Queensberry DESIGN LIMITED

Civil, Structural, Architectural & Geotechnical Consultants

# Approval in Principle

## Gilcon Retaining Walls

## Adjacent the Adopted Highway

**Strata**

**Westgate, Cleckheaton**

**QD - 1776**

**Rev**

June 2025

Office: Unit 5, The Staithes, The Watermark, Metro Riverside, Gateshead, NE11 9SN

## Issue Sheet

| | |
|---|---|
| **Prepared By** | D.J. Phillipson<br>Structural Associate |
| **Reviewed By** | D. Rogers<br>Structural Engineering Director |
| **Issue** | - (20/06/2025) – Initial Issue |

## Design Brief

An AIP has been requested by Kirklees Council for the Gilcon Lock and Load Retaining Walls adjacent the adopted highway. Queensberry Design Ltd (QDL) have prepared an AIP Cat 0 and Design and Check Certificate for this purpose. This is presented in this document.

## Contents

# Appendix A. Model form of Approval in Principle for the design of bridges and other highway structures where UK National Standards (Eurocodes) are used

Name of project

Westgate, Cleckheaton

Name of bridge or structure

Proprietary Lock Load Retaining Walls adjacent the Highway

Structure reference no.

N/A

Summary: set out a brief summary of what this AIP covers, why it is necessary and anticipated construction dates.

## 1. HIGHWAY DETAILS

1.1 Type of highway

Housing Estate Roads to access dwellings

1.2 Design traffic speed

30 mph

1.3 Existing restrictions

The walls form the boundary to the Plot garden areas, access is restricted by the plot layout and associated boundaries.

## 2. SITE DETAILS

2.1 Obstacles crossed

None

## 3. PROPOSED STRUCTURE

3.1 Description of structure and design working life

The proposed structure is a Lock and Load retaining wall to a design life of 120 years, a 1.8m fence will be constructed behind the retaining wall as the boundary treatment.

3.2 Structural type

This wall is designed as a reinforced soil gravity retaining wall.

3.3 Foundation type

The foundations are ground bearing strip foundation, a bearing pressure of 80kN/$m^2$ has been assumed, Foundations are sat on soil inclusion improved ground by Van Elle to achieve the 80kN/$m^2$, this will be verified upon completion.

3.4 Span arrangements

The maximum retained height is in the order of 2.85m.

3.5 Articulation arrangements

N/A

3.6 Classes and levels

1) consequence class;

Consequence class to be CC2 (medium consequence for loss of human life, economic, social or environmental consequences considerable)

2) reliability class;

Reliability class is to be associated with the consequence class detailed in 3.6.1.
Reliability class to be RC2.
Factor for actions to be used KFI = 1,0

3) inspection level.

Inspection Level 2 – Normal inspection (inspection in accordance with the procedures of the inspecting organisation).

3.7 Road restraint systems requirements

N/A

3.8 Proposals for water management

A field drain has been provided behind the retaining wall.

3.9 Proposed arrangements for future maintenance and inspection

General Inspection is from the highway level.

1) traffic management;

N/A

2) arrangements for future maintenance and inspection of structure. Access arrangements to structure.

Inspection is from the adopted highway.

3.10 Environment and sustainability

Drawing provided, showing design requirements.

3.11 Durability - materials and finishes

Concrete Grade RC32/40 XF2
Secugrid PET Grids, refer to BBA Certificate 14/H218

3.12 Risks and hazards considered for design, execution, maintenance and demolition. Consultation with and/or agreement from Overseeing Organisation

Wall to be constructed prior to site levels being raised to mitigate temporary works requirement.

3.13 Estimated cost of proposed structure together with other structural forms considered (including where appropriate proprietary manufactured structure), and the reasons for their rejection (including comparative whole life costs with dates of estimates). Reference should be made to any options reports done.

Costs T.B.C.

3.14 Proposed arrangements for construction

1) construction of structure;

No special requirements

2) traffic management;

Wall will be constructed from within the site boundary

3) service diversions;

N/A

4) interface with existing structures

N/A.

3.15 Resilience and security.

N/A

## 4. DESIGN CRITERIA

4.1 Actions

1) permanent actions;
All permanent actions as outlined in BS EN 1991-1-1 and the national annex.
Backfill density to be 16-20kN/m³
Concrete density to be 25kN/m³
Surfacing density to be 22kN/m³

2) snow, wind and thermal actions;

All permanent actions as outlined in BS EN 1991-1-3 and the National Annex..
Buried Structure, Thermal actions to Concrete Segments, joints as manufacturers recommendations.

3) actions relating to normal traffic under AW regulations and C&U regulations

N/A, Wall is supporting garden/private areas, an allowance of 5kN/m² has been allowed for the surcharge load.

4) actions relating to General Order traffic under STGO regulations;

N/A

5) footway or footbridge variable actions;

N/A

6) actions relating to Special Order traffic, provision for exceptional abnormal indivisible; loads including location of vehicle track on deck cross-section

N/A

7) accidental actions;

N/A

8) actions during construction;

N/A

9) any special action not covered above

N/A

4.2 Heavy or high load route requirements and arrangements being made to preserve the route, including any provision for future heavier loads or future widening

N/A

4.3 Proposed minimum headroom to be provided

N/A

4.4 Set out measures that will be incorporated into design to minimise maintenance.

Low maintenance materials used, concrete and stone

4.5 Authorities consulted and any special conditions required

Kirklees Council, Highways

4.6 Standards and documents listed in the technical approval schedule (TAS)

**The Design Manual for Roads and Bridges (DMRB)**

| DMRB reference | Title | Notes |
|---|---|---|
| BD 97/12 | The Assessment of Scour and other Hydraulic Actions at Highway Structures | |
| CG 300 Revision 0.1.0 | Technical approval of highway structures | Supersedes BD 2/12 |
| CS 450 Revision 0.1.0 | Inspection of highway structures | Supersedes BD 63/17 |
| CS 451 Revision 0 | Structural review and assessment of highway structures | Supersedes BD 101/11 |
| **CS 454 Revision 1.1.0** | **Assessment of highway bridges and structures** | **Supersedes CS 454 Revision 1** |
| **CS 455 Revision 1.1.1** | **The assessment of concrete highway bridges and structures** | **Supersedes CS 455 Revision 1.1.0** |
| CS 458 Revision 0 | The assessment of highway bridges and structures for the effects of special type general order (STGO) and special order (SO) vehicles | Supersedes BD 86/11 |
| CS 459 Revision 1 | The assessment of bridge substructures, retaining structures and buried structures | Supersedes BA 55/06 |
| CS 463 Revision 0 | Load testing for bridge assessment | Supersedes BA 54/94 |
| GG 104 Revision 0 | Requirements for safety risk assessment | Supersedes GD 04/12 |
| | | |
| **Interim Advice Notes** | | |
| **IAN reference** | **Title** | **Notes** |
| IAN 173/13 | Implementation of BD 97/12 – The Assessment of Scour and Other Hydraulic Actions at Highway Structures | |
| | | |
| | | |
| | | |

**Eurocodes and associated UK National Annexes**

| Eurocode part | Title | Amendment / Corrigenda | *Notes* |
|---|---|---|---|
| **Eurocode 0** | **Basis of structural design** | | |
| BS EN 1990:2002 +A1:2005 | Eurocode 0: Basis of structural design | +A1:2005 Incorporating corrigenda December 2008 and April 2010 | See CD 350 Section 7 for additional guidance. |

| | | | |
|---|---|---|---|
| NA to BS EN 1990:2002 + A1:2005 | UK National Annex to Eurocode 0 Basis of structural design | National Amendment No.1 | See CD 350 Section 7 for additional guidance. |
| **Eurocode 1** | **Actions on structures** | | |
| BS EN 1991-2:2003 | Eurocode 1: Actions on structures. Traffic loads on bridges | Corrigenda December 2004 and February 2010 | See CD 350 section 7 for additional guidance. |
| NA +A1:2020 to BS EN 1991-2:2003 | UK National Annex to Eurocode 1: Actions on structures. Traffic loads on bridges | Corrigendum No.1 Amendment June 2020 | See CD 350 section 7 for additional guidance. |
| **Eurocode 2** | **Design of concrete structures** | | |
| BS EN 1992-1-1:2004 + A1:2014 | Eurocode 2: Design of concrete structures– Part 1-1: General rules and rules for buildings | Incorporating corrigendum January 2008, November 2010 and January 2014 | |
| NA + A2:2014 to BS EN 1992-1-1:2004 + A1:2014 | UK National Annex to Eurocode 2: Design of concrete structures – Part 1-1: General rules and rules for buildings | | |
| BS EN 1992-2:2005 | Eurocode 2: Design of concrete structures – Part 2: Concrete bridges – Design and detailing rules | Corrigendum July 2008 | |
| NA to BS EN 1992-2:2005 | UK National Annex to Eurocode 2: Design of concrete structure – Part 2: Concrete bridges – Design and detailing rules | - | |
| **Eurocode 4** | **Design of composite steel and concrete structures** | | |
| BS EN 1994-2:2005 | Eurocode 4: Design of composite steel and concrete structures – Part 2 General rules and rules for bridges | Corrigendum July 2008 | |
| NA to BS EN 1994-2:2005 | UK National Annex to Eurocode 4: Design of composite steel and concrete structures – Part 2 General rules and rules for bridges | - | |
| **Eurocode 7** | **Geotechnical design** | | |
| BS EN 1997-1:2004+A1:2013 | Eurocode 7: Geotechnical design – Part 1 General rules | +A1:2013 Corrigendum February 2009 | |
| NA+A2:2022 to BS EN 1997-1:2004+A1:2013 | UK National Annex to Eurocode 7: Geotechnical design – Part 1 General rules | +A1:2013 Incorporating Corrigendum No.1, Amendment 1 – July 2014 and Amendment 2 - 2022 | Supersedes NA+A1:2014 to BS EN 1997-1:2004+A1:2013 |

**Bsi Published Documents**

| Published Document reference | Title | Notes |
|---|---|---|
| PD 6694-1:2011 + A1:2020 | Recommendations for the design | Incorporating Corrigendum January 2022 |

| | | |
|---|---|---|
| | of structures subject to traffic loading to BS EN 1997-1 | See CD 350 Appendix A for additional guidance. |

**British Standards**

| British Standard reference | Title | Notes |
|---|---|---|
| BS 4-1 | BS 4 - Structural Steel Sections Part 1 - Hot rolled sections | Replaced by BS EN 10365:2017 |
| BS 4360 | Weldable Structural Steel | Replaced by BS EN 10029:1991, BS 7668:1994, BS EN 10113-1:1993, BS EN 10113-3:1993, BS EN 10210-1:1994, BS EN 10113-2:1993 |
| BS 5400-4 | Steel, concrete and composite bridges. Code of practice for design of concrete bridges | Replaced by BS EN 1992-2:2005 |
| BS 5400-5 | Steel, concrete and composite bridges. Part 5: Code of practice for design of composite bridges | Replaced by BS EN 1994-2:2005 |
| BS 5400-10 | Steel, concrete and composite bridges. Part 10: Code of practice for fatigue | Replaced by BS EN 1993-1-9:2005 |
| BS 5628 | Code of practice for the use of masonry | Replaced by BS EN 1996-1-2:2005, BS EN 1996-2:2006, BS EN 1996-3:2006, PD 6697:2010 |
| BS 5975 | Code of practice for temporary works procedures and the permissible stress design of falsework | Current version is BS 5975:2019 but there is also BS 5975:2019 - TC |
| BS 8002 | Code of practice for earth retaining structures | Current version is BS 8002:2015 but there is also BS 8002:2015 - TC |
| BS 8004 | Code of practice for foundations | Current version is BS 8004:2015+A1:2020 but there is also BS 8004:2015 - TC |

**The Manual Contract Document for Highway Works (MCHW)**

| MCHW reference | Title | *Notes* |
|---|---|---|
| **MCHW Volume 1: October 2022** | **Specification for Highway Works** | ***Specification compliant with the execution standards must be used. A Departure is necessary for the parts where a compliant revision has not been published. Amendments October 2022 Supersedes April 2022 version*** |
| **MCHW Volume 2: October 2022** | **Notes for guidance on the Specification for Highway Works** | ***Notes for guidance compliant with the execution standards must be used. A Departure is necessary for the parts where a compliant revision has not been published. Amendments October 2022 Supersedes November 2021 version*** |
| MCHW Volume 3: February 2017 | Highway Construction Details | |

**Miscellaneous**

| Standard reference | Title | Notes |
|---|---|---|

| | | |
|---|---|---|
| CIRIA - C764 | Hidden defects in bridges. Guidance for detection and maintenance | |
| CIRIA - C778 | Management of safety critical fixings in-service. Guidance for the management and design of safety-critical fixings | |
| CIRIA - C800 | Guidance on the assessment of masonry arch bridges | |
| DfT Masonry Parapets Guidance | Guidance on the Design, Assessment and Strengthening of Masonry Parapets on Highway Structures | |
| DfT UK Roads Liaison Group. MHS CoP | Management of Highway Structures - Code of Practice | |

4.7 Proposed departures from standards listed in 4.6

None

4.8 Proposed departures from standards concerning methods for dealing with aspects not covered by standards listed in 4.6

None

4.9 Proposed safety critical fixings

None

## 5. STRUCTURAL ANALYSIS

5.1 Methods of analysis proposed for superstructure, substructure and foundations

The retaining walls design has been analysed by specialist

5.2 Description and diagram of idealised structure to be used for analysis

Structure has been analyzed as a soil reinforced gravity wall.

5.3 Assumptions intended for calculation of structural element stiffness

N/A

5.4 Proposed range of soil parameters to be used in the design of earth retaining elements

Wall designed for a Ground Bearing Pressure of 80kPa.

## 6. GEOTECHNICAL CONDITIONS

6.1 Acceptance of recommendations of the ground investigation report (reference/dates) to be used in the design and reasons for any proposed changes

6.2 Summary of design for highway structure in the ground investigation report

6.3 Differential settlement to be allowed for in the design of the structure

Retaining wall will be on improved strata by Rigid Inclusion to give a consistent strata therefore no differential settlement should occur, base is reinforced, so any slight differences would be catered for.

6.4 If the ground investigation report is not yet available, state when the results are expected and list the sources of information used to justify the preliminary choice of foundations

N/A

## 7. CHECK

7.1 Proposed category and design supervision level

Category 0

7.2 If category 3, name of proposed independent checker

N/A

7.3 Erection proposals or temporary works for which types S and P proposals will be required, listing structural parts of the permanent structure affected with reasons

N/A

## 8. DRAWINGS AND DOCUMENTS

8.1 List of drawings (including numbers) and documents accompanying the submission

BY00099-STH-B01-XX-DR-S-1003, Rev-, – Retaining Wall Heights from Formation
QD1776-14-10 – Masonry and Gillcon Retaining Walls Location Plans
QD1776-14-13 – Gilcon Retaining Wall Sections (Sheet 2 of 4) Rev -
QD1776-14-14 – Gilcon Retaining Wall Sections (Sheet 3 of 4) Rev –
SK24-5558-F1-04B – Lock+Load Wall 03 Elevation
SK24-5558-F1-05B – Lock+Load Wall 03 Cross - Sections
HAPAS Certificate 21/H311 – Lock and Load Retaining Wall System
HAOAS Certificate 14/H218 – Secugrid Geogrids
Design and Check Certificate

## 9. THE ABOVE IS SUBMITTED FOR ACCEPTANCE

We confirm that details of the temporary works design will be/~~have been~~ passed to the permanent works designer for review.[20]

Signed 

Name D. J. Phillipson Design Team Leader

Engineering Qualifications BEng(Hons), CEng, MIStructE

Name of Organisation Queensberry Design Ltd

Date 20/06/2025

Signed _____

Name D. Rogers Check Team Leader

Engineering Qualifications BEng (Hons)

Name of Organisation Queensberry Design Ltd

Date 20/06/25

## 10. THE ABOVE IS REJECTED/AGREED[19] SUBJECT TO THE AMENDMENTS AND CONDITIONS SHOWN BELOW[20]

Signed _____

Name _____

Position held _____

Engineering Qualifications _____ [21]

TAA _____

Date _____

## Notes

1) For a bridge, give over and/or under.
2) Include weight, height, width and any environmental restrictions at or adjacent to the bridge.
3) The design working life of the structure including temporary structure, and replaceable structural parts are to be given. They are to be expressed as a number of years rather than a range of years. A design working life is to be based on the DMRB if stated, otherwise it may be based on the guidance given in the Overseeing Organisation's current requirements for the use of Eurocodes for the design of highway structures.
4) Bearings and joints are components that will require maintenance and are vulnerable to water ingress. Where it is proposed not to have a structure with integral construction provide justification for that.
5) State the classes and levels for the whole structure, as well as those for the individual structural elements if higher or lower. See the Overseeing Organisation's current requirements for the use of Eurocodes for the design of highway structures.
6) Describe how water will be managed within the design of the structure. This includes internally (transport of water through the structure and sealing of elements to prevent water ingress) and externally (global management considering interface with other assets, (watercourses, drainage, pavement, geotechnical features, etc.)
7) Designers to set out the measures they will put in place to ensure that the design will follow industry guidance and best practice on environmental and sustainability aspects in accordance with GG 103 [Ref 8.N].
8) For concrete structures, give applicable exposure classes for particular structural elements. For all material strengths given, list the relevant codes/standards.
9) Designers to confirm that they have reviewed the risks and hazards identified in the AIP and are satisfied. Also see clause 2.27.
10) e.g. Load Models 1 and 2, BS EN 1991-2 [Ref 6.N]
11) e.g. SV model vehicle in Load Model 3, BS EN 1991-2 [Ref 6.N]
12) e.g. SOV model vehicle in Load Model 3, BS EN 1991-2 [Ref 6.N] and/or individual vehicle which includes the following information as applicable:
    a) gross weight of the vehicle in tonnes and vehicle type and number;
    b) axle load and spacing (longitudinally and transversely);
    c) air cushion in tonnes over area applied (in metres, longitudinally and transversely);
    d) single or twin tyres and wheel contact areas.
13) The heavy or high load route requirements should be confirmed by the relevant administration e.g. Abnormal Indivisible Load team in Highways England.
14) e.g. seismic action, atmospheric icing, floating debris, etc.
15) Designs that have minimal maintenance provide significant benefits in reducing the safety risk to the workforce and reducing disruption to the network. Designs that include elements with relatively high maintenance interventions need to be justified through the maintenance and repair statement in accordance with GD 304 [Ref 5.N].
16) List the main structural elements for superstructure, substructure and foundation. If the designs of the superstructure, substructure and/or foundation are carried out by different teams, refer to clause 2.84.
17) When the ground investigation report becomes available, an addendum to the AIP, covering section 6, is to be submitted to the TAA. The addendum is to have its own sections 8, 9 and 10 to provide a list of drawings, documents and signatures.

