

MW Consult Ltd

Civil & Structural Engineering Consultancy

Structural Calculations

Project: Proposed Parking Bays at Hryn House,
5 Varteg Road, Bryn, Port Talbot

Project Ref: 22/237

Revision: –

Client: Mr Rob Thomas

Element: Retaining Walls

Design Codes: BS 648: Weight of Materials
BS 6399: Loadings for Buildings
BS 8002: Earth Retaining Structures
BS 8110: Structural use of Concrete
BS 8004: Foundations

Prepared by:	Issue Date:
Mike Wyatt BEng (Hons) CEng MStructE	26/09/2022

Important: Please note that these structural calculations are for your records and to support any submissions for Building Regulations approval. Do not under any circumstances work to any sizes or measurements (e.g. heights, lengths etc) stated in these calculations; and do not furnish the contractors or steel fabricators with a set of these calculations. All site works must be undertaken in strict accordance with the MW Consult Ltd structural drawings.

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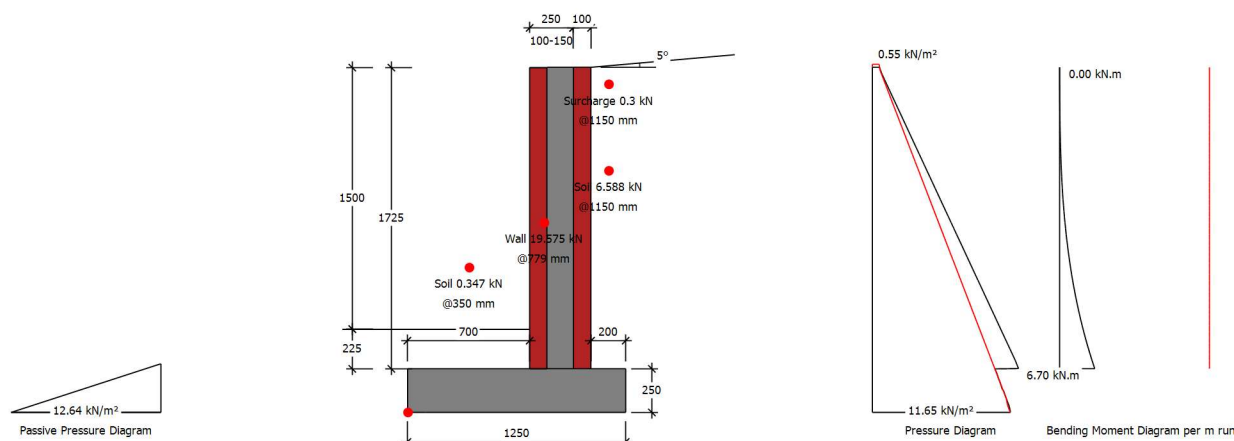
Made by : MW

Date : 26 September 2022 / Ver. 2022.06.07

Checked : MW

Approved : MW

MasterKey : Retaining Wall Design to BS 8002 : 1994, BS 5628 : 2005 and BS 8110 : 1997
RC Retaining Wall - Retained Height of 1.5m (5 degree gradient)
Reinforced Masonry Cavity Filled Retaining Wall with Reinforced Concrete Base

**Summary of Design Data****Notes**

Material Densities (kN/m³)

Angles

Concrete grade

Concrete covers (mm)

Reinforcement design

Surcharge and Water Table

Unplanned excavation depth

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

All dimensions are in mm and all forces are per metre run

Back soil 19.00, Front soil 18.00, Concrete 24.00, Masonry 20.00

Embankment 5°

fcu 35 N/mm², Permissible tensile stress 0.250 N/mm²

Cavity inner cover 40 mm, Cavity outer cover 100 mm, Base cover 50 mm

fy 500 N/mm², fyb 500 N/mm² designed to BS 8110: 1997

Surcharge 1.50 kN/m², Fully drained

Front of wall 198 mm

Soil Properties

Bearing pressure

Back Soil Friction and Cohesion

Base Friction and Cohesion

Front Soil Friction and Cohesion

Premissible service pressure @ front 100.00 kN/m², @ back 100.00 kN/m²

 $\phi = \text{Atn}(\text{Tan}(34)/1.2) = 29.34^\circ$ $\delta = \text{Atn}(0.75 \times \text{Tan}(\text{Atn}(\text{Tan}(34)/1.2))) = 22.86^\circ$ $\phi = \text{Atn}(\text{Tan}(30)/1.2) = 25.69^\circ$ **Loading Cases**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_p- Passive Earth PressureCase 1: Geotechnical Design 1.00 G_{Soil}+1.00 G_{Wall}+1.00 F_{VHeel}+1.00 P_a+1.00 P_{surcharge}+1.00 P_pCase 2: Structural Ultimate Design 1.40 G_{Soil}+1.40 G_{Wall}+1.60 F_{VHeel}+1.00 P_a+1.00 P_{surcharge}+1.00 P_p**Geotechnical Design****Wall Stability - Virtual Back Pressure**

Case 1 Overturning/Stabilising	8.384/23.298	0.360	OK
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Wall Sliding - Virtual Back Pressure

F _x /(R _x Friction + R _x Passive)	12.145/(11.303+1.760)	0.930	OK
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Soil Pressure

Virtual Back (No uplift)	Max(28.524/100, 14.373/100) kN/m²	0.285	OK
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Wall Back (No uplift)	Max(33.419/100, 9.479/100) kN/m²	0.334	OK
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Structural Design**Outer Leaf Details**

