



# GEOMAN

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Approved Designer for:

**MACCAFERRI**

## Gabion Retaining Wall Design

|                                        |                            |
|----------------------------------------|----------------------------|
| <b>Location Address:</b>               | Bca School, Merthyr Tydfil |
| <b>Geoman Design Reference Number:</b> | 23-6011-F2                 |
| <b>Maccaferri CRM Project Number</b>   | 23-42090                   |

| Issued to                       | Issue purpose    | Revision | Designed | Checked | Date     |
|---------------------------------|------------------|----------|----------|---------|----------|
| Maccaferri Ltd., Willmott Dixon | For Approval     | P01      | ST       | WM      | 18.09.24 |
| Maccaferri Ltd., Willmott Dixon | For Construction | C01      | ST       | WM      | 20.11.24 |

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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## 1.0 Introduction

### 1.1 Brief

Maccaferri Ltd. requested that Geoman Ltd. carry out a design for a Gabion retaining wall as an element of the permanent works at the proposed development at BCA Catholic School in Merthyr Tydfil.

### 1.2 Scope

This design covers the proposed Gabion retaining wall that is to retain the carparking area. The limits of the gabion element design are from the base gabion unit, up to ground level to the rear of the top course of gabions.

Two cross-sections have been considered as follows:

| Section | Retained Height | Crest Slope Details              | Toe Slope Details | Drawing Ref                |
|---------|-----------------|----------------------------------|-------------------|----------------------------|
| 1-1     | 1.859m          | Max 1.5m high at 1V:2.5H (23°)   | None (TBC)        | BCA-GEO-VX-XX-D-C-1001-C01 |
| 2-2     | 0.871m          | Max 1.65.m high at 1V:2.5H (23°) | None (TBC)        | BCA-GEO-VX-XX-D-C-1001-C01 |

For the above sections:

- Some settlement will occur after construction, depending on the condition and compaction of the subgrade and retained material. The settlement should be monitored and all finishes should be delayed until settlement is complete.
- A maximum live load of 20kN/m<sup>2</sup> was assumed to act on the retained side of the wall at the top of the 1V:2.5H crest slope. A maximum 5kN/m<sup>2</sup> load was considered on the crest slope. Please advise if a higher allowance (such as for a piling rig) should be considered and we will revise this design.
- There is an allowance for unforeseen future excavation in front of the wall of 10% of the height (limited to a maximum of 0.5m), as per Eurocode 7, Cl. 9.3.2.2.
- We have been advised that no fencing is to be installed behind the wall. Geoman should be contacted if a fence is to be installed to review the proposals.
- 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.
- The Principal Contractor and Client's Consulting Engineer must ensure that any excavation required for the proposed gabion retaining wall does not affect the stability of any surrounding existing or proposed services, roads or structures. Unless the Client's Consulting Engineer accepts this, it is recommended that construction does not proceed.
- If any services are proposed to be installed in the proximity of the wall and/ or below proposed formation level of the wall, these services must be installed and backfilled prior to construction of the wall to avoid undermining the wall. The services should be backfilled with compacted granular fill to avoid creating any weak spots in front of the wall.



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All slope geometry, setting out and required offsets are to be confirmed by the Principal Contractor and Client's Consulting Engineer 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 Gabion wall and its installation.

The Client/Client's Consulting Engineer must check to see if any statutory approvals such as Technical Approval/ Geotechnical Certification are required for proposed works. If approvals are required, these must be gained prior to construction. If construction proceeds prior to necessary approvals being achieved, then it does so at the Client's own risk.

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.

**Please advise us before proceeding with construction if there are any errors in the scope.**

### 1.3 Responsible Parties

- Maccaferri Ltd. is the material supplier and our Client.
- Willmott Dixon is Maccaferri's Client and the Principal Contractor.
- The Client's Consulting Engineer is Cambria Consulting
- The wall installer is to be confirmed.
- Merthyr Tydfil Council are the Project Client.

The above parties should all read and check this design document before proceeding.

### 1.4 Information

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

- Indev Consult drawing '21-028-31M Levels Layout Sheet 2 of 4\_Roads and Sewers\_TEN\_Levels Layout Sheet 2 of 4\_M'
- Integral Geotechnique Site Investigation Report Ref 14075-P04 (Jan 2024)
- Maccaferri Design Brief

Geoman Ltd keep a record of all email correspondence.

## 2.0 Design

### 2.1 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.

#### 2.1.1 Ground Conditions Local to Wall

We have been provided with Integral Geotechnique Site Investigation Report Ref 14075-P04 (Jan 2024) which includes the logs of exploratory holes sunk on the site and associated geotechnical testing.

The logs in the vicinity of the wall were WS172, SA101 and SA102. These logs encountered generally consistent strata, with cohesive MADE GROUND encountered to between 0.7m and 1.0m bgl, overlying original firm to stiff sandy gravelly CLAY. A minimum SPT N value of 21 was recorded in this stratum.



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The wall is to predominantly formed in a cutting therefore the foundation startum is expected to be the original firm to stiff CLAY.

### 2.1.2 Selected Design Parameters

Based on the geotechnical information above, the soil parameters assumed in the design are therefore based on the above as follows:

| Material   | Description                  | Unit Weight (kN/m <sup>3</sup> ) | Assumed Min. Effective Angle of Internal Friction | Cohesion (kN/m <sup>2</sup> ) |
|------------|------------------------------|----------------------------------|---------------------------------------------------|-------------------------------|
| Foundation | Original firm to stiff CLAY  | 19.0                             | 28°                                               | 0                             |
| Retained   | soft CLAY/ Class 1/2C Upfill | 19.0                             | 28°                                               | 0                             |

To achieve a suitable foundation for the Gabion baskets, excavation must take place down to at least the levels indicated on the drawing and allow for the placement and compaction of a minimum 150mm thickness of selected granular material (Class 6F2/6F5 with assumed properties of  $\Phi' = 35$  degrees,  $\gamma = 18\text{kN/m}^3$  and  $c' = 0$  kPa). Formation level assumed to be on firm to still gravelly CLAY or with a minimum safe bearing resistance of 110kPa.

**Any soft/ low strength, loose or unsuitable material (such as made ground, alluvium or organics) at or below formation level that does not comply with the assumed soil parameters must be excavated out down to a competent stratum and replaced with compacted Class 6F2/6F5 granular material.**

The Principal Contractor and/ or a Geotechnical Engineer must confirm the suitability of the founding material, and that it has a safe bearing resistance of >110kPa prior to construction commencing. A series of hand shear vane/plate load tests should be carried out by the Principal Contractor to confirm this.

### 2.1.3 Gabion Wall Backfill

The backfill for the Gabion wall is to be compacted Class 6N/6F2 granular fill. This material is assumed to have the following characteristics:  $\Phi' = 35$  degrees,  $\gamma = 18\text{kN/m}^3$  and  $c' = 0$  kPa. It should be benched into the in-situ soils and compacted in accordance with the MCHW SHW, Series 600, Table 6/4. The Principal Contractor is responsible for the selection of the material to ensure compliance with the geotechnical characteristics as shown on the relevant design documents/ calculations. The soil parameters assumed for the imported fill in the design calculations are as follows:

| Class of Fill (MCHW vol. 1, Series 600) | Description                            | Use      | Unit Weight (kN/m <sup>3</sup> ) | Min. Effective Angle of Internal Friction | Cohesion (kN/m <sup>2</sup> ) |
|-----------------------------------------|----------------------------------------|----------|----------------------------------|-------------------------------------------|-------------------------------|
| Class 6N/6F2                            | Selected well graded granular material | Backfill | 18.0                             | 35°                                       | 0                             |

## 2.2 Surcharge Loads

A maximum live load of  $20\text{kN/m}^2$  was assumed to act on the retained side of the wall at the top of the 1V:2.5H crest slope. A maximum  $5\text{kN/m}^2$  load was considered on the crest slope. Please advise if a higher allowance (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 number BCA-GEO-VX-XX-D-C-1001-C01. A maximum 1V:2.5H crest slope is proposed and no toe slope.

## 2.4 Ground Water

The relevant trial pits remained dry. It has been assumed that the slope and retained material will be maintained in a fully drained condition. Site drainage is outside the scope of this design. The use of granular backfill and the porous nature of Gabions, no groundwater was assumed for analysis purposes. Please advise if water conditions assumed should be more onerous, as the analysis will need to be revised.

Any excavated slopes should be checked for any flows or seepage that requires drainage measures. Any flows, seepage or standing water should be directed to a suitable outfall as soon as they are encountered.

## 2.5 Drainage

A 100mm diameter jettable robust drainage pipe must be provided as indicated on BCA-GEO-VX-XX-D-C-1001-C01 discharging to an approved outlet point. The pipe must be fully jettable and regularly maintained.

Intermediate outlet/ rodding points will be required to ensure the full-length drainage can be fully roddable and drained. We advise rodding / outlet points are installed at maximum 20m spacings along the wall.

Temporary drainage measures should be installed to direct surface water away from the line of walls and also to prevent “ponding” at the toe/foundation which could cause this to deteriorate and soften over time.

## 3.0 Analysis

### 3.1 Wall Design

- Methods of Analysis: BSEN1997-1:2004 - Eurocode 7
- Factors of Safety: According to BSEN1997-1:2004 - Eurocode 7

MacStars W (Rel. 4.0) analysis files MS24-5785-01 to -04 are included in the attached Appendix. As shown by all of the Factors of Safety for the worst Load Combinations being in excess of 1.00, the requirements of BSEN1997-1:2004 were satisfied for all analyses.

The following table is a summary of the analysis results:

| Section | Analysis        | In accordance with:  | Minimum Factors of Safety |       |       |
|---------|-----------------|----------------------|---------------------------|-------|-------|
|         |                 |                      |                           | DA1/1 | DA1/2 |
| 1-1     | MS24-6011-F2-01 | Eurocode 7 EN 1997-1 | Global Stability Check    | 1.411 | 1.149 |
|         |                 |                      |                           | DA1/1 | DA1/2 |
|         | MS24-6011-F2-02 | Eurocode 7 EN 1997-1 | Sliding Check             | 1.628 | 1.09  |
|         |                 |                      | Overtopping Check         | 1.546 | 1.441 |
| 2-2     | MS24-6011-F2-03 | Eurocode 7 EN 1997-1 | Global Stability Check    | DA1/1 | DA1/2 |
|         |                 |                      |                           | 1.452 | 1.187 |
|         | MS24-6011-F2-04 | Eurocode 7 EN 1997-1 | Sliding Check             | 2.174 | 2.238 |
|         |                 |                      | Overtopping Check         | 4.053 | 4.839 |



## 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.



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## 5.0 Construction Supervision Requirements

The following construction supervision requirements should be adhered to by the project team (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 localised suitability of the material at formation level over the full extent of the wall. Refer to Section 2.1.
2. The backfill for the Gabion walls is to be compacted Class 6N/6F2 granular fill, compacted in accordance with SFHW Series 600, Table 6/4.
3. The Gabion wall to be constructed should be checked for the required geometry and retained height to ensure that they are within the scope of this design. Refer to Table 1.
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 of the wall may occur.
7. Gabions are flexible, and some settlement will occur inside and behind the gabion basket during and after construction. Some settlement of the subgrade will also occur after construction, depending on the compaction of the foundation soils and backfill. The settlement should be monitored and all finishes should be delayed until settlement is complete.
8. Setting out to be provided by scheme designer and is outside the scope of Geoman/ Maccaferri's work. Wall line shown on plan is as per drawings provided. Fenceline is offset from toe of wall as shown on sections - any required correction to toe line to accommodate to be confirmed prior to construction.
9. Gabions to be constructed in accordance with BS14475:2006(E). Some settlement (compression) gabion units can occur, but a high standard of installation will ensure settlement does not exceed the recommended tolerance of 5%.

## 6.0 Maintenance Requirements

Maintenance requirements for the retaining wall are as follows;

- Once the works are complete, the Gabion units should be checked annually for damage that can occasionally occur. Maintenance should be undertaken without delay to prevent damage spreading.
- 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.
- The drain to the rear of the wall should be regularly maintained.

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



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## 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, Client's Consulting Engineer and Principal Contractor**.



