



Approval in Principle

Masonry Retaining Walls Adjacent the Adopted Highway Strata Westgate, Cleckheaton QD - 1776

Rev

June 2025

Issue Sheet

Prepared By	D.J. Phillipson Structural Associate
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Reviewed By	D. Rogers Structural Engineering Director
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Issue	- (20/06/2025) – Initial Issue
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Design Brief

An AIP has been requested by Kirklees Council for the Masonry 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.

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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

Masonry 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

20 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 masonry gravity 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 masonry gravity retaining wall.

3.3 Foundation type

The foundations are ground bearing strip foundation, a bearing pressure of 75kN/m² has been assumed, Foundations are sat on clays which will give the 75kN/m², drawing QD1766-14-11 & 12, sections 2 and 7 are sat on fill material, a geotechnical engineer will confirm the required bearing capacity can be achieved.

3.4 Span arrangements

The maximum retained height is in the order of 975mm.

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, with weep holes if this fails.

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 XD3

Brickwork class F2, S2 conforming to BS EN 771-1

Blockwork, conforming to BS EN 771-3

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 Brickwork, 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 brickwork](#)

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 of structures subject to traffic loading to BS EN 1997-1	Incorporating Corrigendum January 2022 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	<i>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</i>
MCHW Volume 2: October 2022	Notes for guidance on the Specification for Highway Works	<i>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</i>
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 using the Masterseries design software to the information supplied by Eastwood Consulting Engineers, dated July 2023.

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

Structure has been analyzed as a masonry gravity wall.

5.3 Assumptions intended for calculation of structural element stiffness

Based masonry cross section, designed to BS EN 1996-1-1.

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 75kPa.
Minimum Friction 30 degrees

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 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 Gilcon Retaining Walls Location Plans
QD1776-14-11 – Masonry Retaining Wall Sections (Sheet 1 of 4) Rev -
QD1776-14-12 – Masonry Retaining Wall Sections (Sheet 2 of 4) Rev –
Retaining Wall Calculations
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 _____ BSc(Hons), MSc
Name of Organisation _____ Queensberry Design Ltd
Date _____ 20/06/2025

**10. THE ABOVE IS REJECTED/AGREED¹⁹ SUBJECT TO THE AMENDMENTS
AND CONDITIONS SHOWN BELOW²⁰**

Signed _____
Name _____
Position held _____
Engineering Qualifications _____ 21
TAA _____
Date _____

Notes

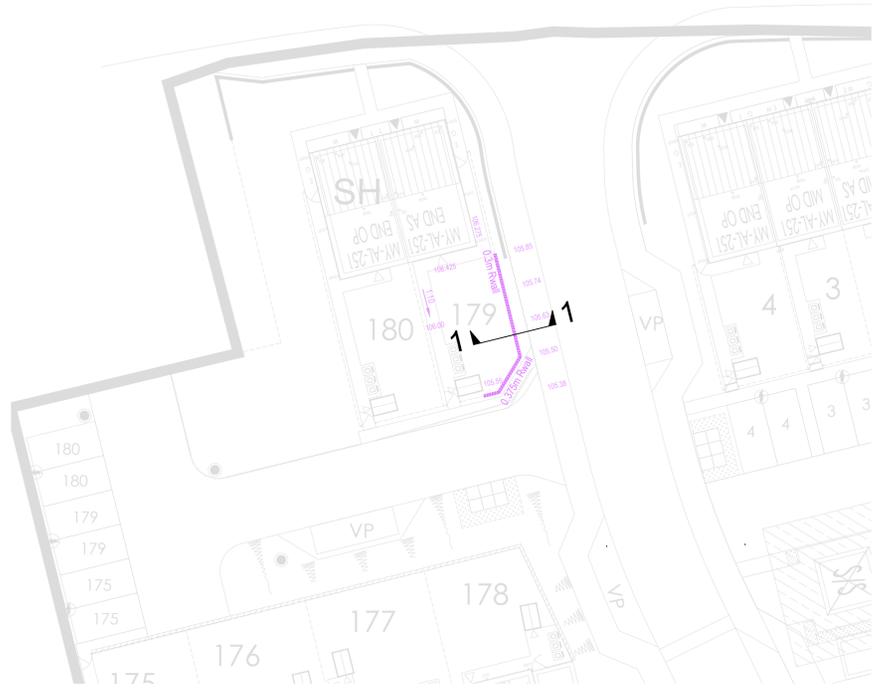
- 1) For a bridge, give over and/or under.
- 2) Include weight, height, width and any environmental restrictions at or adjacent to the bridge.
- 3) The design working life of the structure including temporary structure, and replaceable structural parts are to be given. They are to be expressed as a number 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 MStructE 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
& CALCULATIONS**

- 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.



