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STRUCTURAL CALCULATIONS

for

Highway Retaining Wall

Client:	**Connect Housing**
Site Address:	**Chapelgate** **Scholes**
Project Number:	**22055**
Reference (Revision):	**22055-DCE-XX-XX-T-S-001-C01**
Date:	**November 2025**

Author: .... Date: Nov. 2025

Checker: .... Date: Nov. 2025

Job No.	22055	Sheet No.	i
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PROJECT TITLE	Chapelgate, Scholes
CLIENT	Connect Housing
ARCHITECT	GWP Architecture

DESIGN PHILOSOPHY:

The proposed residential development in Scholes consists of 10No. new properties on a site that was formerly a quarry. Rock is very shallow across site and therefore following a site investigation a safe bearing pressure of 250kN/m^2 has provided.

Due to the levels on site, small retaining walls are required of which one wall supports the highway. Details have been provided to Kirklees Council and as the wall is to remain private, they have confirmed the highway retaining wall will be subject to a Category 0 check.

This document provides the design calculations for the highway retaining wall which requires technical approval from Kirklees Council. Included in this document is a risk assessment on the vehicle restraint system which identifies the risk as low. We have however provided an extension of the concrete retaining wall stem to act as a vehicle barrier.

The retaining wall designs considers the following:

- Unplanned excavations
- At rest earth pressures
- A temporary surcharge during construction of 10kN/m^2 with a permanent/final surcharge of 15kN/m^2 in accordance with Table 5 in PD6694-1:2011 (normal highway traffic at a distance of 2m away.
- Wind loading on the vehicle barrier

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CODES OF PRACTICE

Loading Codes:	Dead and Imposed Loads	BS EN 1991-1-1
	Roof Loads	BS EN 1991-1-3
	Wind Loads	BS EN 1991-1-4
Building Regulations and Codes of Practice:	General	Current Building Regulations
	Steelwork	BS EN 1993
	Reinforced Concrete	BS EN 1992
	Masonry	BS EN 1996
	Timber	BS EN 1995
	Foundations	BS EN 1997
Materials:	Concrete	Grade C28/35
	Reinforcement	f_Y= 500 N/mm^2
	Structural Steel	S355
	Structural Steel Execution Class	EXC2
	Brickwork	20N/mm^2 Clay; (iii) Mortar M4
	Blockwork	Min. 7N/mm^2; (iii) Mortar M4
	Timber	Min. C16
Fire Resistance:	N/A	
Exposure Conditions:	Site altitude 239m	
Subsoil Conditions, Bearing Pressure and Foundation Type:	Sandstone found at very shallow depths across site. Safe bearing pressure of 250kN/m^2.	
Other relevant information, data given, etc:		

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Road Restraint System Risk Assessment

Factor	Priority Rank	Risk Factor Score
Location	0 – All other roads	0
Layout	2 – Situation does not sit strictly in the standard categories in terms of horizontal and vertical alignment. So, this risk score has been applied by independent judgement as Two steps below desirable minimum R with superelevation of 5% 0 – No reason for lane changing/manoeuvres	2
Collision	2 – Longitudinal hazard this is likely to be reached resulting in harm. 0 – Percentage of KSI for primary hazard = <20%	2
Consequential	0 – No secondary event likely 0 – No impact on network availability 0 – No significant cost implications	0
	Total Priority Score	**4**

The risk ranking score is 4 which is considered a 'lower priority' classification however, a vehicle restraint system will be provided in the form of extending the retaining wall stem.

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Highway Retaining Wall				1	
Calcs by	Calcs date	Checked by	Checked date	Approved by	Approved date
KL	17/11/2025	PD			

CONCRETE SPECIFICATION

In accordance with BS8500-1:2015 + A2:2019 incorporating corrigenda No.1 and No.2

Tedds calculation version 1.1.01

Element definition

Element description	Highway Retaining Wall Concrete Spec.
Intended working life	At least 100 years
Type of concrete	Reinforced, normal weight
Maximum aggregate size	20 mm
Allowance for deviation between minimum and nominal covers	
	Δc_{dev} = **10** mm
Allowance for deviation (XA class)	Δc_{dev_s} = **15** mm

Exposure classes

Corrosion induced by carbonation (XC classes) - Table A.1

Class description	Wet, rarely dry
Class designation	XC2

Chemical attack (XA classes) - Table A.10

ACEC class	AC-4
Section width	t = **250** mm
Hydraulic gradient (note B)	Less than or equal to 5
Design chemical class	DC-4(1 No. additional protective measures required)
	The APM should be one from APM2 to APM5.

Concrete requirements and specification

Consistence class	S3

Minimum allowable nominal covers

For exposure class XC2 - Table A.5	35 mm
For design chemical class DC-4 - Table A.10	40 mm
Specified nominal cover	40 mm

PASS - The specified nominal cover is adequate

Minimum strength class with 40 mm cover

For exposure class XC2 - Table A.5	C25/30
For design chemical class DC-4 - Table A.12	C25/30
Specified strength class	C28/35

PASS - The specified strength class is adequate

Maximum water/cement ratio with 40 mm cover, 20 mm aggregate and C28/35 concrete

For exposure class XC2 - Table A.5	0.65
For design chemical class DC-4 - Table A.12	0.45
Specified maximum water/cement ratio	0.45

PASS - The specified maximum water cement ratio is acceptable

Minimum cement content with 40 mm cover and C28/35 concrete

For exposure class XC2 - Table A.5	260 kg/m^3
For design chemical class DC-4 - Table A.12	360 kg/m^3
For water/cement ratio of 0.45 - Table A.7	340 kg/m^3
Specified minimum cement content	360 kg/m^3

PASS - The specified minimum cement content is adequate

Recommended cements/combinations with 40 mm cover and C28/35 concrete

For exposure class XC2 - Table A.5	All in Table A.6
For design chemical class DC-4 - Table A.12	IIIB + SR
Recommended cement/combinations types	IIIB + SR

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KL	17/11/2025	PD			

Designed concrete specification for Highway Retaining Wall Concrete Spec. with 40 mm cover

The concrete shall be produced in accordance with BS8500-2.

