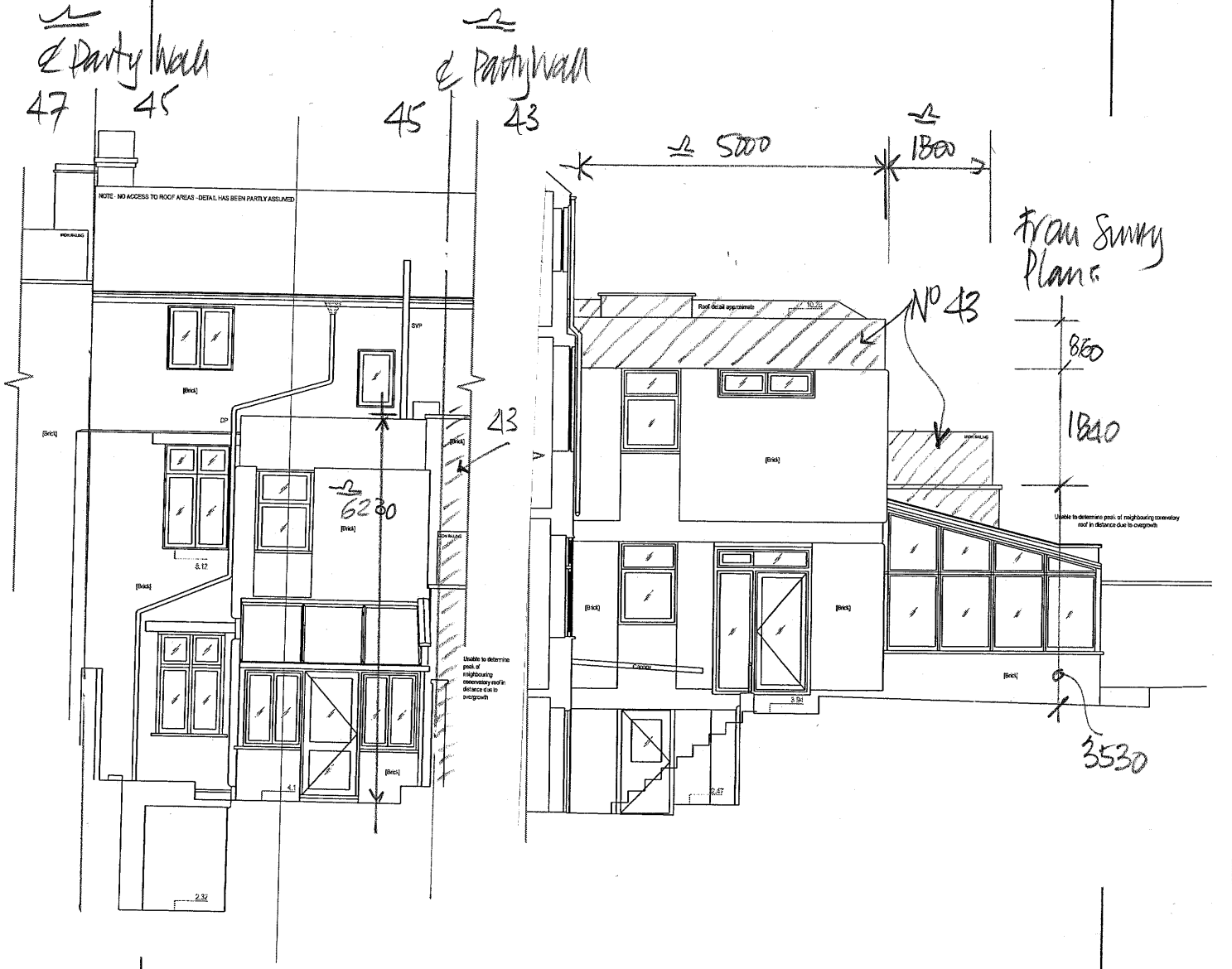
Job No	Location	Page No
360119	45 Plack Walk	PW01

Calculation By	Subject	Date
Tf.	**General Calculations** PARTY WALL WITH No 43	Feb'16

Input Data	Calculation	Output Data



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Job No	Location	Page No
360219	45 Flask Walk	PW02

Calculation By	Subject	Date
Tf.	**General Calculations** PARTY WALL WITH N° 43	Feb'16

Input Data	Calculation	Output Data
Existing	P/wall Higher section.	kN.
	Wall swt = 6.23 x 4.20 = 26.17 kN/m	
	Pitch Roof N°43 = 2 x 3/2 (Assumed) = 3.00 kN/m.	0.9 kN/m
	1 & 2ND Floor N° 43 = 2 x 1 (Allowance) = 2.00 kN/m	1.5 kN/m
	2 x 1 (-"-) = 2.00 kN/m	1.5 kN/m
	1 & 2ND Floor N° 45 2 x 3/2 = 3.00 kN/m	2.25 kN/m
	2 x 3/2 = 3.00 kN/m	2.25 kN/m
	Flat Roof N° 45 2 x 3/2 = 3.00 kN/m	0.9 kN/m.
	Total load. 42.17 kN/m.	9.5 kN
	∴ Dn. 32.87 kN/m.	
Additional load.	BASEMENT FLOOR.	
Sup. 1.10 Fin. 2.40 Sw 4.80 Col 0.30 9.00	RC Slab & Fin. 9 x 5/2 = 22.5 kN/m	Un 37.5 kN/m Dn 18.75 kN/m
	+ Swt Ret Wall.	

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Job No	Location	Page No
360219	45 Plask Walk	PW03

Calculation By	Subject	Date
Tf.	**General Calculations** PARTY WALL WORKS No 43	Feb '16

Input Data	Calculation	Output Data

loads from No 43 to P/W

This survey Drawing shows the Main House projecting approx 5000 from the main rear wall, & then a lower projection a further 1800mm.

Assumptions to be confirmed:-

- Thickness of P/wall - high section - 225mm
- -"- -"- - low -"- - 225mm
- Floors front to back as No 45 To be verified.

Take wall + plaster . 1.20 kN/m².
Assume floors > 2.00 kN/m²
-"- Roof flat > 2.00 kN/m²
-"- -"- Pitched > 1.60 kN/m².

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Job No	Location	Page No
36029	45 Flask Walk	PW04

Calculation By	Subject	Date
Tf.	**General Calculations** PARTY WALL WITH NO 43	Feb 16

Input Data	Calculation	Output Data
Existing	P/Wall - lower section	
	Wall ext. 3.53 x 4.20 = 14.29 kN/m	kN
	Adj Terrace - 2.2 x 3/2 = 3.30 kN/m	2.25 kN/m
	Ged Floor - 2.2 x 3/2 = 3.30 kN/m	2.25 kN/m
	Σ load 20.89 kN/m	4.50 kN/m
	Ln = 4.50 kN/m	
	∴ Dn. 16.39 kN/m	

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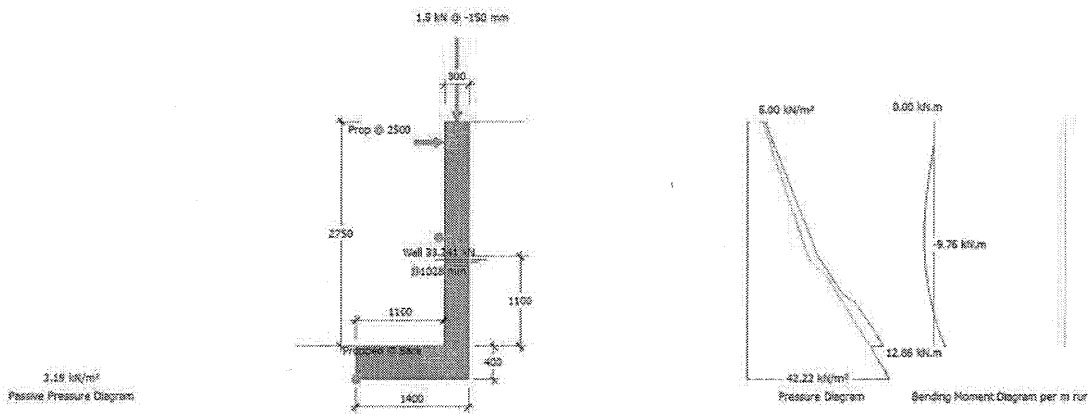
11660

