



GEOMAN

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A&G Vertica Retaining Wall

Location Address:	Siemens Mobility, South Business Park, Chippenham
Date:	05.09.25
Geoman Design Reference Number:	25-5980-F1

Issued to	Issue purpose	Revision	Designed	Prepared	Checked	Date
McDermotts	For Comment- Not for Construction	0	AMcK	HM		05.09.25

This design is in accordance with the principles set out in current British Standards, Codes of Practice and industry specification. Reference to a particular standard, code of practice or specification does not imply total compliance with the whole of the document only that they are complied with where considered appropriate, in the experience of the designer.

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Contents

1.0	Introduction.....	3
1.1	Brief.....	3
1.2	Scope.....	3
1.3	Relevant Parties	4
1.4	Information	4
2.0	Ground Conditions/Design Parameters	5
2.1	Backfill.....	6
2.1.1	Reinforced backfill	6
2.2	Surcharge Loads	6
2.3	Crest/ Toe Slopes	6
2.4	Drainage	6
3.0	Analysis.....	7
3.1	Design Model	7
3.2	Method of Analysis	7
4.0	Summary.....	8
5.0	Construction Supervision Requirements.....	9
6.0	Maintenance Requirements.....	10
7.0	CDM Regulations	11
7.1	SIGNIFICANT DESIGN RISKS REMAINING:	12
8.0	Designer Risk Assessment	14
9.0	Appendices	15



1.0 Introduction

1.1 Brief

McDermott's requested that Geoman Ltd. carry out a design for Vertica retaining wall as element of the permanent works at the proposed development at Siemens Mobility, South Business Park, Chippenham.

1.2 Scope

This design covers the proposed Vertica Wall as shown on the plan on Geoman Ltd. drawing number SK25-5980-F1-01.

The limits of the A&G Vertica walls design are the reinforced soil backfill zone extending from the front face of the base course of facing blocks to the back of the geogrid tails, and up to ground level at the back of the earth fill of the upper course.

The most onerous cross-sections have been considered in the design as follows:

- Section 1A-1A: Vertica retaining wall with a maximum retained height of 1.2m, constructed with geogrid reinforced granular backfill. There is assumed to be a max. -1V:4.2H crest slope and no toe slope. Refer to Section 1A-1A on SK25-5980-F1-01.
- Section 1B-1B: Vertica retaining wall with a maximum retained height of 2.4m, constructed with geogrid reinforced granular backfill. There is assumed to be a max. -1V:4.2H crest slope and no toe slope. Refer to Section 1B-1B on SK25-5980-F1-01.

For the above sections:

- A minimum 150mm diameter perforated drainage pipe is to be placed at the rear of the wall, with a fall to a suitable outlet. The drainage pipe is to be fully jettable and regularly maintained. This should be roddable and connected to appropriate site drainage outlet with consent to discharge. Given the length of the walls intermediate outlets/ rodding points should be provided at minimum 40m spacings along the wall and at all low points along the elevation to ensure the full length of drain can be positively discharged and fully maintained. Site drainage is outside the scope of this design.
- Some settlement will occur after construction, depending on the compaction and condition of the backfill placed.
- There is allowance for unforeseen future excavation in front of the wall of 10% of its height, in accordance with BS EN 1997-1:2004 Eurocode 7.
- A maximum live load of 5kN/m² was assumed to act on the retained side of the wall. Please advise if higher loads should be considered and we will revise this design. (such as if a piling rig).
- It has been assumed it is proposed to install a 1.8m high fence to the top of the wall as pedestrian restraint (design and details are by others). The posts must be fully concreted into minimum 1.0m long, 0.3m Ø sleeves pre-installed into the wall backfill. The geogrid tails can be locally cut to accommodate the fence post sleeves. If a higher fence is to be installed behind the wall, Geoman must be advised as the foundation detail will need to be revised to cater for increased lateral loading.
- Temporary excavations have the potential to collapse rapidly and without warning. The retaining walls' solution is for the permanent works only and is on the basis that a safe system of works is provided for construction. The Principal Contractor should provide a method statement for the works to satisfy the Client's Consulting Engineer. Geoman Ltd. is not responsible for temporary stability or design of any temporary works.



Geoman Ltd.	Project:	Ref:	Date:	Rev:
Vertica Wall	Siemens Mobility, South Business Park, Chippenham	25-5980-F1	05.09.25	0

- The Principal Contractor must contact the Client's Consulting Engineer to ensure that any earthworks required for the proposed retaining wall does not affect the stability of any surrounding existing or proposed services or structures. Unless the Client's Consulting Engineer accepts this, it is recommended that construction does not proceed.
- The Client/ Client's Consulting Engineer must check to see if any statutory approvals such as Technical Approval, NHBC Approval, Geotechnical Certification are required for the retaining wall. If approvals are required, these must be gained before construction. Any approval work is outside the scope of this design. Proceeding without approval is the Client's risk. Geoman cannot be held responsible for failure to obtain Technical Approval.

All slope geometry, setting out and required offsets are to be confirmed by the Principal Contractor prior to construction. The Principal Contractor and Client's Consulting Engineer must also confirm the locations of all services prior to construction and ensure that none will be affected by the Vertica retaining wall and their installation.

The Principal Contractor must contact the Client's Consulting Engineer to ensure that any earthworks required for the proposed retaining wall do not affect the stability of any surrounding existing or proposed structures. Unless the Client's Consulting Engineer accepts this, it is recommended that construction does not proceed.

Any solution outside this scope is not covered by this design and Geoman Ltd. should be informed so that a new design can be advised as necessary. Site drainage is outside the scope of this design.

1.3 Relevant Parties

- A&G is the material supplier.
- Client's Consulting Engineer is to be confirmed.
- McDermotts is our Client and the Principal Contractor.
- The wall installer is to be confirmed.

The above parties should all read and check this design document before proceeding. **Please advise us before proceeding with construction if there are any errors in the scope.**

1.4 Information

This design package is based on the information provided to Geoman Ltd. as follows:

- PDF Files:
 - ENV - 59341 - Gabion Wall Construction Issue Design Report Rev 00(Approved)
 - ENV_Scn4_BAW_GEO_NW15-10.15
 - Q59341-01 - Siemens Mobility, Chippenham
 - QD58 Design Terms ISSUE 1
 - SMC-ENV-XX-XX-DR-G-00001 Rev P00 Gabion Wall Design Proposal A3 (CODES)
 - TD51 ENV-BAW-GF4-GAB Ver 03 Feb 25



2.0 Ground Conditions/Design Parameters

The Client's Consulting Engineer and Principal Contractor must ensure that all parameters used comply with those found on site. Any variance in these must be reported to Geoman Ltd. immediately so that the implications can be assessed.

Stantec 2020 Ground Condition Assessment Report includes the logs relevant to the design of the proposed development at Siemens Mobility, South Business Park, Chippenham. The logs generally indicate that formation level of the wall will be within Cornbrash Formation (Weathered Limestone). A minimum effective angle of internal friction of 25 degrees was assumed for Cornbrash Formation (Weathered Limestone).

The soil parameters assumed in the design are therefore based on the above as follows:

Material	Description	Unit Weight (kN/m ³)	Assumed Effective Angle of Internal Friction	Cohesion (kN/m ²)
Foundation	Cornbrash Formation (Weathered Limestone)	22.0	25°	0
Retained	Kellaway CLAY	19.0	22°	0

To achieve a suitable foundation for the wall, excavation must take place down to the levels indicated on the drawing and allow for the placement of a minimum 300mm deep levelling pad formed on Cornbrash Formation (Weathered Limestone).

The Principal Contractor must appoint a geotechnical specialist to inspect and test the suitability of the founding material - assumed to be Cornbrash Formation (Weathered Limestone) with a minimum safe bearing resistance of 80kPa and an undrained shear strength in excess of 45kPa (if cohesive). This should be confirmed via plate bearing testing prior to construction. Hand shear vane tests would be suitable for cohesive material or plate load tests carried out to BS1377-9 Incremental load test, Cl4.1.6.4.2. would be suitable for either cohesive or granular material. A minimum 600mm diameter plate should be loaded to at least 200kPa in 40kPa increments. If any material with an undrained shear strength <45kPa is left in place at or below formation level, excessive settlement and/ or global instability may occur.

Any soft/loose or unsuitable material (such as soft clay, alluvium or peat) present at or below formation level must be excavated out down to Cornbrash Formation (Weathered Limestone) and replaced with concrete or compacted Class 6F2 granular fill.

Construction must not commence until the Contractor has written confirmation from a local geotechnical specialist that the proposed formation level is competent and achieves the required safe bearing resistance.



2.1 Backfill

2.1.1 Reinforced backfill

The reinforced backfill for the wall shall comprise a selected compacted granular fill material which complies with Class 6I of the Manual of Contract Documents for Highway Works, SFHW, Series 600. This material is assumed to have the following characteristics: $\Phi_i' = 35$ degrees, $\Gamma = 19\text{kN/m}^3$ and $c' = 0\text{ kPa}$, compacted in accordance with SFHW Series 600. The Principal Contractor is responsible for the selection of this material to ensure compliance with the geotechnical characteristics as shown on the relevant drawings and in the design documents/ calculations.

The soil parameters assumed for the imported fill in the design calculations are as follows:

<i>Class of Fill (MCHW vol. 1, Series 600)</i>	<i>Description</i>	<i>Use</i>	<i>Unit Weight (kN/m^3)</i>	<i>Effective Angle of Internal Friction</i>	<i>Cohesion (kN/m^2)</i>
Class 6I	Selected well graded granular material	Reinforced backfill	19.0	35°	0

2.2 Surcharge Loads

A maximum live load of 5kN/m^2 was assumed to act on the retained side of the wall. Please advise if higher loads (such as for a piling rig) should be considered and we will revise this design.

2.3 Crest/ Toe Slopes

Refer to Geoman Ltd. drawing numbers SK25-5980-F1-01.

2.4 Drainage

Standard Vertica Wall drainage detail is to be formed behind the facing blocks, as shown on the sections. This is to comprise a 300mm width of free draining aggregate (CLASS 6H) behind the blocks (with block voids filled with same material). A 150mm $\varnothing$ rigid PVC perforated drain pipe should be placed along the full length of the wall at the base of the drainage column. This should be roddable and connected to appropriate site drainage outlet with consent to discharge.

Intermediate discharge/ rodding points at maximum 40m spacings required to ensure the full length of the wall drainage can be positively drained and maintained.

The installation area must be well drained to provide a stable area of works for the wall installer. The excavated slopes should be checked for any flows or seepage that require drainage measures. Any flows, seepage or standing water must be directed to a suitable outfall as soon as they are encountered. Permanent and maintained site drainage should be installed to ensure the wall remain in a fully drained condition for the design life of the structures. Site drainage is outside the scope of this design. Temporary drainage measures should be installed to direct surface water away from the line of wall and also to prevent “ponding” at the toe/foundation which could cause this to deteriorate and soften over time.



3.0 Analysis

3.1 Design Model

The most onerous sections have been considered. Refer to Section 1.2.

3.2 Method of Analysis

- Methods of Analysis: BS 8006-1:2010
- Retaining System: Vertica

Fine GEO5 software packages MSE Wall and Stability were used for analysis purposes for the proposed Vertica wall. Analyses files GE25-5980-F1-01 & -02 is included in the attached Appendix.

As shown by all Factors of Safety for the worst Load Combinations being less than 100% of utilization, the requirements of BSEN1997-1:2004 and BS 8006-1:2010 were satisfied for all analyses.

The GEO5 software analysis output files are included in the appendix of this report.