## 7.1 DESIGN RISKS REMAINING:

| RISK |                                                                                                                     | SUGGESTED REMEDIATION                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Action By                                              |
|------|---------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------|
| 01   | Wall stability compromised and/ or excessive settlement due to in situ soils not complying with design assumptions. | Principal Contractor and/ or a geotechnical engineer must confirm localised suitability of material at formation level over the full extent of the wall.<br><br><b>Refer to Section 2.1.1 and 2.1.2</b>                                                                                                                                                                                                                                                                                                                                                              | Principal Contractor/<br>Client's Consulting Engineer  |
| 03   | Wall stability compromised due to backfill soils not complying with design assumptions.                             | Backfill for Gabion wall to be confirmed to meet minimum requirements outlined in <b>Section 2.1.3</b><br><br>Quality control testing to follow principles set out in HA 44/91 and under the responsibility of the Principal Contractor.                                                                                                                                                                                                                                                                                                                             | Principal Contractor                                   |
| 04   | Pedestrian Protection                                                                                               | We have been advised that no fencing is to be installed behind the wall. Geoman should be contacted if a fence is to be installed to review the proposals.                                                                                                                                                                                                                                                                                                                                                                                                           | Principal Contractor /<br>Client's Consulting Engineer |
| 05   | 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. Excavation and construction in short lengths and/ or appropriate temporary works (such as sheet piles) should be considered<br><br>Principal Contractor to provide 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. | Principal Contractor                                   |
| 06   | Serviceability movement of Gabions affecting roads, services or structures at the crest of the wall.                | Gabions are flexible, and some settlement will occur inside and behind the gabion baskets during and after construction. Some settlement of the subgrade will also occur after construction, depending on the compaction of the foundation soils and backfill. The settlement should be monitored and all finishes should be delayed until settlement is complete.                                                                                                                                                                                                   | Principal Contractor                                   |
| 07   | More onerous groundwater profile on site than assumed in design.                                                    | 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.<br><br><b>Refer to Section 2.5.</b>                                                                                                                                                                                                                                                                                                                        | Principal Contractor                                   |



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|----|---------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------|
| 08 | Wall constructed outside design tolerances. | <p>Heavy construction plant should not traffic behind the wall during construction as this can cause bulging.</p> <p>We recommend an experienced installer is appointed to construct the wall.</p> <p><b>Refer to manufacturer's installation guidelines and Section 5.0 above for best installation practice.</b></p> | Wall installer/<br>Principal Contractor |
| 09 | Setting out                                 | <p>Setting out to be provided by scheme designer and is outside the scope of Geoman/ Maccaferri's work. Wall line shown on plan is as per drawings provided. Fenceline is offset from toe of wall as shown on sections - any required correction to toe line to accommodate to be confirmed prior to construction.</p> | Scheme Designer                         |



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## 8.0 Manufacturer's Risk Assessment

### CONSTRUCTION OF GABION

This is a Designers Risk Assessment which lists general risk items compiled without visiting site, please refer to the sub-contractor/ solution installers risk assessment for more site specific risks.

| No. | Hazards                              | Risk                                                   | Initial Potential for Harm |   |   | Action Req'd (Y/N) | Control Measures                                                                                                                                                                                                                                                                                                                                     | Residual Potential for Harm |   |   |
|-----|--------------------------------------|--------------------------------------------------------|----------------------------|---|---|--------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------|---|---|
|     |                                      |                                                        | H                          | M | L |                    |                                                                                                                                                                                                                                                                                                                                                      | H                           | M | L |
| 1.  | Ground Collapse                      | Crushing of personnel                                  | X                          |   |   | Y                  | Ground to be excavated and battered back and <b>monitored</b> on a daily basis. Weekly inspection sheet to be completed.                                                                                                                                                                                                                             |                             |   | X |
| 2.  | Plant 360° Excavators                | Collision with other plant or personnel.<br>Reversing. |                            | X |   | Y                  | All plant operators are to hold current CPCs. All Weekly inspection reports to be completed.<br><br>All plant to be inspected daily prior to use. All plant to have all round vision, to include mirrors, and banksman where required. All statutory inspection to be completed. All personnel to wear full PPE. Exclusion to be set up around works |                             |   | X |
| 3.  | Damage to Services                   | Injury to personnel and property                       | X                          |   |   | Y                  | All Services to be clearly marked and briefed to all site personnel at the site induction. All site personnel to carefully follow the site induction when working around the services.                                                                                                                                                               |                             |   | X |
| 4.  | Handling, cutting mesh, lacing, etc. | Personal Injury                                        |                            | X |   | Y                  | Use of suitable PPE (safety goggles, gloves, etc.)                                                                                                                                                                                                                                                                                                   |                             |   | X |



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|    |                                         |                                                                                              |   |   |   |                                                                                                                                                                                                                                                                                                                   |  |   |
|----|-----------------------------------------|----------------------------------------------------------------------------------------------|---|---|---|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|---|
| 5. | Manual Handling                         | Injury to personnel                                                                          |   | X | Y | Tool box Talk on correct lifting techniques, avoidance of manual lifting, use plant when required and risk assessment in place. Maccaferri supervisor to ensure job rotation takes place every 15 minutes to reduce the risk of repetitive injuries happening.                                                    |  | X |
| 6. | Work at Height                          | Falls from height                                                                            |   | X | Y | After completion of the first row of Gabions the rear face will be back filled and compacted in layers up to the top level of the unit and an edge protection system will be installed to the front face. As the wall progresses the backfilling/edge protection system will be re-installed to the higher level. |  | X |
| 7. | Re-fuelling of plant on site            | Contamination to watercourses, injury to personnel                                           |   | X | Y | All operatives to wear gloves during re-fuelling process. All re-fuelling to be carried out in whilst using a drip tray and having a spill kit to hand, and 30m away from any watercourses or drainage.                                                                                                           |  | X |
| 8. | Environmental issues                    | Pollution to watercourse.                                                                    | X |   | Y | All pumped water will be filtered and screened prior to release.                                                                                                                                                                                                                                                  |  | X |
| 9. | Site plant, other vehicles, Live roads. | Collisions with Plant, machinery and other vehicles resulting in serious injury or fatality. | X |   | Y | All Maccaferri Personnel MUST adhere to the site-specific Traffic Management                                                                                                                                                                                                                                      |  | X |



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|     |                                                       |                                                                                 |  |   |  |   |                                                                                                                                                                                                                                                                                                                                                                                                 |  |  |   |
|-----|-------------------------------------------------------|---------------------------------------------------------------------------------|--|---|--|---|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--|---|
| 10. | Excavation into existing material to foundation level | Striking existing services/ Striking live cables/ Personal injury/Electrocution |  | X |  | Y | Principal Designer to provide details of all existing services in the vicinity of the wall to Contractor. Use of Cable Avoidance Tools (CAT scanners).<br><br>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). |  |  | X |
| 11. | General Installation of Gabion                        | Personal Injury                                                                 |  | X |  | Y | Adhere to Supplier Installation Guidelines.                                                                                                                                                                                                                                                                                                                                                     |  |  | X |



|                       |                    |            |          |      |
|-----------------------|--------------------|------------|----------|------|
| Geoman Ltd.           | Project:           | Ref:       | Date:    | Rev: |
| Gabion Retaining Wall | BCA School Merthyr | 23-6011-F2 | 20.11.24 | C01  |

## 9.0 Appendices

- Geoman Ltd. drawing BCA-GEO-VX-XX-D-C-1001-C01
- MacStars analyses files MS24-6011-F2-01,02,03 and -04

GABION WALL NOTES:

- 1) DIMENSIONS IN MM UNLESS OTHERWISE SPECIFIED  
This drawing is based on the information shown on the supplied information and drawings.
- 2) GABION BASKET SPECIFICATION:  
MACCAFFERRI HEXAGONAL WOVEN WIRE MESH (POLYMER COATED)

- 3) INSTALLATION:  
Please refer to standard Maccaferri installation guidelines. Gabions to be constructed in accordance with BS14475:2006(E). Some settlement (compression) gabion units can occur, but a high standard of installation will ensure settlement does not exceed the recommended tolerance of 5%.

- 4) FILL FOR GABION BASKETS:  
Class 66 Gabion Stone as described in the 'Series 600' Specification for Highway Works. The stone fill should be hand placed to a high standard according to the manufacturer's instructions.

- 5) BACKFILL TO GABION WALLS:  
The backfill for the walls is to be compacted Class 6F2 granular fill. This material is assumed to have the following characteristics:  $\rho_{\text{dry}} = 35$  degrees,  $\text{Gamma} = 18 \text{ kN/m}^3$  and  $c = 0\text{KPa}$ , compacted in accordance with STNVI Series 600, Table 6K.

- 6) FOUNDATION FOR GABION WALL:  
To achieve a suitable foundation for the Gabion baskets, excavation must take place down to the levels indicated on the drawing and allow for the placement and compaction of a minimum 150mm thickness of selected material. The level of the excavation should be a minimum of 30 degrees of  $\rho_{\text{dry}} = 35$  degrees,  $\text{Gamma} = 18 \text{ kN/m}^3$  and  $c = 0 \text{ KPa}$ .

- We would suggest pile bearing tests are carried out at proposed locations. The results of these tests should be used to confirm the bearing capacity of the ground to be removed down to competent bearing stratum, and be replaced with compacted Class 6F2 granular fill.

- 7) TYPICAL BATTERY FRONT FACE STEP:  
The battery is constructed at a 0° batter, with a 150mm step at the face of each course.

- 8) SITE / IN-SITU SOILS:  
Retained (firm sandy gravelly CLAY or compacted Class 1/2C fill); this material is assumed to have the following minimum properties:  
 $\phi = 28^\circ$   $\gamma = 18 \text{ kN/m}^3$   $c = 0\text{KPa}$

- Foundation (competent firm to stiff sandy gravelly CLAY); this material is assumed to have the following minimum properties:  
 $\phi = 28^\circ$   $\gamma = 18 \text{ kN/m}^3$   $c = 0\text{KPa}$

- The Principal Contractor is responsible for ensuring the in-situ soils comply with the geotechnical characteristics as shown on the relevant drawings and in the design calculations.

- 9) TYPICAL BATTERY FRONT FACE STEP:  
The battery is constructed at a 0° batter, with a 150mm step at the face of each course.

- 10) TEMPORARY EXCAVATIONS:  
This solution is for the permanent work only, and is issued on the basis that the Principal Contractor must ensure that the Principal Contractor installer must produce a method statement and risk assessment for the works to be approved by the Client's Consulting Engineer. Temporary stability and design of any temporary works is outside our scope and should be confirmed by a Temporary Works Designer appointed by the Principal Contractor.

- 11) CONSTRUCTION TRAFFIC OPERATING CLOSE TO THE WALLS:  
Construction traffic/machinery should not traffic the unprotected crest area of the walls, as this can cause movement of the gabions. If construction of the walls, as this can cause movement of the gabions. If construction must be undertaken by others).

- 12) PEDESTRIAN PROTECTION:  
Any vehicle barrier requirements, impact loads and barrier solutions are to be determined by others.

- 13) NON-COMPLIANCE WITH LOCAL AUTHORITY REQUIREMENTS  
We assume that Technical Approval of the wall by the Local Authority is NOT required. This should be confirmed by the Principal Contractor/Designer. Approval is required, as the design will need to be altered. Any AFRs, etc. must be submitted and approved by the Local Authority prior to construction commencing.

- 14) SETTING OUT:  
Setting out of the walls is outside Geoman's scope and is to be provided by the Scheme Designer. The wall line is as per drawings provided. Fanceline is offset from toe as shown on the sections- any required correction to toe line to accommodate to be confirmed prior to construction.

- 15) CONSTRUCTION:  
Gabions to be constructed in accordance with BS14475:2006(E). Some settlement (compression) gabion units can occur, but a high standard of installation will ensure settlement does not exceed the recommended tolerance of 5%.