Compressive strength class	C28/35
Maximum water/cement ratio	0.45
Minimum cement/combination content	360 kg/m^3
Recommended cement/combinations types	IIIB + SR (DC-4)
Maximum aggregate size	20 mm
Chloride content class	Cl 0, 40
Consistence class	S3

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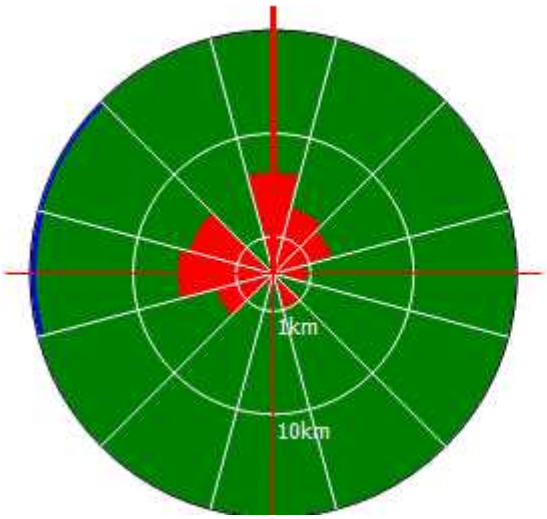
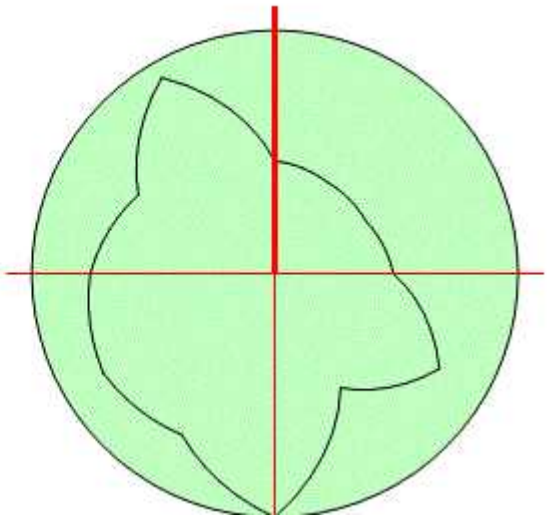
Wind Loading to EN 1991-1-4 UK/Irish NA
Results for site at SE158071 - Altitude 254 m
Wind Reference 1
Using SCIPHYR Wind Analysis Detailed Method





Site Basic Data

Location	Oak Scar Lane, Paris, Holme Valley, Scholes, Kirklees, West Yorkshire, England, HD9 1SQ, United Kingdom
Base wind speed	Base wind speed, Vb,map 22.45 m/s
Site Range	239 m
Altitude and Obstructions	Site altitude 254 m - Shelter effect from obstructions is included
Topographic Increments	Topographic increment from internal parameters
Seasonal factor, Cseason	Season length is All year - Seasonal factor, Cseason 1.000
Annual risk and probability factor	Design annual risk 0.00833333333333333 - Probability factor, Cprob 1.048
Heights (m)	Heights above ground 3
Building height, h (m)	For 0.6 h limit on h_{dis} - Taken from maximum height value

Direction Factors - Using UK direction Factors

Direction (°N)	0	30	60	90	120	150	180	210	240	270	300	330
Direction factor, Sd	0.78	0.73	0.73	0.74	0.73	0.80	0.85	0.93	1.00	0.99	0.91	0.82

Topography

Crest Height (m)	62.3	59.5	0.0	43.0	27.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Site Location (m)	-45.0	0.0	0.0	95.0	120.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Upwind Length (m)	889.0	892.0	0.0	410.0	360.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Downwind Length (m)	400.0	100.0	0.0	1100.0	1800.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Base Altitude (m)	186.7	192.6	0.0	206.0	222.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Upwind Slope	0.1	0.1	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Terrain Roughness

Distance to Sea (km)	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	86.3	90.0	100.0
Distance in Town (km)	4.1	2.0	1.7	0.9	0.0	1.0	0.0	0.6	1.6	3.6	3.0	0.0

Obstructions

Obstructions Height, Ho (m)	10.0	10.0	10.0	10.0	0.0	10.0	0.0	10.0	5.0	5.0	5.0	0.0
Obstructions Spacing, Xo (m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	20.0	20.0	20.0	0.0

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Calculation Results

Height Above Ground = 3 m

Direction (°N)	0	30	60	90	120	150	180	210	240	270	300	330
Altitude factor, Calt	1.187	1.193	1.254	1.206	1.222	1.254	1.254	1.254	1.254	1.254	1.254	1.254
Basic wind speed, Vb (m/s)	21.8	20.5	21.5	21.0	21.0	23.6	25.1	27.4	29.5	29.2	26.9	24.2
Effective height, He (m)	1.20	1.20	1.20	1.20	3.00	1.20	3.00	1.20	1.20	1.20	1.20	3.00
Displacement height, Hdis (m)	1.80	1.80	1.80	1.80	0.00	1.80	0.00	1.80	1.80	1.80	1.80	0.00
Orography factor, Co	1.123	1.134	1.000	1.142	1.090	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Exposure factor, Ce	1.407	1.407	1.407	1.407	1.618	1.407	1.618	1.407	1.407	1.412	1.411	1.618
Exposure adjustment factor, CeT	0.636	0.666	0.674	0.708	1.000	0.702	1.000	0.734	0.677	0.641	0.649	1.000
Roughness factor, Cr	0.724	0.724	0.724	0.724	0.794	0.724	0.794	0.724	0.724	0.725	0.725	0.794
Rough. Correction, CrT	0.573	0.586	0.589	0.604	1.000	0.601	1.000	0.615	0.591	0.575	0.578	1.000
Dynamic Pressure, qp(z) (N/m²)	289.4	270.4	269.9	304.1	487.6	337.6	624.2	477.0	508.7	474.1	404.6	580.9

Net pressure coefficient (free standing walls)
Zone B - $c_{p,net,B}$ = 1.8 (BS EN 1991-1-4 Table 7.9

Zone A ignored due to relatively narrow width and at one end is a buttressing wall and the other end the retain diminishes to nothing.

Max net wind pressure
$W_{net} = q_p(z) \cdot c_{p,net,B} = 0.624\ kN/m^2 \cdot 1.8 = 1.12\ kN/m^2$

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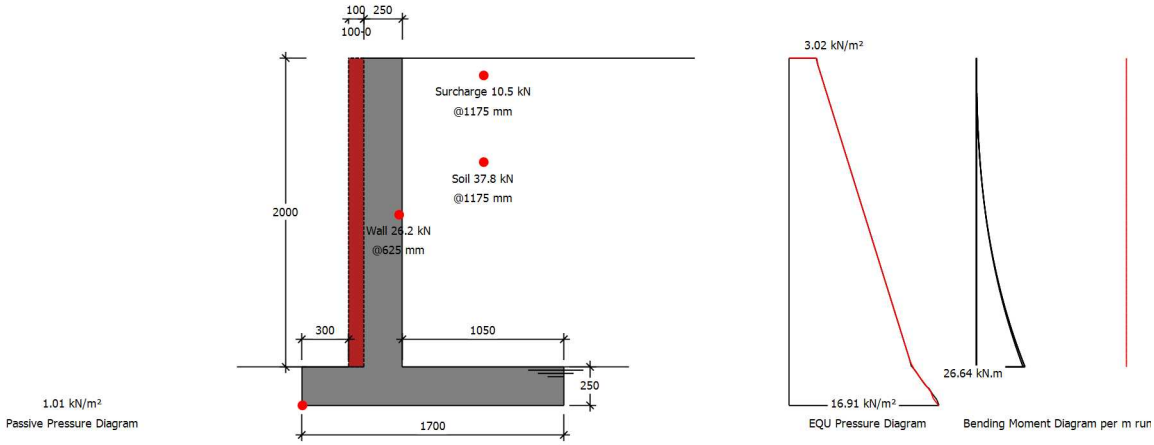
MasterKey : Retaining Wall Design to EC 7 : 2004 and EC 2 : 2004
1.7m Retain (Highways) No Loads
Reinforced Concrete Retaining Wall with External Cladding with Reinforced Base



