

Project Name and Location:

Two 5.3m high, 70m long Rootlok hybrid geogrid/soil nail reinforced walls at Stour view, Brantham, Suffolk

Year of construction:

February 2021

Designer name (Company):

Kenneth Knox
Stabilisure Ltd.

Used software (GEO5):

MSE Wall
Slope Stability

Project description:

This key challenge of this project was fitting an environmentally friendly green faced wall and temporary cut within the 4.20m footprint available between the toe and the site boundary, despite the retained soil being a fissured high plasticity clay.

In order to do this, we combined the soil nail reinforcement for the temporary cut and the geogrid reinforced soil into one structure by creating a positive connection at the head plates of the soil nails by wrapping the geogrid back to the facing.

The bulk of the analysis was carried out in the Slope Stability module, by representing the soil nails with the ground anchor option, taking the free length through the reinforced soil block and the root length as the soil nails. This way any slip plane through the reinforced soil block was restrained by the geogrid pullout plus the coupled soil nails. The Rootlok facing was keyed in as a material with a high shear strength, but using foliation to model the interface shear parameters between the bags when the failure plane was close to horizontal.

Polygonal slope stability analysis was used, restricted to specific locations, to target the key internal and external failure modes. Global and temporary stability checks were carried out as normal.

Due to the unconventional analysis method, the internal and external stability calculations were verified by exporting the body forces from the verification tab to a spreadsheet, where the soil nail pullout loads could be calculated and added in, to ensure the analysis was conservative.

















GeoGrow



Rootlok

Vegetated Wall System

A graphic of a tree root system, with a main trunk and several smaller roots branching out, positioned below the text "Vegetated Wall System".



Slope stability analysis

Input data

Project

Task : Rootlok Retaining Wall
Part : Section 1-1
Description : GE20-3024-02
Customer : Geogrow
Author : Kenneth Knox
Date : 28/07/20
Project ID : Brantham, Suffolk
Project number : 20-3024

Settings

Standard - EN 1997 - DA1

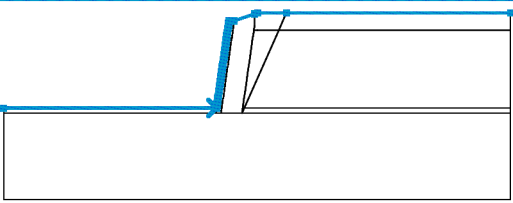
Stability analysis

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 : | $\gamma_w =$ | 1.35 [-] | | 1.00 [-] | |

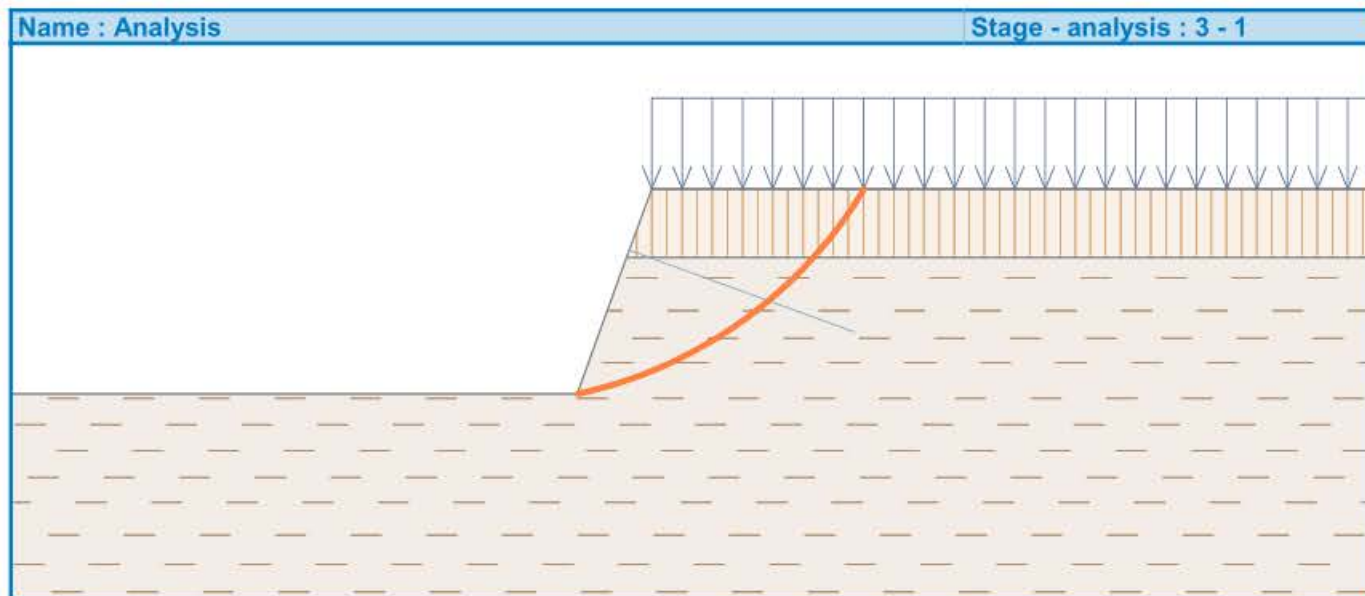
| Partial factors for soil parameters (M) | | | |
|--|-----------------|---------------|---------------|
| Permanent design situation | | | |
| | | Combination 1 | Combination 2 |
| Partial factor on internal friction : | $\gamma_\phi =$ | 1.00 [-] | 1.25 [-] |
| Partial factor on effective cohesion : | $\gamma_c =$ | 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 |  | -13.30 | -5.04 | -1.02 | -5.04 | -1.00 | -5.04 |
| | | -1.00 | -4.90 | -0.98 | -4.90 | -0.98 | -4.76 |
| | | -0.96 | -4.76 | -0.96 | -4.62 | -0.94 | -4.62 |
| | | -0.94 | -4.48 | -0.92 | -4.48 | -0.92 | -4.34 |
| | | -0.90 | -4.34 | -0.90 | -4.20 | -0.88 | -4.20 |
| | | -0.88 | -4.06 | -0.86 | -4.06 | -0.86 | -3.92 |
| | | -0.84 | -3.92 | -0.84 | -3.78 | -0.82 | -3.78 |
| | | -0.82 | -3.64 | -0.80 | -3.64 | -0.80 | -3.50 |
| | | -0.78 | -3.50 | -0.78 | -3.36 | -0.76 | -3.36 |
| | | -0.76 | -3.22 | -0.74 | -3.22 | -0.74 | -3.08 |
| | | -0.72 | -3.08 | -0.72 | -2.94 | -0.70 | -2.94 |
| | | -0.70 | -2.80 | -0.68 | -2.80 | -0.68 | -2.66 |
| | | -0.66 | -2.66 | -0.66 | -2.52 | -0.64 | -2.52 |
| | | -0.64 | -2.38 | -0.62 | -2.38 | -0.62 | -2.24 |
| | | -0.60 | -2.24 | -0.60 | -2.10 | -0.58 | -2.10 |
| | | -0.58 | -1.96 | -0.56 | -1.96 | -0.56 | -1.82 |