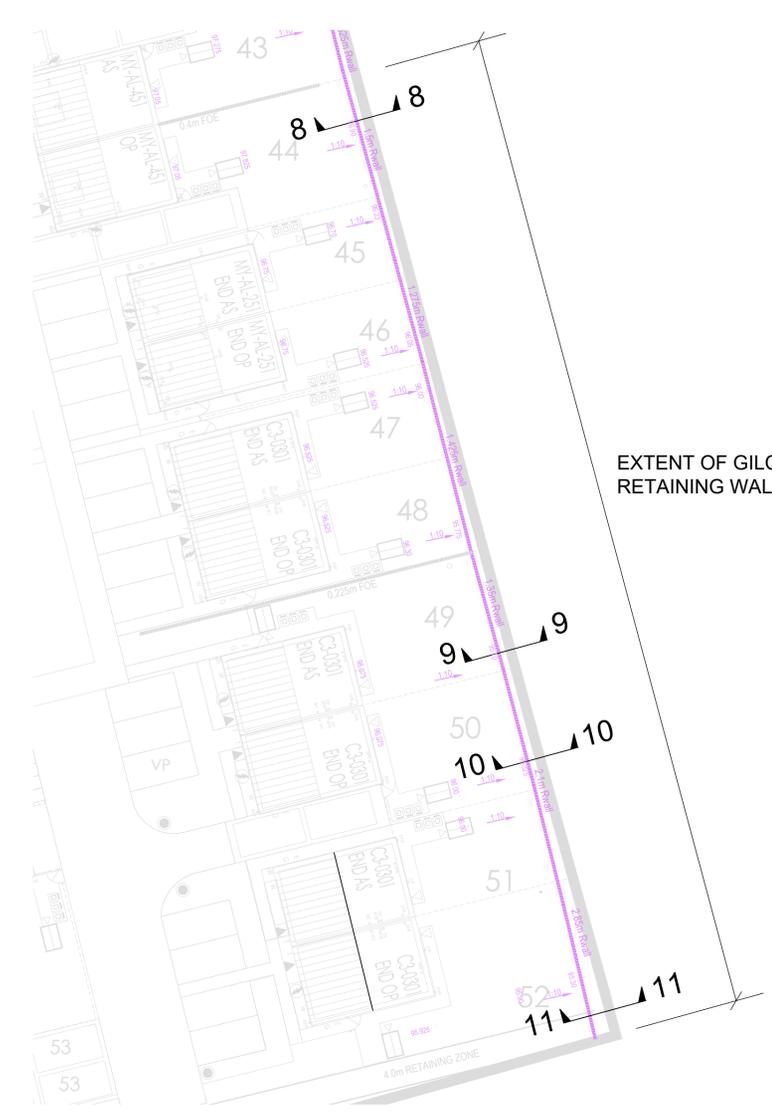
ZONE 1 - PLAN VIEW
SCALE - 1:50



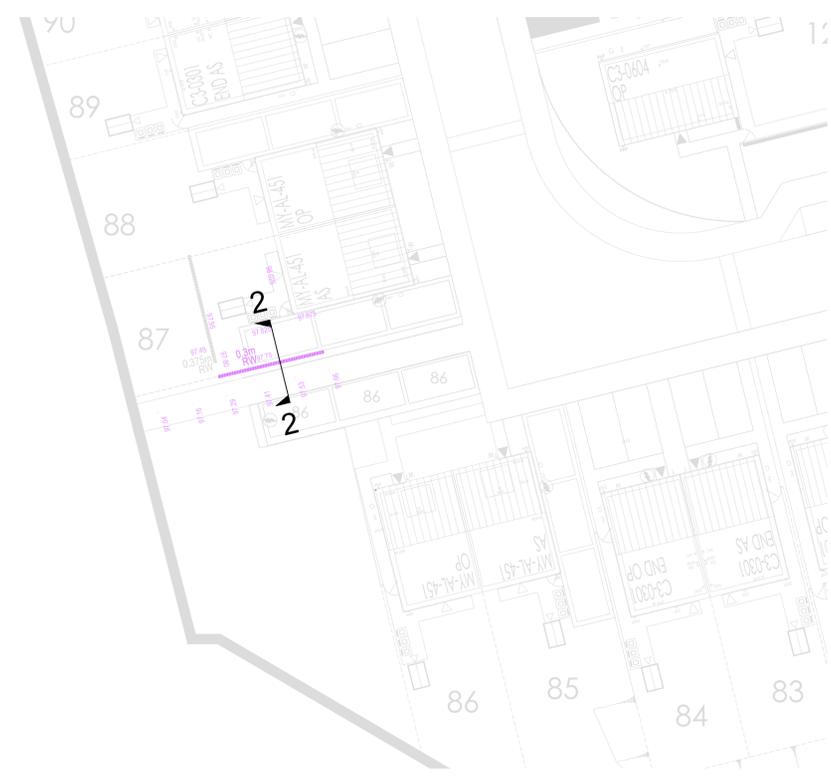
ZONE 2 - PLAN VIEW
SCALE - 1:50



OVERALL ZONAL PLAN



ZONE 4 - PLAN VIEW
SCALE - 1:50



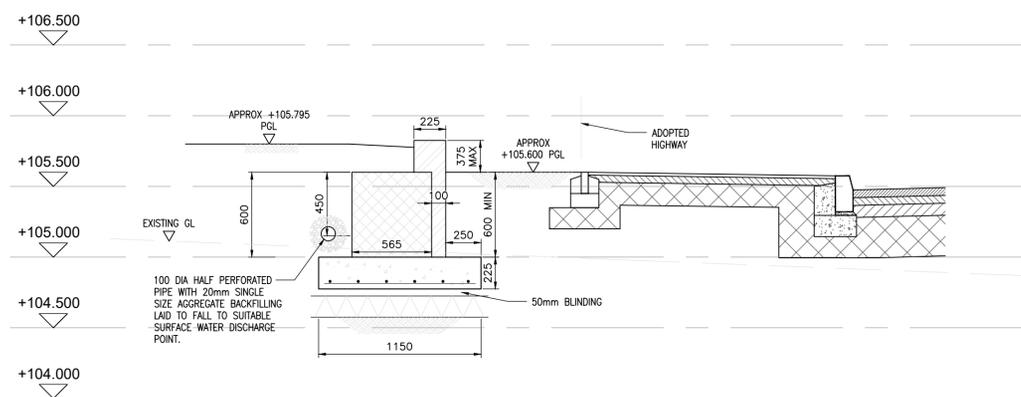
ZONE 3 - PLAN VIEW
SCALE - 1:50

EXTENT OF GILCON RETAINING WALLS

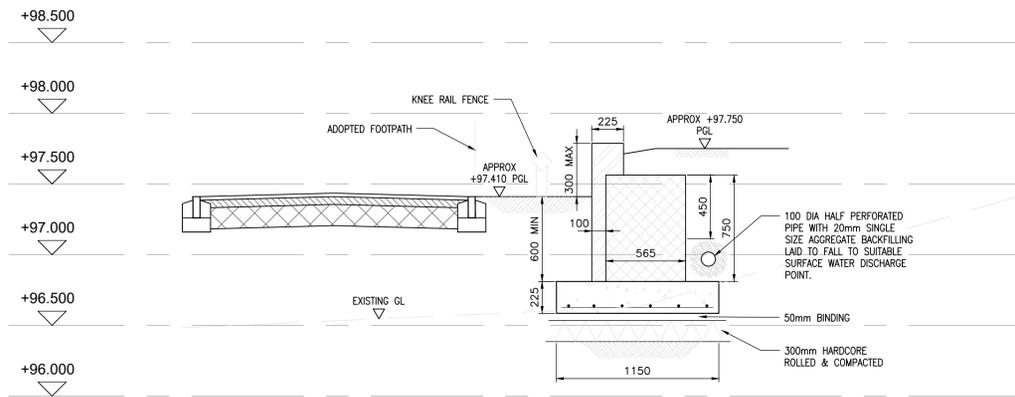
Rev	Date	Revision Details	Drawn	Checked
-	12.06.25	INITIAL ISSUE	DZ	DJP
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 QUEENSBERRY DESIGN CIVIL, STRUCTURAL, ARCHITECTURAL & GEOTECHNICAL CONSULTANTS NORTH-EAST OFFICE 5 STATHES, THE WATERMARK, GATEHEAD, TYNE AND WEAR NE11 9SN T: 0191 400 9500 YORKSHIRE OFFICE SUITE 12A, BROOKFIELD COURT, SELBY ROAD, LEEDS, LS25 1NB T: 0113 517 9999 www.queensberrydesign.co.uk				
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				
INITIAL ISSUE		Scale	1:500 - A1	Rev
				-

Notes:-

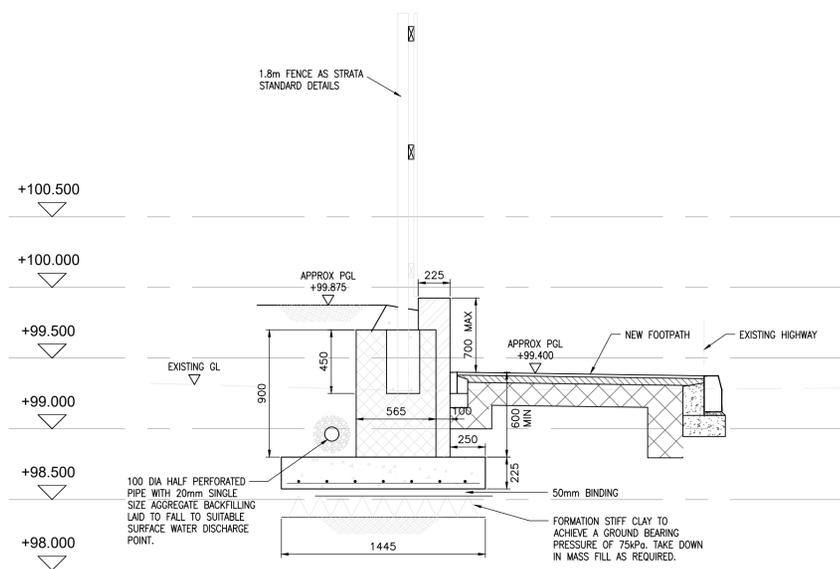
1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT ARCHITECTS, ENGINEERS, MECHANICAL AND ELECTRICAL ENGINEERS DRAWINGS TOGETHER WITH THE SPECIFICATIONS.
2. DIMENSIONS TAKEN FROM PROPOSED LAYOUT.
3. FOR SECTION DETAILS, REFER TO TYPICAL MASONRY DETAIL RETAINING WALL ON DRAWING - QD1776-14-12