Summary of Design Data

EC2, EC7 National Annex	UK
EC6 National Annex	UK
Notes	All dimensions are in mm and all forces are per metre run
Material Densities (kN/m³)	Dry Soil 18.00, Saturated Soil 20.80, Submerged Soil 10.80 Concrete 24.00, Cladding 20.00
Special Assumptions (virtual back)	Use δ =0 @ virtual back
Concrete grade	C28/35 N/mm², Permissible tensile stress 1.033 N/mm²
Concrete covers (mm)	Wall inner cover 40 mm, Wall outer cover 40 mm, Base cover 40 mm
Reinforcement design	fy 500 N/mm² designed to EC 2: 2004
Surcharge and Water Table	Surcharge 10.00 kN/m², Water table level 0 mm
Unplanned excavation depth	Front of wall 225 mm

† The Engineer must satisfy him/herself to the reinforcement detailing requirements of the relevant codes of practice

Soil Properties

Bearing pressure	Ultimate resistance M1 @ front 250.00 kN/m², @ back 250.00 kN/m² Ultimate resistance M2 @ front 250.00 kN/m², @ back 250.00 kN/m²
EC7 EQU - Wall Stability	
Back Soil Friction and Cohesion	ϕ_b = Atn(Tan(35)/1.1) = 32.48°
Base Friction and Cohesion	δ = Atn(1xTan(Atn(Tan(30)/1.1))) = 27.69°
Front Soil Friction and Cohesion	ϕ = Atn(Tan(30)/1.1) = 27.69°
EC7 GEO/STR - M1	
Back Soil Friction and Cohesion	ϕ_b = Atn(Tan(35)/1) = 35°
Base Friction and Cohesion	δ = Atn(1xTan(Atn(Tan(30)/1))) = 30°
Front Soil Friction and Cohesion	ϕ = Atn(Tan(30)/1) = 30°
EC7 GEO/STR - M2	
Back Soil Friction and Cohesion	ϕ_b = Atn(Tan(35)/1.25) = 29.26°
Base Friction and Cohesion	δ = Atn(1xTan(Atn(Tan(30)/1.25))) = 24.79°
Front Soil Friction and Cohesion	ϕ = Atn(Tan(30)/1.25) = 24.79°

Loading Cases EQU and GEO/STR - Design Approach 1

G_{Soil}- Soil Self Weight, G_{Wall}- Wall & Base Self Weight, Fv_{Heel}- 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 Fv_{Heel}+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 Fv_{Heel}+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 Fv_{Heel}+1.35 P_a+1.50 $P_{surcharge}$+1.00 P_p
Case 7: Service Base Pressure Check	1.00 G_{Soil}+1.00 G_{Wall}+1.00 Fv_{Heel}+1.00 P_a+1.00 $P_{surcharge}$+1.00 P_p

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Geotechnical Design

Wall Stability - Virtual Back Pressure

Case 1 Overturning/Stabilising	22.819/54.706	0.417	OK

Wall Sliding - Virtual Back Pressure

Case 2 $Fx/(Rx_{Friction}+ Rx_{Passive})$	26.155/(46.044+0.014)	0.568	OK
Case 3 $Fx/(Rx_{Friction}+ Rx_{Passive})$	25.926/(35.865+0.012)	0.723	OK
Case 4 $Fx/(Rx_{Friction}+ Rx_{Passive})$	26.155/(36.950+0.014)	0.708	OK
Case 5 $Fx/(Rx_{Friction}+ Rx_{Passive})$	25.926/(29.560+0.012)	0.877	OK
Case 6 $Fx/(Rx_{Friction}+ Rx_{Passive})$	26.155/(58.976+0.014)	0.443	OK

Soil Pressure

Case 2 - Virtual Back	56.359/250 kN/m², Length under pressure 1.415 m	0.225	OK
Case 3 - Virtual Back	56.110/250 kN/m², Length under pressure 1.384 m	0.224	OK
Case 4 - Virtual Back	54.011/250 kN/m², Length under pressure 1.185 m	0.216	OK
Case 5 - Virtual Back	54.337/250 kN/m², Length under pressure 1.178 m	0.217	OK
Case 6 - Virtual Back	67.147/250 kN/m², Length under pressure 1.521 m	0.269	OK
Case 7 - Virtual Back SLS (No uplift)	Max(57.066 / (250 / 3), 30.581/ (250 / 3)) kN/m²	0.685	OK
Case 2 - Wall Back	56.316/250 kN/m², Length under pressure 1.416 m	0.225	OK
Case 3 - Wall Back	56.073/250 kN/m², Length under pressure 1.385 m	0.224	OK
Case 4 - Wall Back	53.949/250 kN/m², Length under pressure 1.186 m	0.216	OK
Case 5 - Wall Back	54.286/250 kN/m², Length under pressure 1.179 m	0.217	OK
Case 6 - Wall Back	67.110/250 kN/m², Length under pressure 1.522 m	0.268	OK
Case 7 - Wall Back SLS (No uplift)	Max(57.003 / (250 / 3), 30.644/ (250 / 3)) kN/m²	0.684	OK

Structural Design

At Rest Earth Pressure

At rest earth pressures magnification	$(1+\text{Sin}(\phi)) \times \sqrt{OCR} = (1+\text{Sin}(29.26))\times\sqrt{1}$	1.49

Cladding Details

Partial Safety Factor ($\gamma mc/\gamma mf$)	Units Category II, Execution Control Class 2	3/2.7	Table NA.1
Material	Clay bricks with water absorption between 7% and 12%		
Units and Mortar Strength	5 N/mm², Mortar designation M4/(iii)		
Compressive Strength (f_k)	Group 2, γ=20 kN/m³	1.87 N/mm²	Table NA.4

Wall Design (Inner Steel)

Critical Section	Critical @ 0 mm from base, Case 2		
Steel Provided (Cover)	Main H16@200 (40 mm) Dist. H10@200 (56 mm)	1005 mm²	OK
Compression Steel Provided (Cover)	Main H10@200 (40 mm) Dist. H10@200 (50 mm)	393 mm²	
Leverarm z=fn(d,b,As,fy,Fck)	202 mm, 1000 mm, 1005 mm², 500 N/mm², 28 N/mm²	188 mm	
Mr=fn(above,As',d',x,x/d)	393 mm², 45 mm, 34 mm, 0.17	82.3 kN.m	
Moment Capacity Check (M/Mr)	M 26.6 kN.m, Mr 82.3 kN.m	0.324	OK
Shear Capacity Check	F 33.5 kN, vc 0.576 N/mm², Fvr 116.4 kN	0.29	OK