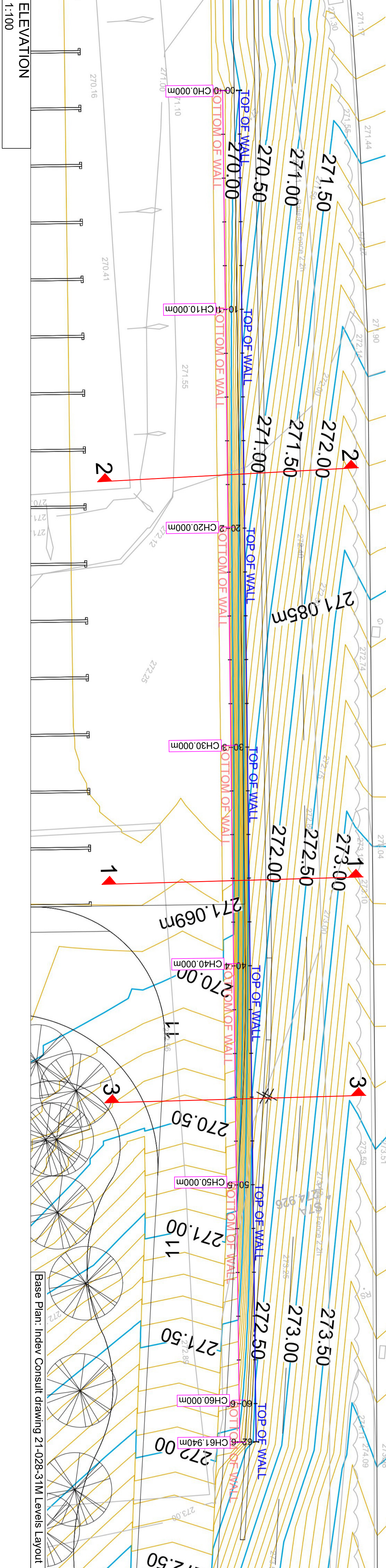
- Construction of the wall shall not commence unless and until the Client/Client's Consulting Engineers has considered the Geoman design and confirmed that the design is acceptable. There are no errors, omissions or conflict with the scheme design.

- This drawing or design proposal, remains the copyright of Maccaferri Ltd and is not to be copied or disclosed to any persons other than the person to whom it is originally intended.

- Maccaferri will not be liable for any loss or damage resulting from or arising out of the use of its products where those products have been used other than in accordance with Maccaferri's advice and product literature. Maccaferri will not be liable for any loss or damage resulting from or arising out of the slope not within the area where the works are undertaken. Maccaferri shall not be liable for any loss or damage resulting from or arising out of any weakness or other problem in the slope outside the area where the works are undertaken.

INDICATIVE PLAN

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



# **MacStARS W – Rel. 4.0**

Maccaferri Stability Analysis of Reinforced Slopes and Walls  
Officine Maccaferri S.p.A. - Via Kennedy 10 - 40069 Zola Predosa (Bologna)  
Tel. 051.6436000 - Fax 051.236507

Geoman

Project Title.....: BCA School, Merthyr

Cross Section.....: 1-1

Site.....:

Folder.....: 23-6011-F2

File.....: MS23-6011-F2-01

Date.....: 09/11/2024

Checks according to:      Eurocode 7 EN 1997-1  
                                 Eurocode 7 EN 1997-1

## **TABLE OF CONTENTS**

**SOIL PROPERTIES**
**Soil: CLASS 6G**

Description:

|                                   |                                          |       |
|-----------------------------------|------------------------------------------|-------|
| Cohesion Class.....               | : Effective cohesion                     |       |
| Cohesion.....                     | [kN/m <sup>2</sup> ]                     | 17.00 |
| Friction Angle Class.....         | : Angle of shearing resistance (Tan phi) |       |
| Friction Angle.....               | [°]                                      | 40.00 |
| Ru value.....                     |                                          | 0.00  |
| Weight Class.....                 | : Weight density                         |       |
| Bulk unit weight - above GWT..... | [kN/m <sup>3</sup> ]                     | 17.50 |
| Bulk unit weight - below GWT..... | [kN/m <sup>3</sup> ]                     | 17.50 |
| Elastic Modulus.....              | [kN/m <sup>2</sup> ]                     | 0.00  |
| Poisson's ratio.....              |                                          | 0.30  |

**Soil: CLASS 6N/6F2**

Description:

|                                   |                                          |       |
|-----------------------------------|------------------------------------------|-------|
| Cohesion Class.....               | : Effective cohesion                     |       |
| Cohesion.....                     | [kN/m <sup>2</sup> ]                     | 0.00  |
| Friction Angle Class.....         | : Angle of shearing resistance (Tan phi) |       |
| Friction Angle.....               | [°]                                      | 35.00 |
| Ru value.....                     |                                          | 0.00  |
| Weight Class.....                 | : Weight density                         |       |
| Bulk unit weight - above GWT..... | [kN/m <sup>3</sup> ]                     | 18.00 |
| Bulk unit weight - below GWT..... | [kN/m <sup>3</sup> ]                     | 18.00 |
| Elastic Modulus.....              | [kN/m <sup>2</sup> ]                     | 0.00  |
| Poisson's ratio.....              |                                          | 0.30  |

**Soil: FOUNDATION**

Description: firm CLAY

|                                   |                                          |       |
|-----------------------------------|------------------------------------------|-------|
| Cohesion Class.....               | : Effective cohesion                     |       |
| Cohesion.....                     | [kN/m <sup>2</sup> ]                     | 0.00  |
| Friction Angle Class.....         | : Angle of shearing resistance (Tan phi) |       |
| Friction Angle.....               | [°]                                      | 28.00 |
| Ru value.....                     |                                          | 0.00  |
| Weight Class.....                 | : Weight density                         |       |
| Bulk unit weight - above GWT..... | [kN/m <sup>3</sup> ]                     | 19.00 |
| Bulk unit weight - below GWT..... | [kN/m <sup>3</sup> ]                     | 19.00 |
| Elastic Modulus.....              | [kN/m <sup>2</sup> ]                     | 0.00  |
| Poisson's ratio.....              |                                          | 0.30  |

**Soil: RETAINED**

Description: Soft CLAY

|                                   |                                          |       |
|-----------------------------------|------------------------------------------|-------|
| Cohesion Class.....               | : Effective cohesion                     |       |
| Cohesion.....                     | [kN/m <sup>2</sup> ]                     | 0.00  |
| Friction Angle Class.....         | : Angle of shearing resistance (Tan phi) |       |
| Friction Angle.....               | [°]                                      | 28.00 |
| Ru value.....                     |                                          | 0.00  |
| Weight Class.....                 | : Weight density                         |       |
| Bulk unit weight - above GWT..... | [kN/m <sup>3</sup> ]                     | 19.00 |
| Bulk unit weight - below GWT..... | [kN/m <sup>3</sup> ]                     | 19.00 |
| Elastic Modulus.....              | [kN/m <sup>2</sup> ]                     | 0.00  |
| Poisson's ratio.....              |                                          | 0.30  |

## STRATA PROFILES

**Stratum: BACKFILL**

Description:

Soil : CLASS 6N/6F2

| X     | Y      | X     | Y      | X     | Y      | X   | Y   |
|-------|--------|-------|--------|-------|--------|-----|-----|
| [m]   | [m]    | [m]   | [m]    | [m]   | [m]    | [m] | [m] |
| 25.09 | 264.41 | 26.47 | 266.27 | 28.61 | 267.15 |     |     |

**Stratum: FOUNDATION**

Description:

Soil : FOUNDATION

| X     | Y      | X     | Y      | X     | Y      | X     | Y      |
|-------|--------|-------|--------|-------|--------|-------|--------|
| [m]   | [m]    | [m]   | [m]    | [m]   | [m]    | [m]   | [m]    |
| 0.00  | 264.41 | 25.09 | 264.41 | 25.75 | 263.83 | 26.64 | 263.74 |
| 27.03 | 264.41 | 50.00 | 264.41 |       |        |       |        |

**Stratum: RETAINED**

Description:

Soil : RETAINED

| X     | Y      | X     | Y      | X     | Y      | X     | Y      |
|-------|--------|-------|--------|-------|--------|-------|--------|
| [m]   | [m]    | [m]   | [m]    | [m]   | [m]    | [m]   | [m]    |
| 27.03 | 264.41 | 28.61 | 267.15 | 30.20 | 267.80 | 50.00 | 267.80 |

## GABION WALL

**Wall : GW**

Wall origin.....[m].....: Abscissa.....= 25.00 Ordinate.....= 263.91

Wall batter.....[°].....= 6.00

Gabion filling soil.....: CLASS 6G  
 Backfill soil.....: CLASS 6N/6F2  
 Gabion covering soil.....: RETAINED  
 Gabion foundation soil.....: FOUNDATION

| Layer | Length [m] | Height [m] | Offset [m] | Pu [kN/m³] |
|-------|------------|------------|------------|------------|
| 1     | 1.50       | 1.00       | 0.00       | 61.31      |
| 2     | 1.00       | 1.00       | 0.15       | 61.31      |
| 3     | 0.85       | 0.50       | 0.30       | 98.10      |

Gabions without diaphragms

Mesh type 10x12

Wire diameter 2,7 [mm]

Brinch Hansen, Vesic or Meyerhof bearing capacity parameters

Embedment depth.....[m] : 0.50

Natural soil slope.....[°] : 0.00

## SURCHARGE LOADS

**Distributed Loads : 20KPA**

Description :

Class : Variable unfavourable

Magnitude.....[kN/m²]..= 20.00 Inclination angle.....[°]..= 0.00

Abscissa.....[m]..: from = 30.00 To = 50.00

**Distributed Loads : 5KPA**

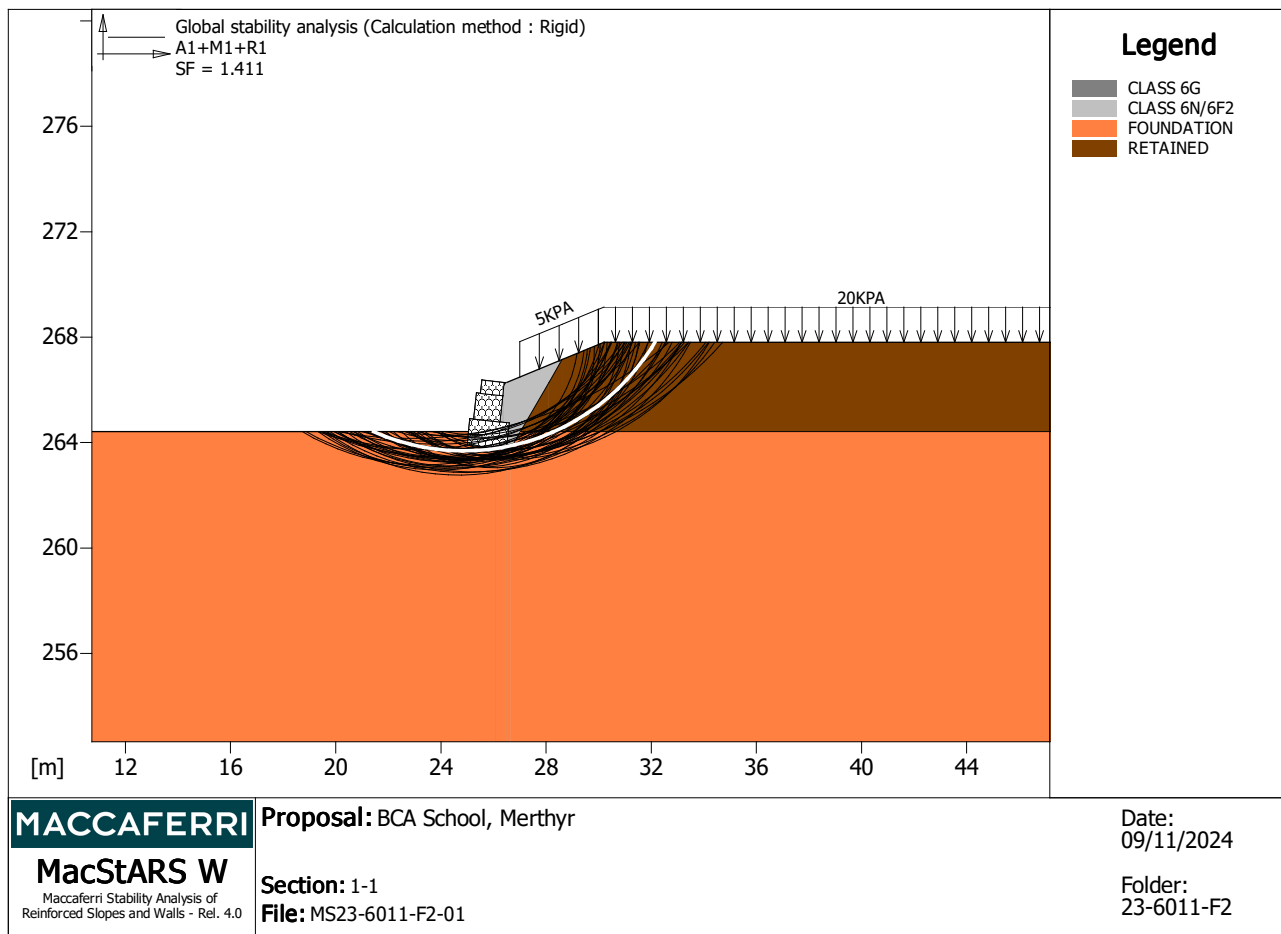
Description :