Job Ref	**: 360219**
Sheet	**: Ret wall case 1 /**
Made by	**: TF**
Date	**: 04 March 2016 / Ver. 2015.05**
Checked	**: jf**
Approved	**:**

PW05

MasterKey : Retaining Wall Design to BS 8002 and BS 8110 : 1997
Basic RC Retaining Wall
Reinforced Concrete Retaining Wall with Reinforced Base



Summary of Design Data

Notes	All dimensions are in mm and all forces are per metre run
Material Densities (kN/m³)	Back Soil - Dry 19.50, Saturated 21.70, Submerged 11.70
	Front Soil - Dry 18.00, Saturated 20.80, Submerged 10.80, Concrete 24.00
Special Assumptions (virtual back)	No surcharge over heel
Concrete grade	fcu 30 N/mm², Permissible tensile stress 0.250 N/mm²
Concrete covers (mm)	Wall inner cover 30 mm, Wall outer cover 30 mm, Base cover 50 mm
Reinforcement design	fy 460 N/mm² designed to BS 8110: 1997
Surcharge and Water Table	Surcharge 10.00 kN/m², Water table level 1100 mm

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

Additional Loads

Wall Propped at Base Level	Therefore no sliding check is required
Additional Wall Prop	Prop @ 2.5 m
Vertical Line Loads	8.5 kN/m @ X -150 mm and Y 0 mm - Load type Dead
	1.5 kN/m @ X -150 mm and Y 0 mm - Load type Live
Distributed Surcharge Load	5 kN/m² starting @ 1700 mm and ending @ 6500 mm - Load type Live
† Dimensions	All props are measured from the top of the base
	Ties, line loads and partial loads are measured from the inner top edge of the wall

Soil Properties

Soil bearing pressure	Allowable pressure @ front 150.00 kN/m², @ back 150.00 kN/m²
Back Soil Friction and Cohesion	ϕ_b = Atn(Tan(23)/1.2) = 19.48°
Base Friction and Cohesion	δ = Atn(0.75xTan(Atn(Tan(23)/1.2))) = 14.86°
Front Soil Friction and Cohesion	ϕ = Atn(Tan(30)/1.2) = 25.69°

Loading Cases

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_{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_{Wall}+1.60 Fv_{Heel}+1.00 P_a+1.00 $P_{surcharge}$+1.00 P_p

Geotechnical Design

Wall Stability - Virtual Back Pressure

Case 1 Overturning/Stabilising	70.452/88.666	0.795	OK

Wall Sliding - Virtual Back Pressure

Fx/($Rx_{Friction}$+ $Rx_{Passive}$)	0.000/(11.471+0.138)	0.000	OK
Prop Reactions Case 2 (Service)	50.6 kN @ Base, 14.5 kN @ 2.900 m		

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Sheet : Ret wall case 1 /
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PN DG

Soil Pressure

Virtual Back	68.429/150 kN/m², Length under pressure 1.264 m	0.456	OK
Wall Back	82.276/150 kN/m², Length under pressure 1.051 m	0.549	OK

Structural Design

Prop Reactions

Maximum Prop Reactions (Ultimate)	54.7 kN @ Base, 16.6 kN @ 2.500 m		

Wall Design (Inner Steel)

Critical Section	Critical @ 0 mm from base, Case 2		
Steel Provided (Cover)	Main B16@150 (30 mm) Dist. B12@175 (46 mm)	1340 mm²	OK
Compression Steel Provided (Cover)	Main B12@250 (30 mm) Dist. B12@175 (42 mm)	452 mm²	
Leverarm z=fn(d,b,As,fy,Fcu)	262 mm, 1000 mm, 1340 mm², 460 N/mm², 30.0 N/mm²	240 mm	
Mr=fn(above,As',d',x,x/d)	452 mm², 36 mm, 48 mm, 0.18	140.7 kN.m	
Moment Capacity Check (M/Mr)	M 12.9 kN.m, Mr 140.7 kN.m	0.091	OK
Shear Capacity Check	F 38.9 kN, vc 0.597 N/mm², Fvr 156.4 kN	0.25	OK

Wall Design (Outer Steel)

Critical Section	Critical @ 1332 mm from base, Case 2		
Steel Provided (Cover)	Main B12@250 (30 mm) Dist. B12@175 (42 mm)	452 mm²	OK
Compression Steel Provided (Cover)	Main B16@150 (30 mm) Dist. B12@175 (46 mm)	1340 mm²	
Leverarm z=fn(d,b,As,fy,Fcu)	264 mm, 1000 mm, 452 mm², 460 N/mm², 30.0 N/mm²	251 mm	
Mr=fn(above,As',d',x,x/d)	1340 mm², 38 mm, 16 mm, 0.06	49.6 kN.m	
Moment Capacity Check (M/Mr)	M 9.8 kN.m, Mr 49.6 kN.m	0.197	OK
Shear Capacity Check	F 0.3 kN, vc 0.414 N/mm², Fvr 109.3 kN	0.00	OK

Base Top Steel Design

Steel Provided (Cover)	Main B16@150 (50 mm) Dist. B12@175 (66 mm)	1340 mm²	OK
Compression Steel Provided (Cover)	Main B12@150 (50 mm) Dist. B12@175 (62 mm)	754 mm²	
Leverarm z=fn(d,b,As,fy,Fcu)	342 mm, 1000 mm, 1340 mm², 460 N/mm², 30 N/mm²	320 mm	
Mr=fn(above,As',d',x,x/d)	754 mm², 56 mm, 48 mm, 0.14	187.5 kN.m	
Moment Capacity Check (M/Mr)	M 0.0 kN.m, Mr 187.5 kN.m	0.000	OK
Shear Capacity Check	F 0.0 kN, vc 0.511 N/mm², Fvr 174.8 kN	0.00	OK

Base Bottom Steel Design

Steel Provided (Cover)	Main B12@150 (50 mm) Dist. B12@175 (62 mm)	754 mm²	OK
Compression Steel Provided (Cover)	Main B16@150 (50 mm) Dist. B12@175 (66 mm)	1340 mm²	
Leverarm z=fn(d,b,As,fy,Fcu)	344 mm, 1000 mm, 754 mm², 460 N/mm², 30 N/mm²	327 mm	
Mr=fn(above,As',d',x,x/d)	1340 mm², 58 mm, 27 mm, 0.08	107.7 kN.m	
Moment Capacity Check (M/Mr)	M 25.6 kN.m, Mr 107.7 kN.m	0.237	OK
Shear Capacity Check	F 39.1 kN, vc 0.420 N/mm², Fvr 144.6 kN	0.27	OK