Base Top Steel Design - Case 2

Steel Provided (Cover)	Main H10@200 (40 mm) Dist. H10@200 (50 mm)	393 mm²	OK
Compression Steel Provided (Cover)	Main H10@200 (40 mm) Dist. H10@200 (50 mm)	393 mm²	
Leverarm z=fn(d,b,As,fy,Fck)	205 mm, 1000 mm, 393 mm², 500 N/mm², 28 N/mm²	195 mm	
Mr=fn(above,As',d',x,x/d)	393 mm², 45 mm, 13 mm, 0.07	33.3 kN.m	
Moment Capacity Check (M/Mr)	M 24.4 kN.m, Mr 33.3 kN.m	0.733	OK
Shear Capacity Check	F 37.9 kN, vc 0.519 N/mm², Fvr 106.4 kN	0.36	OK

Base Bottom Steel Design - Case 4

Steel Provided (Cover)	Main H10@200 (40 mm) Dist. H10@200 (50 mm)	393 mm²	OK
Compression Steel Provided (Cover)	Main H10@200 (40 mm) Dist. H10@200 (50 mm)	393 mm²	
Leverarm z=fn(d,b,As,fy,Fck)	205 mm, 1000 mm, 393 mm², 500 N/mm², 28 N/mm²	195 mm	
Mr=fn(above,As',d',x,x/d)	393 mm², 45 mm, 13 mm, 0.07	33.3 kN.m	
Moment Capacity Check (M/Mr)	M 5.9 kN.m, Mr 33.3 kN.m	0.178	OK
Shear Capacity Check	F 26.5 kN, vc 0.519 N/mm², Fvr 106.4 kN	0.25	OK

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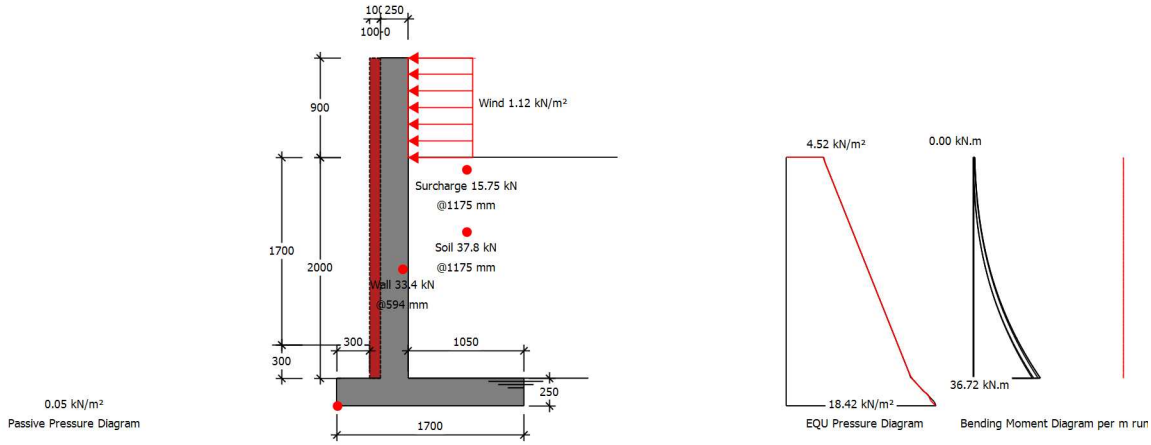
MasterKey : Retaining Wall Design to EC 7 : 2004 and EC 2 : 2004
1.7m Retain (Highways) Extended Height
Reinforced Concrete Retaining Wall with External Cladding with Reinforced Base



Summary of Design Data

EC2, EC7 National Annex	UK
EC6 National Annex	UK
Notes	All dimensions are in mm and all forces are per metre run
Material Densities (kN/m³)	Dry Soil 18.00, Saturated Soil 20.80, Submerged Soil 10.80 Concrete 24.00, Cladding 20.00
Special Assumptions (virtual back)	Use δ =0 @ virtual back
Concrete grade	C28/35 N/mm², Permissible tensile stress 1.033 N/mm²
Concrete covers (mm)	Wall inner cover 40 mm, Wall outer cover 40 mm, Base cover 40 mm
Reinforcement design	fy 500 N/mm² designed to EC 2: 2004
Surcharge and Water Table	Surcharge 15.00 kN/m², Water table level 0 mm
Unplanned excavation depth	Front of wall 550 mm

† The Engineer must satisfy him/herself to the reinforcement detailing requirements of the relevant codes of practice

Soil Properties

Bearing pressure	Ultimate resistance M1 @ front 250.00 kN/m², @ back 250.00 kN/m² Ultimate resistance M2 @ front 250.00 kN/m², @ back 250.00 kN/m²
EC7 EQU - Wall Stability	
Back Soil Friction and Cohesion	⩚ = Atn(Tan(35)/1.1) = 32.48°
Base Friction and Cohesion	δ = Atn(1xTan(Atn(Tan(30)/1.1))) = 27.69°
Front Soil Friction and Cohesion	ϕ = Atn(Tan(30)/1.1) = 27.69°
EC7 GEO/STR - M1	
Back Soil Friction and Cohesion	⩚ = Atn(Tan(35)/1) = 35°
Base Friction and Cohesion	δ = Atn(1xTan(Atn(Tan(30)/1))) = 30°
Front Soil Friction and Cohesion	ϕ = Atn(Tan(30)/1) = 30°
EC7 GEO/STR - M2	
Back Soil Friction and Cohesion	⩚ = Atn(Tan(35)/1.25) = 29.26°
Base Friction and Cohesion	δ = Atn(1xTan(Atn(Tan(30)/1.25))) = 24.79°
Front Soil Friction and Cohesion	ϕ = Atn(Tan(30)/1.25) = 24.79°

Loading Cases EQU and GEO/STR - Design Approach 1

G_{Soil}- Soil Self Weight, G_{Wall}- Wall & Base Self Weight, Fv_{Heel}- 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	$1.00\ G_{Soil}+1.00\ G_{Wall}+1.50\ Fv_{Heel}+1.35\ P_a+1.50\ P_{surcharge}+1.00\ P_p$
Case 3: GEO/STR A2+M2 I	$1.00\ G_{Soil}+1.00\ G_{Wall}+1.30\ Fv_{Heel}+1.00\ P_a+1.30\ P_{surcharge}+1.00\ P_p$
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	$1.35\ G_{Soil}+1.35\ G_{Wall}+1.50\ Fv_{Heel}+1.35\ P_a+1.50\ P_{surcharge}+1.00\ P_p$
Case 7: Service Base Pressure Check	$1.00\ G_{Soil}+1.00\ G_{Wall}+1.00\ Fv_{Heel}+1.00\ P_a+1.00\ P_{surcharge}+1.00\ P_p$

