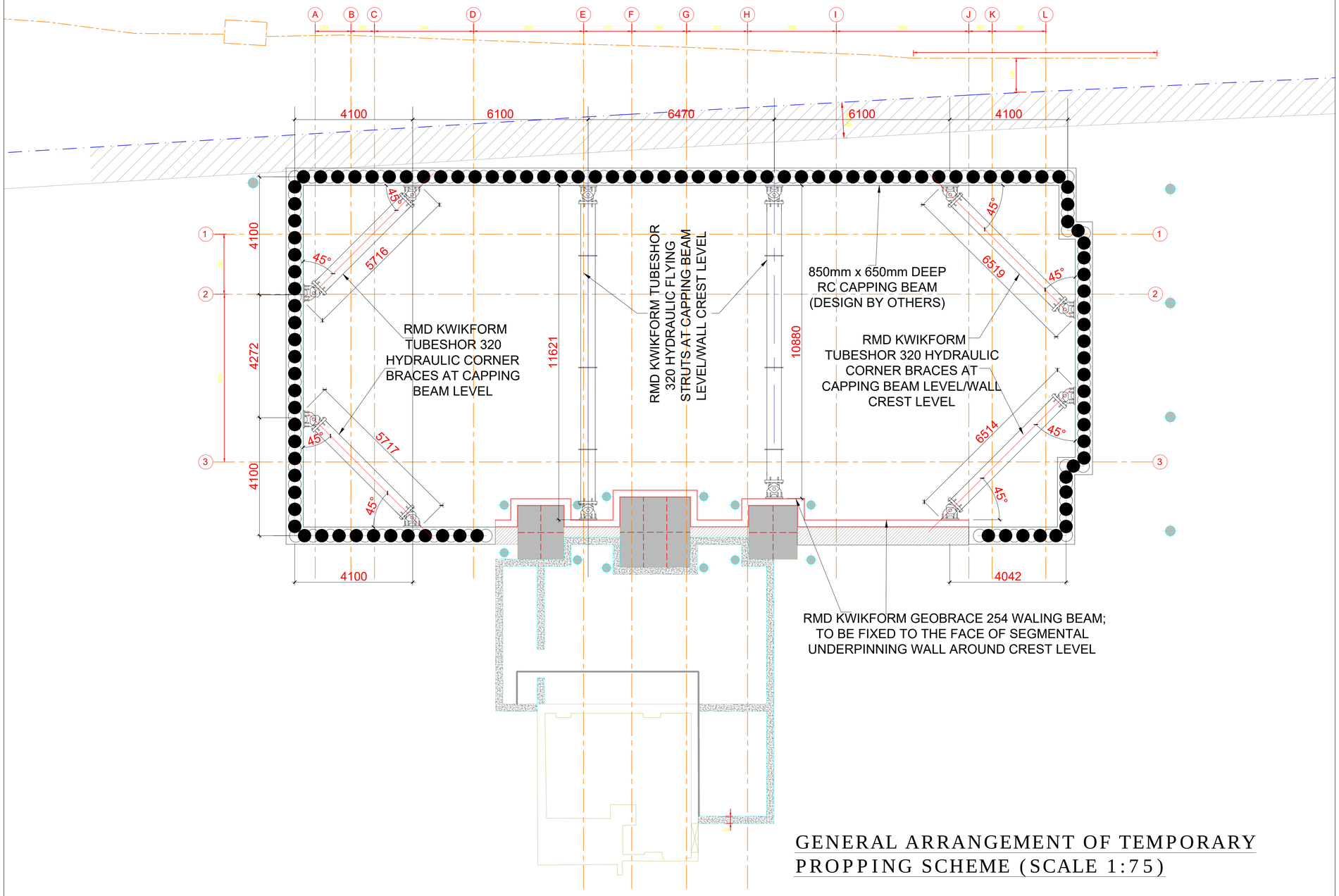
* PROP TYPE A: 4 No's. RMD KWIKFORM TUBESHOR 320 x 7.0m MAXIMUM LENGTH CORNER BRACES (6.0m - 7.0m LENGTHS)

* PROP TYPE B: 2 No's. RMD KWIKFORM TUBESHOR 320 x 12m MAXIMUM LENGTH FLYING STRUTS (10.5m - 12.0m LENGTHS)

* 850mm WIDE x 650mm DEEP RC CAPPING BEAM ON PERIMETER SECANT PILE WALL (DESIGN BY OTHERS)

RC CAPPING BEAM SHALL BE DESIGNED TO SPAN OVER A MINIMUM LENGTH OF 7.0m UNDER SERVICE HORIZONTAL LOADING OF 50 KN/m IN THE TEMPORARY CONDITION.

RC CRADLES ON UNDERPINNING MINIPILES NOT SHOWN FOR CLARITY



GENERAL ARRANGEMENT OF TEMPORARY PROPPING SCHEME (SCALE 1:75)

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4. ONLY FIGURED DIMENSIONS ARE TO BE USED. ANY QUERIES MUST BE REFERRED TO DFS.

5. 50mm COVER TO PILE REINFORCEMENT.

6. STRICT SUPERVISION OF BULK EARTH WORKS IS REQUIRED TO ENSURE THAT EXCAVATIONS DO NOT EXCEED THE DESIGN DEPTH SHOWN IN THESE DRAWINGS (4.85m).

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SLOUGH SL1 1FQ.
TELEPHONE: 01753 396498

CLIENT: BROXWOOD VIEW LIMITED

JOB TITLE: BROXWOOD VIEW, 29 ST. EDMUND'S TERRACE LONDON NW8 7QH

DRAWING TITLE: GENERAL ARRANGEMENT OF TEMPORARY PROPPING SCHEME

DATE	DRAWN	CHECKED
16 OCT 2022	AR	AA

DRAWING No.	REV	SCALE
DFS221011-07	00	SCALE IS AS SHOWN @ A1

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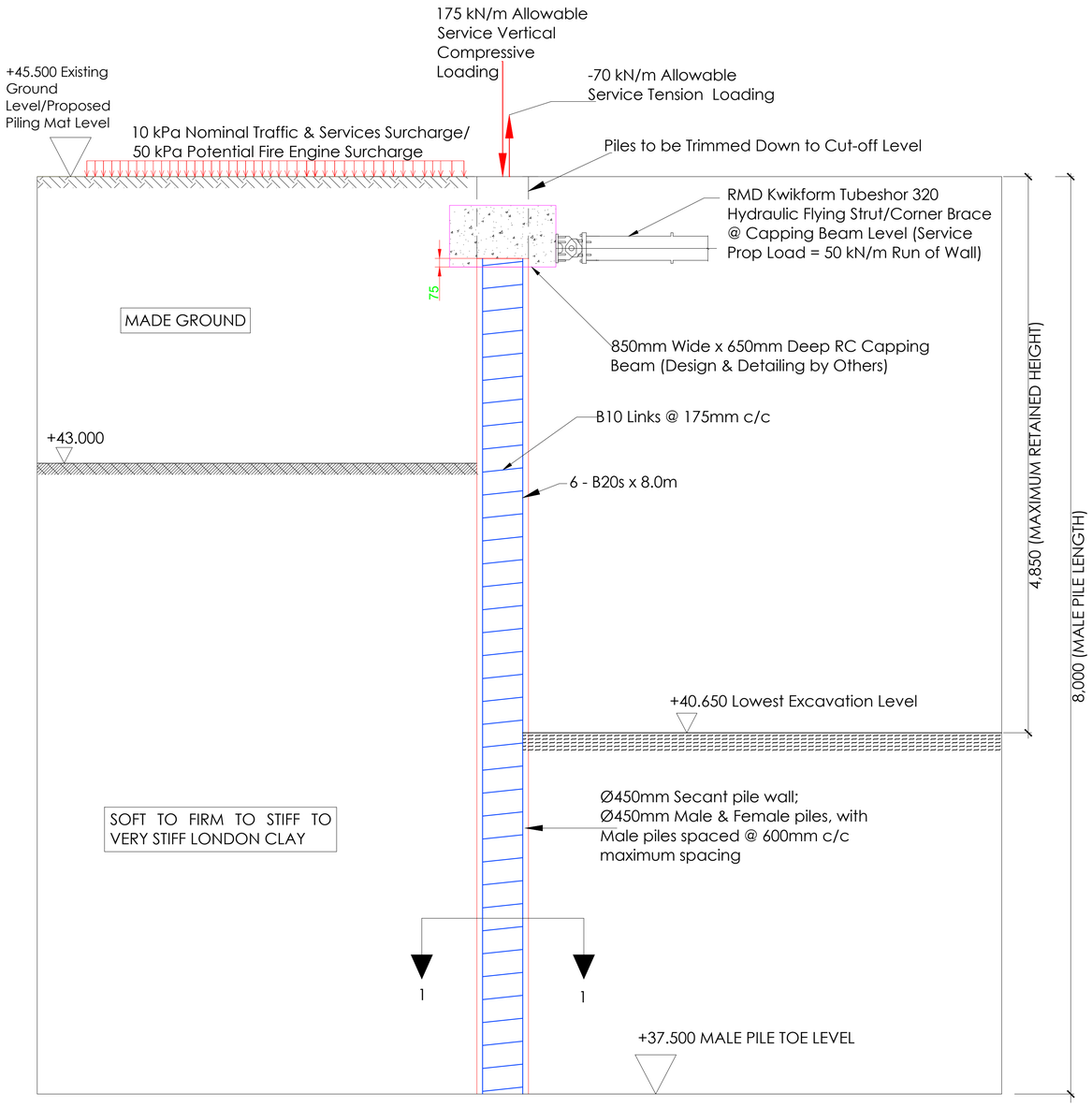
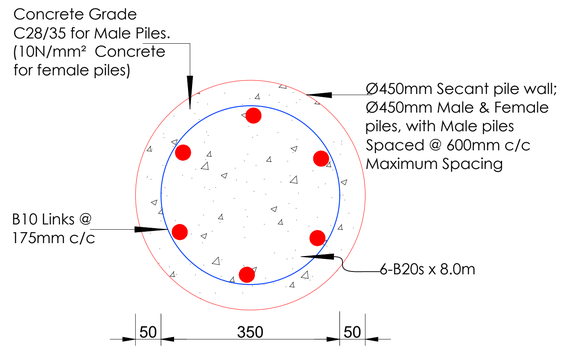
EXPECTED MAXIMUM WALL LATERAL DEFLECTION < 5mm

INSTALL FEMALE PILES TO 6.0m DEPTH ONLY

STRICT SUPERVISION OF BULK EXCAVATION BY MAIN CONTRACTOR IS REQUIRED, SO AS TO ENSURE THAT BULK EXCAVATION DOES NOT PROGRESS BELOW THE DIG DEPTH SHOWN IN THIS DRAWING



TYPICAL SECANT PILE WALL SECTION (SCALE 1:25)



SECTION 1-1 (SCALE 1:6)

PROPOSED SEQUENCE OF CONSTRUCTION:

TYPICAL PILE WALL SECTION (Ø450 PERIMETER SECANT PILE WALL, PROPPED)

A. STRIP THE EXISTING GROUND TO A MAXIMUM DEPTH OF 300mm AND SUBSEQUENTLY PLACE AND COMPACT CAREFULLY SELECTED CLASS 6F2 GRANULAR FILL TO FORM SUITABLE WORKING PLATFORM FOR PILING RIG AND OTHER CONSTRUCTION MACHINERY.

B. INSTALL TEMPORARY GUIDE WALL PRIOR TO THE COMMENCEMENT OF SECANT PILE WALL CONSTRUCTION.

C. CONCURRENTLY INSTALL Ø450 INTERLOCKING MALE AND FEMALE PILES BY CFA DRILLING TECHNIQUE, WITH MALE PILES SPACED @ 600MM C/C, FROM PILING PLATFORM LEVEL (+45.500) TO DEPTHS SPECIFIED BY DFS, TO FORM SECANT PILE WALL, AS WELL AS THE Ø350 BEARING PILES REQUIRED FOR THE PROPOSED UNDERPINNING WORKS UNDERNEATH THE EXISTING NORTHERN WALL OF BARRIE HOUSE; SEE DFS' PILE WALL CONSTRUCTION SCHEDULE AND BEARING PILE CONSTRUCTION SCHEDULE FOR MORE DETAILED INFORMATION.

D. BREAK DOWN PILES TO 75MM ABOVE PROPOSED SOFFIT LEVEL OF RC CAPPING BEAM.

E. CONSTRUCT RC CAPPING BEAMS ON PILES.

F. CARRY OUT SEGMENTAL UNDERPINNING OF THE EXISTING PAD AND STRIP FOOTINGS UNDERNEATH THE NORTHERN WALL OF THE EXISTING BARRIE HOUSE BUILDING, AS DETAILED BY THE PROJECT STRUCTURAL ENGINEER (SEE RICHARD TANT ASSOCIATES' DRAWINGS NO'S 5295-P02, 5295-P04, 5295-P13, 5295-P15, 5295-P17, 5295-P18, 5295-P19, 5295-PSM01 & 5295-PSM02 FOR MORE DETAILS).

G. INSTALL TEMPORARY STRUCTURAL STEEL WALING BEAM ALONG THE FACE OF SEGMENTAL UNDERPINNING RETAINING WALL AROUND CREST LEVEL.

H. INSTALL TEMPORARY PROPS AT CAPPING BEAM LEVEL/WALING BEAM LEVEL OF PILE WALL AND UNDERPINNING WALL.

I. CARRY OUT BULK EXCAVATION DOWN TO BASEMENT FORMATION LEVEL; 4.85M MAXIMUM DIG.

J. PLACE BLINDING OF 50MM MINIMUM THICKNESS AT FORMATION LEVEL.

K. INSTALL/FIX WATER-PROOF MEMBRANE ON PLACED BLINDING, AS WELL AS FACE OF PILE RETAINING WALL/SEGMENTAL UNDERPINNING WALL AND WRAP AROUND CAPPING BEAM.

L. CONSTRUCT 600MM THICK REINFORCED CONCRETE RAFT/LOWER GROUND FLOOR SLAB WITH WATER-PROOF CONCRETE AND DOWEL INTO PILE RETAINING WALL/SEGMENTAL UNDERPINNING WALL, WHILST MAKING ALLOWANCE FOR CAVITY DRAIN IN FRONT OF RETAINING WALLS.

M. CONSTRUCT RC LINER WALL OF 250MM MINIMUM THICKNESS WITH WATER-PROOF CONCRETE, IN FRONT OF PILE RETAINING WALL, FROM BASEMENT LEVEL, UP TO CAPPING BEAM SOFFIT LEVEL AND CONNECT SAME TO CAPPING BEAM.

N. CONSTRUCT GROUND FLOOR SLAB AND CONNECT SAME TO CAPPING BEAM.

O. REMOVE TEMPORARY PROPS AND STRUCTURAL STEEL WALLING BEAM.

P. CONSTRUCT SUPERSTRUCTURE.

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DRAWING TITLE: TYPICAL SECANT PILE WALL SECTION

DATE	DRAWN	CHECKED
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DRAWING No.	REV.	SCALE
DFS221011-02	00	SCALE IS AS SHOWN @ A1

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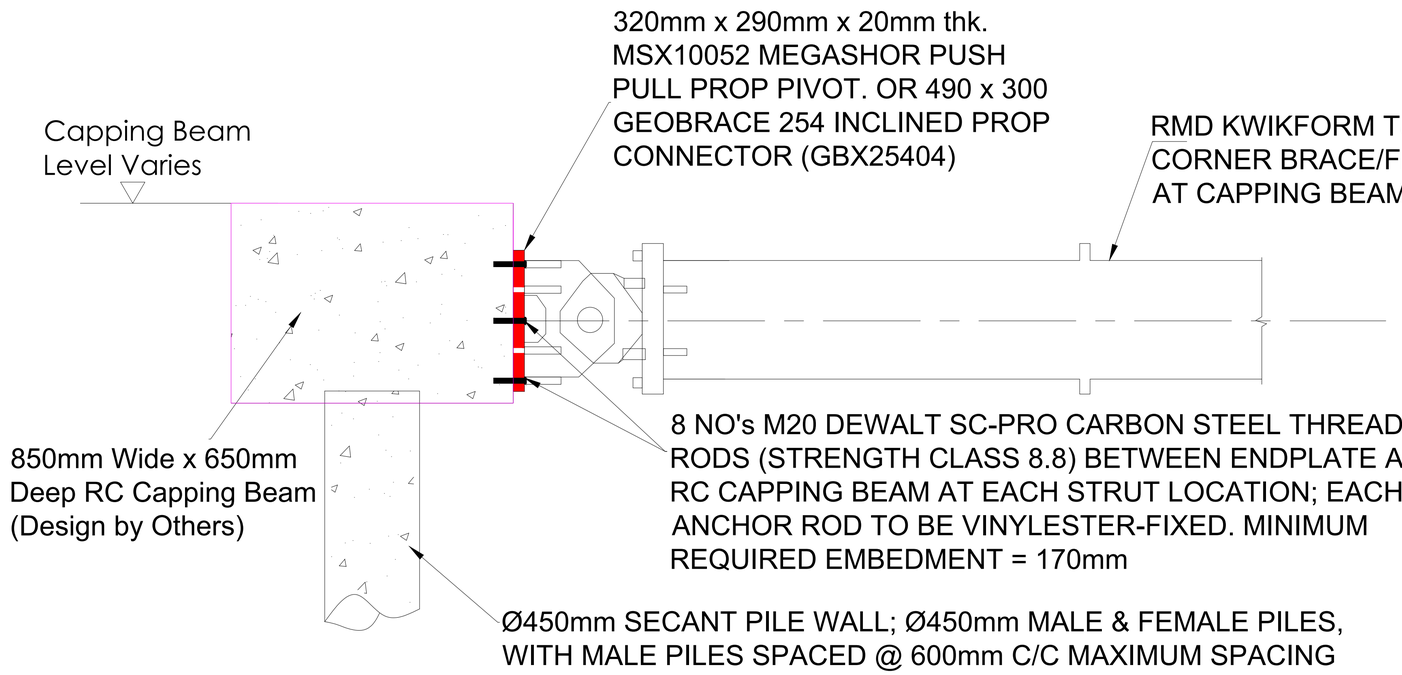
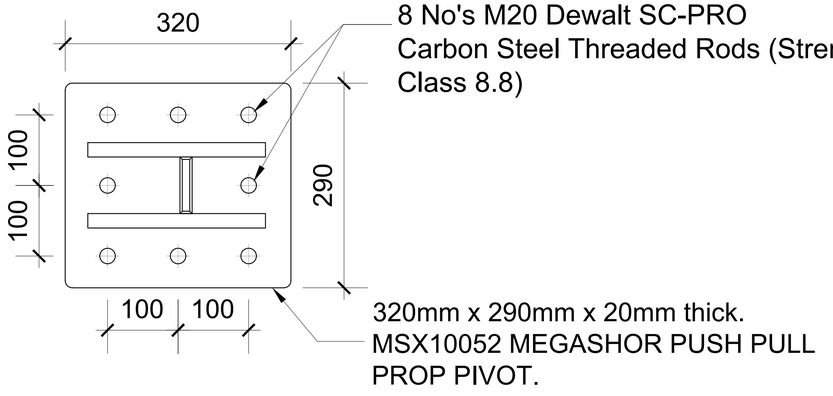


TYPICAL SECTION



ELEVATIONAL VIEW - Y

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DETAIL A: CAPPING BEAM - TEMPORARY PROP CONNECTION DETAILS

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TELEPHONE: 01753 396498

CLIENT
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DRAWING TITLE
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DATE	DRAWN	CHECKED
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DRAWING No.	REV.	SCALE
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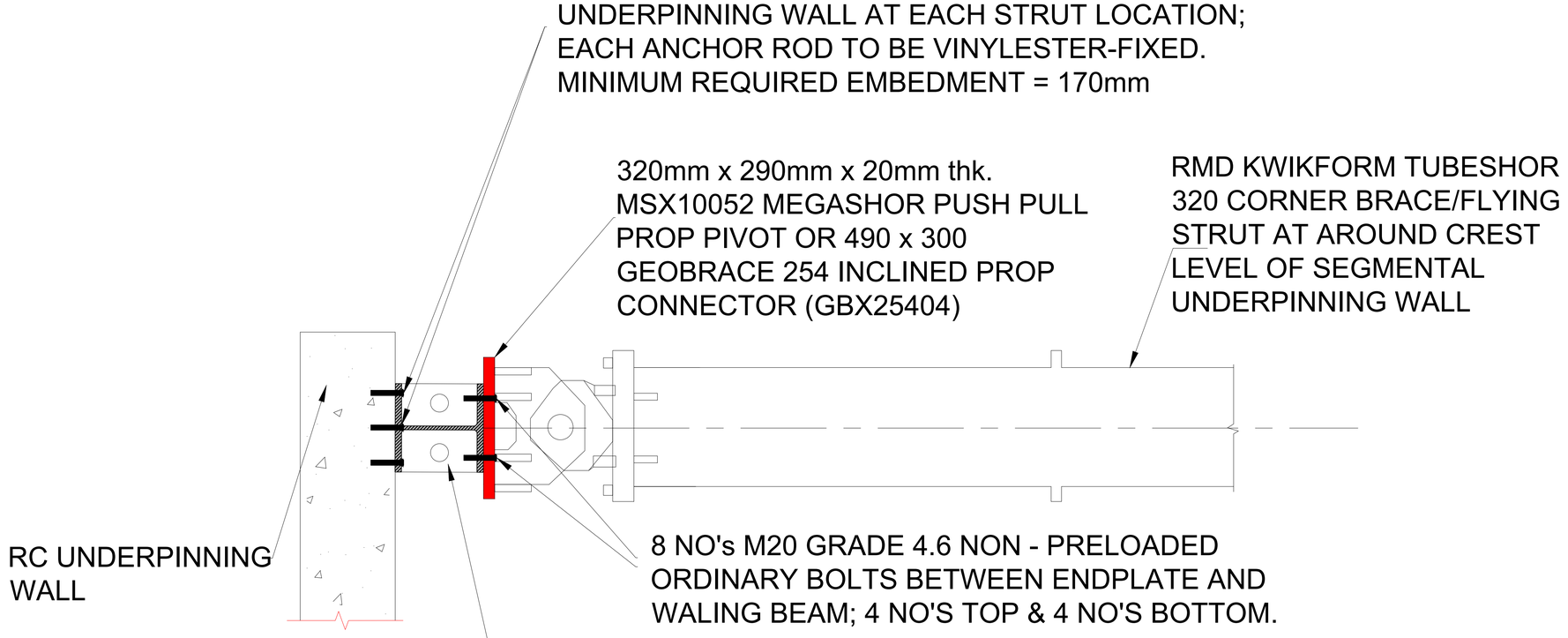

DETAIL B: RC SEGMENTAL UNDERPINNING WALL - WALING BEAM - ENDPLATE - TEMPORARY PROP CONNECTION DETAILS

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TELEPHONE: 01753 396498

CLIENT: BROXWOOD VIEW LIMITED

JOB TITLE: BROXWOOD VIEW, 29 ST. EDMUND'S TERRACE LONDON NW8 7QH

DRAWING TITLE: DETAIL B: RC UNDERPINING - WALING BEAM - ENDPLATE - TEMPORARY PROP CONNECTION DETAILS

DATE	DRAWN	CHECKED
16 OCT 2022	AR	AA

DRAWING No.	REV	SCALE
DFS221011-10	00	SCALE IS AS SHOWN @ A1

DFS' Construction Sequencing Drawings

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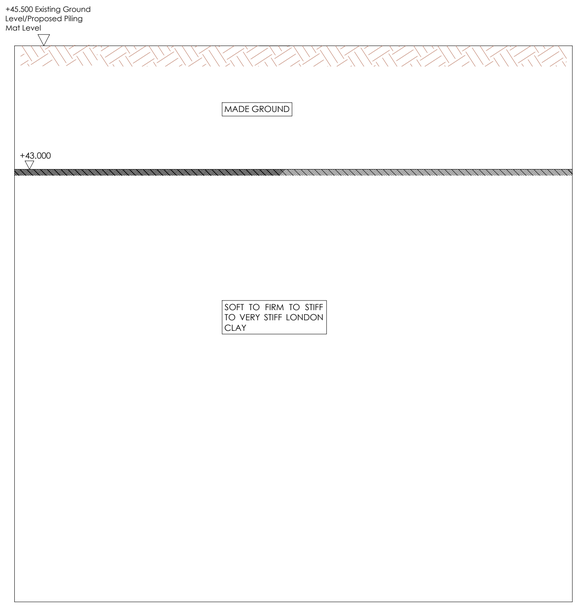
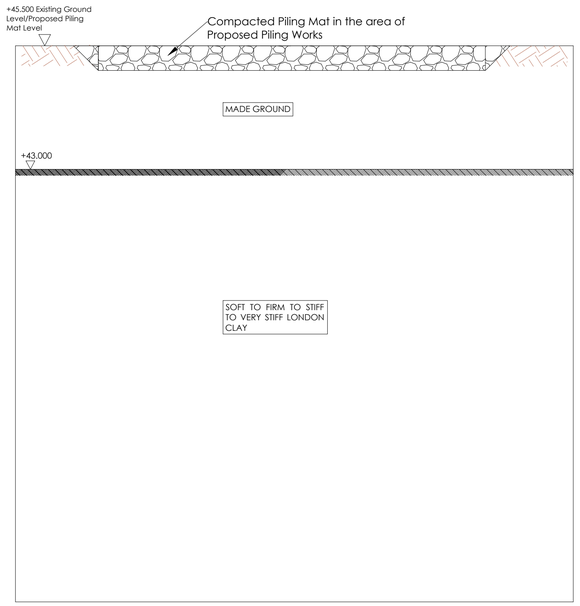


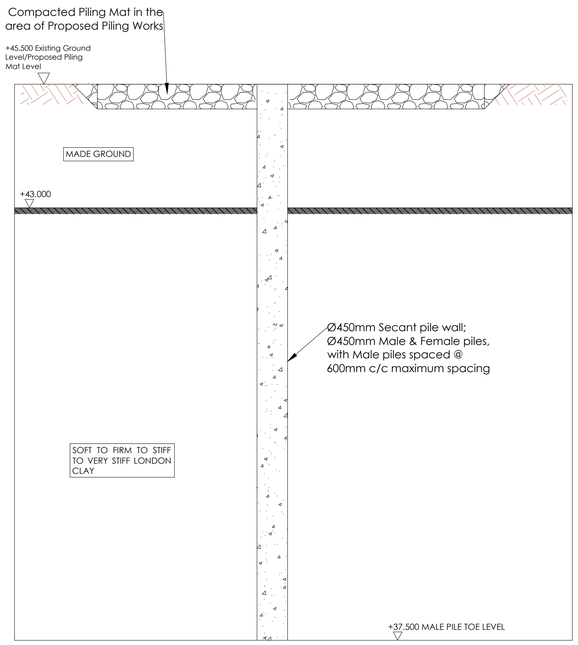
STAGE 0:

PRE-PILING SITE CONDITIONS



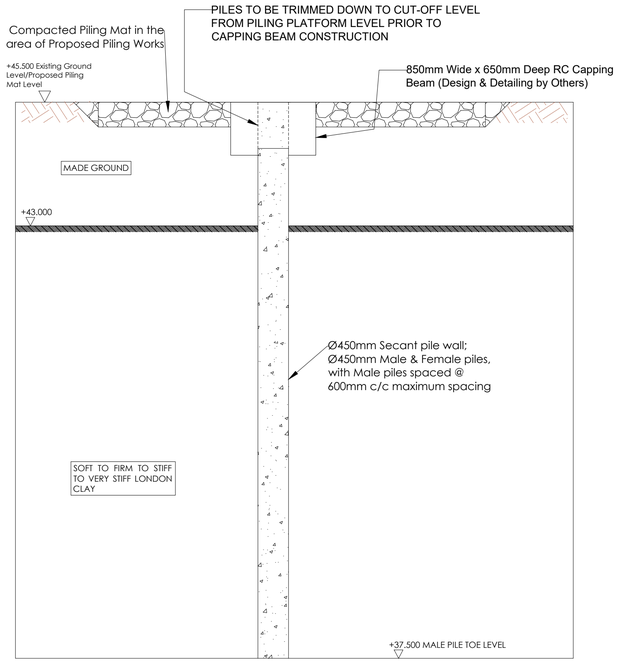
STAGE 1:

STRIP THE EXISTING GROUND AND SUBSEQUENTLY PLACE AND COMPACT PILING MAT IN THE AREA OF PROPOSED PILING WORKS.



STAGE 2:

CONCURRENTLY INSTALL Ø450 INTERLOCKING MALE AND FEMALE PILES BY CFA DRILLING TECHNIQUE, WITH MALE PILES SPACED @ 600MM C/C, FROM PILING PLATFORM LEVEL (+45.500) TO DEPTHS SPECIFIED BY DFS, TO FORM SECANT PILE WALL, AS WELL AS THE Ø350 BEARING PILES REQUIRED FOR THE PROPOSED UNDERPINNING WORKS UNDERNEATH THE EXISTING NORTHERN WALL OF BARRIE HOUSE.



STAGE 3:

BREAK DOWN PILES TO 75MM ABOVE PROPOSED SOFFIT LEVEL OF RC CAPPING BEAM AND CONSTRUCT RC CAPPING BEAM ON PILES.

