



Calculation Report.

Project Reference No. Q2012-035

Date: 18 June 2012

Address: Waters Edge, 1 Botany Close, West Sussex, BN16 2BH.

Nature of works: Design of proposed new boundary wall as detailed in architects drawings 0293 (01)01, 0293(01)06 to 0293(01)11 & 0293(01)14 to 0293(01)15 for works to Waters Edge, 1 Botany Close, West Sussex, BN16 2BH.

Attached is the design calculation and drawings for the boundary wall to be constructed. Drawings are to be read in conjunction with architects drawings which show further details as to position and finishes details.

Project Water Edge, 2 Botany Close			Job no 2012-035		
Calcs for Boundary wall			Start page no / Revision 1		
Calcs by JGF	Calcs date 15/06/2012	Checked by	Checked date	Approved by	Approved date

MASONRY WALL PANEL DESIGN TO BS5628:2005

In accordance with BS5628-1:2005

TE009 calculation version: 1.2.05

Masonry panel details

Unreinforced masonry wall without openings

Panel length $L = 7000$ mm

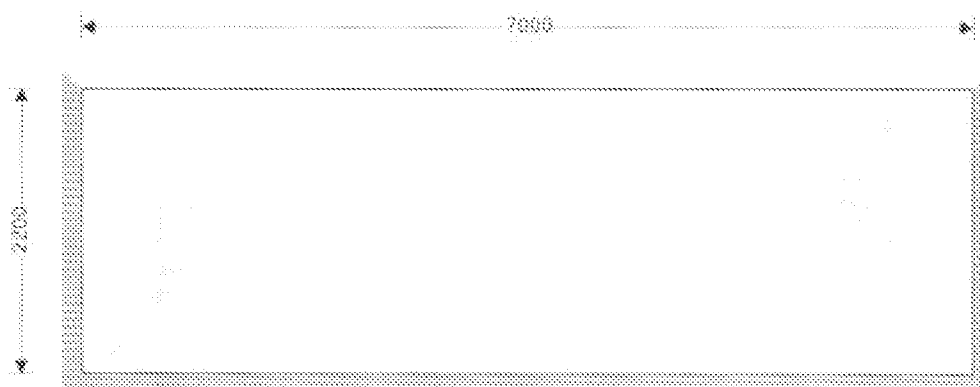
Panel height $h = 2200$ mm

Panel support conditions

Right, left and bottom supported continuously

Effective panel length $L_e = 1.0 \times L = 7000$ mm

Effective panel height $h_e = 1.0 \times h = 2200$ mm



Pier details

Thickness of pier $t_p = 430$ mm

Breadth of pier $b_p = 450$ mm

Spacing between piers $s_p = 7000$ mm

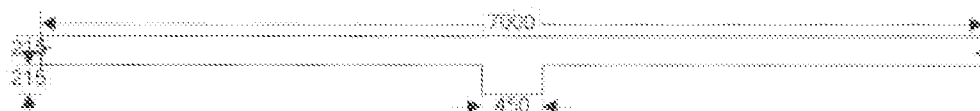
From BS5628-1 Table 5 - Stiffness coefficient for walls stiffened by piers

Stiffness coefficient $K = 1.09$

Single-leaf wall construction details

Wall thickness $t = 215$ mm

Effective wall thickness $t_e = t \times K = 234$ mm



Masonry details

Masonry type Clay bricks having a water absorption between 7% and 12%

Compressive strength of unit $p_{uk} = 5.0$ N/mm²

Mortar strength Class/Designation M4 / (iii)

Height of masonry units $h_u = 65$ mm

Density of masonry $\gamma = 18.0$ kN/m³

 Tedds Elite Designers Unit 12 Princeton Court Plumley SY16 1AZ	Project				Job no.	
	Water Edge, 2 Botany Close				2012-035	
	Cards for				Start page no./Revision	
	Boundary wall				2	
	Calcs by	Calcs date	Checked by	Checked date	Approved by	Approved date
	JGF	15/06/2012				

From BS5628-1 Table 2a - Characteristic compressive strength of masonry

Characteristic compressive strength $f_k = 2.50 \text{ N/mm}^2$

From BS5628-1 Table 3 - Characteristic flexural strength of masonry

Plane of failure parallel to bed joints $f_{k, \text{para}} = 0.40 \text{ N/mm}^2$

Plane of failure perpendicular to bed joints $f_{k, \text{perp}} = 1.10 \text{ N/mm}^2$

Lateral loading details

Characteristic wind load on panel $W_k = 0.700 \text{ kN/m}^2$

Vertical loading details

Dead load on top of wall $G_k = 1.5 \text{ kN/m}$

Partial safety factors for material strength

Category of manufacturing control **Category II**

Category of construction control **Normal**

Partial safety factor for masonry in compression $\gamma_{mc} = 3.50$

Partial safety factor for masonry in flexure $\gamma_{mf} = 3.00$

Partial safety factor for masonry in shear $\gamma_{mv} = 2.50$

Slenderness ratio (cl 24.1)

Allowable slenderness ratio $SR_{all} = 27$

Slenderness ratio $SR = \min(h_{eff}, L_{eff}) / t_{eff} = 9.4$

PASS - Slenderness ratio is less than maximum allowable

Vertical loading (cl 28)

Partial safety factors for design loads

Partial safety factor for design dead load $\gamma_{cd} = 1.40$

Partial safety factor for design imposed load $\gamma_{ci} = 1.60$

Check vertical loads at top of wall

Design vertical load on wall $F_v = G_k \times \gamma_{cd} + Q_k \times \gamma_{ci} = 2.1 \text{ kN/m}$

Design vertical load stress on wall $f_v = F_v / t = 0.010 \text{ N/mm}^2$

Design bending moment $M_v = G_k \times \gamma_{cd} \times e_0 + Q_k \times \gamma_{ci} \times e_0 = 0.0 \text{ kNm/m}$

