



Project Aldi – Old Mill Lane, Barnsley				Job Ref. 15004	
Section Retaining Wall Structural Calculations				Sheet no./rev. 1/-	
Calc. by AA	Date 17/12/2020	Chck'd by MF	Date 17/12/2020	App'd by PL	Date 17/12/2020

Structural Calculations External Retaining Wall Aldi – Old Mill Lane, Barnsley

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Calc. by AA	Date 17/12/2020	Chck'd by MF	Date 17/12/2020	App'd by PL	Date 17/12/2020

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1 Revision Log

Rev No	Date	Description	Checked By
-	17/12/20	Initial Structural Issue	MF

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3 Design Philosophy

3.1 Construction

3.1.1 Retaining Wall

Ground Conditions: Following discussions with the Geo-Environmental Engineer who carried out the site investigation the ground conditions in the location of the retaining wall were sands and gravels and a bearing pressure of 75kN/m² would be appropriate

3.1.2 Super-Strucutre

The retaining wall was to be designed as a reinforced cavity fill wall in order to simplify and speed up construction

3.2 Loading

3.2.1 Dead & Live Loads

Dead and live loads shall in accordance with BS EN 1991-1-1: 2002 + UK National Annex – General actions – Densities, self-weight, imposed loads for buildings. All dead loads shall be calculated using the unit weight of material used in the construction. As the retaining wall is outside of the zone of the adjacent road a surcharge of 5kN/m² was used

3.3 Construction Sequence

The construction sequence shall take due cognisance of temporary support of the retained side of the wall.

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4 Reference

Element	Description	Code
General	Basis of Stucutral Design	BS EN 1990 + NA
Loadings	Applied Loads	
	Dead & Live Loads	BS EN 1991-1-1 + NA
Materials	Concrete	BS EN 206 BS 8500-1
	Cement	BS EN 197-1
	Reinforcement Bars	BS 4449
Foundations	General	BS EN 1997-1 + NA
Concrete	Foundations	BS 1992-1-1 + NA

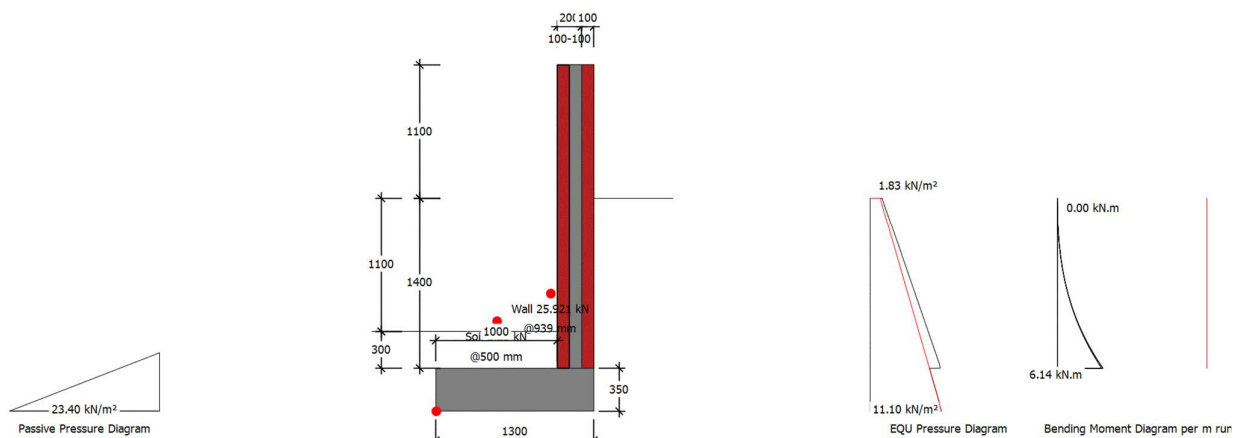
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5 Design

MASTERKEY: RETAINING WALL DESIGN TO EC 7 : 2004, BS EN 1996-1-1:2005 AND EC 2 : 2004

Basic RC Retaining Wall (5kN/m² Surcharge) Reinforced Masonry Cavity Filled Retaining Wall with Reinforced Concrete Base



Summary of Design Data

Notes

Material Densities (kN/m³)

