Partington Associates	Project: Burns Rd				Job Ref.: 4872-22	
	Section: Calculations				Sheet no./rev.: 1	
	Calc. by: PE/DO	Date: Jul '22	Chck'd by: DO	Date: Jul '22	App'd by: DO	Date: Jul '22

Structural calculations for:

Highway Retaining Wall
At
Burn Road,
Birchencliffe,
Huddersfield

Calculations by:

Partington & Associates Ltd

Client: Wiggett Construction

Architect: HNA Architects

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Checked	**: DO**
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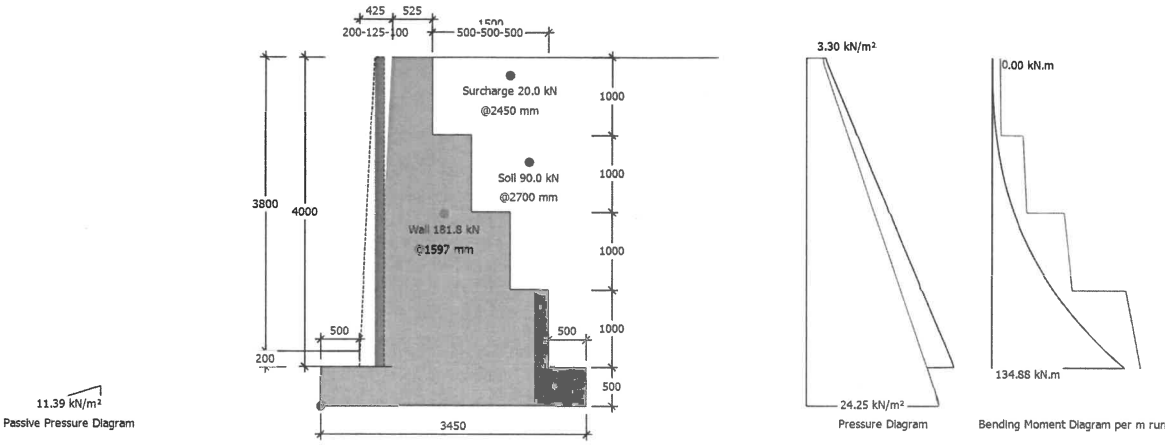
MasterKey : Retaining Wall Design to BS 8002 : 1994 and BS 8110 : 1997
Basic RC Retaining Wall
Gravity Concrete Retaining Wall with External Cladding with Reinforced Base



Summary of Design Data

Notes	All dimensions are in mm and all forces are per metre run
Material Densities (kN/m³)	Soil 18.00, Concrete 24.00, Cladding 20.00
Concrete grade	fcu 35 N/mm², Permissible tensile stress 0.250 N/mm²
Concrete covers (mm)	Base cover 50 mm
Reinforcement design	fy 500 N/mm² designed to BS 8110: 1997
Surcharge and Water Table	Surcharge 10.00 kN/m², Fully drained
Unplanned excavation depth	Front of wall 450 mm

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

Soil Properties

Bearing pressure	Premissable service pressure @ front 125.00 kN/m², @ back 125.00 kN/m²
Back Soil Friction and Cohesion	ϕ_b = Atn(Tan(35)/1.2) = 30.26°
Base Friction and Cohesion	δ = Atn(0.75xTan(Atn(Tan(35)/1.2))) = 23.64°
Front Soil Friction and Cohesion	ϕ = Atn(Tan(30)/1.2) = 25.69°

Loading Cases

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_p- Passive Earth Pressure

Case 1: Geotechnical Design	1.00 G_{Soil}+1.00 G_{Wall}+1.00 Fv_{Heel}+1.00 P_a+1.00 $P_{surcharge}$+1.00 P_p
Case 2: Structural Ultimate Design	1.40 G_{Soil}+1.40 G_{Wall}+1.60 Fv_{Heel}+1.00 P_a+1.00 $P_{surcharge}$

Geotechnical Design

Wall Stability - Virtual Back Pressure

Case 1 Overturning/Stabilising	100.832/549.436	0.184	OK

Wall Sliding - Virtual Back Pressure

$Fx/(Rx_{Friction}+Rx_{Passive})$	61.029/(121.136+1.429)	0.498	OK

Soil Pressure

Virtual Back (No uplift)	Max(94.788/125, 65.676/125) kN/m²	0.758	OK
Wall Back (No uplift)	Max(105.808/125, 54.656/125) kN/m²	0.846	OK

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Structural Design

At Rest Earth Pressure

At rest earth pressures magnification	$(1+\text{Sin}(\phi)) \times \sqrt{OCR} = (1+\text{Sin}(30.26)\times\sqrt{1}$		1.5

Cladding Details

Partial Safety Factor ($\gamma mc/\gamma mf$)	Normal manufacturing, Normal construction	3.5/3	Table 4a/4b
Material	Clay bricks with water absorption less than 7%		
Units and Mortar Strength	5 N/mm², Mortar designation (i)		
Compressive Strength (fk)	Standard format bricks,γ=20 kN/m³	2.5 N/mm²	Table 2

Wall Design (Inner Face Tension)

Critical Section	Critical @ 0 mm from base, Case 2		
Section Properties @ Base	t=2025 mm, Area=20250 cm², Zb=683438 cm³		
Concrete Flexural Strength ft	ft=0.25, gd=0.06 N/mm², ft=ft+0.9 gd.γmf	0.332 N/mm²	
Mr=ft.Zb/γmf	0.332x683438/1.5	151.08 kN.m	
Moment Capacity Check (M/Mr)	M 134.9 kN.m, Mr 151.1 kN.m	0.893	OK
Shear Capacity Check	F 91.1 kN, vc 0.252 N/mm², Fvr 254.9 kN	0.36	OK

Base Top Face Tension

Maximum Tensile Stress	M 7.327, h 500, fcu 35, Permissible 0.25 N/mm²	0.18 N/mm²	OK
Shear Capacity Check	F 28.3 kN, vc 0.350 N/mm², Fvr 87.5 kN	0.32	OK

Base Bottom Steel Design

Steel Provided (Cover)	Main H16@150 (50 mm) Dist. H16@175 (66 mm)	1340 mm²	OK
Leverarm z=fn(d,b,As,fy,Fcu)	442 mm, 1000 mm, 1340 mm², 500 N/mm², 35 N/mm²	420 mm	
Mr=fn(above,x,x/d)	42 mm, 0.09	244.8 kN.m	
Moment Capacity Check (M/Mr)	M 33.5 kN.m, Mr 244.8 kN.m	0.137	OK
Shear Capacity Check	F 79.2 kN, vc 0.463 N/mm², Fvr 204.8 kN	0.39	OK

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