Optimized slip surface for : Combination 2


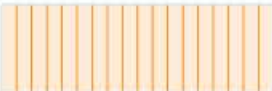
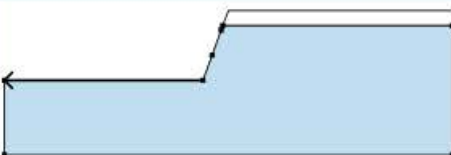



Input data (Stage of construction 4)

Earth cut

| No. | Cut location | Coordinates of cut points [m] | | | | | |
|-----|---|-------------------------------|-------|-------|-------|-------|-------|
| | | x | z | x | z | x | z |
| 1 |  | -15.00 | -4.21 | -1.70 | -4.21 | -1.09 | -2.53 |

Assigning and surfaces

| No. | Surface position | Coordinates of surface points [m] | | | | Assigned soil |
|-----|---|-----------------------------------|-------|--------|-------|--|
| | | x | z | x | z | |
| 1 |  | 15.00 | -0.54 | 15.00 | 0.46 | Tension Crack  |
| | | 0.00 | 0.46 | -0.37 | -0.54 | |
| 2 |  | -1.70 | -4.21 | -15.00 | -4.21 | Thames Valley Group  |
| | | -15.00 | -9.21 | 15.00 | -9.21 | |
| | | 15.00 | -0.54 | -0.37 | -0.54 | |
| | | -0.48 | -0.85 | -1.09 | -2.53 | |

Nails

| No. | Nail new | Start pt. | | Length | nclination | Spacing | Tension strength | Pull out resistance | Nail head strength |
|-----|----------|-----------|-------|--------|--------------|---------|-------------------------------------|---------------------|--------------------|
| | | x [m] | z [m] | l [m] | α [°] | b [m] | | | |
| 1 | No | -0.33 | -0.43 | 3.50 | 20.00 | 0.50 | $d_s = 12.0$ mm, $f_y = 240.00$ MPa | $T_p = 3.00$ kN/m | $R_f = 5.00$ kN |
| 2 | Yes | -0.64 | -1.27 | 3.50 | 20.00 | 0.50 | $d_s = 12.0$ mm, $f_y = 240.00$ MPa | $T_p = 3.00$ kN/m | $R_f = 5.00$ kN |



Nail Bearing capacity [kN/m]

| | |
|---|------|
| 1 | 0.00 |
| 2 | 0.00 |
| 3 | 0.00 |
| 4 | 0.00 |
| 5 | 4.34 |

Combination 2

Nail Bearing capacity [kN/m]

| | |
|---|------|
| 1 | 0.00 |
| 2 | 0.00 |
| 3 | 0.00 |
| 4 | 0.00 |
| 5 | 4.34 |

Slope stability verification (Bishop)