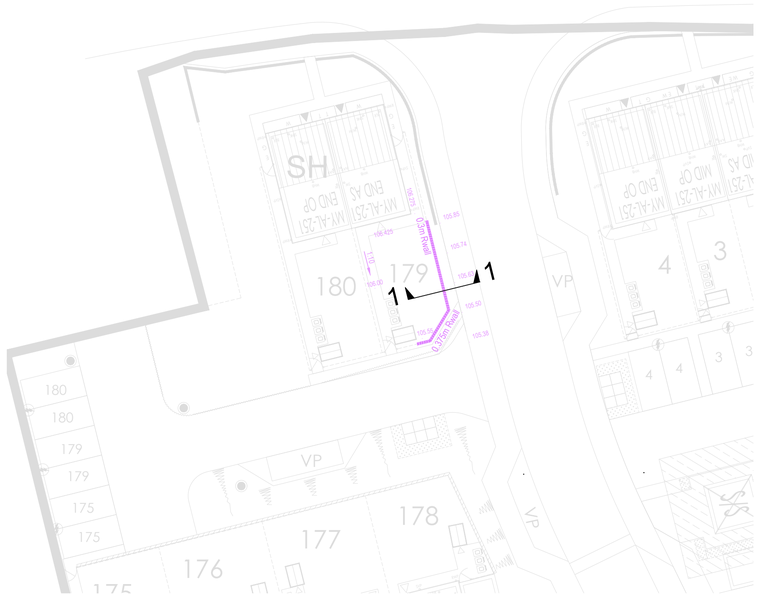
18) Include, without limitation:
    a) technical approval schedule (TAS);
    b) general arrangement drawing;
    c) relevant extracts from the ground investigation report;
    d) departures;
    e) relevant correspondence and documents from consultations.
19) Delete as appropriate.
20) This statement is applicable to temporary works design AIP only.
21) CEng MICE, CEng MIStructE or equivalent.
22) AIP is valid for three years after the date of agreement by the TAA. If the construction has not yet commenced within this period, the AIP is to be re-submitted to the TAA for review.

## APPENDIX B:

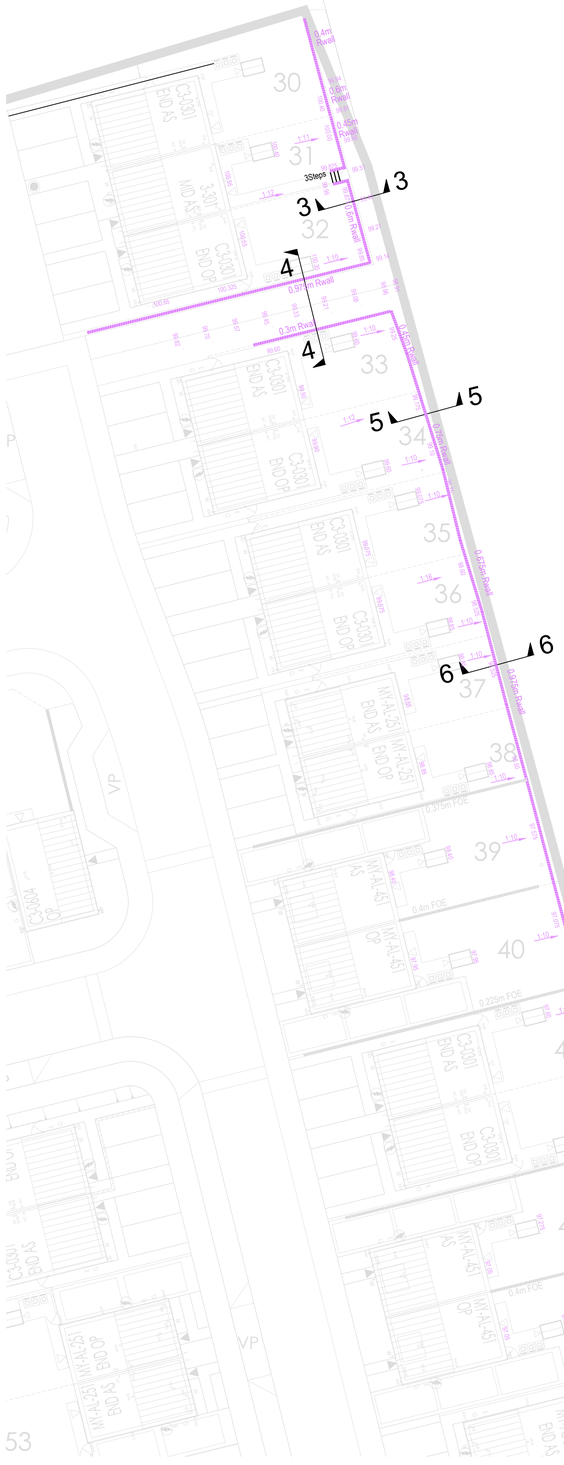
## GENERAL ARRANGEMENT DRAWINGS

Notes:-

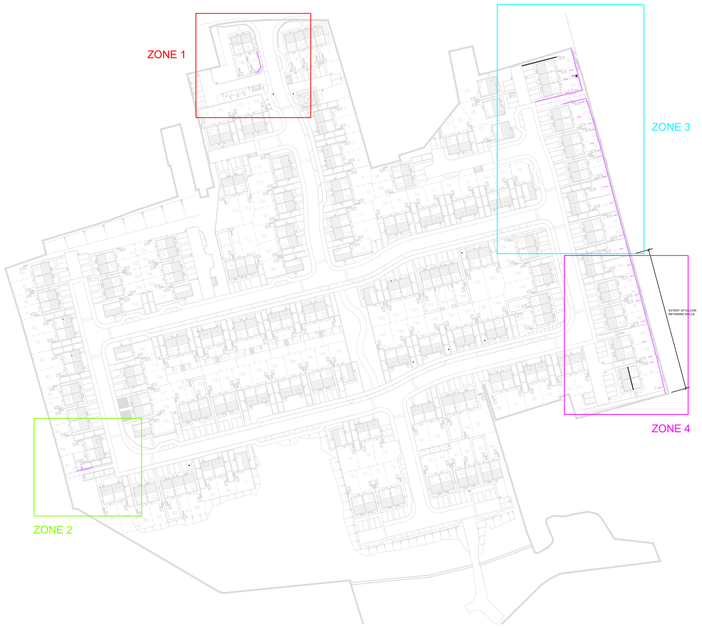
1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT ARCHITECTS ENGINEERS, MECHANICAL AND ELECTRICAL ENGINEERS DRAWINGS TOGETHER WITH THE SPECIFICATIONS.
2. DIMENSIONS TAKEN FROM PROPOSED LAYOUT.



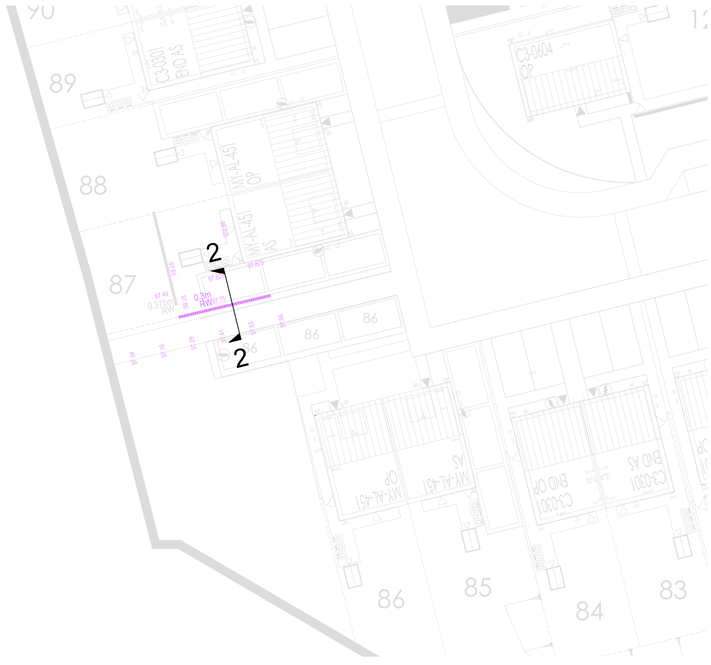

ZONE 1 - PLAN VIEW
SCALE - 1:50




ZONE 3 - PLAN VIEW
SCALE - 1:50




OVERALL ZONAL PLAN




ZONE 2 - PLAN VIEW
SCALE - 1:50


ZONE 4 - PLAN VIEW
SCALE - 1:50

| | | | | |
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Client: STRATA

Project: WESTGATE CLECKHEATON

Title: MASONRY & GILCON RETAINING WALL LOCATION PLANS

| Drawn | Checked | Date |
|---|---|---|
| DR | DJP | 12/06/2025 |

Drawing Number: QD1776-14-10

| Drawing Status | Scale | Rev. |
|---|---|---|
| INITIAL ISSUE | 1:500 - A1 | - |

Notes:–

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH GEOMAN DRAWINGS:

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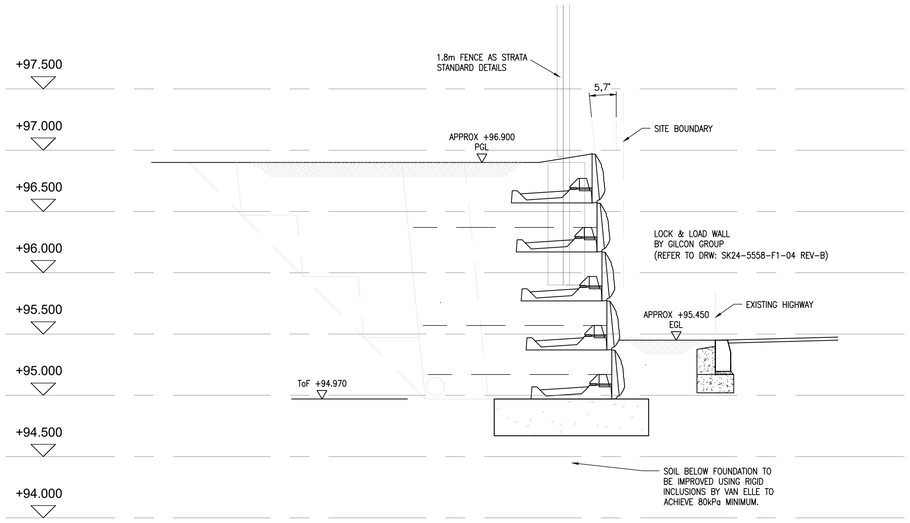
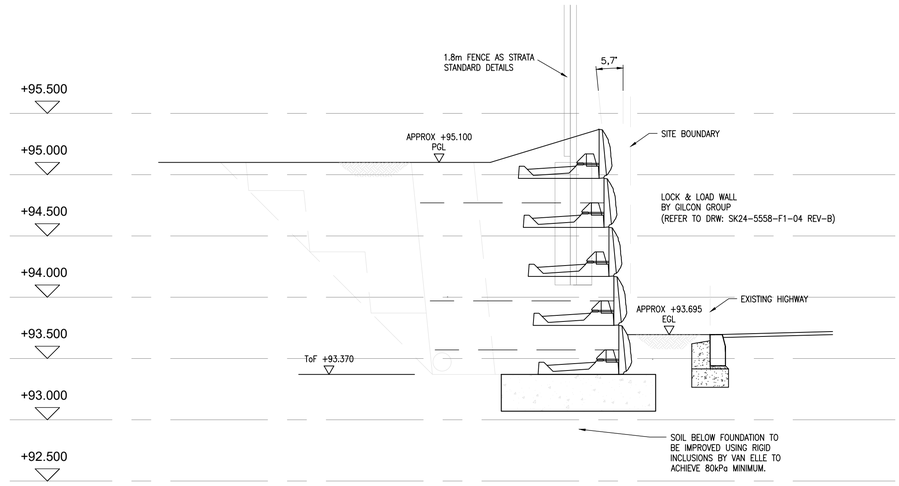
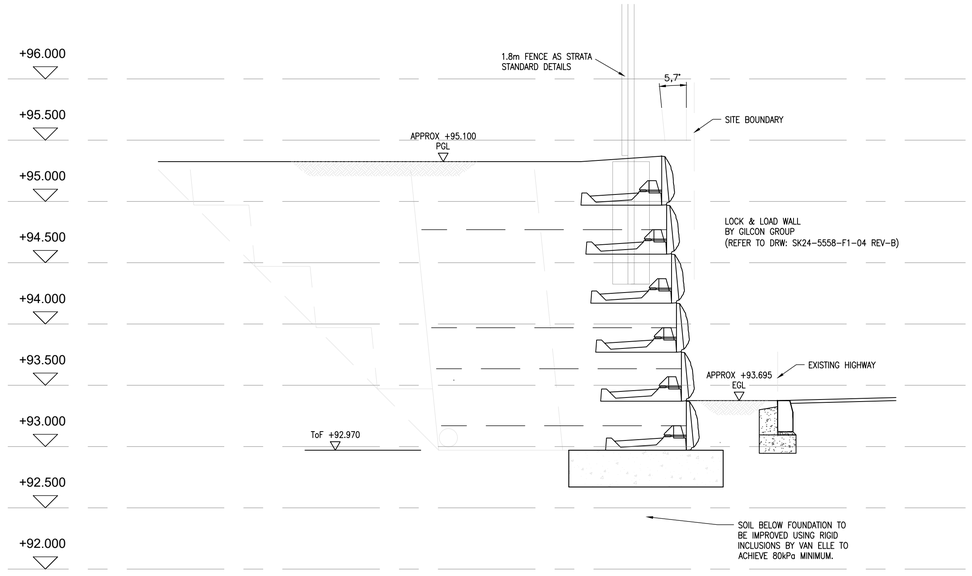
   – SK24–5558–F1–04B
   – SK24–5558–F1–05B



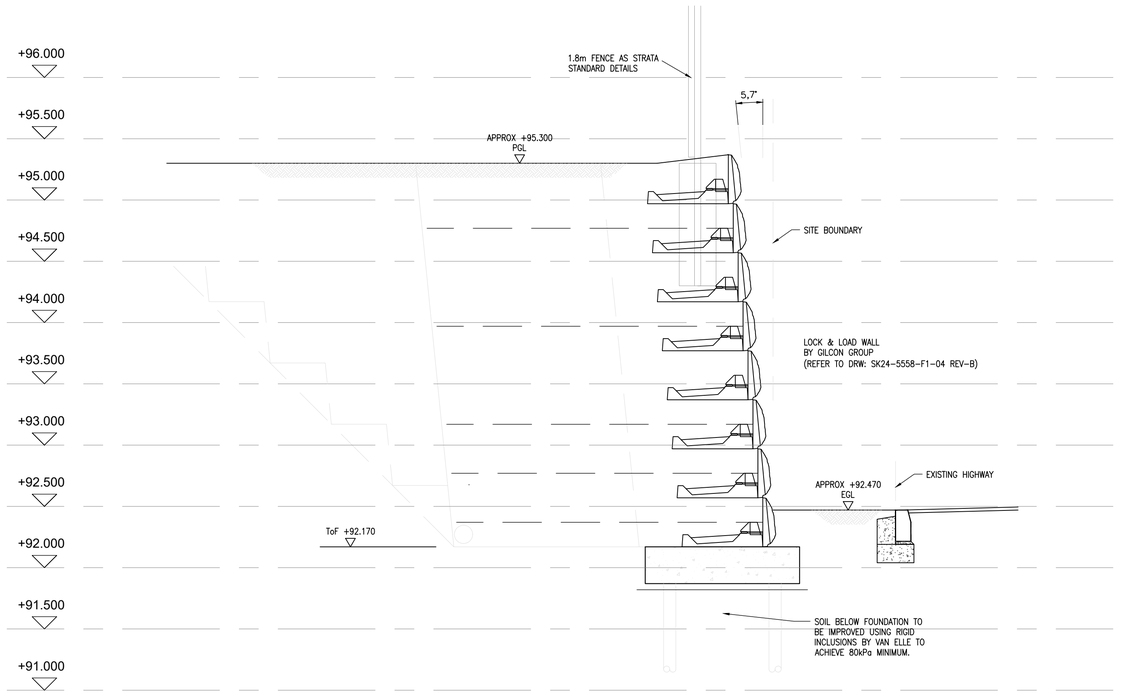

SECTION 8-8
Scale @ 1:25




SECTION 9-9
Scale @ 1:25




SECTION 10-10




SECTION 11-11
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Client: STRATA

Project: WESTGATE CLECKHEATON

Title: GILCON RETAINING WALL SECTIONS (SHEET 3 of 4)

| Drawn | Checked | Date |
|---|---|---|
| DR | DJP | 12/06/2025 |

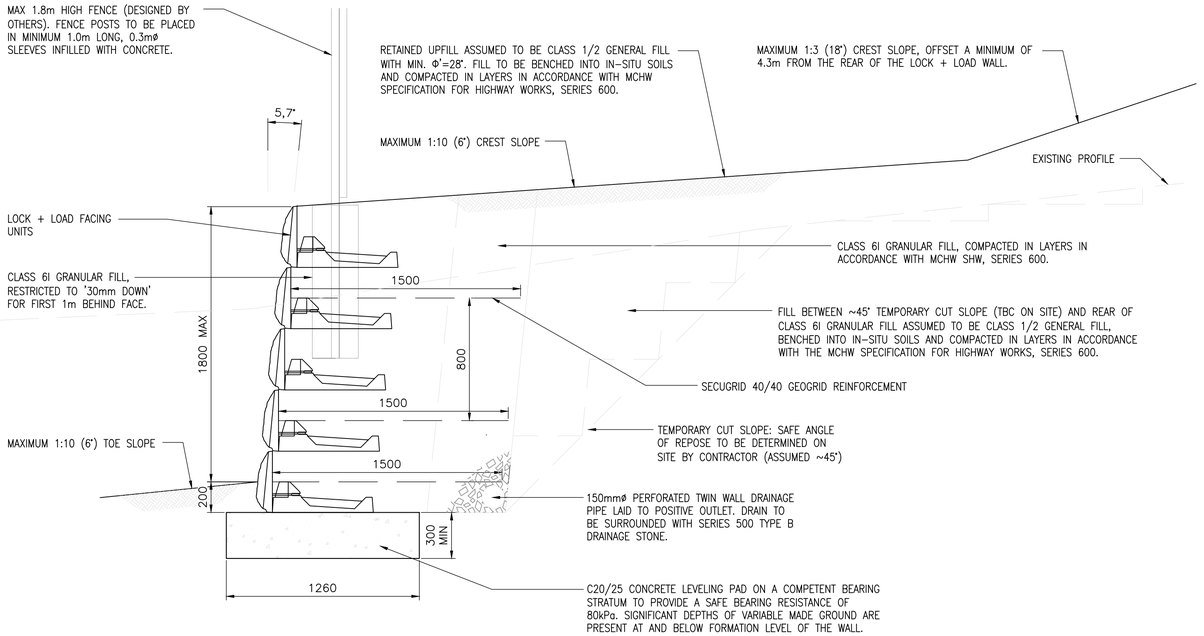
Drawing Number: QD1776-14-13

| Drawing Status | Scale | Rev. |
|---|---|---|
| INITIAL ISSUE | 1:500 - A1 | - |