Resultant eccentricity at the top of the wall $e_v = M_v / F_v = 0 \text{ mm}$

From BS5628-1 Table 7 - Capacity reduction factor

Capacity reduction factor $\beta = 1.00$

Allowable stress capacity $f_{cap} = \beta \times f_k / \gamma_{mc} = 0.714 \text{ N/mm}^2$

PASS - Allowable stress capacity exceeds design vertical load stress on wall

Horizontal loading (cl 32)

Limiting dimensions (cl 32.3)

Area of panel $A_p = h \times L = 15.4 \text{ m}^2$

Limiting area of panel $A_{lim} = 1500 \times t_{eff}^2 = 82.2 \text{ m}^2$

PASS - Area of panel does not exceed limiting area of panel

Limiting panel dimension $L_{lim} = 50 \times t_{eff} = 11706 \text{ mm}$

PASS - Limiting panel dimension is not exceeded

Partial safety factors for design loads

Partial safety factor for design wind load $\gamma_{wv} = 1.40$

Partial safety factor for design dead load $\gamma_{cd} = 0.90$

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	Water Edge, 2 Botany Close				2012-035	
	Calcs for				Start page No./Revision	
	Boundary wall				3	
	Calcs by	Calcs date	Checked by	Checked date	Approved by	Approved date
	JGF	15/06/2012				

Design moments of resistance in panels (cl 32.4.2)

Design vertical compressive stress	$g_s = \gamma_{ps} \times G_v / l = 0.01 \text{ N/mm}^2$
Enhanced flexural strength of masonry	$f_{k, \text{para}} = f_{k, \text{masonry}} + \gamma_{ps} \times g_s = 0.42 \text{ N/mm}^2$
Flange width	$b_f = \min(s_e, b_v + 12 \times t) = 3030 \text{ mm}$
Neutral axis depth	$y_1 = [(b_f \times t^2/2) + (b_v \times (b_f - t) \times (t_f + t)/2)] / (b_f \times t + b_v \times (b_f - t)) = 135 \text{ mm}$ $y_2 = b_v - y_1 = 295 \text{ mm}$
Moment of inertia	$I = b_f t^3/12 + b_f \times t \times (y_2 - t/2)^2 + b_v \times (b_f - t)^3/12 + b_v \times (b_f - t) \times (y_1 - (b_f - t)/2)^2$ $I = 6776086886 \text{ mm}^4$
Section modulus of pier and flange	$Z = I / (\max(y_1, y_2) \times s_e) = 3284756 \text{ mm}^3/\text{m}$
Parallel design moment of resistance	$M_{\text{para}} = f_{k, \text{para}} \times Z / \gamma_{mf} = 0.459 \text{ kNm/m}$
Section modulus of wall	$Z = t^2 / 6 = 7704167 \text{ mm}^3/\text{m}$
Perpendicular design moment of resistance	$M_{\text{perp}} = f_{k, \text{perp}} \times Z / \gamma_{mf} = 2.825 \text{ kNm/m}$
Elastic design moment of resistance	$M_u = M_{\text{perp}} = 2.825 \text{ kNm/m}$

Design moment in panels (cl 32.4.2)

Orthogonal strength ratio	$\mu = M_{\text{para}} / M_{\text{perp}} = 0.16$
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Using yield line analysis to calculate bending moment coefficient

Bending moment coefficient	$\alpha = 0.033$
Design moment in wall	$M = \alpha \times W_k \times \gamma_{mf} \times L^2 = 1.598 \text{ kNm/m}$

PASS - Resistance moment exceeds design moment



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Project

Waters Edge, 1 Botany Close

Job no.

2012-035

Calcs for

Boundary wall footing

Start page no / Revision

1

Calcs by

JGF

Calcs date

18/06/2012

Checked by

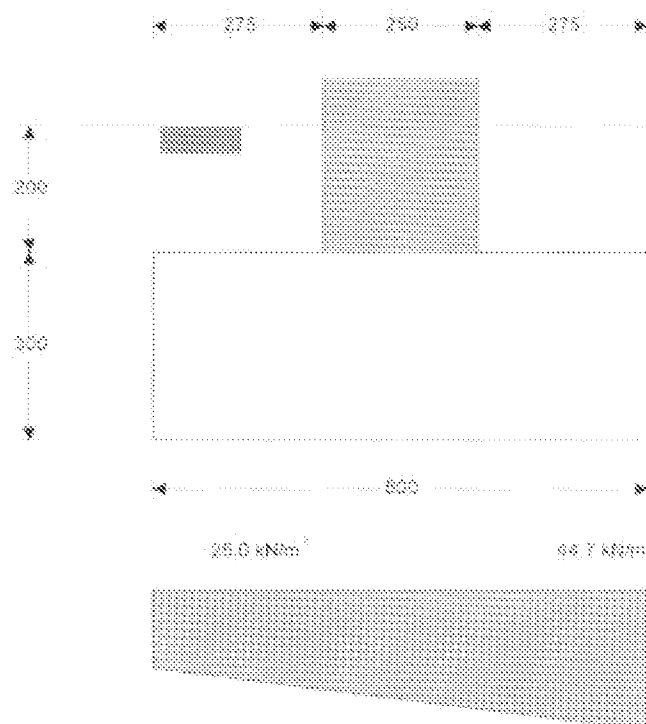
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STRIP FOOTING ANALYSIS AND DESIGN (BS8110-1:1997)

TEDDS calculation version 2.0.02.00



Strip footing details

Width of strip footing $B = 800 \text{ mm}$
 Depth of strip footing $h = 300 \text{ mm}$
 Depth of soil over strip footing $h_{soil} = 200 \text{ mm}$
 Density of concrete $\rho_{conc} = 23.6 \text{ kN/m}^3$