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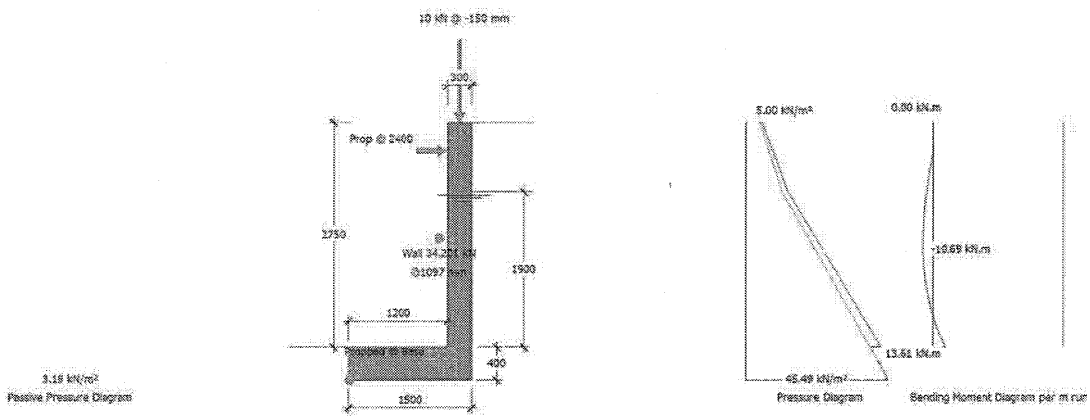
PW07

MasterKey : Retaining Wall Design to BS 8002 and BS 8110 : 1997
Basic RC Retaining Wall
Reinforced Concrete Retaining Wall with Reinforced Base



Summary of Design Data

Notes	All dimensions are in mm and all forces are per metre run
Material Densities (kN/m³)	Back Soil - Dry 19.50, Saturated 21.70, Submerged 11.70
	Front Soil - Dry 18.00, Saturated 20.80, Submerged 10.80, Concrete 24.00
Special Assumptions (virtual back)	No surcharge over heel
Concrete grade	fcu 30 N/mm², Permissible tensile stress 0.250 N/mm²
Concrete covers (mm)	Wall inner cover 30 mm, Wall outer cover 30 mm, Base cover 50 mm
Reinforcement design	fy 460 N/mm² designed to BS 8110: 1997
Surcharge and Water Table	Surcharge 10.00 kN/m², Water table level 1900 mm

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

Additional Loads

Wall Propped at Base Level	Therefore no sliding check is required
Additional Wall Prop	Prop @ 2.4 m
Vertical Line Load	10 kN/m @ X -150 mm and Y 0 mm - Load type Live
† Dimensions	All props are measured from the top of the base
	Ties, line loads and partial loads are measured from the inner top edge of the wall

Soil Properties

Soil bearing pressure	Allowable pressure @ front 150.00 kN/m², @ back 150.00 kN/m²
Back Soil Friction and Cohesion	ϕ_h = Atn(Tan(23)/1.2) = 19.48°
Base Friction and Cohesion	δ = Atn(0.75xTan(Atn(Tan(23)/1.2))) = 14.86°
Front Soil Friction and Cohesion	ϕ = Atn(Tan(30)/1.2) = 25.69°

Loading Cases

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_{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_{Wall}+1.60 Fv_{Heel}+1.00 P_a+1.00 $P_{surcharge}$+1.00 P_p

Geotechnical Design

Wall Stability - Virtual Back Pressure

Case 1 Overturning/Stabilising	78.418/98.454	0.796	OK

Wall Sliding - Virtual Back Pressure

$Fx/(Rx_{Friction}+Rx_{Passive})$	0.000/(11.726+0.138)	0.000	OK
Prop Reactions Case 2 (Service)	55.6 kN @ Base, 16.9 kN @ 2.800 m		

Soil Pressure

Virtual Back	65.001/150 kN/m², Length under pressure 1.36 m	0.433	OK

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PW7

Wall Back	75.980/150 kN/m², Length under pressure 1.163 m	0.507	OK

Structural Design

Prop Reactions

Maximum Prop Reactions (Ultimate)	59.4 kN @ Base, 19.2 kN @ 2.400 m		

Wall Design (Inner Steel)

Critical Section	Critical @ 0 mm from base, Case 2		
Steel Provided (Cover)	Main B16@150 (30 mm) Dist. B12@175 (46 mm)	1340 mm²	OK
Compression Steel Provided (Cover)	Main B12@250 (30 mm) Dist. B12@175 (42 mm)	452 mm²	
Leverarm z=fn(d,b,As,fy,Fcu)	262 mm, 1000 mm, 1340 mm², 460 N/mm², 30.0 N/mm²	240 mm	
Mr=fn(above,As',d',x,x/d)	452 mm², 36 mm, 48 mm, 0.18	140.7 kN.m	
Moment Capacity Check (M/Mr)	M 13.6 kN.m, Mr 140.7 kN.m	0.097	OK
Shear Capacity Check	F 42.3 kN, vc 0.597 N/mm², Fvr 156.4 kN	0.27	OK

Wall Design (Outer Steel)

Critical Section	Critical @ 1280 mm from base, Case 2		
Steel Provided (Cover)	Main B12@250 (30 mm) Dist. B12@175 (42 mm)	452 mm²	OK
Compression Steel Provided (Cover)	Main B16@150 (30 mm) Dist. B12@175 (46 mm)	1340 mm²	
Leverarm z=fn(d,b,As,fy,Fcu)	264 mm, 1000 mm, 452 mm², 460 N/mm², 30.0 N/mm²	251 mm	
Mr=fn(above,As',d',x,x/d)	1340 mm², 38 mm, 16 mm, 0.06	49.6 kN.m	
Moment Capacity Check (M/Mr)	M 10.7 kN.m, Mr 49.6 kN.m	0.216	OK
Shear Capacity Check	F 0.1 kN, vc 0.414 N/mm², Fvr 109.3 kN	0.00	OK

Base Top Steel Design

Steel Provided (Cover)	Main B16@150 (50 mm) Dist. B12@175 (66 mm)	1340 mm²	OK
Compression Steel Provided (Cover)	Main B12@150 (50 mm) Dist. B12@175 (62 mm)	754 mm²	
Leverarm z=fn(d,b,As,fy,Fcu)	342 mm, 1000 mm, 1340 mm², 460 N/mm², 30 N/mm²	320 mm	
Mr=fn(above,As',d',x,x/d)	754 mm², 56 mm, 48 mm, 0.14	187.5 kN.m	
Moment Capacity Check (M/Mr)	M 0.0 kN.m, Mr 187.5 kN.m	0.000	OK
Shear Capacity Check	F 0.0 kN, vc 0.511 N/mm², Fvr 174.8 kN	0.00	OK

Base Bottom Steel Design

Steel Provided (Cover)	Main B12@150 (50 mm) Dist. B12@175 (62 mm)	754 mm²	OK
Compression Steel Provided (Cover)	Main B16@150 (50 mm) Dist. B12@175 (66 mm)	1340 mm²	
Leverarm z=fn(d,b,As,fy,Fcu)	344 mm, 1000 mm, 754 mm², 460 N/mm², 30 N/mm²	327 mm	
Mr=fn(above,As',d',x,x/d)	1340 mm², 58 mm, 27 mm, 0.08	107.7 kN.m	
Moment Capacity Check (M/Mr)	M 27.8 kN.m, Mr 107.7 kN.m	0.259	OK
Shear Capacity Check	F 39.9 kN, vc 0.420 N/mm², Fvr 144.6 kN	0.28	OK