Notes:–

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH GEOMAN DRAWINGS:

   – SK24–5558–F1–03
   – SK24–5558–F1–04B
   – SK24–5558–F1–05B




# TYPICAL GILCON DETAIL
# REFER TO SPECIALIST DRAWINGS

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| Rev. | Date | Revision Details | Drawn | Checked |
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Client: STRATA

Project: WESTGATE
CLECKHEATON

Title: GILCON RETAINING WALL SECTIONS (SHEET 4 of 4)

| Drawn | Checked | Date |
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| DR | DJP | 12/06/2025 |

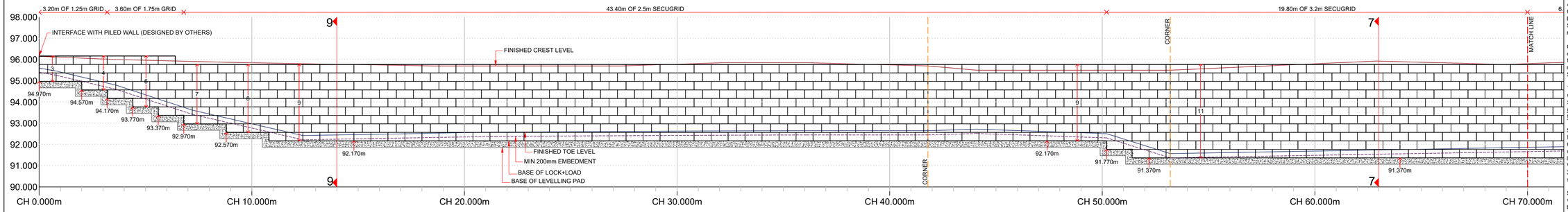
Drawing Number: QD1776-14-14

| Drawing Status | Scale | Rev. |
|---|---|---|
| INITIAL ISSUE | 1:500 - A1 | - |

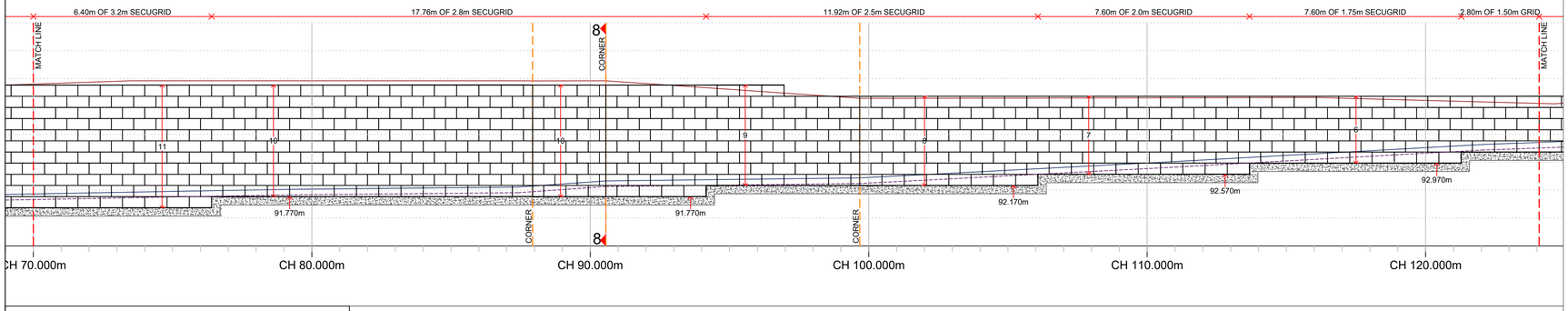
## APPENDIX C:

## GILCON DRAWINGS
## AND BBA CERTIFICATES

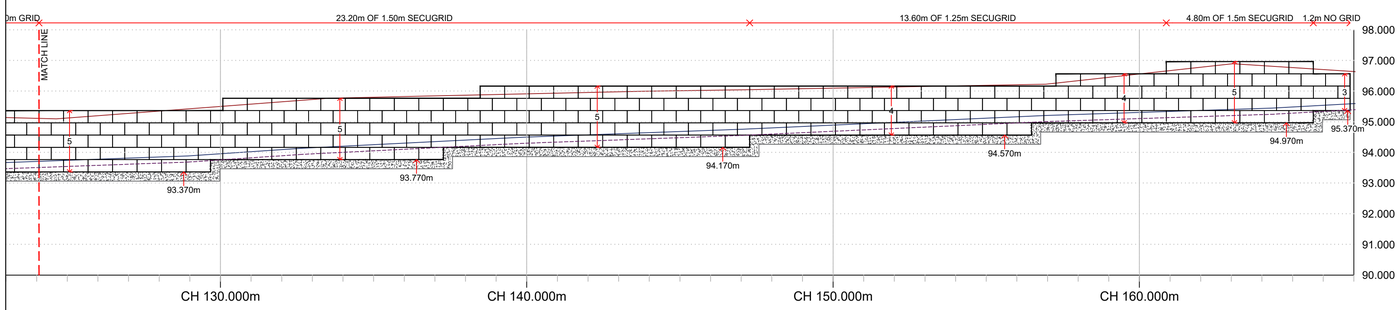
## WALL 03 ELEVATION* (TBC) (1/3)
1:100
*WALL 03 DESIGN IN ABEYANCE PENDING CONFIRMATION OF WALL FOUNDATION SOLUTION AND PILING RIG LOADS



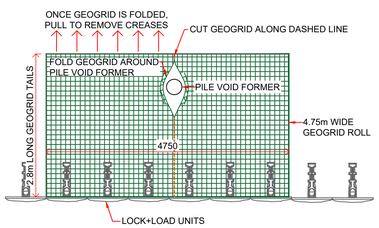

## WALL 03 ELEVATION* (TBC) (2/3)
1:100
*WALL 03 DESIGN IN ABEYANCE PENDING CONFIRMATION OF WALL FOUNDATION SOLUTION AND PILING RIG LOADS

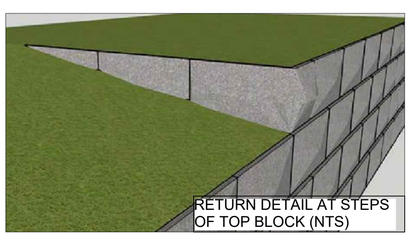



## WALL 03 ELEVATION* (TBC) (3/3)
1:100
*WALL 03 DESIGN IN ABEYANCE PENDING CONFIRMATION OF WALL FOUNDATION SOLUTION AND PILING RIG LOADS




## DETAIL AT WALL 03 PILED FOUNDATIONS - TBC (NTS)




## INDICATIVE LOCATION OF WALL 03
1:250
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 on site prior to construction and ensure that none will be affected by the Lock+Load wall and its installation.




A1

NOTES:

1) All dimensions in mms unless otherwise specified.

2) BLOCKS: LOCK+LOAD GEOGRID: SECUGRID 40/40

3) INSTALLATION: Refer to standard Manufacturer's installation guidelines.

4) REINFORCED BACKFILL:
Class 6I granular fill, in accordance with MCHW SHW Series 600. Granular fill to be benched into in-situ soils and compacted in layers in accordance with the Specification for Highway Works, Series 600, Table 6/4. Class 6I fill to be restricted to '30mm down' for first 1m behind face.

Compliance testing must be undertaken on the Class 6I granular fill, both prior to commencement and throughout the works. This must include particle size testing and shear box of representative samples. Class 6I must have a maximum fines (63µm) content of 15% and comply with the limits in Table 6/3 of Series 600.

This material is assumed to have the following characteristics: Phi' = 35 degrees, Gamma = 19 kN/m³ and c' = 0 kPa, compacted to in accordance with SRW Series 600, Table 6/4. The Contractor is responsible for the selection of this material to ensure compliance with the geotechnical characteristics as shown on the relevant drawings and in the design documents/ calculations.

5) FOUNDATION FOR WALL 03:
Logs in Sirius 'Updated Factual Site Investigation Letter Report' C9907A/AMG/10556 suggest the presence of significant depths of soft (low strength) and very loose MADE GROUND & very low strength ALLUVIUM at the location of Wall 03. An undrained shear strength ($c_u$) of 18kPa was recorded in WS604 at a depth of 2.75m, and SPT 'N' values of 0 were recorded at depths of 3m and 5m in BH601 and BH602 respectively. WS703 encountered soft low strength made ground at a depth of 3m.

Such material would not be a suitable foundation material for the Lock+Load wall, and remedial action must therefore be undertaken to provide a competent base from which to construct Lock+Load Wall 03. We would suggest the following three broad options are considered:

1. Excavation of all soft/ soft-firm ($c_u$<70kPa) and loose material (including all alluvial deposits and cohesive made ground) down to SANDSTONE/ MUDSTONE bedrock. Compacted Class 6F2/ 6F5 granular fill to be used to replace excavated material back up to wall formation level. The depth of excavation and replacement required (5m+) may make this option unfeasible, particularly in such close proximity to the site boundary.
2. Some form of ground improvement (designed by others) to ensure a minimum safe bearing resistance of 140kPa at wall formation level and that global stability and settlement magnitudes satisfy design standards. The may take the form of deep soil mixing, vibro stone columns, etc. (to be confirmed by specialist ground improvement contractor).
3. A piled based (designed by others) for the Lock+Load wall.

**If any soft/ soft-firm, loose or unsuitable material ($c_u$<70kPa, SBR<140kPa) is left in place at or below wall formation level, instability and/ or excessive settlement of the Lock+Load wall may occur.**

6) SITE / IN-SITU SOILS :
Retained: MADE GROUND (ashy gravelly SAND [ASH & CLINKER]) & compacted Class 1/2 upfill. These materials are assumed to have the following minimum properties:
MADE GROUND $\phi'$ = 28°, $\gamma$ = 18kN/m³ and c' = 0 kPa.
CLASS 1/2 FILL $\phi'$ = 28°, $\gamma$ = 19kN/m³ and c' = 0 kPa.

Foundation solution for Wall 03 - **TBC**.

The Contractor & Client's Consulting Engineer are responsible for ensuring the in-situ soils comply with the geotechnical characteristics as shown on the relevant drawings and in the design calculations.

7) DRAINAGE:
A minimum 150mmØ perforated drain pipe should be placed along the full length of the wall. This should be roddable and connected to an appropriate site drainage outlet with consent to discharge. Intermediate rodding points will be required to allow the full length of drain to be maintained (to be determined by scheme drainage designer). Rodding points should be installed at maximum 20m spacings at the top of the walls. Intermediate outlets may be required at any low points in the wall formation (e.g. at CH53m) - to be determined by scheme drainage designer.

8) FACE ANGLE = 5.7°.

9) TEMPORARY EXCAVATIONS/ SETTING OUT
This solution is for the permanent works only, and is issued on the basis that a safe system of works is provided for construction. Temporary excavations have the potential to fail rapidly and without warning, particularly in granular material. The Principal Contractor/ Wall 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 are outside our scope and should be confirmed by others.

All wall geometry, setting out and required offsets to be confirmed by the Principal Contractor and/ or Client's Consulting Engineer prior to construction.

10) BUILDING FOUNDATIONS
It is assumed that any building foundations in the vicinity of the wall will be taken to such a level that no loads will be transferred to the Lock+Load wall and reinforced backfill. Building foundations must not rely on the flexible Lock+Load wall and reinforced backfill for support (including lateral support), and are outside the scope of this design. Please advise us if a piling/ vibro rig and/ or large plant is to be used on the retained side of the Lock+Load wall, as well as their required minimum offsets and maximum operational surcharges, as the design will need to be checked for the rig loads.

11) SETTLEMENT
The Client's Consulting Engineer must assess the risk of settlement of ~4m of upfill over significant depths of very loose MADE GROUND & very low strength ALLUVIUM to the rear of the wall. Ground improvement (designed by others) such as deep soil mixing, vibro stone columns, etc. may be required to limit differential and total settlement (to be confirmed by specialist ground improvement contractor).

12) NOTES ON CALCULATIONS/DRAWINGS:
These plans and the accompanying design documentation should be thoroughly checked by the Client's Consulting Engineer. Any apparent errors, omissions or variations should be reported immediately to Geoman Ltd. Construction of this wall shall not commence unless and until the Client/ Client's Consulting Engineer has considered the Geoman Design Submission Document (QP06 Ref 24-5558) to ensure that there are no errors, omissions or conflict with the scheme design.

Geoman Ltd. will not be liable for any loss or damage resulting from or arising out of the use of this drawing where it has been used other than in accordance with Geoman's advice and specifications. Unless advice is specifically requested in respect of parts of the site not within the area where the works are undertaken, Geoman shall not be liable for any loss or damage resulting from or arising out of any weakness or other problem in the ground outside the area where the works are undertaken.



**CONCEPT ONLY**
**NOT FOR CONSTRUCTION**

| Rev. | Issue / Revision: | Drawn: | Date: |
|---|---|---|---|
| B | | WM | 25.03.25 |
| A | | WM | 04.03.25 |
| 0 | | WM | 27.09.24 |

GEOMAN
44 Elmwood Avenue, Belfast, BT9 6AZ 02890 664941 geoman@geoman.co.uk

Project Title:
WESTGATE, CLECKHEATON

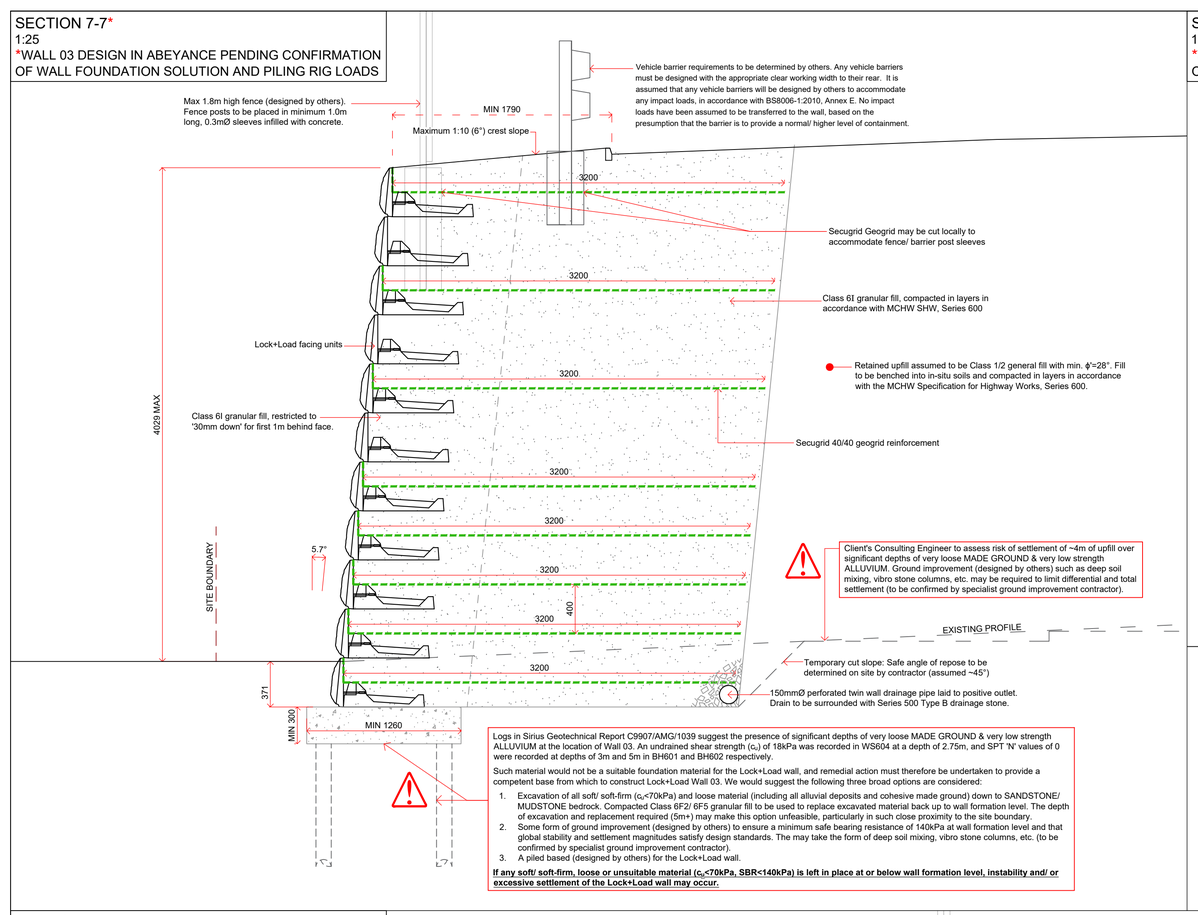
Client:
GILLCON GROUP

Drawing Title:
LOCK+LOAD WALL 03 ELEVATION

| | | | | | |
|---|---|---|---|---|---|
| Designed: | | Date: | | Project No: | 24-5558 |
| Drawn: | WM | Date: | 25.03.25 | Scale: | AS INDICATED AT A1 |
| Checked: | | Date: | | | |

Drawing No: SK24-5558-F1-04 Revision: B

## SECTION 7-7*
1:25
*WALL 03 DESIGN IN ABEYANCE PENDING CONFIRMATION OF WALL FOUNDATION SOLUTION AND PILING RIG LOADS



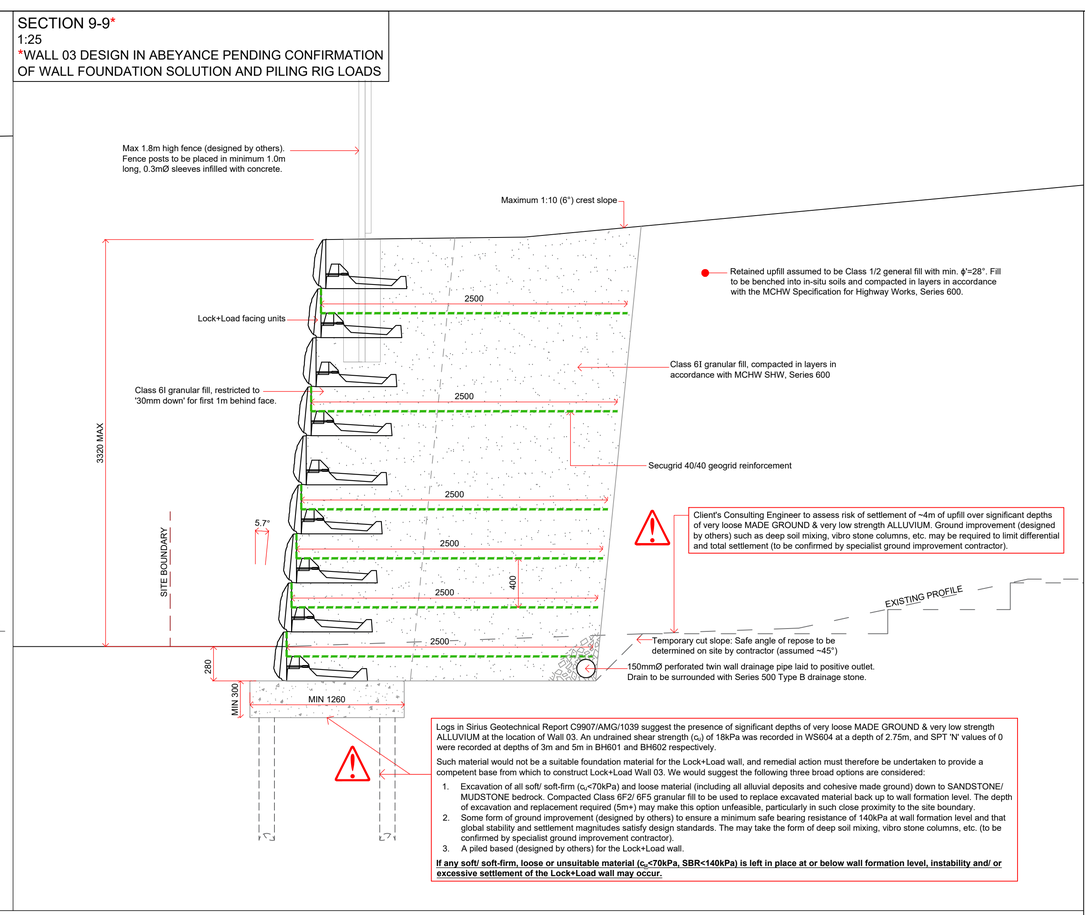

Logs in Sirius Geotechnical Report C9907/AMG/1039 suggest the presence of significant depths of very loose MADE GROUND & very low strength ALLUVIUM at the location of Wall 03. An undrained shear strength ($c_u$) of 18kPa was recorded in WS604 at a depth of 2.75m, and SPT 'N' values of 0 were recorded at depths of 3m and 5m in BH601 and BH602 respectively.