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DRAWING TITLE
PROPOSED CONSTRUCTION SEQUENCE SHEET -1

DATE	DRAWN	CHECKED
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DRAWING No.	REV.	SCALE
DFS221011-03	00	SCALE IS AS SHOWN @ A1

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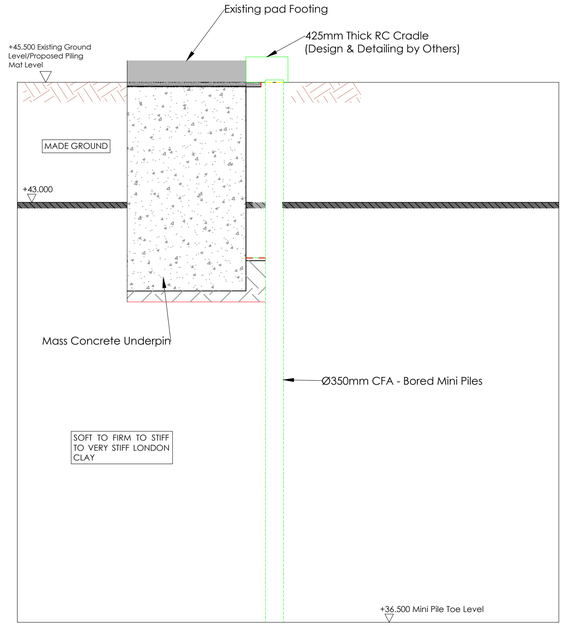
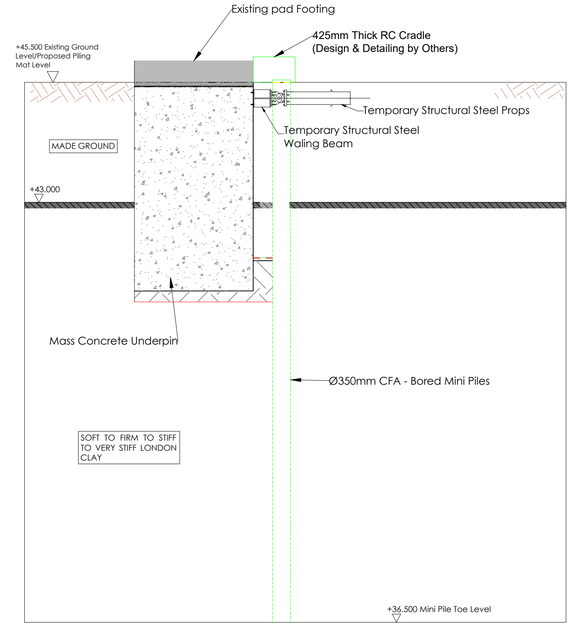


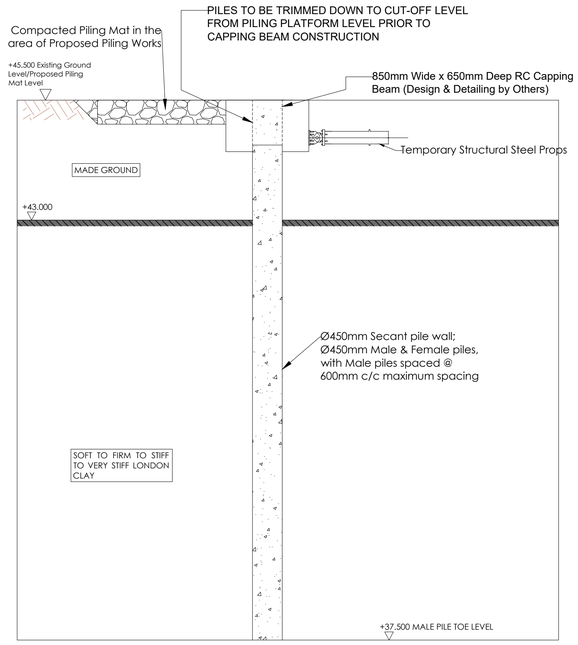
STAGE 4:

CARRY OUT SEGMENTAL UNDERPINNING OF THE EXISTING PAD AND STRIP FOOTINGS UNDERNEATH THE NORTHERN WALL OF THE EXISTING BARRIE HOUSE BUILDING, AS DETAILED BY THE PROJECT STRUCTURAL ENGINEER (SEE RICHARD TANT ASSOCIATES' DRAWING NO'S 5295-P02, 5295-P04, 5295-P13, 5295-P15, 5295-P17, 5295-P18, 5295-P19, 5295-PSM01 & 5295-PSM02).



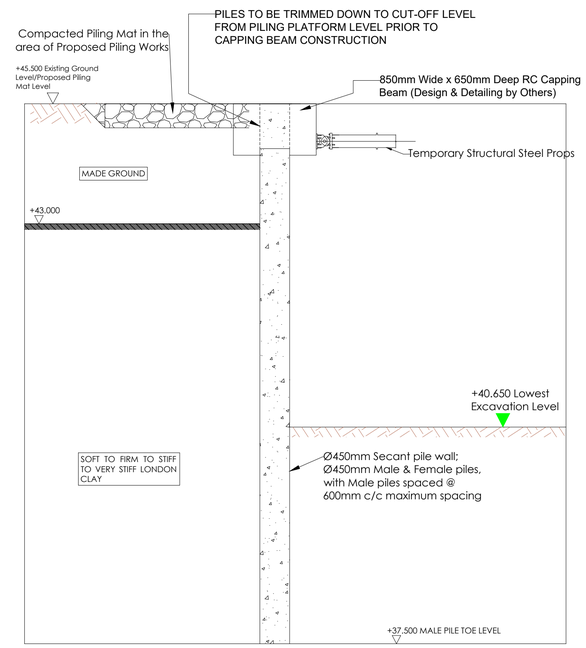
STAGE 5:

INSTALL TEMPORARY STRUCTURAL STEEL WALING BEAM & TEMPORARY PROPS ALONG THE FACE OF SEGMENTAL UNDERPINNING RETAINING WALL AROUND CREST LEVEL.



STAGE 6:

INSTALL TEMPORARY PROPS AT CAPPING BEAM LEVEL OF PILE WALL.



STAGE 7:

CARRY OUT BULK EXCAVATION DOWN TO BASEMENT FORMATION LEVEL; 4.85M MAXIMUM DIG.

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DRAWING TITLE

PROPOSED CONSTRUCTION SEQUENCE SHEET -2

DATE	DRAWN	CHECKED
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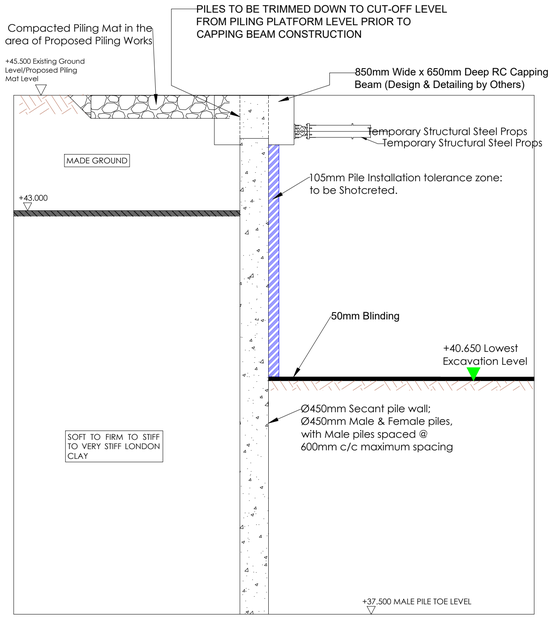
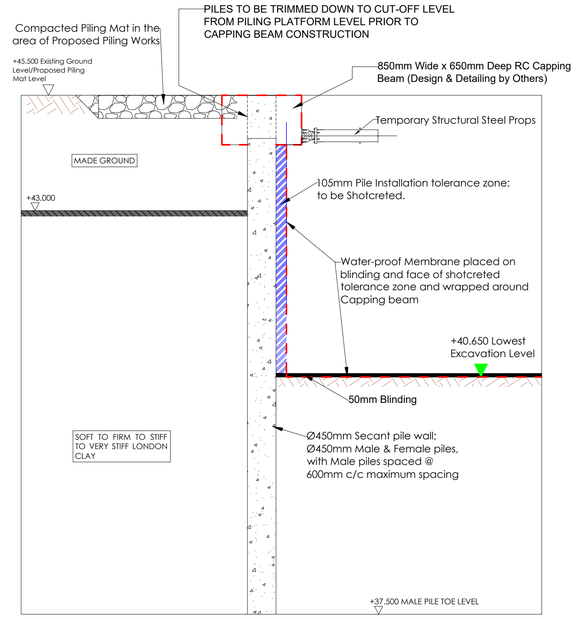


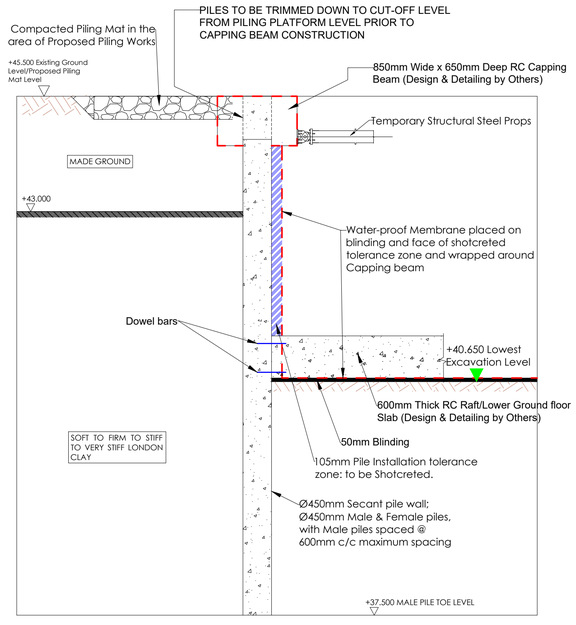
STAGE 8:

PLACE BLINDING OF 50mm MINIMUM THICKNESS AT FORMATION LEVEL AND SHOTCRETE 105mm PILE INSTALLATION TOLERANCE ZONE, IN PREPARATION FOR THE INSTALLATION OF WATER-PROOFING MEMBRANE.



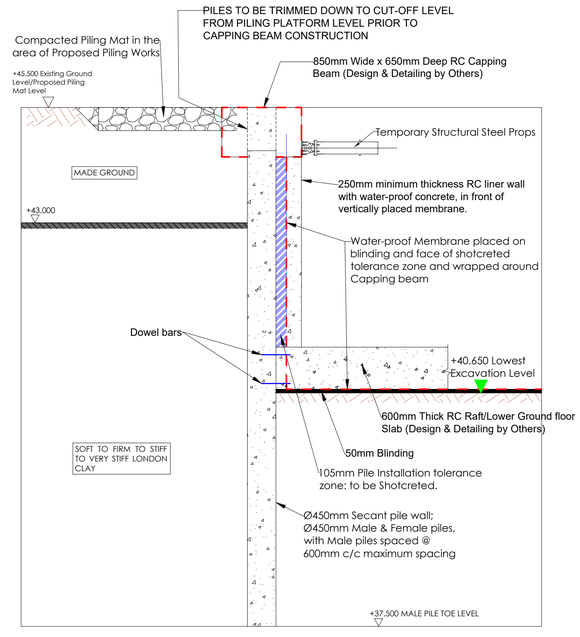
STAGE 9:

INSTALL/FIX WATER-PROOF MEMBRANE ON PLACED BLINDING, AS WELL AS FACE OF PILE RETAINING WALL/SEGMENTAL UNDERPINNING WALL AND WRAP AROUND CAPPING BEAM.



STAGE 10:

CONSTRUCT 600MM THICK REINFORCED CONCRETE RAFT/LOWER GROUND FLOOR SLAB WITH WATER-PROOF CONCRETE AND DOWEL INTO PILE RETAINING WALL/SEGMENTAL UNDERPINNING WALL, WHILST MAKING ALLOWANCE FOR CAVITY DRAIN IN FRONT OF RETAINING WALLS.



STAGE 11:

CONSTRUCT RC LINER WALL OF 250MM MINIMUM THICKNESS WITH WATER-PROOF CONCRETE, IN FRONT OF PILE RETAINING WALL AND SEGMENTAL UNDERPINNING WALL FROM BASEMENT LEVEL, UP TO CAPPING BEAM SOFFIT LEVEL AND CONNECT SAME TO CAPPING BEAM.

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4. ONLY FIGURED DIMENSIONS ARE TO BE USED. ANY QUERIES MUST BE REFERRED TO DFS.

5. 50mm COVER TO PILE REINFORCEMENT.

6. STRICT SUPERVISION OF BULK EARTH WORKS IS REQUIRED TO ENSURE THAT EXCAVATIONS DO NOT EXCEED THE DESIGN DEPTH SHOWN IN THESE DRAWINGS (4.85m).

7. SECANT PILE WALL SHALL BE INSTALLED IN ACCORDANCE WITH THE RECOMMENDATIONS OF THE ICE SPECIFICATIONS FOR PILING AND EMBEDDED RETAINING WALLS (ICESPERW, 2016).

8. THE SECANT PILE WALL IS DESIGNED FOR BOTH TEMPORARY AND PERMANENT USE.

DEEP FOUNDATIONS SPECIALISTS LIMITED
2nd FLOOR, THE PORTER BUILDING 1 BRUNEL WAY
SLOUGH SL1 1FQ.
TELEPHONE: 01753 396498

CLIENT
BROXWOOD VIEW LIMITED

JOB TITLE
BROXWOOD VIEW, 29 ST. EDMUND'S TERRACE LONDON NW8 7QH

DRAWING TITLE
PROPOSED CONSTRUCTION SEQUENCE SHEET -3

DATE	DRAWN	CHECKED
16 OCT 2022	AR	AA

DRAWING No	REV	SCALE
DFS221011-05	00	SCALE IS AS SHOWN @ A1

HEALTH, SAFETY AND ENVIRONMENT

1. THIS GEO–STRUCTURAL DESIGN HAS BEEN CARRIED OUT AND REVIEWED IN ACCORDANCE WITH THE CONSTRUCTION, DESIGN & MANAGEMENT (CDM) REGULATIONS 2015 AND DOES NOT INCLUDE ANY ABNORMAL RISK ITEM THAT A COMPETENT CONTRACTOR WOULD NOT BE AWARE OF WHEN UNDERTAKING CONSTRUCTION WORKS SHOWN.

2. DFS PILE WALL LAYOUT AND DESIGN ACCOUNT FOR 1:100 VERTICALITY TOLERANCE (WITH CFA DRILLING TECHNIQUE, USING HEAVY DUTY AUGERS), 25mm HORIZONTAL POSITIONAL TOLERANCE (WITH A TEMPORARY GUIDE WALL IN–PLACE) AND 30mm OVER–BREAK IN ACCORDANCE WITH THE RECOMMENDATIONS OF THE ICE SPECIFICATION FOR PILING & EMBEDDED RETAINING WALLS (ICE SPERW, 2015). BASED ON THESE, THERE ARE POTENTIALS FOR PILES IN THE SECANT WALL TO ENCROACH INTO THE PROPOSED BASEMENT AREA BY MAGNITUDES OF UP TO 105mm. IT IS IMPERATIVE THAT THE ARCHITECT, PROJECT STRUCTURAL ENGINEER AND PRINCIPAL CONTRACTOR MAKE ALLOWANCE FOR THIS.

3. THE PRINCIPAL CONTRACTOR AND ASSOCIATED SUB–CONTRACTORS MUST CARRY OUT INDEPENDENT RISK ASSESSMENTS THAT ARE APPLICABLE TO THEIR WORKS AND FULLY COMPLY WITH THE ABOVE STATED REGULATION.

4. THE PRINCIPAL CONTRACTOR AND ASSOCIATED SUB–CONTRACTORS MUST REVIEW THE SITE–SPECIFIC AND HISTORICAL BOREHOLE LOGS OF THE SITE TO HAVE ADEQUATE KNOWLEDGE OF GROUND CONDITIONS ON THE SITE, PRIOR TO COMMENCEMENT OF WORKS.

5. DURING SITE OPERATIONS, IF OBSERVED GROUND CONDITIONS DIFFER FROM THE GENERALISED STRATIGRAPHY SHOWN IN THIS SET OF DRAWINGS, DFS MUST BE INFORMED IMMEDIATELY.

6. IT IS THE RESPONSIBILITY OF THE PRINCIPAL CONTRACTOR AND ASSOCIATED SUB–CONTRACTORS TO ENSURE THAT SITE OPERATIVES ARE COMPETENT AND EXPERIENCED IN THE AREA OF WORKS TO BE UNDERTAKEN.

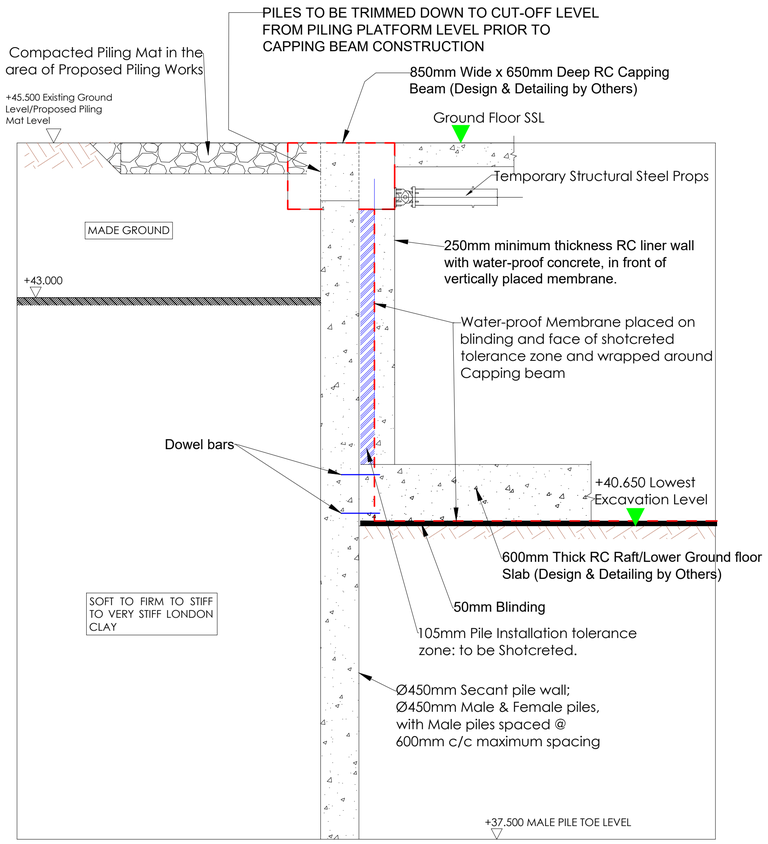
7. IN ADDITION TO THE RISK/HAZARD TYPICALLY ASSOCIATED WITH THE GROUND ENGINEERING WORKS DETAILED IN THIS DRAWING, ADDITIONAL SITE/WORK–SPECIFIC HAZARDS HAVE BEEN IDENTIFIED THROUGH DESIGN RISK ASSESSMENT. THESE ARE OUTLINED IN 7.1 – 7.4 BELOW. ALL SITE OPERATIONS MUST ACCOUNT FOR ALL USUAL AND SITE/WORK–SPECIFIC HAZARDS.

7.1. PILING PLATFORM LEVEL IS UNCONFIRMED AT THIS STAGE. HOWEVER, FOR DESIGN PURPOSE, THE PILING MAT LEVEL FOR THE PERIMETER SECANT PILE WALL AND BEARING PILES IS GENERALLY TAKEN TO BE THE EXISTING GROUND LEVEL IN THE AREA OF PROPOSED WORKS; APPROX. +45.500M OD. NONETHELESS, THE PRINCIPAL CONTRACTOR MUST CONFIRM ACTUAL PILING PLATFORM LEVEL(S) PRIOR TO THE COMMENCEMENT OF PILING WORKS ON THE SITE, SO THAT THE PILE WALL SCHEDULE & BEARING PILE SCHEDULE MAY BE AMENDED ACCORDINGLY.

7.2. A REINFORCED CONCRETE CAPPING BEAM MUST BE CONSTRUCTED ON THE PILE WALL, WHILE TEMPORARY PROPS MUST BE INSTALLED AGAINST THE CAPPING BEAM PRIOR TO THE COMMENCEMENT OF BULK EXCAVATION FOR THE NEW BASEMENT.

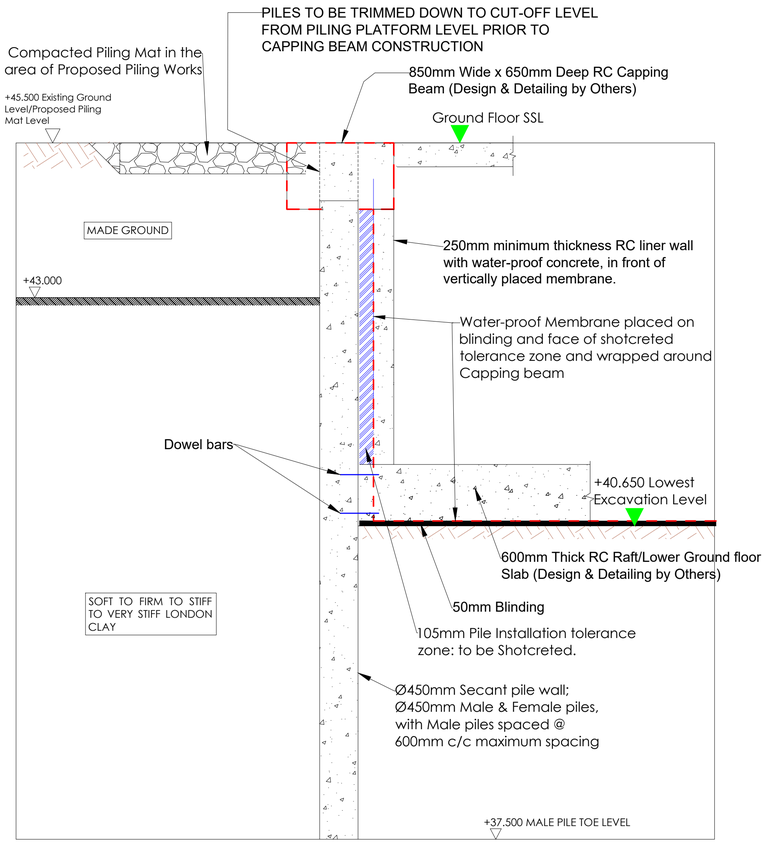
7.3. A TEMPORARY GUIDE WALL MUST BE PUT IN–PLACE PRIOR TO THE INSTALLATION OF SECANT PILE WALL.

7.4. IN ADDITION, IT IS IMPERATIVE THAT THE CONCRETE MIX DESIGN FOR THE MALE PILES IN THE SECANT WALL ACCOUNTS FOR 10MM MAXIMUM AGGREGATE SIZE AND SET–RETARDING ADMIXTURES IN ORDER TO EASE THE INSTALLATION OF REINFORCEMENT CAGES INTO CONCRETED DRILLHOLES. REINFORCEMENT CAGE VIBRATORS MAY ALSO BE REQUIRED TO FORCE THE STEEL CAGES DOWN TO THE DESIGN DEPTHS.



STAGE 12:

CONSTRUCT GROUND FLOOR SLAB AND CONNECT SAME TO CAPPING BEAM



STAGE 13:

REMOVE TEMPORARY PROPS AND STRUCTURAL STEEL WALLING BEAM

IMPORTANT CONSTRUCTION NOTES

1. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS NOTED OTHERWISE.

2. ALL LEVELS ARE IN METRES UNLESS NOTED OTHERWISE.

3. THIS DRAWING SHALL BE READ IN CONJUNCTION WITH ALL RELEVANT ARCHITECTS, ENGINEERS, AND SPECIALISTS LATEST DRAWINGS AND SPECIFICATIONS. ANY DISCREPANCIES MUST BE REPORTED TO DFS, ENGINEER AND ARCHITECT IMMEDIATELY.

4. ONLY FIGURED DIMENSIONS ARE TO BE USED. ANY QUERIES MUST BE REFERRED TO DFS.

5. 50mm COVER TO PILE REINFORCEMENT.

6. STRICT SUPERVISION OF BULK EARTH WORKS IS REQUIRED TO ENSURE THAT EXCAVATIONS DO NOT EXCEED THE DESIGN DEPTH SHOWN IN THESE DRAWINGS (4.85m).

7. SECANT PILE WALL SHALL BE INSTALLED IN ACCORDANCE WITH THE RECOMMENDATIONS OF THE ICE SPECIFICATIONS FOR PILING AND EMBEDDED RETAINING WALLS (ICESPERW, 2016).

8. THE SECANT PILE WALL IS DESIGNED FOR BOTH TEMPORARY AND PERMANENT USE.

DEEP FOUNDATIONS SPECIALISTS LIMITED
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CLIENT: BROXWOOD VIEW LIMITED

JOB TITLE: BROXWOOD VIEW, 29 ST. EDMUND'S TERRACE LONDON NW8 7QH

DRAWING TITLE: PROPOSED CONSTRUCTION SEQUENCE SHEET -4

DATE	DRAWN	CHECKED
16 OCT 2022	AR	AA

DRAWING No.	REV.	SCALE
DFS221011-06	00	SCALE IS AS SHOWN @ A1

GoBeam Version 2015.1 Structural Analysis Output Files

DEEP FOUNDATIONS SPECIALISTS LIMITED	Project:	BROXWOOD VIEW, 29 ST. EDMUND'S TERRACE LONDON NW8 7QH	Engineer:	AR	Project #
			Date:	14-Oct-22	
GoBeam Version 2015.1	Subject:	TEMPORARY PROPPING SCHEME - ELEVATION 1	Checker:	AA	Page:
			Date:	14/10/2022	

Modulus of elasticity, E

Beam:	28000	MPa
Columns:	28000	MPa

Beam end restraints

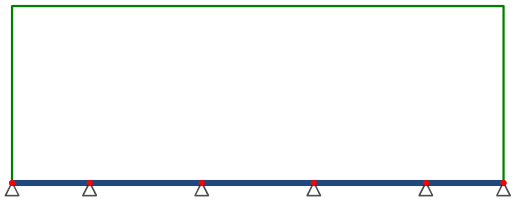
Left End	Right End
Support	Support

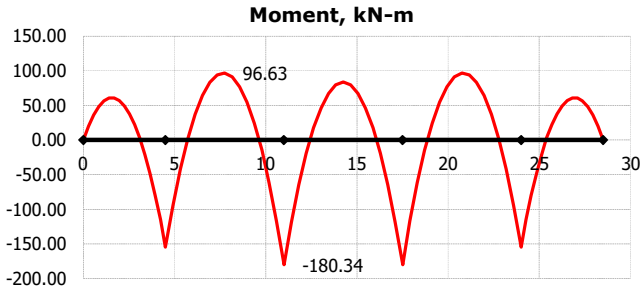
Sway frame: ☑

Span №	1	2	3	4	5
Length, m	4.5	6.5	6.5	6.5	4.5
Moment of Inertia, m⁴	1.95E-02	1.95E-02	1.95E-02	1.95E-02	1.95E-02

Support №	1	2	3	4	5	6
Support coordinate, m	0	4.5	11	17.5	24	28.5
Vertical spring constant, kN/m						
Support type or hinge	Roller	Roller	Roller	Roller	Roller	Roller
Column under Length, m						
Moment of Inertia, m⁴						
Column above Length, m						
Moment of Inertia, m⁴						
Induced support displacements, m						

Positive loads: ↑ ↺	Load case:	DL			
Comment	Load Type	WA kN or kN/m	WB kN/m	LA m	LB m
	Linear	-50	-50	0	28.5



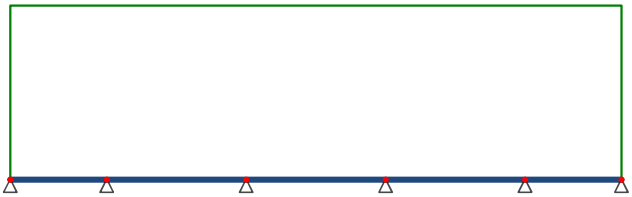


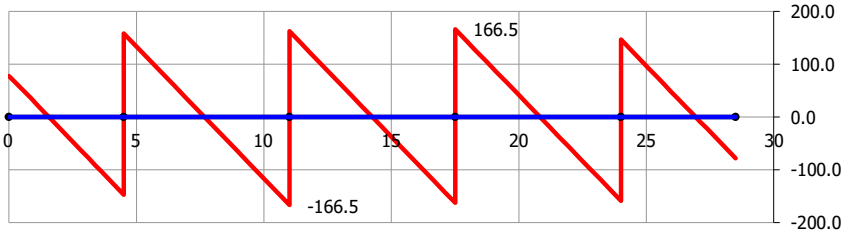
Type of Analysis: Static Loads

Notes:

DEEP FOUNDATIONS SPECIALISTS LIMITED	Project:	BROXWOOD VIEW, 29 ST. EDMUND'S TERRACE LONDON NW8 7QH	Engineer:	AR	Project #
			Date:	14-Oct	
GoBeam Version 2015.1	Subject:	TEMPORARY PROPPING SCHEME - ELEVATION 1	Checker:	AA	Page:
			Date:	44848	