Combination 1

Sum of active forces : $F_a = 473.67$ kN/m

Sum of passive forces : $F_p = 509.34$ kN/m

Sliding moment : $M_a = 5428.26$ kNm/m

Resisting moment : $M_p = 5837.09$ kNm/m

Utilization : 93.0 %

Slope stability ACCEPTABLE

Combination 2

Sum of active forces : $F_a = 365.44$ kN/m

Sum of passive forces : $F_p = 369.16$ kN/m

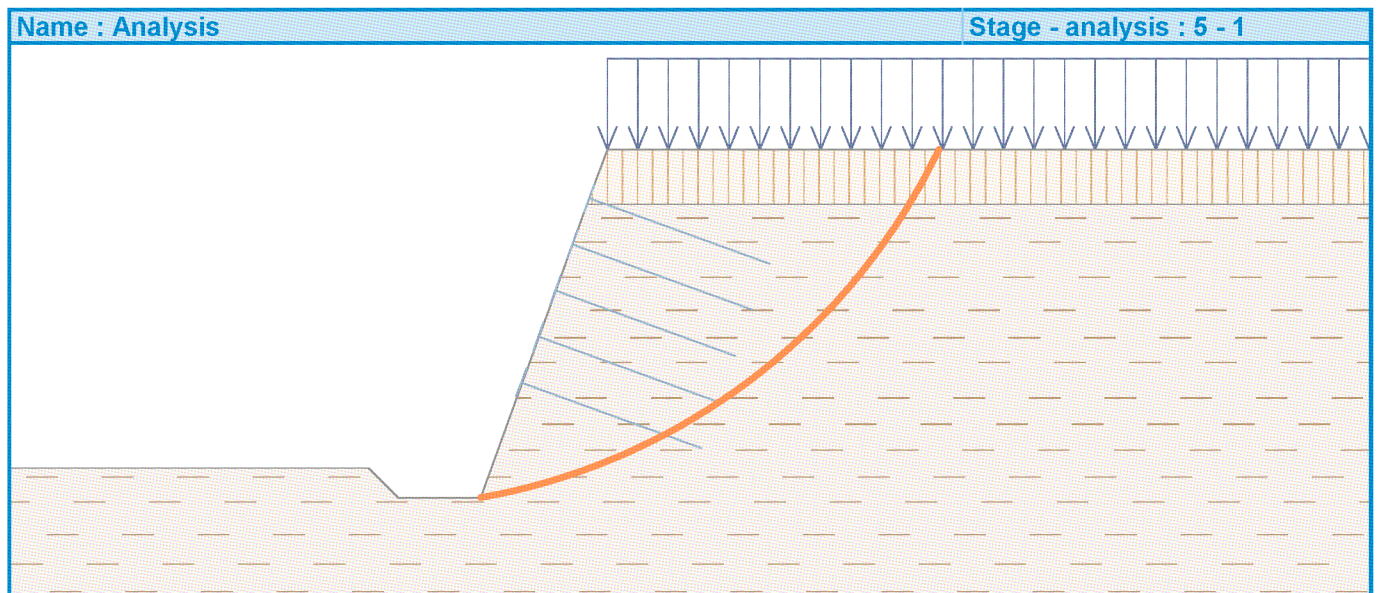
Sliding moment : $M_a = 4187.98$ kNm/m

Resisting moment : $M_p = 4230.61$ kNm/m

Utilization : 99.0 %

Slope stability ACCEPTABLE

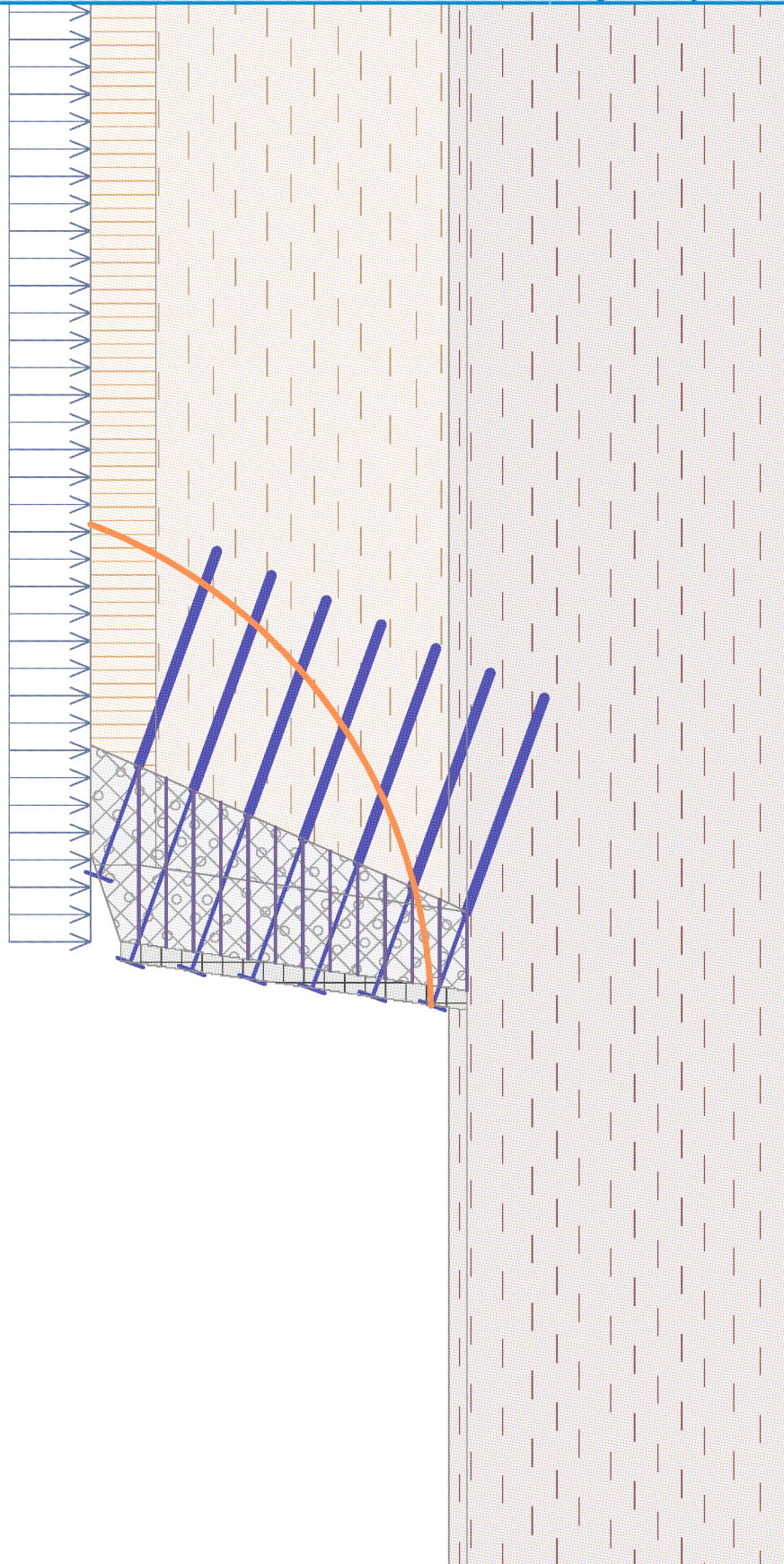
Optimized slip surface for : Combination 2