Geoman Ltd.	Project:	Ref:	Date:	Rev:
Vertica Wall	Siemens Mobility, South Business Park, Chippenham	25-5980-F1	05.09.25	0

4.0 Summary

This design proposal and associated drawing have been produced using the methodology detailed above. However, it should be noted that the design proposal has been generated from information provided to Geoman Ltd, which has not been independently verified and may contain assumptions and inaccuracies regarding geotechnical, hydraulic and other parameters.

If any discrepancy is noted between the site conditions and the design assumptions (regarding water levels, soil conditions, proposed loadings etc.), the Principal Contractor and/ or Client's Consulting Engineer must contact Geoman Ltd. immediately to facilitate a review of the design.

Geoman Ltd did not undertake to supervise the construction of the structure, and therefore cannot comment on the standard of workmanship. The main issues to consider are adequate compaction of the foundation soils and imported fill, and adequate drainage.

Geoman Ltd accordingly does not accept responsibility for the accuracy or completeness of information or assumptions from which the design proposal has been produced.

The design proposal remains the copyright and property of Geoman Ltd and is not to be copied or disclosed to any person other than the person to whom it is originally intended.

The material supplier can provide typical health & safety hazards to consider when approaching this work. Designer's hazards include falling from height and the stability of excavated cuttings.



5.0 Construction Supervision Requirements

The following construction supervision requirements should be adhered to by the project team (Principal Designer, Client's Consulting Engineer & Principal Contractor). If any issues arise on site which differ from what has been assumed in this design, Geoman Ltd. should be contacted immediately so the possible consequences can be assessed.

1. The Principal Contractor and/ or a geotechnical engineer must confirm the ground conditions on site to ensure they comply with the assumptions made in this design.
2. The reinforced backfill is to be compacted Class 6I granular fill, compacted in accordance with SFHW Series 600.
3. The wall is to be constructed should be checked for the required geometry and retained height to ensure that they are within the scope of this design.
4. Any excavations should be checked for any flows or seepage that require drainage measures. Any flows, seepage or standing water should be directed to a suitable outfall as soon as they are encountered.
5. It should be ensured that the face batter is not compromised by the use of heavy compaction plant machinery too close to the front face of the wall.
6. If construction plant is to traffic the crest area of the wall, a suitable haul road design must be undertaken and be set back and adequate distance from the rear of the wall (designed by others). If construction plant operates on the unprotected retained material, distortion/ bulging of the wall may occur.



Geoman Ltd.	Project:	Ref:	Date:	Rev:
Vertica Wall	Siemens Mobility, South Business Park, Chippenham	25-5980-F1	05.09.25	0

6.0 Maintenance Requirements

- The drainage must be routinely inspected and maintained (rodded/jetted) annually and after particularly heavy rainfall events. This is essential to prevent the pore water pressures increasing behind the wall. Rodding facilities must be provided to ensure the full length of drainage can be maintained.
- The segmental wall capping blocks should be checked annually to ensure they are suitably fixed to the upper course of retaining wall blocks. If any capping blocks are missing, they should be replaced and if any are loose they should be fixed using epoxy mortar.
- The wall should be routinely inspected for signs of any faults, vandalism or movement. The batter of the wall should be checked to ensure it remains within the allowed tolerances (+/-2°).
- The ground above and below the wall should also be inspected for signs of any movement.

These requirements should be included in the maintenance regime for the site.



7.0 CDM Regulations

Geoman is not the Principal Designer but has considered the risks associated with this element of the works that affect or are affected by the design. “**Designers**” are responsible for fulfilling their obligations as defined in the Construction (Design & Management) Regulations 2015.

Geoman Ltd., as designers, understand that under the Regulations its duties are generally to;

- Ensure that the client for the project is aware of the duties and responsibilities that they have.
- So far as is reasonably practicable, taking due account of other relevant design considerations, avoid foreseeable risks to the health and safety of any persons carrying out, liable to be affected by such or maintaining the permanent fixtures and fittings of construction work.

In discharging this duty, the designer shall:

- Eliminate hazards that may give rise to risks
- Reduce risks from any remaining hazards and in doing so give collective measures priority over individual measures.

The designer shall also:

- Take all reasonable steps to provide with the design sufficient information about aspects of the design of the structure or its construction or maintenance as will adequately assist clients, other designers and contractors to comply with their duties under the Regulations.

In respect of this particular project, Geoman hereby draws to the attention of the Principal Designer and Principal Contractor that they have specific duties under CDM 2015.

The 'Principal Contractor' must be responsible for and fulfill all the contractor's obligations.

However, since the **Principal Designer** has designated the chosen location and dimensions of the structures on this site, the **Principal Designer** has, in this respect, acted as a 'designer' under CDM 2015. The **Principal Designer** is therefore responsible for fulfilling all the obligations that this entails.

The scope of Geoman, as element 'designer', to minimise design risks is therefore limited by those elements of the design pre-determined by the **Principal Designer**. The significant design risks shown in Section 7.1 remain and must therefore be addressed by the **Principal Designer** and **Principal Contractor**.



7.1 SIGNIFICANT DESIGN RISKS REMAINING:

RISK		SUGGESTED REMEDIATION	Action By
01	Wall stability compromised and/or excessive settlement due to foundation soils not complying with design assumptions.	The Principal Contractor and/ or a geotechnical engineer must confirm the localised suitability of the material at formation level over the full extent of the wall. Please refer to Section 2.0 for further information.	Principal Contractor / Client's Consulting Engineer/ Principal Designer
02	Wall stability compromised due to backfill soils not complying with design assumptions.	The backfill for the wall is to be compacted Class 6I granular fill. This material is assumed to have the following characteristics: $\Phi' = 35$ degrees, $\text{Gamma} = 19\text{kN/m}^3$ and $c' = 0\text{kPa}$, compacted in accordance with SFHW Series 600. Quality control testing should follow the principles set out in HA 44/91 and be under the responsibility of the Principal Contractor. The Principal Contractor is responsible for the selection of this material to ensure compliance with the geotechnical characteristics as shown on the relevant drawings and in the design documents/calculations. We advise shear box testing is carried out to confirm the friction angle of the proposed fill is at least 35-degrees.	Principal Contractor
03	Wind/impact loads on fences affecting the wall stability.	It has been assumed it is proposed to install a 1.8m high fence to the top of the wall as pedestrian restraint (design and details are by others). The posts must be fully concreted into minimum 0.1m long, 0.3m $\varnothing$ sleeves pre-installed into the wall backfill. The geogrid tails can be locally cut to accommodate the fence post sleeves. If a higher fence is to be installed behind the wall, Geoman must be advised as the foundation detail will need to be revised to cater for increased lateral loading.	Principal Contractor / Client's Consulting Engineer
04	Instability of the temporary cut slope.	Temporary excavations have the potential to collapse rapidly and without warning. This retaining wall solution is for the permanent works only and is on the basis that a safe system of works is provided for construction. The Principal Contractor should provide a method statement for the works to satisfy the Client's Consulting Engineer. Geoman Ltd. is not responsible for temporary stability or design of any temporary works. Temporary stability and design of any temporary works is entirely outside our scope and should be confirmed by a temporary works designer appointed by the Principal Contractor. We advise that the excavation for the wall is made in very short lengths (max 4m) and the wall built to its full height prior to excavating out the next short length. The Client's Consulting Engineer / Principal Contractor must ensure that the temporary excavation works do not destabilise any existing buildings/ structures. The Anchor Vertica wall must not be relied upon to provide any support to rigid structures or foundations.	Principal Contractor
05	Incorrect wall geometry assumptions leading to insufficient height of wall	The design has been based on assumed wall heights and crest slope gradients. The Principal Contractor/Principal Designer must check the assumed wall geometry to ensure that it is sufficient for the retaining requirements on site.	Principal Contractor / Client's Consulting Engineer.
06	Walls constructed outside design tolerances.	We recommend that the batter of the wall is checked with every 1m of construction to ensure it is within the allowed tolerances. Heavy construction plant should not be trafficking behind the wall during construction as this can cause excessive bulging of the wall. We recommend that an experienced installer is appointed to construct the wall.	Principal Contractor



07	Damage/ difficult access to services within reinforced soil block for maintenance, etc.	If any services are to be placed within or close to the reinforced soil, the Principal Contractor must ensure that they can accommodate any settlement associated with the reinforced soil block. While the upper layers of the geogrid reinforcement may be cut locally to provide access for repair/ maintenance of any services, the Principal Contractor should contact Geoman Ltd. prior to undertaking any such works to ensure that the wall will not be adversely affected.	Principal Contractor
08	Inexperienced installer appointed to construct the wall	An experienced installer should be appointed to install the wall. The installer should have experience on work of a similar nature in terms of constructing high reinforced earth wall and placing and compacting reinforced granular and granular backfill.	Principal Contractor
09	Serviceability movement of wall affecting proposed roads/ services at the crest of the wall.	Reinforced earth retaining walls are flexible, and some settlement will occur during and after construction. Some settlement will occur after construction, depending on the compaction and condition of the backfill placed. We advise that the surface of the reinforced soil zone is monitored, and the final surfacing is only placed once post construction settlement has ceased.	Principal Contractor / Client's Consulting Engineer.
10	Non-compliance with Local Authority requirements	The Client/ Client's Consulting Engineer must check to see if any statutory approvals such as Technical Approval, NHBC Approval, Geotechnical Certification are required for the retaining wall. If approvals are required, these must be gained before construction. Any approval work is outside the scope of this design. Geoman/ A&G cannot be held responsible if the wall do not obtain Technical Approval. Proceeding without approval is at risk.	Principal Contractor / Client's Consulting Engineer.
11	Heavy construction traffic operating close to the wall	It should be ensured that the face batter is not compromised by the use of heavy compaction plant machinery too close to the front face of the wall. If construction plant is to traffic the crest area of the wall, a suitable haul road design must be undertaken and be set back and adequate distance from the rear of the wall (designed by others). If construction plant operates on the unprotected retained material, distortion/ bulging of the wall may occur.	Principal Contractor
12	Inadequate wall drainage	Refer to Section 2.5 and the design sections for details of the required wall drainage. Given the length of the wall intermediate outlets/ rodding points should be provided at minimum 40m spacings along the wall and at all low points along the elevation to ensure the full length of drain can be positively discharged and fully maintained. Site drainage is outside the scope of our design.	Principal Contractor / Client's Consulting Engineer.
13	Higher than assumed surcharges compromising stability of walls.	A maximum live load of 5kN/m ²) was assumed to act on the retained side of the wall -Client's Consulting Engineer must inform Geoman Ltd. if a more onerous surcharge should be considered prior to construction as this design must be reviewed.	Principal Contractor / Client's Consulting Engineer.
14	Excavations post construction of the Vertica Wall	Excavations through the reinforced zone will damage the geogrids and impact the stability of the Vertica Wall. Excavations are not permitted and any minor/ shallow excavations proposed must be assessed prior to construction to evaluate their effect on the wall stability. No unplanned excavation, temporary or permanent, should take place in the vicinity of the toe of the wall after their construction. Any other excavation planned below the toe should be carefully evaluated by an independent geotechnical engineer to assess the effects of such excavation on the slopes.	Principal Contractor / Client's Consulting Engineer



8.0 Designer Risk Assessment

CONSTRUCTION OF A&G VERTICA WALL

NOTICE OF HAZARD IDENTIFICATION (GENERIC DESIGNER RISK ASSESSMENT)