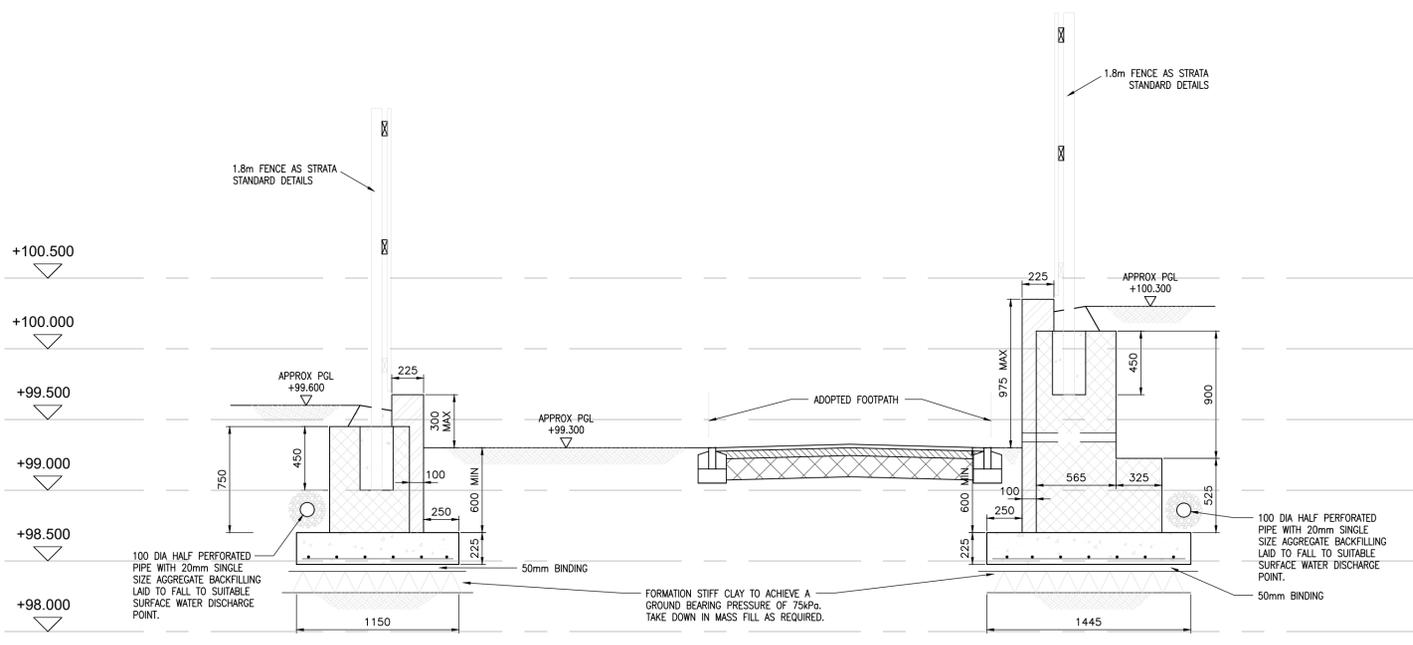
SECTION 1-1
Scale @ 1:25



SECTION 2-2
Scale @ 1:25



SECTION 3-3
Scale @ 1:25



SECTION 4-4
Scale @ 1:25

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Client: STRATA

Project: WESTGATE CLECKHEATON

Title: MASONRY RETAINING WALL SECTIONS (SHEET 1 of 4)

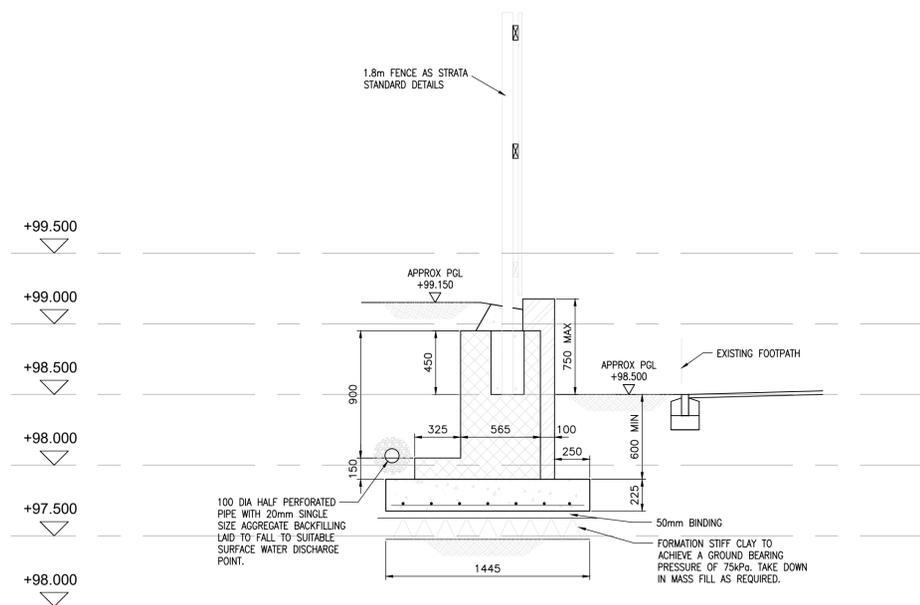
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DR	DJP	12/06/2025

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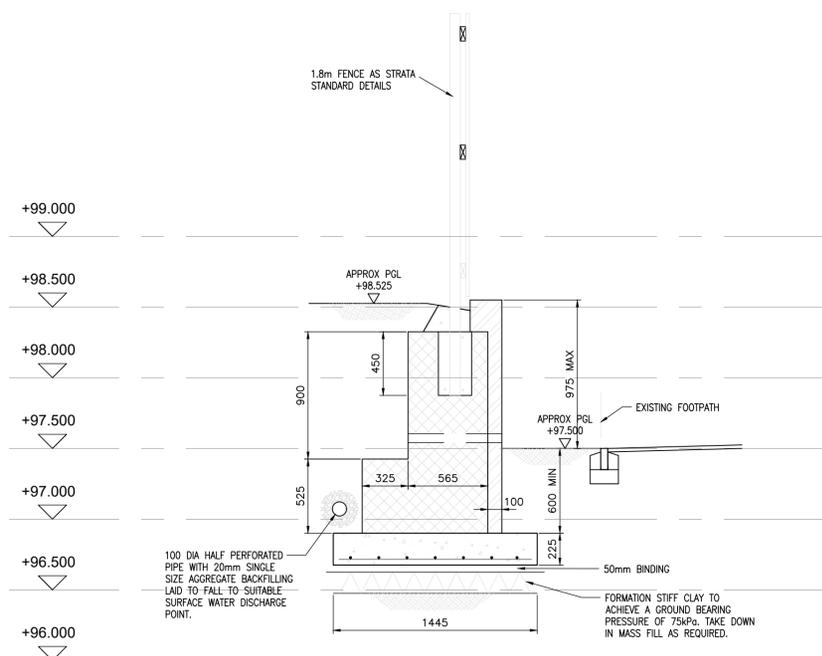
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INITIAL ISSUE	1:500 - A1	-

