

STRUCTURAL CALCULATIONS

Using
MASTERSERIES POWERPAD

PILED GROUND BEAMS & RETAINING WALL

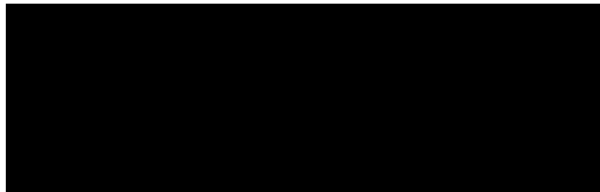
Rond Point
Ham Manor Way
Angmering

ARCHITECT

INSPIRED DESIGN STUDIO

STRUCTURAL ENGINEERS

INGS ENGINEERING LIMITED

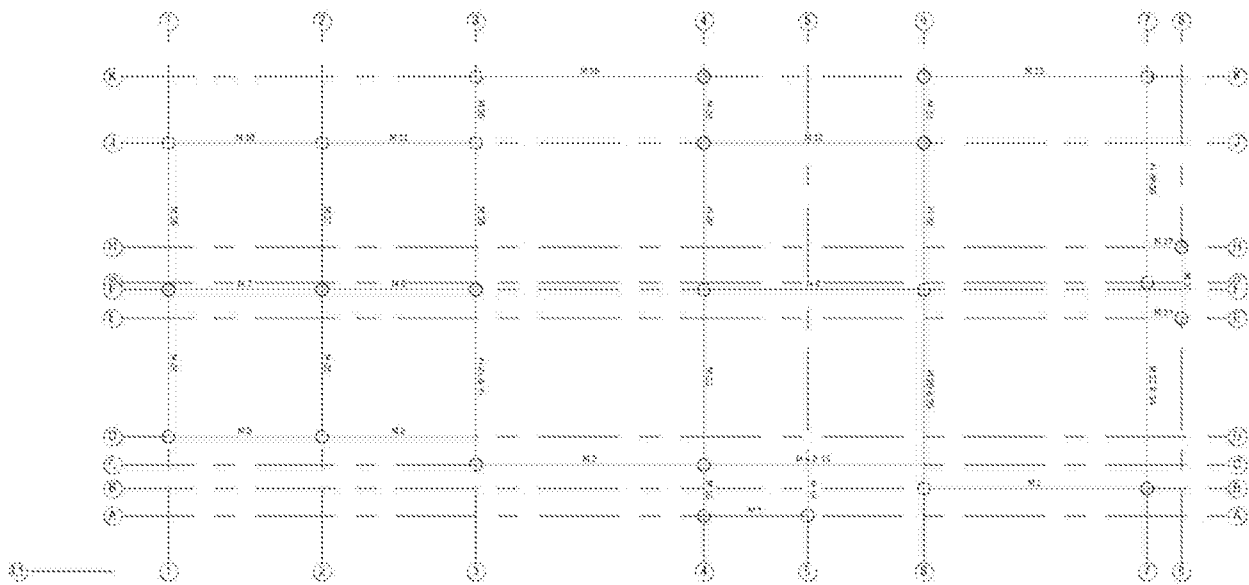


PROJECT No: 8037

December 2019

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	Sheet	: 8037- GB / 2 -
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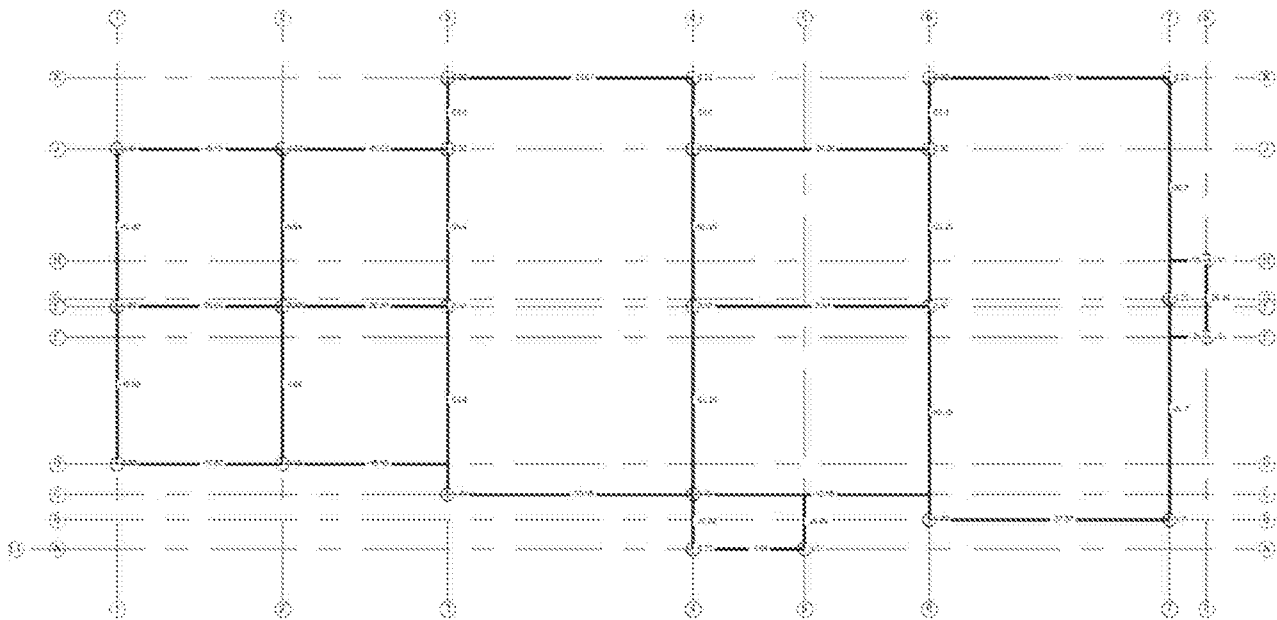
MasterFrame : Graphics