Name : Analysis

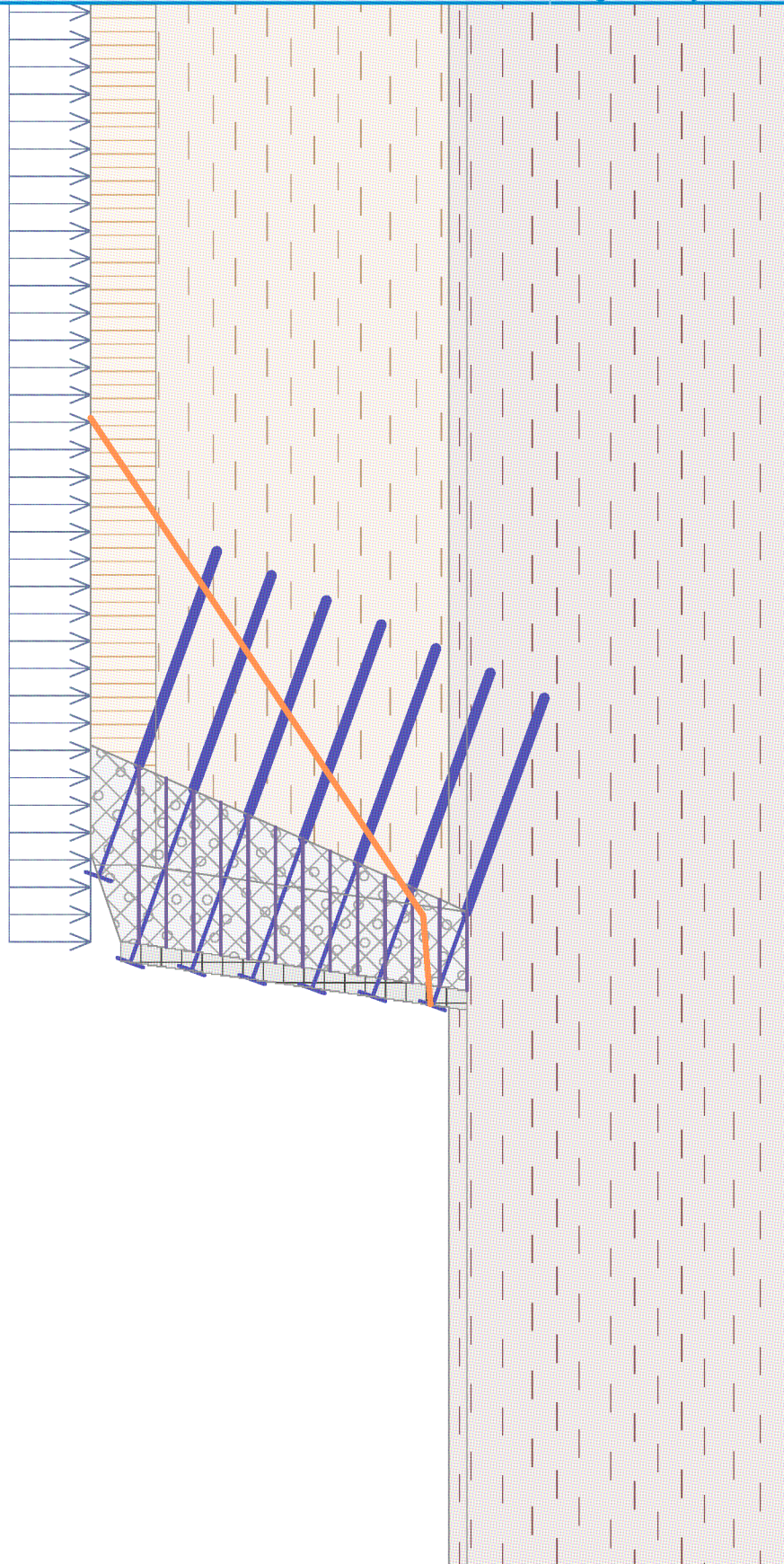
Stage - analysis : 2 - 1