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Job Ref : 360219
Sheet : Ret wall /
Made by : TF
Date : 04 March 2016 / Ver. 2015.05
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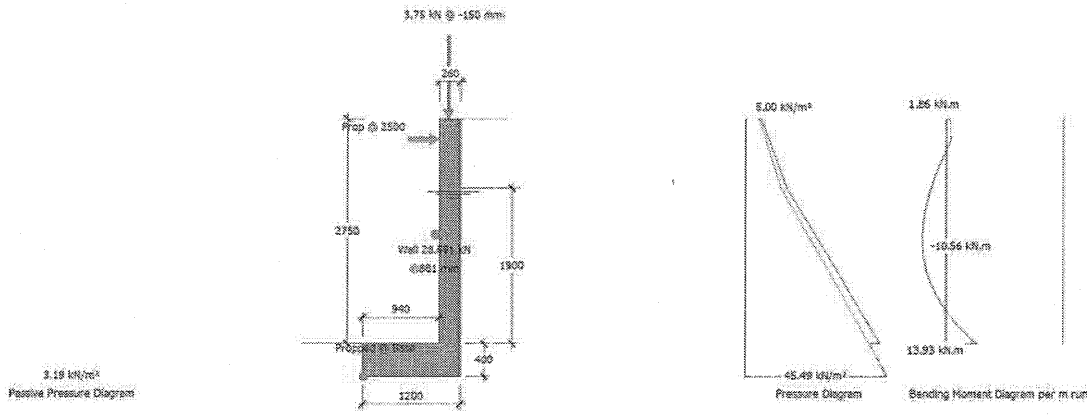
PNB

MasterKey : Retaining Wall Design to BS 8002 and BS 8110 : 1997
Basic RC Retaining Wall
Reinforced Concrete Retaining Wall with Reinforced Base



Summary of Design Data

Notes	All dimensions are in mm and all forces are per metre run
Material Densities (kN/m³)	Back Soil - Dry 19.50, Saturated 21.70, Submerged 11.70
	Front Soil - Dry 18.00, Saturated 20.80, Submerged 10.80, Concrete 24.00
Special Assumptions (virtual back)	No surcharge over heel
Concrete grade	fcu 35 N/mm², Permissible tensile stress 0.250 N/mm²
Concrete covers (mm)	Wall inner cover 30 mm, Wall outer cover 50 mm, Base cover 50 mm
Reinforcement design	fy 460 N/mm² designed to BS 8110: 1997
Surcharge and Water Table	Surcharge 10.00 kN/m², Water table level 1900 mm

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

Additional Loads

Wall Propped at Base Level	Therefore no sliding check is required
Additional Wall Prop	Prop @ 2.5 m
Vertical Line Loads	32.87 kN/m @ X -150 mm and Y 0 mm - Load type Dead
	9.3 kN/m @ X -150 mm and Y 0 mm - Load type Live
	18.75 kN/m @ X -150 mm and Y 0 mm - Load type Dead
	3.75 kN/m @ X -150 mm and Y 0 mm - Load type Live
† Dimensions	All props are measured from the top of the base
	Ties, line loads and partial loads are measured from the inner top edge of the wall

Soil Properties

Soil bearing pressure	Allowable pressure @ front 150.00 kN/m², @ back 150.00 kN/m²
Back Soil Friction and Cohesion	ϕ_b = Atn(Tan(23)/1.2) = 19.48°
Base Friction and Cohesion	δ = Atn(0.75xTan(Atn(Tan(23)/1.2))) = 14.86°
Front Soil Friction and Cohesion	ϕ = Atn(Tan(30)/1.2) = 25.69°

Loading Cases

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_{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_{Wall}+1.60 Fv_{Heel}+1.00 P_a+1.00 $P_{surcharge}$+1.00 P_p

Geotechnical Design

Wall Stability - Virtual Back Pressure

Case 1 Overturning/Stabilising	80.501/143.425	0.561	OK

Wall Sliding - Virtual Back Pressure

Fx/($Rx_{Friction}$+ $Rx_{Passive}$)	0.000/(24.765+0.856)	0.000	OK
Prop Reactions Case 2 (Service)	56.6 kN @ Base, 16.6 kN @ 2.900 m		

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Soil Pressure

Virtual Back (No uplift)	Max(48.998/150, 106.572/150) kN/m²	0.710	OK
Wall Back (No uplift)	Max(61.794/150, 93.777/150) kN/m²	0.625	OK

Structural Design

Prop Reactions

Maximum Prop Reactions (Ultimate) 60.6 kN @ Base, 19.1 kN @ 2.500 m

Wall Design (Inner Steel)

Critical Section	Critical @ 0 mm from base, Case 2		
Steel Provided (Cover)	Main H12@200 (30 mm) Dist. H12@200 (42 mm)	565 mm²	OK
Compression Steel Provided (Cover)	Main H12@200 (50 mm) Dist. H12@200 (62 mm)	565 mm²	
Leverarm z=fn(d,b,As,fy,Fcu)	224 mm, 1000 mm, 565 mm², 460 N/mm², 35.0 N/mm²	213 mm	
Mr=fn(above,As',d',x,x/d)	565 mm², 56 mm, 18 mm, 0.08	52.6 kN.m	
Moment Capacity Check (M/Mr)	M 13.9 kN.m, Mr 52.6 kN.m	0.265	OK
Wall Axail Design (N/Ncap)	N 117.2 kN, Ncap 3640.0 kN	0.032	OK
Wall Slenderness λ_s	Leff/tk =0.80x2750.0/260.0	8.5	OK
Wall Axail-Mom Design (M/Mr_{Axial})	M 13.9 kN, Mr_{Axail} 71.3 kN.m	0.195	OK
Shear Capacity Check	F 42.5 kN, vc 0.517 N/mm², Fvr 115.7 kN	0.37	OK

Wall Design (Outer Steel)

Critical Section	Critical @ 1280 mm from base, Case 2		
Steel Provided (Cover)	Main H12@200 (50 mm) Dist. H12@200 (62 mm)	565 mm²	OK
Compression Steel Provided (Cover)	Main H12@200 (30 mm) Dist. H12@200 (42 mm)	565 mm²	
Leverarm z=fn(d,b,As,fy,Fcu)	204 mm, 1000 mm, 565 mm², 460 N/mm², 35.0 N/mm²	194 mm	
Mr=fn(above,As',d',x,x/d)	565 mm², 36 mm, 18 mm, 0.09	47.9 kN.m	
Moment Capacity Check (M/Mr)	M 10.6 kN.m, Mr 47.9 kN.m	0.220	OK
Wall Axail Design (N/Ncap)	N 117.2 kN, Ncap 3640.0 kN	0.032	OK
Wall Slenderness λ_s	Leff/tk =0.80x2750.0/260.0	8.5	OK
Wall Axail-Mom Design (M/Mr_{Axial})	M 10.6 kN, Mr_{Axail} 61.0 kN.m	0.173	OK
Shear Capacity Check	F 0.0 kN, vc 0.546 N/mm², Fvr 111.3 kN	0.00	OK

Base Top Steel Design

Steel Provided (Cover)	Main H12@200 (50 mm) Dist. H12@200 (62 mm)	565 mm²	OK
Compression Steel Provided (Cover)	Main H12@200 (50 mm) Dist. H12@200 (62 mm)	565 mm²	
Leverarm z=fn(d,b,As,fy,Fcu)	344 mm, 1000 mm, 565 mm², 460 N/mm², 35 N/mm²	327 mm	
Mr=fn(above,As',d',x,x/d)	565 mm², 56 mm, 18 mm, 0.05	80.8 kN.m	
Moment Capacity Check (M/Mr)	M 0.0 kN.m, Mr 80.8 kN.m	0.000	OK
Shear Capacity Check	F 0.0 kN, vc 0.402 N/mm², Fvr 138.4 kN	0.00	OK

Base Bottom Steel Design

Steel Provided (Cover)	Main H12@200 (50 mm) Dist. H12@200 (62 mm)	565 mm²	OK
Compression Steel Provided (Cover)	Main H12@200 (50 mm) Dist. H12@200 (62 mm)	565 mm²	
Leverarm z=fn(d,b,As,fy,Fcu)	344 mm, 1000 mm, 565 mm², 460 N/mm², 35 N/mm²	327 mm	
Mr=fn(above,As',d',x,x/d)	565 mm², 56 mm, 18 mm, 0.05	80.8 kN.m	
Moment Capacity Check (M/Mr)	M 24.8 kN.m, Mr 80.8 kN.m	0.308	OK
Shear Capacity Check	F 74.1 kN, vc 0.402 N/mm², Fvr 138.4 kN	0.54	OK