Load details

Load width $b = 250 \text{ mm}$
 Load eccentricity $e_v = 0 \text{ mm}$

Soil details

Density of soil $\rho_{soil} = 20.0 \text{ kN/m}^3$
 Design shear strength $\phi' = 25.0 \text{ deg}$
 Design base friction $\delta = 19.3 \text{ deg}$
 Allowable bearing pressure $P_{bearing} = 150 \text{ kN/m}^2$

Axial loading on strip footing

Dead axial load $P_D = 10.0 \text{ kN/m}$
 Imposed axial load $P_I = 5.0 \text{ kN/m}$
 Wind axial load $P_W = 0.0 \text{ kN/m}$
 Total axial load $P = 15.0 \text{ kN/m}$

Foundation loads

Dead surcharge load $F_{dead} = 5.000 \text{ kN/m}^2$
 Imposed surcharge load $F_{over} = 0.000 \text{ kN/m}^2$
 Strip footing self weight $F_{foot} = h \times \rho_{conc} = 7.080 \text{ kN/m}^2$

Project Waters Edge, 1 Botany Close.			Job no 2012-035		
Drawn for Boundary wall footing			Start page no / Revision 2		
Drawn by JGF	Calc date 18/06/2012	Checked by	Checked date	Approved by	Approved date

Soil self weight

$$F_{\text{soil}} = f_{\text{soil}} \times p_{\text{soil}} = 4.000 \text{ kN/m}^2$$

Total foundation load

$$F = B \times (F_{\text{soil}} + F_{\text{dead}} + F_{\text{live}} + F_{\text{wind}}) = 12.9 \text{ kN/m}$$

Horizontal loading on strip footing

Dead horizontal load

$$H_d = 0.5 \text{ kN/m}$$

Imposed horizontal load

$$H_i = 0.0 \text{ kN/m}$$

Wind horizontal load

$$H_w = 3.0 \text{ kN/m}$$

Total horizontal load

$$H = 3.5 \text{ kN/m}$$

Check stability against sliding

Resistance to sliding due to base friction

$$H_{\text{resist}} = \max([P_d + (F_{\text{dead}} + F_{\text{live}} + F_{\text{wind}}) \times B], 0 \text{ kN/m}) \times \tan(\phi) = 8.0 \text{ kN/m}$$

Passive pressure coefficient

$$K_p = (1 + \sin(\phi')) / (1 - \sin(\phi')) = 2.454$$

Passive resistance of soil

$$H_{\text{pass}} = 0.5 \times K_p \times (B^2 + 2 \times h \times f_{\text{soil}}) \times p_{\text{soil}} = 5.2 \text{ kN/m}$$

Total resistance to sliding

$$H_{\text{tot}} = H_{\text{resist}} + H_{\text{pass}} = 13.2 \text{ kN/m}$$

PASS - Resistance to sliding is greater than horizontal load

Check stability against overturning

Total overturning moment

$$M_{\text{ot}} = M + H \times h = 1.050 \text{ kNm/m}$$

Restoring moment

Foundation loading

$$M_{\text{soil}} = B^2 \times (F_{\text{dead}} + F_{\text{live}} + F_{\text{wind}}) / 2 = 5.146 \text{ kNm/m}$$

Axial loading on column

$$M_{\text{axial}} = (P_d) \times (B / 2 - e_r) = 4.000 \text{ kNm/m}$$

Total restoring moment

$$M_{\text{res}} = M_{\text{soil}} + M_{\text{axial}} = 9.146 \text{ kNm/m}$$

PASS - Restoring moment is greater than overturning moment

Calculate base reaction

Total base reaction

$$T = F + P = 27.9 \text{ kN/m}$$

Eccentricity of base reaction in x

$$e_r = (P \times e_r + M + H \times h) / T = 38 \text{ mm}$$

Base reaction acts within middle third of base

Calculate base pressures

$$q_1 = (T / B) \times (1 - 6 \times e_r / B) = 24.986 \text{ kN/m}^2$$

$$q_2 = (T / B) \times (1 + 6 \times e_r / B) = 44.674 \text{ kN/m}^2$$

Minimum base pressure

$$q_{\text{min}} = \min(q_1, q_2) = 24.986 \text{ kN/m}^2$$

Maximum base pressure

$$q_{\text{max}} = \max(q_1, q_2) = 44.674 \text{ kN/m}^2$$

PASS - Maximum base pressure is less than allowable bearing pressure

Partial safety factors for loads

Partial safety factor for dead loads

$$\gamma_{\text{ds}} = 1.20$$

Partial safety factor for imposed loads

$$\gamma_{\text{di}} = 1.20$$

Partial safety factor for wind loads

$$\gamma_{\text{dw}} = 1.20$$

Ultimate axial loading

Ultimate axial loading

$$P_u = P_d \times \gamma_{\text{ds}} + P_i \times \gamma_{\text{di}} + P_w \times \gamma_{\text{dw}} = 18.0 \text{ kN/m}$$

Ultimate foundation loading

Ultimate foundation loading

$$F_u = B \times [(F_{\text{dead}} + F_{\text{live}} + F_{\text{wind}}) \times \gamma_{\text{ds}} + F_{\text{dead}} \times \gamma_{\text{di}}] = 15.4 \text{ kN/m}$$

Ultimate horizontal loading

Ultimate horizontal loading

$$H_u = H_d \times \gamma_{\text{ds}} + H_i \times \gamma_{\text{di}} + H_w \times \gamma_{\text{dw}} = 4.2 \text{ kN/m}$$

Ultimate moment on foundation

Ultimate moment

$$M_u = M_d \times \gamma_{\text{ds}} + M_i \times \gamma_{\text{di}} + M_w \times \gamma_{\text{dw}} = 0.000 \text{ kNm/m}$$