Frame Geometry - Full Frame - Plan View

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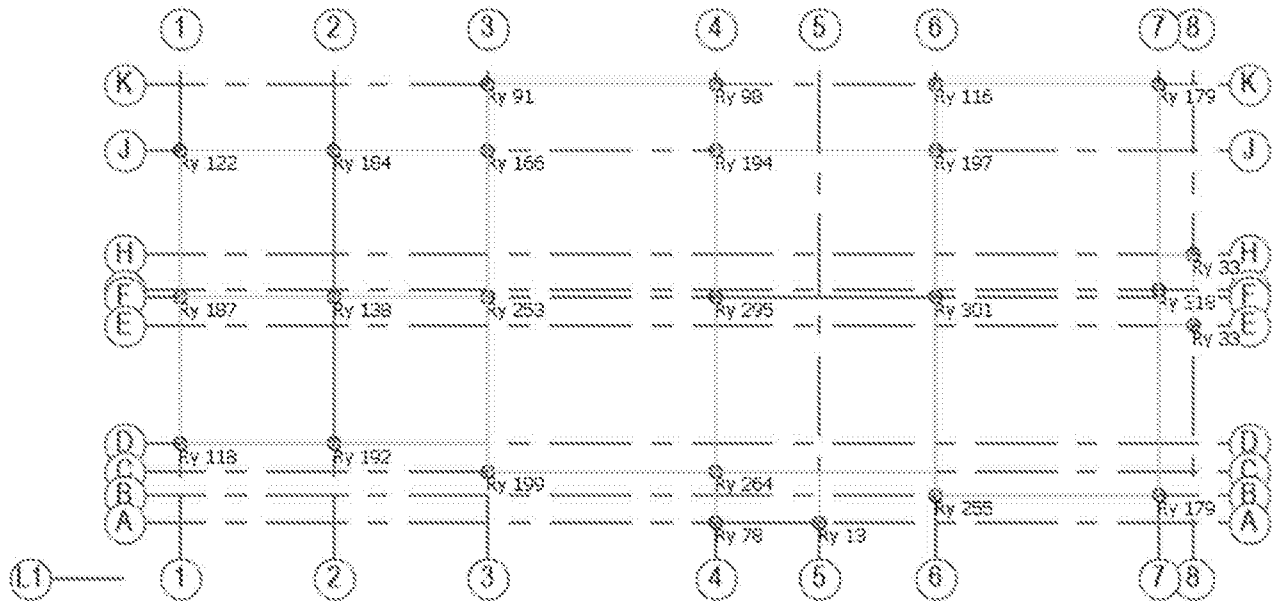
Load Diagram - 003 : Dead plus Live (Serviceability) - All Groups
Frame Geometry - Full Frame - Plan View