FORCE/DISPLACEMENTS DIAGRAMS DUE TO STATIC LOAD CASE: DL





Shear, kN	
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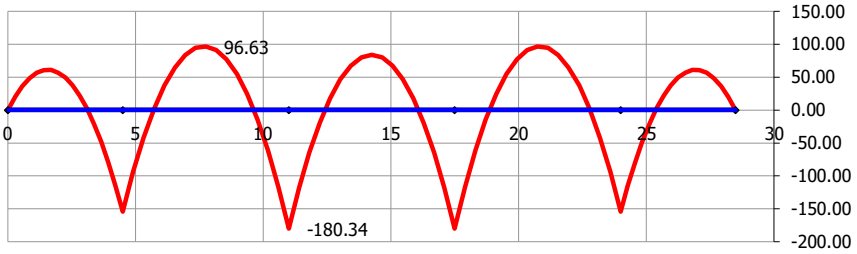
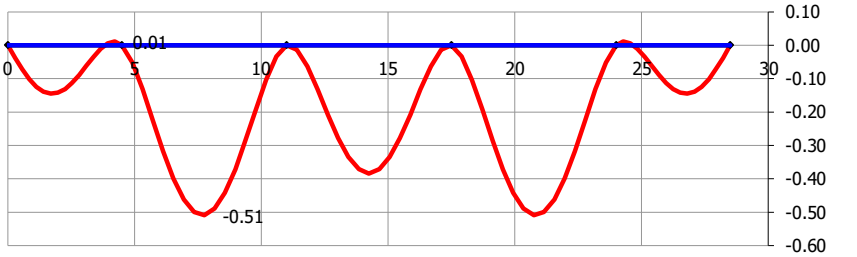
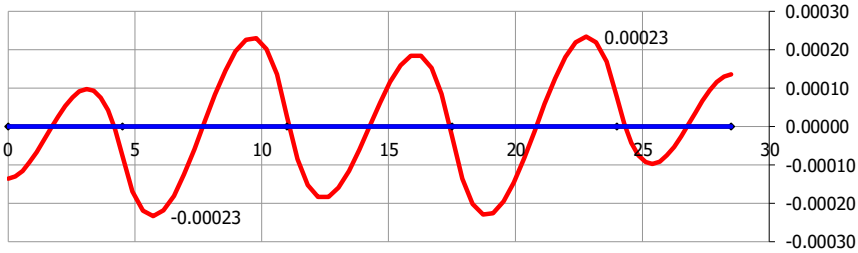
Min =	-166.5



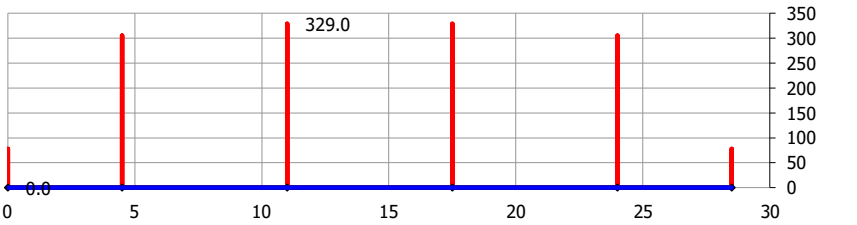
*Moment, kN*m*	
Max =	96.63
Min =	-180.34



Deflections, mm	
Max =	0.01
Min =	-0.51



Rotations, rad	
Max =	0.00023
Min =	-0.00023



Reactions, kN	
Max =	329.0
Min =	0.0
ΣR =	1425

DEEP FOUNDATIONS SPECIALISTS LIMITED	Project:	BROXWOOD VIEW, 29 ST. EDMUND'S TERRACE LONDON NW8 7QH	Engineer:	AR	Project #
			Date:	14-Oct-22	
GoBeam Version 2015.1	Subject:	TEMPORARY PROPPING SCHEME - ELEVATION 2	Checker:	AA	Page:
			Date:	14/10/2022	

Modulus of elasticity, E

Beam:	28000	MPa
Columns:	28000	MPa

Beam end restraints

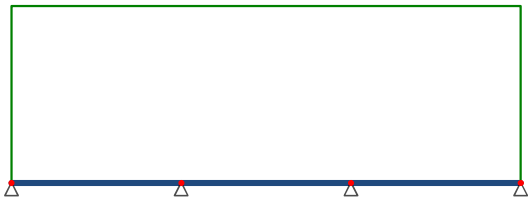
Left End	Right End
Support	Support

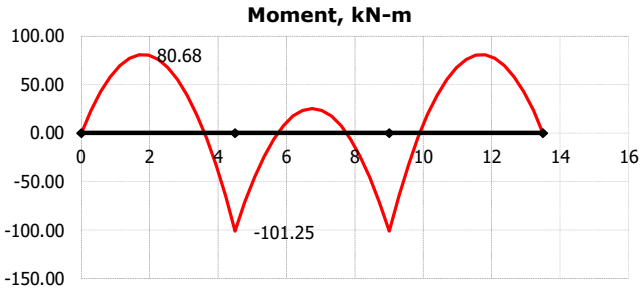
Sway frame: ☑

Span №	1	2	3
Length, m	4.5	4.5	4.5
Moment of Inertia, m⁴	1.95E-02	1.95E-02	1.95E-02

Support №	1	2	3	4
Support coordinate, m	0	4.5	9	13.5
Vertical spring constant, kN/m				
Support type or hinge	Roller	Roller	Roller	Roller
Column under Length, m				
Moment of Inertia, m⁴				
Column above Length, m				
Moment of Inertia, m⁴				
Induced support displacements, m				

Positive loads: ↑ ↺	Load case:	DL			
Comment	Load Type	WA kN or kN/m	WB kN/m	LA m	LB m
	Linear	-50	-50	0	13.5





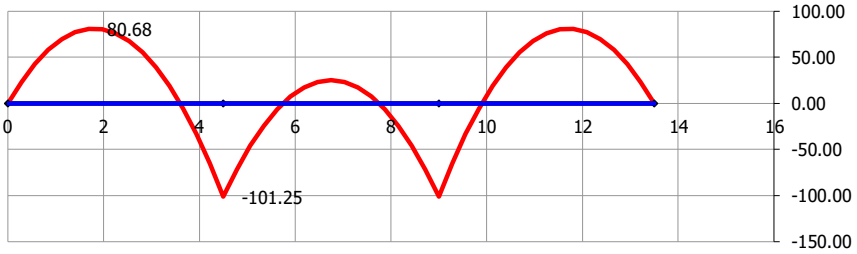
Type of Analysis: Static Loads

Notes:

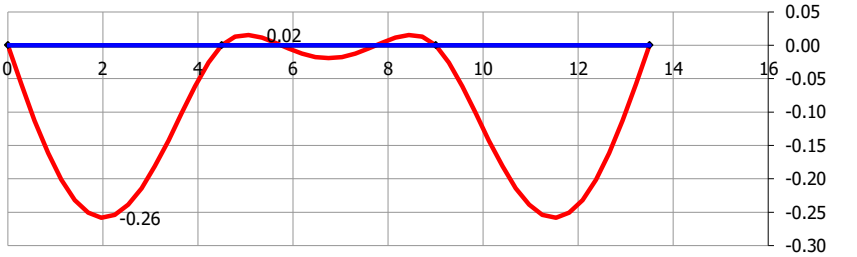
DEEP FOUNDATIONS SPECIALISTS LIMITED	Project:	BROXWOOD VIEW, 29 ST. EDMUND'S TERRACE LONDON NW8 7QH	Engineer:	AR	Project #
			Date:	14-Oct	
GoBeam Version 2015.1	Subject:	TEMPORARY PROPPING SCHEME - ELEVATION 2	Checker:	AA	Page:
			Date:	44848	

FORCE/DISPLACEMENTS DIAGRAMS DUE TO STATIC LOAD CASE: DL

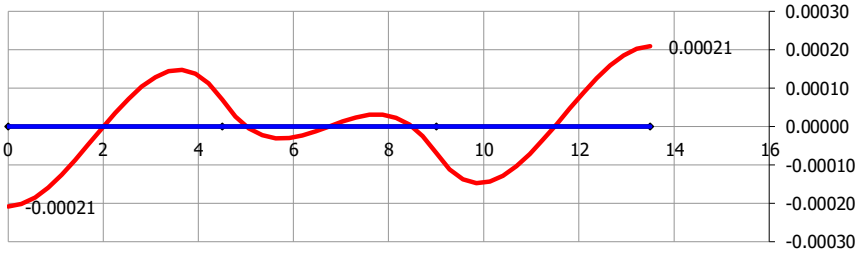
Shear, kN	
Max =	135.0
Min =	-135.0



*Moment, kN*m*	
Max =	80.68
Min =	-101.25



Deflections, mm	
Max =	0.02
Min =	-0.26



Rotations, rad	
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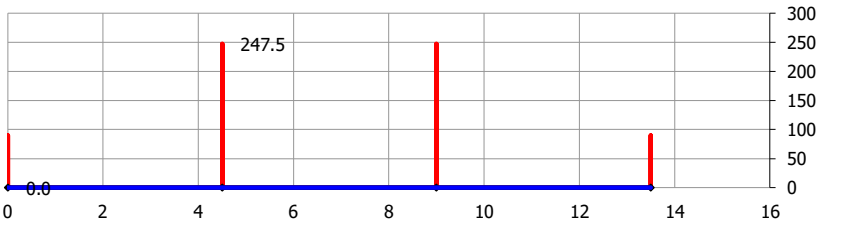
Min =	-0.00021



Reactions, kN	
Max =	247.5
Min =	0.0
ΣR =	675

Job No: DFS221011 Design Engineer: AR Date: 15 October 2022

Job Name: BROXWOOD VIEW, 29 ST. EDMUND'S TERRACE LONDON NW8 7QH

Calc Title: Detailed Design – Temporary Propping Scheme to Laterally Restrain Secant Pile Retaining Wall & Segmental Underpinning Wall Rev. 00

CADS PWS 6.09 Computer Output Files

Pile geometry

Pile top Level	0	m
Pile Length	8	m
Pile toe level	-8	m

Soils and ground water initial data (Soils data given for active and passive sides)

Initial Ground Water level -.5

Top Level m	Description	Bulk Dens kN/m3	Sat' Dens kN/m3	Young Mod kN/m2	Young Inc. kN/m3	Cu C' kN/m2	C Inc. kN/m3	Phi Deg	Wall Shear Ratio	Ka Kp	Kac Kpc
.00	Made Ground	18.00	18.00	15000	0			28	.67	.30	
								28	.50	4.15	
-2.50	S to F to Stiff	19.00	19.00	24000	9600	30	12.0		.67	1.00	2.58
						30	12.0		.50	1.00	2.45

Construction sequence

Stage Ref		Stage Type	Level or Angle m/deg.	Load kN(/m)	Offset m	Width m	Length m
1	A	Active surcharge	0.00	10.0	.3		
2	A	Passive side excavation	-1.00				
3	A	Passive water level	-1.00				
4		Insert prop	-0.50				
5	A	Passive side excavation	-4.80				
6	A	Passive water level	-4.80				
7	A	Insert prop	-4.20				
8		Insert prop	-0.30				
9	A	Remove prop	-0.50				
10	A	Active water level	0.00				

Code of practice

Code of practice or reference document	
Application of pressures for stability	Not applicable for FOS=1 on moments
FOS on moments (stability check)	1.00
ULS factor on Tan(Phi) values	1.00
ULS fFactor on drained cohesion values	1.00
ULS factor on undrained cohesion values	1.00
ULS factor on active soil pressures	1.00
ULS factor on passive soil pressures	1.00
ULS factor on active water pressures	1.00
ULS factor on passive water pressures	1.00
ULS factor on loads applied to the soil	1.00
ULS factor on loads applied to the wall	1.00
FOS on embedment (stability check)	1.00
Correction factor on cantilever embedment	1.00

Wall analysis detail options

Nominal Phi for load distribution	30.0	Degrees
Depth of water filled tension cracks	.0	m
Density of water	9.8	kN/m3
Minimum equivalent fluid density	5.0	kN/m3
Depth of passive softened soil	.0	m
Continuity model for wall analysis	Pins at second and lower props	

Deflection parameters

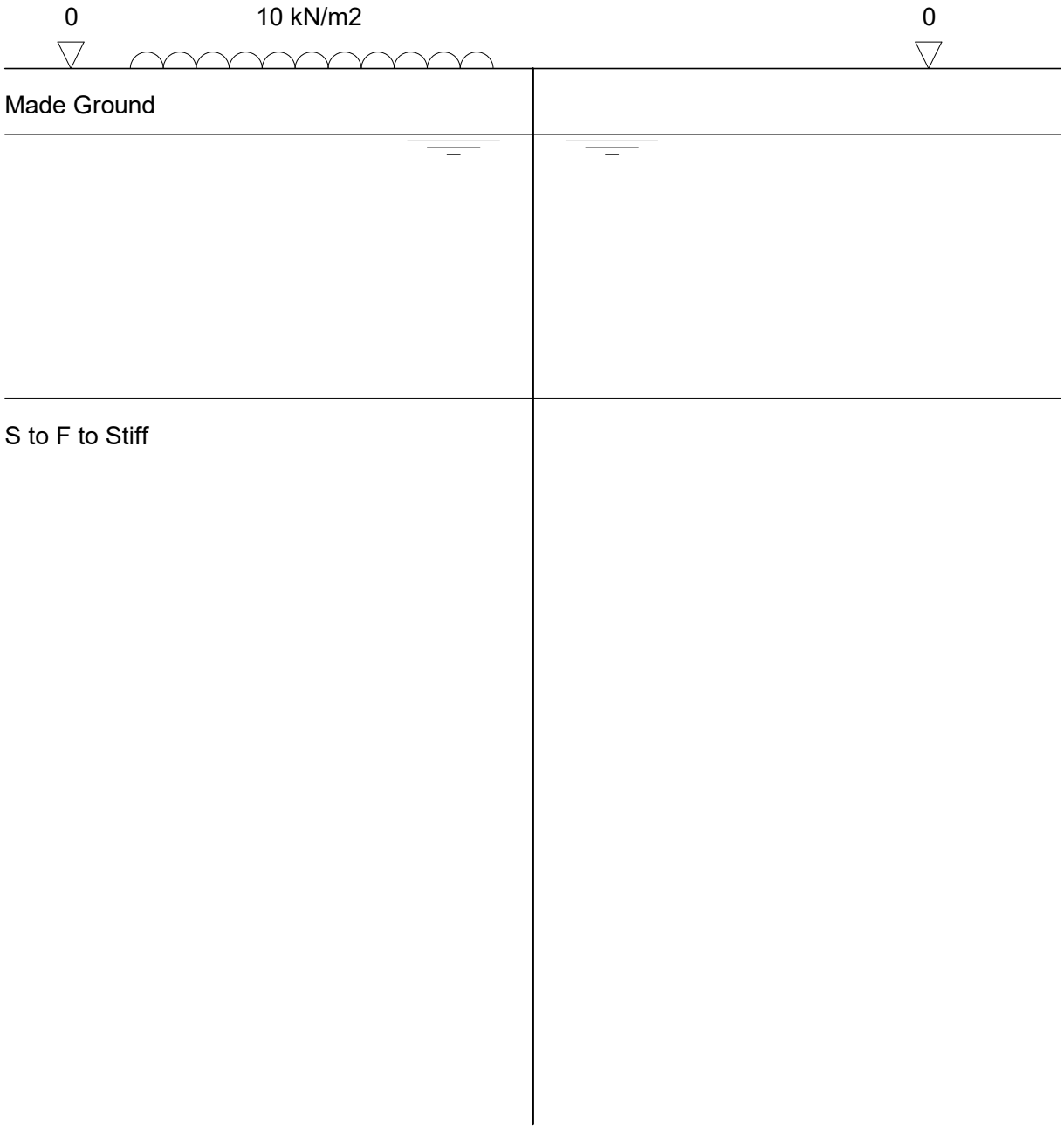
Wall moment of inertia	335482	cm4/m
Wall Youngs modulus	27000000	kN/m2
Properties for prop at -0.5		
Prop/Tie cross sectional area	3	cm2 each
Prop/Tie Youngs modulus	200000000	kN/m2
Prop/Tie length	1.0	m
Prop/Tie spacing	1.0	m
Waling moment of inertia	Waling deflection not included	
Waling Youngs modulus	Waling deflection not included	
Prop/Tie preload	0	kN
Initial lack of fit	0.0	mm
Properties for prop at -4.2		
Prop/Tie cross sectional area	72	cm2 each
Prop/Tie Youngs modulus	28000000	kN/m2
Prop/Tie length	1.0	m
Prop/Tie spacing	1.0	m
Waling moment of inertia	Waling deflection not included	
Waling Youngs modulus	Waling deflection not included	
Prop/Tie preload	0	kN
Initial lack of fit	0.0	mm

Deflection parameters - continued

Properties for prop at -0.3

Prop/Tie cross sectional area	72	cm2 each
Prop/Tie Youngs modulus	28000000	kN/m2
Prop/Tie length	1.0	m
Prop/Tie spacing	1.0	m
Waling moment of inertia	Waling deflection not included	
Waling Youngs modulus	Waling deflection not included	
Prop/Tie preload	0	kN
Initial lack of fit	0.0	mm

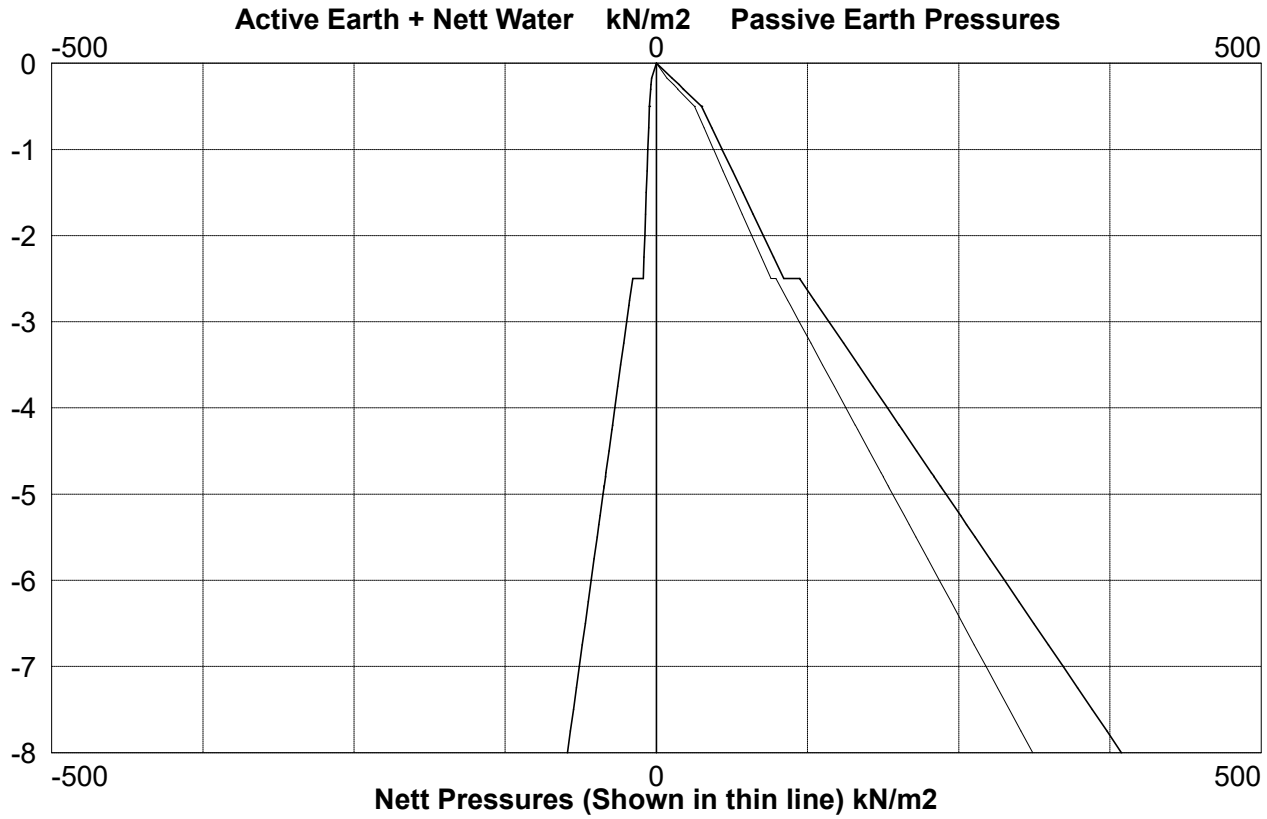
Stage ref. **1**
Stage type **Active surcharge**

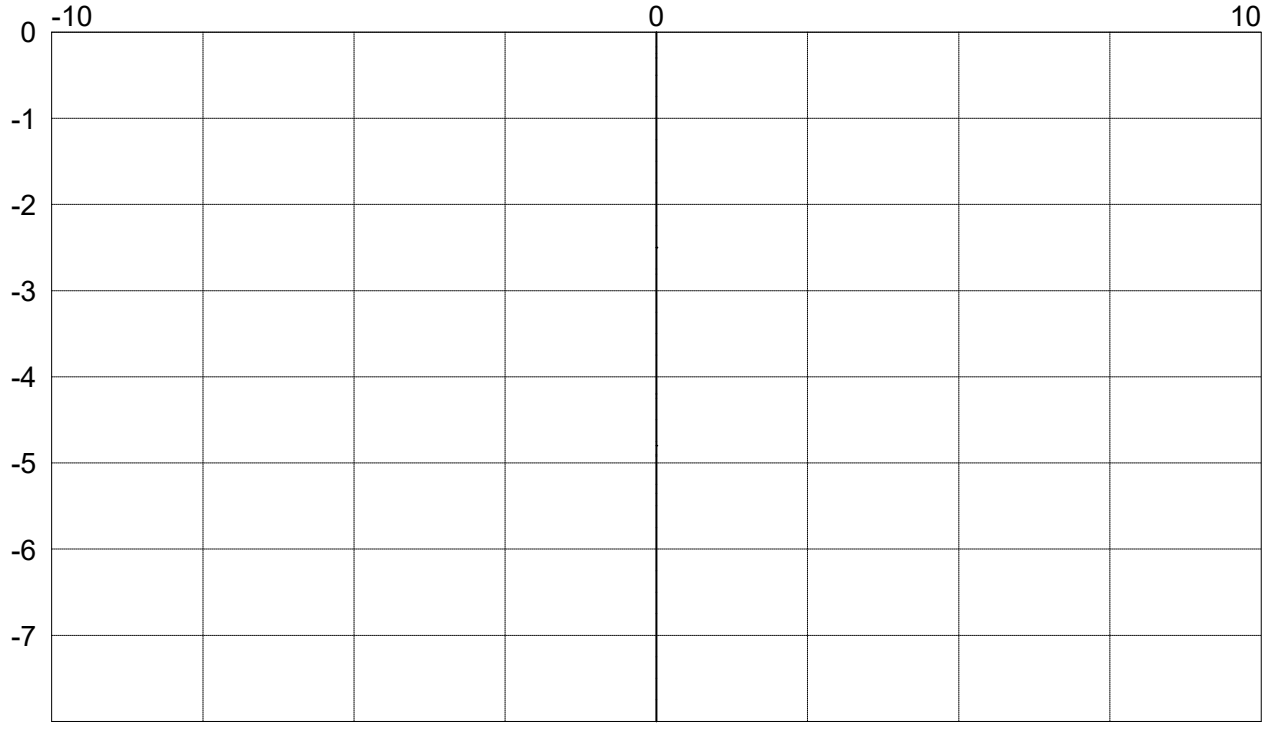


Tabular results from analysis of stage ref 1

Calc Level m	Active Vert kN/m2	Active Earth kN/m2	Active Water kN/m2	Pas' Vert kN/m2	Pas' Earth kN/m2	Pas' Water kN/m2	Total Nett kN/m2	Bend. Moment kNm/m	Shear Force kN/m	Defl't mm	Prop Force kN/m	FOS
.00	.0	.0	.0	.0	.0	.0	0	0	0	0		.00
-.17	13.1	4.0	.0	3.1	12.9	.0	-9.0	0	0	0		>100.00
-.30	15.4	4.7	.0	5.4	22.4	.0	-17.7	0	0	0	.0	>100.00
-.30	15.4	4.7	.0	5.4	22.6	.0	-17.9	0	0	0		>100.00
-.50	19.0	5.8	.0	9.0	37.4	.0	-31.6	0	0	0	.0	>100.00
-.50	19.0	5.8	.0	9.0	37.4	.0	-31.6	0	0	0		>100.00
-1.00	23.1	7.0	4.9	13.1	54.3	4.9	-47.3	0	0	0		>100.00
-1.00	23.1	7.0	4.9	13.1	54.4	4.9	-47.3	0	0	0		>100.00
-2.00	31.3	9.5	14.7	21.3	88.4	14.7	-78.9	0	0	0		>100.00
-2.50	35.4	10.8	19.6	25.4	105.4	19.6	-94.7	0	0	0		>100.00
w -2.50	55.0	.0	19.6	45.0	118.5	.0	-98.9	0	0	0		>100.00
w -2.50	55.0	.0	19.6	45.0	118.6	.0	-99.0	0	0	0		>100.00
w -2.81	60.9	.0	22.6	50.9	133.5	.0	-110.8	0	0	0		>100.00
w -3.00	64.5	.0	24.5	54.5	142.7	.0	-118.2	0	0	0		>100.00
w -4.00	83.5	.0	34.3	73.5	191.1	.0	-156.8	0	0	0		>100.00
w -4.20	87.3	.0	36.3	77.3	200.8	.0	-164.5	0	0	0	.0	>100.00
w -4.20	87.3	.0	36.3	77.3	200.9	.0	-164.6	0	0	0		>100.00
w -4.80	98.7	.0	42.1	88.7	229.7	.0	-187.6	0	0	0		>100.00
w -4.80	98.7	.0	42.1	88.7	229.8	.0	-187.7	0	0	0		>100.00
w -4.90	100.7	.0	43.2	90.7	234.8	.0	-191.7	0	0	0		>100.00
w -4.91	100.8	.0	43.2	90.8	235.1	.0	-191.9	0	0	0		>100.00
w -4.93	101.1	.0	43.4	91.1	235.9	.0	-192.5	0	0	0		>100.00
w -5.00	102.5	.0	44.1	92.5	239.5	.0	-195.4	0	0	0		>100.00
w -5.35	109.2	.0	47.5	99.2	256.5	.0	-209.0	0	0	0		>100.00
w -6.00	121.5	.0	53.9	111.5	287.9	.0	-234.0	0	0	0		>100.00
w -7.00	140.5	.0	63.7	130.5	336.3	.0	-272.6	0	0	0		>100.00
w -8.00	159.5	.0	73.5	149.5	384.7	.0	-311.2	0	0	0		>100.00

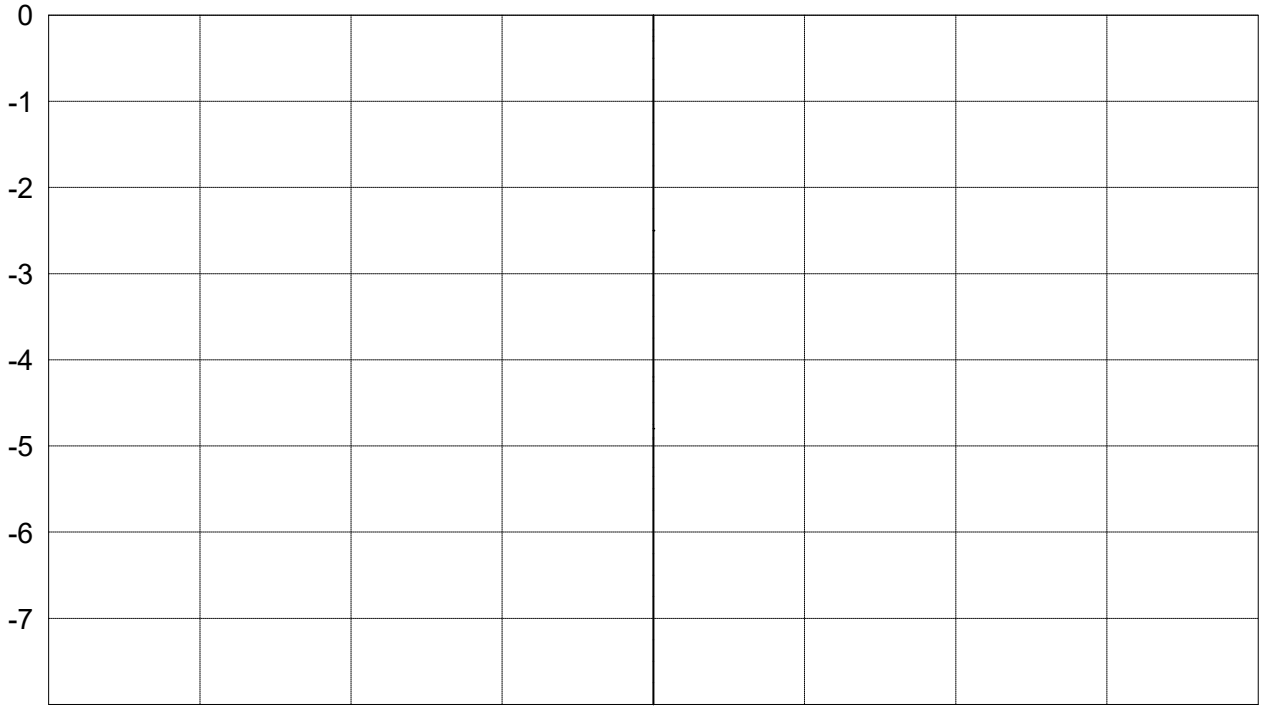
Graphical results from analysis of stage ref 1