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Sheet : Ret wall case 1 / PW10
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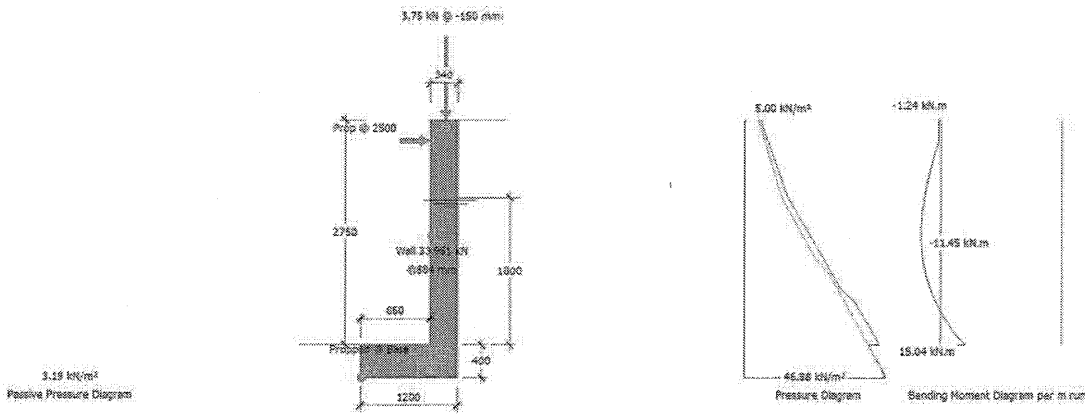
Date : 04 March 2016 / Ver. 2015.05
Checked : jf
Approved :

MasterKey : Retaining Wall Design to BS 8002 and BS 8110 : 1997
Basic RC Retaining Wall
Reinforced Concrete Retaining Wall with Reinforced Base



Summary of Design Data

Notes	All dimensions are in mm and all forces are per metre run
Material Densities (kN/m³)	Back Soil - Dry 19.50, Saturated 21.70, Submerged 11.70
	Front Soil - Dry 18.00, Saturated 20.80, Submerged 10.80, Concrete 24.00
Special Assumptions (virtual back)	No surcharge over heel
Concrete grade	fcu 35 N/mm², Permissible tensile stress 0.250 N/mm²
Concrete covers (mm)	Wall inner cover 30 mm, Wall outer cover 150 mm, Base cover 50 mm
Reinforcement design	fy 460 N/mm² designed to BS 8110: 1997
Surcharge and Water Table	Surcharge 10.00 kN/m², Water table level 1800 mm

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

Additional Loads

Wall Propped at Base Level	Therefore no sliding check is required
Additional Wall Prop	Prop @ 2.5 m
Vertical Line Loads	16.39 kN/m @ X -150 mm and Y 0 mm - Load type Dead
	4.5 kN/m @ X -150 mm and Y 0 mm - Load type Live
	18.75 kN/m @ X -150 mm and Y 0 mm - Load type Dead
	3.75 kN/m @ X -150 mm and Y 0 mm - Load type Live
Distributed Surcharge Load	5 kN/m² starting @ 1700 mm and ending @ 6500 mm - Load type Live
† Dimensions	All props are measured from the top of the base
	Ties, line loads and partial loads are measured from the inner top edge of the wall

Soil Properties

Soil bearing pressure	Allowable pressure @ front 150.00 kN/m², @ back 150.00 kN/m²
Back Soil Friction and Cohesion	ϕ_b = Atn(Tan(23)/1.2) = 19.48°
Base Friction and Cohesion	δ = Atn(0.75xTan(Atn(Tan(23)/1.2))) = 14.86°
Front Soil Friction and Cohesion	ϕ = Atn(Tan(30)/1.2) = 25.69°

Loading Cases

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_{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_{Wall}+1.60 Fv_{Heel}+1.00 P_a+1.00 $P_{surcharge}$+1.00 P_p

Geotechnical Design

Wall Stability - Virtual Back Pressure

Case 1 Overturning/Stabilising	77.172/118.500	0.651	OK

Wall Sliding - Virtual Back Pressure

$Fx/(Rx_{Friction}+Rx_{Passive})$	0.000/(20.520+0.000)	0.000	OK

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Prop Reactions Case 2 (Service)	58.3 kN @ Base, 15.3 kN @ 2.900 m		

Soil Pressure

Virtual Back (No uplift)	Max(85.633/150, 43.273/150) kN/m²	0.571	OK
Wall Back (No uplift)	Max(97.040/150, 31.866/150) kN/m²	0.647	OK

Structural Design

Prop Reactions

Maximum Prop Reactions (Ultimate)	62.1 kN @ Base, 17.3 kN @ 2.500 m		

Wall Design (Inner Steel)

Critical Section	Critical @ 0 mm from base, Case 2		
Steel Provided (Cover)	Main H12@200 (30 mm) Dist. H12@200 (42 mm)	565 mm²	OK
Compression Steel Provided (Cover)	Main H12@200 (150 mm) Dist. H12@200 (162 mm)	565 mm²	
Leverarm z=fn(d,b,As,fy,Fcu)	304 mm, 1000 mm, 565 mm², 460 N/mm², 35.0 N/mm²	289 mm	
Mr=fn(above,As',d',x,x/d)	565 mm², 156 mm, 18 mm, 0.06	71.4 kN.m	
Moment Capacity Check (M/Mr)	M 15.0 kN.m, Mr 71.4 kN.m	0.211	OK
Shear Capacity Check	F 44.6 kN, vc 0.432 N/mm², Fvr 131.4 kN	0.34	OK

Wall Design (Outer Steel)

Critical Section	Critical @ 1332 mm from base, Case 2		
Steel Provided (Cover)	Main H12@200 (150 mm) Dist. H12@200 (162 mm)	565 mm²	OK
Compression Steel Provided (Cover)	Main H12@200 (30 mm) Dist. H12@200 (42 mm)	565 mm²	
Leverarm z=fn(d,b,As,fy,Fcu)	184 mm, 1000 mm, 565 mm², 460 N/mm², 35.0 N/mm²	175 mm	
Mr=fn(above,As',d',x,x/d)	565 mm², 36 mm, 18 mm, 0.10	43.2 kN.m	
Moment Capacity Check (M/Mr)	M 11.4 kN.m, Mr 43.2 kN.m	0.265	OK
Shear Capacity Check	F 0.5 kN, vc 0.579 N/mm², Fvr 106.6 kN	0.00	OK

Base Top Steel Design

Steel Provided (Cover)	Main H12@200 (50 mm) Dist. H12@200 (62 mm)	565 mm²	OK
Compression Steel Provided (Cover)	Main H12@200 (50 mm) Dist. H12@200 (62 mm)	565 mm²	
Leverarm z=fn(d,b,As,fy,Fcu)	344 mm, 1000 mm, 565 mm², 460 N/mm², 35 N/mm²	327 mm	
Mr=fn(above,As',d',x,x/d)	565 mm², 56 mm, 18 mm, 0.05	80.8 kN.m	
Moment Capacity Check (M/Mr)	M 0.0 kN.m, Mr 80.8 kN.m	0.000	OK
Shear Capacity Check	F 0.0 kN, vc 0.402 N/mm², Fvr 138.4 kN	0.00	OK