CATEGORY C/D/M	ACTIVITY/ELEMENT	POSSIBLE HAZARD	RISK ASSESSMENT Low/Medium/High	ACTION PROPOSED	ACTION BY
C	Working at heights >2m	Falling	H	Wear Harness OR provide access scaffold	Contractor
C/M	Working at heights	Falling	M	Wear Harness OR provide access scaffold	Contractor
C	Cutting mesh, compacting concrete backfill etc.	Personal Injury	M	Use of suitable PPE (safety goggles, gloves, etc.)	Contractor
C	Placing backfill	Personal Injury	M	Use mini excavator to place stone fill where practicable	Contractor
C	Excavation of embankment/ existing wall prior to installation of wall	Embankment Slip - Personal Injury	H	Excavation of embankment to a safe angle of repose for the short term. Consider using temporary propping such as sheet piles and excavating in short lengths	Contractor/ Principal Designer
M	Steep retaining structures > 2m in height	Falling/Personal Injury	H	Provision of permanent fence/ barrier at crest of retaining structure	Client

Category: C = Construction, M = Maintenance/Use, D = Demolition

NOTICE OF HAZARD IDENTIFICATION (SPECIFIC DESIGNER RISK ASSESSMENT)

CATEGORY C/D/M	ACTIVITY/ELEMENT	POSSIBLE HAZARD	RISK ASSESSMENT Low/Medium/High	ACTION PROPOSED	ACTION BY
C	Excavation into existing material to foundation level	Bank slip / Personal injury	H	Excavation of ground to a safe angle of repose for the short term and/ or foundation excavation & construction of lower block courses carried out in short lengths. Temporary propping of cut embankment such as sheet piles. Use of granular backfill.	Principal Contractor / Wall Installer
C	Excavation into existing material to foundation level	Striking existing services/ Personal injury	M	Principal Designer to provide details of all existing services in the vicinity of the wall to Contractor. Use of Cable Avoidance Tools (CAT scanners).	Principal Designer / Principal Contractor / Wall Installer
C	Excavation into existing material to foundation level	Striking live cables/ electrocution	M	Principal Designer to provide details of all existing electrical services in the vicinity of the wall to Contractor. Electrical services to be relocated where risk is unacceptable. Use of Cable Avoidance Tools (CAT scanners). unacceptable. Use of Cable Avoidance Tools (CAT scanners).	Principal Designer / Principal Contractor / Wall Installer
C	General Installation of wall	Personal Injury	M	Adhere to Supplier Installation Guidelines.	Contractor

Category: C = Construction, M = Maintenance/Use, D = Demolition



Geoman Ltd.	Project:	Ref:	Date:	Rev:
Vertica Wall	Siemens Mobility, South Business Park, Chippenham	25-5980-F1	05.09.25	0

9.0 Appendices

- Geoman Ltd. drawing number SK25-5980-F1-01.
- GEO5 analysis file GE25-5980-F1-01 to -02.



Analysis of reinforced slopes

Input data

Project

Task : Siemens Mobility, South Business Park, Chippenham
Part : Section 1A-1A
Description : Vertical Wall
Author : HM
Date : 09/09/2025
Project number : 25-5980

Settings

BS 8006 - MSE Wall

Materials and standards

Concrete structures : EN 1992-1-1 (EC2)
Coefficients EN 1992-1-1 : standard

Wall analysis

Active earth pressure calculation : Coulomb
Passive earth pressure calculation : Caquot-Kerisel
Earthquake analysis : Mononobe-Okabe
Shape of earth wedge : Calculate as skew
Allowable eccentricity : 0.333
Internal stability : Standard - straight slip surface
Verification methodology : according to BS 8006

Partial factors of soil properties			
Partial factor on internal friction :	$f_{ms} =$	1.00	[-]
Partial factor on effective cohesion :	$f_{ms} =$	1.60	[-]
Partial factor on undrained shear strength :	$f_{ms} =$	1.00	[-]
Resistance factors			
Resistance factor on sliding :	$f_s =$	1.20	[-]
Resistance factor on bearing capacity :	$f_{ms} =$	1.35	[-]
Resistance factor for pullout of reinforcement :	$f_p =$	1.30	[-]
Partial factors of slip on reinforcement :	$f_s =$	1.30	[-]
Partial factors - wall			
		Combination A	Combination B
Dead load of structural components :	$f_{fs} =$	1.50 [-]	1.00 [-]
Earth pressure - active :	$f_{fs} =$	1.50 [-]	1.50 [-]
Permanent load - on the block :	$f_f =$	1.50 [-]	1.00 [-]
Permanent load - behind the block :	$f_f =$	1.50 [-]	1.50 [-]
Variable load - on the block :	$f_q =$	1.50 [-]	0.00 [-]
Variable load - behind the block :	$f_q =$	1.50 [-]	1.50 [-]
Partial factors - slope			
Dead load of structural components :	$f_{fs} =$	1.50	[-]
Earth surcharge load (permanent) :	$f_f =$	1.20	[-]
Live load surcharge :	$f_q =$	1.30	[-]



Stability analysis

Verification methodology : according to EN 1997

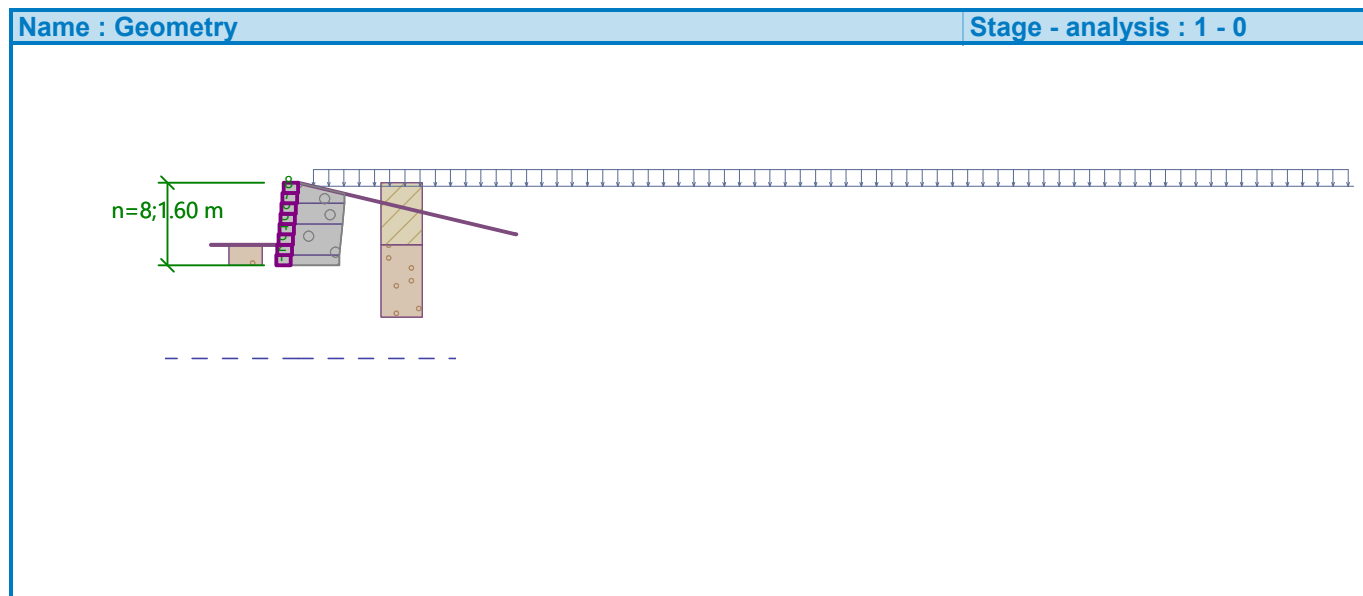
Design approach : 1 - reduction of actions and soil parameters

Partial factors on actions (A)					
Permanent design situation					
		Combination 1		Combination 2	
		Unfavourable	Favourable	Unfavourable	Favourable
Permanent actions :	$\gamma_G =$	1.35 [-]	1.00 [-]	1.00 [-]	1.00 [-]
Variable actions :	$\gamma_Q =$	1.50 [-]	0.00 [-]	1.30 [-]	0.00 [-]
Water load :	$\gamma_w =$	1.00 [-]		1.00 [-]	

Partial factors for soil parameters (M)			
Permanent design situation			
		Combination 1	Combination 2
Partial factor on internal friction :	$\gamma_\phi =$	1.00 [-]	1.25 [-]
Partial factor on effective cohesion :	$\gamma_c =$	1.00 [-]	1.25 [-]
Partial factor on undrained shear strength :	$\gamma_{cu} =$	1.00 [-]	1.40 [-]

Geometry of structure

Number of blocks $n = 8$
Block height $h = 0.20$ m
Block width $b = 0.28$ m
Block offset $o_1 = 0.02$ m



Material

Block material

Unit weight $\gamma = 20.50$ kN/m³
Cohesion $c = 0.00$ kPa
Friction $f = 0.533$
Shear bearing capacity of joint $R_s = 0.00$ kN/m

Reinforced soil - Class 6I

Reinforcement

Total number of input reinforcements : 3.



Reinforcement details

Block No.	Type of reinforcement	Origin l_1 [m]	End l_2 [m]	Height from bottom y [m]	Length l [m]
2	Paragrid 50 (user)	-0.12	0.80	0.20	0.92
5	Paragrid 50 (user)	-0.06	0.86	0.80	0.92
7	Paragrid 50 (user)	-0.02	0.90	1.20	0.92

Soil parameters

Kellaway CLAY (R)

Unit weight : $\gamma = 19.00 \text{ kN/m}^3$
Angle of internal friction : $\varphi_{ef} = 22.00^\circ$
Cohesion of soil : $c_{ef} = 0.00 \text{ kPa}$
Angle of friction struc.-soil : $\delta = 14.67^\circ$
Saturated unit weight : $\gamma_{sat} = 22.00 \text{ kN/m}^3$

Class 6I

Unit weight : $\gamma = 19.00 \text{ kN/m}^3$
Angle of internal friction : $\varphi_{ef} = 35.00^\circ$
Cohesion of soil : $c_{ef} = 0.00 \text{ kPa}$
Angle of friction struc.-soil : $\delta = 23.30^\circ$
Saturated unit weight : $\gamma_{sat} = 20.00 \text{ kN/m}^3$

Cornbrash formation (F)

Unit weight : $\gamma = 22.00 \text{ kN/m}^3$
Angle of internal friction : $\varphi_{ef} = 25.00^\circ$
Cohesion of soil : $c_{ef} = 0.00 \text{ kPa}$
Angle of friction struc.-soil : $\delta = 16.67^\circ$
Saturated unit weight : $\gamma_{sat} = 22.00 \text{ kN/m}^3$

Geological profile and assigned soils

Position information

Terrain elevation = 2.40 m

Geological profile and assigned soils

No.	Thickness of layer t [m]	Depth z [m]	Altitude [m]	Assigned soil	Pattern
1	1.20	0.00 .. 1.20	2.40 .. 1.20	Kellaway CLAY (R)	
2	-	1.20 .. ∞	1.20 .. -	Cornbrash formation (F)	

Terrain profile

Terrain behind construction has the slope 1: 4.20 (slope angle is 13.39°).
Excavation depth is 1.00 m, excavation length is 4.20 m.

Water influence

GWT behind the structure lies at a depth of 3.40 m
GWT in front of the structure lies at a depth of 3.40 m
Subgrade at the heel is not permeable.
Uplift in foot. bottom due to different pressures is not considered.

Input surface surcharges

No.	Surcharge new	Surcharge change	Action	Mag.1 [kN/m ²]	Mag.2 [kN/m ²]	Ord.x x [m]	Length l [m]	Depth z [m]
1	Yes		variable	5.00		0.30	20.00	on terrain



No.	Name
1	5kPa

Resistance on front face of the structure

Resistance on front face of the structure: not considered

Soil on front face of the structure - Cornbrash formation (F)

Soil thickness in front of structure $h = 0.40$ m

Terrain in front of structure is flat.