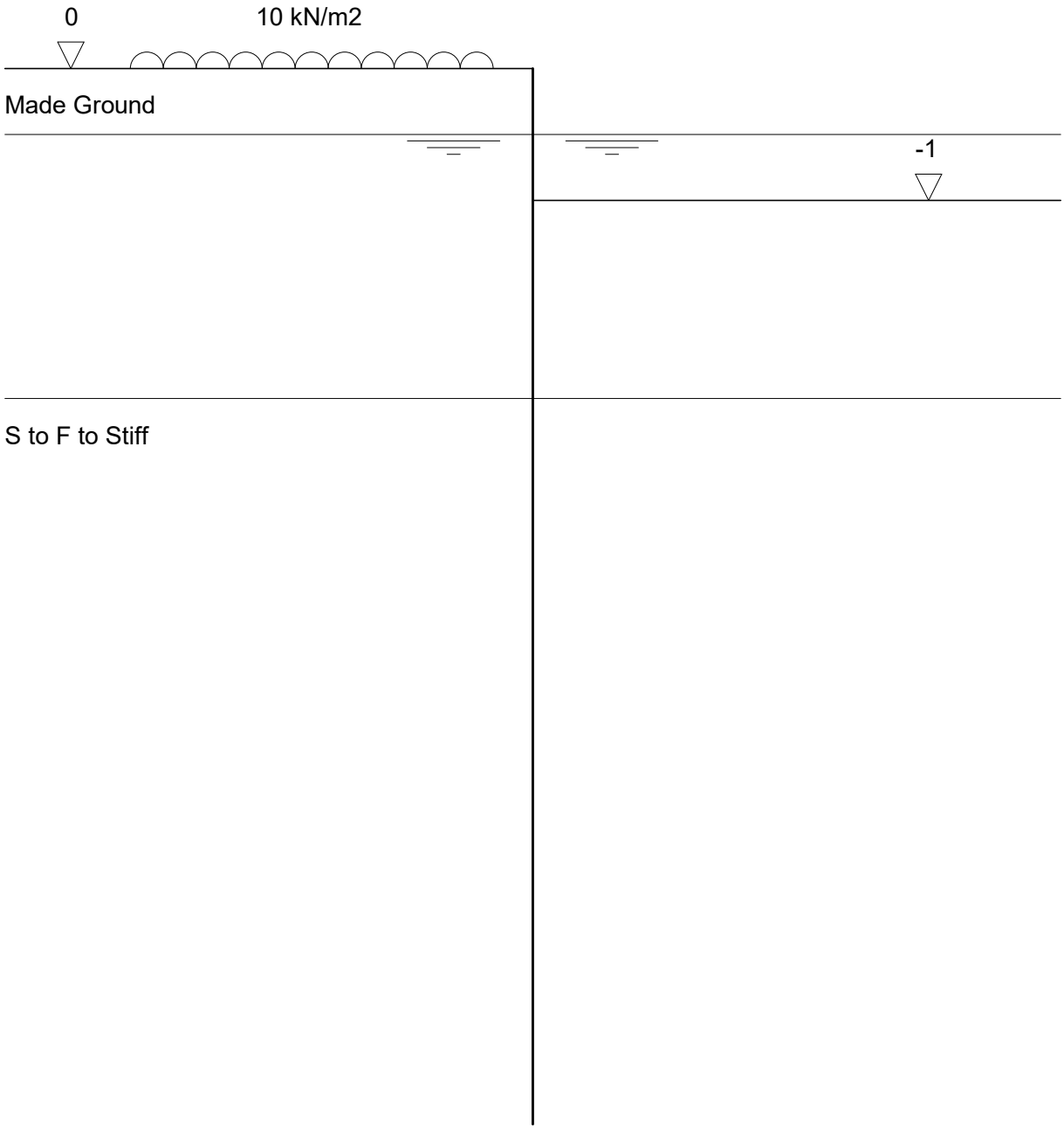
Graphical results from analysis of stage ref 1 continued

Bending Moment Diagram (kNm/m)



Shear Force Diagram (kN/m)

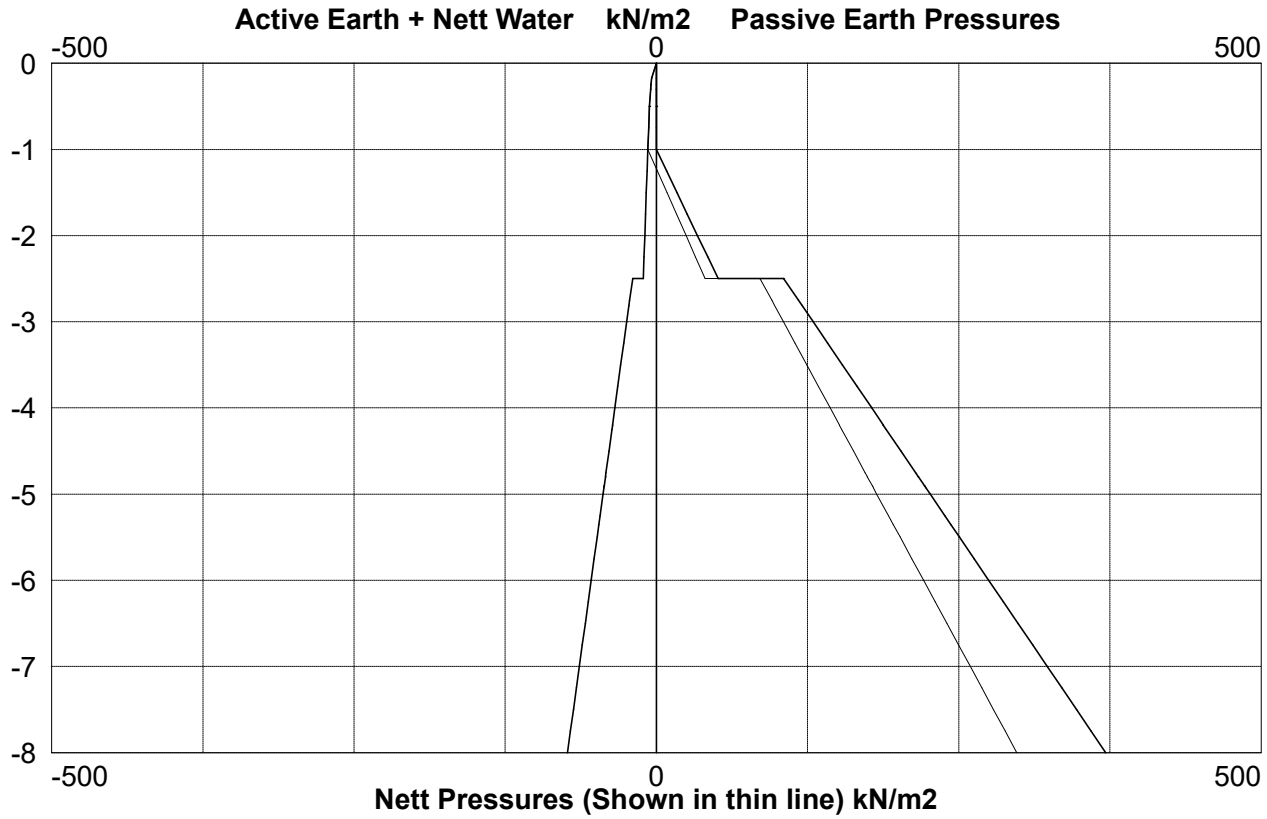
Stage ref. **2**
Stage type **Passive side excavation**

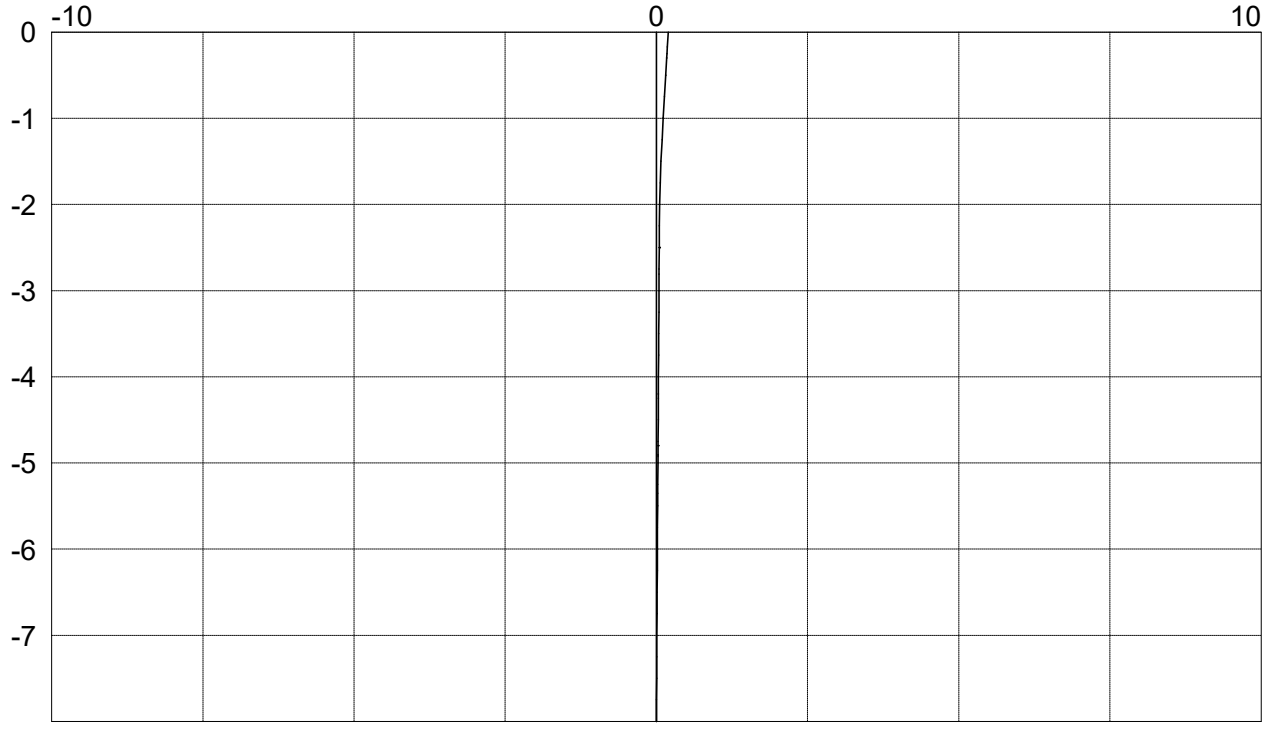


Tabular results from analysis of stage ref 2

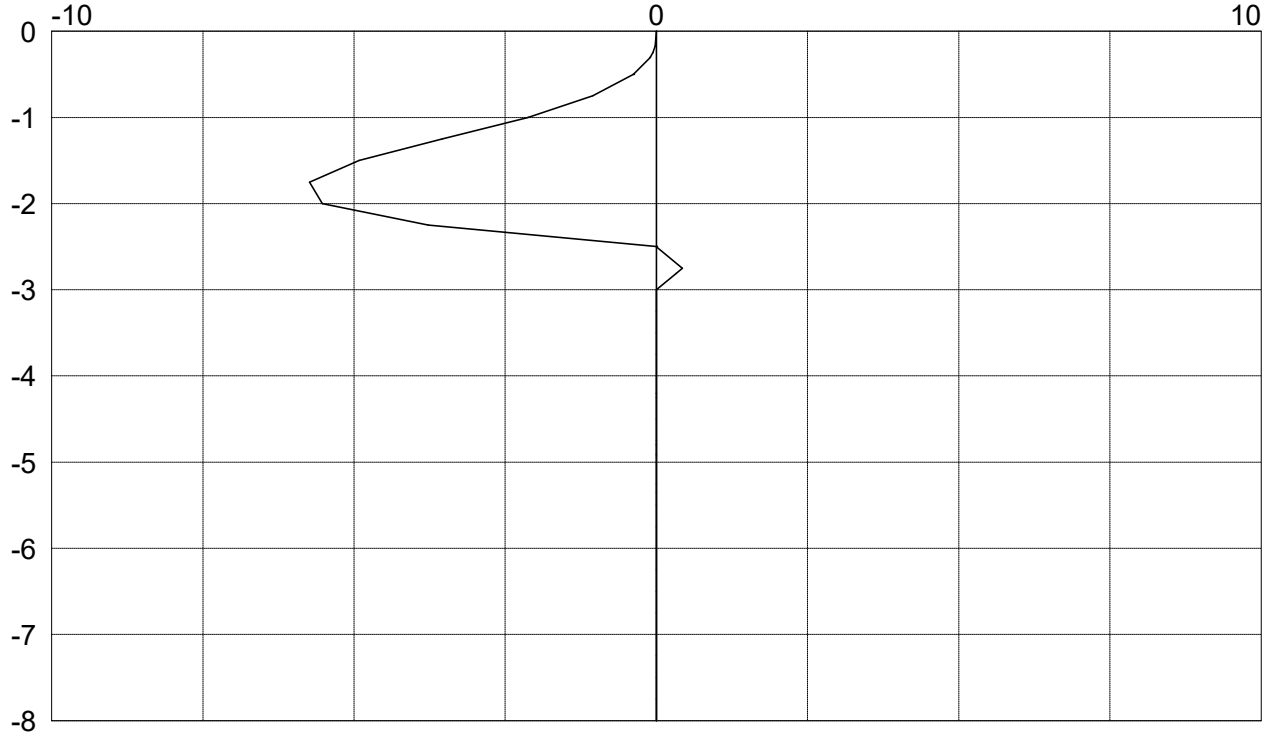
Calc Level m	Active Vert kN/m2	Active Earth kN/m2	Active Water kN/m2	Pas' Vert kN/m2	Pas' Earth kN/m2	Pas' Water kN/m2	Total Nett kN/m2	Bend. Moment kNm/m	Shear Force kN/m	Defl't mm	Prop Force kN/m	FOS
.00	.0	.0	.0	.0	.0	.0	0	0	0	.2		.00
-.17	13.1	4.0	.0	.0	.0	.0	4.0	0	-.3	.2		.00
-.30	15.4	4.7	.0	.0	.0	.0	4.7	.1	-.9	.2	.0	.00
-.30	15.4	4.7	.0	.0	.0	.0	4.7	.1	-.9	.2		.00
-.50	19.0	5.8	.0	.0	.0	.0	5.8	.4	-1.9	.2	.0	.00
-.50	19.0	5.8	.0	.0	.0	.0	5.8	.4	-2.0	.2		.00
-1.00	23.1	7.0	4.9	.0	.0	4.9	7.0	2.1	-5.1	.1		.00
-1.00	23.1	7.0	4.9	.0	.0	4.9	7.0	2.1	-5.1	.1		.00
-2.00	31.3	9.5	14.7	8.2	34.0	14.7	-24.5	5.5	3.6	.1		.51
-2.50	35.4	10.8	19.6	12.3	51.1	19.6	-40.3	0	19.8	0		1.00
w -2.50	55.0	.0	19.6	31.9	105.4	.0	-85.8	0	19.8	0		1.00
w -2.50	55.0	.0	19.6	31.9	105.5	.0	-85.9	0	20.0	0		1.00
w -2.81	60.9	.0	22.6	37.8	120.4	.0	-97.7	-.3	2.6	0		1.41
w -3.00	64.5	.0	24.5	41.4	129.6	.0	-105.1	0	0	0		1.69
w -4.00	83.5	.0	34.3	60.4	178.0	.0	-143.7	0	0	0		2.99
w -4.20	87.3	.0	36.3	64.2	187.7	.0	-151.4	0	0	0	.0	3.18
w -4.20	87.3	.0	36.3	64.2	187.8	.0	-151.5	0	0	0		3.18
w -4.80	98.7	.0	42.1	75.6	216.6	.0	-174.5	0	0	0		3.63
w -4.80	98.7	.0	42.1	75.6	216.7	.0	-174.6	0	0	0		3.63
w -4.90	100.7	.0	43.2	77.6	221.7	.0	-178.6	0	0	0		3.69
w -4.91	100.8	.0	43.2	77.7	222.0	.0	-178.8	0	0	0		3.69
w -4.93	101.1	.0	43.4	78.0	222.8	.0	-179.4	0	0	0		3.70
w -5.00	102.5	.0	44.1	79.4	226.4	.0	-182.3	0	0	0		3.75
w -5.35	109.2	.0	47.5	86.1	243.4	.0	-195.9	0	0	0		3.92
w -6.00	121.5	.0	53.9	98.4	274.8	.0	-220.9	0	0	0		4.18
w -7.00	140.5	.0	63.7	117.4	323.2	.0	-259.5	0	0	0		4.43
w -8.00	159.5	.0	73.5	136.4	371.6	.0	-298.1	0	0	0		4.59

Graphical results from analysis of stage ref 2

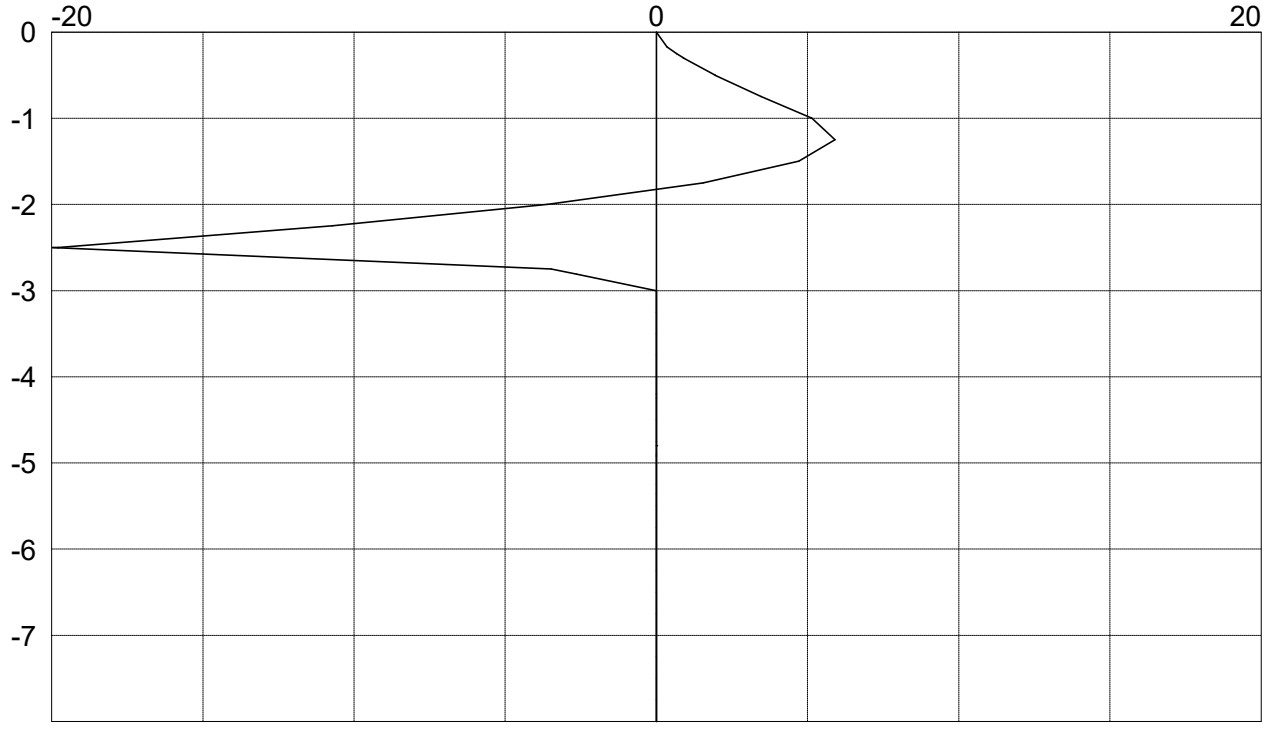




Graphical results from analysis of stage ref 2 continued

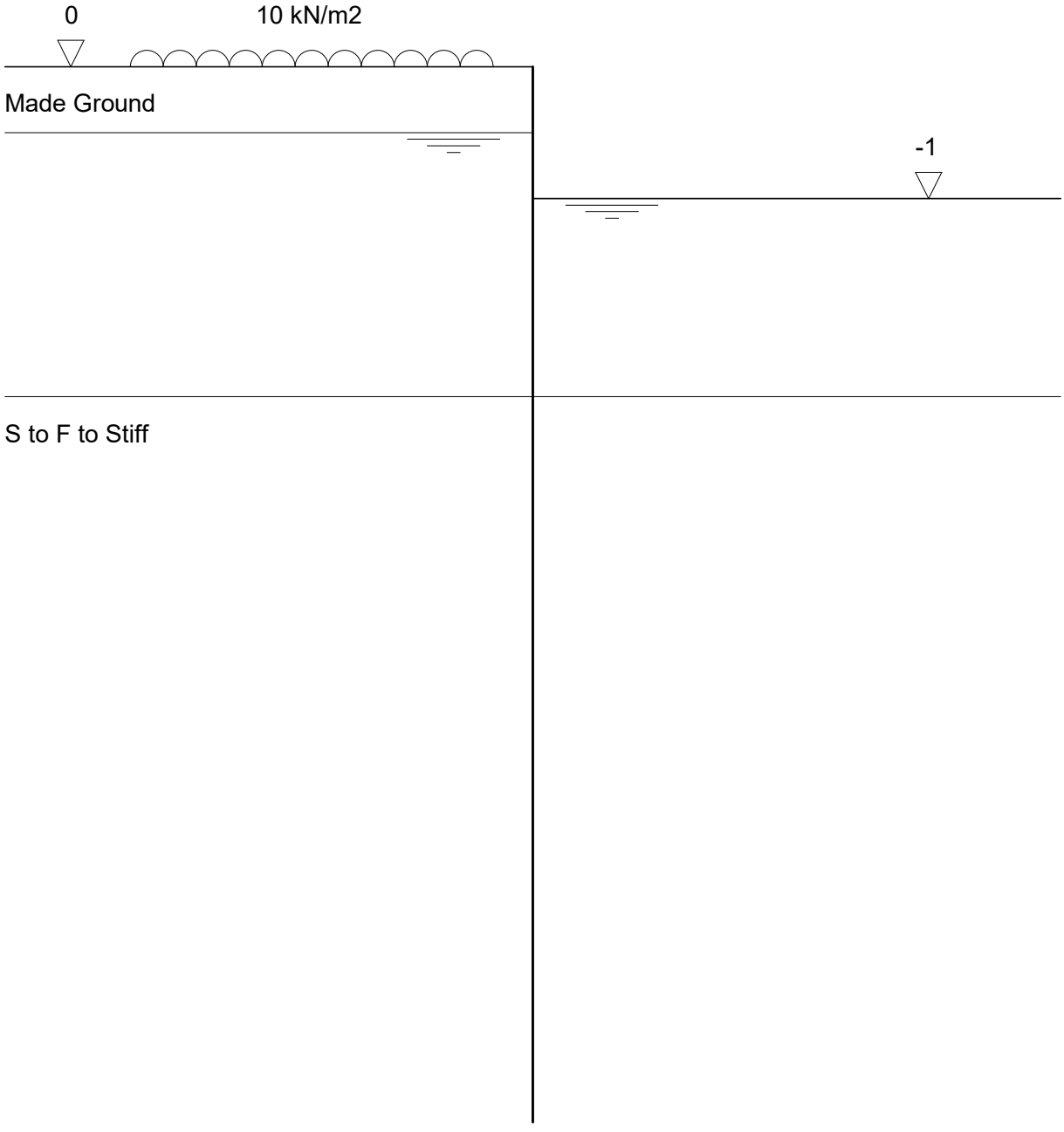


Bending Moment Diagram (kNm/m)



Shear Force Diagram (kN/m)

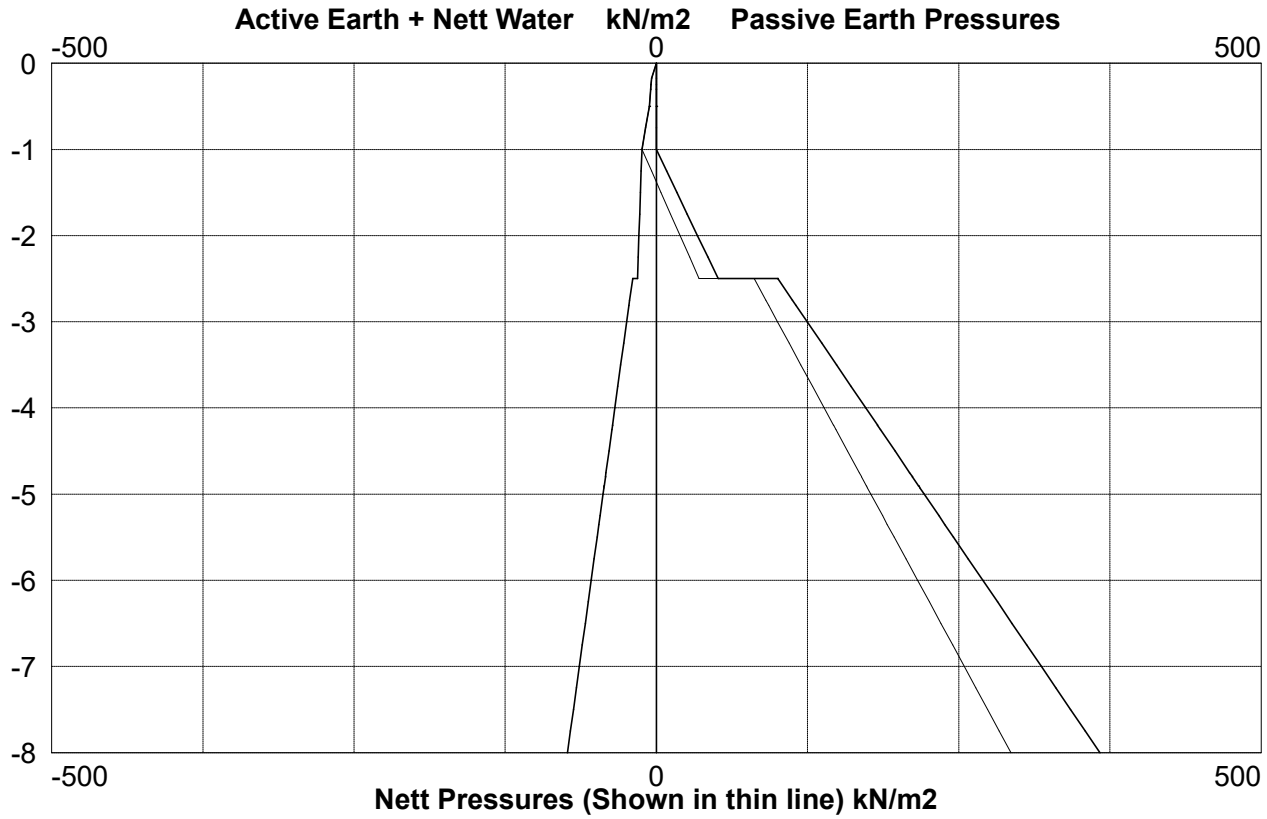
Stage ref. **3**
Stage type **Passive water level**