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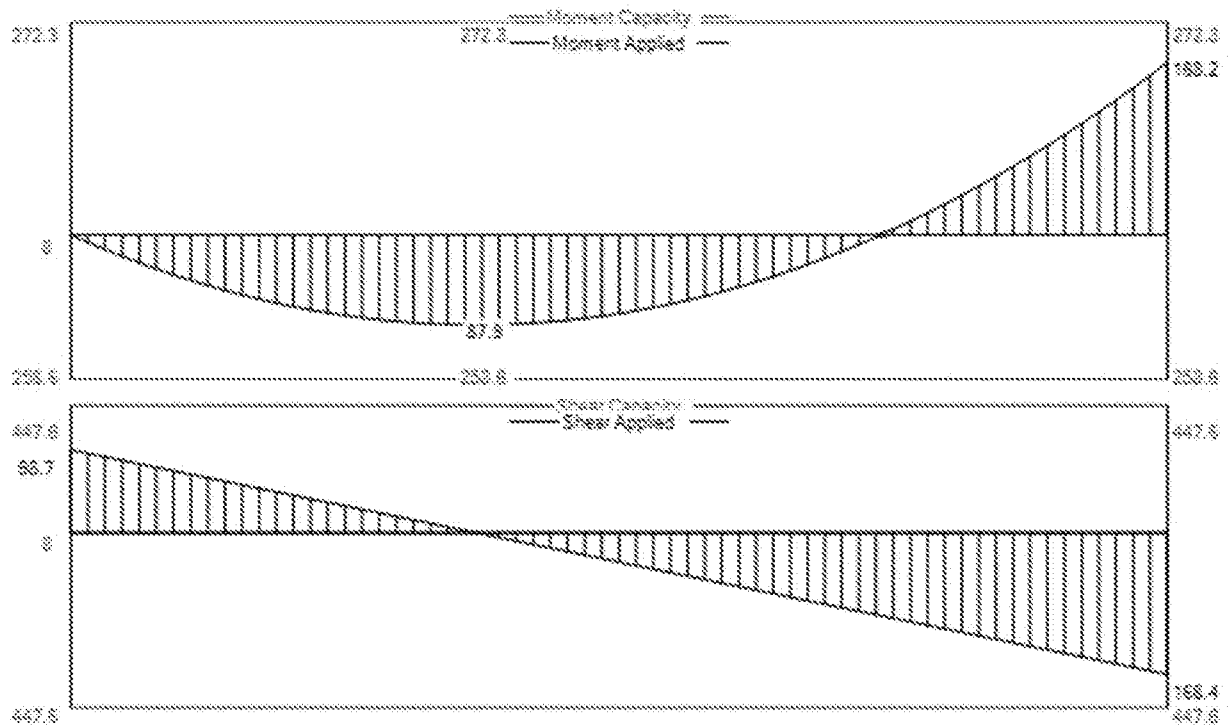
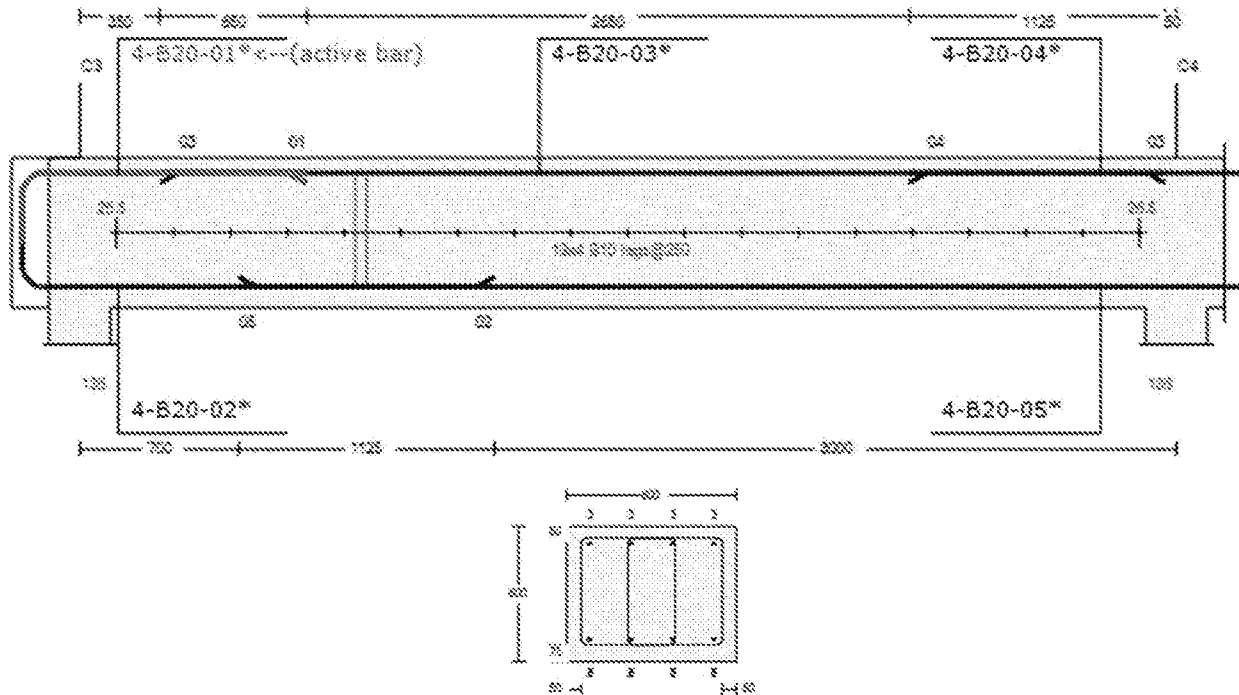
Frame Geometry - Full Frame - Plan View
Support Reactions - Load Case 003 : Dead plus Live (Serviceability)