Such material would not be a suitable foundation material for the Lock+Load wall, and remedial action must therefore be undertaken to provide a competent base from which to construct Lock+Load Wall 03. We would suggest the following three broad options are considered:

1. Excavation of all soft/ soft-firm ($c_u$<70kPa) and loose material (including all alluvial deposits and cohesive made ground) down to SANDSTONE/ MUDSTONE bedrock. Compacted Class 6F2/ 6F5 granular fill to be used to replace excavated material back up to wall formation level. The depth of excavation and replacement required (5m+) may make this option unfeasible, particularly in such close proximity to the site boundary.
2. Some form of ground improvement (designed by others) to ensure a minimum safe bearing resistance of 140kPa at wall formation level and that global stability and settlement magnitudes satisfy design standards. The may take the form of deep soil mixing, vibro stone columns, etc. (to be confirmed by specialist ground improvement contractor).
3. A piled based (designed by others) for the Lock+Load wall.

**If any soft/ soft-firm, loose or unsuitable material ($c_u$<70kPa, SBR<140kPa) is left in place at or below wall formation level, instability and/ or excessive settlement of the Lock+Load wall may occur.**

## SECTION 9-9*
1:25
*WALL 03 DESIGN IN ABEYANCE PENDING CONFIRMATION OF WALL FOUNDATION SOLUTION AND PILING RIG LOADS

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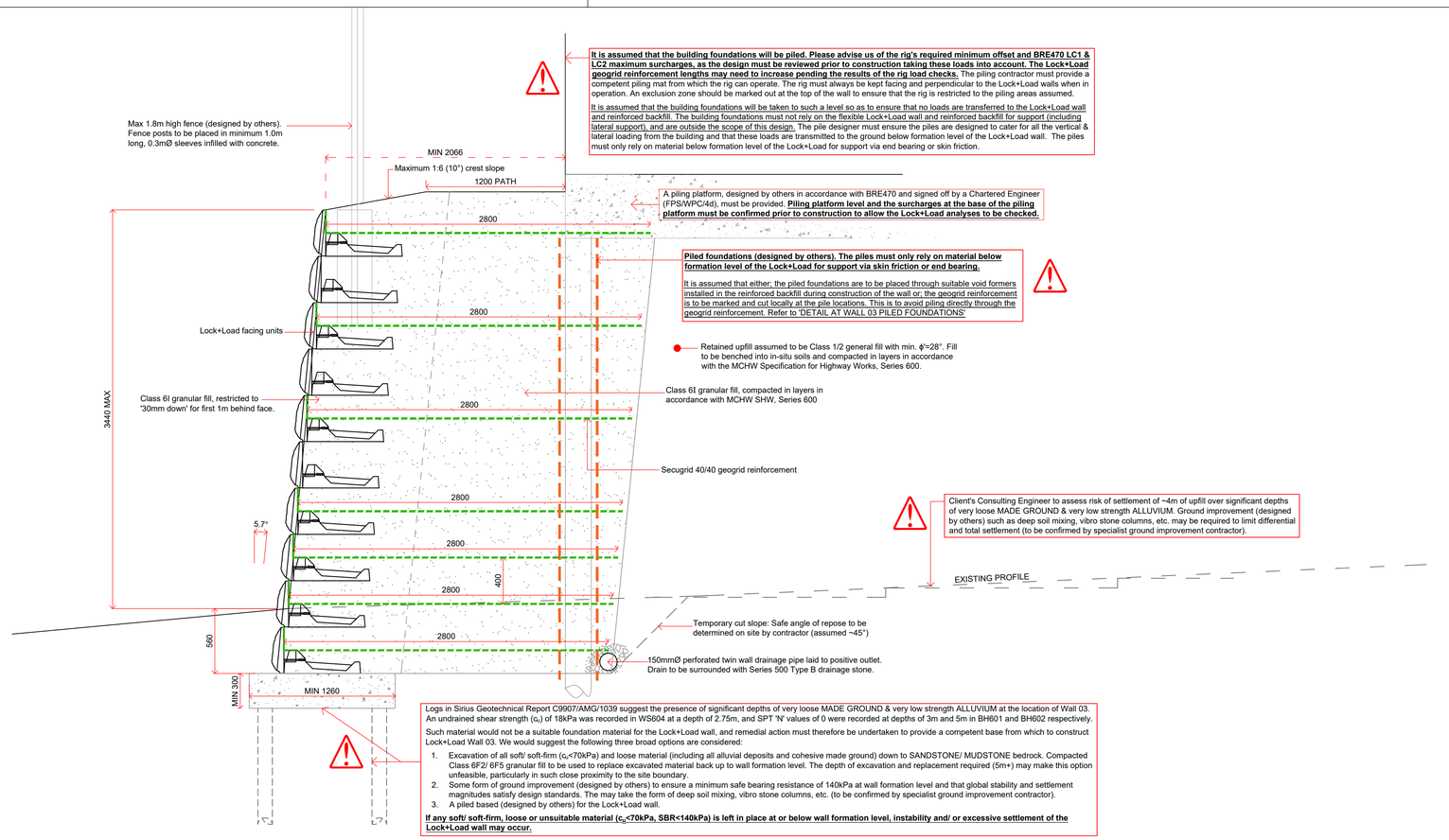
## SECTION 8-8*
1:25
*WALL 03 DESIGN IN ABEYANCE PENDING CONFIRMATION OF WALL FOUNDATION SOLUTION AND PILING RIG LOADS

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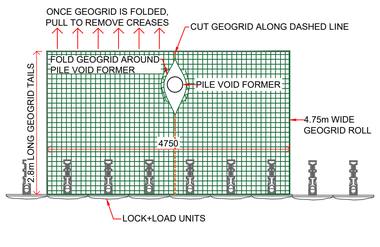


A1

NOTES:

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Foundation solution for Wall 03 - **TBC**.

The Contractor & Client's Consulting Engineer are responsible for ensuring the in-situ soils comply with the geotechnical characteristics as shown on the relevant drawings and in the design calculations.

7) DRAINAGE:
A minimum 150mmØ perforated drain pipe should be placed along the full length of the wall. This should be roddable and connected to an appropriate site drainage outlet with consent to discharge. Intermediate rodding points will be required to allow the full length of drain to be maintained (to be determined by scheme drainage designer). Rodding points should be installed at maximum 20m spacings at the top of the walls. Intermediate outlets may be required at any low points in the wall formation (e.g. at CH53m) - to be determined by scheme drainage designer.

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| Rev. | Issue / Revision: | Drawn: | Date: |
|---|---|---|---|
| B | | WM | 25.03.25 |
| A | | WM | 04.03.25 |
| 0 | | WM | 27.09.24 |

GEOMAN
44 Elmwood Avenue, Belfast, BT9 6AZ 02890 664941 geoman@geoman.co.uk

Project Title:
WESTGATE, CLECKHEATON

Client:
GILLCON GROUP

Drawing Title:
LOCK+LOAD WALL 03 CROSS-SECTIONS

| | | | | | |
|---|---|---|---|---|---|
| Designed: | | Date: | | Project No: | 24-5558 |
| Drawn: | WM | Date: | 25.03.25 | Scale: | AS INDICATED AT A1 |
| Checked: | | Date: | | | |

Drawing No: SK24-5558-F1-05 Revision: B

# HAPAS

**McGiolla Quarries**
Crolly
Letterkenny
Donegal
Ireland

Tel: 00353 (074) 95 48253
e-mail: info@gillespiequarries.ie
website: www.lockandload.ie

**HAPAS Certificate**
**21/H311**
Product Sheet 1

## LOCK+LOAD RETAINING WALL SYSTEM

## LOCK+LOAD WALL SYSTEM FOR REINFORCED SOIL-RETAINING WALLS AND BRIDGE ABUTMENTS

This HAPAS Certificate Product Sheet[1] is issued by the British Board of Agrément (BBA), supported by Highways England (HE) (acting on behalf of the Overseeing Organisations of the Department for Transport; Transport Scotland; the Welsh Government and the Department for Infrastructure, Northern Ireland), the Association of Directors of Environment, Economy, Planning and Transport (ADEPT), the Local Government Technical Advisers Group and industry bodies. HAPAS Certificates are normally each subject to a review every three years.
(1) Hereinafter referred to as 'Certificate'.

This Certificate relates to the Lock+Load Wall System for reinforced soil-retaining walls and bridge abutments. The system comprises concrete block facing units with connected concrete block counterforts, in conjunction with Secugrid geogrids and compacted fill.

**CERTIFICATION INCLUDES:**

- factors relating to compliance with HAPAS requirements
- factors relating to compliance with Regulations where applicable
- independently verified technical specification
- assessment criteria and technical investigations
- design consideration
- installation guidance
- regular surveillance of production
- formal three-yearly review.

**KEY FACTORS ASSESSED**

**Mechanical properties** — the concrete block units and the geogrids are not physically connected, and transfer no force between them. The forces for which the geogrid is designed are predetermined. The facing system has been designed for pull out forces and shear between segmental units (see section 7).

**Durability** — when designed and installed in accordance with the provisions of this Certificate, the system will have adequate durability for its intended use as a retaining wall or bridge abutment over 120 year design life (see section 9).

The BBA has awarded this Certificate to the company named above for the system described herein. This system has been assessed by the BBA as being fit for its intended use provided it is installed, used and maintained as set out in this Certificate.

On behalf of the British Board of Agrément

Date of First issue: 1 October 2021

Hardy Giesler
Chief Executive Officer

## Requirements

In the opinion of the BBA, the LOCK+LOAD Wall System for reinforced soil-retaining walls and bridge abutments, when designed and installed in accordance with the provisions of this Certificate, will contribute to meeting the requirements of Highways England and local Highway Authorities for the design and construction of reinforced soil-retaining walls and bridge abutments.

## Regulations

### Construction (Design and Management) Regulations 2015
### Construction (Design and Management) Regulations (Northern Ireland) 2016

Information in this Certificate may assist the client, designer (including Principal Designer) and contractor (including Principal Contractor) to address their obligations under these Regulations.

See sections: 1 *Description* (1.2), 3 *Delivery and site handling* (3.1, 3.3, 3.5 and 3.6), 11 *General* (11.6) and the *Installation* part of this Certificate.

## Additional Information

### CE marking

The Certificate holder has taken the responsibility of CE marking the blocks in accordance with harmonised European Standard BS EN 771-3 : 2011.

The manufacturer has taken the responsibility of CE marking the geogrids in accordance with harmonised European Standard BS EN 13251 : 2001.

## Technical Specification

### 1 Description

1.1 The LOCK+LOAD Wall System for reinforced soil-retaining walls and bridge abutments comprise:

- L+L Typical, L+L Half Panel, L+L Left Outside Corner and L+L Right Outside Corner concrete facing units
- L+L Counterfort
- Secugrid geogrids(1)
- Compacted fill material.

(1) Covered by BBA Certificate 14/H218.

**Concrete facing units**

1.2 The facing units are manufactured from concrete conforming to the following minimum specification, satisfying Highways England requirements for durability of class XF2 exposure to BS 8500-1 : 2006 (see Table 1 of this Certificate).

*Table 1 Concrete characteristics*

| Property | Value |
|---|---|
| Minimum concrete cube strength at 28 days ($N \cdot mm^{-2}$) | 40 |
| Minimum cement content ($Kg \cdot m^{-3}$) | 340 |
| Maximum water/cement ratio | 0.55 |

1.3 The concrete block facing units covered by this Certificate are shown in Table 2 and Figures 1a and 1b.

*Table 2 Concrete block facing units*

| Unit type | Height (mm) | Depth (mm) | Width (mm) | Weight (kg) |
|---|---|---|---|---|
| L+L Facing Panel | 405 | 95 | 810 | 40 |
| L+L Counterfort | 195 | 685 | 152.5 | 19 |

*Figure 1a L+L facing units*

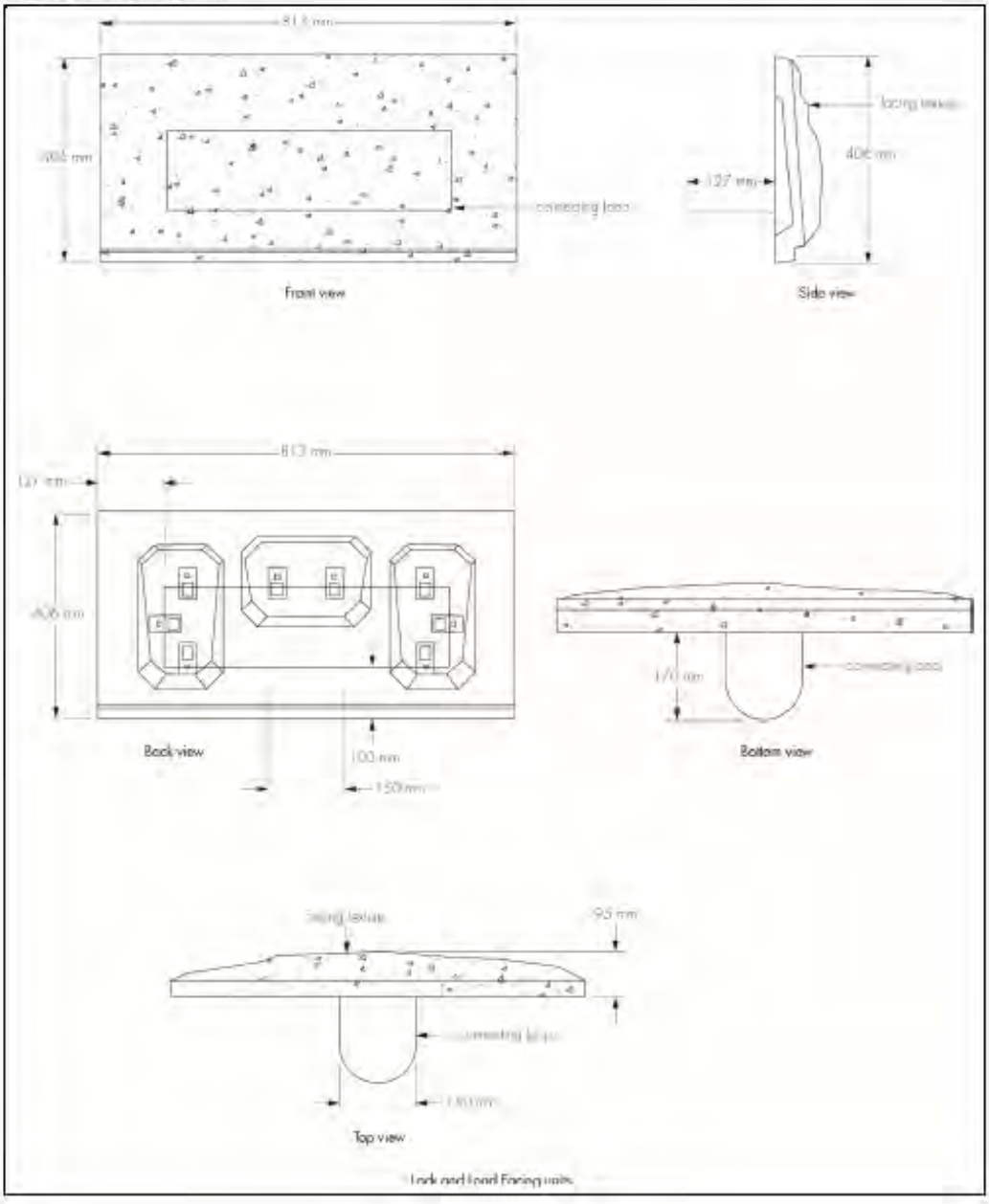
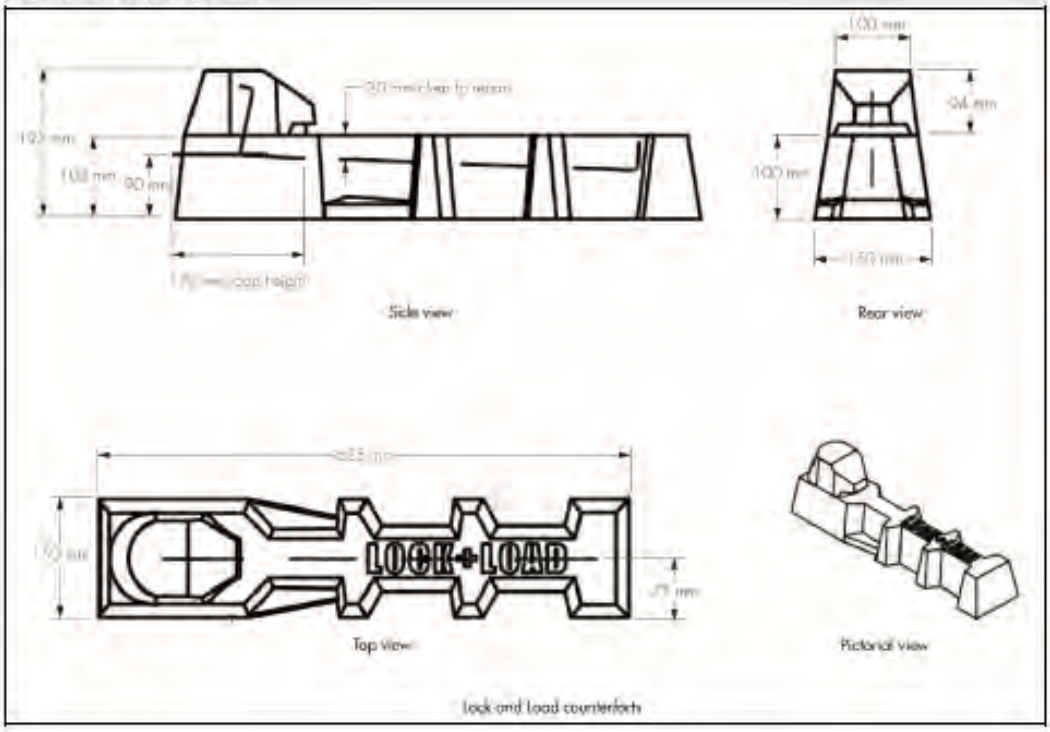


*Figure 1b L+L facing units*




1.4 The concrete block facing units conform to BS EN 771-3 : 2011. The performance characteristics given in Table 3 have been declared by the manufacturer in accordance with this Standard.