Class : Variable unfavourable

Magnitude.....[kN/m²]..= 5.00 Inclination angle.....[°]..= 0.00

Abscissa.....[m]..: from = 27.00 To = 29.99

# CHECKS RESULTS



## Global Stability Check :

Multiplier combination : A1+M1+R1

Reinforcements active Forces according to Rigid Method

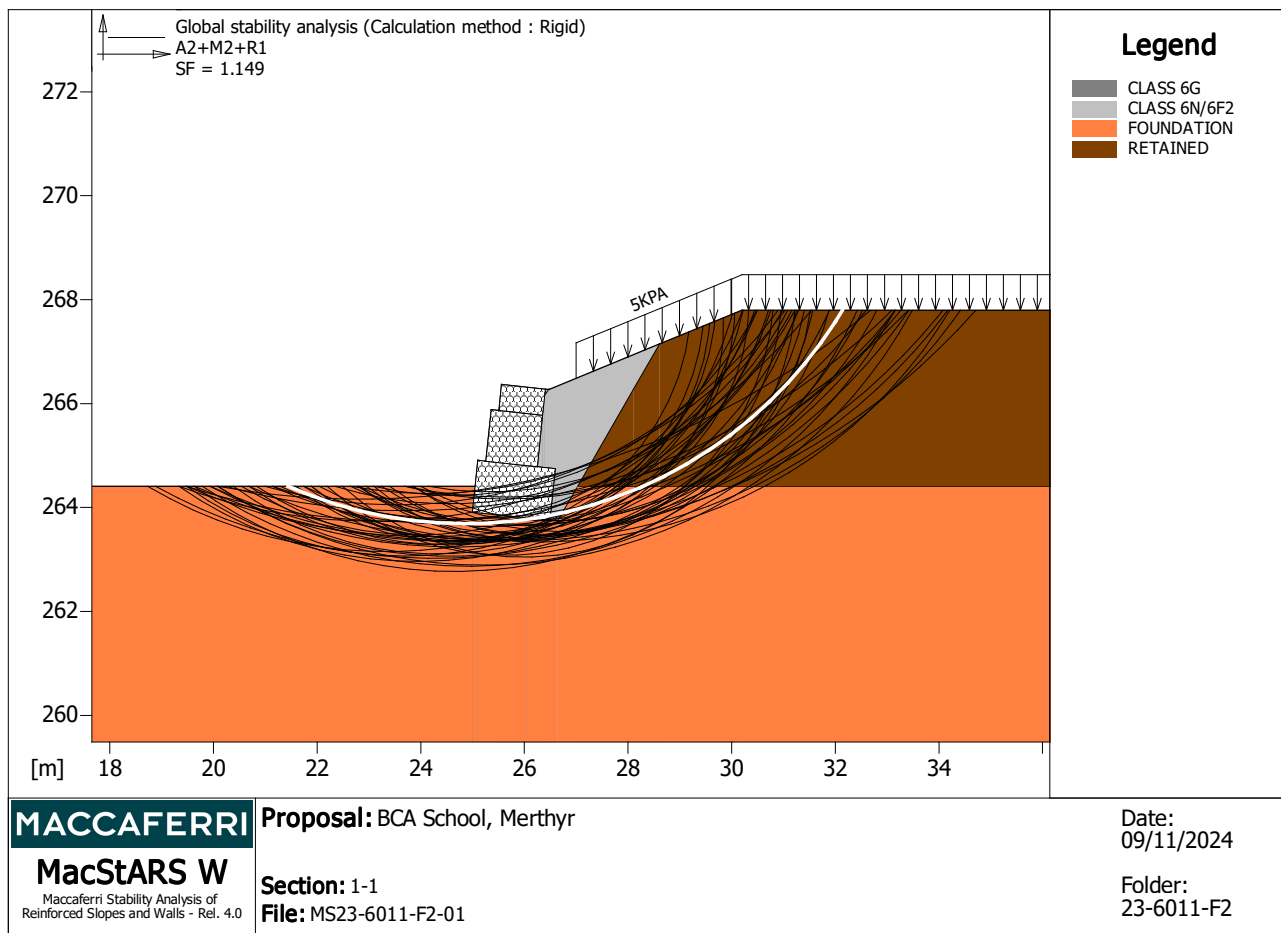
Stability analysis with circular surfaces according to Bishop's Method

Evaluated Safety Factor.....: 1.411

## Surfaces searching range

| Starting range, abscises [m]                           |              | Arrival range, abscises [m] |              |
|--------------------------------------------------------|--------------|-----------------------------|--------------|
| First point                                            | Second point | First point                 | Second point |
| 10.00                                                  | 24.90        | 28.00                       | 45.00        |
| Number of starting point on the starting segment.....: |              | 100                         |              |
| Total number of trial surfaces.....:                   |              | 1000                        |              |
| Minimum base length of slices.....[m].....:            |              | 0.50                        |              |
| Superior limit search angle.....[°].....:              |              | 0.00                        |              |
| Inferior limit search angle.....[°].....:              |              | 0.00                        |              |

| Multiplier | Class                                   |
|------------|-----------------------------------------|
| 1.50       | Variable unfavourable                   |
| 1.00       | Angle of shearing resistance (Tan phi)  |
| 1.00       | Effective cohesion                      |
| 1.00       | Undrained shear strength                |
| 1.00       | Weight density                          |
| 1.00       | Tensile strength of reinforcement       |
| 1.00       | Pullout resistance of reinforcement     |
| 1.00       | Ground resistance for overall stability |



## Global Stability Check :

Multiplier combination : A2+M2+R1

Reinforcements active Forces according to Rigid Method

Stability analysis with circular surfaces according to Bishop's Method

Evaluated Safety Factor.....: 1.149

### Surfaces searching range

| Starting range, abscises [m]                           |              | Arrival range, abscises [m] |              |
|--------------------------------------------------------|--------------|-----------------------------|--------------|
| First point                                            | Second point | First point                 | Second point |
| 10.00                                                  | 24.90        | 28.00                       | 45.00        |
| Number of starting point on the starting segment.....: |              | 100                         |              |
| Total number of trial surfaces.....:                   |              | 1000                        |              |
| Minimum base length of slices.....[m].....:            |              | 0.50                        |              |
| Superior limit search angle.....[°].....:              |              | 0.00                        |              |
| Inferior limit search angle.....[°].....:              |              | 0.00                        |              |

| Multiplier | Class                                   |
|------------|-----------------------------------------|
| 1.30       | Variable unfavourable                   |
| 1.25       | Angle of shearing resistance (Tan phi)  |
| 1.25       | Effective cohesion                      |
| 1.40       | Undrained shear strength                |
| 1.00       | Weight density                          |
| 1.00       | Tensile strength of reinforcement       |
| 1.00       | Pullout resistance of reinforcement     |
| 1.00       | Ground resistance for overall stability |

-----  
Officine Maccaferri assumes no responsibilities for the drawings and calculations submitted to the customer based on the data provided by him, nor it is responsible for the project and site visits that were subsequently realized without specific assignment.

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# **MacStARS W – Rel. 4.0**

Maccaferri Stability Analysis of Reinforced Slopes and Walls  
Officine Maccaferri S.p.A. - Via Kennedy 10 - 40069 Zola Predosa (Bologna)  
Tel. 051.6436000 - Fax 051.236507

Geoman

Project Title.....: BCA School, Merthyr

Cross Section.....: 1-1

Site.....:

Folder.....: 23-6011-F2

File.....: MS23-6011-F2-02

Date.....: 09/11/2024

Checks according to:      Eurocode 7 EN 1997-1  
                                 Eurocode 7 EN 1997-1

## **TABLE OF CONTENTS**

**SOIL PROPERTIES**

|                                   |                                          |       |
|-----------------------------------|------------------------------------------|-------|
| <b>Soil: CLASS 6G</b>             | Description:                             |       |
| Cohesion Class.....               | : Effective cohesion                     |       |
| Cohesion.....                     | [kN/m <sup>2</sup> ].....                | 0.00  |
| Friction Angle Class.....         | : Angle of shearing resistance (Tan phi) |       |
| Friction Angle.....               | [°].....                                 | 40.00 |
| Ru value.....                     |                                          | 0.00  |
| Weight Class.....                 | : Weight density                         |       |
| Bulk unit weight - above GWT..... | [kN/m <sup>3</sup> ].....                | 17.50 |
| Bulk unit weight - below GWT..... | [kN/m <sup>3</sup> ].....                | 17.50 |
| Elastic Modulus.....              | [kN/m <sup>2</sup> ].....                | 0.00  |
| Poisson's ratio.....              |                                          | 0.30  |

|                                   |                                          |       |
|-----------------------------------|------------------------------------------|-------|
| <b>Soil: CLASS 6N/6F2</b>         | Description:                             |       |
| Cohesion Class.....               | : Effective cohesion                     |       |
| Cohesion.....                     | [kN/m <sup>2</sup> ].....                | 0.00  |
| Friction Angle Class.....         | : Angle of shearing resistance (Tan phi) |       |
| Friction Angle.....               | [°].....                                 | 35.00 |
| Ru value.....                     |                                          | 0.00  |
| Weight Class.....                 | : Weight density                         |       |
| Bulk unit weight - above GWT..... | [kN/m <sup>3</sup> ].....                | 18.00 |
| Bulk unit weight - below GWT..... | [kN/m <sup>3</sup> ].....                | 18.00 |
| Elastic Modulus.....              | [kN/m <sup>2</sup> ].....                | 0.00  |
| Poisson's ratio.....              |                                          | 0.30  |

|                                   |                                          |       |
|-----------------------------------|------------------------------------------|-------|
| <b>Soil: FOUNDATION</b>           | Description: firm CLAY                   |       |
| Cohesion Class.....               | : Effective cohesion                     |       |
| Cohesion.....                     | [kN/m <sup>2</sup> ].....                | 0.00  |
| Friction Angle Class.....         | : Angle of shearing resistance (Tan phi) |       |
| Friction Angle.....               | [°].....                                 | 28.00 |
| Ru value.....                     |                                          | 0.00  |
| Weight Class.....                 | : Weight density                         |       |
| Bulk unit weight - above GWT..... | [kN/m <sup>3</sup> ].....                | 19.00 |
| Bulk unit weight - below GWT..... | [kN/m <sup>3</sup> ].....                | 19.00 |
| Elastic Modulus.....              | [kN/m <sup>2</sup> ].....                | 0.00  |
| Poisson's ratio.....              |                                          | 0.30  |

|                                   |                                          |       |
|-----------------------------------|------------------------------------------|-------|
| <b>Soil: RETAINED</b>             | Description: Soft CLAY                   |       |
| Cohesion Class.....               | : Effective cohesion                     |       |
| Cohesion.....                     | [kN/m <sup>2</sup> ].....                | 0.00  |
| Friction Angle Class.....         | : Angle of shearing resistance (Tan phi) |       |
| Friction Angle.....               | [°].....                                 | 28.00 |
| Ru value.....                     |                                          | 0.00  |
| Weight Class.....                 | : Weight density                         |       |
| Bulk unit weight - above GWT..... | [kN/m <sup>3</sup> ].....                | 19.00 |
| Bulk unit weight - below GWT..... | [kN/m <sup>3</sup> ].....                | 19.00 |
| Elastic Modulus.....              | [kN/m <sup>2</sup> ].....                | 0.00  |
| Poisson's ratio.....              |                                          | 0.30  |

## STRATA PROFILES

**Stratum: BACKFILL**

Description:

Soil : CLASS 6N/6F2

| X     | Y      | X     | Y      | X     | Y      | X   | Y   |
|-------|--------|-------|--------|-------|--------|-----|-----|
| [m]   | [m]    | [m]   | [m]    | [m]   | [m]    | [m] | [m] |
| 25.09 | 264.41 | 26.47 | 266.27 | 28.61 | 267.15 |     |     |

**Stratum: FOUNDATION**

Description:

Soil : FOUNDATION

| X     | Y      | X     | Y      | X     | Y      | X     | Y      |
|-------|--------|-------|--------|-------|--------|-------|--------|
| [m]   | [m]    | [m]   | [m]    | [m]   | [m]    | [m]   | [m]    |
| 0.00  | 264.41 | 25.09 | 264.41 | 25.75 | 263.83 | 26.64 | 263.74 |
| 27.03 | 264.41 | 50.00 | 264.41 |       |        |       |        |

**Stratum: RETAINED**

Description:

Soil : RETAINED

| X     | Y      | X     | Y      | X     | Y      | X     | Y      |
|-------|--------|-------|--------|-------|--------|-------|--------|
| [m]   | [m]    | [m]   | [m]    | [m]   | [m]    | [m]   | [m]    |
| 27.03 | 264.41 | 28.61 | 267.15 | 30.20 | 267.80 | 50.00 | 267.80 |

## GABION WALL

**Wall : GW**

Wall origin.....[m].....: Abscissa.....= 25.00 Ordinate.....= 263.91

Wall batter.....[°].....= 6.00

Gabion filling soil.....: CLASS 6G  
 Backfill soil.....: CLASS 6N/6F2  
 Gabion covering soil.....: RETAINED  
 Gabion foundation soil.....: FOUNDATION

| Layer | Length [m] | Height [m] | Offset [m] | Pu [kN/m³] |
|-------|------------|------------|------------|------------|
| 1     | 1.50       | 1.00       | 0.00       | 61.31      |
| 2     | 1.00       | 1.00       | 0.15       | 61.31      |
| 3     | 0.85       | 0.50       | 0.30       | 98.10      |

Gabions without diaphragms

Mesh type 10x12

Wire diameter 2,7 [mm]

Brinch Hansen, Vesic or Meyerhof bearing capacity parameters

Embedment depth.....[m] : 0.50

Natural soil slope.....[°] : 0.00

## SURCHARGE LOADS

**Distributed Loads : 20KPA**

Description :

Class : Variable unfavourable

Magnitude.....[kN/m²]..= 20.00 Inclination angle.....[°]..= 0.00

Abscissa.....[m]..: from = 30.00 To = 50.00

**Distributed Loads : 5KPA**

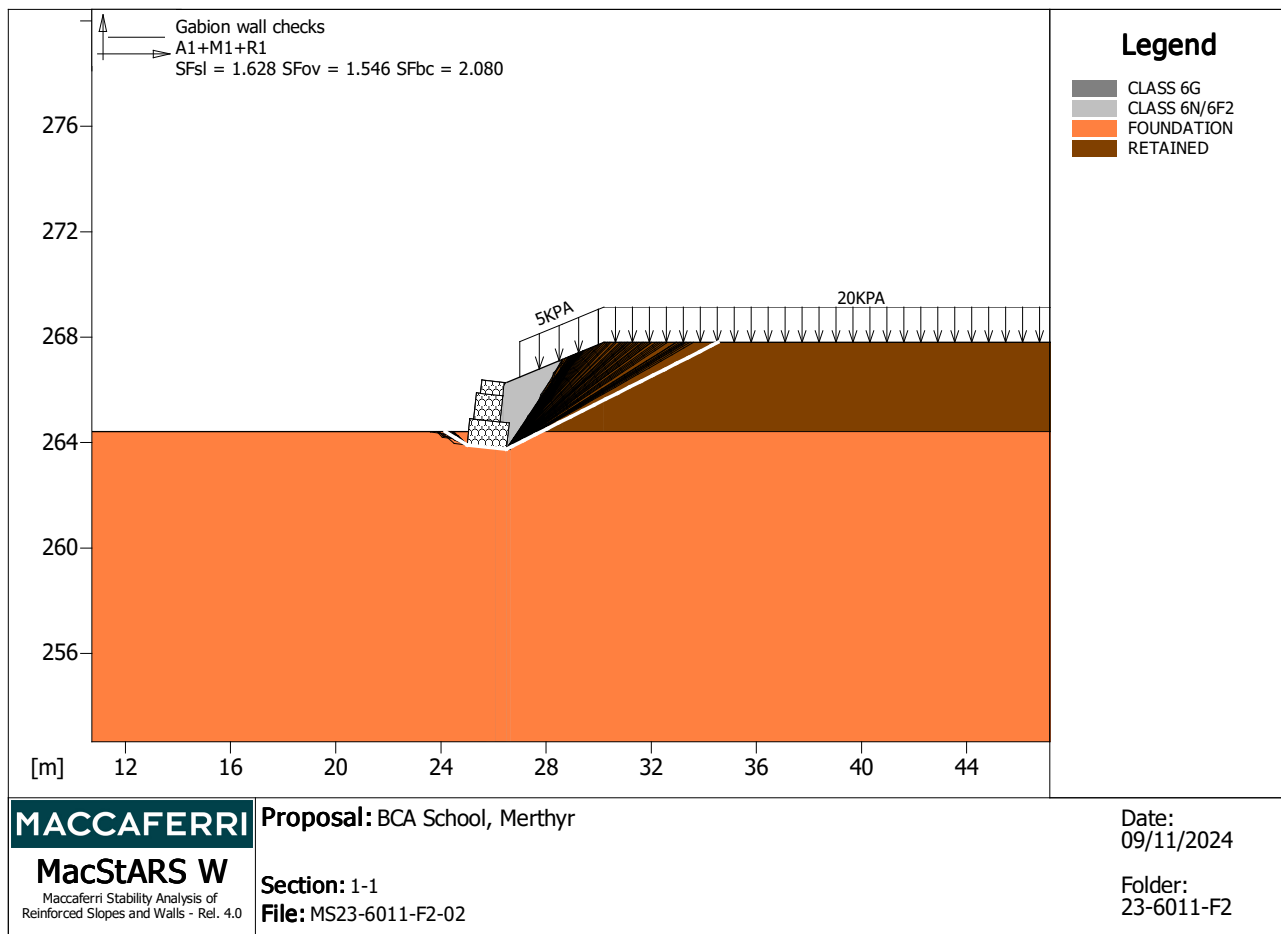
Description :

Class : Variable unfavourable

Magnitude.....[kN/m²]..= 5.00 Inclination angle.....[°]..= 0.00

Abscissa.....[m]..: from = 27.00 To = 29.99

## CHECKS RESULTS



### Wall Checks :

Multiplier combination : A1+M1+R1

Considered block : GW

Resisting force.....[kN/m].....: 51.28

Active force.....[kN/m].....: 31.51

Sliding class.....: Sliding resistance

Sliding safety factor.....: 1.628

Restoring moment.....[kN\*m/m].....: 82.25

Overturning moment.....[kN\*m/m].....: 53.20

Overturning class.....: Overturning

Overturning safety factor.....: 1.546

Imposed ultimate bearing pressure

Ultimate bearing pressure.....[kN/m<sup>2</sup>].....: 250.00

Active pressure.....[kN/m<sup>2</sup>].....: 114.66

Pressure class.....: Bearing capacity

Bearing capacity safety factor.....: 2.080

Equivalent bearing area.....[m].....: 0.72

Eccentricity of normal force.....[m].....: 0.39

Lever arm of overturning force.....[m].....: 1.69

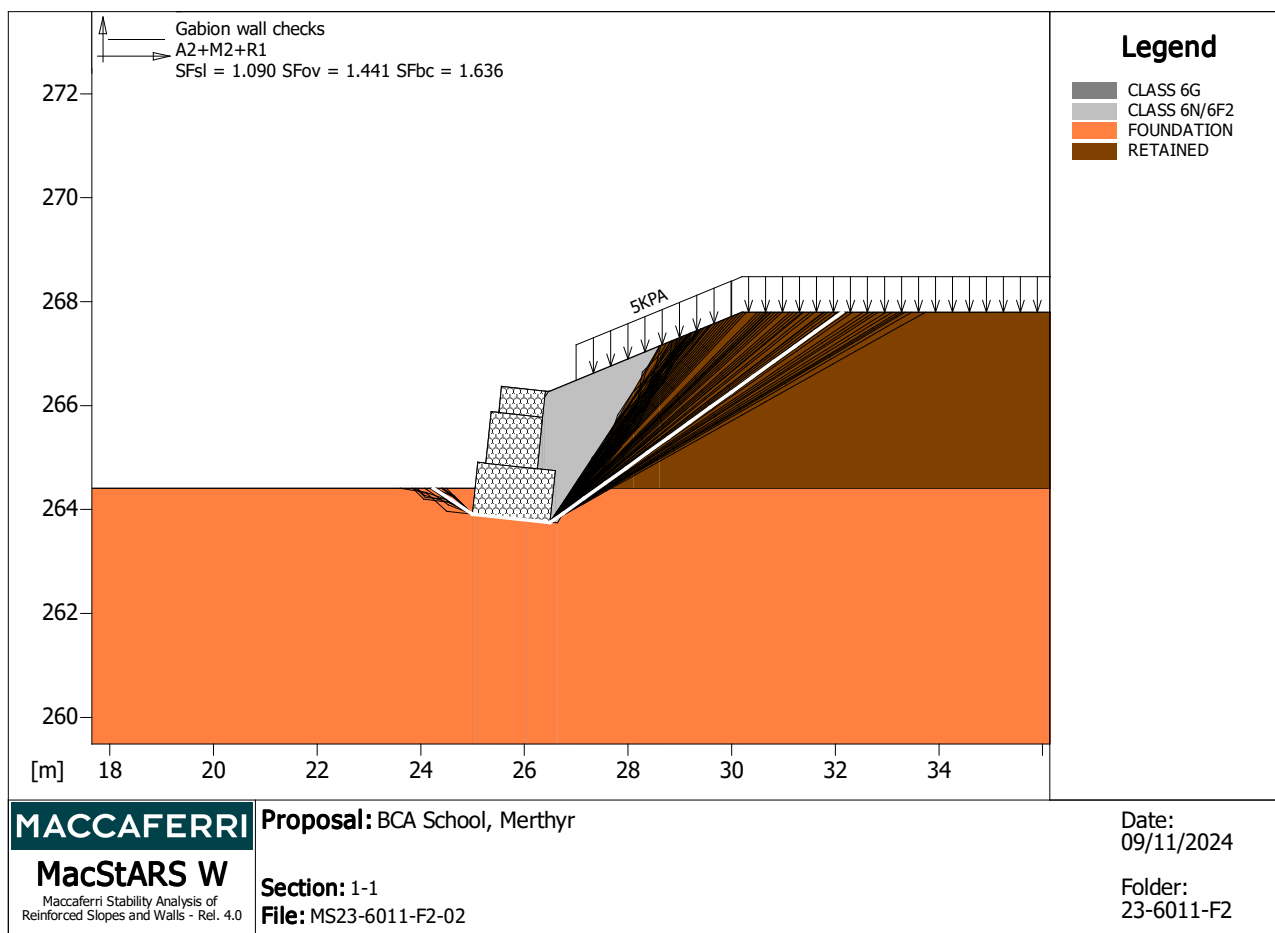
Normal force on the base.....[kN].....: 82.32

Outer edge stress.....[kN/m<sup>2</sup>].....: 152.88

Inner edge stress.....[kN/m<sup>2</sup>].....: 0.00

| Multiplier | Class                                  |
|------------|----------------------------------------|
| 1.50       | Variable unfavourable                  |
| 1.00       | Angle of shearing resistance (Tan phi) |

|      |                          |
|------|--------------------------|
| 1.00 | Effective cohesion       |
| 1.00 | Undrained shear strength |
| 1.00 | Weight density           |
| 1.00 | Sliding resistance       |
| 1.00 | Bearing capacity         |
| 1.00 | Overturning              |