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TYPICAL GROUND BEAM – MEMBER C\3-4

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Basic Data

Design to BS 8110: 1997
 f_{cu} , f_y , f_{yv} , v_{crit} , K1, K2 30, 460, 460, 4.38, 0.4, 0.45

Bending Moments**In-Span Steel @ 1809 mm. Sagging**

$X/d = F_n(A_s, f_y, K1, B_{eff}, d, f_{cu}, \gamma_m)$ 1257, 460, 0.4, 600, 505.0, 30, 0.95 0.15
 $M_u = (K_1 \cdot f_{cu} \cdot B \cdot X) \cdot \min(d - k_2 \cdot X, 0.95 \cdot d)$ (0.4 • 30 • 600 • 75.7) • (505.0 - 0.5 • 75.7) 259 kN.m
 M_{app}/M_u 87.9 / 258.6 0.340
 A_s Required to BS8110 Cl 3.4.4.4 Assuming $d = 500$, $d' = 75$ bottom 424 mm² OK

Right Support Steel Hogging

$X/d = F_n(A_s, f_y, K1, B_{eff}, d, f_{cu}, \gamma_m)$ 1257, 460, 0.4, 600, 530.0, 30, 0.95 0.14
 $M_u = (K_1 \cdot f_{cu} \cdot B \cdot X) \cdot \min(d - k_2 \cdot X, 0.95 \cdot d)$ (0.4 • 30 • 600 • 75.7) • (530.0 - 0.5 • 75.7) 272 kN.m
 M_{app}/M_u 168.2 / 272.3 0.618
 A_s Required to BS8110 Cl 3.4.4.4 Assuming $d = 525$, $d' = 100$ top 772 OK

Shear**Max Shear**

$v_{crit} = \min(5, 0.8 \cdot \sqrt{f_{cu}})$ $\min(5, 0.8 \cdot \sqrt{30})$ 4.382 N/mm²
 $v = V_{max} / (d \cdot b)$ 160 • 1000 / (530 • 600) 0.503 N/mm² OK

Nominal Shear Zone at 137 mm

$v_c = F_n(A_s, b_v, d, f_{cu})$ 1257, 600, 530, 30 0.49 N/mm² Table 3.8
 $V_{cap} = F_n(A_{sv}, S_v, b_v, d, f_{yv}, v_c)$ 314, 250, 600, 530, 460, 0.49 447.6 kN Table 3.7
 V/V_{cap} 91.0/ 447.6 0.203 OK

Nominal Shear Zone at 4688 mm

$v_c = F_n(A_s, b_v, d, f_{cu})$ 2513, 600, 530, 30 0.62 N/mm² Table 3.8
 $V_{cap} = F_n(A_{sv}, S_v, b_v, d, f_{yv}, v_c)$ 314, 250, 600, 530, 460, 0.62 488.4 kN Table 3.7
 V/V_{cap} 160.8/ 488.4 0.329 OK

Shear at L.H. Column Head

$v_{crit} = \min(5, 0.8 \cdot \sqrt{f_{cu}})$ $\min(5, 0.8 \cdot \sqrt{30})$ 4.382 N/mm²
 $v = V / d / (b_c + d_c)$ 99 • 1000 / 530 / (272 + 273) 0.342 N/mm² OK