Base Bottom Steel Design

Steel Provided (Cover)	Main H12@200 (50 mm) Dist. H12@200 (62 mm)	565 mm²	OK
Compression Steel Provided (Cover)	Main H12@200 (50 mm) Dist. H12@200 (62 mm)	565 mm²	
Leverarm z=fn(d,b,As,fy,Fcu)	344 mm, 1000 mm, 565 mm², 460 N/mm², 35 N/mm²	327 mm	
Mr=fn(above,As',d',x,x/d)	565 mm², 56 mm, 18 mm, 0.05	80.8 kN.m	
Moment Capacity Check (M/Mr)	M 25.7 kN.m, Mr 80.8 kN.m	0.318	OK
Shear Capacity Check	F 63.2 kN, vc 0.402 N/mm², Fvr 138.4 kN	0.46	OK

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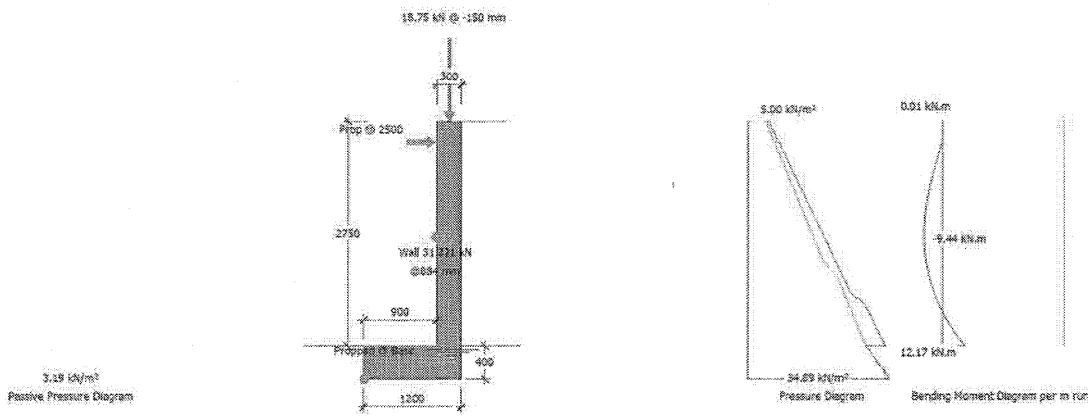
Basic RC Retaining Wall
Reinforced Concrete Retaining Wall with Reinforced Base



Summary of Design Data

Notes	All dimensions are in mm and all forces are per metre run
Material Densities (kN/m³)	Back Soil - Dry 19.50, Saturated 21.70, Submerged 11.70
	Front Soil - Dry 18.00, Saturated 20.80, Submerged 10.80, Concrete 24.00
Special Assumptions (virtual back)	No surcharge over heel
Concrete grade	fcu 35 N/mm², Permissible tensile stress 0.250 N/mm²
Concrete covers (mm)	Wall inner cover 20 mm, Wall outer cover 40 mm, Base cover 50 mm
Reinforcement design	fy 460 N/mm² designed to BS 8110: 1997
Surcharge and Water Table	Surcharge 10.00 kN/m², Water table level 0 mm

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

Additional Loads

Wall Propped at Base Level	Therefore no sliding check is required
Additional Wall Prop	Prop @ 2.5 m
Vertical Line Loads	3.75 kN/m @ X -150 mm and Y 0 mm - Load type Live
	18.75 kN/m @ X -150 mm and Y 0 mm - Load type Dead
Distributed Surcharge Load	5 kN/m² starting @ 1700 mm and ending @ 6500 mm - Load type Live
† Dimensions	All props are measured from the top of the base
	Ties, line loads and partial loads are measured from the inner top edge of the wall

Soil Properties

Soil bearing pressure	Allowable pressure @ front 150.00 kN/m², @ back 150.00 kN/m²
Back Soil Friction and Cohesion	ϕ_h = Atn(Tan(23)/1.2) = 19.48°
Base Friction and Cohesion	δ = Atn(0.75xTan(Atn(Tan(23)/1.2))) = 14.86°
Front Soil Friction and Cohesion	ϕ = Atn(Tan(30)/1.2) = 25.69°

Loading Cases

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_{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_{Wall}+1.60 Fv_{Heel}+1.00 P_a+1.00 $P_{surcharge}$+1.00 P_p

Geotechnical Design

Wall Stability - Virtual Back Pressure

Case 1 Overturning/Stabilising	66.728/92.449	0.722	OK

Wall Sliding - Virtual Back Pressure

$Fx/(Rx_{Friction}+Rx_{Passive})$	0.000/(14.278+0.138)	0.000	OK
Prop Reactions Case 2 (Service)	43.9 kN @ Base, 14.2 kN @ 2.900 m		

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PW 17

Soil Pressure

Virtual Back (No uplift)	Max(72.229/150, 17.464/150) kN/m²	0.482	OK
Wall Back (No uplift)	Max(85.809/150, 3.884/150) kN/m²	0.572	OK

Structural Design

Prop Reactions

Maximum Prop Reactions (Ultimate)	48.3 kN @ Base, 16.4 kN @ 2.500 m		

Wall Design (Inner Steel)

Critical Section	Critical @ 0 mm from base, Case 2		
Steel Provided (Cover)	Main H12@200 (20 mm) Dist. H12@200 (32 mm)	565 mm²	OK
Compression Steel Provided (Cover)	Main H12@200 (40 mm) Dist. H12@200 (52 mm)	565 mm²	
Leverarm z=fn(d,b,As,fy,Fcu)	274 mm, 1000 mm, 565 mm², 460 N/mm², 35.0 N/mm²	260 mm	
Mr=fn(above,As',d',x,x/d)	565 mm², 46 mm, 18 mm, 0.06	64.3 kN.m	
Moment Capacity Check (M/Mr)	M 12.2 kN.m, Mr 64.3 kN.m	0.189	OK
Shear Capacity Check	F 35.5 kN, vc 0.459 N/mm², Fvr 125.8 kN	0.28	OK

Wall Design (Outer Steel)

Critical Section	Critical @ 1385 mm from base, Case 2		
Steel Provided (Cover)	Main H12@200 (40 mm) Dist. H12@200 (52 mm)	565 mm²	OK
Compression Steel Provided (Cover)	Main H12@200 (20 mm) Dist. H12@200 (32 mm)	565 mm²	
Leverarm z=fn(d,b,As,fy,Fcu)	254 mm, 1000 mm, 565 mm², 460 N/mm², 35.0 N/mm²	241 mm	
Mr=fn(above,As',d',x,x/d)	565 mm², 26 mm, 18 mm, 0.07	59.6 kN.m	
Moment Capacity Check (M/Mr)	M 9.4 kN.m, Mr 59.6 kN.m	0.158	OK
Shear Capacity Check	F 0.4 kN, vc 0.480 N/mm², Fvr 121.9 kN	0.00	OK

Base Top Steel Design

Steel Provided (Cover)	Main H12@200 (50 mm) Dist. H12@200 (62 mm)	565 mm²	OK
Compression Steel Provided (Cover)	Main H12@200 (50 mm) Dist. H12@200 (62 mm)	565 mm²	
Leverarm z=fn(d,b,As,fy,Fcu)	344 mm, 1000 mm, 565 mm², 460 N/mm², 35 N/mm²	327 mm	
Mr=fn(above,As',d',x,x/d)	565 mm², 56 mm, 18 mm, 0.05	80.8 kN.m	
Moment Capacity Check (M/Mr)	M 0.0 kN.m, Mr 80.8 kN.m	0.000	OK
Shear Capacity Check	F 0.0 kN, vc 0.402 N/mm², Fvr 138.4 kN	0.00	OK