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Geotechnical Design

Wall Stability - Virtual Back Pressure

Case 1 Overturning/Stabilising	32.619/57.825	0.564	OK

Wall Sliding - Virtual Back Pressure

Case 2 $Fx/(Rx_{Friction}+ Rx_{Passive})$	32.242/(54.747+0.000)	0.589	OK
Case 3 $Fx/(Rx_{Friction}+ Rx_{Passive})$	32.258/(42.343+0.000)	0.762	OK
Case 4 $Fx/(Rx_{Friction}+ Rx_{Passive})$	32.242/(41.107+0.000)	0.784	OK
Case 5 $Fx/(Rx_{Friction}+ Rx_{Passive})$	32.258/(32.886+0.000)	0.981	OK
Case 6 $Fx/(Rx_{Friction}+ Rx_{Passive})$	32.242/(69.135+0.000)	0.466	OK

Soil Pressure

Case 2 - Virtual Back	75.040/250 kN/m², Length under pressure 1.264 m	0.300	OK
Case 3 - Virtual Back	75.005/250 kN/m², Length under pressure 1.222 m	0.300	OK
Case 4 - Virtual Back	78.831/250 kN/m², Length under pressure 0.903 m	0.315	OK
Case 5 - Virtual Back	79.291/250 kN/m², Length under pressure 0.898 m	0.317	OK
Case 6 - Virtual Back	87.007/250 kN/m², Length under pressure 1.376 m	0.348	OK
Case 7 - Virtual Back SLS (No uplift)	Max(79.133 / (250 / 3), 23.161/ (250 / 3)) kN/m²	0.950	OK
Case 2 - Wall Back	74.997/250 kN/m², Length under pressure 1.264 m	0.300	OK
Case 3 - Wall Back	74.960/250 kN/m², Length under pressure 1.223 m	0.300	OK
Case 4 - Wall Back	69.883/250 kN/m², Length under pressure 1.019 m	0.280	OK
Case 5 - Wall Back	71.323/250 kN/m², Length under pressure 0.998 m	0.285	OK
Case 6 - Wall Back	86.970/250 kN/m², Length under pressure 1.377 m	0.348	OK
Case 7 - Wall Back SLS (No uplift)	Max(79.083 / (250 / 3), 23.212/ (250 / 3)) kN/m²	0.949	OK

Structural Design

At Rest Earth Pressure

At rest earth pressures magnification	$(1+\text{Sin}(\phi)) \times \sqrt{OCR} = (1+\text{Sin}(29.26))\times\sqrt{1}$	1.49

Cladding Details

Partial Safety Factor ($\gamma mc/\gamma mf$)	Units Category II, Execution Control Class 2	3/2.7	Table NA.1
Material	Clay bricks with water absorption between 7% and 12%		
Units and Mortar Strength	5 N/mm², Mortar designation M4/(iii)		
Compressive Strength (f_k)	Group 2, γ=20 kN/m³	1.87 N/mm²	Table NA.4

Wall Design (Inner Steel)

Critical Section	Critical @ 0 mm from base, Case 2		
Steel Provided (Cover)	Main H16@200 (40 mm) Dist. H10@200 (56 mm)	1005 mm²	OK
Compression Steel Provided (Cover)	Main H10@200 (40 mm) Dist. H10@200 (50 mm)	393 mm²	
Leverarm z=fn(d,b,As,fy,Fck)	202 mm, 1000 mm, 1005 mm², 500 N/mm², 28 N/mm²	188 mm	
Mr=fn(above,As',d',x,x/d)	393 mm², 45 mm, 34 mm, 0.17	82.3 kN.m	
Moment Capacity Check (M/Mr)	M 36.7 kN.m, Mr 82.3 kN.m	0.446	OK
Shear Capacity Check	F 41.4 kN, vc 0.576 N/mm², Fvr 116.4 kN	0.36	OK

Base Top Steel Design - Case 6

Steel Provided (Cover)	Main H10@200 (40 mm) Dist. H10@200 (50 mm)	393 mm²	OK
Compression Steel Provided (Cover)	Main H10@200 (40 mm) Dist. H10@200 (50 mm)	393 mm²	
Leverarm z=fn(d,b,As,fy,Fck)	205 mm, 1000 mm, 393 mm², 500 N/mm², 28 N/mm²	195 mm	
Mr=fn(above,As',d',x,x/d)	393 mm², 45 mm, 13 mm, 0.07	33.3 kN.m	
Moment Capacity Check (M/Mr)	M 32.2 kN.m, Mr 33.3 kN.m	0.970	OK
Shear Capacity Check	F 49.3 kN, vc 0.519 N/mm², Fvr 106.4 kN	0.46	OK

Base Bottom Steel Design - Case 4

Steel Provided (Cover)	Main H10@200 (40 mm) Dist. H10@200 (50 mm)	393 mm²	OK
Compression Steel Provided (Cover)	Main H10@200 (40 mm) Dist. H10@200 (50 mm)	393 mm²	
Leverarm z=fn(d,b,As,fy,Fck)	205 mm, 1000 mm, 393 mm², 500 N/mm², 28 N/mm²	195 mm	
Mr=fn(above,As',d',x,x/d)	393 mm², 45 mm, 13 mm, 0.07	33.3 kN.m	
Moment Capacity Check (M/Mr)	M 9.2 kN.m, Mr 33.3 kN.m	0.278	OK
Shear Capacity Check	F 41.8 kN, vc 0.519 N/mm², Fvr 106.4 kN	0.39	OK

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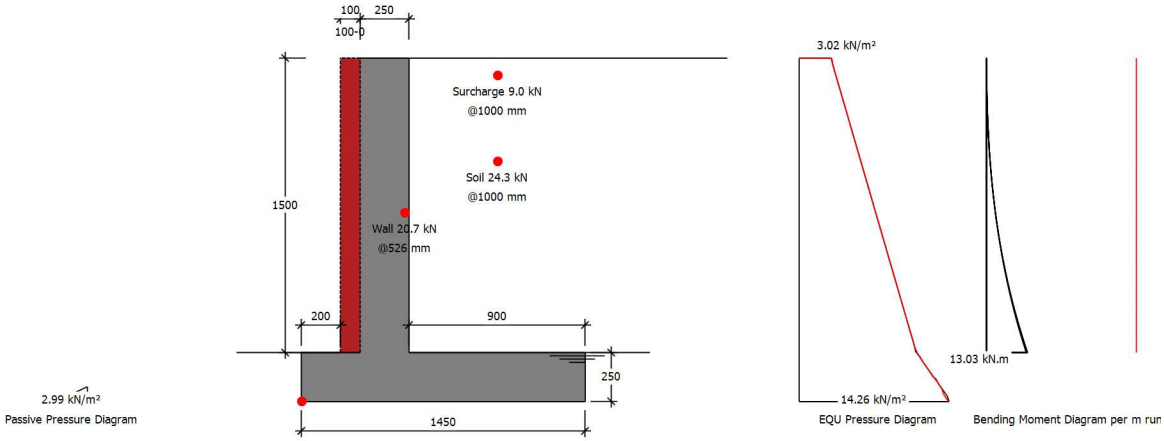
MasterKey : Retaining Wall Design to EC 7 : 2004 and EC 2 : 2004
1.2m Retain (Highways) No Loads
Reinforced Concrete Retaining Wall with External Cladding with Reinforced Base