Shear at R.H. Column Head

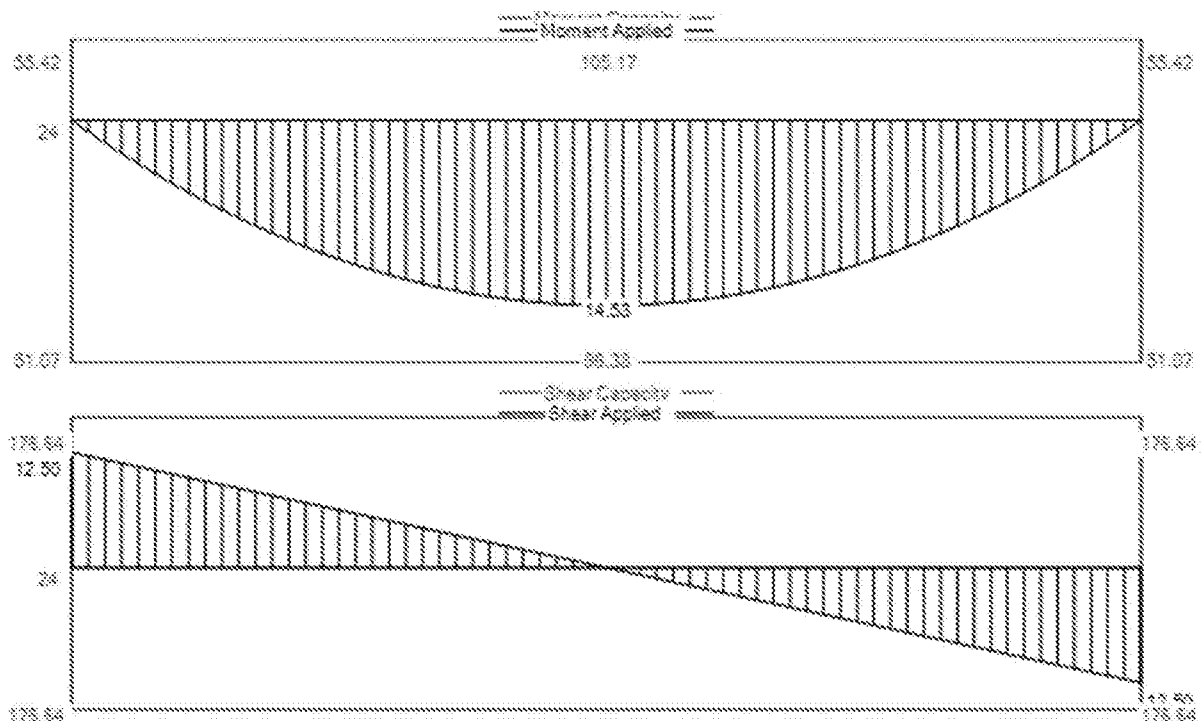
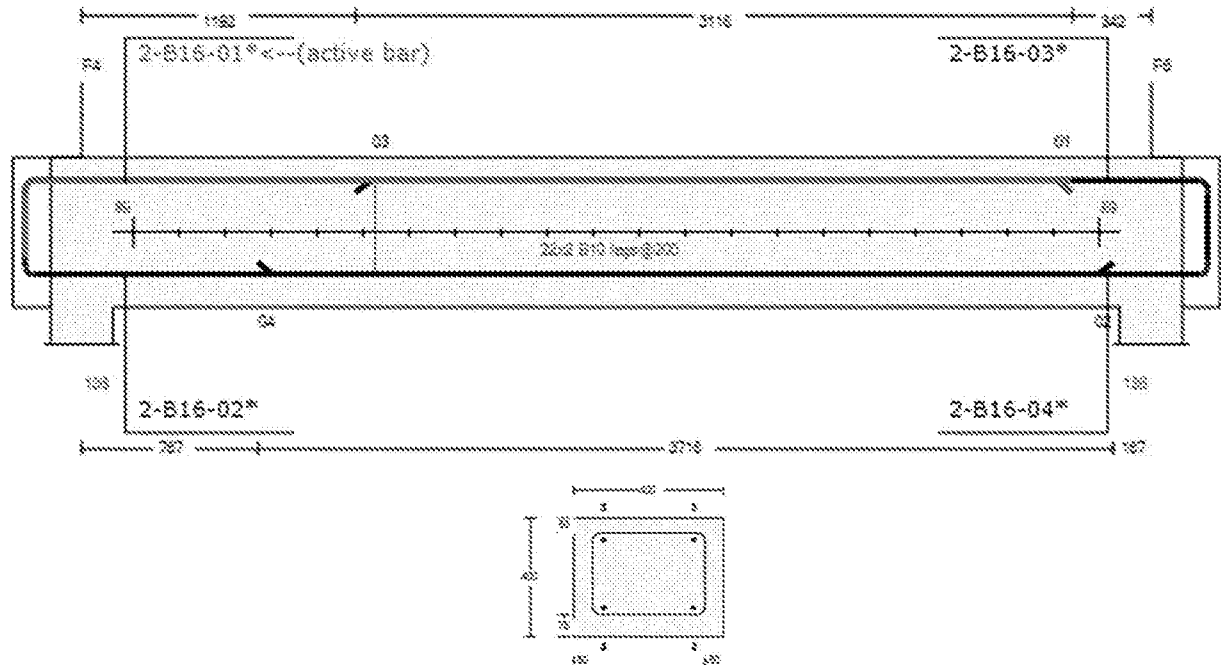
$v_{crit} = \min(5, 0.8 \cdot \sqrt{f_{cu}})$ $\min(5, 0.8 \cdot \sqrt{30})$ 4.382 N/mm²
 $v = V / d / (b_c + d_c)$ 168 • 1000 / 530 / (272 + 273) 0.583 N/mm² OK