Base Bottom Steel Design

Steel Provided (Cover)	Main H12@200 (50 mm) Dist. H12@200 (62 mm)	565 mm²	OK
Compression Steel Provided (Cover)	Main H12@200 (50 mm) Dist. H12@200 (62 mm)	565 mm²	
Leverarm z=fn(d,b,As,fy,Fcu)	344 mm, 1000 mm, 565 mm², 460 N/mm², 35 N/mm²	327 mm	
Mr=fn(above,As',d',x,x/d)	565 mm², 56 mm, 18 mm, 0.05	80.8 kN.m	
Moment Capacity Check (M/Mr)	M 21.8 kN.m, Mr 80.8 kN.m	0.270	OK
Shear Capacity Check	F 46.7 kN, vc 0.402 N/mm², Fvr 138.4 kN	0.34	OK

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Job Ref : **360219**
Sheet : **Basement slab case 1 /** PW14
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MasterKey Concrete - Continuous One-Way Slab
Slab 1

Basic Data

Dimensions	Lx=3200, D=250		
Grades and Covers	fcu=35, fy=460, top=20, bottom=40, Aggregate = 20		
Load = 1.4•(gk + Den•D) + 1.6•qk	1.4•(3.00 + 24.00•0.250) + 1.6•1.50	15.00 kN/m²	
Live Load to Clause 3.5.2.3	qk = 1.5 kN/m² and	<= 5.0 kN/m²	OK
	qk / gk = 1.5 / 9.0 = 0.17	<= 1.25	OK

Bottom Steel at Mid-Span of End Span

As bottom (0.226%)	12 @ 200 mm c/c	565 mm²	OK
BM app = Fn(Wult, Lx, Coef)	15.00, 3200, 0.075	11.5 kN.m	
X/d = Fn(As, fy, K1, fcu,γ_m)	565, 460, 0.40, 35, 0.87 = 16 / 204	0.08	
Mu conc = Fn(Z, X, K1, fcu)	194, 16, 0.40, 35	43.86 kN.m	OK
Tens MF=Fn(Asr, Asp, fy, M, d)	149, 565, 460, 204	2.00	Table 3.10
Allow L/d=Fn(Basic, Ten)	26, 2.000	52.00	Cl 3.5.7
Actual L/d=Fn(L,d)	3200, 204	15.69	OK

Bottom Steel at Mid-Span of Internal Spans

As bottom (0.226%)	12 @ 200 mm c/c	565 mm²	OK
BM app = Fn(Wult, Lx, Coef)	15.00, 3200, 0.063	9.7 kN.m	
X/d = Fn(As, fy, K1, fcu,γ_m)	565, 460, 0.40, 35, 0.87 = 16 / 204	0.08	
Mu conc = Fn(Z, X, K1, fcu)	194, 16, 0.40, 35	43.86 kN.m	OK
Tens MF=Fn(Asr, Asp, fy, M, d)	125, 565, 460, 204	2.00	Table 3.10
Allow L/d=Fn(Basic, Ten)	26, 2.000	52.00	Cl 3.5.7
Actual L/d=Fn(L,d)	3200, 204	15.69	OK

Top Steel at Outer Support

As top (0.151%)	12 @ 300 mm c/c	377 mm²	OK
BM app = Fn(Wult, Lx, Coef)	15.00, 3200, -0.040	6.1 kN.m	
X/d = Fn(As, fy, K1, fcu,γ_m)	377, 460, 0.40, 35, 0.87 = 11 / 224	0.05	
Mu conc = Fn(Z, X, K1, fcu)	213, 11, 0.40, 35	32.11 kN.m	OK
SF app = Fn(Wult, Lx, Coef)	15.00, 3200, 0.460	22.1 kN	
Vcap = Fn(As, d, fcu, vc)	377, 224, 35, 0.45	101.08 kN	OK

Top Steel at First Internal Support

As top (0.226%)	12 @ 200 mm c/c	565 mm²	OK
BM app = Fn(Wult, Lx, Coef)	15.00, 3200, -0.086	13.2 kN.m	
X/d = Fn(As, fy, K1, fcu,γ_m)	565, 460, 0.40, 35, 0.87 = 16 / 224	0.07	
Mu conc = Fn(Z, X, K1, fcu)	213, 16, 0.40, 35	48.16 kN.m	OK
SF app = Fn(Wult, Lx, Coef)	15.00, 3200, 0.600	28.8 kN	
Vcap = Fn(As, d, fcu, vc)	565, 224, 35, 0.52	115.71 kN	OK

Top Steel at Other Internal Supports

As top (0.226%)	12 @ 200 mm c/c	565 mm²	OK
BM app = Fn(Wult, Lx, Coef)	15.00, 3200, -0.063	9.7 kN.m	
X/d = Fn(As, fy, K1, fcu,γ_m)	565, 460, 0.40, 35, 0.87 = 16 / 224	0.07	
Mu conc = Fn(Z, X, K1, fcu)	213, 16, 0.40, 35	48.16 kN.m	OK
SF app = Fn(Wult, Lx, Coef)	15.00, 3200, 0.500	24.0 kN	
Vcap = Fn(As, d, fcu, vc)	565, 224, 35, 0.52	115.71 kN	OK

Distribution Steel

As Min = Fn(fy, d, b, As%)	460, 250, 1000, 0.13	325 mm²/m	

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Sheet : daed & Basement slab case /001
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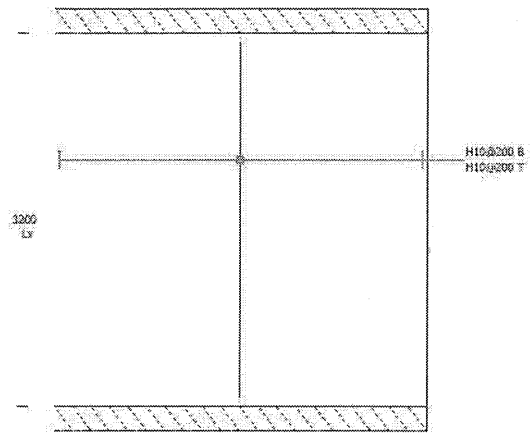
PW/S

MasterKey Concrete - Simply Supported One-Way Slab
Slab 1



Basic Data

Dimensions	Lx=3200, D=250		
Grades and Covers	fcu=35, fy=460, top=20, bottom=40, Aggregate = 20		
Load = 1.4•(gk + Den•D) + 1.6•qk	1.4•(3.00 + 24.00•0.250) + 1.6•1.50	15.00 kN/m²	

Mid-Span Steel

As bottom (0.157%)	10 @ 200 mm c/c	393 mm²	OK
BM app = Fn(Wult, Lx, Coef)	15.00, 3200, 0.125	19.2 kN.m	
X/d = Fn(As, fy, K1, fcu,γ_m)	393, 460, 0.40, 35, 0.87 = 11 / 205	0.05	
Mu conc = Fn(Z, X, K1, fcu)	195, 11, 0.40, 35	30.61 kN.m	OK
Tens MF=Fn(Asr, Asp, fy, M, d)	248, 393, 460, 205	2.00	Table 3.10
Allow L/d=Fn(Basic, Ten)	20, 2.000	40.00	Cl 3.5.7
Actual L/d=Fn(L,d)	3200, 205	15.61	OK

Support Steel

As bottom (0.157%)	10 @ 200 mm c/c	393 mm²	OK
SF app = Fn(Wult, Lx, Coef)	15.00, 3200, 0.500	24.0 kN	
Vcap = Fn(As, d, fcu, vc)	393, 205, 35, 0.48	98.75 kN	OK