Summary of Design Data

EC2, EC7 National Annex	UK
EC6 National Annex	UK
Notes	All dimensions are in mm and all forces are per metre run
Material Densities (kN/m³)	Dry Soil 18.00, Saturated Soil 20.80, Submerged Soil 10.80 Concrete 24.00, Cladding 20.00
Special Assumptions (virtual back)	Use δ =0 @ virtual back
Concrete grade	C28/35 N/mm², Permissible tensile stress 1.033 N/mm²
Concrete covers (mm)	Wall inner cover 40 mm, Wall outer cover 40 mm, Base cover 40 mm
Reinforcement design	fy 500 N/mm² designed to EC 2: 2004
Surcharge and Water Table	Surcharge 10.00 kN/m², Water table level 0 mm
Unplanned excavation depth	Front of wall 175 mm

† The Engineer must satisfy him/herself to the reinforcement detailing requirements of the relevant codes of practice

Soil Properties

Bearing pressure	Ultimate resistance M1 @ front 250.00 kN/m², @ back 250.00 kN/m² Ultimate resistance M2 @ front 250.00 kN/m², @ back 250.00 kN/m²
EC7 EQU - Wall Stability	
Back Soil Friction and Cohesion	⫛ = Atn(Tan(35)/1.1) = 32.48°
Base Friction and Cohesion	δ = Atn(1xTan(Atn(Tan(30)/1.1))) = 27.69°
Front Soil Friction and Cohesion	ϕ = Atn(Tan(30)/1.1) = 27.69°
EC7 GEO/STR - M1	
Back Soil Friction and Cohesion	⫛ = Atn(Tan(35)/1) = 35°
Base Friction and Cohesion	δ = Atn(1xTan(Atn(Tan(30)/1))) = 30°
Front Soil Friction and Cohesion	ϕ = Atn(Tan(30)/1) = 30°
EC7 GEO/STR - M2	
Back Soil Friction and Cohesion	⫛ = Atn(Tan(35)/1.25) = 29.26°
Base Friction and Cohesion	δ = Atn(1xTan(Atn(Tan(30)/1.25))) = 24.79°
Front Soil Friction and Cohesion	ϕ = Atn(Tan(30)/1.25) = 24.79°

Loading Cases EQU and GEO/STR - Design Approach 1

G_{Soil}- Soil Self Weight, G_{Wall}- Wall & Base Self Weight, Fv_{Heel}- 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	$1.00\ G_{Soil}+1.00\ G_{Wall}+1.50\ Fv_{Heel}+1.35\ P_a+1.50\ P_{surcharge}+1.00\ P_p$
Case 3: GEO/STR A2+M2 I	$1.00\ G_{Soil}+1.00\ G_{Wall}+1.30\ Fv_{Heel}+1.00\ P_a+1.30\ P_{surcharge}+1.00\ P_p$
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	$1.35\ G_{Soil}+1.35\ G_{Wall}+1.50\ Fv_{Heel}+1.35\ P_a+1.50\ P_{surcharge}+1.00\ P_p$
Case 7: Service Base Pressure Check	$1.00\ G_{Soil}+1.00\ G_{Wall}+1.00\ Fv_{Heel}+1.00\ P_a+1.00\ P_{surcharge}+1.00\ P_p$

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Geotechnical Design

Wall Stability - Virtual Back Pressure

Case 1 Overturning/Stabilising	12.294/31.664	0.388	OK

Wall Sliding - Virtual Back Pressure

Case 2 $Fx/(Rx_{Friction}+ Rx_{Passive})$	17.529/(33.775+0.122)	0.517	OK
Case 3 $Fx/(Rx_{Friction}+ Rx_{Passive})$	17.516/(26.189+0.105)	0.666	OK
Case 4 $Fx/(Rx_{Friction}+ Rx_{Passive})$	17.529/(25.981+0.122)	0.672	OK
Case 5 $Fx/(Rx_{Friction}+ Rx_{Passive})$	17.516/(20.785+0.105)	0.839	OK
Case 6 $Fx/(Rx_{Friction}+ Rx_{Passive})$	17.529/(42.868+0.122)	0.408	OK

Soil Pressure

Case 2 - Virtual Back	46.838/250 kN/m², Length under pressure 1.249 m	0.187	OK
Case 3 - Virtual Back	46.611/250 kN/m², Length under pressure 1.216 m	0.186	OK
Case 4 - Virtual Back	43.959/250 kN/m², Length under pressure 1.024 m	0.176	OK
Case 5 - Virtual Back	44.434/250 kN/m², Length under pressure 1.013 m	0.178	OK
Case 6 - Virtual Back	56.432/250 kN/m², Length under pressure 1.316 m	0.226	OK
Case 7 - Virtual Back SLS (No uplift)	Max(47.246 / (250 / 3), 27.237/ (250 / 3)) kN/m²	0.567	OK
Case 2 - Wall Back	46.808/250 kN/m², Length under pressure 1.25 m	0.187	OK
Case 3 - Wall Back	46.575/250 kN/m², Length under pressure 1.217 m	0.186	OK
Case 4 - Wall Back	43.915/250 kN/m², Length under pressure 1.025 m	0.176	OK
Case 5 - Wall Back	44.383/250 kN/m², Length under pressure 1.014 m	0.178	OK
Case 6 - Wall Back	56.405/250 kN/m², Length under pressure 1.316 m	0.226	OK
Case 7 - Wall Back SLS (No uplift)	Max(47.199 / (250 / 3), 27.284/ (250 / 3)) kN/m²	0.566	OK

Structural Design

At Rest Earth Pressure

At rest earth pressures magnification	$(1+\text{Sin}(\phi)) \times \sqrt{\text{OCR}} = (1+\text{Sin}(29.26))\times\sqrt{1}$	1.49

Cladding Details

Partial Safety Factor ($\gamma mc/\gamma mf$)	Units Category II, Execution Control Class 2	3/2.7	Table NA.1
Material	Clay bricks with water absorption between 7% and 12%		
Units and Mortar Strength	5 N/mm², Mortar designation M4/(iii)		
Compressive Strength (f_k)	Group 2, γ=20 kN/m³	1.87 N/mm²	Table NA.4