Partial Safety Factor (γ_{mc}/γ_{mf})	Normal manufacturing, Normal construction	3.5/3	Table 4a/4b
Material	Concrete blocks, $\gamma=20$ 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 (fk)	Solid Concrete block wall	6.8 N/mm ²	Table 3

Inner Leaf Details

Partial Safety Factor (γ_{mc}/γ_{mf})	Normal manufacturing, Normal construction	3.5/3	Table 4a/4b
Material	Concrete blocks, $\gamma=20$ 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 (fk)	Solid Concrete block wall	6.8 N/mm ²	Table 3

Wall Design (Inner Steel)

Critical Section	Critical @ 0 mm from base, Case 2		
Steel Provided (Cover)	Dist. B10@200 (40 mm in cavity)		
	Main B10@200 (40 mm in cavity)	393 mm ²	OK
Leverarm $z=fn(d,b,As,fy,fk)$	205 mm, 1000 mm, 393 mm ² , 500 N/mm ² , 6.8 N/mm ²	167 mm	
$Mr=fn(above,\gamma_{mf},\gamma_{ms})$	3.00, 1.15	28.6 kN.m	
Moment Capacity Check (M/Mr)	M 6.7 kN.m, Mr 28.6 kN.m	0.234	OK
Shear Capacity Check	F 11.1 kN, fv 0.677 N/mm ² , Fvr 55.5 kN	0.20	OK

Base Top Steel Design

Steel Provided (Cover)	Main B10@200 (60 mm) Dist. B10@200 (50 mm)	393 mm ²	OK
Compression Steel Provided (Cover)	Main B10@200 (60 mm) Dist. B10@200 (50 mm)	393 mm ²	
Leverarm $z=fn(d,b,As,fy,Fcu)$	185 mm, 1000 mm, 393 mm ² , 500 N/mm ² , 35 N/mm ²	176 mm	
$Mr=fn(above,As',d',x,x/d)$	393 mm ² , 65 mm, 12 mm, 0.07	30.0 kN.m	
Moment Capacity Check (M/Mr)	M 1.7 kN.m, Mr 30.0 kN.m	0.057	OK
Shear Capacity Check	F 9.7 kN, vc 0.511 N/mm ² , Fvr 94.6 kN	0.10	OK

Base Bottom Steel Design

Steel Provided (Cover)	Main B10@200 (60 mm) Dist. B10@200 (50 mm)	393 mm ²	OK
Compression Steel Provided (Cover)	Main B10@200 (60 mm) Dist. B10@200 (50 mm)	393 mm ²	
Leverarm $z=fn(d,b,As,fy,Fcu)$	185 mm, 1000 mm, 393 mm ² , 500 N/mm ² , 35 N/mm ²	176 mm	
$Mr=fn(above,As',d',x,x/d)$	393 mm ² , 65 mm, 12 mm, 0.07	30.0 kN.m	
Moment Capacity Check (M/Mr)	M 7.5 kN.m, Mr 30.0 kN.m	0.248	OK
Shear Capacity Check	F 14.9 kN, vc 0.511 N/mm ² , Fvr 94.6 kN	0.16	OK

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Inner Leaf Details

Partial Safety Factor (γ_{mc}/γ_{mf})	Normal manufacturing, Normal construction	3.5/3	Table 4a/4b
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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 (fk)	Solid Concrete block wall	6.8 N/mm ²	Table 3

Wall Design (Inner Steel)

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	Main B10@200 (40 mm in cavity)	393 mm ²	OK
Leverarm $z=fn(d,b,As,fy,fk)$	205 mm, 1000 mm, 393 mm ² , 500 N/mm ² , 6.8 N/mm ²	167 mm	
$Mr=fn(above,\gamma_{mf},\gamma_{ms})$	3.00, 1.15	28.6 kN.m	
Moment Capacity Check (M/Mr)	M 7.5 kN.m, Mr 28.6 kN.m	0.263	OK
Shear Capacity Check	F 12.5 kN, fv 0.677 N/mm ² , Fvr 55.5 kN	0.22	OK

Base Top Steel Design

Steel Provided (Cover)	Main B10@200 (60 mm) Dist. B10@200 (50 mm)	393 mm ²	OK
Compression Steel Provided (Cover)	Main B10@200 (60 mm) Dist. B10@200 (50 mm)	393 mm ²	
Leverarm $z=fn(d,b,As,fy,Fcu)$	185 mm, 1000 mm, 393 mm ² , 500 N/mm ² , 35 N/mm ²	176 mm	
$Mr=fn(above,As',d',x,x/d)$	393 mm ² , 65 mm, 12 mm, 0.07	30.0 kN.m	
Moment Capacity Check (M/Mr)	M 2.4 kN.m, Mr 30.0 kN.m	0.079	OK
Shear Capacity Check	F 10.6 kN, vc 0.511 N/mm ² , Fvr 94.6 kN	0.11	OK

Base Bottom Steel Design

Steel Provided (Cover)	Main B10@200 (60 mm) Dist. B10@200 (50 mm)	393 mm ²	OK
Compression Steel Provided (Cover)	Main B10@200 (60 mm) Dist. B10@200 (50 mm)	393 mm ²	
Leverarm $z=fn(d,b,As,fy,Fcu)$	185 mm, 1000 mm, 393 mm ² , 500 N/mm ² , 35 N/mm ²	176 mm	
$Mr=fn(above,As',d',x,x/d)$	393 mm ² , 65 mm, 12 mm, 0.07	30.0 kN.m	
Moment Capacity Check (M/Mr)	M 7.9 kN.m, Mr 30.0 kN.m	0.263	OK
Shear Capacity Check	F 15.2 kN, vc 0.511 N/mm ² , Fvr 94.6 kN	0.16	OK