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TYPICAL TIE BEAM – MEMBER F\4-6

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Date : Dec 2019/ Version 2015.04
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Approved :**Basic Data**Design to BS 8110: 1997
 f_{cu} , f_y , f_{yv} , v_{crit} , K1, K2 30, 460, 460, 4.38, 0.4, 0.45**Bending Moments****In-Span Steel @ 2324 mm. Sagging**

$X/d = F_n(A_s, f_y, K1, B_{eff}, d, f_{cu}, \gamma_m)$	804, 460, 0.4, 400, 307.0, 30, 0.95	0.24	
$M_u = (K_1 \cdot f_{cu} \cdot B \cdot X) \cdot \min(d - k_2 \cdot X, 0.95 \cdot d)$	$(0.4 \cdot 30 \cdot 400 \cdot 72.7) \cdot (307.0 - 0.5 \cdot 72.7)$	96 kN.m	
M_{app}/M_u	14.5 / 96.4	0.151	OK
A_s Required to BS8110 Cl 3.4.4.4	Assuming $d = 300$, $d' = 75$	bottom 117 mm ²	

Shear**Max Shear**

$v_{crit} = \min(5, 0.8 \cdot \sqrt{f_{cu}})$	$\min(5, 0.8 \cdot \sqrt{30})$	4.382 N/mm ²	
$v = V_{max} / (d \cdot b)$	$12 \cdot 1000 / (332 \cdot 400)$	0.088 N/mm ²	OK

Nominal Shear Zone at 137 mm

$v_c = F_n(A_s, b_v, d, f_{cu})$	402, 400, 332, 30	0.47 N/mm ²	Table 3.8
$V_{cap} = F_n(A_{sv}, S_v, b_v, d, f_{yv}, v_c)$	157, 200, 400, 332, 460, 0.47	176.6 kN	Table 3.7
V/V_{cap}	11.8 / 176.6	0.067	OK

Nominal Shear Zone at 4513 mm

$v_c = F_n(A_s, b_v, d, f_{cu})$	402, 400, 332, 30	0.47 N/mm ²	Table 3.8
$V_{cap} = F_n(A_{sv}, S_v, b_v, d, f_{yv}, v_c)$	157, 200, 400, 332, 460, 0.47	176.6 kN	Table 3.7
V/V_{cap}	11.8 / 176.6	0.067	OK

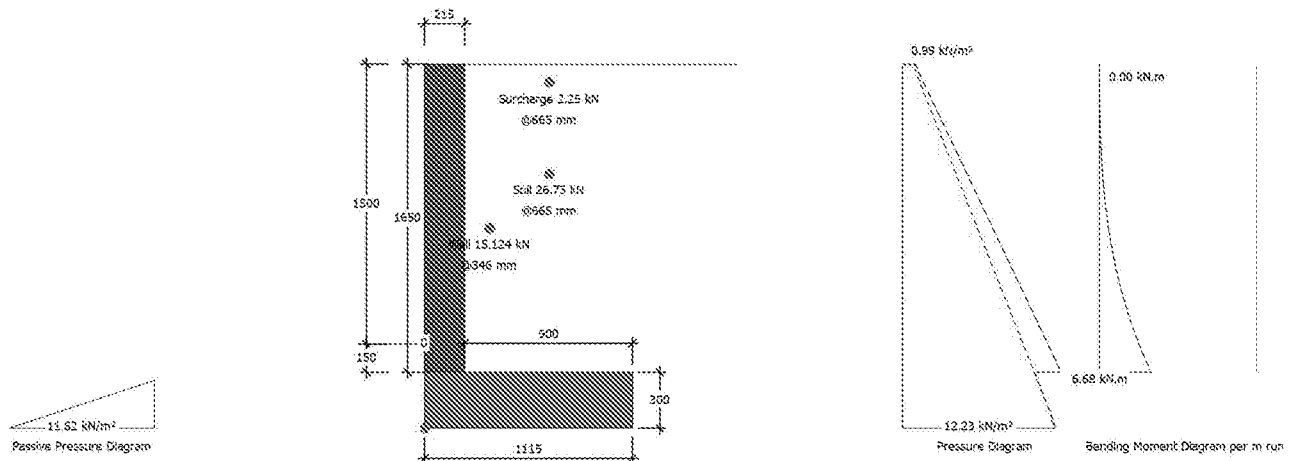
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**MASTERKEY : RETAINING WALL DESIGN TO BS 8002 : 1994, BS 5628 : 1992
AND BS 8110 : 1997**
Basic Garden Retaining Wall
Reinforced Masonry Retaining Wall with Reinforced Concrete Base