Wall Design (Inner Steel)

Critical Section	Critical @ 0 mm from base, Case 2		
Steel Provided (Cover)	Main H12@200 (40 mm) Dist. H10@200 (52 mm)	565 mm²	OK
Compression Steel Provided (Cover)	Main H10@200 (40 mm) Dist. H10@200 (50 mm)	393 mm²	
Leverarm z=fn(d,b,As,fy,Fck)	204 mm, 1000 mm, 565 mm², 500 N/mm², 28 N/mm²	194 mm	
Mr=fn(above,As',d',x,x/d)	393 mm², 45 mm, 19 mm, 0.09	47.6 kN.m	
Moment Capacity Check (M/Mr)	M 13.0 kN.m, Mr 47.6 kN.m	0.274	OK
Shear Capacity Check	F 21.2 kN, vc 0.520 N/mm², Fvr 106.1 kN	0.20	OK

Base Top Steel Design - Case 2

Steel Provided (Cover)	Main H10@200 (40 mm) Dist. H10@200 (50 mm)	393 mm²	OK
Compression Steel Provided (Cover)	Main H10@200 (40 mm) Dist. H10@200 (50 mm)	393 mm²	
Leverarm z=fn(d,b,As,fy,Fck)	205 mm, 1000 mm, 393 mm², 500 N/mm², 28 N/mm²	195 mm	
Mr=fn(above,As',d',x,x/d)	393 mm², 45 mm, 13 mm, 0.07	33.3 kN.m	
Moment Capacity Check (M/Mr)	M 13.3 kN.m, Mr 33.3 kN.m	0.399	OK
Shear Capacity Check	F 23.8 kN, vc 0.519 N/mm², Fvr 106.4 kN	0.22	OK

Base Bottom Steel Design - Case 4

Steel Provided (Cover)	Main H10@200 (40 mm) Dist. H10@200 (50 mm)	393 mm²	OK
Compression Steel Provided (Cover)	Main H10@200 (40 mm) Dist. H10@200 (50 mm)	393 mm²	
Leverarm z=fn(d,b,As,fy,Fck)	205 mm, 1000 mm, 393 mm², 500 N/mm², 28 N/mm²	195 mm	
Mr=fn(above,As',d',x,x/d)	393 mm², 45 mm, 13 mm, 0.07	33.3 kN.m	
Moment Capacity Check (M/Mr)	M 2.4 kN.m, Mr 33.3 kN.m	0.072	OK
Shear Capacity Check	F 14.1 kN, vc 0.519 N/mm², Fvr 106.4 kN	0.13	OK

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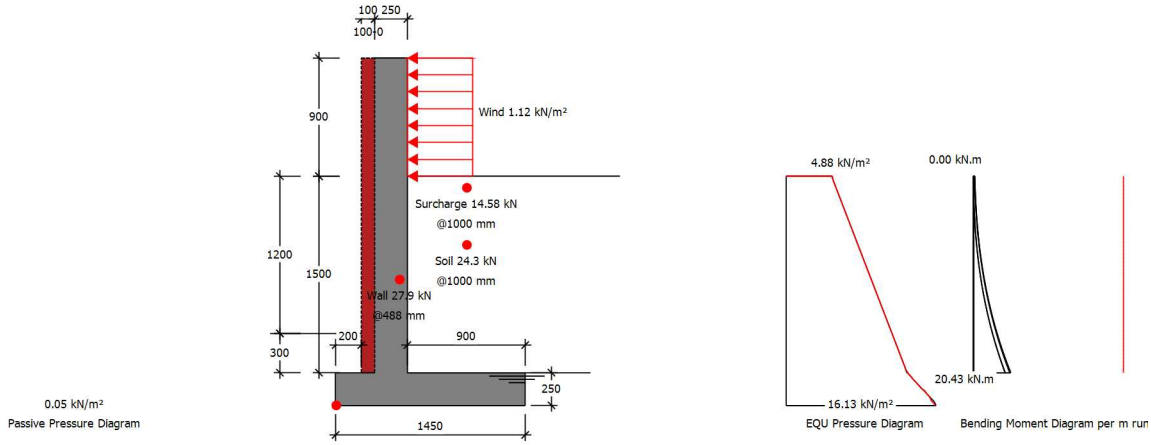
MasterKey : Retaining Wall Design to EC 7 : 2004 and EC 2 : 2004
1.2m Retain (Highways) Extended Height
Reinforced Concrete Retaining Wall with External Cladding with Reinforced Base



Summary of Design Data

EC2, EC7 National Annex	UK
EC6 National Annex	UK
Notes	All dimensions are in mm and all forces are per metre run
Material Densities (kN/m³)	Dry Soil 18.00, Saturated Soil 20.80, Submerged Soil 10.80 Concrete 24.00, Cladding 20.00
Special Assumptions (virtual back)	Use δ =0 @ virtual back
Concrete grade	C28/35 N/mm², Permissible tensile stress 1.033 N/mm²
Concrete covers (mm)	Wall inner cover 40 mm, Wall outer cover 40 mm, Base cover 40 mm
Reinforcement design	fy 500 N/mm² designed to EC 2: 2004
Surcharge and Water Table	Surcharge 16.20 kN/m², Water table level 0 mm
Unplanned excavation depth	Front of wall 550 mm

† The Engineer must satisfy him/herself to the reinforcement detailing requirements of the relevant codes of practice

Soil Properties

Bearing pressure	Ultimate resistance M1 @ front 250.00 kN/m², @ back 250.00 kN/m² Ultimate resistance M2 @ front 250.00 kN/m², @ back 250.00 kN/m²
EC7 EQU - Wall Stability	
Back Soil Friction and Cohesion	ϕ = Atn(Tan(35)/1.1) = 32.48°
Base Friction and Cohesion	δ = Atn(1xTan(Atn(Tan(30)/1.1))) = 27.69°
Front Soil Friction and Cohesion	ϕ = Atn(Tan(30)/1.1) = 27.69°
EC7 GEO/STR - M1	
Back Soil Friction and Cohesion	ϕ = Atn(Tan(35)/1) = 35°
Base Friction and Cohesion	δ = Atn(1xTan(Atn(Tan(30)/1))) = 30°
Front Soil Friction and Cohesion	ϕ = Atn(Tan(30)/1) = 30°
EC7 GEO/STR - M2	
Back Soil Friction and Cohesion	ϕ = Atn(Tan(35)/1.25) = 29.26°
Base Friction and Cohesion	δ = Atn(1xTan(Atn(Tan(30)/1.25))) = 24.79°
Front Soil Friction and Cohesion	ϕ = Atn(Tan(30)/1.25) = 24.79°