Name : Analysis

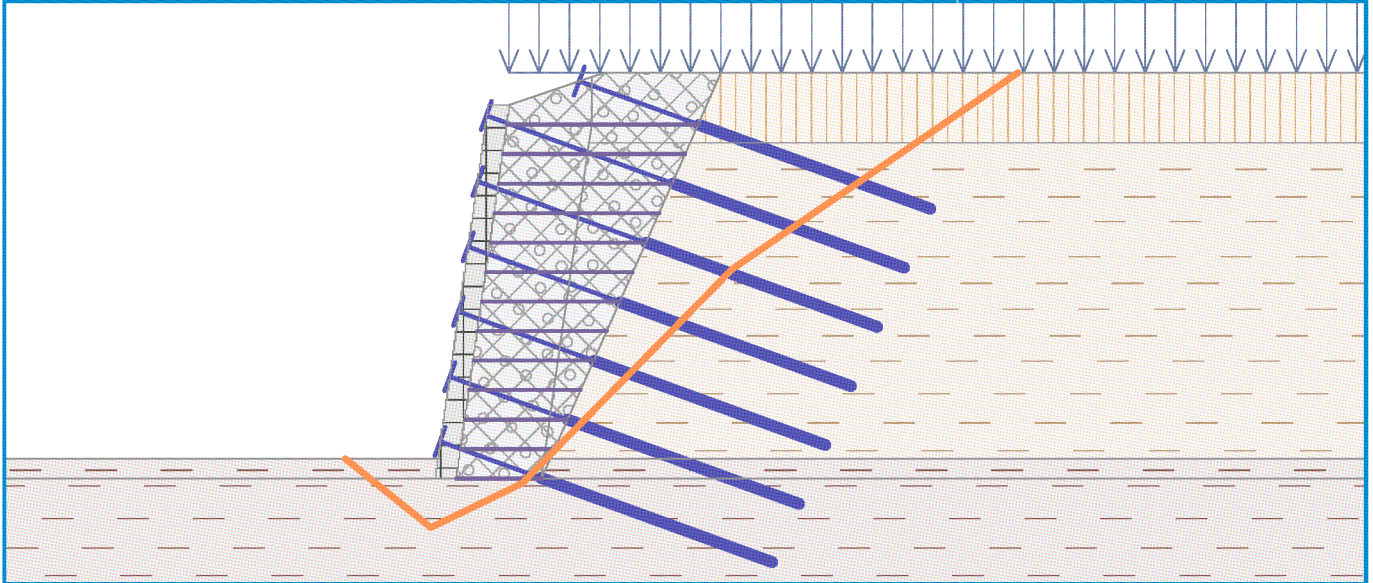
Stage - analysis : 2 - 2