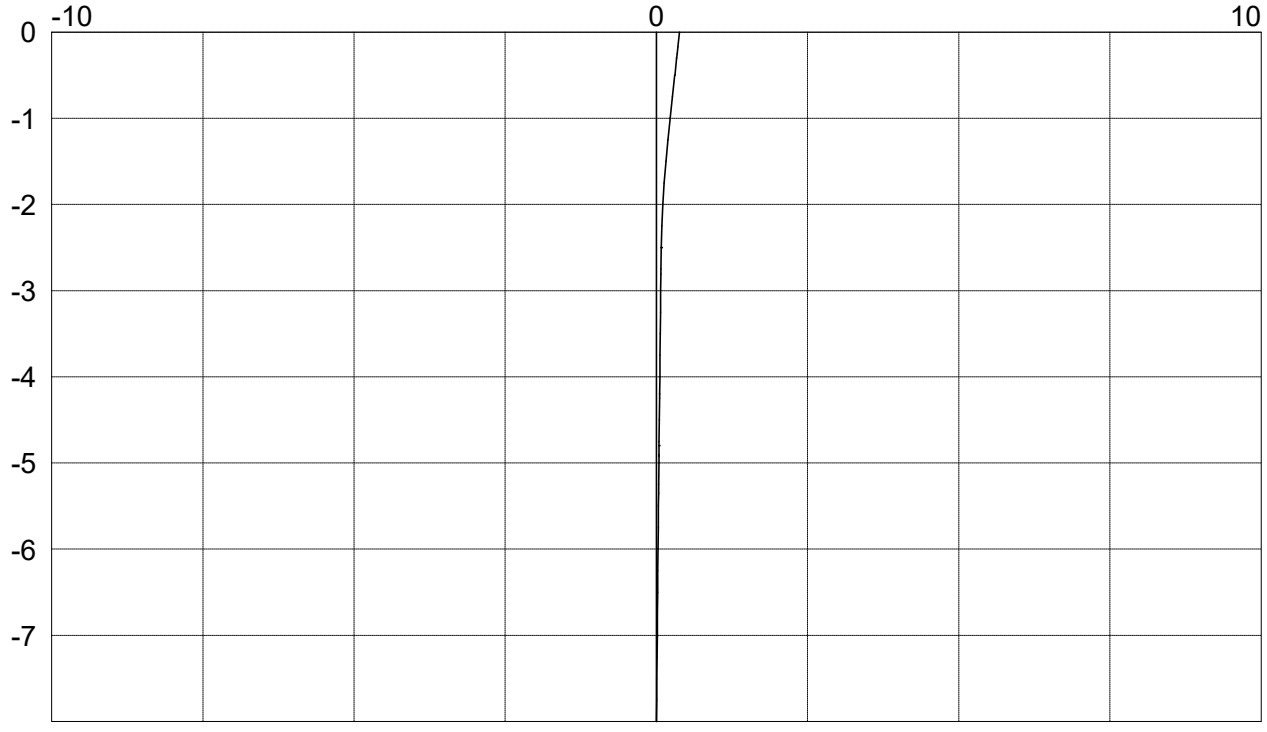


Tabular results from analysis of stage ref 3

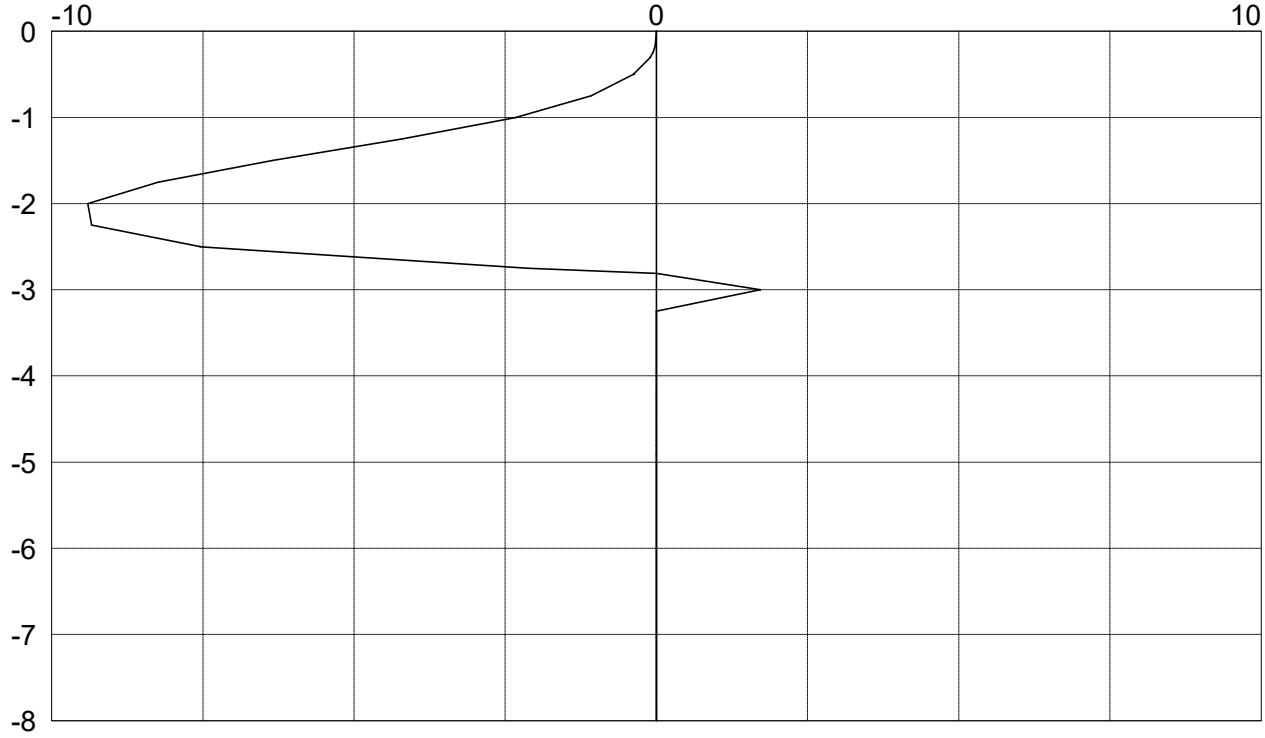
Calc Level m	Active Vert kN/m2	Active Earth kN/m2	Active Water kN/m2	Pas' Vert kN/m2	Pas' Earth kN/m2	Pas' Water kN/m2	Total Nett kN/m2	Bend. Moment kNm/m	Shear Force kN/m	Defl't mm	Prop Force kN/m	FOS
.00	.0	.0	.0	.0	.0	.0	0	0	0	.4		.00
-.17	13.1	4.0	.0	.0	.0	.0	4.0	0	-.3	.4		.00
-.30	15.4	4.7	.0	.0	.0	.0	4.7	.1	-.9	.3	.0	.00
-.30	15.4	4.7	.0	.0	.0	.0	4.7	.1	-.9	.3		.00
-.50	19.0	5.8	.0	.0	.0	.0	5.8	.4	-1.9	.3	.0	.00
-.50	19.0	5.8	.0	.0	.0	.0	5.8	.4	-2.0	.3		.00
-1.00	23.1	7.0	4.9	.0	.0	.0	11.9	2.3	-6.3	.2		.00
-1.00	23.1	7.0	4.9	.0	.0	.0	11.9	2.3	-6.4	.2		.00
-2.00	31.3	9.5	14.7	8.2	34.0	9.8	-19.6	9.4	-2.5	.1		.38
-2.50	35.4	10.8	19.6	12.3	51.1	14.7	-35.4	7.6	11.2	.1		.72
w -2.50	55.0	.0	19.6	27.0	100.5	.0	-80.9	7.5	11.2	.1		.72
w -2.50	55.0	.0	19.6	27.0	100.6	.0	-81.0	7.5	11.4	.1		.72
w -2.81	60.9	.0	22.6	32.9	115.5	.0	-92.8	0	38.2	.1		1.00
w -3.00	64.5	.0	24.5	36.5	124.7	.0	-100.2	-1.7	18.1	.1		1.21
w -4.00	83.5	.0	34.3	55.5	173.1	.0	-138.8	0	0	.1		2.29
w -4.20	87.3	.0	36.3	59.3	182.8	.0	-146.5	0	0	.1	.0	2.47
w -4.20	87.3	.0	36.3	59.3	182.9	.0	-146.6	0	0	.1		2.47
w -4.80	98.7	.0	42.1	70.7	211.7	.0	-169.6	0	0	0		2.93
w -4.80	98.7	.0	42.1	70.7	211.8	.0	-169.7	0	0	0		2.93
w -4.90	100.7	.0	43.2	72.7	216.8	.0	-173.7	0	0	0		3.00
w -4.91	100.8	.0	43.2	72.8	217.1	.0	-173.9	0	0	0		3.00
w -4.93	101.1	.0	43.4	73.1	217.9	.0	-174.5	0	0	0		3.02
w -5.00	102.5	.0	44.1	74.5	221.5	.0	-177.4	0	0	0		3.06
w -5.35	109.2	.0	47.5	81.2	238.5	.0	-191.0	0	0	0		3.27
w -6.00	121.5	.0	53.9	93.5	269.9	.0	-216.0	0	0	0		3.58
w -7.00	140.5	.0	63.7	112.5	318.3	.0	-254.6	0	0	0		3.92
w -8.00	159.5	.0	73.5	131.5	366.7	.0	-293.2	0	0	0		4.16

Graphical results from analysis of stage ref 3

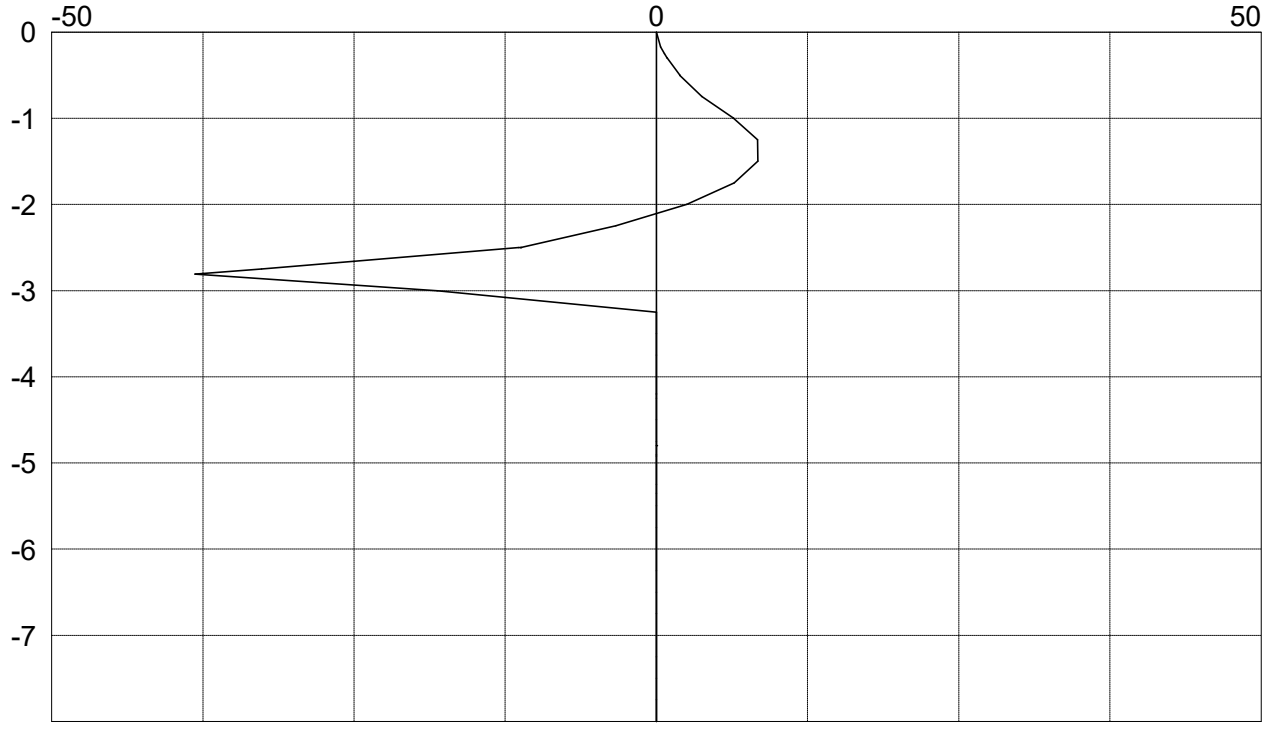




Graphical results from analysis of stage ref 3 continued

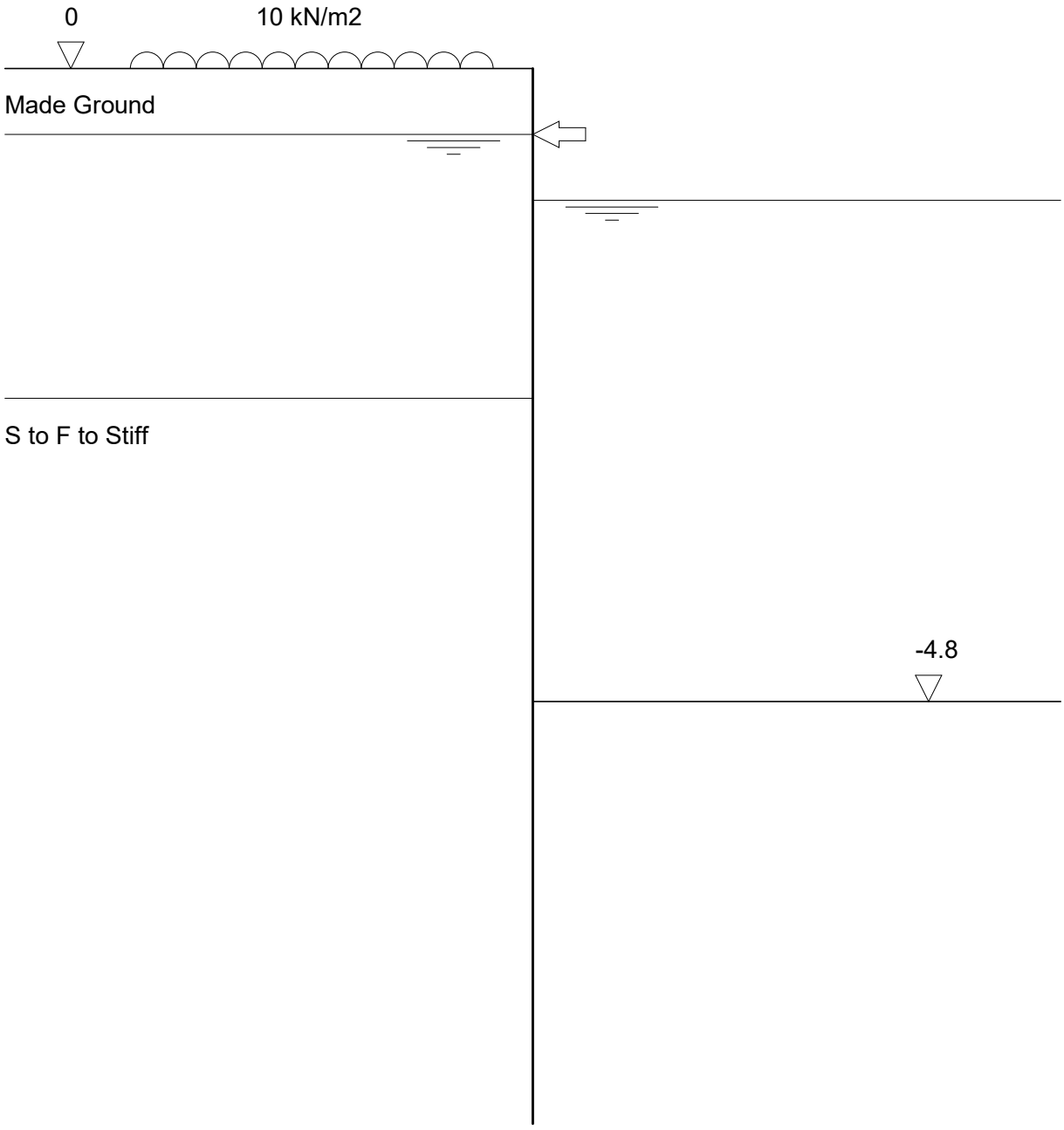


Bending Moment Diagram (kNm/m)



Shear Force Diagram (kN/m)

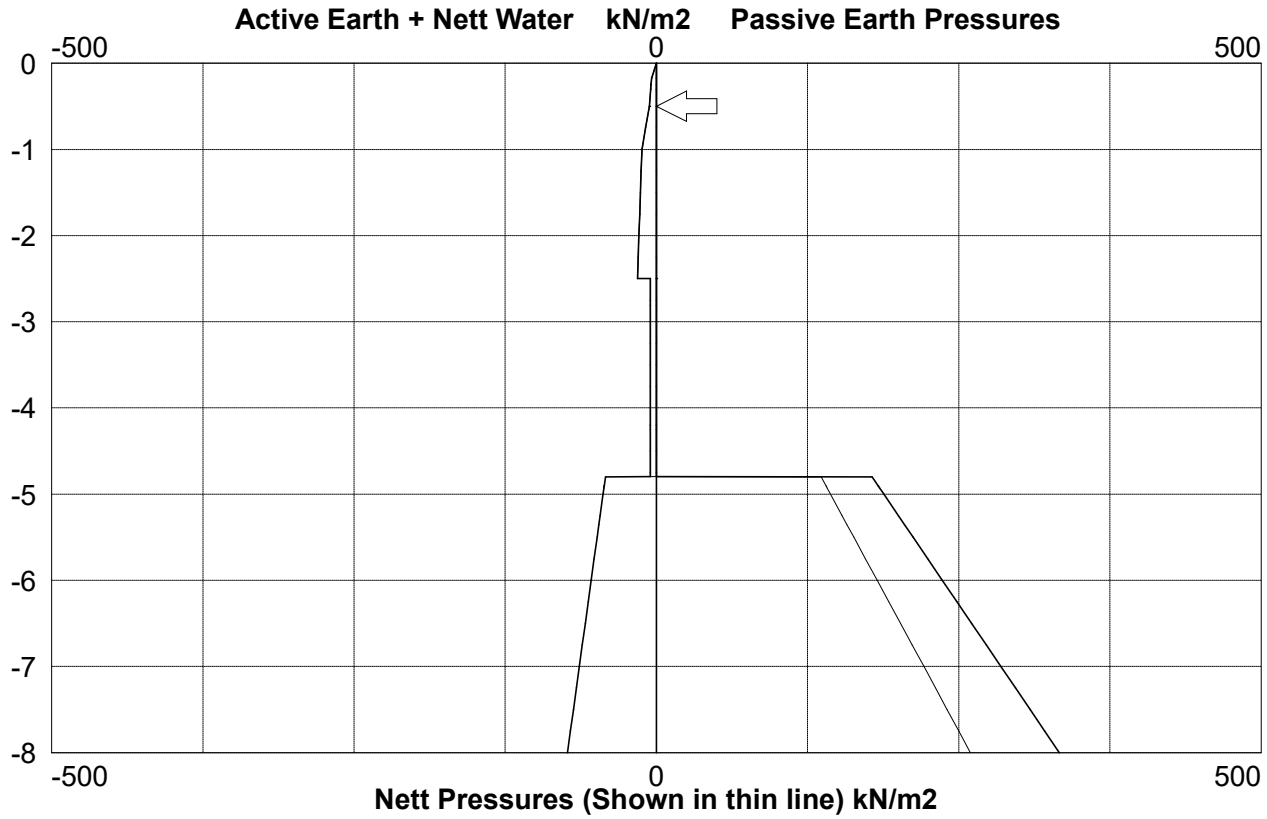
Stage ref. **5**
Stage type **Passive side excavation**

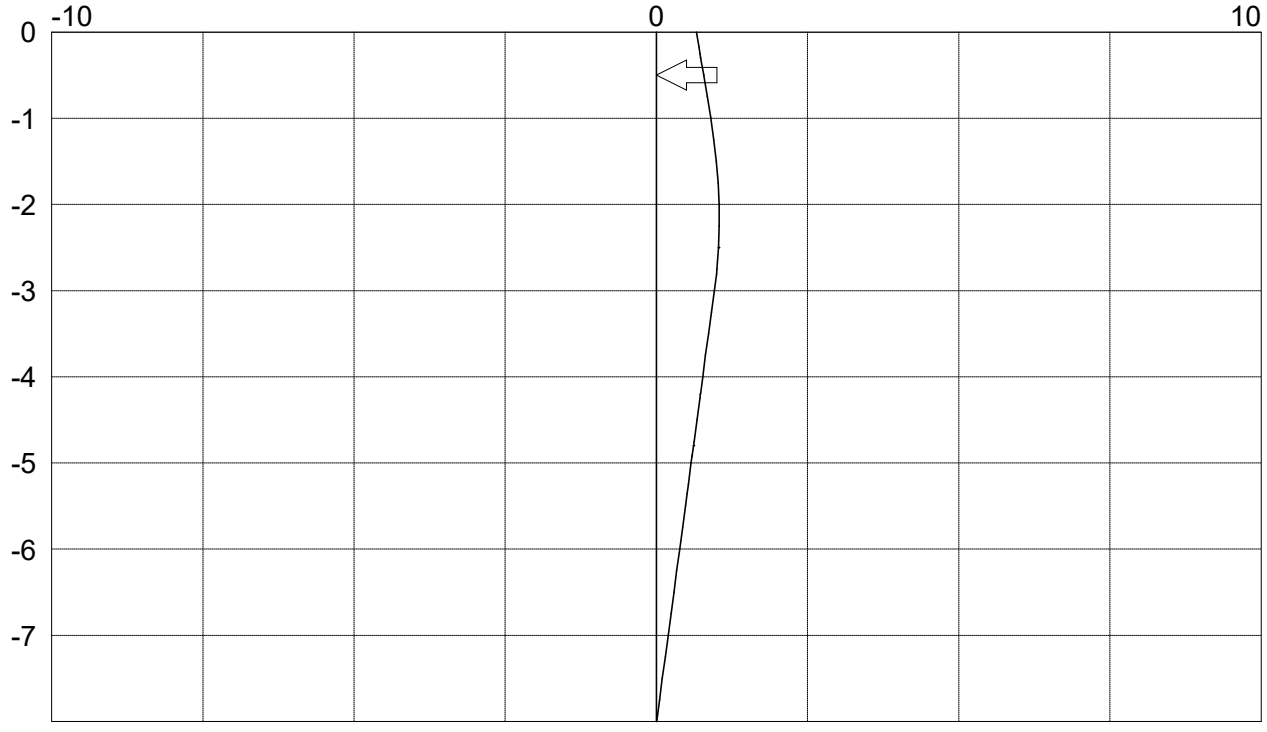


Tabular results from analysis of stage ref 5

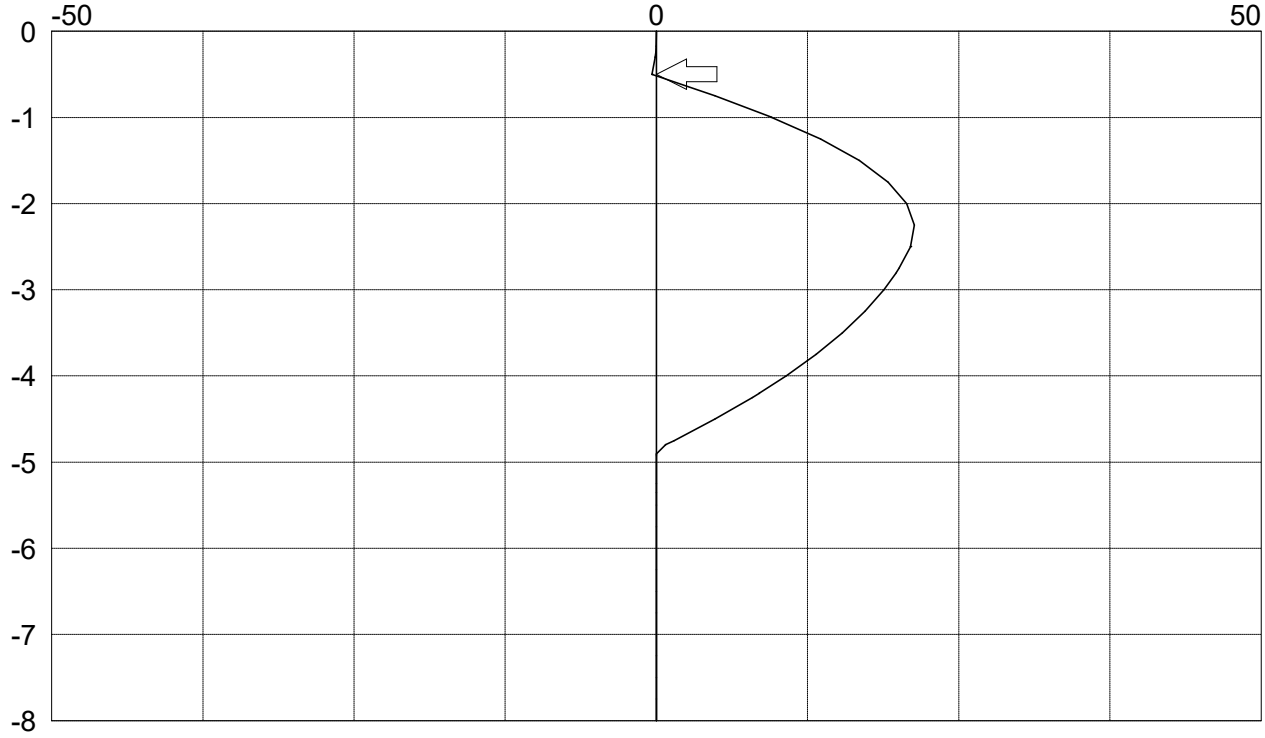
Calc Level m	Active Vert kN/m2	Active Earth kN/m2	Active Water kN/m2	Pas' Vert kN/m2	Pas' Earth kN/m2	Pas' Water kN/m2	Total Nett kN/m2	Bend. Moment kNm/m	Shear Force kN/m	Defl't mm	Prop Force kN/m	FOS
.00	.0	.0	.0	.0	.0	.0	0	0	0	.7		.00
-.17	13.1	4.0	.0	.0	.0	.0	4.0	0	-.3	.7		.00
-.30	15.4	4.7	.0	.0	.0	.0	4.7	.1	-.9	.7	.0	.00
-.30	15.4	4.7	.0	.0	.0	.0	4.7	.1	-.9	.7		.00
-.50	19.0	5.8	.0	.0	.0	.0	5.8	.4	-1.9	.8	23.9	.00
-.50	19.0	5.8	.0	.0	.0	.0	5.8	.4	21.9	.8		.00
-1.00	23.1	7.0	4.9	.0	.0	.0	11.9	-9.5	17.5	.9		.00
-1.00	23.1	7.0	4.9	.0	.0	.0	11.9	-9.6	17.5	.9		.00
-2.00	31.3	9.5	14.7	.0	.0	9.8	14.4	-20.7	4.3	1.0		.00
-2.50	35.4	10.8	19.6	.0	.0	14.7	15.7	-21.0	-3.2	1.0		.00
w -2.50	55.0	.0	19.6	.0	.0	14.7	4.9	-21.0	-3.2	1.0		.00
w -2.50	55.0	.0	19.6	.0	.0	14.7	4.9	-21.0	-3.2	1.0		.00
w -2.81	60.9	.0	22.6	.0	.0	17.7	4.9	-19.8	-4.7	1.0		.00
w -3.00	64.5	.0	24.5	.0	.0	19.6	4.9	-18.8	-5.6	1.0		.00
w -4.00	83.5	.0	34.3	.0	.0	29.4	4.9	-10.7	-10.5	.8		.00
w -4.20	87.3	.0	36.3	.0	.0	31.4	4.9	-8.5	-11.5	.7	.0	.00
w -4.20	87.3	.0	36.3	.0	.0	31.4	4.9	-8.5	-11.5	.7		.00
w -4.80	98.7	.0	42.1	.0	.0	37.2	4.9	-.8	-14.4	.6		.00
w -4.80	98.7	.0	42.1	37.2	178.3	.0	-136.2	-.7	-14.3	.6		.01
w -4.90	100.7	.0	43.2	39.2	183.4	.0	-140.2	0	0	.6		.84
w -4.91	100.8	.0	43.2	39.3	183.7	.0	-140.4	0	0	.6		.89
w -4.93	101.1	.0	43.4	39.6	184.4	.0	-141.1	0	0	.6		1.01
w -5.00	102.5	.0	44.1	41.0	188.0	.0	-143.9	0	0	.6		1.60
w -5.35	109.2	.0	47.5	47.7	205.0	.0	-157.5	0	0	.5		2.72
w -6.00	121.5	.0	53.9	60.0	236.4	.0	-182.5	0	0	.4		3.54
w -7.00	140.5	.0	63.7	79.0	284.8	.0	-221.1	0	0	.2		3.99
w -8.00	159.5	.0	73.5	98.0	333.2	.0	-259.7	0	0	0		4.20