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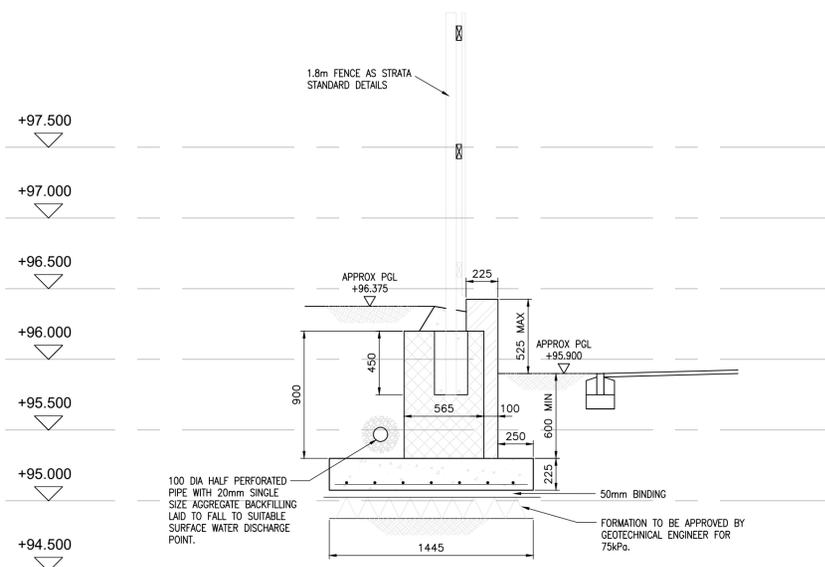
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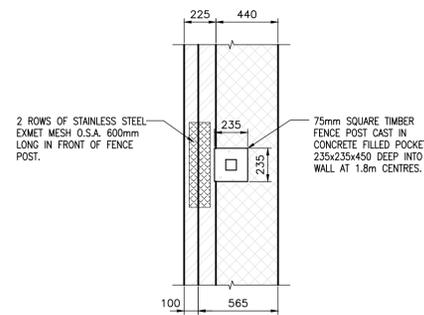
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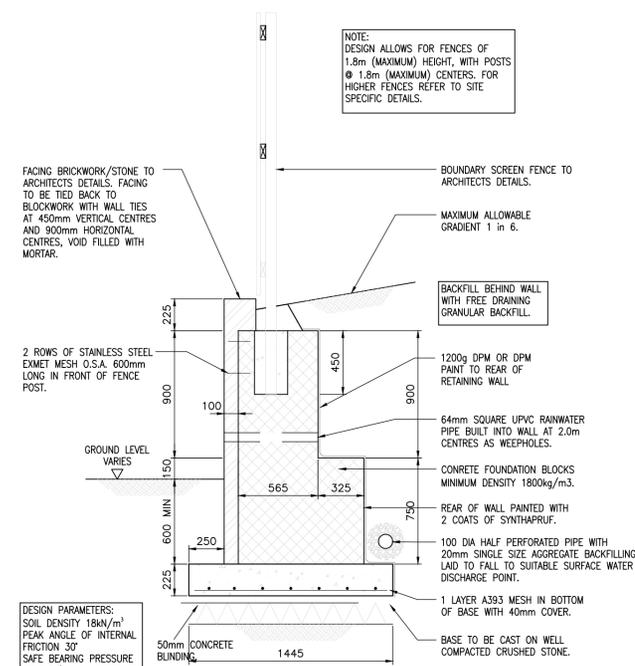
SECTION 6-6
Scale @ 1:25



SECTION 7-7
Scale @ 1:25



PLAN ON FENCE POST LOCATION POCKET
Scale @ 1:20



TYPICAL MASONRY DETAIL RETAINING WALL (1.2m MAX)
Scale @ 1:20

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-	12.06.25	INITIAL ISSUE	DZ	DJP

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Client: STRATA

Project: WESTGATE CLECKHEATON

Title: MASONRY RETAINING WALL SECTIONS (SHEET 2 of 4)

Drawn	Checked	Date
DR	DJP	12/06/2025

Drawing Number: QD1776-14-12

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

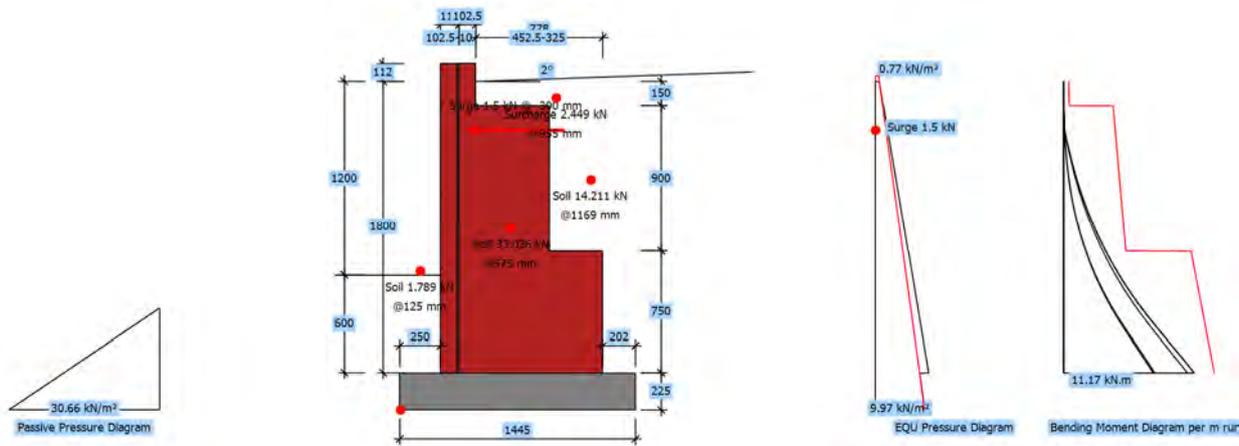
Queensberry Design Ltd

Unit 5 The Staithes
The Watermark, Metro Centre
Gateshead, NE11 9SN
Tel: (0191) 460 9090

Cloud fc03e

Job Ref : QD 1776
Sheet : M - /001
Made by : D.J.P.
Date : 19 June 2025 / Ver. 2024.13.20
Checked : D.R.
Approved :

MasterKey : Retaining Wall Design to EC 7 : 2004, BS EN 1996-1-1:2005+A1:2012 and EC 2 : 2004 1200 Retained Reinforced Masonry Cavity Filled Retaining Wall with Reinforced Concrete Base



Summary of Design Data

EC 7 National Annex	UK
EC6 National Annex	UK
Notes	All dimensions are in mm and all forces are per metre run
Material Densities (kN/m³)	Soil 18.00, Concrete 24.00, Masonry 18.00
Angles	Embankment 2°
Concrete grade	C28/35 N/mm², Permissible tensile stress 1.033 N/mm²
Concrete covers (mm)	Cavity inner cover 30 mm, Cavity outer cover -20 mm, Base cover 50 mm
Reinforcement design	fy 500 N/mm², fyb 500 N/mm² designed to EC 2: 2004
Surcharge and Water Table	Surcharge 2.50 kN/m², Fully drained
Unplanned excavation depth	Front of wall 203 mm
† The Engineer must satisfy him/herself to the reinforcement detailing requirements of the relevant codes of practice	

Additional Loads

Horizontal Surge	1.5 kN acting @ -300 mm above the top edge of the wall
† Dimensions	

Soil Properties

Bearing pressure	Ultimate resistance M1 @ front 60.00 kN/m², @ back 60.00 kN/m² Ultimate resistance M2 @ front 60.00 kN/m², @ back 60.00 kN/m²
EC7 EQU - Wall Stability	
Back Soil Friction and Cohesion	$\phi = \text{Atn}(\text{Tan}(35)/1.1) = 32.48^\circ$
Base Friction and Cohesion	$\delta = \text{Atn}(1 \times \text{Tan}(\text{Atn}(\text{Tan}(30)/1.1))) = 27.69^\circ$
Front Soil Friction and Cohesion	$\phi = \text{Atn}(\text{Tan}(30)/1.1) = 27.69^\circ$
EC7 GEO/STR - M1	
Back Soil Friction and Cohesion	$\phi = \text{Atn}(\text{Tan}(35)/1) = 35^\circ$
Base Friction and Cohesion	$\delta = \text{Atn}(1 \times \text{Tan}(\text{Atn}(\text{Tan}(30)/1))) = 30^\circ$
Front Soil Friction and Cohesion	$\phi = \text{Atn}(\text{Tan}(30)/1) = 30^\circ$
EC7 GEO/STR - M2	
Back Soil Friction and Cohesion	$\phi = \text{Atn}(\text{Tan}(35)/1.25) = 29.26^\circ$
Base Friction and Cohesion	$\delta = \text{Atn}(1 \times \text{Tan}(\text{Atn}(\text{Tan}(30)/1.25))) = 24.79^\circ$
Front Soil Friction and Cohesion	$\phi = \text{Atn}(\text{Tan}(30)/1.25) = 24.79^\circ$