Settings of the stage of construction

Coeff. for structure types : wall

Verification No. 1

Forces acting on construction - combination B

Name	F_{hor} [kN/m]	App.Pt. z [m]	F_{vert} [kN/m]	App.Pt. x [m]	Coeff. overtur.	Coeff. sliding	Coeff. stress
Weight - reinforced soil	0.00	-0.75	26.29	0.80	1.000	1.000	1.000
Active pressure	5.14	-0.47	1.81	1.22	1.500	1.500	1.500
Water pressure	0.00	-1.60	0.00	2.10	1.000	1.000	1.500
5kPa	2.52	-0.71	0.82	1.25	1.500	1.500	1.500
Weight - wall	0.00	-0.80	9.18	0.21	1.000	1.000	1.000
5kPa	0.00	-1.46	3.00	1.02	0.000	0.000	1.500

Verification of complete wall

Check for overturning stability

Resisting moment $M_{res} = 27.76$ kNm/m

Overturning moment $M_{ovr} = 6.31$ kNm/m

Wall for overturning is **SATISFACTORY**

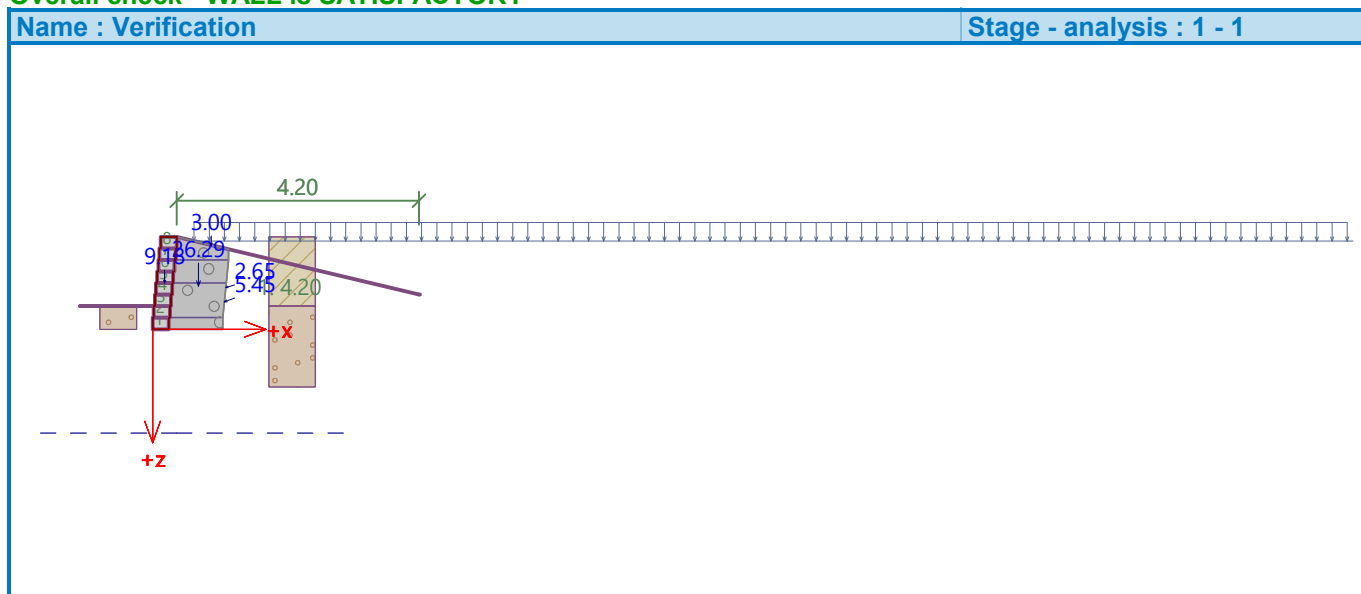
Check for slip

Resisting horizontal force $H_{res} = 15.32$ kN/m

Active horizontal force $H_{act} = 11.49$ kN/m

Wall for slip is **SATISFACTORY**

Overall check - WALL is SATISFACTORY





Bearing capacity of foundation soil

Design load acting at the center of footing bottom

No.	Moment [kNm/m]	Norm. force [kN/m]	Shear Force [kN/m]	Eccentricity [-]	Stress [kPa]
1	-0.49	61.65	11.49	0.000	51.38
2	2.21	39.42	11.49	0.047	36.23
3	0.32	43.92	11.49	0.006	37.04

Service load acting at the center of footing bottom

No.	Moment [kNm/m]	Norm. force [kN/m]	Shear Force [kN/m]
1	-0.33	41.10	7.66

Verification of foundation soil

Stress in the footing bottom : rectangle

Eccentricity verification

Max. eccentricity of normal force $e = 0.000$

Maximum allowable eccentricity $e_{alw} = 0.333$

Eccentricity of the normal force is SATISFACTORY

Verification of bearing capacity

Bearing capacity of foundation soil $R = 250.00$ kPa

Partial factor on bearing capacity $\gamma_{Rv} = 1.35$

Max. stress at footing bottom $\sigma = 51.38$ kPa

Bearing capacity of foundation soil $R_d = 185.19$ kPa

Bearing capacity of foundation soil is SATISFACTORY

Overall verification - bearing capacity of found. soil is SATISFACTORY

Verification of slip on georeinforcement No. 1

Forces acting on construction (verification of most utilized reinforcement)

Name	F_{hor} [kN/m]	App.Pt. z [m]	F_{vert} [kN/m]	App.Pt. x [m]	Design coefficient
Weight - wall	0.00	-0.70	8.04	-0.06	1.000
Active pressure	3.82	-0.39	1.10	0.94	1.500
5kPa	2.20	-0.58	0.63	0.96	1.500
Weight - reinforced soil	0.00	-0.65	22.83	0.51	1.000
5kPa	0.00	-1.25	3.12	0.75	0.000

Check for slip along geo-reinforcement with the maximal utilization (Reinforc. No.: 1)

Inclination of slip surface $= 84.00^\circ$

Overall normal force acting on reinforcement $= 25.42$ kN/m

Coefficient of reduction of slip along

geo-textile

Resistance along geo-reinforcement $= 10.68$ kN/m

Wall resistance $= 4.28$ kN/m

Overall bearing capacity of reinforcements $= 0.00$ kN/m

Check for slip:

Resisting horizontal force $H_{res} = 11.51$ kN/m

Active horiz. force $H_{act} = 9.03$ kN/m

Slip along geotextile is SATISFACTORY



Slope stability analysis

Input data

Project

Settings

BS 8006 - MSE Wall

Wall analysis

Partial factors of soil properties			
Partial factor on internal friction :	f_{ms} =	1.00	[-]
Partial factor on effective cohesion :	f_{ms} =	1.60	[-]
Partial factor on undrained shear strength :	f_{ms} =	1.00	[-]
Resistance factors			
Resistance factor on sliding :	f_s =	1.20	[-]
Resistance factor on bearing capacity :	f_{ms} =	1.35	[-]
Resistance factor for pullout of reinforcement :	f_p =	1.30	[-]
Partial factors of slip on reinforcement :	f_s =	1.30	[-]
Partial factors - wall			
		Combination A	Combination B
Dead load of structural components :	f_{fs} =	1.50 [-]	1.00 [-]
Earth pressure - active :	f_{fs} =	1.50 [-]	1.50 [-]
Permanent load - on the block :	f_f =	1.50 [-]	1.00 [-]
Permanent load - behind the block :	f_f =	1.50 [-]	1.50 [-]
Variable load - on the block :	f_q =	1.50 [-]	0.00 [-]
Variable load - behind the block :	f_q =	1.50 [-]	1.50 [-]
Partial factors - slope			
Dead load of structural components :	f_{fs} =	1.50 [-]	
Earth surcharge load (permanent) :	f_f =	1.20 [-]	
Live load surcharge :	f_q =	1.30 [-]	

Stability analysis

Earthquake analysis : Standard

Verification methodology : according to EN 1997

Design approach : 1 - reduction of actions and soil parameters

Partial factors on actions (A)					
Permanent design situation					
		Combination 1		Combination 2	
		Unfavourable	Favourable	Unfavourable	Favourable
Permanent actions :	γ_G =	1.35 [-]	1.00 [-]	1.00 [-]	1.00 [-]
Variable actions :	γ_Q =	1.50 [-]	0.00 [-]	1.30 [-]	0.00 [-]
Water load :	γ_w =	1.00 [-]		1.00 [-]	
Partial factors for soil parameters (M)					
Permanent design situation					
		Combination 1		Combination 2	



Partial factors for soil parameters (M)

Permanent design situation

Partial factor on internal friction :	$\gamma_{\phi} =$	1.00 [-]	1.25 [-]
Partial factor on effective cohesion :	$\gamma_c =$	1.00 [-]	1.25 [-]
Partial factor on undrained shear strength :	$\gamma_{cu} =$	1.00 [-]	1.40 [-]

Interface

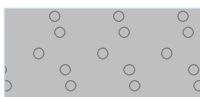
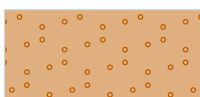
No.	Interface location	Coordinates of interface points [m]					
		x	z	x	z	x	z
1		-10.00	1.20	-0.40	1.20	-0.38	1.20
		-0.38	1.40	-0.36	1.40	-0.36	1.60
		-0.34	1.60	-0.34	1.80	-0.32	1.80
		-0.32	2.00	-0.30	2.00	-0.30	2.20
		-0.28	2.20	-0.28	2.40	0.00	2.40
		0.90	2.19	4.20	1.40	20.30	1.40
2		-0.42	0.80	-0.14	0.80	-0.14	1.00
		-0.12	1.00	-0.12	1.20	-0.10	1.20
		-0.10	1.40	-0.08	1.40	-0.08	1.60
		-0.06	1.60	-0.06	1.80	-0.04	1.80
		-0.04	2.00	-0.02	2.00	-0.02	2.20
		0.00	2.20	0.00	2.40		
3		-0.14	0.80	0.78	0.80	0.80	1.00
		0.82	1.20	0.86	1.60	0.90	2.00
		0.90	2.19				
4		0.82	1.20	20.30	1.20		
5		-10.00	0.80	-0.42	0.80	-0.42	1.00
		-0.40	1.00	-0.40	1.20		

Soil parameters - effective stress state

No.	Name	Pattern	ϕ_{ef} [°]	c_{ef} [kPa]	γ [kN/m ³]
1	Kellaway CLAY (R)		22.00	0.00	19.00
2	Class 6l		35.00	0.00	19.00
3	Cornbrash formation (F)		25.00	0.00	22.00



Soil parameters - uplift

No.	Name	Pattern	γ_{sat} [kN/m ³]	γ_s [kN/m ³]	n [-]
1	Kellaway CLAY (R)		22.00		
2	Class 6I		20.00		
3	Cornbrash formation (F)		22.00		

Soil parameters

Kellaway CLAY (R)

Unit weight : $\gamma = 19.00 \text{ kN/m}^3$
Stress-state : effective
Angle of internal friction : $\phi_{ef} = 22.00^\circ$
Cohesion of soil : $c_{ef} = 0.00 \text{ kPa}$
Saturated unit weight : $\gamma_{sat} = 22.00 \text{ kN/m}^3$

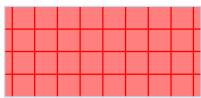
Class 6I

Unit weight : $\gamma = 19.00 \text{ kN/m}^3$
Stress-state : effective
Angle of internal friction : $\phi_{ef} = 35.00^\circ$
Cohesion of soil : $c_{ef} = 0.00 \text{ kPa}$
Saturated unit weight : $\gamma_{sat} = 20.00 \text{ kN/m}^3$