Graphical results from analysis of stage ref 5

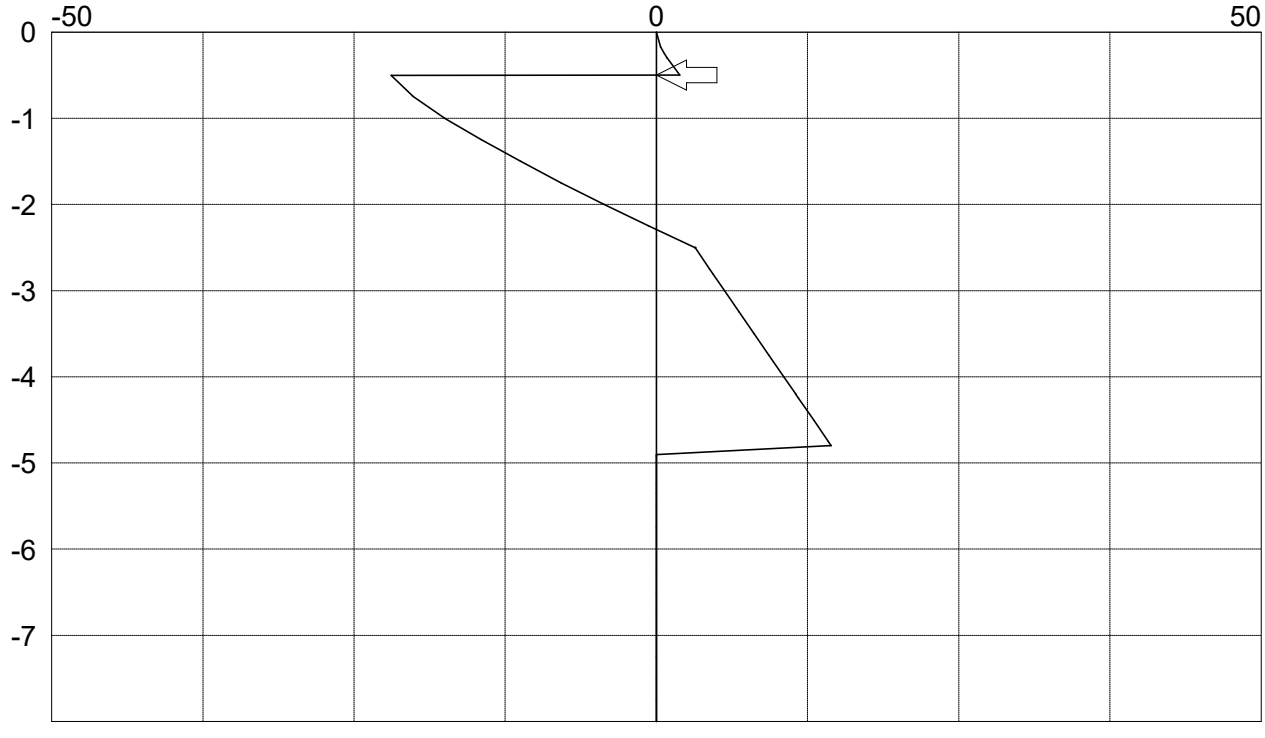




Graphical results from analysis of stage ref 5 continued

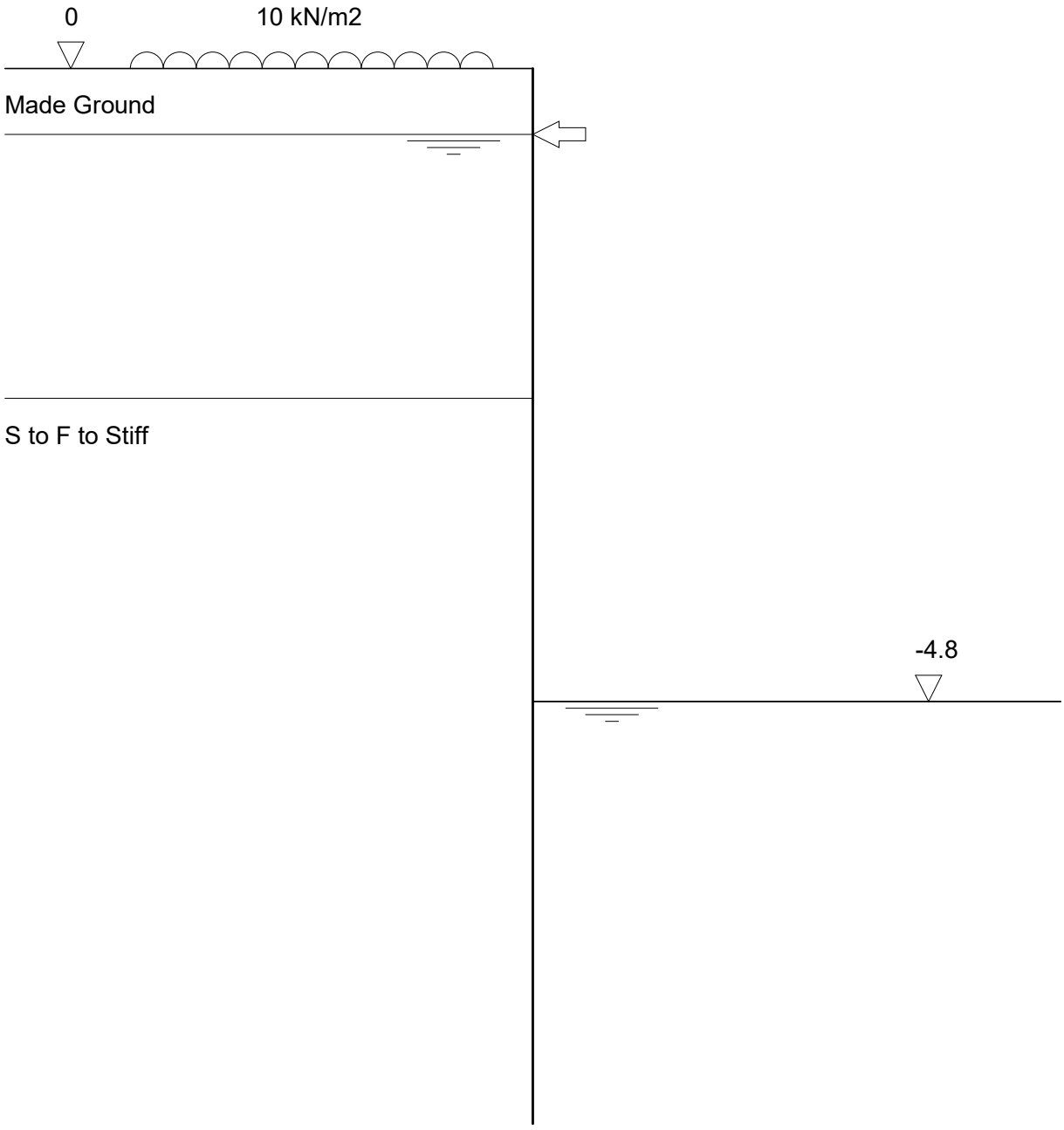


Bending Moment Diagram (kNm/m)



Shear Force Diagram (kN/m)

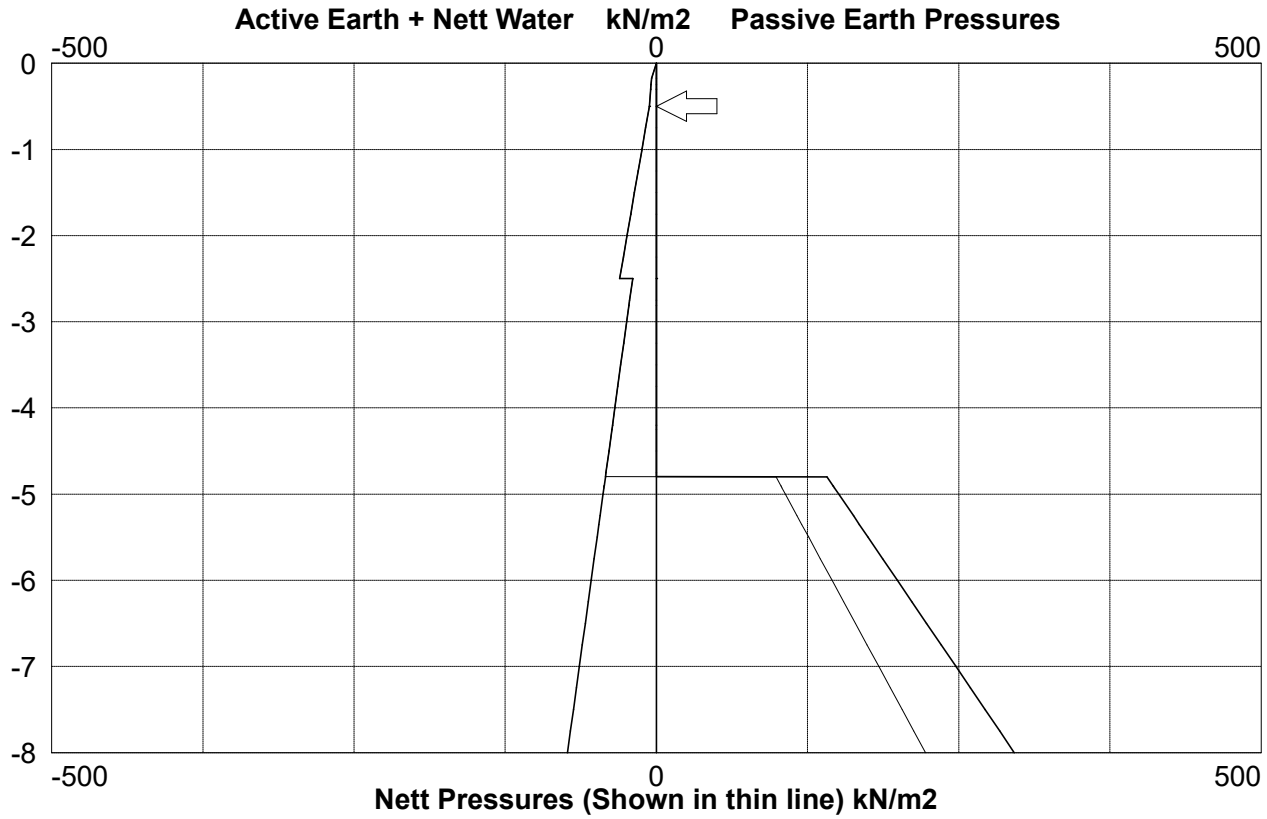
Stage ref. **6**
Stage type **Passive water level**

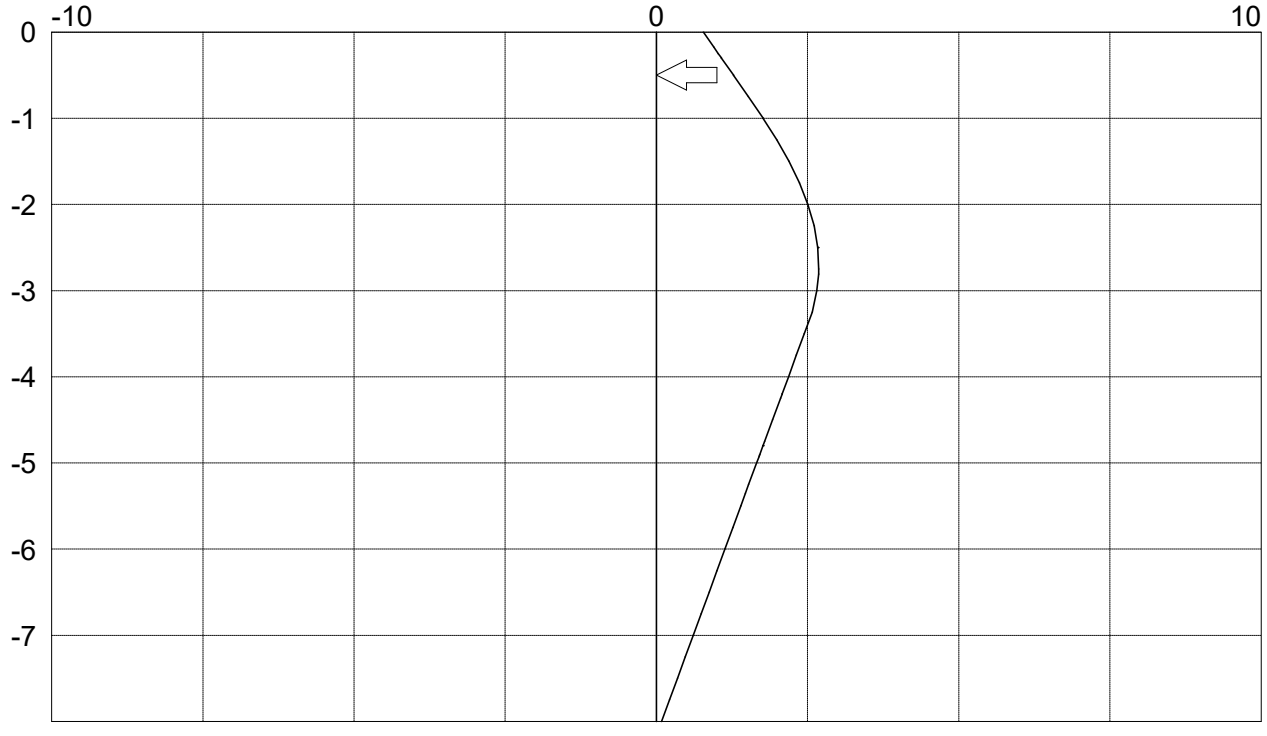


Tabular results from analysis of stage ref 6

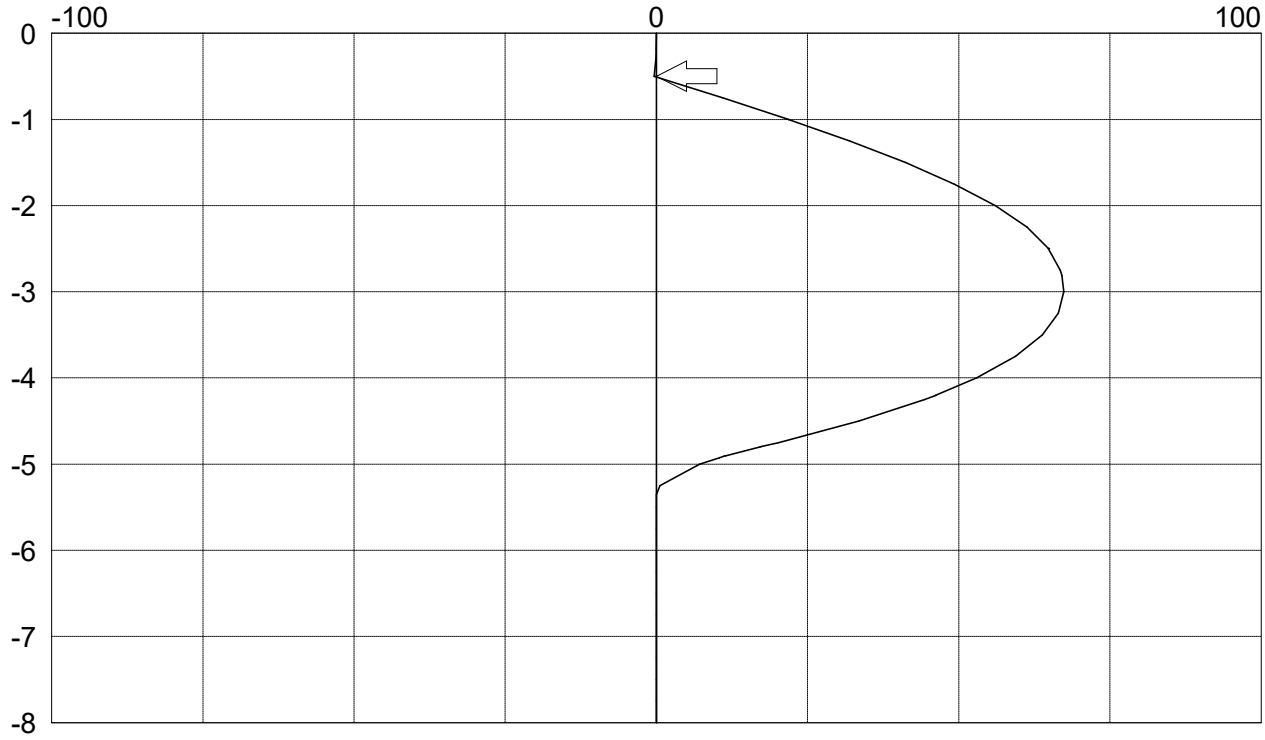
Calc Level m	Active Vert kN/m2	Active Earth kN/m2	Active Water kN/m2	Pas' Vert kN/m2	Pas' Earth kN/m2	Pas' Water kN/m2	Total Nett kN/m2	Bend. Moment kNm/m	Shear Force kN/m	Defl't mm	Prop Force kN/m	FOS
.00	.0	.0	.0	.0	.0	.0	0	0	0	.8		.00
-.17	13.1	4.0	.0	.0	.0	.0	4.0	0	-.3	.9		.00
-.30	15.4	4.7	.0	.0	.0	.0	4.7	.1	-.9	1.1	.0	.00
-.30	15.4	4.7	.0	.0	.0	.0	4.7	.1	-.9	1.1		.00
-.50	19.0	5.8	.0	.0	.0	.0	5.8	.4	-1.9	1.3	48.6	.00
-.50	19.0	5.8	.0	.0	.0	.0	5.8	.4	46.6	1.3		.00
-1.00	23.1	7.0	4.9	.0	.0	.0	11.9	-21.8	42.2	1.8		.00
-1.00	23.1	7.0	4.9	.0	.0	.0	11.9	-21.9	42.2	1.8		.00
-2.00	31.3	9.5	14.7	.0	.0	.0	24.2	-56.0	24.1	2.5		.00
-2.50	35.4	10.8	19.6	.0	.0	.0	30.4	-64.8	10.5	2.7		.00
w -2.50	55.0	.0	19.6	.0	.0	.0	19.6	-64.8	10.5	2.7		.00
w -2.50	55.0	.0	19.6	.0	.0	.0	19.6	-64.8	10.4	2.7		.00
w -2.81	60.9	.0	22.6	.0	.0	.0	22.6	-67.1	3.9	2.7		.00
w -3.00	64.5	.0	24.5	.0	.0	.0	24.5	-67.4	-.6	2.7		.00
w -4.00	83.5	.0	34.3	.0	.0	.0	34.3	-53.0	-30.0	2.2		.00
w -4.20	87.3	.0	36.3	.0	.0	.0	36.3	-46.3	-37.0	2.1	.0	.00
w -4.20	87.3	.0	36.3	.0	.0	.0	36.3	-46.2	-37.1	2.1		.00
w -4.80	98.7	.0	42.1	.0	.0	.0	42.1	-17.3	-60.4	1.8		.00
w -4.80	98.7	.0	42.1	.0	141.1	.0	-99.0	-17.2	-60.4	1.8		.00
w -4.90	100.7	.0	43.2	2.0	146.1	.0	-103.0	-11.4	-49.9	1.7		.22
w -4.91	100.8	.0	43.2	2.1	146.4	.0	-103.2	-11.2	-49.3	1.7		.23
w -4.93	101.1	.0	43.4	2.4	147.2	.0	-103.8	-10.5	-47.6	1.7		.26
w -5.00	102.5	.0	44.1	3.8	150.8	.0	-106.7	-7.1	-39.8	1.7		.41
w -5.35	109.2	.0	47.5	10.5	167.8	.0	-120.3	0	0	1.5		.99
w -6.00	121.5	.0	53.9	22.8	199.2	.0	-145.3	0	0	1.1		1.80
w -7.00	140.5	.0	63.7	41.8	247.6	.0	-183.9	0	0	.6		2.57
w -8.00	159.5	.0	73.5	60.8	296.0	.0	-222.5	0	0	.1		3.05

Graphical results from analysis of stage ref 6

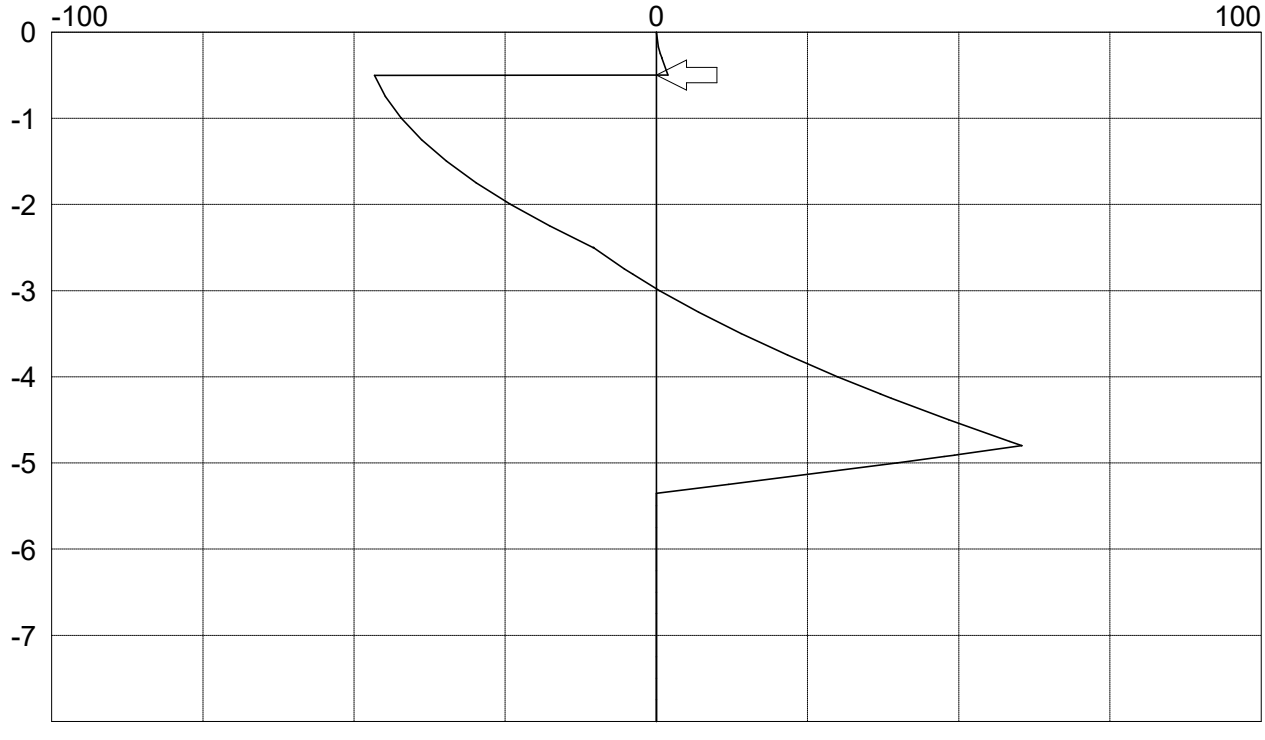




Graphical results from analysis of stage ref 6 continued

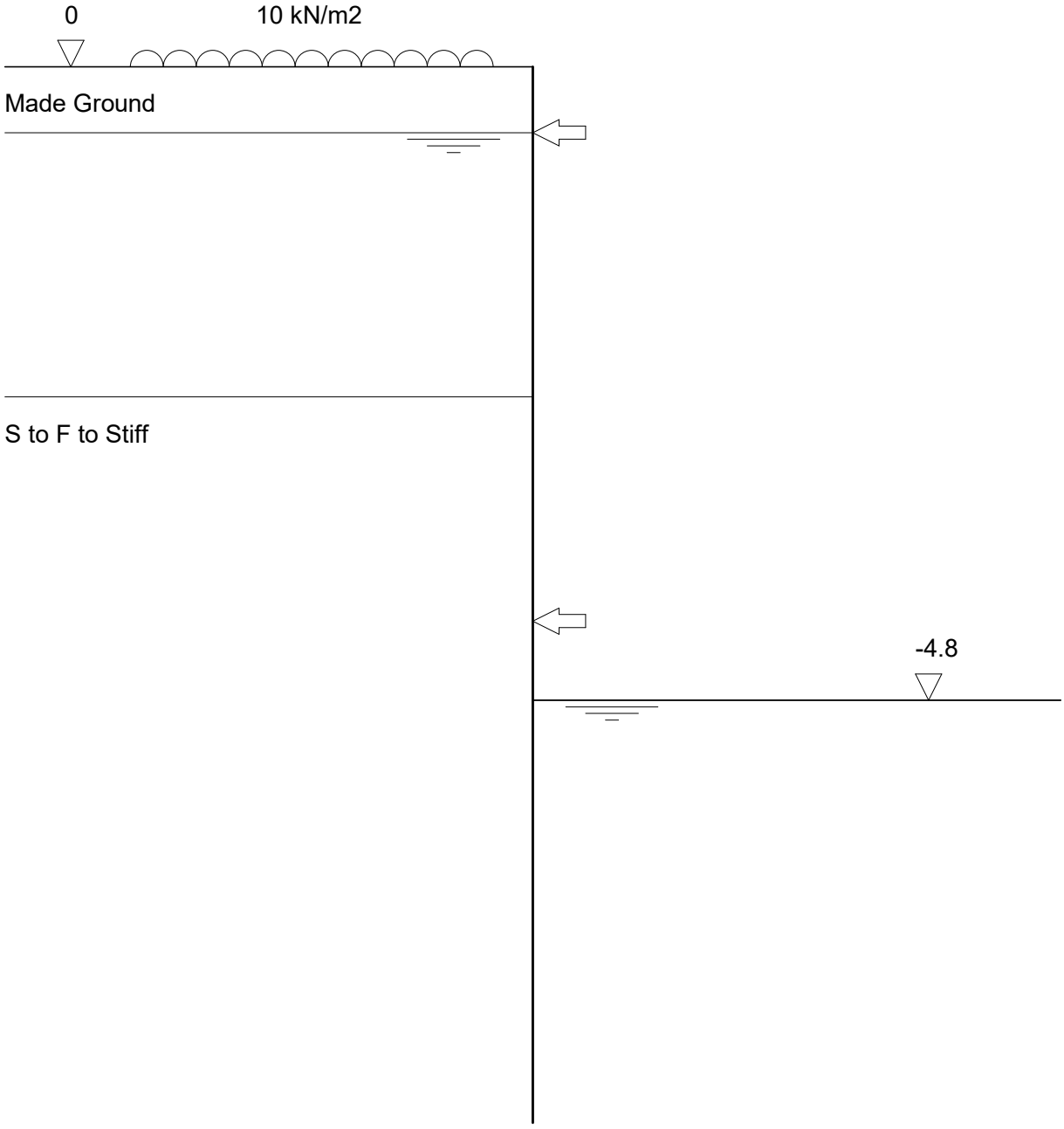


Bending Moment Diagram (kNm/m)



Shear Force Diagram (kN/m)

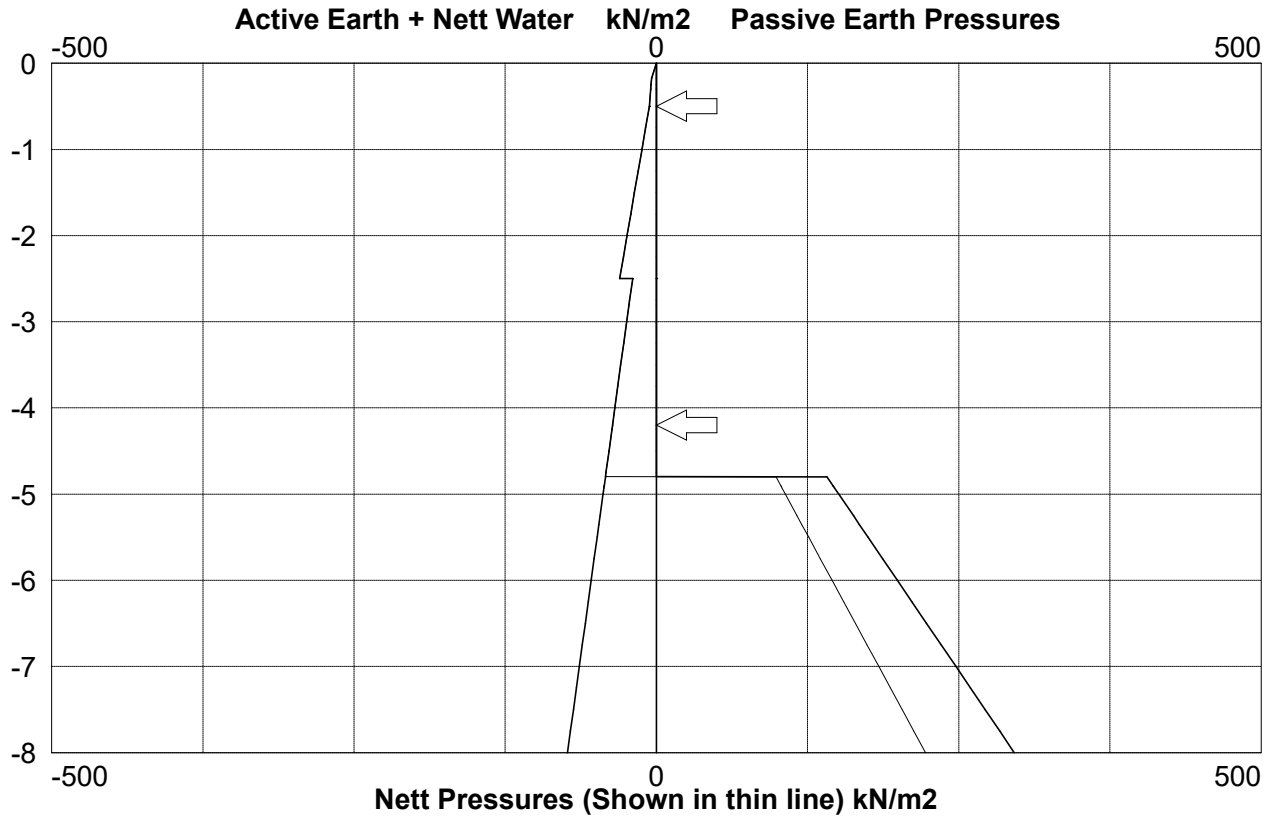
Stage ref. **7**
Stage type **Insert prop**