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	Drawn by Boundary wall footing				Start page no./Revision 3	
	Calcs by JGF	Calcs date 18/06/2012	Checked by	Checked date	Approved by	Approved date

Calculate ultimate base reaction

Ultimate base reaction

$$T_u = F_u + P_u = 33.4 \text{ kN/m}$$

Eccentricity of ultimate base reaction

$$e_{tu} = (P_u \times e + M_u + H_u \times h) / T_u = 38 \text{ mm}$$

Calculate ultimate pad base pressures

$$q_{tu} = (T_u / B) \times (1 - 6 \times e_{tu} / B) = 29.984 \text{ kN/m}^2$$

$$q_{tu} = (T_u / B) \times (1 + 6 \times e_{tu} / B) = 53.608 \text{ kN/m}^2$$

Minimum ultimate base pressure

$$q_{tu\min} = \min(q_{tu}, q_{tu}) = 29.984 \text{ kN/m}^2$$

Maximum ultimate base pressure

$$q_{tu\max} = \max(q_{tu}, q_{tu}) = 53.608 \text{ kN/m}^2$$

Calculate base lengths

Left hand length

$$B_L = B / 2 + e = 400 \text{ mm}$$

Right hand length

$$B_R = B / 2 - e = 400 \text{ mm}$$

Calculate rate of change of base pressure

Length of base reaction

$$B_x = B = 800 \text{ mm}$$

Rate of change of base pressure

$$C_x = (q_{tu} - q_{tu}) / B_x = 29.531 \text{ kN/m}^2/\text{m}$$

Calculate ultimate moment

Ultimate moment

$$M_u = (q_{tu} \times F_u / B) \times B_x / 2 + C_x \times B_x^2 / 6 + H_u \times h = 2.430 \text{ kNm/m}$$

Material details

Characteristic strength of concrete

$$f_{cu} = 30 \text{ N/mm}^2$$

Characteristic strength of reinforcement

$$f_y = 500 \text{ N/mm}^2$$

Characteristic strength of shear reinforcement

$$f_{sv} = 500 \text{ N/mm}^2$$

Nominal cover to reinforcement

$$C_{nom} = 30 \text{ mm}$$

Moment design

Diameter of tension reinforcement

$$\phi_s = 10 \text{ mm}$$

Depth of tension reinforcement

$$d = h - C_{nom} - \phi_s / 2 = 265 \text{ mm}$$

Design formula for rectangular beams (cf 3.4.4.4)

$$K = M_u / (d^2 \times f_{cu}) = 0.001$$

$$K' = 0.156$$

K < K' compression reinforcement is not required

Lever arm

$$z = d \times \min([0.5 + \sqrt{(0.25 - K / 0.9)}], 0.95) = 262 \text{ mm}$$

Area of tension reinforcement required

$$A_{s,req} = M_u / (0.87 \times f_y \times z) = 22 \text{ mm}^2/\text{m}$$

Minimum area of tension reinforcement

$$A_{s,min} = 0.0013 \times h = 390 \text{ mm}^2/\text{m}$$

Tension reinforcement provided

$$10 \text{ dia. bars @ 200 centres bottom}$$

Area of tension reinforcement provided

$$A_{s,prov} = n \times a_s / (4 \times 50) = 383 \text{ mm}^2/\text{m}$$

PASS - Tension reinforcement provided exceeds tension reinforcement required

Calculate ultimate shear force at distance d from face of wall

Ultimate shear force at face of load

$$V_{tu} = (q_{tu} - F_u / B) \times (B_x - b / 2 - d) - C_x \times (B_x - b / 2 - d)^2 / 2 = 0.342 \text{ kN/m}$$

kN/m

Shear stresses at distance d from face of wall (cf 3.5.5.2)

Design shear stress

$$v_{tu} = V_{tu} / d = 0.001 \text{ N/mm}^2$$

From BS 8110:Part 1:1997 - Table 3.9

Design concrete shear stress

$$v_c = 0.354 \text{ N/mm}^2$$

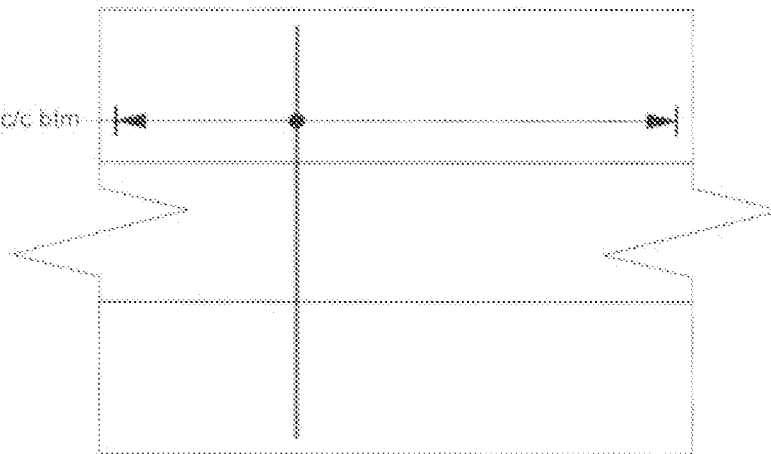
Allowable design shear stress

$$v_{red} = \min(0.8 \text{ N/mm}^2 \times \sqrt{f_{cu} / 1 \text{ N/mm}^2}, 5 \text{ N/mm}^2) = 4.382 \text{ N/mm}^2$$

PASS - $v_{tu} < v_c$ - No shear reinforcement required

Project Waters Edge, 1 Botany Close.				Job no 2012-035	
Calcs for Boundary wall footing				Start page no / Revision 4	
Calcs by JGF	Calcs date 18/06/2012	Checked by	Checked date	Approved by	Approved date