Loading Cases EQU and GEO/STR - Design Approach 1

G_{Soil} - Soil Self Weight, G_{Wall} - Wall & Base Self Weight, F_{VHeel} - Vertical Loads over Heel, P_a - Active Earth Pressure, $P_{\text{surcharge}}$ - Earth pressure from surcharge, $P_{\text{surch(fav)}}$ - Earth pressure from surcharge (no load over heel), P_p - Passive Earth Pressure

Case 1: EQU Wall Stability	$0.90 G_{\text{Soil}} + 0.90 G_{\text{Wall}} + 1.10 P_a + 1.50 P_{\text{surcharge}} + 0.90 P_p$
Case 2: GEO/STR A1+M1 I	$1.00 G_{\text{Soil}} + 1.00 G_{\text{Wall}} + 1.50 F_{\text{VHeel}} + 1.35 P_a + 1.50 P_{\text{surcharge}} + 1.00 P_p$
Case 3: GEO/STR A2+M2 I	$1.00 G_{\text{Soil}} + 1.00 G_{\text{Wall}} + 1.30 F_{\text{VHeel}} + 1.00 P_a + 1.30 P_{\text{surcharge}} + 1.00 P_p$
Case 4: GEO/STR A1+M1 II	$1.00 G_{\text{Soil}} + 1.00 G_{\text{Wall}} + 1.35 P_a + 1.50 P_{\text{surch(fav)}} + 1.00 P_p$
Case 5: GEO/STR A2+M2 II	$1.00 G_{\text{Soil}} + 1.00 G_{\text{Wall}} + 1.00 P_a + 1.30 P_{\text{surch(fav)}} + 1.00 P_p$
Case 6: GEO/STR A1+M1 III	$1.35 G_{\text{Soil}} + 1.35 G_{\text{Wall}} + 1.50 F_{\text{VHeel}} + 1.35 P_a + 1.50 P_{\text{surcharge}} + 1.00 P_p$

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Job Ref : QD 1776
Sheet : M - /002
Made by : D.J.P.
Date : 19 June 2025 / Ver. 2024.13.20
Checked : D.R.
Approved :

Geotechnical Design**Wall Stability - Virtual Back Pressure**

Case 1 Overturning/Stabilising	13.251/35.056	0.378	OK
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Wall Sliding - Virtual Back Pressure

Case 2 $F_x/(R_x F_{friction} + R_x P_{passive})$	15.655/(28.743+10.480)	0.399	OK
Case 3 $F_x/(R_x F_{friction} + R_x P_{passive})$	15.109/(22.948+8.538)	0.480	OK
Case 4 $F_x/(R_x F_{friction} + R_x P_{passive})$	15.655/(28.306+10.480)	0.404	OK
Case 5 $F_x/(R_x F_{friction} + R_x P_{passive})$	15.109/(22.645+8.538)	0.485	OK
Case 6 $F_x/(R_x F_{friction} + R_x P_{passive})$	15.655/(38.650+10.480)	0.319	OK

Soil Pressure

Case 2 - Virtual Back	43.249/60 kN/m ² , Length under pressure 1.151 m	0.721	OK
Case 3 - Virtual Back	42.963/60 kN/m ² , Length under pressure 1.156 m	0.716	OK
Case 4 - Virtual Back	43.488/60 kN/m ² , Length under pressure 1.127 m	0.725	OK
Case 5 - Virtual Back	43.161/60 kN/m ² , Length under pressure 1.136 m	0.719	OK
Case 6 - Virtual Back	52.894/60 kN/m ² , Length under pressure 1.266 m	0.882	OK
Case 2 - Wall Back	46.020/60 kN/m ² , Length under pressure 1.082 m	0.767	OK
Case 3 - Wall Back	45.294/60 kN/m ² , Length under pressure 1.097 m	0.755	OK
Case 4 - Wall Back	40.339/60 kN/m ² , Length under pressure 1.215 m	0.672	OK
Case 5 - Wall Back	40.423/60 kN/m ² , Length under pressure 1.213 m	0.674	OK
Case 6 - Wall Back	55.140/60 kN/m ² , Length under pressure 1.214 m	0.919	OK

Structural Design**Outer Leaf Details**

Partial Safety Factor (γ_{mc}/γ_{mf})	Units Category I, Execution Control Class 2	2.7/2.7	Table NA.1
Material	Clay bricks with water absorption between 7% and 12%		
Units and Mortar Strength	20 N/mm ² , Mortar designation M12/(i)		
Compressive Strength (f_k)	Group 1, $\gamma=18$ kN/m ³	8.58 N/mm ²	Table NA.6

Inner Leaf Details

Partial Safety Factor (γ_{mc}/γ_{mf})	Units Category I, Execution Control Class 2	2.7/2.7	Table NA.1
Material	Concrete blocks, $\gamma=18$ kN/m ³		
Units and Mortar Strength	7.3 N/mm ² , Mortar designation M12/(i)		
Blocks Ratio	Unit height=215, Least horizontal dimensions=100	2.15	
Compressive Strength (f_k)	Group 1	5.48 N/mm ²	Table NA.6

Wall Design (Inner Face Tension)

Critical Section	Critical @ 0 mm from base, Case 2		
Section Properties @ Base	$t=992$ mm, Area=9925 cm ² , $Z_b=164176$ cm ³		
Flexural Strength f_{xk1}	$f_{xk1}=0.15$, $gd=0.025$ N/mm ² , $f_{xk1}=f_{xk1}+0.9$ gd. γ_{mf}	0.212 N/mm ²	Table NA.6
$M_r=f_{xk1} \cdot Z_b/\gamma_{mf}$	0.212x164176/2.7	12.88 kN.m	
Moment Capacity Check (M/M _r)	M 11.2 kN.m, M _r 12.9 kN.m	0.867	OK
Shear Capacity Check	F 10.9 kN, $f_{vk}0.210$ N/mm ² , F _{vr} 83.4 kN	0.13	OK

Base Top Face Tension - Case 2

Maximum Tensile Stress	M 11.214, h 225, f_{cu} 35, Permissible 1.03 N/mm ²	1.33 N/mm ²	Warning
Shear Capacity Check	F 11.3 kN, v_c 0.350 N/mm ² , F _{vr} 39.4 kN	0.29	OK

Base Bottom Steel Design - Case 6

Steel Provided (Cover)	Main H10@200 (50 mm) Dist. H10@200 (60 mm)	393 mm ²	OK
Leverarm $z=fn(d,b,As,f_y,F_{ck})$	170 mm, 1000 mm, 393 mm ² , 500 N/mm ² , 28 N/mm ²	162 mm	
$M_r=fn(\text{above}, x, x/d)$	13 mm, 0.08	27.6 kN.m	
Moment Capacity Check (M/M _r)	M 2.1 kN.m, M _r 27.6 kN.m	0.076	OK
Shear Capacity Check	F 9.7 kN, v_c 0.524 N/mm ² , F _{vr} 89.1 kN	0.11	OK