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

Soil 18.00, Concrete 24.00, Masonry 20.00

C28/35 N/mm², Permissible tensile stress 1.291 N/mm²

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

f_y 500 N/mm², f_{yb} 500 N/mm² designed to EC 2: 2004

Surcharge 5.00 kN/m², Fully drained

Front of wall 175 mm

Soil Properties

Soil bearing pressure

Allowable pressure M1 @ front 75.00 kN/m², @ back 75.00 kN/m²

Allowable pressure M2 @ front 75.00 kN/m², @ back 75.00 kN/m²

EC7 EQU - Wall Stability

Back Soil Friction and Cohesion

Base Friction and Cohesion

Front Soil Friction and Cohesion

EC7 GEO/STR - M1

Back Soil Friction and Cohesion

Base Friction and Cohesion

Front Soil Friction and Cohesion

EC7 GEO/STR - M2

Back Soil Friction and Cohesion

Base Friction and Cohesion

Front Soil Friction and Cohesion

$$\phi = \text{Atn}(\tan(30)/1.1) = 27.69^\circ$$

$$\delta = \text{Atn}(1 \times \tan(\text{Atn}(\tan(30)/1.1))) = 27.69^\circ$$

$$\phi = \text{Atn}(\tan(30)/1.1) = 27.69^\circ$$

$$\phi = \text{Atn}(\tan(30)/1) = 30^\circ$$

$$\delta = \text{Atn}(1 \times \tan(\text{Atn}(\tan(30)/1))) = 30^\circ$$

$$\phi = \text{Atn}(\tan(30)/1) = 30^\circ$$

$$\phi = \text{Atn}(\tan(30)/1.25) = 24.79^\circ$$

$$\delta = \text{Atn}(1 \times \tan(\text{Atn}(\tan(30)/1.25))) = 24.79^\circ$$

$$\phi = \text{Atn}(\tan(30)/1.25) = 24.79^\circ$$

Loading Cases EQU and GEO/STR - Design Approach 1

G_{Soil}- Soil Self Weight, G_{Wall}- Wall & Base Self Weight, 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

$$0.90 G_{\text{Soil}} + 0.90 G_{\text{Wall}} + 1.10 P_a + 1.50 P_{\text{surcharge}} + 0.90 P_p$$

Case 2: GEO/STR A1+M1 I

$$1.00 G_{\text{Soil}} + 1.00 G_{\text{Wall}} + 1.35 P_a + 1.50 P_{\text{surch(fav)}}$$

Case 3: GEO/STR A2+M2 I

$$1.00 G_{\text{Soil}} + 1.00 G_{\text{Wall}} + 1.00 P_a + 1.30 P_{\text{surch(fav)}}$$

Case 4: GEO/STR A1+M1 II

$$1.00 G_{\text{Soil}} + 1.00 G_{\text{Wall}} + 1.35 P_a + 1.50 P_{\text{surch(fav)}}$$

Case 5: GEO/STR A2+M2 II

$$1.00 G_{\text{Soil}} + 1.00 G_{\text{Wall}} + 1.00 P_a + 1.30 P_{\text{surch(fav)}}$$

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Case 6: GEO/STR A1+M1 III 1.35 G_{soil} +1.35 G_{wall} +1.35 P_a +1.50 $P_{surch}(fav)$

Geotechnical Design

Wall Stability - Virtual Back Pressure

EQU Case 1 Overturning/Stabilising 8.943/22.838 0.392 OK

Wall Sliding - Virtual Back Pressure

Case 2 $F_x/(R_{xfriction} + R_{xpassive})$	13.943/(16.264+6.105)	0.623	OK
Case 3 $F_x/(R_{xfriction} + R_{xpassive})$	13.510/(13.012+4.974)	0.751	OK
Case 4 $F_x/(R_{xfriction} + R_{xpassive})$	13.943/(16.264+6.105)	0.623	OK
Case 5 $F_x/(R_{xfriction} + R_{xpassive})$	13.510/(13.012+4.974)	0.751	OK
Case 6 $F_x/(R_{xfriction} + R_{xpassive})$	13.943/(21.957+6.105)	0.497	OK