*Table 3 Performance values in accordance with BS EN 771-3*

| Property | Test method | Manufacturer's declared values |
|---|---|---|
| Dimensional tolerances | | Category D2 |
| Compressive strength (mean) ($N \cdot mm^{-2}$) | | >40 |
| Density ($kg \cdot m^{-3}$) | | 2350 |
| Maximum water absorption (%) | BS EN 1338 : 2003 Annex E | 6 |

1.5 The concrete block facing units are available in a range of colours including Sandstone and Black. All pigments used for the coloration of the concrete units comply with BS EN 12878 : 2014.

**Geogrids**

1.6 Secugrid PET geogrids are planar structures consisting of a regular open network of woven or knitted integrally connected tensile elements of extruded polyester bars welded together to form grids. The grades[1] covered by this Certificate are:

- Secugrid 30/30 Q6
- Secugrid 40/40 Q6
- Secugrid 60/60 Q6
- Secugrid 40/20 R6
- Secugrid 60/20 R6
- Secugrid 80/20 R6
- Secugrid 120/40 R6
- Secugrid 150/40 R6
- Secugrid 200/40 R6
- Secugrid 400/40 R6

(1) Full product details are given in BBA Certificate 14/H218.

**Fill material**

1.7 Fill material must comply with the requirements set out in BS 8006-1 : 2010 and the *Manual of Contract Documents for Highway Works* (MCHW), Volume 1 *Specification for Highway Works* (SHW).

## 2 Manufacture

2.1 The concrete block facing units are manufactured to an agreed specification by the Certificate holder. Ingredients for the concrete are weighed by a computer-controlled weigh-batcher system, and the blocks cast in block machines.

2.2 The geogrids are manufactured from extruded high tenacity polyester (PET) bars of various section sizes, which are welded together at the appropriate centres to form the grids.

2.3 As part of the assessment and ongoing surveillance of product quality, the BBA has:

- agreed with the manufacturer the quality control procedures and product testing to be undertaken
- assessed and agreed the quality control operated over batches of incoming materials
- monitored the production process and verified that it is in accordance with the documented process
- evaluated the process for management of nonconformities
- checked that equipment has been properly tested and calibrated
- undertaken to carry out the above measures on a regular basis through a surveillance process, to verify that the specifications and quality control being operated by the manufacturer are being maintained.

2.4 The manufacturer's management system for the concrete block facing units has been assessed by the BBA

2.5 The management system of the geogrid manufacturer has been assessed and registered as meeting the requirements of BS EN ISO 9001 : 2015 by TüV Nord Cert GmBH (Certificate 44 100 940655).

## 3 Delivery and site handling

3.1 The concrete block facing units and counterforts are tied together with steel loops and delivered to site on shrink-wrapped pallets. The pallets carry a manufacturer's label bearing the product type and batch code. Pallets should not be stacked more than two high.

3.2 To avoid damage, care should be taken in transit and handling. Damaged materials must not be used. During prolonged periods of storage on site, the blocks should remain covered on pallets.

3.3 The geogrids are delivered to site in 4.75 m wide rolls, either 50 or 100 m in length. Each roll is wrapped for transit and site protection, in stretch foil.

3.4 Rolls are labelled with the geogrid grade and identification. The grade of geogrid is ink-jet printed on the cross machine direction bars approximately every metre, to aid in identification on site in accordance with BS EN ISO 10320 : 2019.

3.5 The geogrids should be stored in clean, dry conditions and protected from mechanical or chemical damage, exposure to direct sunlight (to protect against UV degradation) and extreme temperatures. When laid horizontally, the rolls may be stacked up to seven high. No other loads should be stored on top of the stack. The packaging should not be removed until immediately prior to installation.

3.6 Toxic fumes are given off if the geogrids catch fire and, therefore, the necessary precautions should be taken, following the instructions of the material safety data sheet for the product.

# Assessment and Technical Investigations

The following is a summary of the assessment and technical investigations carried out on the LOCK+LOAD Wall System for reinforced soil-retaining walls and bridge abutments.

## Design Considerations

## 4 General

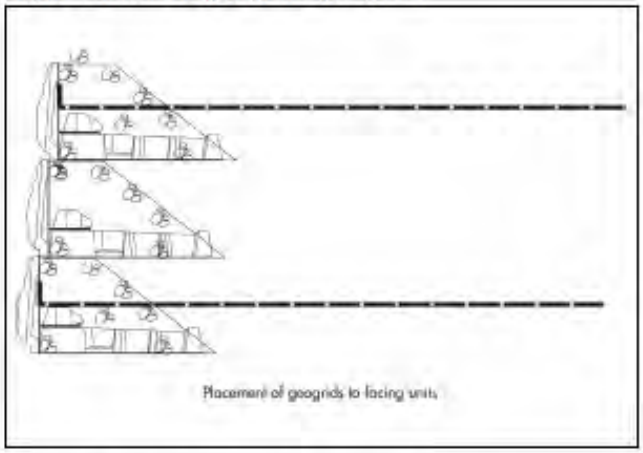
4.1 When designed and installed in accordance with this Certificate, the system is satisfactory for the construction of reinforced soil-retaining walls and bridge abutments.

4.2 Structural stability of the system is achieved through:

- interface shear capacity between face and counterfort
- the tensile strength of the geogrids
- the embedment and resistance to sliding and pull out of the geogrids from the fill material
- the embedment and resistance to sliding and pull out of the counterfort from the fill material.

4.3 The connection between the facing unit and the counterfort is provided by the steel loop, and the force generated by the counterfort restrains the facing unit. No attachment is made between the concrete units and the geogrid so force is not shared or transferred between them. The geogrid is laid up to and against facing material, however. It is critical the construction of the connection is carried out carefully and is closely supervised (see the *Installation* part of this Certificate).

*Figure 2 Placement of geogrids to facing units*




4.4 Prior to the commencement of work, the designer must satisfy the design approval and certification procedures of the relevant Highway Authority.

4.5 The BBA has not assessed the structures for supporting parapet loading caused by vehicle collision at the top of the concrete block facing units.

4.6 Reinforced soil structures constructed using the system should be protected with suitable barriers, to protect the structure against potential damage from vehicle impact and vehicle fires.

4.7 In addition to those factors covered in section 6, attention must also be paid in design to:

- site preparation
- fill material properties
- the specification for placing and compaction of the fill material
- drainage behind the wall
- protection of the geogrid against damage during installation.

4.8 It is considered that with correct design and workmanship, and by following the recommendations of this Certificate, normally accepted tolerances of line and level for the construction of retaining walls as defined in BS 8006-1 : 2010, Table 18, can be achieved. However, where the alignment of the vertical face is critical, consideration may be given to providing a brickwork skin, or similar, to the wall units.

4.9. Particular attention should be paid to changes in direction of walls where overlapping of the geogrids may occur. Detailed guidance is given in the Certificate holder's technical literature. BS 8006-1 : 2010 also gives guidance on typical layout plans for the geogrids (reinforcing elements) in bridge abutments.

## 5 Practicability of installation

The system is designed to be installed by trained contractors in accordance with the specifications and construction drawings (see the *Installation* part of this Certificate). Close supervision is required to ensure the integrity of the connection between the geogrids and concrete block facing units.

## 6 Design

**Design methodology**

6.1 Reinforced soil-retaining walls and bridge abutments constructed using the system must be designed in accordance with BS 8006-1 : 2010 and the Manual of Contract Document for Highway Works Volume 1, *Specification for Highway Works*.

6.2 In accordance with BS 8006-1 : 2010, Annex B, the required design life for permanent walls and bridge abutments is 120 years.

6.3 To evaluate the overall stability of the wall system, it is necessary to consider:

- the design strength and length of embedment of the geogrid
- the design strength of concrete facing units
- the interface shear capacity of the blocks between layers of geogrid reinforcement.

**Design strength of geogrids (ultimate limit state)**

6.4 The design methodology for determination of the ultimate limit state (ULS) design strength of the geogrids is given in BS 8006-1 : 2010 and in the design sections of BBA HAPAS Certificate 14/H218 (see also section 7.1 of this Certificate).

6.5 The ULS design strength of the geogrid ($T_{D\,(ULS)}$), should be taken as:

$T_{CR}/f_m$,

where:

$T_{CR}$ is the long-term tensile creep strength of the geogrid, at the appropriate design life and design temperature

$f_m$ is the partial material factor.

6.6 For the ULS, the design load ($T_j$) at each level that the geogrid must resist, is calculated using prescribed load factors in accordance with BS 8006-1 : 2010. In all cases, $T_j$ must be $< T_{D\,(ULS)}$.

**Design strength of geogrids (serviceability limit state)**

6.7 The serviceability limit state (SLS) design strength of the geogrid ($T_{D\,(SLS)}$), should be taken as:

$T_{CS}/f_m$,

where:

$T_{CS}$ is the tensile load in the reinforcement which induces the prescribed limit value of post-construction strain in the geogrid

$f_m$ is the partial material factor.

6.8 The strain in the geogrid must be limited to 0.5% over the service life for installations subject to permanent structural loading, such as bridge abutments, and limited to 1.0% post-construction for structures not subject to permanent structural loading (eg retaining walls). The definitions of prescribed post-construction strain limit and $T_{CS}$, the tensile load that would create the prescribed post-construction strain, are explained in Figure 3.

6.16 Where concrete wall units are to be embedded in potentially aggressive soils, the guidance given in BRE Special Digest 1 : 2005 should be followed.

6.17 Fill materials classified as 6I, 6J, 7B, 7C and 7D should comply with the limits of the MCHW, Volume 1, 600 series, Table 6/3, regarding maximum water soluble sulfate content and maximum oxidisable sulfides content.

## 7 Mechanical properties

**ULS design strength of geogrids ($T_{D(ULS)}$)**

7.1 The characteristic short-term tensile strength ($T_{char}$) and the associated reduction factors for creep ($RF_{CR}$), installation damage ($RF_{ID}$), weathering ($RF_{W}$), environmental degradation ($RF_{CH}$) and extrapolation of data ($f_s$) required for determination of the ULS design strength of the geogrids ($T_{D(ULS)}$) are given in BBA HAPAS Certificate 14/H218, Product Sheet 1.

**SLS design strength of geogrids ($T_{CS}$)**

7.2 Secugrid geogrids design values for $T_{CS}$ are given in Table 5. To limit strain to less than 0.5% over design life, limit loading to 30% of $T_{Char}$.

*Table 5 Maximum tensile load inducing prescribed post-construction strain limits for Secugrid geogrids*

| Grade | Machine Direction (MD) | | | | Cross Machine Direction (CMD) | | | |
|---|---|---|---|---|---|---|---|---|
| | Short Term Tensile Strength[1] (kN per m width) | | | Mean Strain at Maximum Tensile Load[1] (%) | Short Term Tensile Strength[1] (kN per m width) | | | Mean Strain at Maximum Tensile Load[1] (%) |
| | Mean Value | Tolerance | $T_{char}$[2] | | Mean Value | Tolerance | $T_{char}$[2] | |
| Secugrid 30/30 Q6 | 30.0 | 0.0 | 30.0 | 6.0 (+2.0/-2.0) | 30.0 | 0.0 | 30.0 | 6.0 (+2.0/-2.0) |
| Secugrid 40/40 Q6 | 40.0 | 0.0 | 40.0 | 6.0 (+2.0/-2.0) | 40.0 | 0.0 | 40.0 | 6.0 (+2.0/-2.0) |
| Secugrid 60/60 Q6 | 60.0 | 0.0 | 60.0 | 6.0 (+2.0/-2.0) | 60.0 | 0.0 | 60.0 | 6.0 (+2.0/-2.0) |
| Secugrid 80/80 Q6 | 80.0 | 0.0 | 80.0 | 6.0 (+2.0/-2.0) | 80.0 | 0.0 | 80.0 | 6.0 (+2.0/-2.0) |
| Secugrid 40/20 R6 | 40.0 | 0.0 | 40.0 | 6.5 (+2.0/-2.0) | 20.0 | 0.0 | 20.0 | 6.5 (+2.0/-2.0) |
| Secugrid 60/20 R6 | 60.0 | 0.0 | 60.0 | 6.5 (+2.0/-2.0) | 20.0 | 0.0 | 20.0 | 6.5 (+2.0/-2.0) |
| Secugrid 80/20 R6 | 80.0 | 0.0 | 80.0 | 6.5 (+2.0/-2.0) | 20.0 | 0.0 | 20.0 | 6.5 (+2.0/-2.0) |
| Secugrid 120/40 R6 | 120.0 | 0.0 | 120.0 | 6.5 (+2.0/-2.0) | 40.0 | 0.0 | 40.0 | 6.5 (+2.0/-2.0) |
| Secugrid 150/40 R6 | 150.0 | 0.0 | 150.0 | 6.5 (+2.0/-2.0) | 40.0 | 0.0 | 40.0 | 6.5 (+2.0/-2.0) |
| Secugrid 200/40 R6 | 200.0 | 0.0 | 200.0 | 6.5 (+2.0/-2.0) | 40.0 | 0.0 | 40.0 | 6.5 (+2.0/-2.0) |
| Secugrid 400/40 R6 | 400.0 | 0.0 | 400.0 | 6.5 (+2.0/-2.0) | 40.0 | 0.0 | 40.0 | 6.5 (+2.0/-2.0) |

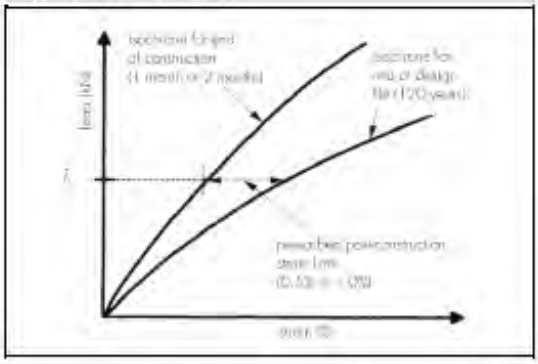
(1) Values derived from short-term tests in accordance with BS EN ISO 10319 : 2015.
(2) The characteristic short-term tensile strength (Tchar) values are the mean short-term tensile strength minus 1 x the tolerance value, in accordance with BS EN 13251 : 2016.

7.3 Reduction factors for installation damage, weathering and environmental degradation ($RF_{ID}$, $RF_{W}$ and $RF_{CH}$) and factors of safety for the extrapolation of data ($f_s$) required for determination of the serviceability design strength of the geogrids ($T_{D(SLS)}$) are given in BBA HAPAS Certificate 14/H218, Product Sheet 1.

**Counterfort capacity**

7.4 The counterforts are tested for resistance to pull out forces by soil interaction. Long term capacities have been determined by testing in accordance with ASTM D6706-01.

*Figure 3 Definition of $T_{CS}$*



6.9 The prescribed maximum allowable post-construction creep strains allowed by BS 8006-1 : 2010 for the SLS of reinforced soil-retaining walls and bridge abutments are shown in Table 4 of this Certificate.

*Table 4 Serviceability limits on post-construction internal strains for bridge abutments and retaining walls*

| Structure | Strain (%) | Design period for the purposes of determining limiting strain |
|---|---|---|
| Bridge abutments and retaining walls with permanent structural loading | 0.5 | 2 months – 120 years |
| Retaining walls, with no applied structural loading, ie transient live loadings only | 1.0 | 1 month – 120 years |

6.10 Post-construction strain can be related to the average load in the reinforcement. The average SLS design loads ($T_{av}$) that the geogrid must resist is to be calculated in accordance with BS 8006-1 : 2010. The average load in the $j$th level ($T_{avj}$), is related to the maximum load in the reinforcement ($T_j$) by a factor $k$ such that $T_{avj} = T_j/k$. The factor $k$ has a minimum value of unity and generally falls in the range of 1.0 to 2.0. Where the distribution of tensile load along the loaded length of the reinforcement is not proven by field measurements, the factor $k$ should be taken as unity. In all cases, $T_{avj} < T_{D(SLS)}$.

6.11 Design values for $T_{ca}$ and reduction factors for determination of $T_{D(SLS)}$ are given in sections 7.2 to 7.3.

**Design of geogrids (determination of resistance to direct sliding and pull out)**

6.12 The design methodology for determination of resistance to pull out and direct sliding and, therefore, the required length of embedment of the geogrids, is given in BS 8006-1 : 2010 and in the design sections of BBA HAPAS Certificate 14/H218, Product Sheet 1.

**Design strength of concrete facing units**

6.13 The design resistance to pull-out between the concrete block units and soil is determined by testing in accordance with ASTM Designation Number D 6706-01 and is considered acceptable for the intended use specified in this Certificate.

**Interface shear capacity between concrete facing units and counterforts**

6.14 The interface shear capacity between the concrete block facing units should be checked at the ULS and checks should be made to ensure that it is not exceeded by the design load ($T_j$) at each level (see section 7.7).

**Specification of fill material**

6.15 The designer should specify the relevant properties of the fill material for the reinforced soil structure deemed acceptable for the purposes of the design. Acceptable materials should satisfy the requirements of BS 8006-1 : 2010 and the MCHW, Volume 1, Series 600.