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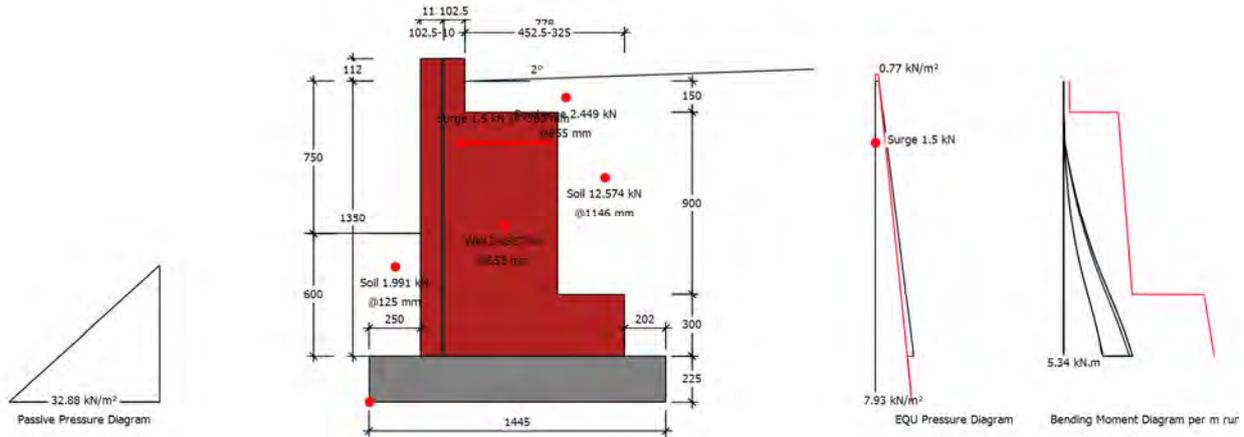
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Job Ref : QD 1776
Sheet : M - /003
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Date : 19 June 2025 / Ver. 2024.13.20
Checked : D.R.
Approved :

MasterKey : Retaining Wall Design to EC 7 : 2004, BS EN 1996-1-1:2005+A1:2012 and EC 2 : 2004 700 Retained

Reinforced Masonry Cavity Filled Retaining Wall with Reinforced Concrete Base



Summary of Design Data

EC 7 National Annex	UK
EC6 National Annex	UK
Notes	All dimensions are in mm and all forces are per metre run
Material Densities (kN/m³)	Soil 18.00, Concrete 24.00, Masonry 18.00
Angles	Embankment 2°
Concrete grade	C28/35 N/mm², Permissible tensile stress 1.033 N/mm²
Concrete covers (mm)	Cavity inner cover 30 mm, Cavity outer cover -20 mm, Base cover 50 mm
Reinforcement design	fy 500 N/mm², fyt 500 N/mm² designed to EC 2: 2004
Surcharge and Water Table	Surcharge 2.50 kN/m², Fully drained
Unplanned excavation depth	Front of wall 158 mm
† The Engineer must satisfy him/herself to the reinforcement detailing requirements of the relevant codes of practice	

Additional Loads

Horizontal Surge	1.5 kN acting @ -300 mm above the top edge of the wall
† Dimensions	

Soil Properties

Bearing pressure	Ultimate resistance M1 @ front 60.00 kN/m², @ back 60.00 kN/m² Ultimate resistance M2 @ front 60.00 kN/m², @ back 60.00 kN/m²
EC7 EQU - Wall Stability	
Back Soil Friction and Cohesion	$\phi = \text{Atn}(\text{Tan}(35)/1.1) = 32.48^\circ$
Base Friction and Cohesion	$\delta = \text{Atn}(1 \times \text{Tan}(\text{Atn}(\text{Tan}(30)/1.1))) = 27.69^\circ$
Front Soil Friction and Cohesion	$\phi = \text{Atn}(\text{Tan}(30)/1.1) = 27.69^\circ$
EC7 GEO/STR - M1	
Back Soil Friction and Cohesion	$\phi = \text{Atn}(\text{Tan}(35)/1) = 35^\circ$
Base Friction and Cohesion	$\delta = \text{Atn}(1 \times \text{Tan}(\text{Atn}(\text{Tan}(30)/1))) = 30^\circ$
Front Soil Friction and Cohesion	$\phi = \text{Atn}(\text{Tan}(30)/1) = 30^\circ$
EC7 GEO/STR - M2	
Back Soil Friction and Cohesion	$\phi = \text{Atn}(\text{Tan}(35)/1.25) = 29.26^\circ$
Base Friction and Cohesion	$\delta = \text{Atn}(1 \times \text{Tan}(\text{Atn}(\text{Tan}(30)/1.25))) = 24.79^\circ$
Front Soil Friction and Cohesion	$\phi = \text{Atn}(\text{Tan}(30)/1.25) = 24.79^\circ$

Loading Cases EQU and GEO/STR - Design Approach 1

G_{Soil} - Soil Self Weight, G_{Wall} - Wall & Base Self Weight, F_{VHeel} - Vertical Loads over Heel,	
P_a - Active Earth Pressure, $P_{\text{surcharge}}$ - Earth pressure from surcharge,	
$P_{\text{surch}}(\text{fav})$ - Earth pressure from surcharge (no load over heel), P_p - Passive Earth Pressure	
Case 1: EQU Wall Stability	$0.90 G_{\text{Soil}} + 0.90 G_{\text{Wall}} + 1.10 P_a + 1.50 P_{\text{surcharge}} + 0.90 P_p$
Case 2: GEO/STR A1+M1 I	$1.00 G_{\text{Soil}} + 1.00 G_{\text{Wall}} + 1.50 F_{\text{VHeel}} + 1.35 P_a + 1.50 P_{\text{surcharge}} + 1.00 P_p$
Case 3: GEO/STR A2+M2 I	$1.00 G_{\text{Soil}} + 1.00 G_{\text{Wall}} + 1.30 F_{\text{VHeel}} + 1.00 P_a + 1.30 P_{\text{surcharge}} + 1.00 P_p$
Case 4: GEO/STR A1+M1 II	$1.00 G_{\text{Soil}} + 1.00 G_{\text{Wall}} + 1.35 P_a + 1.50 P_{\text{surch}}(\text{fav}) + 1.00 P_p$
Case 5: GEO/STR A2+M2 II	$1.00 G_{\text{Soil}} + 1.00 G_{\text{Wall}} + 1.00 P_a + 1.30 P_{\text{surch}}(\text{fav}) + 1.00 P_p$
Case 6: GEO/STR A1+M1 III	$1.35 G_{\text{Soil}} + 1.35 G_{\text{Wall}} + 1.50 F_{\text{VHeel}} + 1.35 P_a + 1.50 P_{\text{surcharge}} + 1.00 P_p$

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Job Ref : QD 1776
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Made by : D.J.P.
Date : 19 June 2025 / Ver. 2024.13.20
Checked : D.R.
Approved :

Geotechnical Design**Wall Stability - Virtual Back Pressure**

Case 1 Overturning/Stabilising	7.613/27.649	0.275	OK
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Wall Sliding - Virtual Back Pressure

Case 2 $F_x/(R_x F_{\text{Friction}} + R_x P_{\text{Passive}})$	10.740/(23.273+12.048)	0.304	OK
Case 3 $F_x/(R_x F_{\text{Friction}} + R_x P_{\text{Passive}})$	10.311/(18.572-9.816)	0.363	OK
Case 4 $F_x/(R_x F_{\text{Friction}} + R_x P_{\text{Passive}})$	10.740/(22.836+12.048)	0.308	OK
Case 5 $F_x/(R_x F_{\text{Friction}} + R_x P_{\text{Passive}})$	10.311/(18.269-9.816)	0.367	OK
Case 6 $F_x/(R_x F_{\text{Friction}} + R_x P_{\text{Passive}})$	10.740/(31.266+12.048)	0.248	OK