Distribution Steel

As Min = Fn(fy, d, b, As%)	460, 250, 1000, 0.13	325 mm²/m	

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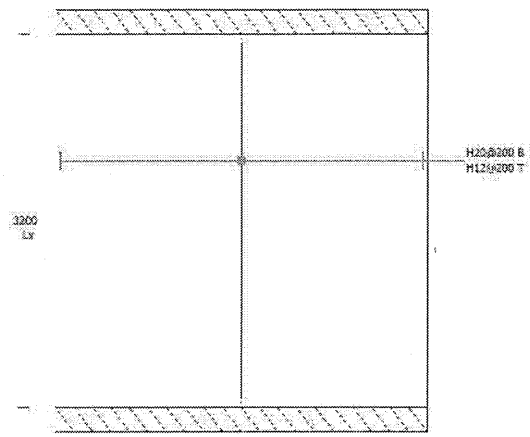
PW16

MasterKey Concrete - Simply Supported One-Way Slab
Slab 1



Basic Data

Dimensions	Lx=3200, D=250	
Grades and Covers	fck=C28/35, fy=460, top=20, bottom=40, Aggregate = 20	
Load = 1.35•(gk + Den•D) + 1.5•qk	1.35•(3.00 + 24.00•0.250) + 1.5•-48.50	-60.60 kN/m²

Mid-Span Steel

As' top (0.226%)	12 @ 200 mm c/c	565 mm²	
Min % = 0.26•f_{ct}/f_{yk}	0.26•2.77/460 < 0.13	0.156	
As bottom (0.628%)	20 @ 200 mm c/c	1571 mm²	OK
BM app = Fn(Wult, Lx, Coef)	-60.60, 3200, 0.125	77.6 kN.m	
Mu_c= z • Fc	183.99 • 508.0	93.5 kN.m	
Mu_{st}= z • Fst	183.99 • 628.3	115.6 kN.m	
Mu_{sc}= (d-d1) • Fsc	(200.0 - 26.0 • 120.6	21.0 kN.m	
M_{app}/M_u	77.6 / 114.4	0.678	OK

Deflections 7.4.2 (and Concise EC2 15.7)

l/d_{max}= l/d_{basic}• MF_{F1}• MF_{F2}•MF_{F3}	107.0•1.0•1.0•1.5	160.6	
l/d =	3200.0 / 200.0	16.0	OK

Support Steel

As' bottom (0.226%)	12 @ 200 mm c/c	565 mm²	
Min % = 0.26•f_{ct}/f_{yk}	0.26•2.77/460 < 0.13	0.156	
As bottom (0.628%)	20 @ 200 mm c/c	1571 mm²	OK
SF app = Fn(Wult, Lx, Coef)	-60.60, 3200, 0.500	-97.0 kN	
V_{app}/ max(V_{Rd},c.a, V_{Rd},c.b)	-97.0 / Max(134.5, 104.8)	-0.721	OK

Distribution Steel

As Min = Fn(fy, d, b, As%)	460, 250, 1000, 0.13	325 mm²/m

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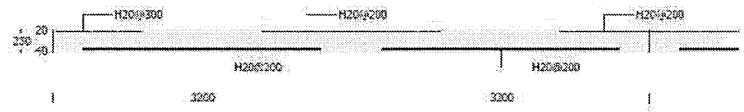
Made by : tf
Date : 04 March 2016 / Ver. 2015.05
Checked :
Approved :

PW7

MasterKey Concrete - Continuous One-Way Slab
Slab 1



Basic Data

Dimensions	Lx=3200, D=250		
Grades and Covers	fcu=35, fy=460, top=20, bottom=40, Aggregate = 20		
Load = 1.4•(gk + Den•D) + 1.6•qk	1.4•(3.00 + 24.00•0.250) + 1.6•-48.50	-65.00 kN/m²	
Live Load to Clause 3.5.2.3	qk = -48.5 kN/m² and	<= 5.0 kN/m²	Warning
	qk / gk = -48.5 / 9.0 = -5.39	<= 1.25	Warning

Bottom Steel at Mid-Span of End Span

As bottom (0.628%)	20 @ 200 mm c/c	1571 mm²	OK
BM app = Fn(Wult, Lx, Coef)	-65.00, 3200, 0.075	49.9 kN.m	
X/d = Fn(As, fy, K1, fcu,γ_m)	1571, 460, 0.40, 35, 0.95 = 49 / 200	0.25	
Mu conc = Fn(Z, X, K1, fcu)	178, 49, 0.40, 35	122.21 kN.m	OK
Tens MF=Fn(Asr, Asp, fy, M, d)	0, 1571, 460, 200	2.00	Table 3.10
Allow L/d=Fn(Basic, Ten)	26, 2.000	52.00	Cl 3.5.7
Actual L/d=Fn(L,d)	3200, 200	16.00	OK

Bottom Steel at Mid-Span of Internal Spans

As bottom (0.628%)	20 @ 200 mm c/c	1571 mm²	OK
BM app = Fn(Wult, Lx, Coef)	-65.00, 3200, 0.063	41.9 kN.m	
X/d = Fn(As, fy, K1, fcu,γ_m)	1571, 460, 0.40, 35, 0.95 = 49 / 200	0.25	
Mu conc = Fn(Z, X, K1, fcu)	178, 49, 0.40, 35	122.21 kN.m	OK
Tens MF=Fn(Asr, Asp, fy, M, d)	0, 1571, 460, 200	2.00	Table 3.10
Allow L/d=Fn(Basic, Ten)	26, 2.000	52.00	Cl 3.5.7
Actual L/d=Fn(L,d)	3200, 200	16.00	OK

Top Steel at Outer Support

As top (0.419%)	20 @ 300 mm c/c	1047 mm²	OK
BM app = Fn(Wult, Lx, Coef)	-65.00, 3200, -0.040	26.6 kN.m	
X/d = Fn(As, fy, K1, fcu,γ_m)	1047, 460, 0.40, 35, 0.95 = 33 / 220	0.15	
Mu conc = Fn(Z, X, K1, fcu)	205, 33, 0.40, 35	93.98 kN.m	OK
SF app = Fn(Wult, Lx, Coef)	-65.00, 3200, 0.460	-95.7 kN	
Vcap = Fn(As, d, fcu, vc)	1047, 220, 35, 0.64	141.02 kN	OK

Top Steel at First Internal Support

As top (0.628%)	20 @ 200 mm c/c	1571 mm²	OK
BM app = Fn(Wult, Lx, Coef)	-65.00, 3200, -0.086	57.2 kN.m	
X/d = Fn(As, fy, K1, fcu,γ_m)	1571, 460, 0.40, 35, 0.95 = 49 / 220	0.22	
Mu conc = Fn(Z, X, K1, fcu)	198, 49, 0.40, 35	135.94 kN.m	OK
SF app = Fn(Wult, Lx, Coef)	-65.00, 3200, 0.600	-124.8 kN	
Vcap = Fn(As, d, fcu, vc)	1571, 220, 35, 0.73	161.43 kN	OK

Top Steel at Other Internal Supports

As top (0.628%)	20 @ 200 mm c/c	1571 mm²	OK
BM app = Fn(Wult, Lx, Coef)	-65.00, 3200, -0.063	41.9 kN.m	
X/d = Fn(As, fy, K1, fcu,γ_m)	1571, 460, 0.40, 35, 0.95 = 49 / 220	0.22	
Mu conc = Fn(Z, X, K1, fcu)	198, 49, 0.40, 35	135.94 kN.m	OK
SF app = Fn(Wult, Lx, Coef)	-65.00, 3200, 0.500	-104.0 kN	
Vcap = Fn(As, d, fcu, vc)	1571, 220, 35, 0.73	161.43 kN	OK

Distribution Steel

As Min = Fn(fy, d, b, As%)	460, 250, 1000, 0.13	325 mm²/m