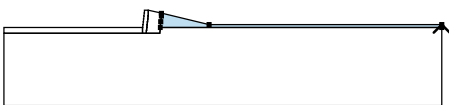
Cornbrash formation (F)

Unit weight : $\gamma = 22.00 \text{ kN/m}^3$
Stress-state : effective
Angle of internal friction : $\phi_{ef} = 25.00^\circ$
Cohesion of soil : $c_{ef} = 0.00 \text{ kPa}$
Saturated unit weight : $\gamma_{sat} = 22.00 \text{ kN/m}^3$

Rigid Bodies

No.	Name	Sample	γ [kN/m ³]
1	Material of structure		20.50

Assigning and surfaces

No.	Surface position	Coordinates of surface points [m]				Assigned soil
		x	z	x	z	
1		20.30	1.20	20.30	1.40	Kellaway CLAY (R) 
		4.20	1.40	0.90	2.19	
		0.90	2.00	0.86	1.60	
		0.82	1.20			



No.	Surface position	Coordinates of surface points [m]				Assigned soil
		x	z	x	z	
2		-0.40	1.00	-0.42	1.00	Material of structure
		-0.42	0.80	-0.14	0.80	
		-0.14	1.00	-0.12	1.00	
		-0.12	1.20	-0.10	1.20	
		-0.10	1.40	-0.08	1.40	
		-0.08	1.60	-0.06	1.60	
		-0.06	1.80	-0.04	1.80	
		-0.04	2.00	-0.02	2.00	
		-0.02	2.20	0.00	2.20	
		0.00	2.40	-0.28	2.40	
		-0.28	2.20	-0.30	2.20	
		-0.30	2.00	-0.32	2.00	
		-0.32	1.80	-0.34	1.80	
		-0.34	1.60	-0.36	1.60	
		-0.36	1.40	-0.38	1.40	
		-0.38	1.20	-0.40	1.20	
3		0.78	0.80	0.80	1.00	Class 6l
		0.82	1.20	0.86	1.60	
		0.90	2.00	0.90	2.19	
		0.00	2.40	0.00	2.20	
		-0.02	2.20	-0.02	2.00	
		-0.04	2.00	-0.04	1.80	
		-0.06	1.80	-0.06	1.60	
		-0.08	1.60	-0.08	1.40	
		-0.10	1.40	-0.10	1.20	
		-0.12	1.20	-0.12	1.00	
		-0.14	1.00	-0.14	0.80	
4		-0.42	0.80	-0.42	1.00	Cornbrash formation (F)
		-0.40	1.00	-0.40	1.20	
		-10.00	1.20	-10.00	0.80	
5		-10.00	0.80	-10.00	-4.20	Cornbrash formation (F)
		20.30	-4.20	20.30	1.20	
		0.82	1.20	0.80	1.00	
		0.78	0.80	-0.14	0.80	
		-0.42	0.80			

Reinforcements

No.	Point to the left		Point to the right		Length L [m]	Strength R_t [kN/m]	Pull out resist.	End of reinf.
	x [m]	z [m]	x [m]	z [m]				
1	-0.02	2.00	0.90	2.00	0.92	27.64	$T_p = 4.30 \text{ kN/m}^2$	Fixed
2	-0.06	1.60	0.86	1.60	0.92	27.64	$T_p = 8.60 \text{ kN/m}^2$	Fixed
3	-0.12	1.00	0.80	1.00	0.92	27.64	$T_p = 17.37 \text{ kN/m}^2$	Fixed



Surcharge

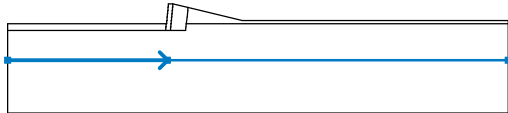
No.	Type	Type of action	Location z [m]	Origin x [m]	Length l [m]	Width b [m]	Slope α [°]	Magnitude		
								q, q ₁ , f, F, x	q ₂ , z	unit
1	strip	variable	on terrain	x = 0.30	l = 20.00		0.00	5.00		kN/m ²

Surcharges

No.	Name
1	5kPa

Water

Water type : GWT

No.	GWT location	Coordinates of GWT points [m]					
		x	z	x	z	x	z
1		-10.00	-1.00	-0.32	-1.00	20.30	-1.00

Tensile crack

Tensile crack not input.

Earthquake

Earthquake not included.

Settings of the stage of construction

Design situation : permanent

Results (Stage of construction 1)

Analysis 1

Circular slip surface

Slip surface parameters					
Center :	x =	-0.36 [m]	Angles :	α_1 =	-46.96 [°]
	z =	2.49 [m]		α_2 =	76.59 [°]
Radius :	R =	1.89 [m]			
The slip surface after optimization.					

Reinforcement bearing capacity

Combination 1

Reinforcement Bearing capacity [kN/m]

1	0.00
2	0.00
3	0.00

Combination 2

Reinforcement Bearing capacity [kN/m]

1	0.00
2	0.00
3	0.00

Slope stability verification (Bishop)



Combination 1

Sum of active forces : $F_a = 22.76 \text{ kN/m}$

Sum of passive forces : $F_p = 37.07 \text{ kN/m}$

Sliding moment : $M_a = 43.02 \text{ kNm/m}$

Resisting moment : $M_p = 70.05 \text{ kNm/m}$

Utilization : 61.4 %

Slope stability ACCEPTABLE

Combination 2

Sum of active forces : $F_a = 18.89 \text{ kN/m}$

Sum of passive forces : $F_p = 27.47 \text{ kN/m}$

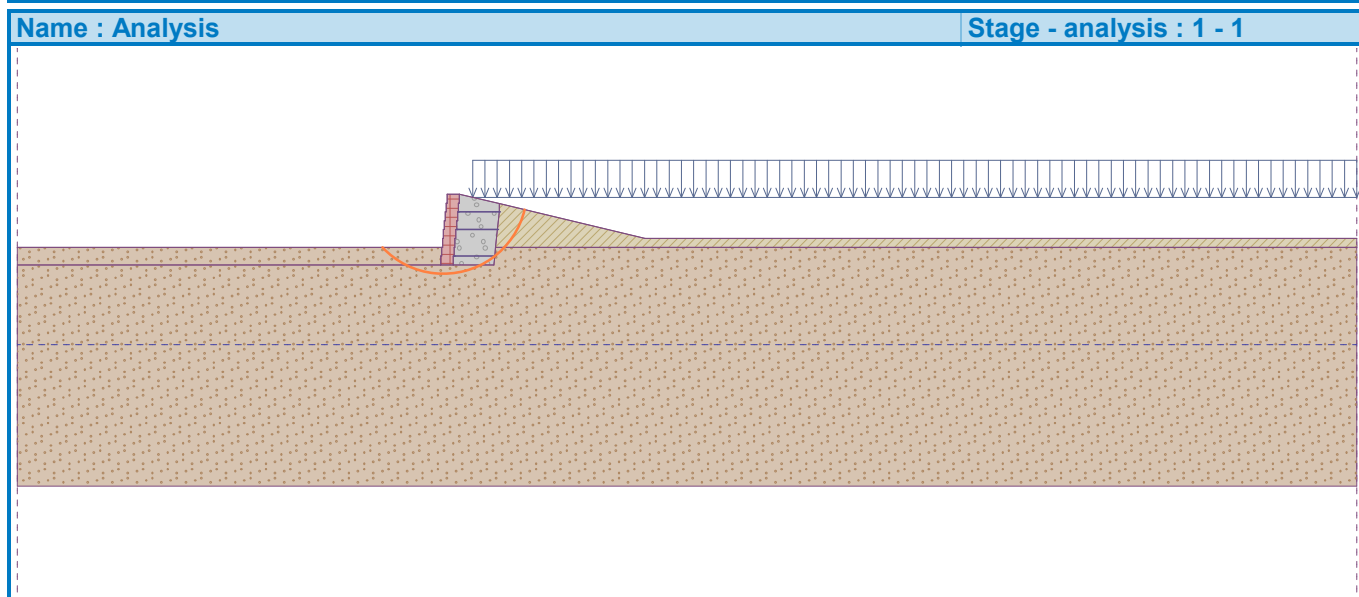
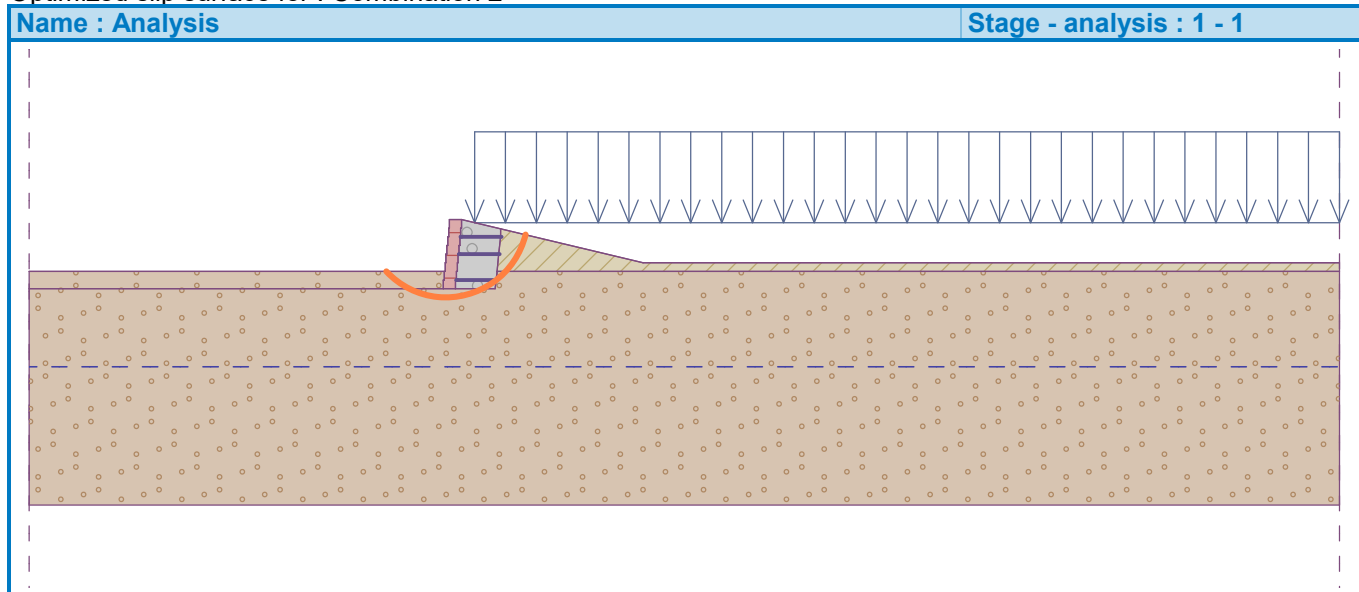
Sliding moment : $M_a = 35.69 \text{ kNm/m}$