Loading Cases EQU and GEO/STR - Design Approach 1

G_{Soil}- Soil Self Weight, G_{Wall}- Wall & Base Self Weight, Fv_{Heel}- 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 Fv_{Heel}+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 Fv_{Heel}+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 Fv_{Heel}+1.35 P_a+1.50 $P_{surcharge}$+1.00 P_p
Case 7: Service Base Pressure Check	1.00 G_{Soil}+1.00 G_{Wall}+1.00 Fv_{Heel}+1.00 P_a+1.00 $P_{surcharge}$+1.00 P_p

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Geotechnical Design

Wall Stability - Virtual Back Pressure

Case 1 Overturning/Stabilising	19.903/34.135	0.583	OK

Wall Sliding - Virtual Back Pressure

Case 2 $Fx/(Rx_{Friction}+ Rx_{Passive})$	23.465/(42.764+0.000)	0.549	OK
Case 3 $Fx/(Rx_{Friction}+ Rx_{Passive})$	23.669/(32.865+0.000)	0.720	OK
Case 4 $Fx/(Rx_{Friction}+ Rx_{Passive})$	23.465/(30.138+0.000)	0.779	OK
Case 5 $Fx/(Rx_{Friction}+ Rx_{Passive})$	23.669/(24.110+0.000)	0.982	OK
Case 6 $Fx/(Rx_{Friction}+ Rx_{Passive})$	23.465/(53.313+0.000)	0.440	OK

Soil Pressure

Case 2 - Virtual Back	67.818/250 kN/m², Length under pressure 1.092 m	0.271	OK
Case 3 - Virtual Back	67.753/250 kN/m², Length under pressure 1.05 m	0.271	OK
Case 4 - Virtual Back	73.330/250 kN/m², Length under pressure 0.712 m	0.293	OK
Case 5 - Virtual Back	74.008/250 kN/m², Length under pressure 0.705 m	0.296	OK
Case 6 - Virtual Back	79.357/250 kN/m², Length under pressure 1.164 m	0.317	OK
Case 7 - Virtual Back SLS (No uplift)	Max(72.442 / (250 / 3), 19.668/ (250 / 3)) kN/m²	0.869	OK
Case 2 - Wall Back	67.762/250 kN/m², Length under pressure 1.093 m	0.271	OK
Case 3 - Wall Back	67.694/250 kN/m², Length under pressure 1.051 m	0.271	OK
Case 4 - Wall Back	62.101/250 kN/m², Length under pressure 0.841 m	0.248	OK
Case 5 - Wall Back	63.891/250 kN/m², Length under pressure 0.817 m	0.256	OK
Case 6 - Wall Back	79.307/250 kN/m², Length under pressure 1.164 m	0.317	OK
Case 7 - Wall Back SLS (No uplift)	Max(72.375 / (250 / 3), 19.735/ (250 / 3)) kN/m²	0.869	OK

Structural Design

At Rest Earth Pressure

At rest earth pressures magnification	$(1+\text{Sin}(\phi)) \times \sqrt{OCR} = (1+\text{Sin}(29.26))\times\sqrt{1}$	1.49

Cladding Details

Partial Safety Factor ($\gamma mc/\gamma mf$)	Units Category II, Execution Control Class 2	3/2.7	Table NA.1
Material	Clay bricks with water absorption between 7% and 12%		
Units and Mortar Strength	5 N/mm², Mortar designation M4/(iii)		
Compressive Strength (f_k)	Group 2, γ=20 kN/m³	1.87 N/mm²	Table NA.4

Wall Design (Inner Steel)

Critical Section	Critical @ 0 mm from base, Case 2		
Steel Provided (Cover)	Main H16@200 (40 mm) Dist. H10@200 (56 mm)	1005 mm²	OK
Compression Steel Provided (Cover)	Main H10@200 (40 mm) Dist. H10@200 (50 mm)	393 mm²	
Leverarm z=fn(d,b,As,fy,Fck)	202 mm, 1000 mm, 1005 mm², 500 N/mm², 28 N/mm²	188 mm	
Mr=fn(above,As',d',x,x/d)	393 mm², 45 mm, 34 mm, 0.17	82.3 kN.m	
Moment Capacity Check (M/Mr)	M 20.4 kN.m, Mr 82.3 kN.m	0.248	OK
Shear Capacity Check	F 28.7 kN, vc 0.576 N/mm², Fvr 116.4 kN	0.25	OK

Base Top Steel Design - Case 6

Steel Provided (Cover)	Main H10@200 (40 mm) Dist. H10@200 (50 mm)	393 mm²	OK
Compression Steel Provided (Cover)	Main H10@200 (40 mm) Dist. H10@200 (50 mm)	393 mm²	
Leverarm z=fn(d,b,As,fy,Fck)	205 mm, 1000 mm, 393 mm², 500 N/mm², 28 N/mm²	195 mm	
Mr=fn(above,As',d',x,x/d)	393 mm², 45 mm, 13 mm, 0.07	33.3 kN.m	
Moment Capacity Check (M/Mr)	M 19.6 kN.m, Mr 33.3 kN.m	0.590	OK
Shear Capacity Check	F 33.8 kN, vc 0.519 N/mm², Fvr 106.4 kN	0.32	OK

Base Bottom Steel Design - Case 4

Steel Provided (Cover)	Main H10@200 (40 mm) Dist. H10@200 (50 mm)	393 mm²	OK
Compression Steel Provided (Cover)	Main H10@200 (40 mm) Dist. H10@200 (50 mm)	393 mm²	
Leverarm z=fn(d,b,As,fy,Fck)	205 mm, 1000 mm, 393 mm², 500 N/mm², 28 N/mm²	195 mm	
Mr=fn(above,As',d',x,x/d)	393 mm², 45 mm, 13 mm, 0.07	33.3 kN.m	
Moment Capacity Check (M/Mr)	M 4.3 kN.m, Mr 33.3 kN.m	0.129	OK
Shear Capacity Check	F 25.3 kN, vc 0.519 N/mm², Fvr 106.4 kN	0.24	OK

DUDLEYS
CONSULTING ENGINEERS

PROJECT
CHIPPINGS

PROJECT No. 22055
SHEET No.
BY
DATE NOV '25

RETAINING WALL IMPACT LOAD

FROM TABLE 4.1 IN BS EN 1991-1-7:

COURTYARDS / PARKING → F_{dx} = 150kN FOR LORRIES

∴ APPLY 150kN OVER 1.5m LENGTH @ 0.5m H

150kN ÷ 1.5m = 100 kN/m.

FOR REINFORCEMENT CHECK AT JUNCTION BETWEEN VEHICLE BARRIER AND RETAINING WALL

100 kN/m x 1m UNIT LENGTH x 0.5m ABOVE G.L. = 50 kNm

$$K = \frac{50\text{kNm} \times 10^6}{1000 \times 120^2 \times 28} = 0.12$$

$$A_s = \frac{50\text{kNm} \times 10^6}{0.87 \times 500 \times 0.88 \times 120} = 1089\text{mm}^2/\text{m}.$$

∴ PROVIDE B1131 MESH