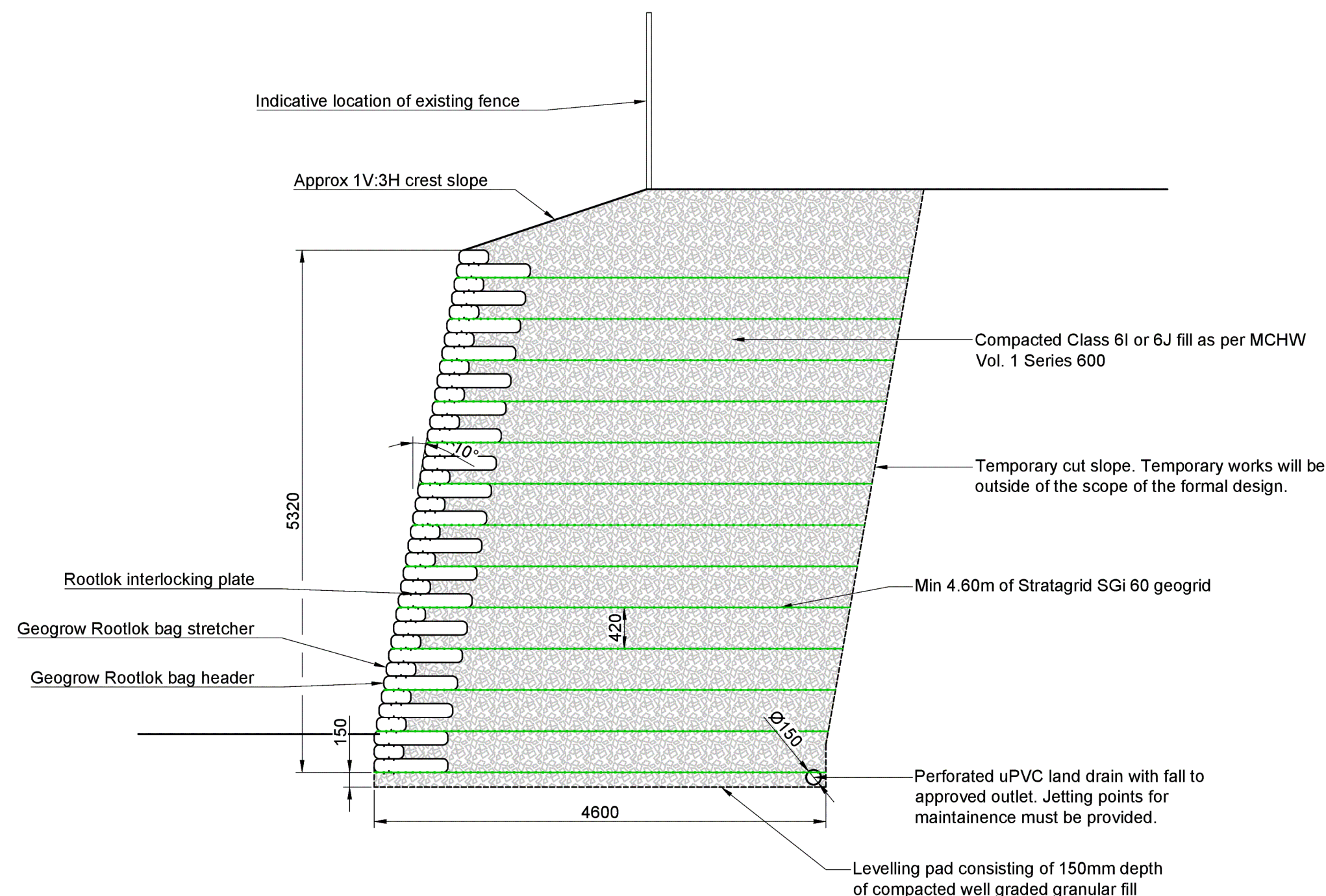
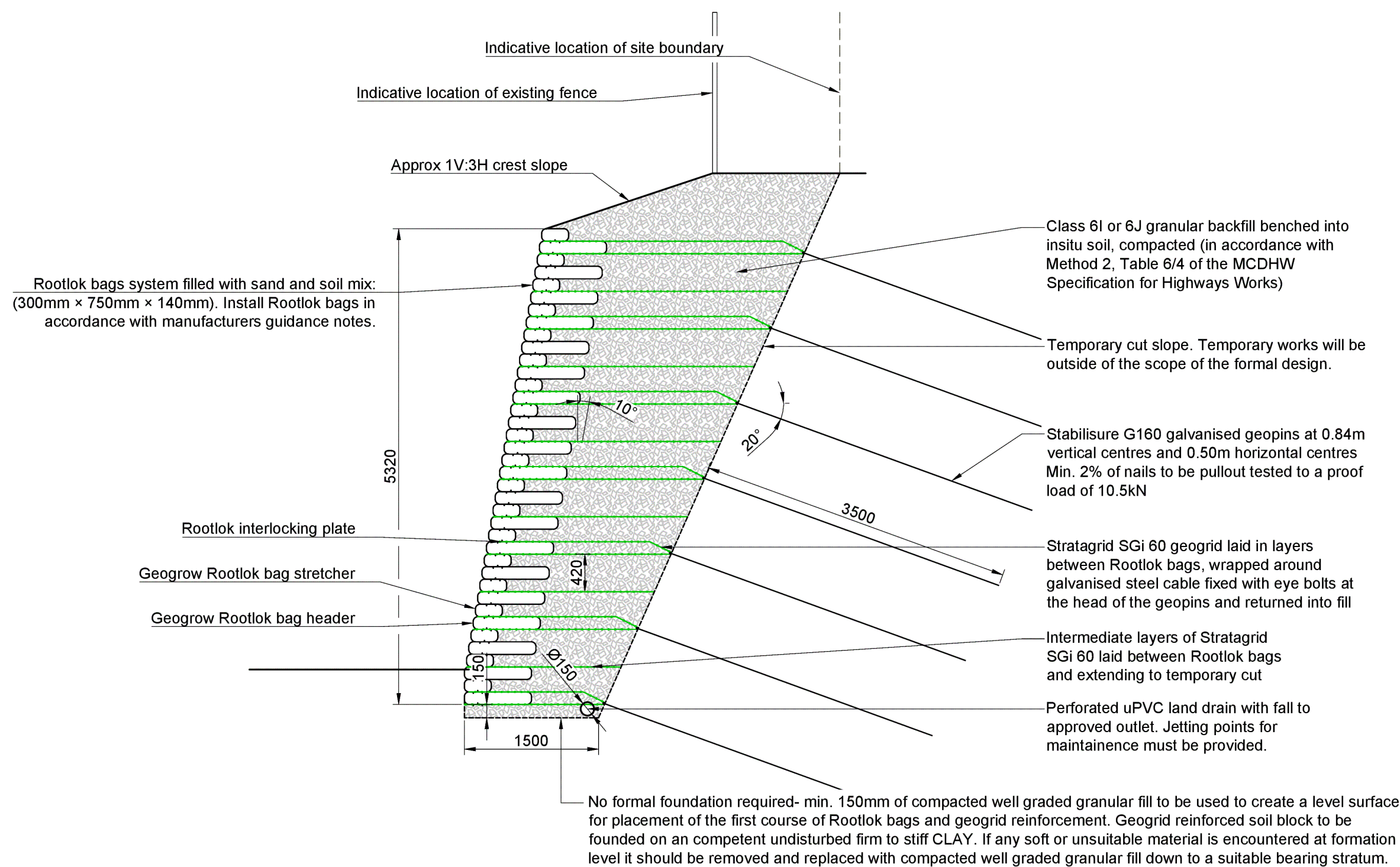