Soil Pressure

Case 2 - Virtual Back	30.215/60 kN/m ² , Length under pressure 1.334 m	0.504	OK
Case 3 - Virtual Back	30.315/60 kN/m ² , Length under pressure 1.326 m	0.505	OK
Case 4 - Virtual Back	30.235/60 kN/m ² , Length under pressure 1.308 m	0.504	OK
Case 5 - Virtual Back	30.337/60 kN/m ² , Length under pressure 1.304 m	0.506	OK
Case 6 - Virtual Back	38.857/60 kN/m ² , Length under pressure 1.394 m	0.648	OK
Case 2 - Wall Back	31.109/60 kN/m ² , Length under pressure 1.296 m	0.518	OK
Case 3 - Wall Back	31.103/60 kN/m ² , Length under pressure 1.293 m	0.518	OK
Case 4 - Wall Back	27.968/60 kN/m ² , Length under pressure 1.414 m	0.466	OK
Case 5 - Wall Back	28.346/60 kN/m ² , Length under pressure 1.395 m	0.472	OK
Case 6 - Wall Back	39.670/60 kN/m ² , Length under pressure 1.365 m	0.661	OK

Structural Design**Outer Leaf Details**

Partial Safety Factor (γ_{mc}/γ_{mf})	Units Category I, Execution Control Class 2	2.7/2.7	Table NA.1
Material	Clay bricks with water absorption between 7% and 12%		
Units and Mortar Strength	20 N/mm ² , Mortar designation M12/(i)		
Compressive Strength (f_k)	Group 1, $\gamma=18$ kN/m ³	8.58 N/mm ²	Table NA.6

Inner Leaf Details

Partial Safety Factor (γ_{mc}/γ_{mf})	Units Category I, Execution Control Class 2	2.7/2.7	Table NA.1
Material	Concrete blocks, $\gamma=18$ kN/m ³		
Units and Mortar Strength	7.3 N/mm ² , Mortar designation M12/(i)		
Blocks Ratio	Unit height=215, Least horizontal dimensions=100	2.15	
Compressive Strength (f_k)	Group 1	5.48 N/mm ²	Table NA.6

Wall Design (Inner Face Tension)

Critical Section	Critical @ 301 mm from base, Case 2		
Section Properties @ 301 mm	$t=667$ mm, Area=6675 cm ² , $Z_b=74259$ cm ³		
Flexural Strength f_{xk1}	$f_{xk1}=0.15$, $gd=0.018$ N/mm ² , $f_{xk1}=f_{xk1}+0.9$ $gd \cdot \gamma_{mf}$	0.193 N/mm ²	Table NA.6
$M_r=f_{xk1} \cdot Z_b/\gamma_{mf}$	0.193x74259/2.7	5.31 kN.m	
Moment Capacity Check (M/M _r)	M 3.6 kN.m, M _r 5.3 kN.m	0.670	OK
Shear Capacity Check	F 6.6 kN, $f_{vk}0.207$ N/mm ² , F _v 55.3 kN	0.12	OK

Base Top Face Tension - Case 2

Maximum Tensile Stress	M 4.824, h 225, f_{cu} 35, Permissible 1.03 N/mm ²	0.57 N/mm ²	OK
Shear Capacity Check	F 5.2 kN, v_c 0.350 N/mm ² , F _v 39.4 kN	0.13	OK

Base Bottom Steel Design - Case 6

Steel Provided (Cover)	Main H10@200 (50 mm) Dist. H10@200 (60 mm)	393 mm ²	OK
Leverarm $z=fn(d,b,As,f_y,F_{ck})$	170 mm, 1000 mm, 393 mm ² , 500 N/mm ² , 28 N/mm ²	162 mm	
$M_r=fn(\text{above}, x, x/d)$	13 mm, 0.08	27.6 kN.m	
Moment Capacity Check (M/M _r)	M 1.2 kN.m, M _r 27.6 kN.m	0.043	OK
Shear Capacity Check	F 5.4 kN, v_c 0.524 N/mm ² , F _v 89.1 kN	0.06	OK

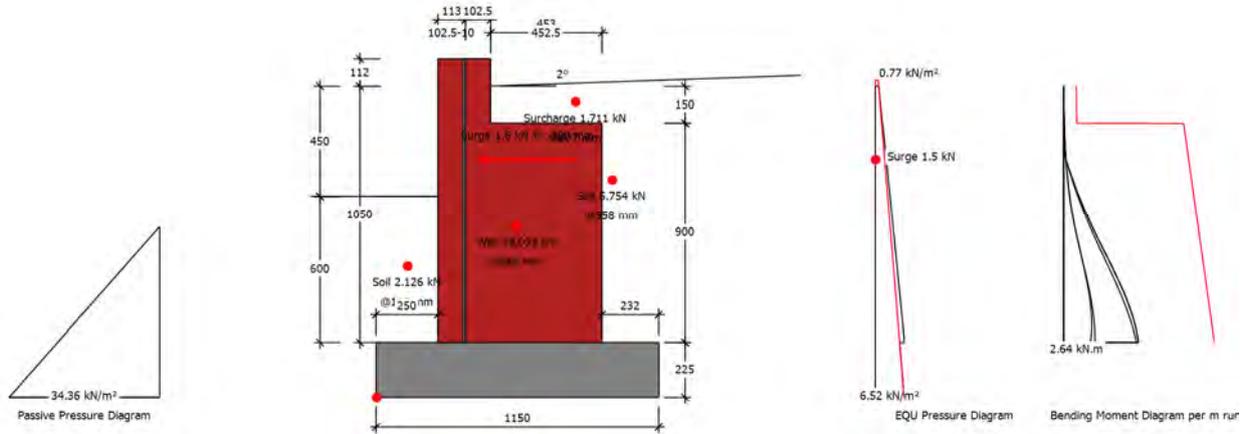
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Sheet : M - /005
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Approved :

MasterKey : Retaining Wall Design to EC 7 : 2004, BS EN 1996-1-1:2005+A1:2012 and EC 2 : 2004 450 Retained Reinforced Masonry Cavity Filled Retaining Wall with Reinforced Concrete Base



Summary of Design Data

EC 7 National Annex	UK
EC6 National Annex	UK
Notes	All dimensions are in mm and all forces are per metre run
Material Densities (kN/m³)	Soil 18.00, Concrete 24.00, Masonry 18.00
Angles	Embankment 2°
Concrete grade	C28/35 N/mm², Permissible tensile stress 1.033 N/mm²
Concrete covers (mm)	Cavity inner cover 30 mm, Cavity outer cover -20 mm, Base cover 50 mm
Reinforcement design	fy 500 N/mm², fyb 500 N/mm² designed to EC 2: 2004
Surcharge and Water Table	Surcharge 2.50 kN/m², Fully drained
Unplanned excavation depth	Front of wall 128 mm
† The Engineer must satisfy him/herself to the reinforcement detailing requirements of the relevant codes of practice	

Additional Loads

Horizontal Surge	1.5 kN acting @ -300 mm above the top edge of the wall
† Dimensions	

Soil Properties

Bearing pressure	Ultimate resistance M1 @ front 60.00 kN/m², @ back 60.00 kN/m² Ultimate resistance M2 @ front 60.00 kN/m², @ back 60.00 kN/m²
EC7 EQU - Wall Stability	
Back Soil Friction and Cohesion	$\delta = \text{Atn}(\text{Tan}(35)/1.1) = 32.48^\circ$
Base Friction and Cohesion	$\delta = \text{Atn}(1 \times \text{Tan}(\text{Atn}(\text{Tan}(30)/1.1))) = 27.69^\circ$
Front Soil Friction and Cohesion	$\phi = \text{Atn}(\text{Tan}(30)/1.1) = 27.69^\circ$
EC7 GEO/STR - M1	
Back Soil Friction and Cohesion	$\delta = \text{Atn}(\text{Tan}(35)/1) = 35^\circ$
Base Friction and Cohesion	$\delta = \text{Atn}(1 \times \text{Tan}(\text{Atn}(\text{Tan}(30)/1))) = 30^\circ$
Front Soil Friction and Cohesion	$\phi = \text{Atn}(\text{Tan}(30)/1) = 30^\circ$
EC7 GEO/STR - M2	
Back Soil Friction and Cohesion	$\delta = \text{Atn}(\text{Tan}(35)/1.25) = 29.26^\circ$
Base Friction and Cohesion	$\delta = \text{Atn}(1 \times \text{Tan}(\text{Atn}(\text{Tan}(30)/1.25))) = 24.79^\circ$
Front Soil Friction and Cohesion	$\phi = \text{Atn}(\text{Tan}(30)/1.25) = 24.79^\circ$