Resisting moment : $M_p = 51.92 \text{ kNm/m}$

Utilization : 68.7 %

Slope stability ACCEPTABLE

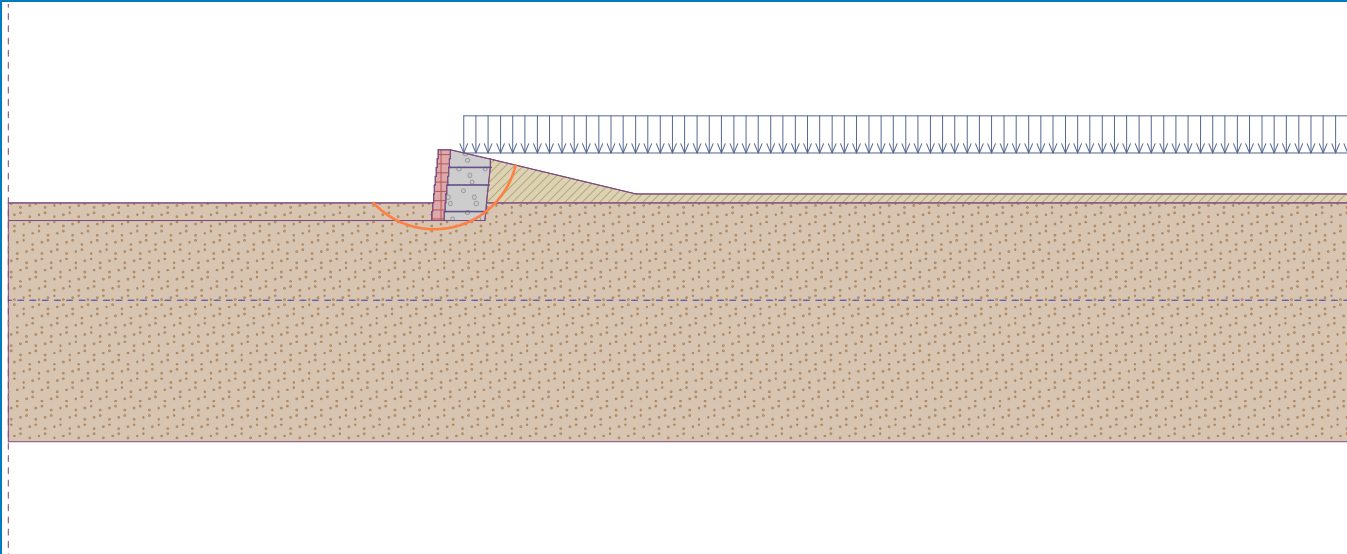
Optimized slip surface for : Combination 2





Name : Analysis

Stage - analysis : 1 - 1





Analysis of reinforced slopes

Input data

Project

Task : Siemens Mobility, South Business Park, Chippenham
Part : Section 1B-1B
Description : Vertical Wall
Author : HM
Date : 03/09/2025
Project number : 25-5980

Settings

BS 8006 - MSE Wall

Materials and standards

Concrete structures : EN 1992-1-1 (EC2)
Coefficients EN 1992-1-1 : standard

Wall analysis

Active earth pressure calculation : Coulomb
Passive earth pressure calculation : Caquot-Kerisel
Earthquake analysis : Mononobe-Okabe
Shape of earth wedge : Calculate as skew
Allowable eccentricity : 0.333
Internal stability : Standard - straight slip surface
Verification methodology : according to BS 8006

Partial factors of soil properties			
Partial factor on internal friction :	$f_{ms} =$	1.00	[-]
Partial factor on effective cohesion :	$f_{ms} =$	1.60	[-]
Partial factor on undrained shear strength :	$f_{ms} =$	1.00	[-]
Resistance factors			
Resistance factor on sliding :	$f_s =$	1.20	[-]
Resistance factor on bearing capacity :	$f_{ms} =$	1.35	[-]
Resistance factor for pullout of reinforcement :	$f_p =$	1.30	[-]
Partial factors of slip on reinforcement :	$f_s =$	1.30	[-]
Partial factors - wall			
		Combination A	Combination B
Dead load of structural components :	$f_{fs} =$	1.50 [-]	1.00 [-]
Earth pressure - active :	$f_{fs} =$	1.50 [-]	1.50 [-]
Permanent load - on the block :	$f_f =$	1.50 [-]	1.00 [-]
Permanent load - behind the block :	$f_f =$	1.50 [-]	1.50 [-]
Variable load - on the block :	$f_q =$	1.50 [-]	0.00 [-]
Variable load - behind the block :	$f_q =$	1.50 [-]	1.50 [-]
Partial factors - slope			
Dead load of structural components :	$f_{fs} =$	1.50	[-]
Earth surcharge load (permanent) :	$f_f =$	1.20	[-]
Live load surcharge :	$f_q =$	1.30	[-]



Stability analysis

Verification methodology : according to EN 1997

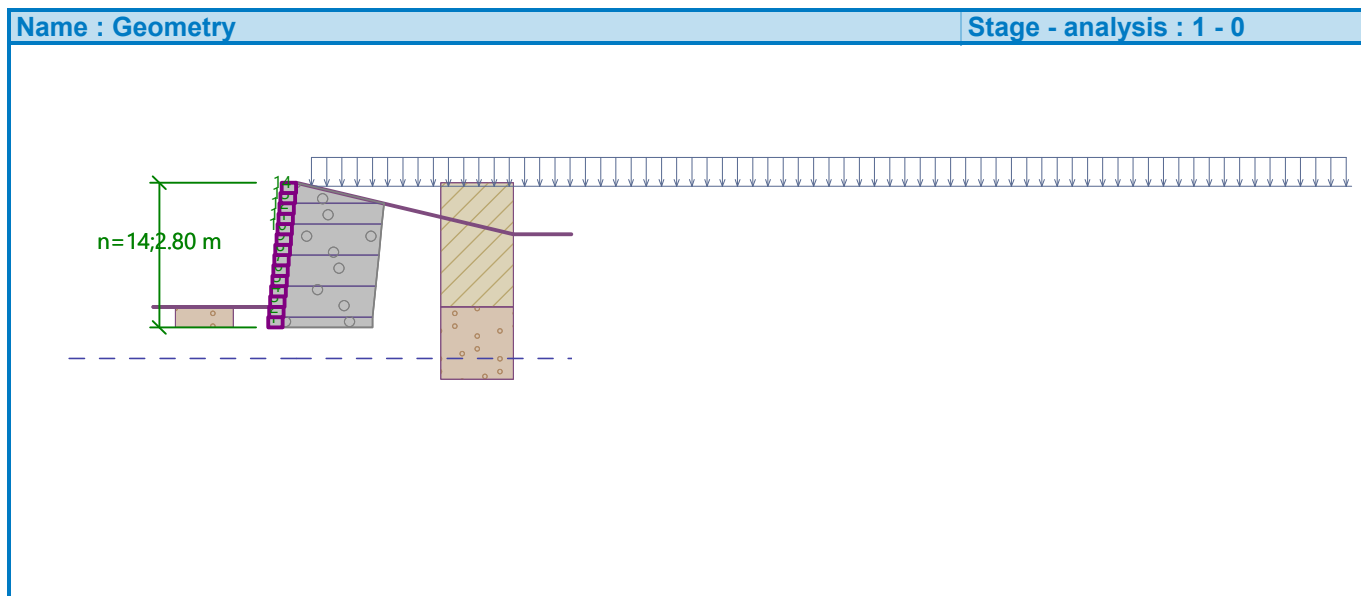
Design approach : 1 - reduction of actions and soil parameters

Partial factors on actions (A)					
Permanent design situation					
		Combination 1		Combination 2	
		Unfavourable	Favourable	Unfavourable	Favourable
Permanent actions :	$\gamma_G =$	1.35 [-]	1.00 [-]	1.00 [-]	1.00 [-]
Variable actions :	$\gamma_Q =$	1.50 [-]	0.00 [-]	1.30 [-]	0.00 [-]
Water load :	$\gamma_w =$	1.00 [-]		1.00 [-]	

Partial factors for soil parameters (M)			
Permanent design situation			
		Combination 1	Combination 2
Partial factor on internal friction :	$\gamma_\phi =$	1.00 [-]	1.25 [-]
Partial factor on effective cohesion :	$\gamma_c =$	1.00 [-]	1.25 [-]
Partial factor on undrained shear strength :	$\gamma_{cu} =$	1.00 [-]	1.40 [-]

Geometry of structure

Number of blocks $n = 14$
Block height $h = 0.20$ m
Block width $b = 0.28$ m
Block offset $o_1 = 0.02$ m



Material

Block material

Unit weight $\gamma = 20.50$ kN/m³
Cohesion $c = 0.00$ kPa
Friction $f = 0.533$
Shear bearing capacity of joint $R_s = 0.00$ kN/m

Reinforced soil - Class 6I

Reinforcement

Total number of input reinforcements : 5.



Reinforcement details

Block No.	Type of reinforcement	Origin l_1 [m]	End l_2 [m]	Height from bottom y [m]	Length l [m]
2	Paragrid 50 (user)	-0.24	1.48	0.20	1.72
5	Paragrid 50 (user)	-0.18	1.54	0.80	1.72
8	Paragrid 50 (user)	-0.12	1.60	1.40	1.72
11	Paragrid 50 (user)	-0.06	1.66	2.00	1.72
13	Paragrid 50 (user)	-0.02	1.70	2.40	1.72

Soil parameters

Kellaway CLAY (R)

Unit weight : $\gamma = 19.00 \text{ kN/m}^3$
 Angle of internal friction : $\varphi_{ef} = 22.00^\circ$
 Cohesion of soil : $c_{ef} = 0.00 \text{ kPa}$
 Angle of friction struc.-soil : $\delta = 14.67^\circ$
 Saturated unit weight : $\gamma_{sat} = 22.00 \text{ kN/m}^3$

Class 6I

Unit weight : $\gamma = 19.00 \text{ kN/m}^3$
 Angle of internal friction : $\varphi_{ef} = 35.00^\circ$
 Cohesion of soil : $c_{ef} = 0.00 \text{ kPa}$
 Angle of friction struc.-soil : $\delta = 23.30^\circ$
 Saturated unit weight : $\gamma_{sat} = 20.00 \text{ kN/m}^3$

Cornbrash formation (F)

Unit weight : $\gamma = 22.00 \text{ kN/m}^3$
 Angle of internal friction : $\varphi_{ef} = 25.00^\circ$
 Cohesion of soil : $c_{ef} = 0.00 \text{ kPa}$
 Angle of friction struc.-soil : $\delta = 16.67^\circ$
 Saturated unit weight : $\gamma_{sat} = 22.00 \text{ kN/m}^3$

Geological profile and assigned soils

Position information

Terrain elevation = 2.40 m

Geological profile and assigned soils

No.	Thickness of layer t [m]	Depth z [m]	Altitude [m]	Assigned soil	Pattern
1	2.40	0.00 .. 2.40	2.40 .. 0.00	Kellaway CLAY (R)	
2	-	2.40 .. ∞	0.00 .. -	Cornbrash formation (F)	

Terrain profile

Terrain behind construction has the slope 1: 4.20 (slope angle is 13.39°).

Excavation depth is 1.00 m, excavation length is 4.20 m.

Water influence

GWT behind the structure lies at a depth of 3.40 m

GWT in front of the structure lies at a depth of 3.40 m

Subgrade at the heel is not permeable.

Uplift in foot. bottom due to different pressures is not considered.



Input surface surcharges

No.	Surcharge		Action	Mag.1 [kN/m ²]	Mag.2 [kN/m ²]	Ord.x x [m]	Length l [m]	Depth z [m]
	new	change						
1	Yes		variable	5.00		0.30	20.00	on terrain

No.	Name
1	5kPa

Resistance on front face of the structure

Resistance on front face of the structure: not considered

Soil on front face of the structure - Cornbrash formation (F)

Soil thickness in front of structure $h = 0.40$ m

Terrain in front of structure is flat.