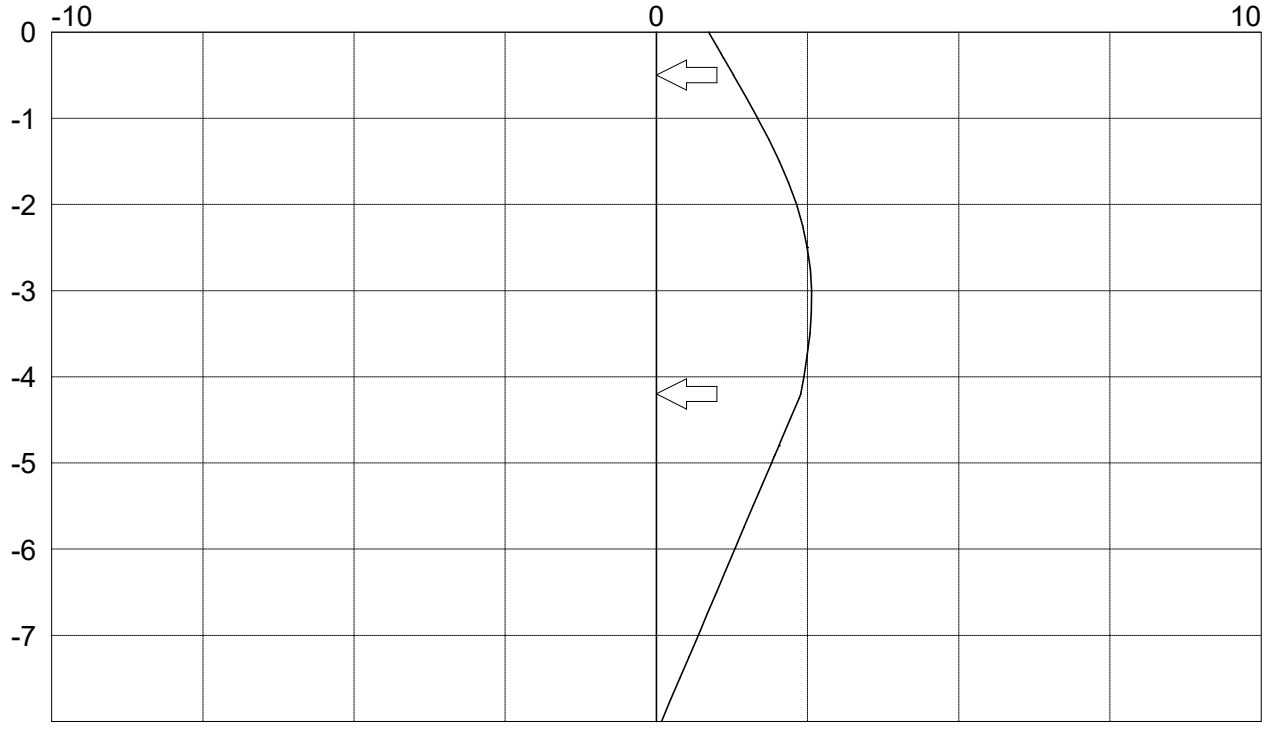


Tabular results from analysis of stage ref 7

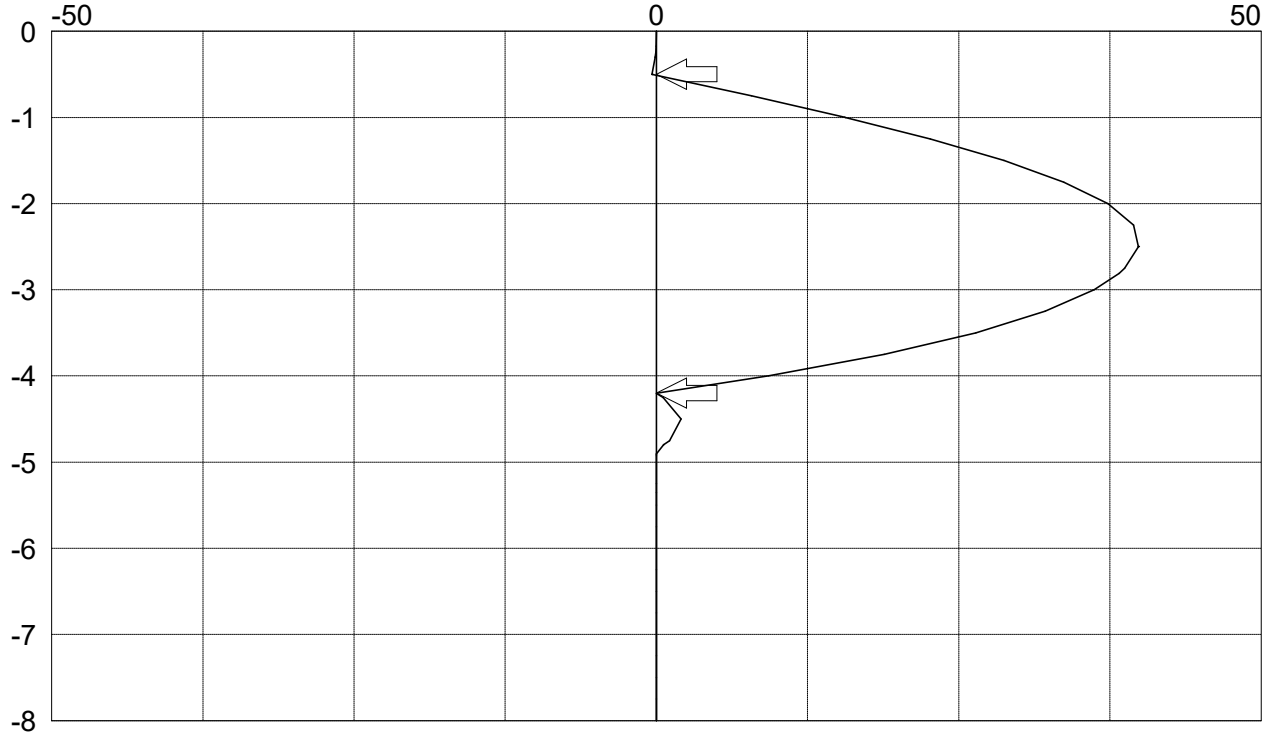
Calc Level m	Active Vert kN/m2	Active Earth kN/m2	Active Water kN/m2	Pas' Vert kN/m2	Pas' Earth kN/m2	Pas' Water kN/m2	Total Nett kN/m2	Bend. Moment kNm/m	Shear Force kN/m	Defl't mm	Prop Force kN/m	FOS
.00	.0	.0	.0	.0	.0	.0	0	0	0	.9		.00
-.17	13.1	4.0	.0	.0	.0	.0	4.0	0	-.3	1.0		.00
-.30	15.4	4.7	.0	.0	.0	.0	4.7	.1	-.9	1.1	.0	.00
-.30	15.4	4.7	.0	.0	.0	.0	4.7	.1	-.9	1.1		.00
-.50	19.0	5.8	.0	.0	.0	.0	5.8	.4	-1.9	1.3	36.1	.00
-.50	19.0	5.8	.0	.0	.0	.0	5.8	.4	34.1	1.3		.00
-1.00	23.1	7.0	4.9	.0	.0	.0	11.9	-15.6	29.7	1.7		.00
-1.00	23.1	7.0	4.9	.0	.0	.0	11.9	-15.6	29.7	1.7		.00
-2.00	31.3	9.5	14.7	.0	.0	.0	24.2	-37.3	11.6	2.3		.00
-2.50	35.4	10.8	19.6	.0	.0	.0	30.4	-39.9	-2.0	2.5		.00
w -2.50	55.0	.0	19.6	.0	.0	.0	19.6	-39.9	-2.0	2.5		.00
w -2.50	55.0	.0	19.6	.0	.0	.0	19.6	-39.9	-2.1	2.5		.00
w -2.81	60.9	.0	22.6	.0	.0	.0	22.6	-38.3	-8.6	2.6		.00
w -3.00	64.5	.0	24.5	.0	.0	.0	24.5	-36.2	-13.0	2.6		.00
w -4.00	83.5	.0	34.3	.0	.0	.0	34.3	-9.3	-42.4	2.4		.00
w -4.20	87.3	.0	36.3	.0	.0	.0	36.3	-.1	-49.5	2.4	62.0	.00
w -4.20	87.3	.0	36.3	.0	.0	.0	36.3	0	12.4	2.4		.00
w -4.80	98.7	.0	42.1	.0	.0	.0	42.1	-.6	-10.9	2.0		.00
w -4.80	98.7	.0	42.1	.0	141.1	.0	-99.0	-.6	-10.9	2.0		.01
w -4.90	100.7	.0	43.2	2.0	146.1	.0	-103.0	0	-.4	2.0		.97
w -4.91	100.8	.0	43.2	2.1	146.4	.0	-103.2	0	0	2.0		1.01
w -4.93	101.1	.0	43.4	2.4	147.2	.0	-103.8	0	0	1.9		1.10
w -5.00	102.5	.0	44.1	3.8	150.8	.0	-106.7	0	0	1.9		1.55
w -5.35	109.2	.0	47.5	10.5	167.8	.0	-120.3	0	0	1.7		2.60
w -6.00	121.5	.0	53.9	22.8	199.2	.0	-145.3	0	0	1.3		3.24
w -7.00	140.5	.0	63.7	41.8	247.6	.0	-183.9	0	0	.7		3.60
w -8.00	159.5	.0	73.5	60.8	296.0	.0	-222.5	0	0	.1		3.79

Graphical results from analysis of stage ref 7

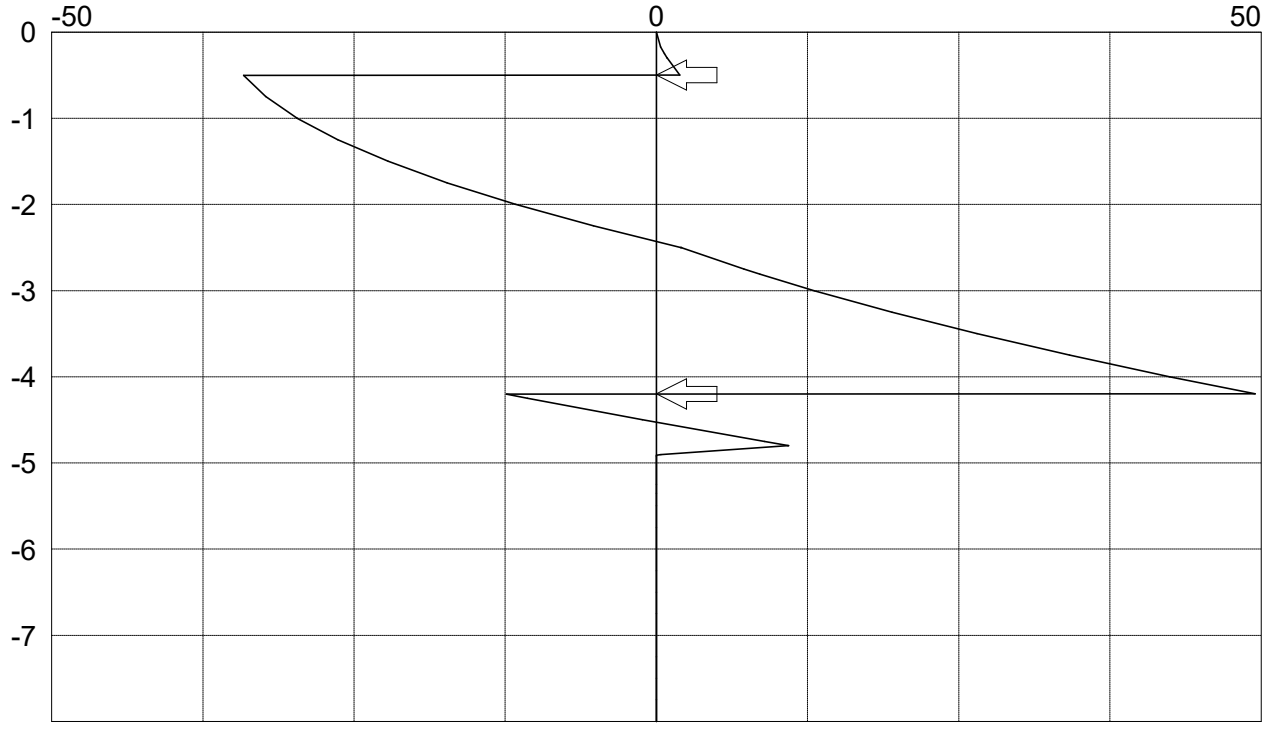




Graphical results from analysis of stage ref 7 continued

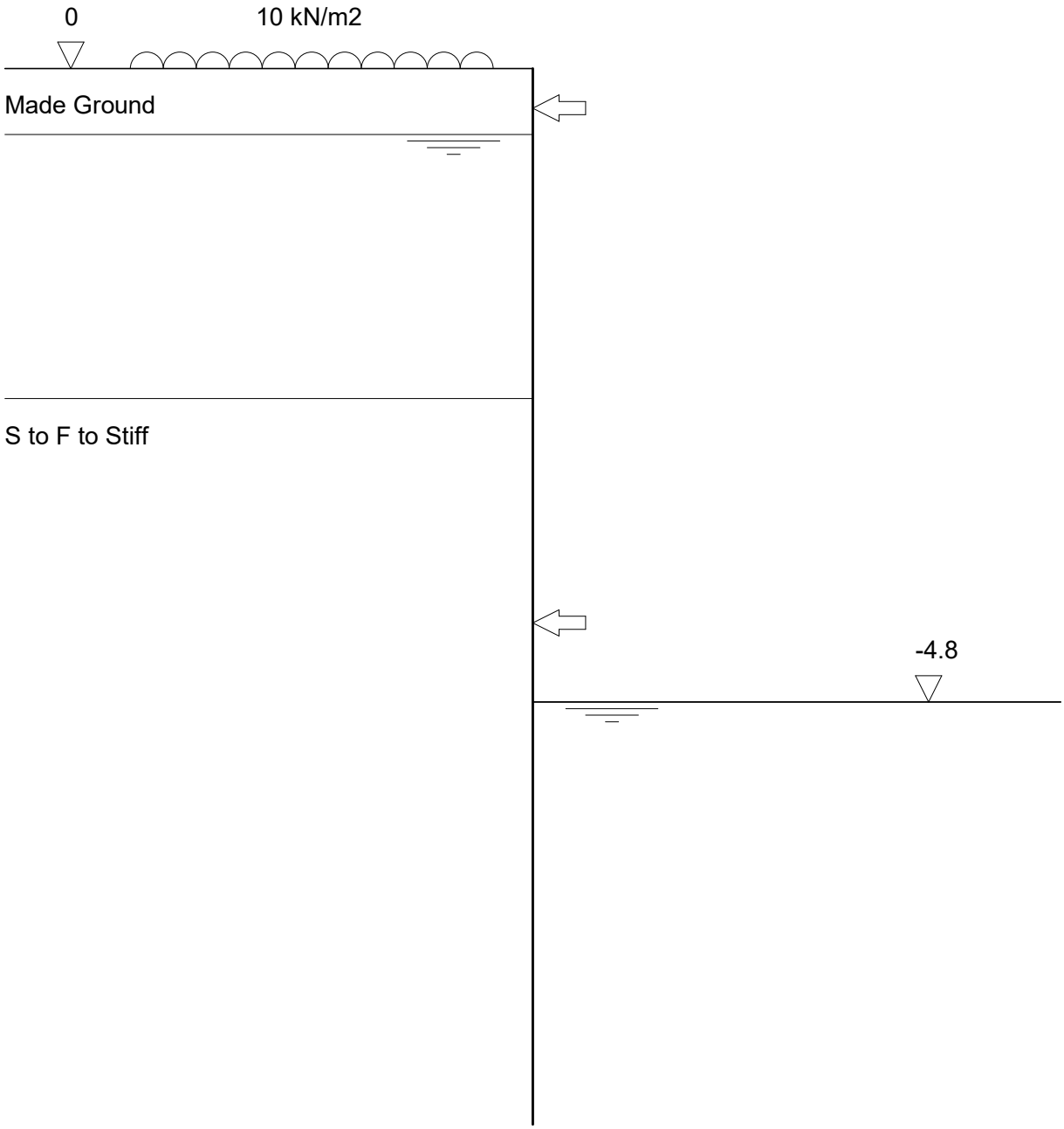


Bending Moment Diagram (kNm/m)



Shear Force Diagram (kN/m)

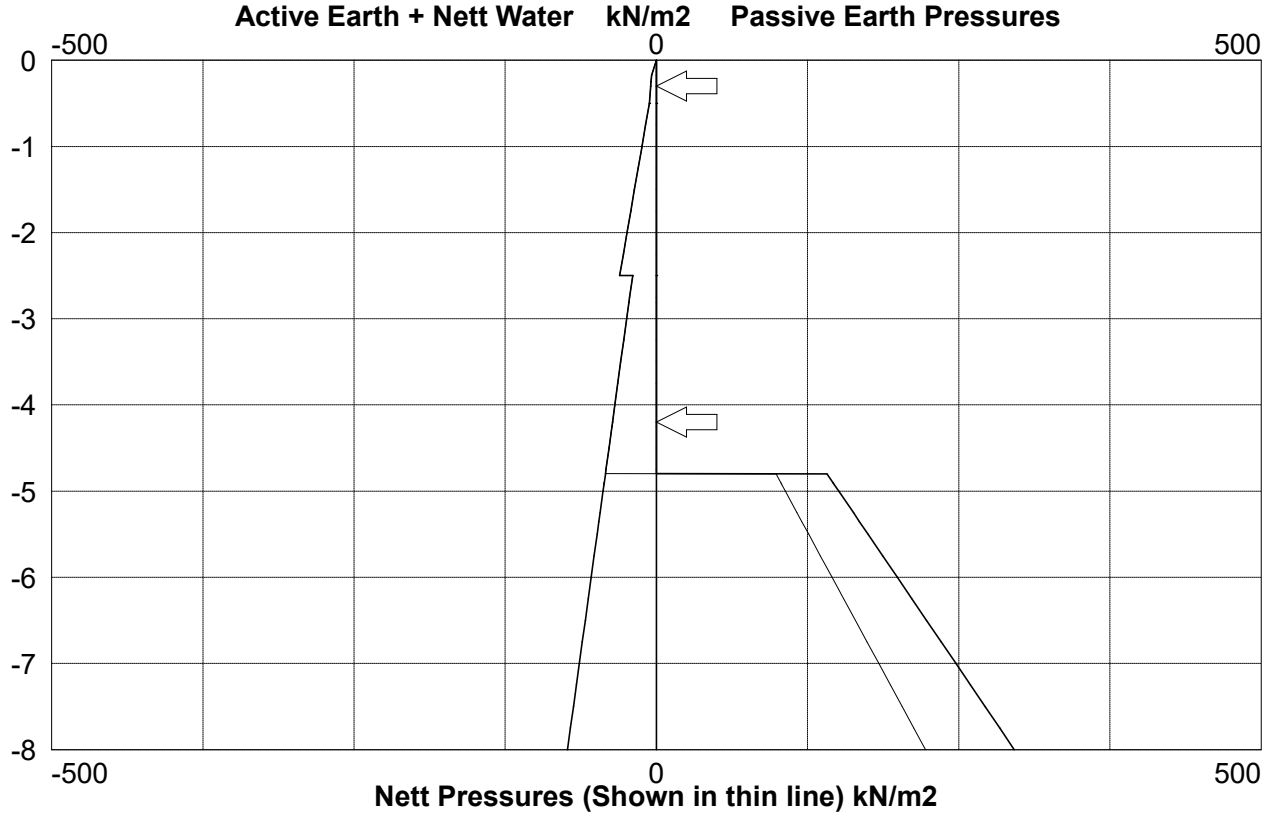
Stage ref. **9**
Stage type **Remove prop**

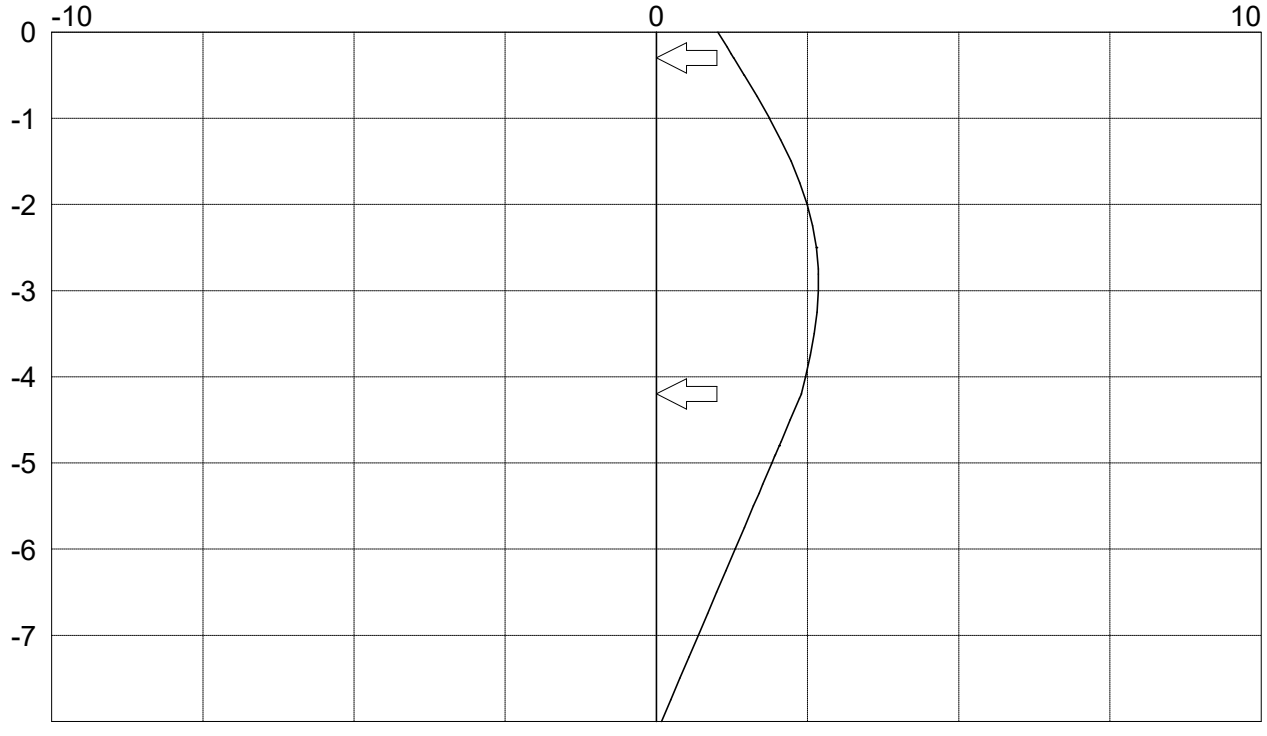


Tabular results from analysis of stage ref 9

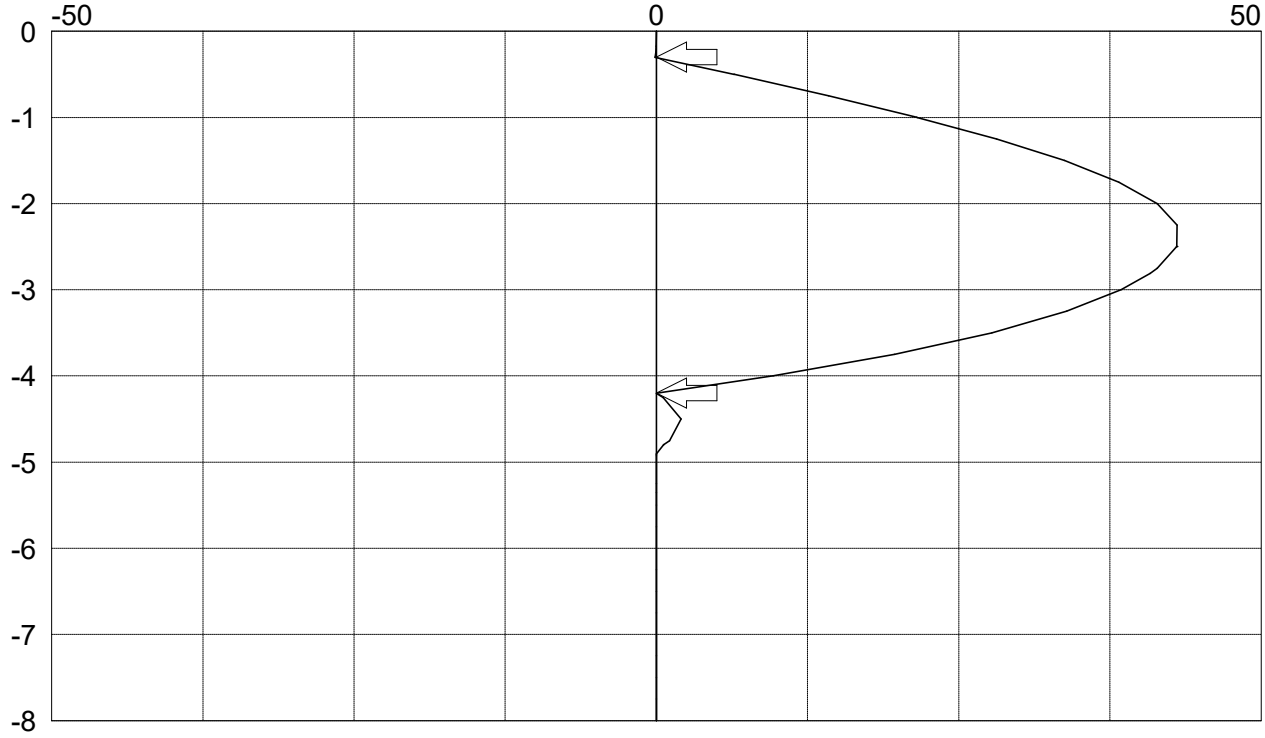
Calc Level m	Active Vert kN/m2	Active Earth kN/m2	Active Water kN/m2	Pas' Vert kN/m2	Pas' Earth kN/m2	Pas' Water kN/m2	Total Nett kN/m2	Bend. Moment kNm/m	Shear Force kN/m	Defl't mm	Prop Force kN/m	FOS
.00	.0	.0	.0	.0	.0	.0	0	0	0	1.0		.00
-.17	13.1	4.0	.0	.0	.0	.0	4.0	0	-.3	1.2		.00
-.30	15.4	4.7	.0	.0	.0	.0	4.7	.1	-.9	1.3	34.2	.00
-.30	15.4	4.7	.0	.0	.0	.0	4.7	.1	33.3	1.3		.00
-.50	19.0	5.8	.0	.0	.0	.0	5.8	-6.4	32.3	1.5	.0	.00
-.50	19.0	5.8	.0	.0	.0	.0	5.8	-6.5	32.3	1.5		.00
-1.00	23.1	7.0	4.9	.0	.0	.0	11.9	-21.5	27.9	1.9		.00
-1.00	23.1	7.0	4.9	.0	.0	.0	11.9	-21.6	27.9	1.9		.00
-2.00	31.3	9.5	14.7	.0	.0	.0	24.2	-41.4	9.8	2.5		.00
-2.50	35.4	10.8	19.6	.0	.0	.0	30.4	-43.0	-3.9	2.6		.00
w -2.50	55.0	.0	19.6	.0	.0	.0	19.6	-43.0	-3.9	2.6		.00
w -2.50	55.0	.0	19.6	.0	.0	.0	19.6	-43.0	-3.9	2.6		.00
w -2.81	60.9	.0	22.6	.0	.0	.0	22.6	-40.8	-10.4	2.7		.00
w -3.00	64.5	.0	24.5	.0	.0	.0	24.5	-38.4	-14.9	2.7		.00
w -4.00	83.5	.0	34.3	.0	.0	.0	34.3	-9.7	-44.3	2.5		.00
w -4.20	87.3	.0	36.3	.0	.0	.0	36.3	-.1	-51.3	2.4	63.8	.00
w -4.20	87.3	.0	36.3	.0	.0	.0	36.3	0	12.4	2.4		.00
w -4.80	98.7	.0	42.1	.0	.0	.0	42.1	-.6	-10.9	2.0		.00
w -4.80	98.7	.0	42.1	.0	141.1	.0	-99.0	-.6	-10.9	2.0		.01
w -4.90	100.7	.0	43.2	2.0	146.1	.0	-103.0	0	-.4	2.0		.97
w -4.91	100.8	.0	43.2	2.1	146.4	.0	-103.2	0	0	2.0		1.01
w -4.93	101.1	.0	43.4	2.4	147.2	.0	-103.8	0	0	2.0		1.11
w -5.00	102.5	.0	44.1	3.8	150.8	.0	-106.7	0	0	1.9		1.55
w -5.35	109.2	.0	47.5	10.5	167.8	.0	-120.3	0	0	1.7		2.60
w -6.00	121.5	.0	53.9	22.8	199.2	.0	-145.3	0	0	1.3		3.24
w -7.00	140.5	.0	63.7	41.8	247.6	.0	-183.9	0	0	.7		3.60
w -8.00	159.5	.0	73.5	60.8	296.0	.0	-222.5	0	0	.1		3.79