10 dia. bars @ 200 c/c btm



 Tedds Elite Designers Unit 12 Pinewood Court Putney SW15 1AZ	Project Water Edge, 2 Botany Close		Job no 2012-035	
	Calcs for Boundary wall		Start page no / Revision 1	
	Calcs by JGF	Calcs date 15/06/2012	Checked by	Checked date
			Approved by	Approved date

MASONRY WALL PANEL DESIGN TO BS5628:2005

In accordance with BS5628-1:2005

TEDDS calculation version 1.2.05

Masonry panel details

Unreinforced masonry wall without openings

Panel length $L = 7000 \text{ mm}$

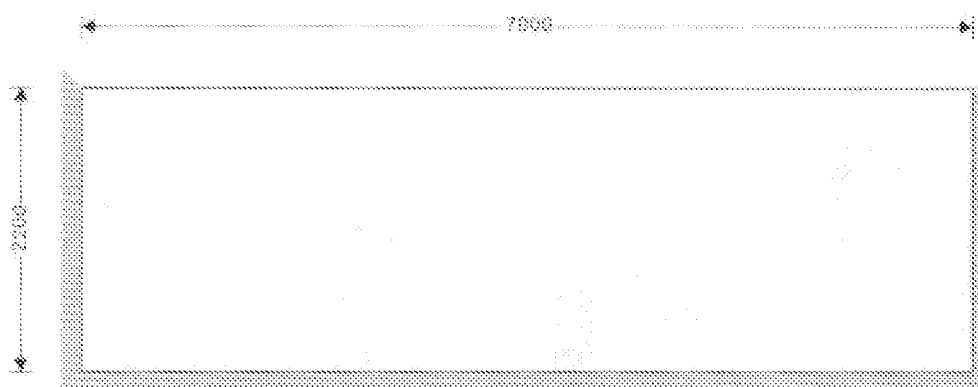
Panel height $h = 2200 \text{ mm}$

Panel support conditions

Right, left and bottom supported continuously

Effective panel length $L_{\text{eff}} = 1.0 \times L = 7000 \text{ mm}$

Effective panel height $h_{\text{eff}} = 1.0 \times h = 2200 \text{ mm}$



Pier details

Thickness of pier $t_p = 430 \text{ mm}$

Breadth of pier $b_p = 450 \text{ mm}$

Spacing between piers $s_p = 7000 \text{ mm}$

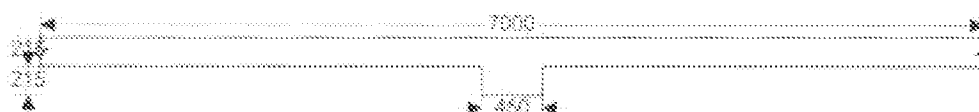
From BS5628-1 Table 5 - Stiffness coefficient for walls stiffened by piers

Stiffness coefficient $K = 1.09$

Single-leaf wall construction details

Wall thickness $t = 215 \text{ mm}$

Effective wall thickness $t_{\text{eff}} = t \times K = 234 \text{ mm}$



Masonry details

Masonry type **Clay bricks having a water absorption between 7% and 12%**

Compressive strength of unit $p_{\text{unit}} = 5.0 \text{ N/mm}^2$

Mortar strength Class/Designation **M4 / (iii)**

Height of masonry units $h_u = 85 \text{ mm}$

Density of masonry $\gamma = 18.0 \text{ kN/m}^3$

 Tedds Elite Designers Unit 12 Princeton Court Putney SW15 1AZ	Project				Job no	
	Water Edge, 2 Botany Close				2012-035	
	Calcs for				Start page no./Revision	
	Boundary wall				2	
	Calcs by	Calcs date	Checked by	Checked date	Approved by	Approved date
	JGF	15/06/2012				

From BS5628-1 Table 2a - Characteristic compressive strength of masonry

Characteristic compressive strength $f_k = 2.50 \text{ N/mm}^2$

From BS5628-1 Table 3 - Characteristic flexural strength of masonry

Plane of failure parallel to bed joints $f_{k, \text{para}} = 0.40 \text{ N/mm}^2$

Plane of failure perpendicular to bed joints $f_{k, \text{perp}} = 1.10 \text{ N/mm}^2$

Lateral loading details

Characteristic wind load on panel $W_k = 0.700 \text{ kN/m}^2$

Vertical loading details

Dead load on top of wall $G_k = 1.5 \text{ kN/m}$

Partial safety factors for material strength

Category of manufacturing control **Category II**

Category of construction control **Normal**

Partial safety factor for masonry in compression $\gamma_{mc} = 3.50$

Partial safety factor for masonry in flexure $\gamma_{mf} = 3.00$

Partial safety factor for masonry in shear $\gamma_{mv} = 2.50$

Slenderness ratio (cl 24.1)

Allowable slenderness ratio $SR_{\text{allow}} = 27$

Slenderness ratio $SR = \min(h_{\text{eff}}, L_{\text{eff}}) / t_r = 9.4$

PASS - Slenderness ratio is less than maximum allowable

Vertical loading (cl 28)

Partial safety factors for design loads

Partial safety factor for design dead load $\gamma_{Gd} = 1.40$

Partial safety factor for design imposed load $\gamma_{Gd} = 1.60$

Check vertical loads at top of wall

Design vertical load on wall $F_v = G_k \times \gamma_{Gd} + Q_k \times \gamma_{Gd} = 2.1 \text{ kN/m}$

Design vertical load stress on wall $f_v = F_v / t = 0.010 \text{ N/mm}^2$

Design bending moment $M_v = G_k \times \gamma_{Gd} \times e_d + Q_k \times \gamma_{Gd} \times e_d = 0.0 \text{ kNm/m}$