Name : Analysis

Stage - analysis : 2 - 3





Advice regarding Temporary Works for Section 1-1

There is a risk of dissection of the upper layers of Thames Valley Group clay causing fissures within the retained soil that may weaken the soil, particularly following rainfall, therefore a visual inspection of the retained side of the temporary cut is strongly recommended prior to beginning excavation.

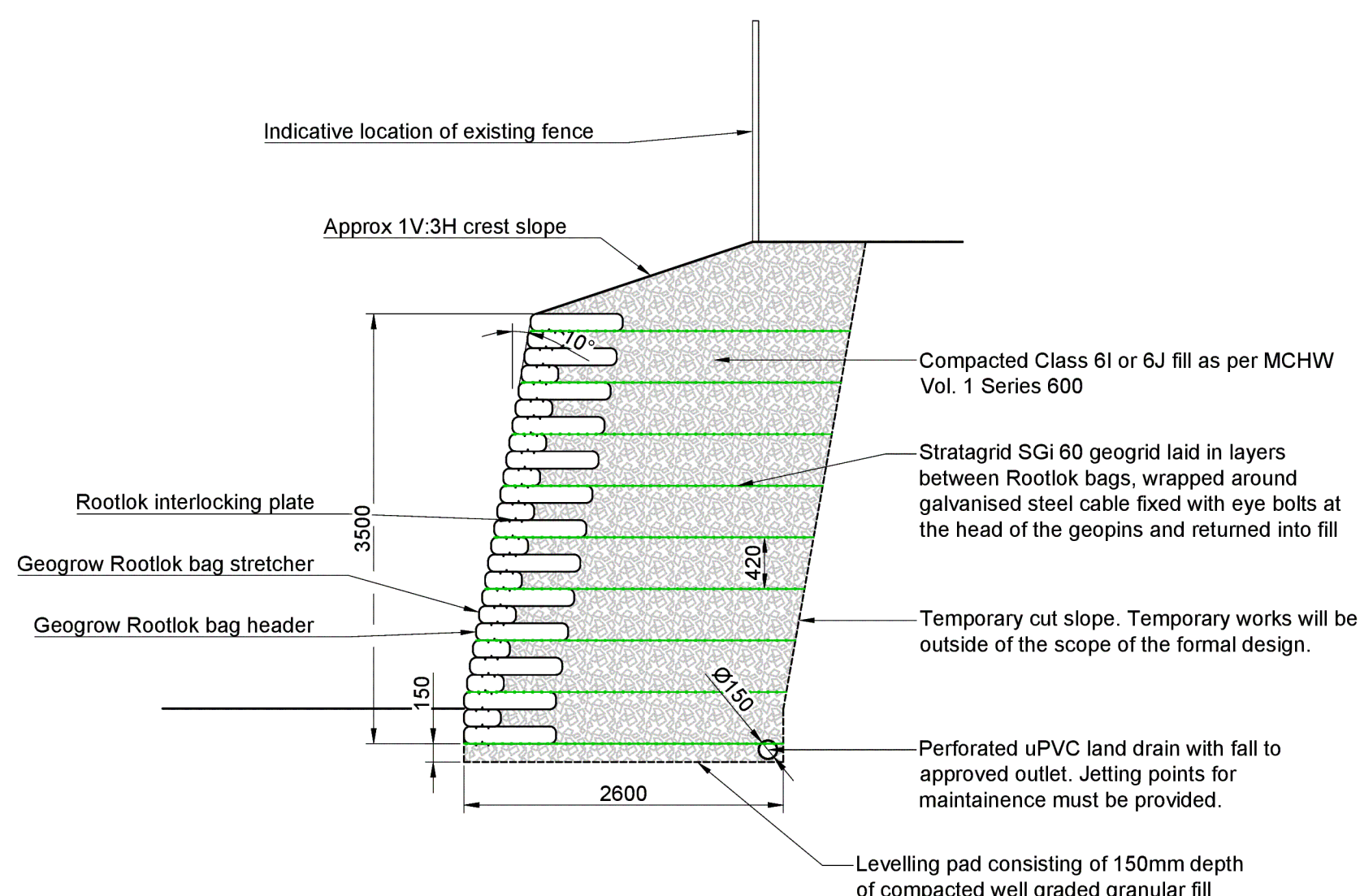
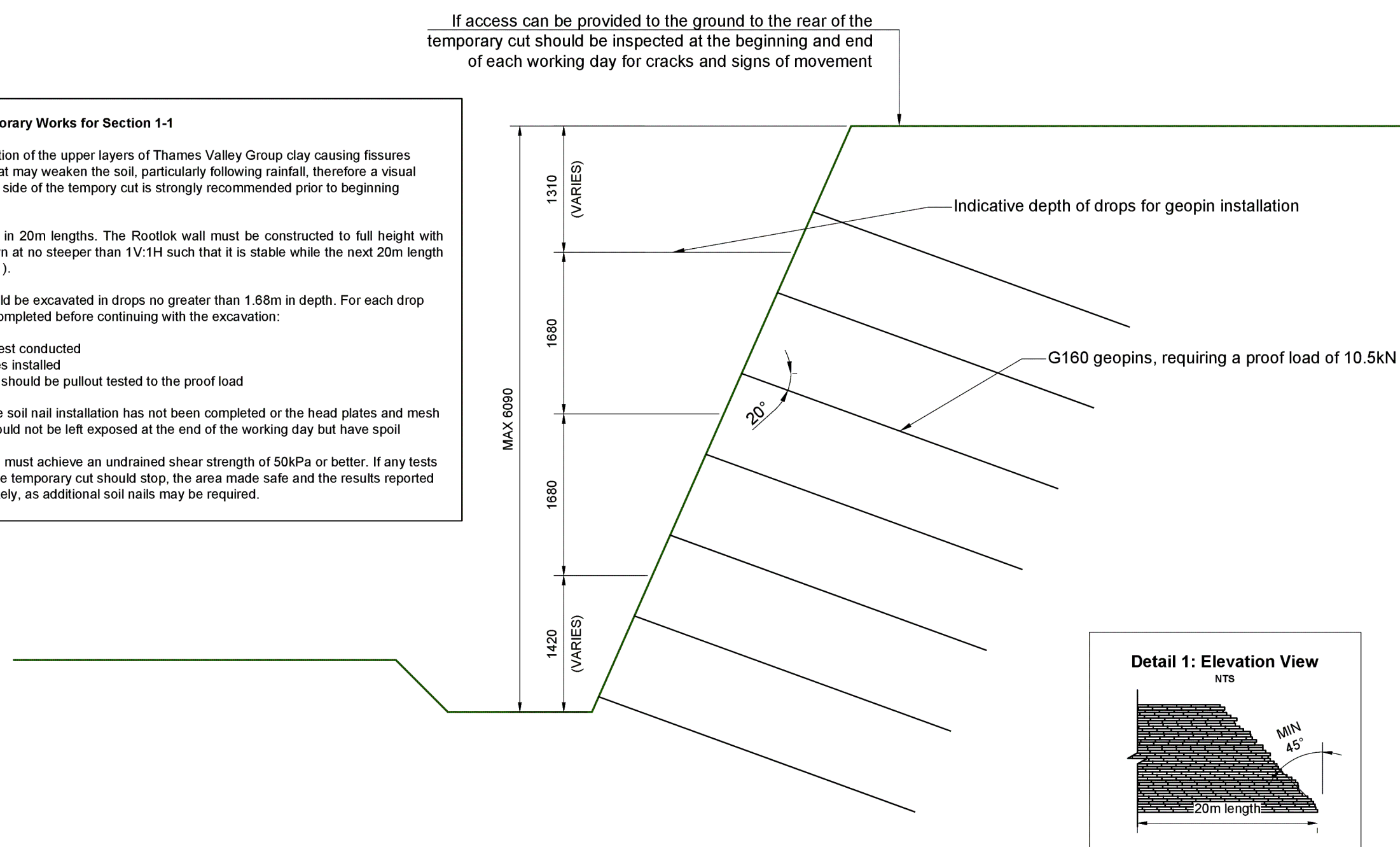
Excavation to take place in 20m lengths. The Rootlock wall must be constructed to full height with leading end battered down at no steeper than 1V:1H such that it is stable while the next 20m length is excavated (see Detail 1).