**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

f_{cu} 30 N/mm², Permissible tensile stress 0.250 N/mm²

Wall inner cover 30 mm, Wall outer cover 30 mm, Base cover 75 mm

f_y 460 N/mm², f_{yb} 460 N/mm² designed to BS 8110: 1997

Surcharge 2.50 kN/m², Fully drained

Front of wall 195 mm

Soil Properties

Soil bearing pressure

Back Soil Friction and Cohesion

Base Friction and Cohesion

Front Soil Friction and Cohesion

Allowable pressure @ front 100.00 kN/m², @ back 100.00 kN/m²

 $\phi = \text{Atn}(\text{Tan}(30)/1.2) = 25.69^\circ$ $\delta = \text{Atn}(0.75 \times \text{Tan}(\text{Atn}(\text{Tan}(30)/1.2))) = 19.84^\circ$ $\phi = \text{Atn}(\text{Tan}(30)/1.2) = 25.69^\circ$ **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 Pressure

Case 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_p

Case 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

8.878/24.499

0.362

OK

Wall Sliding - Virtual Back PressureF_x/(R_xFriction+ R_xPassive)

12.824/(15.915+1.487)

0.737

OK

Soil Pressure

Virtual Back

83.019/100 kN/m², Length under pressure 1.062 m

0.830

OK

Wall Back

92.260/100 kN/m², Length under pressure 0.956 m

0.923

OK

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Structural Design**Masonry Wall Details**

Partial Safety Factor (γ_{mc}/γ_{mf})	Normal manufacturing, Normal construction	3.5/3	Table 4a/4b
Material	Concrete blocks, $\gamma=20 \text{ kN/m}^3$		
Units and Mortar Strength	7 N/mm ² , Mortar designation (i)		
Blocks Ratio	Unit height=215, Least horizontal dimensions=102.5	2.10	
Compressive Strength (f_k)	Hollow block wall	5.7 N/mm ²	Table 3

Wall Design (Inner Steel)

Critical Section	Critical @ 0 mm from base, Case 2		
Steel Provided (Cover)	Main B10@220 (30 mm) Bed B6@225 (30 mm)	357 mm ²	OK
Leverarm $z=fn(d,b,As,f_y,f_k)$	180 mm, 1000 mm, 357 mm ² , 460 N/mm ² , 5.7 N/mm ²	142 mm	
$M_r=fn(\text{above}, \gamma_{mf}, \gamma_{ms})$	3.00, 1.15	20.3 kN.m	
Moment Capacity Check (M/M_r)	M 6.7 kN.m, M_r 20.3 kN.m	0.328	OK
Shear Capacity Check	F 11.3 kN, f_v 0.646 N/mm ² , F_vr 46.5 kN	0.24	OK

Base Top Steel Design

Steel Provided (Cover)	Main B10@200 (75 mm) Dist. B10@200 (85 mm)	393 mm ²	OK
Leverarm $z=fn(d,b,As,f_y,F_{cu})$	220 mm, 1000 mm, 393 mm ² , 460 N/mm ² , 30 N/mm ²	209 mm	
$M_r=fn(\text{above}, x, x/d)$	14 mm, 0.06	35.9 kN.m	
Moment Capacity Check (M/M_r)	M 9.4 kN.m, M_r 35.9 kN.m	0.263	OK
Shear Capacity Check	F 14.1 kN, v_c 0.439 N/mm ² , F_vr 96.6 kN	0.15	OK

Base Bottom Face Tension

Maximum Tensile Stress	M 0.000, h 300, f_{cu} 30, Permissible 0.25 N/mm ²	0.00 N/mm ²	OK
Shear Capacity Check	F 0.0 kN, v_c 0.350 N/mm ² , F_vr 52.5 kN	0.00	OK

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Consulting Structural Engineers