**Interface capacity between concrete facing units and counterforts**

7.5 Interface capacity between the concrete block facing units and the counterfort is provided by the steel loop connection. Steel loop connection complies with BS EN 14475 : 2006 and contributes to compliance with BS 8006-1 : 2010 + A1 : 2016 (steel coating exceeds 70µm). For the system, the interface shear capacity of the blocks is higher than the corresponding connection strength values. Therefore, the connection strength values govern the design.

## 8 Maintenance

The exposed faces of the concrete block facing units may require periodic maintenance, to remove dirt build up, mould and moss growth. All other components of the system are confined within the wall and do not require maintenance.

## 9 Durability

9.1 When designed and installed in accordance with this Certificate, the system will have adequate durability for the required 120 year design life of a retaining wall and bridge abutment in conditions encountered in the UK.

9.2 Where the blocks are to be embedded in potentially aggressive soils, the guidance given in BS 8006-1 : 2010 and BRE Special Digest 1 : 2005 should be followed.

## 10 Reuse and recyclability

The concrete facing units can be crushed and re-used as aggregate. The fill material can also be re-used.

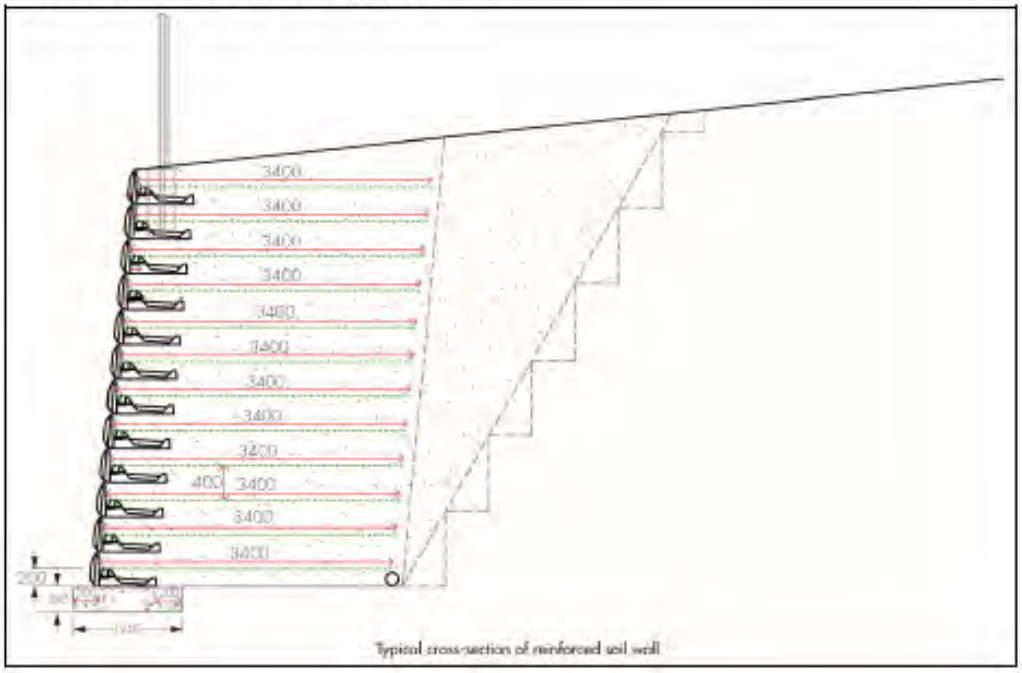
# Installation

## 11 General

11.1 Detailed information on installation of the LOCK+LOAD Wall System for reinforced soil-retaining walls and bridge abutments can be found in the Certificate holder's Installation Guide.

11.2 A typical cross-section of a reinforced soil-retaining wall constructed using the system is shown in Figure 4.

*Figure 4 Typical cross-section of reinforced soil wall*



11.3 Installation should also comply with the requirements of BS 8006-1 : 2010 and BS EN 14475 : 2006.

11.4 Close supervision is required, particularly during placement of the geogrids and initial compaction of the backfill material.

11.5 Detailed guidance on forming curves and corners, including the placement of geogrids, can be found in the Certificate holder's Installation Guide.

11.6 Where accurate cutting of concrete block facing units is required on site, disc-cutting techniques may be used, for which appropriate precautions must be taken to mitigate against hazards associated with dust.

11.7 During construction it is particularly important to ensure that:

- fill is properly compacted, especially close to concrete block facing units
- at each construction stage, the level of the compacted fill coincides with the level of the concrete block facing unit connection to prevent the risk of voids occurring below the geogrid
- the geogrid is tensioned at right angles to the plane of the facing, within a tolerance of ± 50 mm in a five-metre length, and the geogrid is pulled tight to ensure that all slack is removed
- regular checks are made to confirm the alignment of the face and to ensure that any disturbance from the compaction process is promptly corrected.

## 12 Procedure

12.1 The first row of concrete block facing units is laid on a levelling pad comprising either well-graded, good compactable material ranging in diameter from 6 to 38 mm, or a suitable concrete foundation laid to the correct level. It is important that the first course of concrete block facing units is laid accurately to the correct line and level, to avoid compounding errors in alignment as the wall is built. If steps occur in the base level, refer to the Certificate holder's Installation Guide.

12.2 The drain pipe and drainage stone are placed at the back of the counterfort, or as specified on plans.

12.3 The backfill is placed over the tail of the counterfort first, with a minimum of 610 mm of select 4/20 mm material kept behind the wall face for the foundation of the next row. Beyond this, the specified back fill material is used. For rows that will contain soil reinforcement, the grid is placed after the first lift of fill is compacted (305 mm).

12.4 The compaction requirements for the main fill material depend on the fill type selected and can be found in the MCHW, Volume 1, Clause 612. Heavy plant exceeding one tonne should not be allowed within 610 mm of the wall (Note: This differs from typical modular block wall systems). A large vibrating plate compactor must be used to carry out compaction within this zone, and must compact right up to the rear of the wall.

12.5 Geogrids are placed at the levels shown on the project construction drawings. A suitable length of geogrid is cut from the roll and laid with a minimum of 50 mm of the cut edge rolled up against the back edge of the raised front lip of the concrete block facing units. The geogrid is placed with the machine direction perpendicular to the wall face and pulled back over the compacted area. Steps 12.3 to 12.4 are repeated until the backfill is level with the top of concrete facing unit.

12.6 The next course of concrete blocks facing units is laid, ensuring that the vertical faces are offset by at least 20 mm. The filling and compaction process is repeated as detailed in sections 12.3 to 12.5.

12.7 The general construction procedure described is repeated until the required coping is reached.

## Technical Investigations

## 13 Investigations

13.1 The manufacturing process for the concrete block facing units was evaluated, including the methods adopted for quality control, and details were obtained of the quality and composition of the materials used.

13.2 An examination was made of test data relating to:

- strength of concrete block facing units
- durability
- the connection strength between the geogrids and concrete block facing units.

13.3 An assessment was made of the method of installation to assess the practicability and ease of construction of the system.

13.4 Research papers and test reports regarding the performance of the system during seismic activity were examined.

13.5 Case studies relating to use of the system in projects around the world were examined.

13.6 Dimensional check tests were carried out on the concrete block facing panels and the counterfort units.

## Bibliography


BRE Special Digest 1 : 2005 *Concrete in aggressive ground*

BS 8006-1 : 2010 + A1 : 2016 *Code of practice for strengthened/reinforced soils and other fills*

BS 8500-1 : 2006 + A1 : 2012 *Concrete — Complementary British Standard to BS EN 206-1 — Method of specifying and guidance for the specifier*

BS EN 1338:2003 *Concrete paving blocks — Requirements and test methods*

BS EN 771-3 : 2011 + A1 : 2015 *Specification for masonry units — Aggregate concrete masonry units (Dense and lightweight aggregates)*

BS EN 12878 : 2014 *Pigments for the colouring of building materials based on cement and/or lime — Specifications and methods of test*

BS EN 13251 : 2001 *Geotextiles and geotextile-related products — Characteristic required for use in earthworks, foundations and retaining structures*

BS EN 14475 : 2006 *Execution of special geotechnical works — Reinforced fill*

BS EN ISO 9001 : 2015 *Quality management systems — Requirements*

BS EN ISO 10320 : 2019 *Geotextiles and geotextile-related products — Identification on site*

BS EN ISO 10319 : 2015 *Geosynthetics. Wide-width tensile test*

ASTM D6706-01 *Standard Test Method for Measuring Geosynthetic Pullout Resistance in Soil*

Manual of Contract Documents For Highway Works, Volume 1 *Specification for Highway Works*, amendment November 2008

## 14 Conditions

14.1 This Certificate:

- relates only to the product/system that is named and described on the front page
- is issued only to the company, firm, organisation or person named on the front page – no other company, firm, organisation or person may hold or claim that this Certificate has been issued to them
- is valid only within the UK
- has to be read, considered and used as a whole document – it may be misleading and will be incomplete to be selective
- is copyright of the BBA
- is subject to English Law.

14.2 Publications, documents, specifications, legislation, regulations, standards and the like referenced in this Certificate are those that were current and/or deemed relevant by the BBA at the date of issue or reissue of this Certificate.

14.3 This Certificate will remain valid for an unlimited period provided that the product/system and its manufacture and/or fabrication, including all related and relevant parts and processes thereof:

- are maintained at or above the levels which have been assessed and found to be satisfactory by the BBA
- continue to be checked as and when deemed appropriate by the BBA under arrangements that it will determine
- are reviewed by the BBA as and when it considers appropriate.

14.4 The BBA has used due skill, care and diligence in preparing this Certificate, but no warranty is provided.

14.5 In issuing this Certificate the BBA is not responsible and is excluded from any liability to any company, firm, organisation or person, for any matters arising directly or indirectly from:

- the presence or absence of any patent, intellectual property or similar rights subsisting in the product/system or any other product/system
- the right of the Certificate holder to manufacture, supply, install, maintain or market the product/system
- actual installations of the product/system, including their nature, design, methods, performance, workmanship and maintenance
- any works and constructions in which the product/system is installed, including their nature, design, methods, performance, workmanship and maintenance
- any loss or damage, including personal injury, howsoever caused by the product/system, including its manufacture, supply, installation, use, maintenance and removal
- any claims by the manufacturer relating to CE marking.

14.6 Any information relating to the manufacture, supply, installation, use, maintenance and removal of this product/system which is contained or referred to in this Certificate is the minimum required to be met when the product/system is manufactured, supplied, installed, used, maintained and removed. It does not purport in any way to restate the requirements of the Health and Safety at Work etc. Act 1974, or of any other statutory, common law or other duty which may exist at the date of issue or reissue of this Certificate; nor is conformity with such information to be taken as satisfying the requirements of the 1974 Act or of any statutory, common law or other duty of care.

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**HAPAS Certificate**
**14/H218**
Product Sheet 1 Issue 3

# SECUGRID GEOGRIDS

## SECUGRID PET GEOGRIDS FOR REINFORCED SOIL EMBANKMENTS

This Product Sheet[1] is issued by the British Board of Agrément (BBA). The Highways Authorities Product Approval Scheme (HAPAS) is supported by National Highways (NH) (acting on behalf of the Overseeing Organisations of the Department for Transport; Transport Scotland; the Welsh Government; and the Department for Infrastructure, Northern Ireland), the Association of Directors of Environment, Economy, Planning and Transport (ADEPT), the Local Government Technical Advisers Group and industry bodies.

(1) Hereinafter referred to as 'Certificate'.

This Certificate relates to Secugrid PET Geogrids for reinforced soil embankments, a range of uniaxial and biaxial extruded and welded high tenacity polyester (PET) geogrids, for use as reinforcement in embankments with slope angles up to 70°, in accordance with the *Manual of Contract Documents for Highway Works* (MCHW), Volume 1 *Specification for Highway Works* (SHW), Series 600, and designated Standards BS EN 13251 : 2016, BS 8006-1 : 2010, PD/ISO TR 20432 : 2007, CIRIA SP123 : 1996 and BS EN 14475 : 2006.

The BBA has awarded this Certificate to the company named above for the products described herein. These products have been assessed as complying with the requirements of the BBA HAPAS Certification Scheme according to the assessments set out in this Certificate.

On behalf of the British Board of Agrément

Date of Third issue: 23 August 2024
Originally certified on 23 June 2014

Hardy Giesler
Chief Executive Officer



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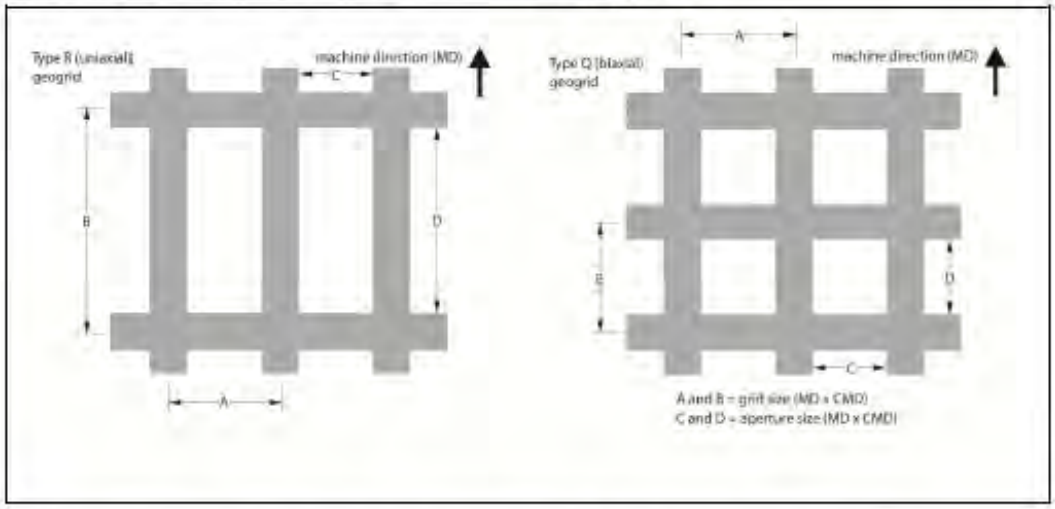
## 1 Product Description

1.1 The Certificate holder specifies the products under assessment, Secugrid PET Geogrids for reinforced soil embankments, as a range of uniaxial and biaxial extruded and welded high tenacity polyester (PET) geogrids, for use as reinforcement in embankments with slope angles up to 70° in accordance with the MCHW, Volume 1 (SHW), and designated Standards BS EN 13251 : 2016, BS 8006-1 : 2010, PD/ISO TR 20432 : 2007, CIRIA SP123 : 1996 and BS EN 14475 : 2006.

1.2 The geogrids are manufactured in one standard grade of various strengths and mesh sizes. Typical uniaxial and biaxial geogrids are illustrated in Figure 1.

*Figure 1 Secugrid PET Geogrids for reinforced soil embankments – configuration*




1.3 Secugrid PET Geogrids for reinforced soil embankments have the characteristics given in Table 1.

*Table 1 General specifications for Secugrid PET Geogrids for reinforced soil embankments*

| Grade | Nominal mass[1] ($g \cdot m^{-2}$) | Grid size[2] warp/weft A x B (mm) | Aperture size[2] warp/weft C x D (mm) | Nominal roll width (m) | Nominal roll length (m) |
|---|---|---|---|---|---|
| 30/30 Q6 | 320 | 40 x 40 | 34 x 34 | 4.75 | 100 |
| 40/40 Q6 | 360 | 40 x 40 | 34 x 34 | | 100 |
| 60/60 Q6 | 620 | 40 x 40 | 32 x 32 | | 100 |
| 80/80 Q6 | 675 | 40 x 40 | 30 x 30 | | 100 |
| 40/20 R6 | 285 | 40 x 80 | 33 x 73 | | 100 |
| 60/20 R6 | 420 | 40 x 80 | 31 x 73 | | 100 |
| 80/20 R6 | 380 | 40 x 80 | 30 x 73 | | 100 |
| 120/40 R6 | 580 | 40 x 80 | 28 x 71 | | 100 |
| 150/40 R6 | 680 | 40 x 80 | 27 x 71 | | 100 |
| 200/40 R6 | 810 | 40 x 80 | 25 x 71 | | 100 |
| 400/40 R6 | 1420 | 40 x 80 | 14 x 70 | | 50 |

(1) Mass/unit area measured in accordance with BS EN ISO 9864 : 2005.

(2) Mean measured dimensions (see Figure 1 for reference).

## 2 Requirements

Requirements for the products are outlined in the BBA HAPAS Certification Scheme and Technical Specifications Documents, and have been established from the following specification documents:

- the MCHW(1), Volume 1 (SHW), Series 600
- BS EN 13251 : 2016
- BS 8006-1 : 2010
- PD/ISO TR 20432 : 2007
- CIRIA SP123 : 1996
- BS EN 14475 : 2006.

(1) The MCHW is operated by National Highways (NH) (acting on behalf of the Overseeing Organisations of the Department for Transport; Transport Scotland; the Welsh Government; and the Department for Infrastructure, Northern Ireland).

## 3 Summary of Product Assessment

The products were assessed on the basis of the following characteristics in accordance with HAPAS requirements.

3.1 Short-term tensile strength

3.1.1 Secugrid PET Geogrids for reinforced soil embankments have the tensile strength and elongation characteristics shown in Tables 2 to 5 and Figure 2.