Soil Pressure

Case 2 - Virtual Back	23.029/75 kN/m ² , Length under pressure 1.223 m	0.307	OK
Case 3 - Virtual Back	23.050/75 kN/m ² , Length under pressure 1.222 m	0.307	OK
Case 4 - Virtual Back	23.029/75 kN/m ² , Length under pressure 1.223 m	0.307	OK
Case 5 - Virtual Back	23.050/75 kN/m ² , Length under pressure 1.222 m	0.307	OK
Case 6 - Virtual Back	31.040/75 kN/m ² , Length under pressure 1.225 m	0.414	OK
Case 2 - Wall Back	25.544/75 kN/m ² , Length under pressure 1.103 m	0.341	OK
Case 3 - Wall Back	25.197/75 kN/m ² , Length under pressure 1.118 m	0.336	OK
Case 4 - Wall Back	25.544/75 kN/m ² , Length under pressure 1.103 m	0.341	OK
Case 5 - Wall Back	25.197/75 kN/m ² , Length under pressure 1.118 m	0.336	OK
Case 6 - Wall Back	29.578/75 kN/m ² , Length under pressure 1.286 m	0.394	OK

Structural Design

Outer Leaf Details

Partial Safety Factor (γ_{mc}/γ_{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	20 N/mm ² , Mortar designation M12/(i)		
Compressive Strength (f_k)	Group 1, $\gamma=20$ kN/m ³	8.58 N/mm ²	Table NA.6

Inner Leaf Details

Partial Safety Factor (γ_{mc}/γ_{mf})	Units Category II, Execution Control Class 2	3/2.7	Table NA.1
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=102.5	2.10	
Compressive Strength (f_k)	Group 1	5.48 N/mm ²	Table NA.6

Wall Design (Inner Steel)

Critical Section	Critical @ 0 mm from base, Case 2		
Steel Provided (Cover)	Dist. H10@200 (30 mm in cavity)		
	Main H10@200 (50 mm in cavity)	393 mm ²	OK
Leverarm $z=fn(d,b,As,f_y,f_k)$	145 mm, 1000 mm, 393 mm ² , 500 N/mm ² , 28 N/mm ²	118 mm	
$M_r=fn(above, \gamma_{mf}, \gamma_{ms})$	2.70, 1.15	20.2 kN.m	
Moment Capacity Check (M/M_r)	M 6.1 kN.m, M_r 20.2 kN.m	0.304	OK
Shear Capacity Check	F 11.0 kN, f_{vk} 0.611 N/mm ² , F_{vr} 35.4 kN	0.31	OK

Base Top Steel Design - Case 3

Steel Provided (Cover)	Main H10@100 (50 mm) Dist. H10@100 (60 mm)	785 mm ²	OK
Compression Steel Provided (Cover)	Main H10@100 (50 mm) Dist. H10@100 (60 mm)	785 mm ²	
Leverarm $z=fn(d,b,As,f_y,F_{ck})$	295 mm, 1000 mm, 785 mm ² , 500 N/mm ² , 28 N/mm ²	280 mm	
$M_r=fn(above, As', d', x, x/d)$	785 mm ² , 55 mm, 27 mm, 0.09	95.7 kN.m	
Moment Capacity Check (M/M_r)	M 0.3 kN.m, M_r 95.7 kN.m	0.003	OK
Shear Capacity Check	F 5.8 kN, v_c 0.456 N/mm ² , F_{vr} 134.5 kN	0.04	OK

Base Bottom Steel Design - Case 6

Steel Provided (Cover)	Main H10@100 (50 mm) Dist. H10@100 (60 mm)	785 mm ²	OK
Compression Steel Provided (Cover)	Main H10@100 (50 mm) Dist. H10@100 (60 mm)	785 mm ²	
Leverarm $z=fn(d,b,As,f_y,F_{ck})$	295 mm, 1000 mm, 785 mm ² , 500 N/mm ² , 28 N/mm ²	280 mm	
$M_r=fn(above, As', d', x, x/d)$	785 mm ² , 55 mm, 27 mm, 0.09	95.7 kN.m	
Moment Capacity Check (M/M_r)	M 9.2 kN.m, M_r 95.7 kN.m	0.097	OK
Shear Capacity Check	F 14.6 kN, v_c 0.456 N/mm ² , F_{vr} 134.5 kN	0.11	OK