Project: Rond Point, Ham Manor Way

Project No: 8037

By: JI

Date: Dec 19 MASS RETAINING WALL

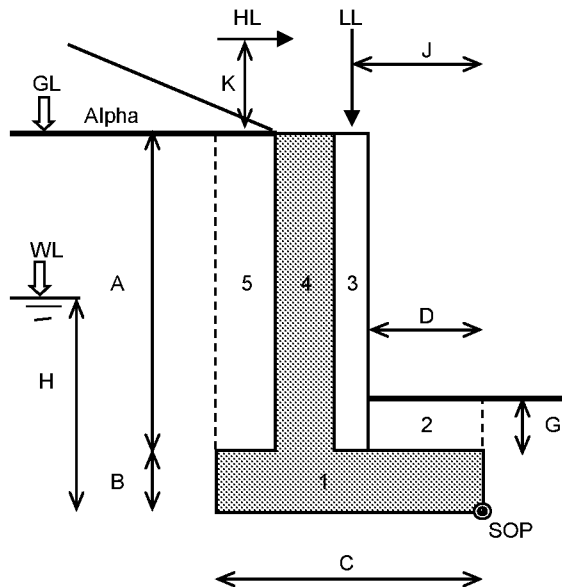
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T: 01273 470066

Wall Arrangement:



Dimensions:

A = Wall Height	1.050	m
B = Base Height	0.300	m
C = Base Width	0.650	m
D = Distance to Face	0.000	m
E = Facing Width (3)	0.100	m
F = Stem Width (4)	0.550	m
G = Finishes Height	0.150	m
H = Hydrostatic Head	0.000	m
J = Distance to Line Load	0.000	m
K = Height to Horiz Load	0.000	m
L = Backfill Width (5)	0.000	m
Surface Angle Alpha	0.000	deg

Design Information:

Angle of Repose	=	30	deg
Co-efficient of Friction	=	0.5	
Ka	=	0.333	
Kp	=	3.000	
Finishes Density	=	18.00	kN/m ³
Facing Density	=	18.00	kN/m ³
Base & Stem Density	=	24.00	kN/m ³
Soil Density	=	19.00	kN/m ³

Loads:

Imposed Load	=	2.50	kN/m ²
Line Load (LL)	=	0.00	kN/m
Horizontal Load (HL)	=	0.00	kN/m

Design Limitations:

F of S Overturning	=	2.0	
F of S Sliding	=	1.4	
Allowable GBP	=	100	kN/m ²

Restoring Moment at Underside of Base:

	Weight	x	Lever Arm	=	Moment
1. Base	4.68		0.33		1.52
2. Finishes	0.00		0.00		0.00
3. Facing	1.89		0.05		0.09
4. Stem	13.86		0.38		5.20
5. Soil	0.00		0.65		0.00
6. Line Load	0.00		0.00		0.00
Total	20.43	kN			6.81
					kNm

Restoring Moment at Top of Base:

	Weight	x	Lever Arm	=	Moment
3. Facing	1.89		0.05		0.09
4. Stem	13.86		0.38		5.20
6. Line Load	0.00		0.00		0.00
Total	15.75	kN			5.29
					kNm

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Consulting Structural Engineers

Project: Rond Point, Ham Manor Way

Project No: 8037

By: JI

Date: Dec 19 MASS RETAINING WALL

No: GB12

Spithurst Hub Spithurst Road

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OTM at Underside of Base:

	Weight	x	Lever Arm	=	Moment
Imposed Load	1.13		0.68		0.76
Soil	5.77		0.45		2.60
Water	0.00		0.00		0.00
Submerged Soil	0.00		0.00		0.00
Dry Soil Pressure	0.00		0.00		0.00
Horizontal Load	0.00		1.35		0.00
Total	6.90	kN			3.36
					kNm

OTM at Top of Base:

	Weight	x	Lever Arm	=	Moment
Imposed Load	0.88		0.53		0.46
Soil	3.49		0.35		1.22
Water	0.00		0.00		0.00
Submerged Soil	0.00		0.00		0.00
Dry Soil Pressure	0.00		0.00		0.00
Horizontal Load	0.00		0.00		0.00
Total	4.37	kN			1.68
					kNm

F of S at Base Level: 2.03

F of S at Top of Base: 3.15

Resistance to Sliding:

Passive Resistance:	2.57
Frictional Resistance:	10.22
Total	12.78
	kN

F of S against sliding: 1.85

Moment about centre line of base: 3.18 kNm

Eccentricity from centreline: 0.156 mm Outside middle 1/3rd
GBP outside middle 1/3rd

GBP toe:	77	kN/m ²
front face GBP:	63	kN/m ²
rear face GBP:	- 14	kN/m ²
GBP heel:	- 14	kN/m ²

Toe Bending Moment: 0.2 kNm

Heel Bending Moment: 0.0 kNm