Resultant eccentricity at the top of the wall $e_v = M_v / F_v = 0 \text{ mm}$

From BS5628-1 Table 7 - Capacity reduction factor

Capacity reduction factor $\beta = 1.00$

Allowable stress capacity $f_{\text{cap}} = \beta \times f_k / \gamma_{mc} = 0.714 \text{ N/mm}^2$

PASS - Allowable stress capacity exceeds design vertical load stress on wall

Horizontal loading (cl 32)

Limiting dimensions (cl 22.3)

Area of panel $A_p = h \times L = 15.4 \text{ m}^2$

Limiting area of panel $A_{\text{lim}} = 1500 \times t_r^2 = 82.2 \text{ m}^2$

PASS - Area of panel does not exceed limiting area of panel

Limiting panel dimension $L_{\text{lim}} = 50 \times t_r = 11706 \text{ mm}$

PASS - Limiting panel dimension is not exceeded

Partial safety factors for design loads

Partial safety factor for design wind load $\gamma_{Wd} = 1.40$

Partial safety factor for design dead load $\gamma_{Gd} = 0.90$

Project Water Edge, 2 Botany Close				Job no 2012-035	
Calcs for Boundary wall				Start page no./Revision 3	
Calcs by JGF	Calcs date 15/06/2012	Checked by	Checked date	Approved by	Approved date

Design moments of resistance in panels (cl 32.4.2)

Design vertical compressive stress	$g_v = \gamma_{ov} \times G_v / l = 0.01 \text{ N/mm}^2$
Enhanced flexural strength of masonry	$f_{k,par} = f_{k,perp} + \gamma_{ov} \times g_v = 0.42 \text{ N/mm}^2$
Flange width	$b = \min(s_e, b_p + 12 \times t) = 3030 \text{ mm}$
Neutral axis depth	$y_1 = [(b \times t^3/2) + (b_p \times (l-t) \times (l+t)/2)] / (b \times t + b_p \times (l-t)) = 135 \text{ mm}$ $y_2 = l - y_1 = 295 \text{ mm}$
Moment of inertia	$I = b \times t^3/12 + b_p \times t \times (y_2 - t/2)^2 + b_p \times (l-t)^3/12 + b_p \times (l-t) \times (y_1 - (l-t)/2)^2$ $I = 6776086886 \text{ mm}^4$
Section modulus of pier and flange	$Z = I / (\max(y_1, y_2) \times s_e) = 3284758 \text{ mm}^3/\text{m}$
Parallel design moment of resistance	$M_{par} = f_{k,par} \times Z / \gamma_{mf} = 0.458 \text{ kNm/m}$
Section modulus of wall	$Z = l^3 / 6 = 7704167 \text{ mm}^3/\text{m}$
Perpendicular design moment of resistance	$M_{perp} = f_{k,perp} \times Z / \gamma_{mf} = 2.825 \text{ kNm/m}$
Elastic design moment of resistance	$M_d = M_{par} = 2.825 \text{ kNm/m}$

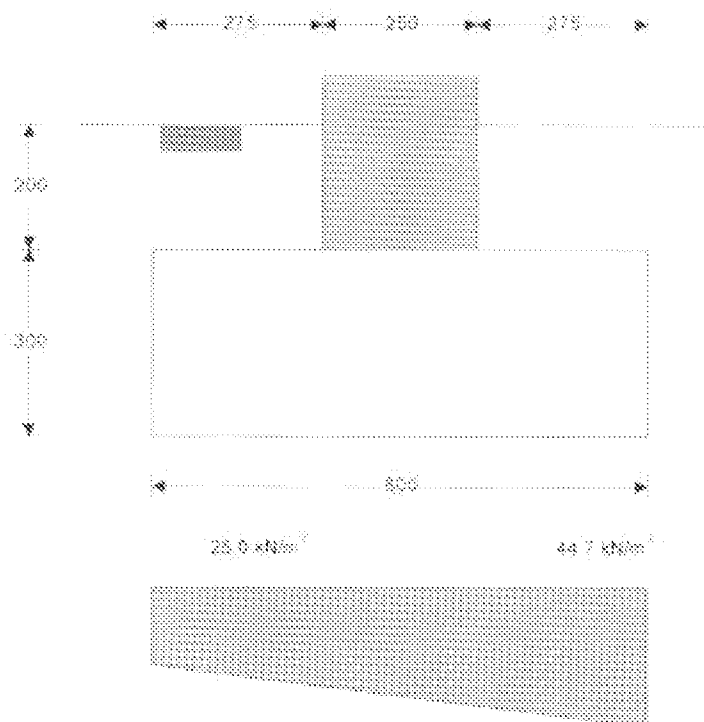
Design moment in panels (cl 32.4.2)

Orthogonal strength ratio	$\mu = M_{par} / M_{perp} = 0.16$
Using yield line analysis to calculate bending moment coefficient	
Bending moment coefficient	$\alpha = 0.033$
Design moment in wall	$M = \alpha \times W_k \times \gamma_{ov} \times L^2 = 1.598 \text{ kNm/m}$ PASS - Resistance moment exceeds design moment

Project Waters Edge, 1 Botany Close			Job no 2012-035		
Dates for Boundary wall footing			Start page no (Revision) 1		
Drawn by JGF	Drawn date 18/06/2012	Checked by	Checked date	Approved by	Approved date

STRIP FOOTING ANALYSIS AND DESIGN (BS8110-1:1997)

TEDDS calculation version 2.0 (2.00)



Strip footing details

Width of strip footing	$b = 800 \text{ mm}$
Depth of strip footing	$h = 300 \text{ mm}$
Depth of soil over strip footing	$h_{soil} = 200 \text{ mm}$
Density of concrete	$\rho_{conc} = 23.6 \text{ kN/m}^3$