## Wall Checks :

Multiplier combination : A2+M2+R1

Considered block : GW

Resisting force.....[kN/m] : 45.54

Active force.....[kN/m] : 41.79

Sliding class.....: Sliding resistance

Sliding safety factor.....: 1.090

Restoring moment.....[kN\*m/m] : 92.08

Overturning moment.....[kN\*m/m] : 63.88

Overturning class.....: Overturning

Overturning safety factor.....: 1.441

Imposed ultimate bearing pressure

Ultimate bearing pressure.....[kN/m<sup>2</sup>] : 250.00

Active pressure.....[kN/m<sup>2</sup>] : 141.72

Pressure class.....: Bearing capacity

Bearing capacity safety factor.....: 1.636

Equivalent bearing area.....[m] : 0.64

Eccentricity of normal force.....[m] : 0.43

Lever arm of overturning force.....[m] : 1.53

Normal force on the base.....[kN] : 90.24

Outer edge stress.....[kN/m<sup>2</sup>] : 188.96

Inner edge stress.....[kN/m<sup>2</sup>] : 0.00

| Multiplier | Class                                  |
|------------|----------------------------------------|
| 1.30       | Variable unfavourable                  |
| 1.25       | Angle of shearing resistance (Tan phi) |
| 1.25       | Effective cohesion                     |
| 1.40       | Undrained shear strength               |

|      |                    |
|------|--------------------|
| 1.00 | Weight density     |
| 1.00 | Sliding resistance |
| 1.00 | Bearing capacity   |
| 1.00 | Overturning        |

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# **MacStARS W – Rel. 4.0**

Maccaferri Stability Analysis of Reinforced Slopes and Walls  
Officine Maccaferri S.p.A. - Via Kennedy 10 - 40069 Zola Predosa (Bologna)  
Tel. 051.6436000 - Fax 051.236507

Geoman

Project Title.....: BCA School, Merthyr

Cross Section.....: 1-1

Site.....:

Folder.....: 23-6011-F2

File.....: MS23-6011-F2-03

Date.....: 09/11/2024

Checks according to:      Eurocode 7 EN 1997-1  
                                 Eurocode 7 EN 1997-1

## **TABLE OF CONTENTS**

**SOIL PROPERTIES**

|                                   |                                          |       |
|-----------------------------------|------------------------------------------|-------|
| <b>Soil: CLASS 6G</b>             | Description:                             |       |
| Cohesion Class.....               | : Effective cohesion                     |       |
| Cohesion.....                     | [kN/m <sup>2</sup> ]:                    | 17.00 |
| Friction Angle Class.....         | : Angle of shearing resistance (Tan phi) |       |
| Friction Angle.....               | [°]:                                     | 40.00 |
| Ru value.....                     | :                                        | 0.00  |
| Weight Class.....                 | : Weight density                         |       |
| Bulk unit weight - above GWT..... | [kN/m <sup>3</sup> ]:                    | 17.50 |
| Bulk unit weight - below GWT..... | [kN/m <sup>3</sup> ]:                    | 17.50 |
| Elastic Modulus.....              | [kN/m <sup>2</sup> ]:                    | 0.00  |
| Poisson's ratio.....              | :                                        | 0.30  |
| <b>Soil: CLASS 6N/6F2</b>         | Description:                             |       |
| Cohesion Class.....               | : Effective cohesion                     |       |
| Cohesion.....                     | [kN/m <sup>2</sup> ]:                    | 0.00  |
| Friction Angle Class.....         | : Angle of shearing resistance (Tan phi) |       |
| Friction Angle.....               | [°]:                                     | 35.00 |
| Ru value.....                     | :                                        | 0.00  |
| Weight Class.....                 | : Weight density                         |       |
| Bulk unit weight - above GWT..... | [kN/m <sup>3</sup> ]:                    | 18.00 |
| Bulk unit weight - below GWT..... | [kN/m <sup>3</sup> ]:                    | 18.00 |
| Elastic Modulus.....              | [kN/m <sup>2</sup> ]:                    | 0.00  |
| Poisson's ratio.....              | :                                        | 0.30  |
| <b>Soil: FOUNDATION</b>           | Description: firm CLAY                   |       |
| Cohesion Class.....               | : Effective cohesion                     |       |
| Cohesion.....                     | [kN/m <sup>2</sup> ]:                    | 0.00  |
| Friction Angle Class.....         | : Angle of shearing resistance (Tan phi) |       |
| Friction Angle.....               | [°]:                                     | 28.00 |
| Ru value.....                     | :                                        | 0.00  |
| Weight Class.....                 | : Weight density                         |       |
| Bulk unit weight - above GWT..... | [kN/m <sup>3</sup> ]:                    | 19.00 |
| Bulk unit weight - below GWT..... | [kN/m <sup>3</sup> ]:                    | 19.00 |
| Elastic Modulus.....              | [kN/m <sup>2</sup> ]:                    | 0.00  |
| Poisson's ratio.....              | :                                        | 0.30  |
| <b>Soil: RETAINED</b>             | Description: Soft CLAY                   |       |
| Cohesion Class.....               | : Effective cohesion                     |       |
| Cohesion.....                     | [kN/m <sup>2</sup> ]:                    | 0.00  |
| Friction Angle Class.....         | : Angle of shearing resistance (Tan phi) |       |
| Friction Angle.....               | [°]:                                     | 28.00 |
| Ru value.....                     | :                                        | 0.00  |
| Weight Class.....                 | : Weight density                         |       |
| Bulk unit weight - above GWT..... | [kN/m <sup>3</sup> ]:                    | 19.00 |
| Bulk unit weight - below GWT..... | [kN/m <sup>3</sup> ]:                    | 19.00 |
| Elastic Modulus.....              | [kN/m <sup>2</sup> ]:                    | 0.00  |
| Poisson's ratio.....              | :                                        | 0.30  |

## STRATA PROFILES

**Stratum: BACKFILL**

Description:

Soil : CLASS 6N/6F2

| X     | Y      | X     | Y      | X     | Y      | X   | Y   |
|-------|--------|-------|--------|-------|--------|-----|-----|
| [m]   | [m]    | [m]   | [m]    | [m]   | [m]    | [m] | [m] |
| 25.13 | 269.77 | 26.22 | 270.65 | 27.25 | 271.07 |     |     |

**Stratum: FOUNDATION**

Description:

Soil : FOUNDATION

| X     | Y      | X     | Y      | X     | Y      | X     | Y      |
|-------|--------|-------|--------|-------|--------|-------|--------|
| [m]   | [m]    | [m]   | [m]    | [m]   | [m]    | [m]   | [m]    |
| 0.00  | 269.77 | 25.13 | 269.77 | 25.50 | 269.22 | 26.14 | 269.15 |
| 26.50 | 269.77 | 50.00 | 269.77 |       |        |       |        |

**Stratum: RETAINED**

Description:

Soil : RETAINED

| X     | Y      | X     | Y      | X     | Y      | X     | Y      |
|-------|--------|-------|--------|-------|--------|-------|--------|
| [m]   | [m]    | [m]   | [m]    | [m]   | [m]    | [m]   | [m]    |
| 26.50 | 269.77 | 27.25 | 271.07 | 30.30 | 272.30 | 50.00 | 272.30 |

## GABION WALL

**Wall : GW**

Wall origin.....[m].....: Abscissa.....= 25.00 Ordinate.....= 269.27

Wall batter.....[°].....= 6.00

Gabion filling soil.....: CLASS 6G  
 Backfill soil.....: CLASS 6N/6F2  
 Gabion covering soil.....: RETAINED  
 Gabion foundation soil.....: FOUNDATION

| Layer | Length [m] | Height [m] | Offset [m] | Pu [kN/m <sup>3</sup> ] |
|-------|------------|------------|------------|-------------------------|
| 1     | 1.00       | 1.00       | 0.00       | 61.31                   |
| 2     | 0.85       | 0.50       | 0.15       | 98.10                   |

Gabions without diaphragms

Mesh type 10x12 Wire diameter 2,7 [mm]

Brinch Hansen, Vesic or Meyerhof bearing capacity parameters

Embedment depth.....[m] : 0.50

Natural soil slope.....[°] : 0.00

## SURCHARGE LOADS

**Distributed Loads : 20KPA**

Description :

Class : Variable unfavourable

 Magnitude.....[kN/m<sup>2</sup>]..= 20.00 Inclination angle.....[°]..= 0.00

Abscissa.....[m]..: from = 30.00 To = 50.00

**Distributed Loads : 5KPA**

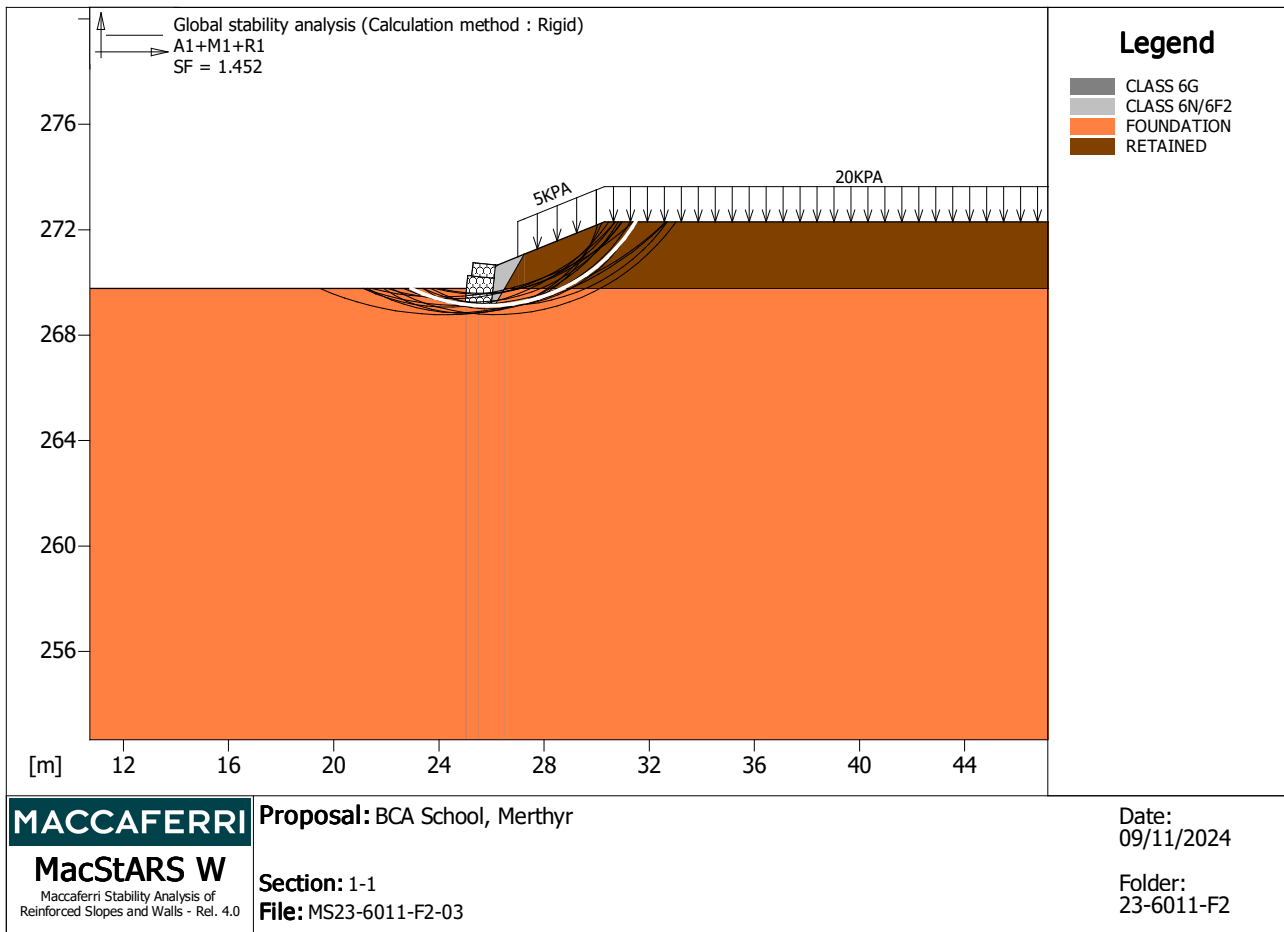
Description :