*Table 2 Characteristic machine direction tensile strength of Secugrid PET Geogrids for reinforced soil embankments*

| Product assessed | Assessment method | Requirement | Result |
|---|---|---|---|
| 30/30 Q6 | Short-term tensile test to EN ISO 10319 : 2015 | ≥ 30 kN·m$^{-1}$ | Pass |
| 40/40 Q6 | | ≥ 40 kN·m$^{-1}$ | Pass |
| 60/60 Q6 | | ≥ 60 kN·m$^{-1}$ | Pass |
| 80/80 Q6 | | ≥ 80 kN·m$^{-1}$ | Pass |
| 40/20 R6 | | ≥ 40 kN·m$^{-1}$ | Pass |
| 60/20 R6 | | ≥ 60 kN·m$^{-1}$ | Pass |
| 80/20 R6 | | ≥ 80 kN·m$^{-1}$ | Pass |
| 120/40 R6 | | ≥ 120 kN·m$^{-1}$ | Pass |
| 150/40 R6 | | ≥ 150 kN·m$^{-1}$ | Pass |
| 200/40 R6 | | ≥ 200 kN·m$^{-1}$ | Pass |
| 400/40 R6 | | ≥ 400 kN·m$^{-1}$ | Pass |

*Table 3 Characteristic machine direction elongation at minimum tensile strength of Secugrid PET Geogrids for reinforced soil embankments*

| Product assessed | Assessment method | Requirement | Result |
|---|---|---|---|
| 30/30 Q6 | Short-term tensile test to EN ISO 10319 : 2015 | 6.0 % (± 2.0 %) | Pass |
| 40/40 Q6 | | 6.0 % (± 2.0 %) | Pass |
| 60/60 Q6 | | 6.0 % (± 2.0 %) | Pass |
| 80/80 Q6 | | 6.0 % (± 2.0 %) | Pass |
| 40/20 R6 | | 6.5 % (± 2.0 %) | Pass |
| 60/20 R6 | | 6.5 % (± 2.0 %) | Pass |
| 80/20 R6 | | 6.5 % (± 2.0 %) | Pass |
| 120/40 R6 | | 6.5 % (± 2.0 %) | Pass |
| 150/40 R6 | | 6.5 % (± 2.0 %) | Pass |
| 200/40 R6 | | 6.5 % (± 2.0 %) | Pass |
| 400/40 R6 | | 6.5 % (± 2.0 %) | Pass |

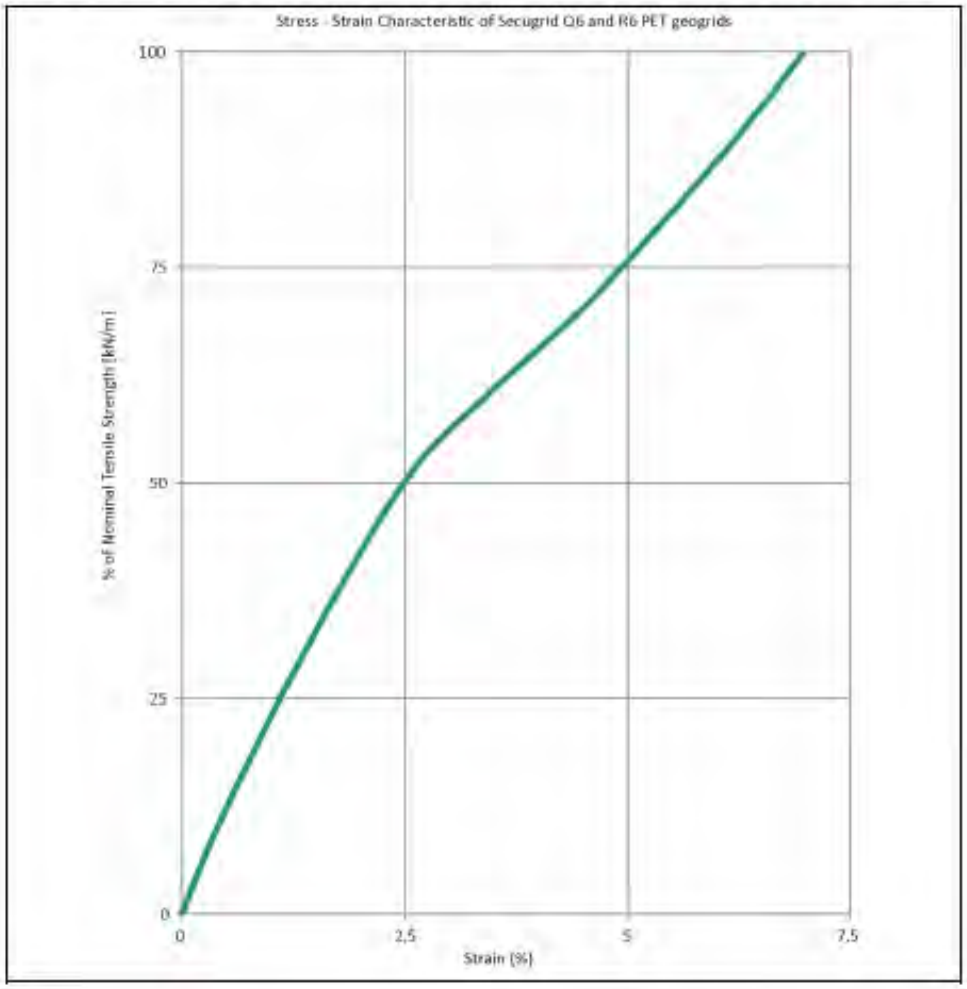
*Table 4 Characteristic cross machine direction tensile strength of Secugrid PET Geogrids for reinforced soil embankments*

| Product assessed | Assessment method | Requirement | Result |
|---|---|---|---|
| 30/30 Q6 | Short-term tensile test to EN ISO 10319 : 2015 | ≥ 30 kN·m$^{-1}$ | Pass |
| 40/40 Q6 | | ≥ 40 kN·m$^{-1}$ | Pass |
| 60/60 Q6 | | ≥ 60 kN·m$^{-1}$ | Pass |
| 80/80 Q6 | | ≥ 80 kN·m$^{-1}$ | Pass |
| 40/20 R6 | | ≥ 20 kN·m$^{-1}$ | Pass |
| 60/20 R6 | | ≥ 20 kN·m$^{-1}$ | Pass |
| 80/20 R6 | | ≥ 20 kN·m$^{-1}$ | Pass |
| 120/40 R6 | | ≥ 40 kN·m$^{-1}$ | Pass |
| 150/40 R6 | | ≥ 40 kN·m$^{-1}$ | Pass |
| 200/40 R6 | | ≥ 40 kN·m$^{-1}$ | Pass |
| 400/40 R6 | | ≥ 40 kN·m$^{-1}$ | Pass |

*Table 5 Characteristic cross machine direction elongation at minimum tensile strength of Secugrid PET Geogrids for reinforced soil embankments*

| Product assessed | Assessment method | Requirement | Result |
|---|---|---|---|
| 30/30 Q6 | Short-term tensile test to EN ISO 10319 : 2015 | 6.0 % (± 2.0 %) | Pass |
| 40/40 Q6 | | 6.0 % (± 2.0 %) | Pass |
| 60/60 Q6 | | 6.0 % (± 2.0 %) | Pass |
| 80/80 Q6 | | 6.0 % (± 2.0 %) | Pass |
| 40/20 R6 | | 6.5 % (± 2.0 %) | Pass |
| 60/20 R6 | | 6.5 % (± 2.0 %) | Pass |
| 80/20 R6 | | 6.5 % (± 2.0 %) | Pass |
| 120/40 R6 | | 6.5 % (± 2.0 %) | Pass |
| 150/40 R6 | | 6.5 % (± 2.0 %) | Pass |
| 200/40 R6 | | 6.5 % (± 2.0 %) | Pass |
| 400/40 R6 | | 6.5 % (± 2.0 %) | Pass |

*Figure 2 Typical stress-strain characteristics of Secugrid PET Geogrids for reinforced soil embankments*

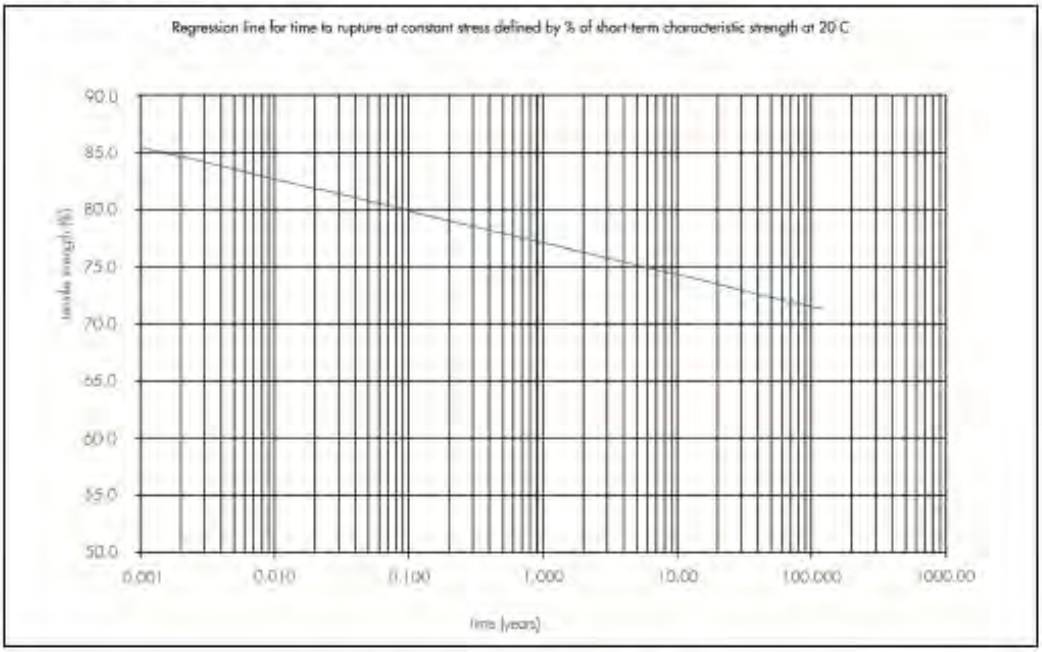



3.1.2 The assessment showed that the products comply with HAPAS requirements for short-term tensile strength.

3.2 Long-term tensile strength

3.2.1 The long-term creep performance of the products has been determined in accordance with the principles of PD/ISO TR 20432 : 2007 using conventional test data and stepped isothermal method (SIM) creep rupture test. The resultant creep rupture diagram is shown in Figure 3 of this Certificate.

*Figure 3 Regression line for life expectancy at constant stress defined by percentage of characteristic short-term tensile strength at 20 °C*




3.2.2 Long-term tensile strength ($T_{CR}$) values for the products can be derived using the formula given in BS 8006-1 : 2010, with the long-term creep reduction factors ($RF_{CR}$) and $R_1$ to be determined using the method stated in PD/ISO TR 20432 shown in Tables 6 and 7 of this Certificate.

*Table 6 Long term creep reduction factors ($RF_{CR}$) for Secugrid PET Geogrids for reinforced soil embankments*

| Product assessed | Assessment method | Requirement | Result |
|---|---|---|---|
| Secugrid PET Geogrids for reinforced soil embankments | Long term creep rupture to PD/ISO TR 20432 : 2007 using conventional test data to EN ISO 13431 : 1999-08 and SIM test data to ASTM D6992 : 2016 | 60 years design life Design soil temperature 20 °C | 1.39 |
| | | 120 years design life Design soil temperature 20 °C | 1.40 |

*Table 7 Long term creep $R_1$ for Secugrid PET Geogrids for reinforced soil embankments*

| Product assessed | Assessment method | Requirement | Result |
|---|---|---|---|
| Secugrid PET Geogrids for reinforced soil embankments | Long term creep rupture to PD ISO/TR 20432 : 2007 using conventional test data to EN ISO 13431 : 1999-08 and SIM test data to ASTM D6992 : 2016 | 60 years design life Design soil temperature 20 °C | 1.00 |
| | | 120 years design life Design soil temperature 20 °C | 1.00 |

3.2.3 The assessment showed that the products comply with HAPAS requirements for long-term tensile strength.

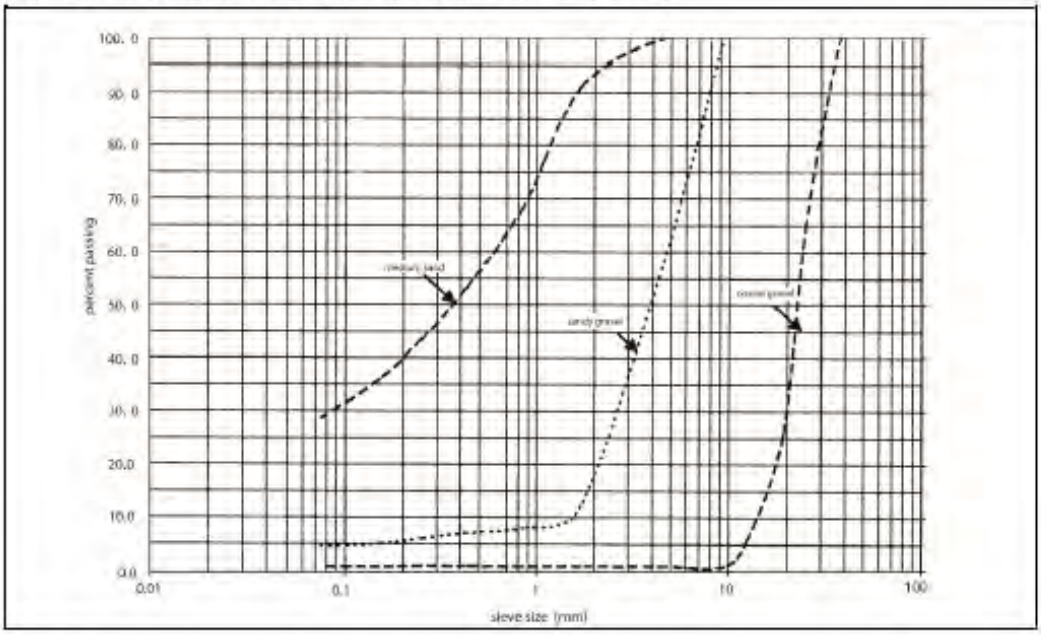
3.3 Installation damage

3.3.1 To allow for loss of strength due to mechanical damage sustained during installation, the appropriate reduction factor ($RF_{ID}$) should be selected from Table 8. These reduction factors have been established from full-scale installation damage tests using a range of materials whose gradings can be seen in Figure 4, with a minimum compacted depth of 200 mm. For soils not covered by Table 8, appropriate values of $RF_{ID}$ may be determined from site-specific trials, or the engineer responsible for the design of the project may exercise engineering judgment to interpolate between the values given.

*Table 8 Reduction factors for installation damage ($RF_{ID}$) for Secugrid PET Geogrids for reinforced soil embankments*

| Product assessed | Assessment method | Requirement / Result | | |
|---|---|---|---|---|
| | | Sand 0/2 mm (coarse sand) $d_{90} \leq 1.17$ (mm) | Crushed sand-split mixture 0/8 mm (sandy gravel) $d_{90} \leq 7.18$ (mm) | Split 0/32 mm (coarse gravel) $d_{90} \leq 26.06$ (mm) |
| 30/30 Q6<br>40/40 Q6<br>40/20 R6 | Installation damage to BS 8006-1 : 2010, Annex D | 1.06 | 1.08 | 1.09 |
| 60/60 Q6<br>60/20 R6 | | 1.02 | 1.05 | 1.08 |
| 80/80 Q6<br>80/20 R6 | | 1.01 | 1.03 | 1.05 |
| 120/40 R6<br>150/40 R6<br>200/40 R6<br>400/40 R6 | | 1.00 | 1.02 | |

*Figure 4 Particle size distributions of soils used in installation damage testing*




3.3.2 The assessment showed that the products comply with HAPAS requirements for installation damage.

3.4 Pull-out resistance

3.4.1 The BBA recommends that site-specific pull-out tests are carried out to confirm the value of bond coefficient ($f_b$) used in the final design.

3.5 Weathering (including exposure to UV light)

3.5.1 In accordance with PD/ISO TR 20432 : 2007, Section 9.3, if Secugrid PET Geogrids for reinforced soil embankments are exposed for a maximum of 12 hours, no reduction factor needs to be applied. If the exposure time is longer, then the reduction factor $RF_W$ in Table 9 of this Certificate must be used for the maximum exposure of 1 month.

*Table 9 Reduction factors for Weathering ($RF_W$) for Secugrid PET Geogrids for reinforced soil embankments*

| Product assessed | Assessment method | Requirement | Result |
|---|---|---|---|
| Secugrid PET Geogrids for reinforced soil embankments | Weathering to EN 12224 : 2000 and PD/ISO TR 20432 : 2007 | Periods of exposure are limited to a maximum of 1 month | 1.00 |

3.5.2 The assessment showed that the products comply with HAPAS requirements for weathering.

3.6 Hydrolysis

*Table 10 Reduction factors for hydrolysis ($RF_{CH}$) for Secugrid PET Geogrids for reinforced soil embankments*

| Product assessed | Assessment method | Requirement | Result |
|---|---|---|---|
| Secugrid PET Geogrids for reinforced soil embankments | Hydrolysis from PD/ISO TR 20432 : 2007, Table 2 Index tests to EN 12224 : 2000, EN 12447 : 2001, and EN 14030 : 2001<br>Test and control specimens were prepared to EN 12226 : 2012. | pH range of 2 to 4 for 60 years design lifetime at 20 °C service temperature | $RF_{CH}$ = 1.07 and $R_2$ = 1.03 |
| | | pH range of 4.1 to 9 for 60 years design lifetime at 20 °C service temperature | $RF_{CH}$ = 1.00 and $R_2$ = 1.03 |
| | | pH range of 9.1 to 10 for 60 years design lifetime at 20 °C service temperature | $RF_{CH}$ = 1.01 and $R_2$ = 1.03 |
| | | pH range of 10.1 to 11 for 60 years design lifetime at 20 °C service temperature | $RF_{CH}$ = 1.03 and $R_2$ = 1.03 |
| | | pH range of 11.1 to 12.5 for 60 years design lifetime at 20 °C service temperature | $RF_{CH}$ = 1.11 and $R_2$ = 1.03 |
| | | pH range of 2 to 4 for 120 years design lifetime at 20 °C service temperature | $RF_{CH}$ = 1.10 and $R_2$ = 1.05 |
| | | pH range of 4.1 to 9 for 120 years design lifetime at 20 °C service temperature | $RF_{CH}$ = 1.01 and $R_2$ = 1.05 |
| | | pH range of 9.1 to 10 for 120 years design lifetime at 20 °C service temperature | $RF_{CH}$ = 1.02 and $R_2$ = 1.05 |
| | | pH range of 10.1 to 11 for 120 years design lifetime at 20 °C service temperature | $RF_{CH}$ = 1.06 and $R_2$ = 1.05 |
| | | pH range of 11.1 to 12.5 for 120 years design lifetime at 20 °C service temperature | $RF_{CH}$ = 1.21 and $R_2$ = 1.05 |

3.6.1 The assessment showed that the products comply with HAPAS requirements for hydrolysis.

3.7 Microbiological degradation

*Table 11 Microbiological degradation for Secugrid PET Geogrids for reinforced soil embankments*

| Product assessed | Assessment method | Requirement | Result |
|---|---|---|---|
| Secugrid PET Geogrids for reinforced soil embankments | Microbiological degradation to EN 12225 : 2000 | No considerable loss of retained tensile strength | Pass |

3.7.1 The assessment showed that the products comply with HAPAS requirements for microbiological degradation.

3.8 CEG and molecular weight

*Table 12 CEG and molecular weight for Secugrid PET Geogrids for reinforced soil embankments*

| Product assessed | Assessment method | Requirement | Result |
|---|---|---|---|
| Secugrid PET Geogrids for reinforced soil embankments | Carboxyl end group (CEG) count to ASTM D7409 | < 30 mmol·kg$^{-1}$ | Pass |
| | Molecular weight ($M_n$) by viscosity to ASTM D4603 | ≥ 25000 g·mol$^{-1}$ | Pass |

3.8.1 The assessment showed that the products comply with HAPAS requirements for CEG and molecular weight.

3.9 Screening test for resistance to acid and alkaline liquids

*Table 13 Screening test for resistance to acid and alkaline liquids for Secugrid PET Geogrids for reinforced soil embankments*

| Product assessed | Assessment method | Requirement | Result |
|---|---|---|---|
| Secugrid PET Geogrids for reinforced soil embankments | Screening test method for determining the resistance to acid and alkaline liquids to EN 14030 : 2001. Test and control specimens were prepared to EN 12226 : 2012 | No considerable loss of retained tensile strength | Pass |

3.9.1 The assessment showed that the products comply with HAPAS requirements for resistance to acid and alkaline liquids.