Load details

Load width	$b = 250 \text{ mm}$
Load eccentricity	$ee = 0 \text{ mm}$

Soil details

Density of soil	$\rho_{soil} = 20.0 \text{ kN/m}^3$
Design shear strength	$\phi' = 25.0 \text{ deg}$
Design base friction	$\delta = 19.3 \text{ deg}$
Allowable bearing pressure	$P_{allow} = 150 \text{ kN/m}^2$

Axial loading on strip footing

Dead axial load	$P_D = 10.0 \text{ kN/m}$
Imposed axial load	$P_U = 5.0 \text{ kN/m}$
Wind axial load	$P_W = 0.0 \text{ kN/m}$
Total axial load	$P = 15.0 \text{ kN/m}$

Foundation loads

Dead surcharge load	$F_{sur} = 5.000 \text{ kN/m}^2$
Imposed surcharge load	$F_{sur} = 0.000 \text{ kN/m}^2$
Strip footing self weight	$F_{sw} = h \times \rho_{conc} = 7.080 \text{ kN/m}^2$



Tedds
Elite Designers
Unit 12 Pinewood Court
Putney
SW15 1AZ

Project Waters Edge, 1 Botany Close.				Job no. 2012-035	
Calcs for Boundary wall footing				Start page no./Revision 2	
Calcs by JGF	Calcs date 18/06/2012	Checked by	Checked date	Approved by	Approved date

Soil self weight

$$F_{\text{soil}} = h_{\text{soil}} \times p_{\text{soil}} = 4.000 \text{ kN/m}^2$$

Total foundation load

$$F = B \times (F_{\text{dead}} + F_{\text{live}} + F_{\text{wind}} + F_{\text{soil}}) = 12.9 \text{ kN/m}$$

Horizontal loading on strip footing

Dead horizontal load

$$H_D = 0.5 \text{ kN/m}$$

Imposed horizontal load

$$H_I = 0.0 \text{ kN/m}$$

Wind horizontal load

$$H_W = 3.0 \text{ kN/m}$$

Total horizontal load

$$H = 3.5 \text{ kN/m}$$

Check stability against sliding

Resistance to sliding due to base friction

$$H_{\text{resist}} = \max([P_D + (F_{\text{dead}} + F_{\text{live}} + F_{\text{soil}}) \times B], 0 \text{ kN/m}) \times \tan(\delta) = 8.0 \text{ kN/m}$$

Passive pressure coefficient

$$K_0 = (1 + \sin(\phi')) / (1 - \sin(\phi')) = 2.454$$

Passive resistance of soil

$$H_{\text{pass}} = 0.5 \times K_0 \times (h^2 + 2 \times h \times h_{\text{soil}}) \times p_{\text{soil}} = 5.2 \text{ kN/m}$$

Total resistance to sliding

$$H_{\text{res}} = H_{\text{resist}} + H_{\text{pass}} = 13.2 \text{ kN/m}$$

PASS - Resistance to sliding is greater than horizontal load

Check stability against overturning

Total overturning moment

$$M_{\text{OT}} = M + H \times h = 1.050 \text{ kNm/m}$$

Restoring moment

Foundation loading

$$M_{\text{base}} = B^2 \times (F_{\text{dead}} + F_{\text{live}} + F_{\text{soil}}) / 2 = 5.146 \text{ kNm/m}$$

Axial loading on column

$$M_{\text{axis}} = (P_D) \times (B / 2 - e) = 4.000 \text{ kNm/m}$$

Total restoring moment

$$M_{\text{res}} = M_{\text{base}} + M_{\text{axis}} = 9.146 \text{ kNm/m}$$

PASS - Restoring moment is greater than overturning moment

Calculate base reaction

Total base reaction

$$T = F + P = 27.9 \text{ kN/m}$$

Eccentricity of base reaction in x

$$e_x = (P \times e_x + M + H \times h) / T = 38 \text{ mm}$$

Base reaction acts within middle third of base

Calculate base pressures

$$q_1 = (T / B) \times (1 - 6 \times e_x / B) = 24.986 \text{ kN/m}^2$$

$$q_2 = (T / B) \times (1 + 6 \times e_x / B) = 44.674 \text{ kN/m}^2$$

Minimum base pressure

$$q_{\text{min}} = \min(q_1, q_2) = 24.986 \text{ kN/m}^2$$

Maximum base pressure

$$q_{\text{max}} = \max(q_1, q_2) = 44.674 \text{ kN/m}^2$$

PASS - Maximum base pressure is less than allowable bearing pressure

Partial safety factors for loads

Partial safety factor for dead loads

$$\gamma_D = 1.20$$

Partial safety factor for imposed loads

$$\gamma_{\text{IM}} = 1.20$$

Partial safety factor for wind loads

$$\gamma_{\text{W}} = 1.20$$

Ultimate axial loading

Ultimate axial loading

$$F_u = P_D \times \gamma_D + P_I \times \gamma_{\text{IM}} + P_W \times \gamma_{\text{W}} = 18.0 \text{ kN/m}$$

Ultimate foundation loading

Ultimate foundation loading

$$F_u = B \times [(F_{\text{dead}} + F_{\text{live}} + F_{\text{soil}}) \times \gamma_D + F_{\text{dead}} \times \gamma_{\text{IM}}] = 15.4 \text{ kN/m}$$

Ultimate horizontal loading

Ultimate horizontal loading

$$H_u = H_D \times \gamma_D + H_I \times \gamma_{\text{IM}} + H_W \times \gamma_{\text{W}} = 4.2 \text{ kN/m}$$

Ultimate moment on foundation

Ultimate moment

$$M_u = M_D \times \gamma_D + M_I \times \gamma_{\text{IM}} + M_W \times \gamma_{\text{W}} = 0.000 \text{ kNm/m}$$