Settings of the stage of construction

Coeff. for structure types : wall

Verification No. 1

Forces acting on construction - combination B

Name	F_{hor} [kN/m]	App.Pt. z [m]	F_{vert} [kN/m]	App.Pt. x [m]	Coeff. overtur.	Coeff. sliding	Coeff. stress
Weight - reinforced soil	0.00	-1.30	85.28	1.24	1.000	1.000	1.000
Active pressure	15.61	-0.81	5.37	2.04	1.500	1.500	1.500
Water pressure	0.00	-2.80	0.00	3.70	1.000	1.000	1.500
5kPa	4.43	-1.22	1.41	2.08	1.500	1.500	1.500
Weight - wall	0.00	-1.40	16.07	0.27	1.000	1.000	1.000
5kPa	0.00	-2.56	7.00	1.54	0.000	0.000	1.500

Verification of complete wall

Check for overturning stability

Resisting moment $M_{res} = 131.11$ kNm/m

Overturning moment $M_{ovr} = 27.02$ kNm/m

Wall for overturning is SATISFACTORY

Check for slip

Resisting horizontal force $H_{res} = 43.33$ kN/m

Active horizontal force $H_{act} = 30.06$ kN/m

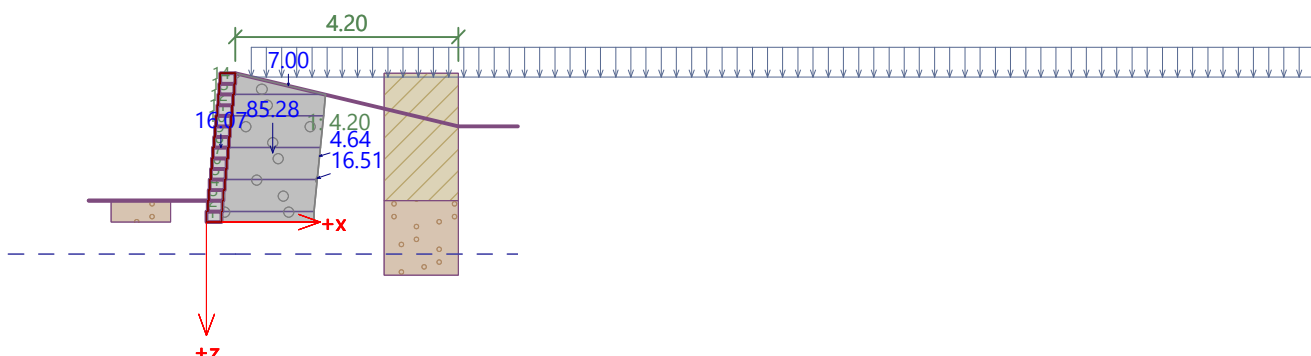
Wall for slip is SATISFACTORY

Overall check - WALL is SATISFACTORY



Name : Verification

Stage - analysis : 1 - 1



Bearing capacity of foundation soil

Design load acting at the center of footing bottom

No.	Moment [kNm/m]	Norm. force [kN/m]	Shear Force [kN/m]	Eccentricity [-]	Stress [kPa]
1	-2.72	172.69	30.06	0.000	86.35
2	7.42	111.51	30.06	0.033	59.74
3	1.75	122.01	30.06	0.007	61.90

Service load acting at the center of footing bottom

No.	Moment [kNm/m]	Norm. force [kN/m]	Shear Force [kN/m]
1	-1.81	115.13	20.04

Verification of foundation soil

Stress in the footing bottom : rectangle

Eccentricity verification

Max. eccentricity of normal force $e = 0.000$

Maximum allowable eccentricity $e_{alw} = 0.333$

Eccentricity of the normal force is SATISFACTORY

Verification of bearing capacity

Bearing capacity of foundation soil $R = 250.00$ kPa

Partial factor on bearing capacity $\gamma_{Rv} = 1.35$

Max. stress at footing bottom $\sigma = 86.35$ kPa

Bearing capacity of foundation soil $R_d = 185.19$ kPa

Bearing capacity of foundation soil is SATISFACTORY

Overall verification - bearing capacity of found. soil is SATISFACTORY

Verification of slip on georeinforcement No. 1

Forces acting on construction (verification of most utilized reinforcement)

Name	F_{hor} [kN/m]	App.Pt. z [m]	F_{vert} [kN/m]	App.Pt. x [m]	Design coefficient
Weight - wall	0.00	-1.30	14.92	0.00	1.000
Active pressure	13.22	-0.73	3.79	1.76	1.500



Name	F_{hor} [kN/m]	App.Pt. z [m]	F_{vert} [kN/m]	App.Pt. x [m]	Design coefficient
5kPa	4.12	-1.08	1.18	1.79	1.500
Weight - reinforced soil	0.00	-1.20	78.97	0.95	1.000
5kPa	0.00	-2.36	7.05	1.27	0.000

Check for slip along geo-reinforcement with the maximal utilization (Reinforc. No.: 1)

Inclination of slip surface = 84.00 °
Overall normal force acting on reinforcement = 86.43 kN/m
Coefficient of reduction of slip along
geo-textile = 0.60
Resistance along geo-reinforcement = 36.31 kN/m
Wall resistance = 7.95 kN/m
Overall bearing capacity of reinforcements = 0.00 kN/m

Check for slip:

Resisting horizontal force H_{res} = 34.05 kN/m
Active horiz. force H_{act} = 26.01 kN/m

Slip along geotextile is SATISFACTORY

Slope stability analysis

Input data

Project

Settings

BS 8006 - MSE Wall

Wall analysis

Partial factors of soil properties			
Partial factor on internal friction :	f_{ms} =	1.00	[-]
Partial factor on effective cohesion :	f_{ms} =	1.60	[-]
Partial factor on undrained shear strength :	f_{ms} =	1.00	[-]
Resistance factors			
Resistance factor on sliding :	f_s =	1.20	[-]
Resistance factor on bearing capacity :	f_{ms} =	1.35	[-]
Resistance factor for pullout of reinforcement :	f_p =	1.30	[-]
Partial factors of slip on reinforcement :	f_s =	1.30	[-]
Partial factors - wall			
	Combination A		Combination B
Dead load of structural components :	f_{fs} =	1.50 [-]	1.00 [-]
Earth pressure - active :	f_{fs} =	1.50 [-]	1.50 [-]
Permanent load - on the block :	f_f =	1.50 [-]	1.00 [-]
Permanent load - behind the block :	f_f =	1.50 [-]	1.50 [-]
Variable load - on the block :	f_q =	1.50 [-]	0.00 [-]
Variable load - behind the block :	f_q =	1.50 [-]	1.50 [-]
Partial factors - slope			
Dead load of structural components :	f_{fs} =	1.50	[-]



Partial factors - slope

Earth surcharge load (permanent) :	$f_f =$	1.20	[-]
Live load surcharge :	$f_q =$	1.30	[-]

Stability analysis

Earthquake analysis : Standard

Verification methodology : according to EN 1997

Design approach : 1 - reduction of actions and soil parameters

Partial factors on actions (A)

Permanent design situation

		Combination 1		Combination 2	
		Unfavourable	Favourable	Unfavourable	Favourable
Permanent actions :	$\gamma_G =$	1.35 [-]	1.00 [-]	1.00 [-]	1.00 [-]
Variable actions :	$\gamma_Q =$	1.50 [-]	0.00 [-]	1.30 [-]	0.00 [-]
Water load :	$\gamma_w =$	1.00 [-]		1.00 [-]	

Partial factors for soil parameters (M)

Permanent design situation

		Combination 1		Combination 2	
Partial factor on internal friction :	$\gamma_\phi =$	1.00 [-]		1.25 [-]	
Partial factor on effective cohesion :	$\gamma_c =$	1.00 [-]		1.25 [-]	
Partial factor on undrained shear strength :	$\gamma_{cu} =$	1.00 [-]		1.40 [-]	

Interface

No.	Interface location	Coordinates of interface points [m]					
		x	z	x	z	x	z
1		-10.00	0.00	-0.52	0.00	-0.50	0.00
		-0.50	0.20	-0.48	0.20	-0.48	0.40
		-0.46	0.40	-0.46	0.60	-0.44	0.60
		-0.44	0.80	-0.42	0.80	-0.42	1.00
		-0.40	1.00	-0.40	1.20	-0.38	1.20
		-0.38	1.40	-0.36	1.40	-0.36	1.60
		-0.34	1.60	-0.34	1.80	-0.32	1.80
		-0.32	2.00	-0.30	2.00	-0.30	2.20
		-0.28	2.20	-0.28	2.40	0.00	2.40
		1.70	2.00	4.20	1.40	20.30	1.40
2		-0.54	-0.40	-0.26	-0.40	-0.26	-0.20
		-0.24	-0.20	-0.24	0.00	-0.22	0.00
		-0.22	0.20	-0.20	0.20	-0.20	0.40
		-0.18	0.40	-0.18	0.60	-0.16	0.60
		-0.16	0.80	-0.14	0.80	-0.14	1.00
		-0.12	1.00	-0.12	1.20	-0.10	1.20
		-0.10	1.40	-0.08	1.40	-0.08	1.60
		-0.06	1.60	-0.06	1.80	-0.04	1.80
		-0.04	2.00	-0.02	2.00	-0.02	2.20
		0.00	2.20	0.00	2.40		
3		-0.26	-0.40	1.46	-0.40	1.48	-0.20
		1.50	0.00	1.54	0.40	1.60	1.00
		1.66	1.60	1.70	2.00		



No.	Interface location	Coordinates of interface points [m]					
		x	z	x	z	x	z
4		1.50	0.00	20.30	0.00		
5		-10.00	-0.40	-0.54	-0.40	-0.54	-0.20
		-0.52	-0.20	-0.52	0.00		

Soil parameters - effective stress state

No.	Name	Pattern	ϕ_{ef} [°]	c_{ef} [kPa]	γ [kN/m ³]
1	Kellaway CLAY (R)		22.00	0.00	19.00
2	Class 6l		35.00	0.00	19.00
3	Cornbrash formation (F)		25.00	0.00	22.00

Soil parameters - uplift

No.	Name	Pattern	γ_{sat} [kN/m ³]	γ_s [kN/m ³]	n [-]
1	Kellaway CLAY (R)		22.00		
2	Class 6l		20.00		
3	Cornbrash formation (F)		22.00		

Soil parameters

Kellaway CLAY (R)

Unit weight : $\gamma = 19.00$ kN/m³
Stress-state : effective
Angle of internal friction : $\phi_{ef} = 22.00$ °
Cohesion of soil : $c_{ef} = 0.00$ kPa
Saturated unit weight : $\gamma_{sat} = 22.00$ kN/m³

Class 6l

Unit weight : $\gamma = 19.00$ kN/m³
Stress-state : effective

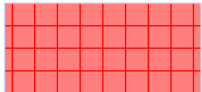


Angle of internal friction : $\varphi_{ef} = 35.00^\circ$
Cohesion of soil : $c_{ef} = 0.00 \text{ kPa}$
Saturated unit weight : $\gamma_{sat} = 20.00 \text{ kN/m}^3$

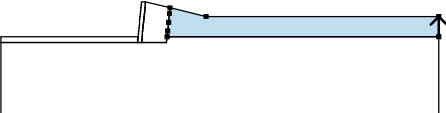
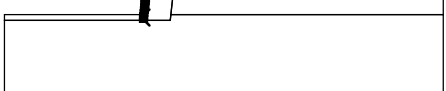
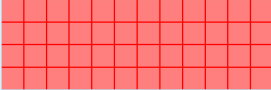
Cornbrash formation (F)

Unit weight : $\gamma = 22.00 \text{ kN/m}^3$
Stress-state : effective
Angle of internal friction : $\varphi_{ef} = 25.00^\circ$
Cohesion of soil : $c_{ef} = 0.00 \text{ kPa}$
Saturated unit weight : $\gamma_{sat} = 22.00 \text{ kN/m}^3$