Class : Variable unfavourable

 Magnitude.....[kN/m<sup>2</sup>]..= 5.00 Inclination angle.....[°]..= 0.00

Abscissa.....[m]..: from = 27.00 To = 29.99

**CHECKS RESULTS**



**Global Stability Check :**

Multiplier combination : A1+M1+R1

Reinforcements active Forces according to Rigid Method

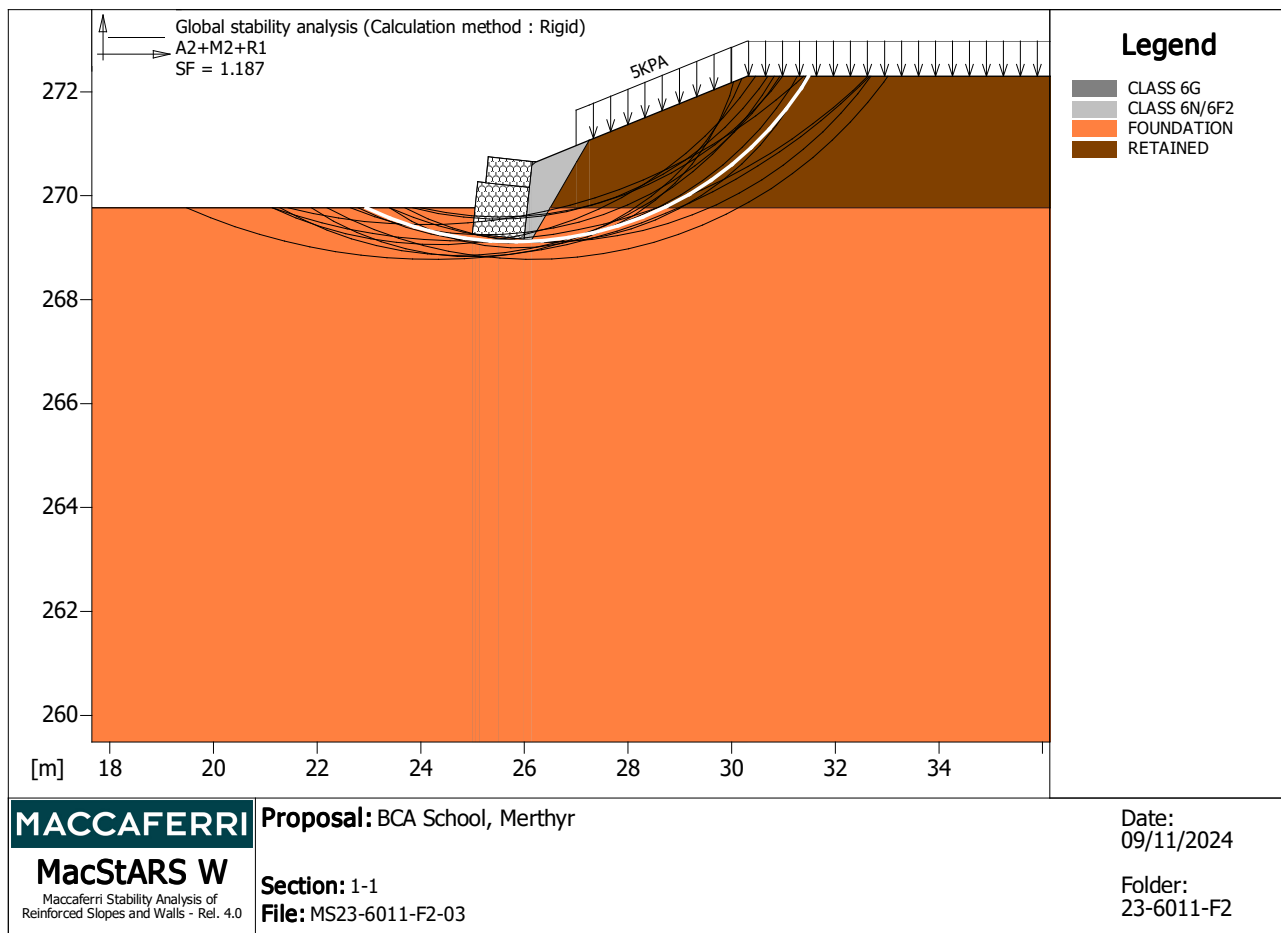
Stability analysis with circular surfaces according to Bishop's Method

Evaluated Safety Factor.....: 1.452

**Surfaces searching range**

| Starting range, abscises [m]                           |              | Arrival range, abscises [m] |              |
|--------------------------------------------------------|--------------|-----------------------------|--------------|
| First point                                            | Second point | First point                 | Second point |
| 10.00                                                  | 24.90        | 27.00                       | 45.00        |
| Number of starting point on the starting segment.....: |              | 100                         |              |
| Total number of trial surfaces.....:                   |              | 1000                        |              |
| Minimum base length of slices.....[m].....:            |              | 0.50                        |              |
| Superior limit search angle.....[°].....:              |              | 0.00                        |              |
| Inferior limit search angle.....[°].....:              |              | 0.00                        |              |

| Multiplier | Class                                   |
|------------|-----------------------------------------|
| 1.50       | Variable unfavourable                   |
| 1.00       | Angle of shearing resistance (Tan phi)  |
| 1.00       | Effective cohesion                      |
| 1.00       | Undrained shear strength                |
| 1.00       | Weight density                          |
| 1.00       | Tensile strength of reinforcement       |
| 1.00       | Pullout resistance of reinforcement     |
| 1.00       | Ground resistance for overall stability |



## Global Stability Check :

Multiplier combination : A2+M2+R1

Reinforcements active Forces according to Rigid Method

Stability analysis with circular surfaces according to Bishop's Method

Evaluated Safety Factor.....: 1.187

### Surfaces searching range

| Starting range, abscises [m]                           |              | Arrival range, abscises [m] |              |
|--------------------------------------------------------|--------------|-----------------------------|--------------|
| First point                                            | Second point | First point                 | Second point |
| 10.00                                                  | 24.90        | 27.00                       | 45.00        |
| Number of starting point on the starting segment.....: |              | 100                         |              |
| Total number of trial surfaces.....:                   |              | 1000                        |              |
| Minimum base length of slices.....[m].....:            |              | 0.50                        |              |
| Superior limit search angle.....[°].....:              |              | 0.00                        |              |
| Inferior limit search angle.....[°].....:              |              | 0.00                        |              |

| Multiplier | Class                                   |
|------------|-----------------------------------------|
| 1.30       | Variable unfavourable                   |
| 1.25       | Angle of shearing resistance (Tan phi)  |
| 1.25       | Effective cohesion                      |
| 1.40       | Undrained shear strength                |
| 1.00       | Weight density                          |
| 1.00       | Tensile strength of reinforcement       |
| 1.00       | Pullout resistance of reinforcement     |
| 1.00       | Ground resistance for overall stability |

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# **MacStARS W – Rel. 4.0**

Maccaferri Stability Analysis of Reinforced Slopes and Walls  
Officine Maccaferri S.p.A. - Via Kennedy 10 - 40069 Zola Predosa (Bologna)  
Tel. 051.6436000 - Fax 051.236507

Geoman

Project Title.....: BCA School, Merthyr

Cross Section.....: 1-1

Site.....:

Folder.....: 23-6011-F2

File.....: MS23-6011-F2-04

Date.....: 09/11/2024

Checks according to:      Eurocode 7 EN 1997-1  
                                 Eurocode 7 EN 1997-1

## **TABLE OF CONTENTS**

**SOIL PROPERTIES**

|                                   |                                          |       |
|-----------------------------------|------------------------------------------|-------|
| <b>Soil: CLASS 6G</b>             | Description:                             |       |
| Cohesion Class.....               | : Effective cohesion                     |       |
| Cohesion.....                     | [kN/m <sup>2</sup> ].....                | 0.00  |
| Friction Angle Class.....         | : Angle of shearing resistance (Tan phi) |       |
| Friction Angle.....               | [°].....                                 | 40.00 |
| Ru value.....                     |                                          | 0.00  |
| Weight Class.....                 | : Weight density                         |       |
| Bulk unit weight - above GWT..... | [kN/m <sup>3</sup> ].....                | 17.50 |
| Bulk unit weight - below GWT..... | [kN/m <sup>3</sup> ].....                | 17.50 |
| Elastic Modulus.....              | [kN/m <sup>2</sup> ].....                | 0.00  |
| Poisson's ratio.....              |                                          | 0.30  |

|                                   |                                          |       |
|-----------------------------------|------------------------------------------|-------|
| <b>Soil: CLASS 6N/6F2</b>         | Description:                             |       |
| Cohesion Class.....               | : Effective cohesion                     |       |
| Cohesion.....                     | [kN/m <sup>2</sup> ].....                | 0.00  |
| Friction Angle Class.....         | : Angle of shearing resistance (Tan phi) |       |
| Friction Angle.....               | [°].....                                 | 35.00 |
| Ru value.....                     |                                          | 0.00  |
| Weight Class.....                 | : Weight density                         |       |
| Bulk unit weight - above GWT..... | [kN/m <sup>3</sup> ].....                | 18.00 |
| Bulk unit weight - below GWT..... | [kN/m <sup>3</sup> ].....                | 18.00 |
| Elastic Modulus.....              | [kN/m <sup>2</sup> ].....                | 0.00  |
| Poisson's ratio.....              |                                          | 0.30  |

|                                   |                                          |       |
|-----------------------------------|------------------------------------------|-------|
| <b>Soil: FOUNDATION</b>           | Description: firm CLAY                   |       |
| Cohesion Class.....               | : Effective cohesion                     |       |
| Cohesion.....                     | [kN/m <sup>2</sup> ].....                | 0.00  |
| Friction Angle Class.....         | : Angle of shearing resistance (Tan phi) |       |
| Friction Angle.....               | [°].....                                 | 28.00 |
| Ru value.....                     |                                          | 0.00  |
| Weight Class.....                 | : Weight density                         |       |
| Bulk unit weight - above GWT..... | [kN/m <sup>3</sup> ].....                | 19.00 |
| Bulk unit weight - below GWT..... | [kN/m <sup>3</sup> ].....                | 19.00 |
| Elastic Modulus.....              | [kN/m <sup>2</sup> ].....                | 0.00  |
| Poisson's ratio.....              |                                          | 0.30  |

|                                   |                                          |       |
|-----------------------------------|------------------------------------------|-------|
| <b>Soil: RETAINED</b>             | Description: Soft CLAY                   |       |
| Cohesion Class.....               | : Effective cohesion                     |       |
| Cohesion.....                     | [kN/m <sup>2</sup> ].....                | 0.00  |
| Friction Angle Class.....         | : Angle of shearing resistance (Tan phi) |       |
| Friction Angle.....               | [°].....                                 | 28.00 |
| Ru value.....                     |                                          | 0.00  |
| Weight Class.....                 | : Weight density                         |       |
| Bulk unit weight - above GWT..... | [kN/m <sup>3</sup> ].....                | 19.00 |
| Bulk unit weight - below GWT..... | [kN/m <sup>3</sup> ].....                | 19.00 |
| Elastic Modulus.....              | [kN/m <sup>2</sup> ].....                | 0.00  |
| Poisson's ratio.....              |                                          | 0.30  |

## STRATA PROFILES

**Stratum: BACKFILL**

Description:

Soil : CLASS 6N/6F2

| X     | Y      | X     | Y      | X     | Y      | X   | Y   |
|-------|--------|-------|--------|-------|--------|-----|-----|
| [m]   | [m]    | [m]   | [m]    | [m]   | [m]    | [m] | [m] |
| 25.13 | 269.77 | 26.22 | 270.65 | 27.25 | 271.07 |     |     |

**Stratum: FOUNDATION**

Description:

Soil : FOUNDATION

| X     | Y      | X     | Y      | X     | Y      | X     | Y      |
|-------|--------|-------|--------|-------|--------|-------|--------|
| [m]   | [m]    | [m]   | [m]    | [m]   | [m]    | [m]   | [m]    |
| 0.00  | 269.77 | 25.13 | 269.77 | 25.50 | 269.22 | 26.14 | 269.15 |
| 26.50 | 269.77 | 50.00 | 269.77 |       |        |       |        |

**Stratum: RETAINED**

Description:

Soil : RETAINED

| X     | Y      | X     | Y      | X     | Y      | X     | Y      |
|-------|--------|-------|--------|-------|--------|-------|--------|
| [m]   | [m]    | [m]   | [m]    | [m]   | [m]    | [m]   | [m]    |
| 26.50 | 269.77 | 27.25 | 271.07 | 30.30 | 272.30 | 50.00 | 272.30 |

## GABION WALL

**Wall : GW**

Wall origin.....[m].....: Abscissa.....= 25.00 Ordinate.....= 269.27

Wall batter.....[°].....= 6.00

Gabion filling soil.....: CLASS 6G  
 Backfill soil.....: CLASS 6N/6F2  
 Gabion covering soil.....: RETAINED  
 Gabion foundation soil.....: FOUNDATION

| Layer | Length [m] | Height [m] | Offset [m] | Pu [kN/m <sup>3</sup> ] |
|-------|------------|------------|------------|-------------------------|
| 1     | 1.00       | 1.00       | 0.00       | 61.31                   |
| 2     | 0.85       | 0.50       | 0.15       | 98.10                   |

Gabions without diaphragms

Mesh type 10x12 Wire diameter 2,7 [mm]

Brinch Hansen, Vesic or Meyerhof bearing capacity parameters

Embedment depth.....[m] : 0.50

Natural soil slope.....[°] : 0.00

## SURCHARGE LOADS

**Distributed Loads : 20KPA**

Description :

Class : Variable unfavourable

 Magnitude.....[kN/m<sup>2</sup>]..= 20.00 Inclination angle.....[°]..= 0.00

Abscissa.....[m]..: from = 30.00 To = 50.00

**Distributed Loads : 5KPA**

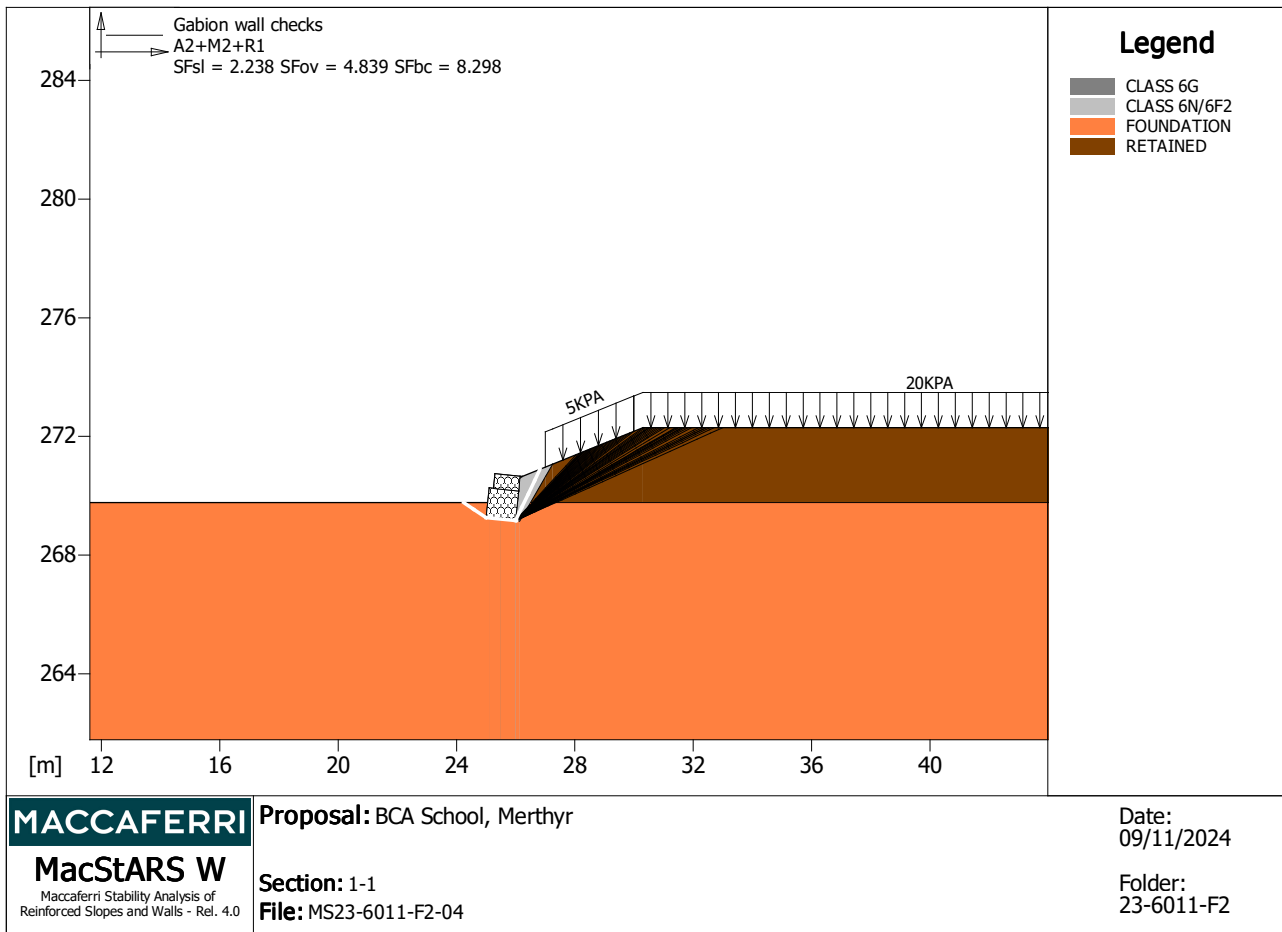
Description :

Class : Variable unfavourable

 Magnitude.....[kN/m<sup>2</sup>]..= 5.00 Inclination angle.....[°]..= 0.00

Abscissa.....[m]..: from = 27.00 To = 29.99

## CHECKS RESULTS



### Wall Checks :

Multiplier combination : A2+M2+R1

Considered block : GW

Resisting force.....[kN/m].....: 16.39

Active force.....[kN/m].....: 7.32

Sliding class.....: Sliding resistance

Sliding safety factor.....: 2.238

Restoring moment.....[kN\*m/m].....: 17.85

Overturning moment.....[kN\*m/m].....: 3.69

Overturning class.....: Overturning

Overturning safety factor.....: 4.839

Imposed ultimate bearing pressure

Ultimate bearing pressure.....[kN/m²].....: 250.00

Active pressure.....[kN/m²].....: 29.77

Pressure class.....: Bearing capacity

Bearing capacity safety factor.....: 8.298

Equivalent bearing area.....[m].....: 0.98

Eccentricity of normal force.....[m].....: 0.01

Lever arm of overturning force.....[m].....: 0.50

Normal force on the base.....[kN].....: 29.20

Outer edge stress.....[kN/m²].....: 31.16

Inner edge stress.....[kN/m²].....: 26.92

Multiplier

1.30

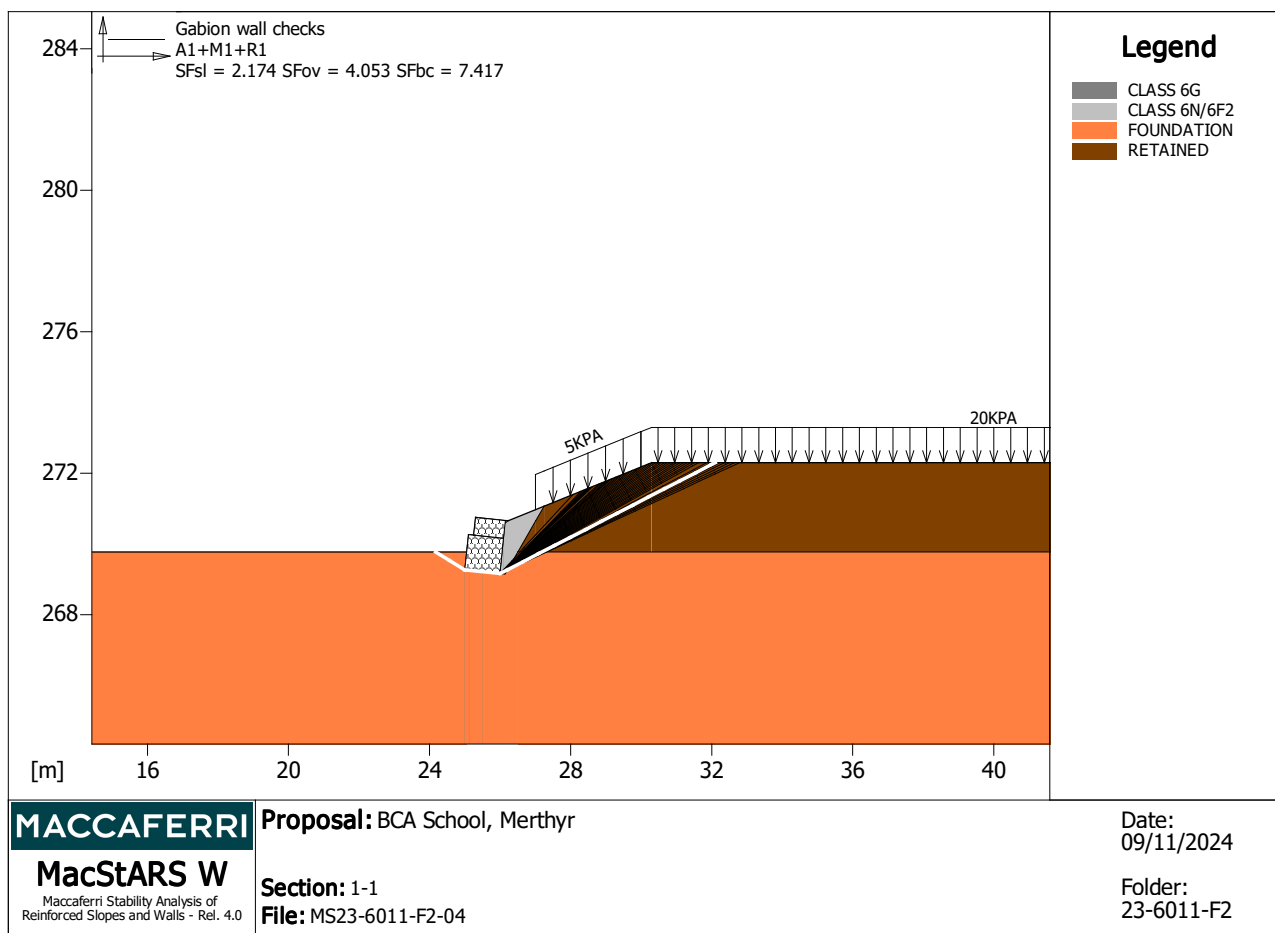
1.25

Class

Variable unfavourable

Angle of shearing resistance (Tan phi)

|      |                          |
|------|--------------------------|
| 1.25 | Effective cohesion       |
| 1.40 | Undrained shear strength |
| 1.00 | Weight density           |
| 1.00 | Sliding resistance       |
| 1.00 | Bearing capacity         |
| 1.00 | Overturning              |



## Wall Checks :

Multiplier combination : A1+M1+R1

Considered block : GW

Resisting force.....[kN/m] : 21.40

Active force.....[kN/m] : 9.84

Sliding class.....: Sliding resistance

Sliding safety factor.....: 2.174

Restoring moment.....[kN\*m/m] : 20.36

Overturning moment.....[kN\*m/m] : 5.02

Overturning class.....: Overturning

Overturning safety factor.....: 4.053

Imposed ultimate bearing pressure

Ultimate bearing pressure.....[kN/m²] : 250.00

Active pressure.....[kN/m²] : 33.04

Pressure class.....: Bearing capacity

Bearing capacity safety factor.....: 7.417

Equivalent bearing area.....[m] : 0.97

Eccentricity of normal force.....[m] : 0.02

Lever arm of overturning force.....[m] : 0.51

Normal force on the base.....[kN] : 32.01

Outer edge stress.....[kN/m²] : 35.30

Inner edge stress.....[kN/m²] : 28.39

| Multiplier | Class                                  |
|------------|----------------------------------------|
| 1.50       | Variable unfavourable                  |
| 1.00       | Angle of shearing resistance (Tan phi) |
| 1.00       | Effective cohesion                     |
| 1.00       | Undrained shear strength               |

|      |                    |
|------|--------------------|
| 1.00 | Weight density     |
| 1.00 | Sliding resistance |
| 1.00 | Bearing capacity   |
| 1.00 | Overturning        |

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