Graphical results from analysis of stage ref 9

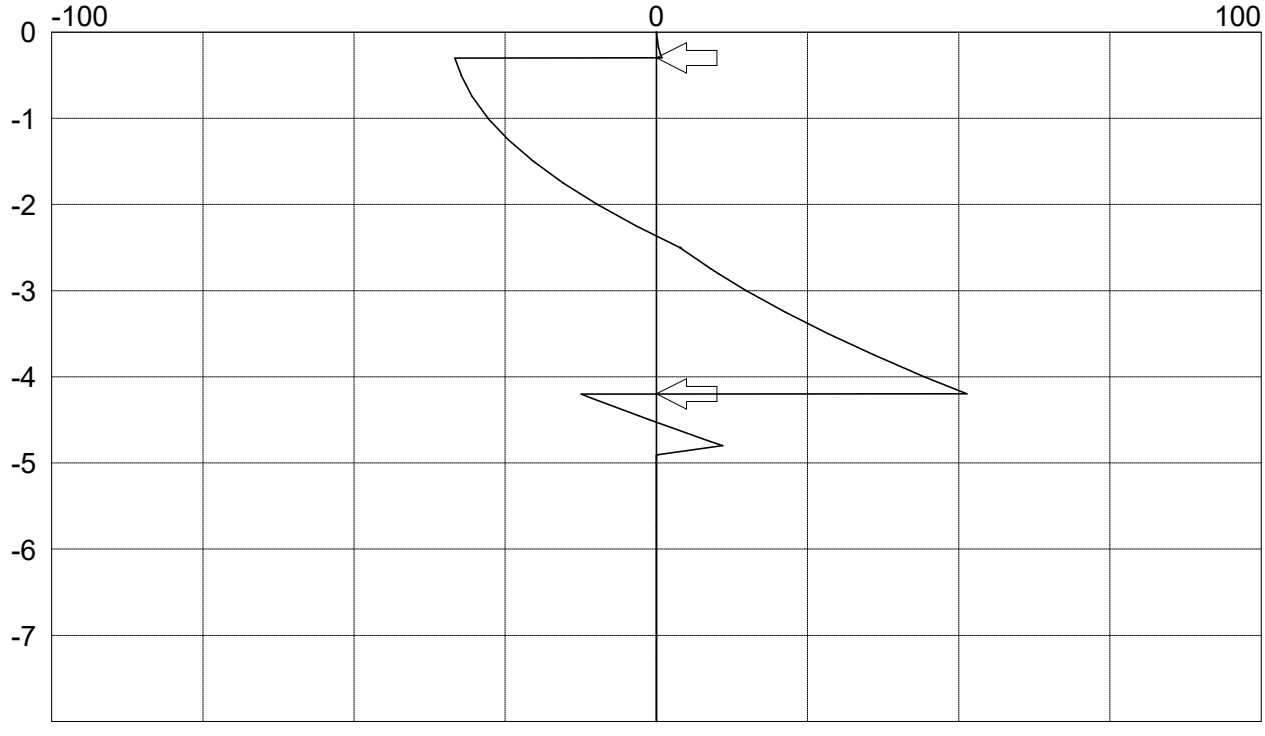




Graphical results from analysis of stage ref 9 continued

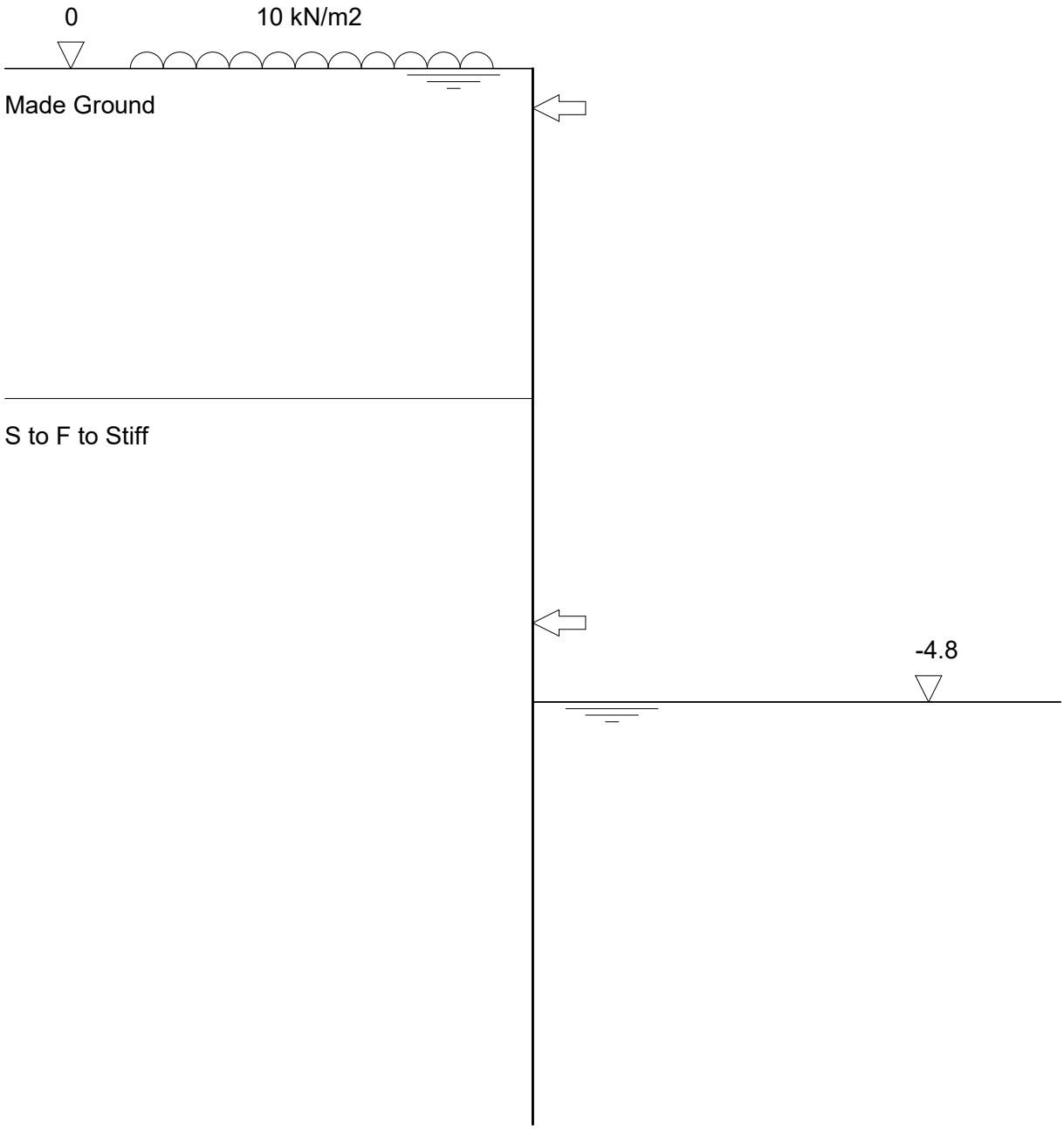


Bending Moment Diagram (kNm/m)



Shear Force Diagram (kN/m)

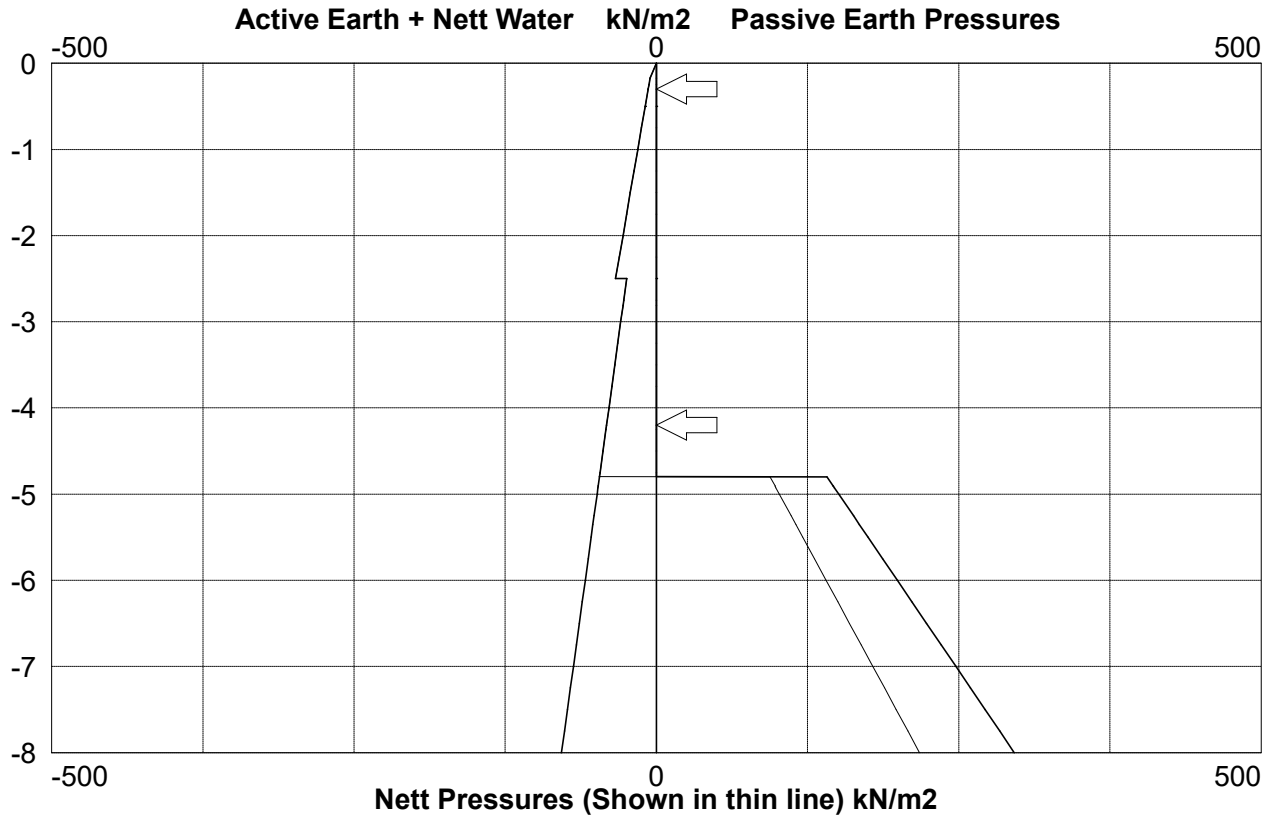
Stage ref. **10**
Stage type **Active water level**

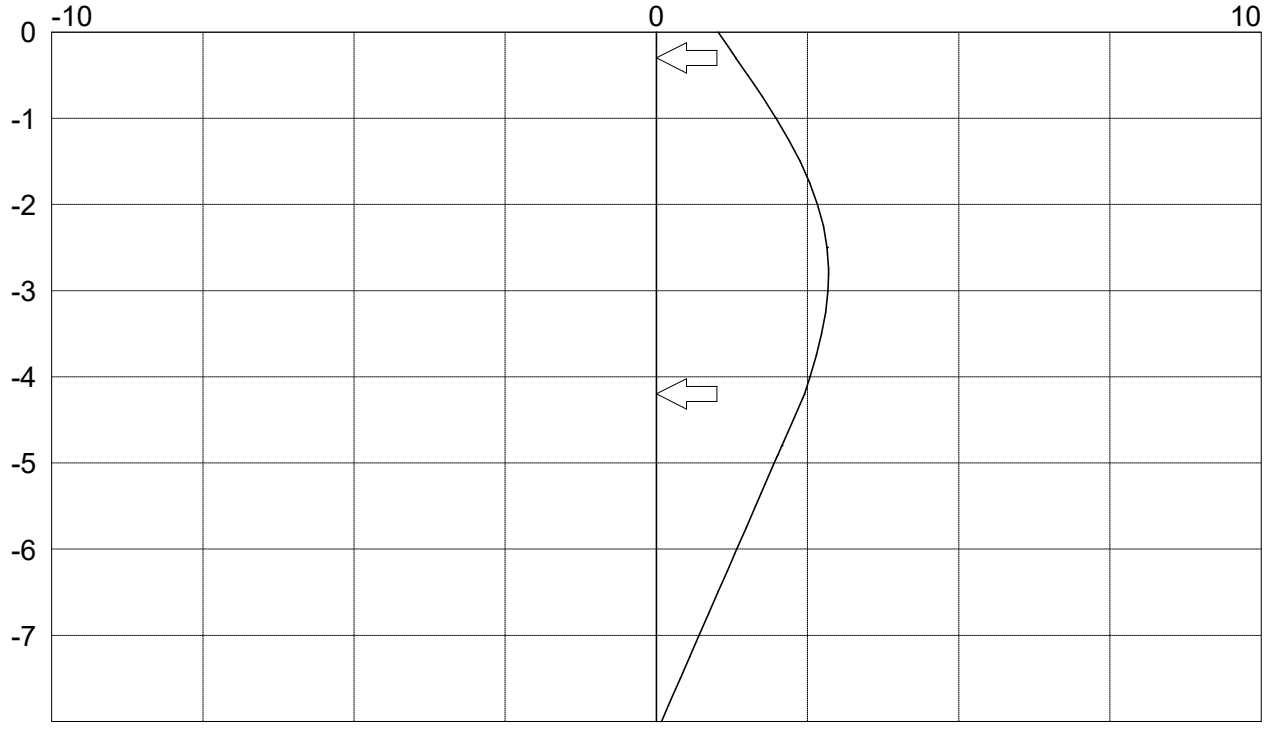


Tabular results from analysis of stage ref 10

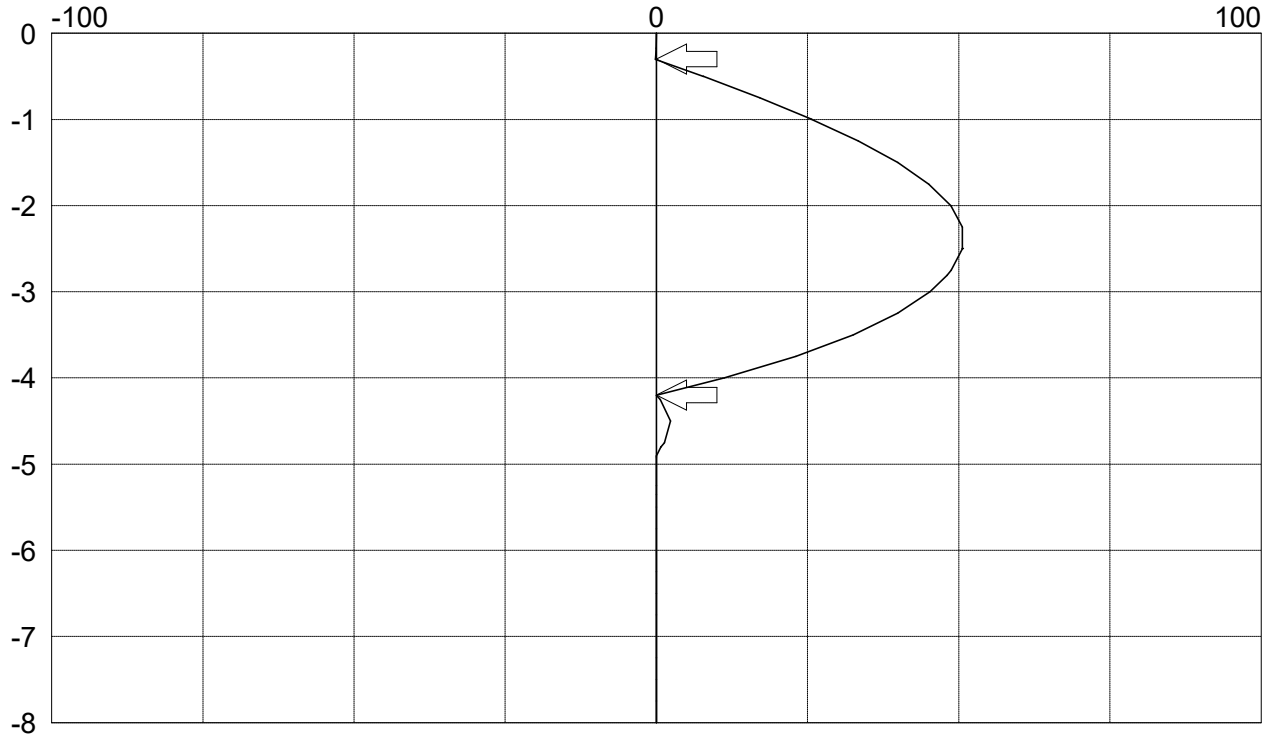
Calc Level m	Active Vert kN/m2	Active Earth kN/m2	Active Water kN/m2	Pas' Vert kN/m2	Pas' Earth kN/m2	Pas' Water kN/m2	Total Nett kN/m2	Bend. Moment kNm/m	Shear Force kN/m	Defl't mm	Prop Force kN/m	FOS
.00	.0	.0	.0	.0	.0	.0	0	0	0	1.0		.00
-.17	11.4	3.5	1.7	.0	.0	.0	5.2	0	-.4	1.2		.00
-.30	12.5	3.8	2.9	.0	.0	.0	6.7	.1	-1.2	1.3	41.6	.00
-.30	12.5	3.8	3.0	.0	.0	.0	6.8	.1	40.4	1.3		.00
-.50	14.1	4.3	4.9	.0	.0	.0	9.2	-7.7	38.8	1.5	.0	.00
-.50	14.1	4.3	4.9	.0	.0	.0	9.2	-7.8	38.8	1.5		.00
-1.00	18.2	5.5	9.8	.0	.0	.0	15.3	-25.7	32.7	2.0		.00
-1.00	18.2	5.5	9.8	.0	.0	.0	15.3	-25.7	32.7	2.0		.00
-2.00	26.4	8.0	19.6	.0	.0	.0	27.6	-48.7	11.2	2.7		.00
-2.50	30.5	9.3	24.5	.0	.0	.0	33.8	-50.6	-4.1	2.8		.00
w -2.50	55.0	.0	24.5	.0	.0	.0	24.5	-50.6	-4.1	2.8		.00
w -2.50	55.0	.0	24.5	.0	.0	.0	24.5	-50.6	-4.2	2.8		.00
w -2.81	60.9	.0	27.5	.0	.0	.0	27.5	-48.1	-12.2	2.8		.00
w -3.00	64.5	.0	29.4	.0	.0	.0	29.4	-45.3	-17.6	2.8		.00
w -4.00	83.5	.0	39.2	.0	.0	.0	39.2	-11.3	-51.9	2.5		.00
w -4.20	87.3	.0	41.2	.0	.0	.0	41.2	-.1	-60.0	2.5	74.2	.00
w -4.20	87.3	.0	41.2	.0	.0	.0	41.2	0	14.2	2.4		.00
w -4.80	98.7	.0	47.0	.0	.0	.0	47.0	-.8	-12.1	2.1		.00
w -4.80	98.7	.0	47.0	.0	141.1	.0	-94.1	-.8	-12.1	2.1		.01
w -4.90	100.7	.0	48.1	2.0	146.1	.0	-98.1	0	-2.1	2.0		.87
w -4.91	100.8	.0	48.1	2.1	146.4	.0	-98.3	0	-1.5	2.0		.91
w -4.93	101.1	.0	48.3	2.4	147.2	.0	-98.9	0	0	2.0		.99
w -5.00	102.5	.0	49.0	3.8	150.8	.0	-101.8	0	0	2.0		1.38
w -5.35	109.2	.0	52.4	10.5	167.8	.0	-115.4	0	0	1.7		2.34
w -6.00	121.5	.0	58.8	22.8	199.2	.0	-140.4	0	0	1.3		2.94
w -7.00	140.5	.0	68.6	41.8	247.6	.0	-179.0	0	0	.7		3.30
w -8.00	159.5	.0	78.4	60.8	296.0	.0	-217.6	0	0	.1		3.51

Graphical results from analysis of stage ref 10

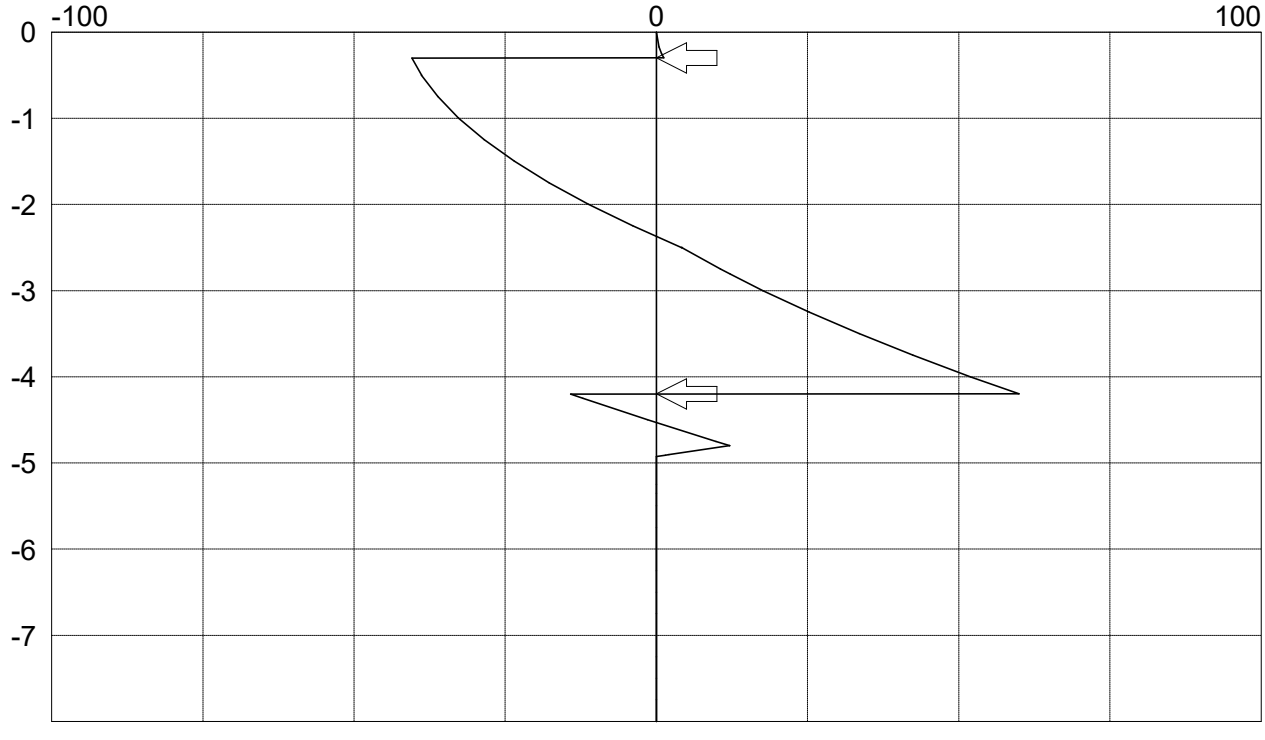




Graphical results from analysis of stage ref 10 continued

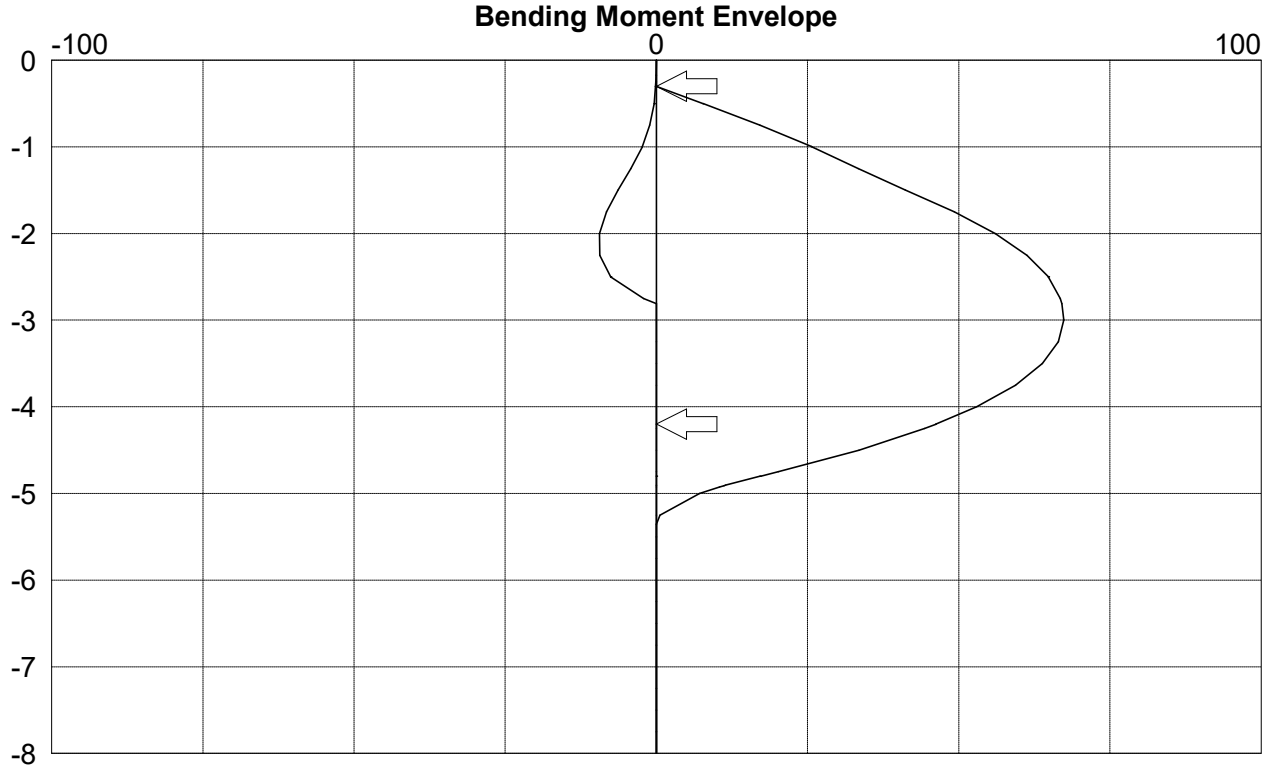


Bending Moment Diagram (kNm/m)



Shear Force Diagram (kN/m)

Graphical plot of envelope from selected construction stages



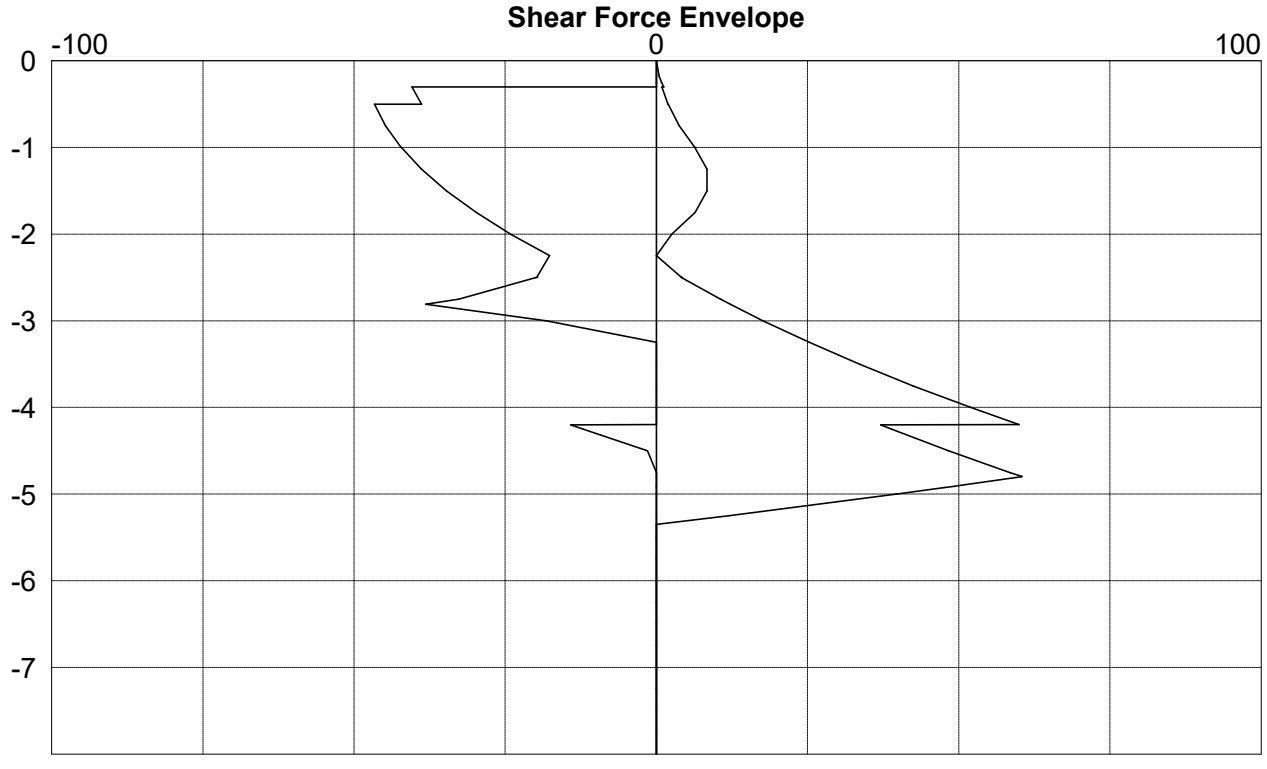


Table of envelope for wall forces

Calc Level m	Bending Minimum kNm/m	Bending Maximum kNm/m	Shear Minimum kN/m	Shear Maximum kN/m	Prop Force kN/m
.00	.0	.0	.0	.0	
-.17	.0	.0	-.4	.0	
-.30	.0	.1	-1.2	.0	41.6
-.30	.0	.1	-.9	40.4	
-.50	-7.7	.4	-1.9	38.8	48.6
-.50	-7.8	.4	-2.0	46.6	
-1.00	-25.7	2.3	-6.3	42.2	
-1.00	-25.7	2.3	-6.4	42.2	
-2.00	-56.0	9.4	-2.5	24.1	
-2.50	-64.8	7.6	-4.1	19.8	
-2.50	-64.8	7.5	-4.1	19.8	
-2.50	-64.8	7.5	-4.2	20.0	
-2.81	-67.1	.0	-12.2	38.2	
-3.00	-67.4	.0	-17.6	18.1	
-4.00	-53.0	.0	-51.9	.0	
-4.20	-46.3	.0	-60.0	.0	74.2
-4.20	-46.2	.0	-37.1	14.2	
-4.80	-17.3	.0	-60.4	.0	
-4.80	-17.2	.0	-60.4	.0	
-4.90	-11.4	.0	-49.9	.0	
-4.91	-11.2	.0	-49.3	.0	
-4.93	-10.5	.0	-47.6	.0	
-5.00	-7.1	.0	-39.8	.0	
-5.35	.0	.0	.0	.0	
-6.00	.0	.0	.0	.0	
-7.00	.0	.0	.0	.0	
-8.00	.0	.0	.0	.0	

Structural design of wall

Wall section properties

Primary pile diameter	450	mm
Primary pile spacing	600	mm
Infill pile diameter		mm
Main rebar bar diameter	20	mm
Main rebar number of bars	6	
Links/Helix bar diameter	10	mm
Links/Helix spacing/pitch	175	mm

Wall material properties

Concrete cube strength	35	N/mm2
Concrete cover	50	mm
Main rebar steel grade	500	N/mm2
Link rebar steel grade	500	N/mm2
Ultimate load factor	1.50	

Wall structural design checks

Check description	Required or Limit	Provided or Actual	Units
Bending resistance. BS8110 plane strain analysis	61	118	kNm
Max longitudinal steel. BS8110 max 6% by area	9543	1885	mm2
Min longitudinal steel. BS8110 min 0.4% by area	636	1885	mm2
Shear resistance. BS8110	54	172	kN
Min link dia. BS8110 6mm or 0.25x bar dia	6	10	mm
Max link spacing. BS8110 12x main bar dia or 0.75d	192	175	mm
Min shear link area. BS8110 Clause 3.4.5	247	898	mm2/m