Rigid Bodies

No.	Name	Sample	γ [kN/m ³]
1	Material of structure		20.50

Assigning and surfaces

No.	Surface position	Coordinates of surface points [m]				Assigned soil
		x	z	x	z	
1		20.30	0.00	20.30	1.40	Kellaway CLAY (R) 
		4.20	1.40	1.70	2.00	
		1.66	1.60	1.60	1.00	
		1.54	0.40	1.50	0.00	
2		-0.52	-0.20	-0.54	-0.20	Material of structure 
		-0.54	-0.40	-0.26	-0.40	
		-0.26	-0.20	-0.24	-0.20	
		-0.24	0.00	-0.22	0.00	
		-0.22	0.20	-0.20	0.20	
		-0.20	0.40	-0.18	0.40	
		-0.18	0.60	-0.16	0.60	
		-0.16	0.80	-0.14	0.80	
		-0.14	1.00	-0.12	1.00	
		-0.12	1.20	-0.10	1.20	
		-0.10	1.40	-0.08	1.40	
		-0.08	1.60	-0.06	1.60	
		-0.06	1.80	-0.04	1.80	
		-0.04	2.00	-0.02	2.00	
		-0.02	2.20	0.00	2.20	
		0.00	2.40	-0.28	2.40	
		-0.28	2.20	-0.30	2.20	
		-0.30	2.00	-0.32	2.00	
		-0.32	1.80	-0.34	1.80	
		-0.34	1.60	-0.36	1.60	
		-0.36	1.40	-0.38	1.40	
		-0.38	1.20	-0.40	1.20	
		-0.40	1.00	-0.42	1.00	
		-0.42	0.80	-0.44	0.80	
		-0.44	0.60	-0.46	0.60	



No.	Surface position	Coordinates of surface points [m]				Assigned soil
		x	z	x	z	
3		-0.46	0.40	-0.48	0.40	Class 6I
		-0.48	0.20	-0.50	0.20	
		-0.50	0.00	-0.52	0.00	
		1.46	-0.40	1.48	-0.20	
		1.50	0.00	1.54	0.40	
		1.60	1.00	1.66	1.60	
		1.70	2.00	0.00	2.40	
		0.00	2.20	-0.02	2.20	
		-0.02	2.00	-0.04	2.00	
		-0.04	1.80	-0.06	1.80	
		-0.06	1.60	-0.08	1.60	
		-0.08	1.40	-0.10	1.40	
		-0.10	1.20	-0.12	1.20	
		-0.12	1.00	-0.14	1.00	
		-0.14	0.80	-0.16	0.80	
		-0.16	0.60	-0.18	0.60	
		-0.18	0.40	-0.20	0.40	
		-0.20	0.20	-0.22	0.20	
		-0.22	0.00	-0.24	0.00	
		-0.24	-0.20	-0.26	-0.20	
4		-0.54	-0.40	-0.54	-0.20	Cornbrash formation (F)
		-0.52	-0.20	-0.52	0.00	
		-10.00	0.00	-10.00	-0.40	
5		-10.00	-0.40	-10.00	-5.40	Cornbrash formation (F)
		20.30	-5.40	20.30	0.00	
		1.50	0.00	1.48	-0.20	
		1.46	-0.40	-0.26	-0.40	
		-0.54	-0.40			

Reinforcements

No.	Point to the left		Point to the right		Length L [m]	Strength R_t [kN/m]	Pull out resist.	End of reinf.
	x [m]	z [m]	x [m]	z [m]				
1	-0.02	2.00	1.70	2.00	1.72	27.64	$T_p = 4.30 \text{ kN/m}^2$	Fixed
2	-0.06	1.60	1.66	1.60	1.72	27.64	$T_p = 8.60 \text{ kN/m}^2$	Fixed
3	-0.12	1.00	1.60	1.00	1.72	27.64	$T_p = 15.05 \text{ kN/m}^2$	Fixed
4	-0.18	0.40	1.54	0.40	1.72	27.64	$T_p = 21.49 \text{ kN/m}^2$	Fixed
5	-0.24	-0.20	1.48	-0.20	1.72	27.64	$T_p = 32.25 \text{ kN/m}^2$	Fixed

Surcharge

No.	Type	Type of action	Location z [m]	Origin x [m]	Length l [m]	Width b [m]	Slope α [°]	Magnitude		
								q, q_1, f, F, x	q_2, z	unit
1	strip	variable	on terrain	$x = 0.30$	$l = 20.00$		0.00	5.00		kN/m ²

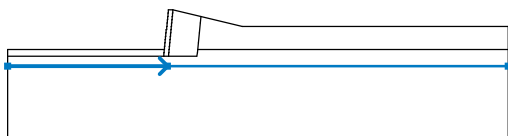


Surcharges

No.	Name
1	5kPa

Water

Water type : GWT

No.	GWT location	Coordinates of GWT points [m]					
		x	z	x	z	x	z
1		-10.00	-1.00	-0.32	-1.00	20.30	-1.00

Tensile crack

Tensile crack not input.

Earthquake

Earthquake not included.

Settings of the stage of construction

Design situation : permanent

Results (Stage of construction 1)

Analysis 1

Circular slip surface

Slip surface parameters					
Center :	x =	-0.58 [m]	Angles :	α_1 =	-39.02 [°]
	z =	2.89 [m]		α_2 =	71.36 [°]
Radius :	R =	3.72 [m]			
The slip surface after optimization.					

Reinforcement bearing capacity

Combination 1

Reinforcement Bearing capacity [kN/m]

1	0.00
2	0.00
3	0.00
4	0.00
5	0.13

Combination 2

Reinforcement Bearing capacity [kN/m]

1	0.00
2	0.00
3	0.00
4	0.00
5	0.00

Slope stability verification (Bishop)

Combination 1

Sum of active forces : F_a = 72.38 kN/m

Sum of passive forces : F_p = 102.63 kN/m



Sliding moment : $M_a = 233.06$ kNm/m
Resisting moment : $M_p = 330.47$ kNm/m
Utilization : 70.5 %

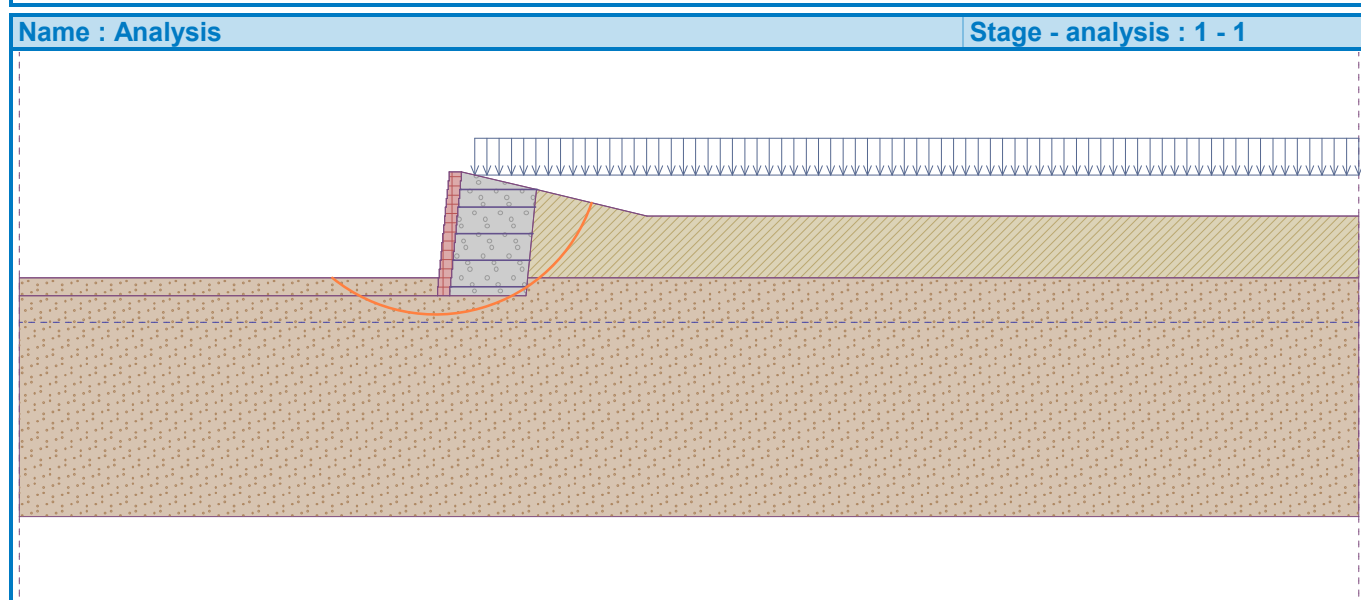
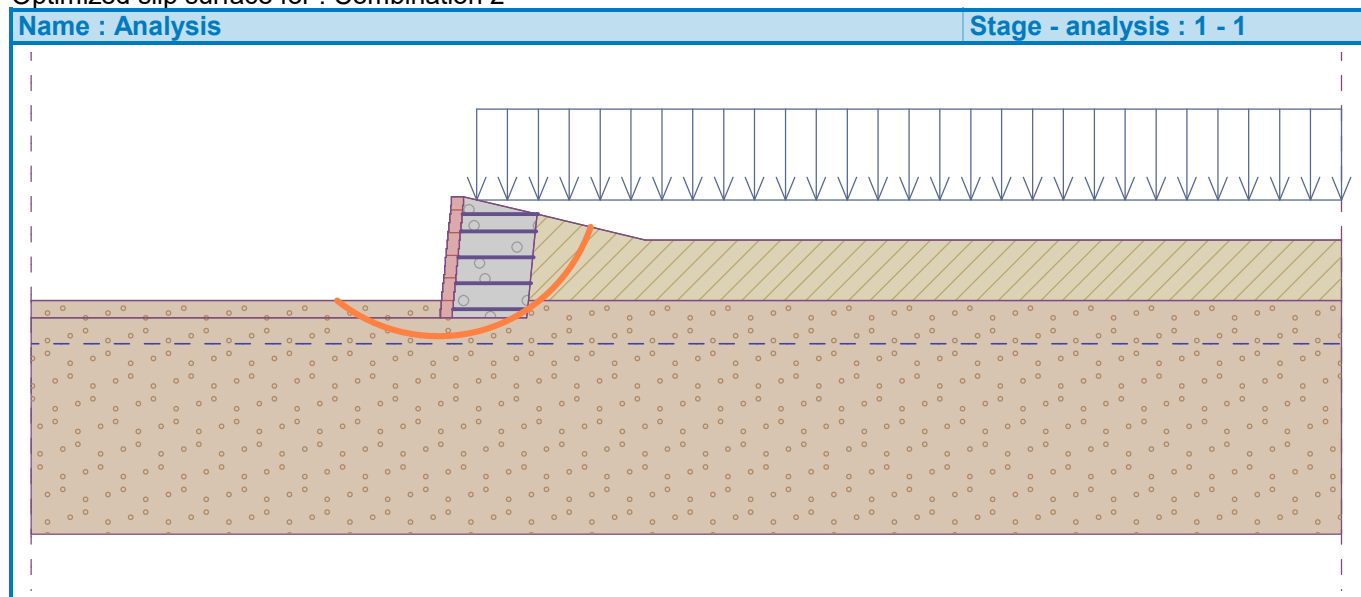
Slope stability ACCEPTABLE

Combination 2

Sum of active forces : $F_a = 58.89$ kN/m
Sum of passive forces : $F_p = 74.66$ kN/m
Sliding moment : $M_a = 219.08$ kNm/m
Resisting moment : $M_p = 277.75$ kNm/m
Utilization : 78.9 %

Slope stability ACCEPTABLE

Optimized slip surface for : Combination 2





Name : Analysis

Stage - analysis : 1 - 1