The existing ground should be excavated in drops no greater than 1.68m the following should be completed before continuing with the excavation:

- Geopins installed
- Hand shear vane test conducted
- Soil nail head plates installed
- Min. 1 nail per row should be pullout tested to the proof load

Any excavation where the soil nail installation has not been completed or the head plates and mesh have not been affixed should not be left exposed at the end of the working day but have spoil banked up at the face.

All hand shear vane tests must achieve an undrained shear strength of 50kPa or better. If any tests are failed then work on the temporary cut should stop, the area made safe and the results reported to Geoman Ltd. immediately, as additional soil nails may be required.



- 1) **Dimensions**
All dimensions in mm unless otherwise specified.

- 2) **Material Specification**
Geogrow Ltd. Rootlok bags system filled with sand and soil mix: (300mm x 750mm x 140mm) as per manufacturers details. Interlocking plates to be provided between courses of Rootlok bags.
Stabilisure G160 solid core high tensile steel geopins installed by Stabilisure Ltd
Stratagrid SGi 60 uniaxial geogrid

- 3) **Engineered Fill**
Imported well graded granular fill compliant with Class 6I or Class 6J fill, as defined by Series 600 of the MCHW Specification for Highway Works, must be used as the reinforced backfill. Suitable material must be placed and compacted in accordance with the MCHW Specification for Highway Works, Series 600, Table 6/4 Method 2.

Quality control testing should follow the principles set out in HA 44/91 and under responsibility of the Principal Contractor and Client's Consulting Engineer.

- 4) Rootlok Facing**
Rootlok bags to be installed as per Geogrow's installation guidelines. The Rootlok bags must be filled with a sand and topsoil mix as recommended by Geogrow. The Principal Contractor must accept it will be their responsibility to ensure successful vegetation achieved by careful construction, inclusion of suitable seeded topsoil and ensuring the Rootlok bags do not dry out. The face of the Rootlok slope is to be hydroseeded within 2 weeks of construction.

- 5) **Ground Profile**
Foundation (assumed to be original stiff CLAY):
 $\phi' = 20^\circ$, $\gamma = 18.5 \text{ kN/m}^3$ and $c' = 20 \text{ kPa}$
Retained (assumed to be original stiff CLAY, partially fissured or weathered):
 $\phi' = 20^\circ$, $\gamma = 18.5 \text{ kN/m}^3$ and $c' = 2 \text{ kPa}$

- 6) Temporary Cut**
This solution is for the permanent works only, and is issued on the basis that a safe system of works is provided for construction. However some measures have been advised on SK20-3024-04 as a minimum due to the hazardous ground conditions and limited space to the site boundary.

- 7) **Stabilisire Geopins**
The G160 geopins will be driven 3.50m at 20° below the horizontal into original firm CLAY. A minimum of 2% of geopins should be pull out tested to verify the design bond strength, to a proof load of 10.5kN. Any failed geopins are to be removed and replaced at a different location.

Eye bolt to be attached to the head of the geopins and a galvanised steel cable threaded through. Once installed the geogrid should be wrapped around, and returned to the face over a compacted layer of fill. Secondary strands of the geogrid may be cut around the eye bolts.

- 8) **Drainage**
A 150mmØ perforated drainage pipe should be placed along the full length of the wall as shown on the cross-sections. This should be fully roddable/jettable and connected to appropriate site drainage outlet.

- 9) **Site Geometry**
All slope geometry, setting out and required offsets to be confirmed by the Principal Contractor and/or Principal Designer prior to construction. The Principal Contractor must also confirm the locations of all services prior to construction and ensure that none will be affected by the reinforced slope and its installation.

- 10) Additional Notes**
This drawing and geotechnical design report should be reviewed by the project consulting engineer prior to construction to identify any errors, omissions or conflict with the overall scheme design. Construction of this slope shall not commence unless and until these have been reviewed.

FOR APPROVAL

| | | | |
|------|-------------------|--------|----------|
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| 0 | | KK | 08/08/20 |
| Rev. | Issue / Revision: | Drawn: | Date: |



Project Title: **Stour View, Brantham, Suffolk**

client: **GeoGrow**

Drawing Title:
Geopin Reinforced Wall with Rootlock
Facing - General Arrangement

| | | | | |
|-----------|----|-------|----------|--------------------------|
| Designed: | KK | Date: | 01/09/20 | Project No: 20-3024 |
| Drawn: | KK | Date: | 01/09/20 | |
| Checked: | | Date: | | Scale: AS INDICATED AT A |

Drawing No: SK20-3024-2-02

C