3.10 Factor of safety for the extrapolation of data (fs)

*Table 14 Factor of safety for the extrapolation of data ($f_s$) for Secugrid PET Geogrids for reinforced soil embankments*

| Product assessed | Assessment method | Requirement | Result |
|---|---|---|---|
| Secugrid PET Geogrids for reinforced soil embankments | The values calculated in accordance with PD ISO/TR 20432 : 2007, using the $R_1$ and $R_2$ values given in Tables 7 and 12 of this Certificate. | 60 years design life Design soil temperature 20 °C | 1.03 |
| | | 120 years design life Design soil temperature 20 °C | 1.05 |

3.10.1 The assessment showed that the products comply with HAPAS requirements for factor of safety for the extrapolation of data ($f_s$).

3.11 Durability

3.11.1 When designed and installed in accordance with the requirements of BS 8006-1 : 2010, BS EN 14475 : 2006 and PD ISO/TR 20432 : 2007 and this Certificate, Secugrid PET Geogrids for reinforced soil embankments will have a service life of up to 120 years, exceeding the typical service life required for reinforced soil embankments.

## 4 Summary of Process Assessment

| | |
|---|---|
| **Manufacturing process and quality control** | Complies with HAPAS requirements |
| **Delivery and site handling** | Complies with HAPAS requirements |
| **Installation** | Complies with HAPAS requirements |

4.1 Manufacture

4.1.1 The BBA has undertaken the following tasks for the assessment of product manufacture and has established that the manufacture complies with BBA HAPAS Certification Scheme requirements:

- the BBA has recorded and evaluated the manufacturer's documentation of the methods adopted for quality control procedures and product testing against HAPAS requirements
- the BBA has assessed the quality control operated over batches of incoming materials and formulations against HAPAS Requirements
- the BBA has evaluated the process for management of non-conforming work
- the BBA has audited the production process and verified that it is in accordance with the documented process

- the BBA has checked that equipment has been properly tested and calibrated.

4.1.2 The BBA has undertaken to review the above measures on a regular basis through a surveillance process, to verify that the specifications and quality control operated by the manufacturer are being maintained.

† 4.1.3 The management system of the manufacturer has been assessed and registered as meeting the requirements of ISO/IEC 9001 : 2015 by TÜV Nord Cert GmBH (Certificate 44 100 940655).

4.2 Delivery and site handling

† 4.2.1 Secugrid PET Geogrids for reinforced soil embankments are delivered to site in rolls with the nominal widths, lengths and weights shown in Table 1. Each roll is wrapped for transit and site protection in stretch foil and is labelled with the geogrid grade and identification. The packaging must not be removed until immediately prior to installation. The grade of geogrid is ink-jet printed on the cross-machine direction bars approximately every metre.

*Figure 5 Label*


4.2.2 To achieve the performance described in this Certificate, delivery and site handing must be performed in accordance with the Certificate holder's instructions and this Certificate, including:

- rolls must be stored in clean, dry conditions and protected from mechanical or chemical damage, exposure to direct sunlight and extreme temperatures. When laid horizontally, the rolls may be stacked up to seven high. No other loads should be stored on top of the stack. It must be ensured that the rolls cannot move at any time once stacked and stored
- toxic fumes are given off if the geogrids catch fire and therefore the necessary precautions must be taken following the instructions given in the material safety data sheet for the products.

4.3 Design

4.3.1 Reinforced soil embankments constructed using Secugrid PET Geogrids must be designed in accordance with BS 8006-1 : 2010 and the MCHW, Volume 1 (SHW), Series 600.

4.3.2 The design tensile strength of reinforcement ($T_D$), the long-term tensile creep rupture strength ($T_{CR}$), extrapolated tensile load based on creep strain at the end of the design life ($T_{CS}$) and the material safety factor ($f_m$) must be calculated in accordance with the methodology set out in BS 8006-1 : 2010.

4.3.3 Recommended values for $RF_{CR}$, $RF_{ID}$, $RF_W$, $RF_{CH}$ and $f_s$ are given in section 3. Conditions of use outside the scope for which the reduction factors are defined are not covered by this Certificate and advice should be sought from the Certificate holder.

4.3.4 CIRIA SP123 : 1996, Sections 4.5 and 4.6, describes the methods for determining resistance to direct sliding and maximum available bond, to which the appropriate partial factors should be applied in accordance with BS 8006-1 : 2010. For detailed design, the resistance to direct sliding should be determined from soil and Secugrid PET Geogrid specific shear box testing.

4.3.5 The designer should specify the relevant properties of fill and the thickness and compaction of the fill material deemed acceptable for the purpose of the design. Acceptable materials should satisfy the requirements of BS 8006-1 : 2010 and the MCHW, Volume 1 (SHW), Series 600 and be in line with those conditions used to determine the installation damage partial safety factors in the design.

4.4 Installation

4.4.1 The Certificate holder's instructions for installation of the products were confirmed as meeting the BBA HAPAS Certification Scheme requirements.

4.4.2 To achieve the performance described in this Certificate, the products must be installed by competent ground engineering contractors familiar with these types of products, in accordance with the specifications and construction drawings.

4.4.3 To achieve the performance described in this Certificate, installation of reinforced soil embankments incorporating Secugrid PET Geogrids must be in accordance with the Certificate's holder's installation instructions, BS 8006-1 : 2010, BS EN 14475 : 2006 and the MCHW, Volume 1 (SHW), Series 600 and HAPAS requirements.

† 4.4.4 The Certificate holder's instructions advise that care should be taken to ensure that the products are laid with the warp (longitudinal) direction parallel to the direction of principal stress. Design drawings should indicate orientation of the products.

4.4.5 Installation procedure

† 4.4.5.1 The products are laid by unrolling manually or mechanically to the length required. Grades up to 40 $kN \cdot m^{-1}$ can be cut with a sharp knife, but for grades exceeding this, an angle grinder with a smooth diamond grinding wheel and a cutting depth of at least 300 mm is recommended. Due to the mechanical stresses during the cutting process, individual, small damages of the geogrid bars can occur in the direct area of influence. For installation, therefore, the first 100 mm away from the cutting edge must not be considered for overlaps required by the design. As a result, in overlapping areas, a larger overlapping length in the transverse direction of 100 mm should be considered in comparison to the recommended value stated in the design.

4.4.5.2 Lengths of the geogrids are laid flat without folds, parallel with widths in contact and overlapping by a minimum of 300 mm. Each reinforcing layer must be continuous in the direction of loading. If wrinkles occur, these are to be worked out to the free ends of the products. Recommendations for overlaps and soil type can be provided by the manufacturer. Pre-tensioning of the geogrids is usually not required since they are produced without any construction-related strain. If pre-stressing is required, it must be carried out according to the project specification or after consultation with the Certificate holder.

† 4.4.5.3 Particular care should be taken to ensure that the geogrids are adequately covered before compaction or trafficking. Construction traffic will damage unprotected geogrids.

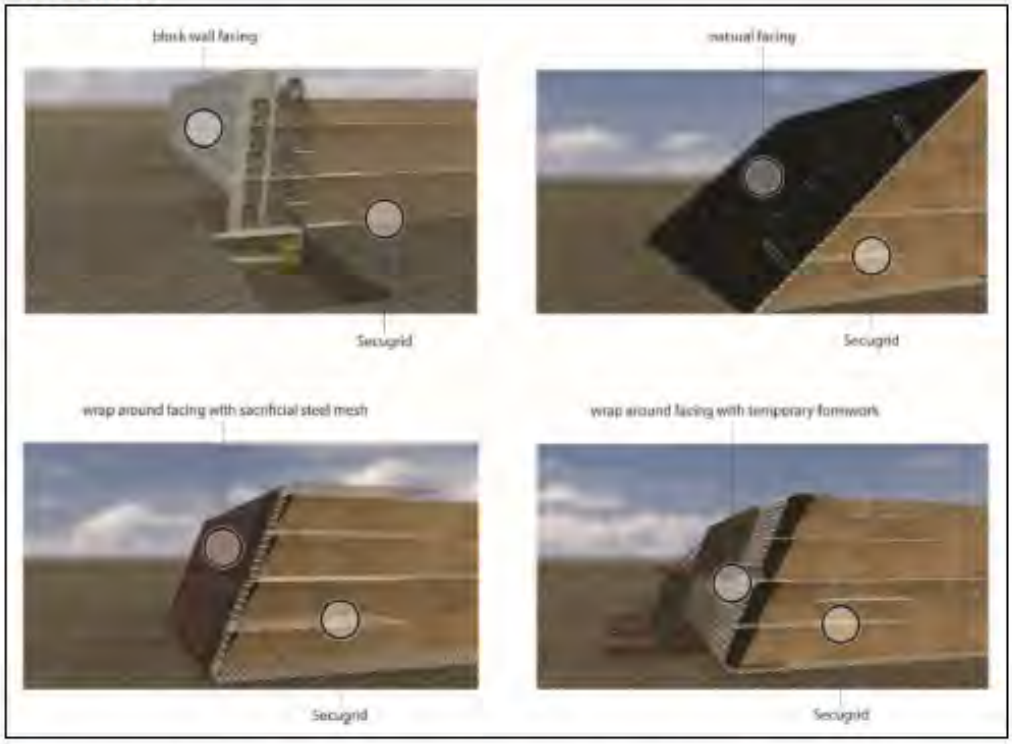
4.4.5.4 Fill material is placed to a minimum compacted depth of 200 mm. During the installation of the fill material, the geogrids must not develop folds and wrinkles.

4.4.5.5 All coarse and mixed-granular soils or base course materials according to the project specification or requirements outlined in the national Building Regulations [eg the MCHW, Volume 1 (SHW), Series 600 or BS 8006-1 : 2010] can be used. In subbase and base courses for road construction, preferably crushed stone-sand mixtures and/or gravel-sand mixtures of grading specifications 0/32, 0/45 or 0/56, are used. The respective soil-mechanical parameters must be observed during the planning phase. The bulk material should be selected according to the specifications of the detailed design. The use of recycled aggregates might be appropriate for some applications. Consideration should be given to the use of such materials, and guidance can be found in the national Building Regulations. An optimal mode of operation is achieved by a well-graded crushed granular mixture, without considerable fines. If coarse-granular material > 63 mm maximum particle size must be used, the suitability must be discussed with the Certificate holder.

4.4.5.6 The products must be covered with fill within the time specified in the design to prevent degradation caused by UV light.

† 4.4.5.7 Facings are positioned as detailed on the engineer's design drawing and, where the products are used for this purpose, they must be wrapped around and anchored back into the fill. Formwork is used to assist in maintaining the shape of the facing but, whether prefabricated or otherwise, such facings are outside the scope of this Certificate. A typical example is shown in Figure 6.

*Figure 6 Facings*




4.4.6 Visits were made to installations in progress to assess the practicability and ease of construction of the products.

4.5 Maintenance

As the products are confined within the soil and have suitable durability, maintenance is not required.

## 5 Fulfilment of Requirements

5.1 The conclusion of this BBA assessment is that Secugrid PET Geogrids for reinforced soil embankments, when used in accordance with the provisions of this Certificate, comply with the BBA HAPAS Certification Scheme requirements.

5.2 In order for the products to continue to meet Scheme requirements, they must be installed, used and maintained as per the manufacturer's instructions and as detailed in the Certificate.

## 6 Validity of Certificate

Continuing validity of this Certificate is dependent on the following factors:

- continuing compliance with product or process requirements, as described in the HAPAS Scheme document, and the specification documents referred to therein

- ongoing BBA surveillance of factory production control, to verify that the specifications and quality control being operated by the manufacturer are being maintained
- acceptable results from long-term exposure monitoring
- acceptable data to confirm durability
- formal triennial Review of the Certificate, and Reissue for required technical or non-technical updates
- compliance with ongoing Certificate obligations by the Certificate holder and manufacturer(s).

## † 7 Additional Regulations

**Construction (Design and Management) Regulations 2015**
**Construction (Design and Management) Regulations (Northern Ireland) 2016**

Information in this Certificate may assist the client, designer (including Principal Designer) and contractor (including Principal Contractor) to address their obligations under these Regulations.

**CE marking**

The Certificate holder has taken the responsibility of CE marking the products in accordance with Designated Standard EN 13251 : 2016.

**Annex A**

When Secugrid PET Geogrids for reinforced soil embankments are used as part of retaining wall systems, both serviceability limit state and ultimate limit state design in the form of isochronous curves are required. Serviceability limit state and ultimate limit state design in the form of isochronous curves must be declared by the Certificate holder, as per BS 8006-1 : 2010, and approved by the BBA.

## 8 Bibliography


ASTM D4603 *Average Molecular weight*

ASTM D6992 : 2016 *Accelerated creep rupture based on Time Temperature Superposition using Stepped Isothermal Method (SIM)*

ASTM D7409 *Carboxyl end group (CEG) count*

BS 8006-1 : 2010 + A1 : 2016 *Code of practice for strengthened/reinforced soils and other fills*

BS EN 13251 : 2016 *Geotextiles and geotextile-related products — Characteristics required for use in earthworks, foundations and retaining structures*

BS EN 14475 : 2006 *Execution of special geotechnical works — Reinforced fill*

BS EN ISO 9864 : 2005 *Geosynthetics — Test method for the determination of mass per unit area of geotextiles and geotextile-related products*

CIRIA SP123 : 1996 *Soil Reinforcement with Geotextiles, Jewell R.A*

EN 12224 : 2000 *Geotextiles and geotextile-related products — Determination of the resistance to weathering*

EN 12225 : 2000 *Geosynthetics — Method for determining the microbiological resistance by a soil burial test*

EN 12226 : 2012 *Test and control specimens' preparation*

EN 12447 : 2001 *Geotextiles and geotextile-related products — Screening test method for determining the resistance to hydrolysis in water*

EN 14030 : 2001 *Geotextiles and geotextile-related products — Screening test method for determining the resistance to acid and alkaline liquids*

EN ISO 10319 : 2015 *Geosynthetics — Wide-width tensile test*

EN ISO 13431 : 1999-08 *Determination of tensile creep behaviour*

ISO/IEC 9001 : 2015 *Quality management systems — Requirements*

Manual of Contract Documents for Highway Works, Volume 1 *Specification for Highway Works*

PD/ISO TR 20432 : 2007 *Guidelines for the determination of the long-term strength of geosynthetics for soil reinforcement*

## 9 Conditions of Certification

9.1 This Certificate:

- relates only to the product/system that is named and described on the front page
- is issued only to the company, firm, organisation or person named on the front page – no other company, firm, organisation or person may hold or claim that this Certificate has been issued to them
- is valid only within the UK
- has to be read, considered and used as a whole document – it may be misleading and will be incomplete to be selective
- is copyright of the BBA
- is subject to English Law.

9.2 Publications, documents, specifications, legislation, regulations, standards and the like referenced in this Certificate are those that were current and/or deemed relevant by the BBA at the date of issue or reissue of this Certificate.

9.3 This Certificate will remain valid for an unlimited period provided that the product/system and its manufacture and/or fabrication, including all related and relevant parts and processes thereof:

- are maintained at or above the levels which have been assessed and found to be satisfactory by the BBA
- continue to be checked as and when deemed appropriate by the BBA under arrangements that it will determine
- are reviewed by the BBA as and when it considers appropriate.

9.4 The BBA has used due skill, care and diligence in preparing this Certificate, but no warranty is provided.

9.5 In issuing this Certificate the BBA is not responsible and is excluded from any liability to any company, firm, organisation or person, for any matters arising directly or indirectly from:

- the presence or absence of any patent, intellectual property or similar rights subsisting in the product/system or any other product/system
- the right of the Certificate holder to manufacture, supply, install, maintain or market the product/system
- actual installations of the product/system, including their nature, design, methods, performance, workmanship and maintenance
- any works and constructions in which the product/system is installed, including their nature, design, methods, performance, workmanship and maintenance
- any loss or damage, including personal injury, howsoever caused by the product/system, including its manufacture, supply, installation, use, maintenance and removal
- any claims by the manufacturer relating to UKCA marking and CE marking.

9.6 Any information relating to the manufacture, supply, installation, use, maintenance and removal of this product/system which is contained or referred to in this Certificate is the minimum required to be met when the product/system is manufactured, supplied, installed, used, maintained and removed. It does not purport in any way to restate the requirements of the Health and Safety at Work etc. Act 1974, or of any other statutory, common law or other duty which may exist at the date of issue or reissue of this Certificate; nor is conformity with such information to be taken as satisfying the requirements of the 1974 Act or of any statutory, common law or other duty of care.

## APPENDIX D:

## DESIGN AND CHECK CERTIFICATES

**Name of Project** Strata - Westgate, Cleckheaton

**Name of Structure** Gilcon Retaining Walls

**Structure Ref No** N/A

1. We certify that reasonable professional skill and care has been used in the preparation of the design of the Proprietary Lock and Load Retaining Walls adjacent the adopted Highway, with a view to securing that:

   i. It has been designed in accordance with

   The Standards listed in the AIP dated 20th June 2025;

   ii. It has been checked for compliance with the relevant standards in i

   iii. It has been accurately translated into construction drawings and bar bending schedules all of which have been checked. The unique numbers of these drawings and schedules are:-
   BY00099-STH-B01-XX-DR-S-1003, Rev-, – Retaining Wall Heights from Formation
   QD1776-14-10 – Masonry and Gillcon Retaining Walls Location Plans
   QD1776-14-13 – Gilcon Retaining Wall Sections (Sheet 2 of 4) Rev -
   QD1776-14-14 – Gilcon Retaining Wall Sections (Sheet 3 of 4) Rev –
   SK24-5558-F1-04B – Lock+Load Wall 03 Elevation
   SK24-5558-F1-05B – Lock+Load Wall 03 Cross - Sections
   HAPAS Certificate 21/H311 – Lock and Load Retaining Wall System
   HAOAS Certificate 14/H218 – Secugrid Geogrids

Signed 

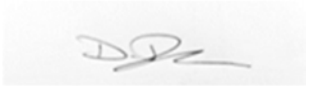
Name D. J. Phillipson
Design Team Leader

Engineering Qualifications BEng(Hons), CEng, MIStructE.

Signed 

Name D. Rogers
Check Team Leader

Engineering Qualifications BSc(Hons), MSc

Signed 

Name D. Rogers

Position held Structural Engineering Director

Name of Organisation Queensberry Design Ltd

Date 20:06:2025

The certificate is accepted by the TAA

Signed _____

Name _____

Position held _____

Engineering Qualifications _____

TAA _____

Date _____