Loading Cases EQU and GEO/STR - Design Approach 1

G _{Soil} - Soil Self Weight, G _{Wall} - Wall & Base Self Weight, F _{VHeel} - Vertical Loads over Heel,	
P _a - Active Earth Pressure, P _{Surcharge} - Earth pressure from surcharge,	
P _{Surch(fav)} - Earth pressure from surcharge (no load over heel), P _P - Passive Earth Pressure	
Case 1: EQU Wall Stability	0.90 G _{Soil} +0.90 G _{Wall} +1.10 P _a +1.50 P _{Surcharge} +0.90 P _P
Case 2: GEO/STR A1+M1 I	1.00 G _{Soil} +1.00 G _{Wall} +1.50 F _{VHeel} +1.35 P _a +1.50 P _{Surcharge} +1.00 P _P
Case 3: GEO/STR A2+M2 I	1.00 G _{Soil} +1.00 G _{Wall} +1.30 F _{VHeel} +1.00 P _a +1.30 P _{Surcharge} +1.00 P _P
Case 4: GEO/STR A1+M1 II	1.00 G _{Soil} +1.00 G _{Wall} +1.35 P _a +1.50 P _{Surch(fav)} +1.00 P _P
Case 5: GEO/STR A2+M2 II	1.00 G _{Soil} +1.00 G _{Wall} +1.00 P _a +1.30 P _{Surch(fav)} +1.00 P _P
Case 6: GEO/STR A1+M1 III	1.35 G _{Soil} +1.35 G _{Wall} +1.50 F _{VHeel} +1.35 P _a +1.50 P _{Surcharge} +1.00 P _P

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Date : 19 June 2025 / Ver. 2024.13.20
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Geotechnical Design**Wall Stability - Virtual Back Pressure**

Case 1 Overturning/Stabilising	4.842/14.152	0.342	OK
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Wall Sliding - Virtual Back Pressure

Case 2 $F_x/(R_{x\text{Friction}} + R_{x\text{Passive}})$	7.995/(15.465+13.155)	0.279	OK
Case 3 $F_x/(R_{x\text{Friction}} + R_{x\text{Passive}})$	7.637/(12.318+10.718)	0.332	OK
Case 4 $F_x/(R_{x\text{Friction}} + R_{x\text{Passive}})$	7.995/(14.962+13.155)	0.284	OK
Case 5 $F_x/(R_{x\text{Friction}} + R_{x\text{Passive}})$	7.637/(11.970+10.718)	0.337	OK
Case 6 $F_x/(R_{x\text{Friction}} + R_{x\text{Passive}})$	7.995/(20.701+13.155)	0.236	OK

Soil Pressure

Case 2 - Virtual Back	23.807/60 kN/m ² , Length under pressure 1.125 m	0.397	OK
Case 3 - Virtual Back	24.243/60 kN/m ² , Length under pressure 1.1 m	0.404	OK
Case 4 - Virtual Back	23.700/60 kN/m ² , Length under pressure 1.093 m	0.395	OK
Case 5 - Virtual Back	24.176/60 kN/m ² , Length under pressure 1.072 m	0.403	OK
Case 6 - Virtual Back	31.301/60 kN/m ² , Length under pressure 1.146 m	0.522	OK
Case 2 - Wall Back	24.538/60 kN/m ² , Length under pressure 1.092 m	0.409	OK
Case 3 - Wall Back	24.915/60 kN/m ² , Length under pressure 1.07 m	0.415	OK
Case 4 - Wall Back	24.201/60 kN/m ² , Length under pressure 1.071 m	0.403	OK
Case 5 - Wall Back	23.331/60 kN/m ² , Length under pressure 1.111 m	0.389	OK
Case 6 - Wall Back	31.775/60 kN/m ² , Length under pressure 1.128 m	0.530	OK

Structural Design**Outer Leaf Details**

Partial Safety Factor (γ_{mc}/γ_{mf})	Units Category I, Execution Control Class 2	2.7/2.7	Table NA.1
Material	Clay bricks with water absorption between 7% and 12%		
Units and Mortar Strength	20 N/mm ² , Mortar designation M6/(ii)		
Compressive Strength (f_k)	Group 1, $\gamma=18$ kN/m ³	6.97 N/mm ²	Table NA.6

Inner Leaf Details

Partial Safety Factor (γ_{mc}/γ_{mf})	Units Category I, Execution Control Class 2	2.7/2.7	Table NA.1
Material	Concrete blocks, $\gamma=18$ kN/m ³		
Units and Mortar Strength	7.3 N/mm ² , Mortar designation M6/(ii)		
Blocks Ratio	Unit height=215, Least horizontal dimensions=100	2.15	
Compressive Strength (f_k)	Group 1	5.16 N/mm ²	Table NA.6

Wall Design (Inner Face Tension)

Critical Section	Critical @ 0 mm from base, Case 2		
Section Properties @ Base	$t=668$ mm, Area=6675 cm ² , $Z_b=74259$ cm ³		
Flexural Strength f_{xk1}	$f_{xk1}=0.15$, $gd=0.018$ N/mm ² , $f_{xk1}=f_{xk1}+0.9$ $gd \cdot \gamma_{mf}$	0.193 N/mm ²	Table NA.6
$M_r=f_{xk1} \cdot Z_b/\gamma_{mf}$	0.193x74259/2.7	5.31 kN.m	
Moment Capacity Check (M/M _r)	M 2.6 kN.m, M _r 5.3 kN.m	0.496	OK
Shear Capacity Check	F 1.1 kN, $f_{vk}0.157$ N/mm ² , F _{vr} 42.0 kN	0.03	OK

Base Top Face Tension - Case 3

Maximum Tensile Stress	M 1.891, h 225, f_{cu} 35, Permissible 1.03 N/mm ²	0.22 N/mm ²	OK
Shear Capacity Check	F 2.9 kN, v_c 0.350 N/mm ² , F _{vr} 39.4 kN	0.07	OK

Base Bottom Steel Design - Case 6

Steel Provided (Cover)	Main H10@200 (50 mm) Dist. H10@200 (60 mm)	393 mm ²	OK
Leverarm $z=fn(d,b,As,f_y,F_{ck})$	170 mm, 1000 mm, 393 mm ² , 500 N/mm ² , 28 N/mm ²	162 mm	
$M_r=fn(\text{above}, x, x/d)$	13 mm, 0.08	27.6 kN.m	
Moment Capacity Check (M/M _r)	M 0.7 kN.m, M _r 27.6 kN.m	0.025	OK
Shear Capacity Check	F 3.2 kN, v_c 0.524 N/mm ² , F _{vr} 89.1 kN	0.04	OK

APPENDIX C:

Design & Check Certificate

Name of Project Strata - Westgate, Cleckheaton
Name of Structure Masonry 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 Masonry 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](#)
[QD1776-14-11 – Masonry Retaining Wall Sections \(Sheet 1 of 4\) Rev -](#)
[QD1776-14-12 – Masonry Retaining Wall Sections \(Sheet 2 of 4\) Rev –](#)
Retaining Wall Calculations

Signed



Name D. J. Phillipson
Design Team Leader

Engineering Qualifications BEng(Hons), CEng, MStructE.

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

**DESIGN AND CHECK CERTIFICATE
(Highway Structures/Road or Service Tunnels)**

**Westgate, Cleckheaton
Masonry Retaining Walls**

The certificate is accepted by the TAA

Signed	_____
Name	_____
Position held	_____
Engineering Qualifications	_____
TAA	_____
Date	_____