 Tedds Elite Designers Unit 12 Princeton Court Putney SW15 1AZ	Project Waters Edge, 1 Botany Close		Job no. 2012-035	
	Calc for Boundary wall footing		Start page no / Revision 3	
	Calc by JGF	Calc date 18/06/2012	Checked by	Checked date
			Approved by	Approved date

Calculate ultimate base reaction

Ultimate base reaction

$$T_u = F_u + P_u = 33.4 \text{ kN/m}$$

Eccentricity of ultimate base reaction

$$e_u = (P_u \times e_p + M_u + H_u \times h) / T_u = 38 \text{ mm}$$

Calculate ultimate pad base pressures

$$q_{1u} = (T_u / B) \times (1 - 6 \times e_u / B) = 29.984 \text{ kN/m}^2$$

$$q_{2u} = (T_u / B) \times (1 + 6 \times e_u / B) = 53.608 \text{ kN/m}^2$$

Minimum ultimate base pressure

$$q_{\min u} = \min(q_{1u}, q_{2u}) = 29.984 \text{ kN/m}^2$$

Maximum ultimate base pressure

$$q_{\max u} = \max(q_{1u}, q_{2u}) = 53.608 \text{ kN/m}^2$$

Calculate base lengths

Left hand length

$$B_L = B / 2 + e_u = 400 \text{ mm}$$

Right hand length

$$B_R = B / 2 - e_u = 400 \text{ mm}$$

Calculate rate of change of base pressure

Length of base reaction

$$B_r = B = 800 \text{ mm}$$

Rate of change of base pressure

$$C_u = (q_{2u} - q_{1u}) / B_r = 29.531 \text{ kN/m}^2/\text{m}$$

Calculate ultimate moment

Ultimate moment

$$M_u = (q_{1u} \times F_u / B) \times B_r^2 / 2 + C_u \times B_r^3 / 6 + H_u \times h = 2.430 \text{ kNm/m}$$

Material details

Characteristic strength of concrete

$$f_{cu} = 30 \text{ N/mm}^2$$

Characteristic strength of reinforcement

$$f_y = 500 \text{ N/mm}^2$$

Characteristic strength of shear reinforcement

$$f_{yv} = 500 \text{ N/mm}^2$$

Nominal cover to reinforcement

$$c_{nom} = 30 \text{ mm}$$

Moment design

Diameter of tension reinforcement

$$\phi_s = 10 \text{ mm}$$

Depth of tension reinforcement

$$d = h - c_{nom} - \phi_s / 2 = 265 \text{ mm}$$

Design formula for rectangular beams (cl 3.4.4.4)

$$K = M_u / (d^2 \times f_{cu}) = 0.001$$

$$K' = 0.156$$

K < K' compression reinforcement is not required

Lever arm

$$z = d \times \min([0.5 + \sqrt{(0.25 - K / 0.9)}], 0.95) = 252 \text{ mm}$$

Area of tension reinforcement required

$$A_{s, req} = M_u / (0.87 \times f_y \times z) = 22 \text{ mm}^2/\text{m}$$

Minimum area of tension reinforcement

$$A_{s, min} = 0.0013 \times h = 390 \text{ mm}^2/\text{m}$$

Tension reinforcement provided

$$10 \text{ dia. bars @ 200 centres bottom}$$

Area of tension reinforcement provided

$$A_{s, p, prov} = \pi \times \phi_s^2 / (4 \times se) = 393 \text{ mm}^2/\text{m}$$

PASS - Tension reinforcement provided exceeds tension reinforcement required

Calculate ultimate shear force at distance d from face of wall

Ultimate shear force at face of load

$$V_{du} = (q_{2u} - F_u / B) \times (B_R - b / 2 - d) - C_u \times (B_R - b / 2 - d)^2 / 2 = 0.342 \text{ kN/m}$$

kN/m

Shear stresses at distance d from face of wall (cl 3.5.5.2)

Design shear stress

$$v_{du} = V_{du} / d = 0.001 \text{ N/mm}^2$$

From BS 8110:Part 1:1997 - Table 3.8

Design concrete shear stress

$$v_c = 0.394 \text{ N/mm}^2$$

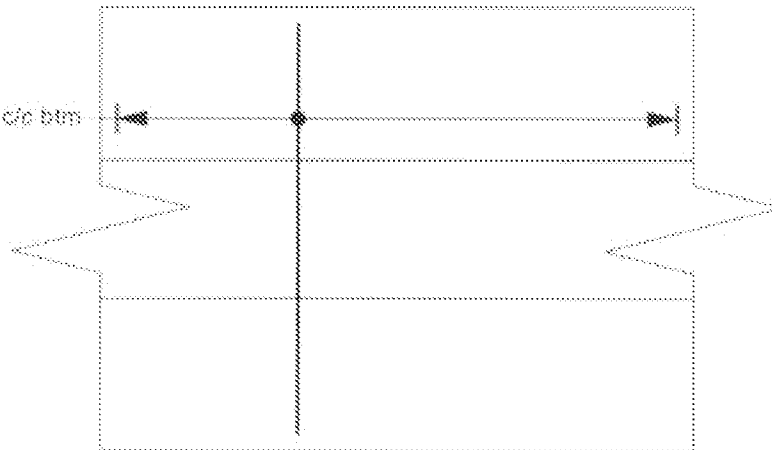
Allowable design shear stress

$$v_{max} = \min(0.8 \text{ N/mm}^2 \times \sqrt{f_{cu} / 1 \text{ N/mm}^2}, 5 \text{ N/mm}^2) = 4.382 \text{ N/mm}^2$$

PASS - $v_{du} < v_c$ - No shear reinforcement required

Project Waters Edge, 1 Botany Close			Job no 2012-035		
Covers for Boundary wall footing			Sheet page no./Revisions 4		
Covers by JGF	Covers date 18/06/2012	Checked by	Checked date	Approved by	Approved date

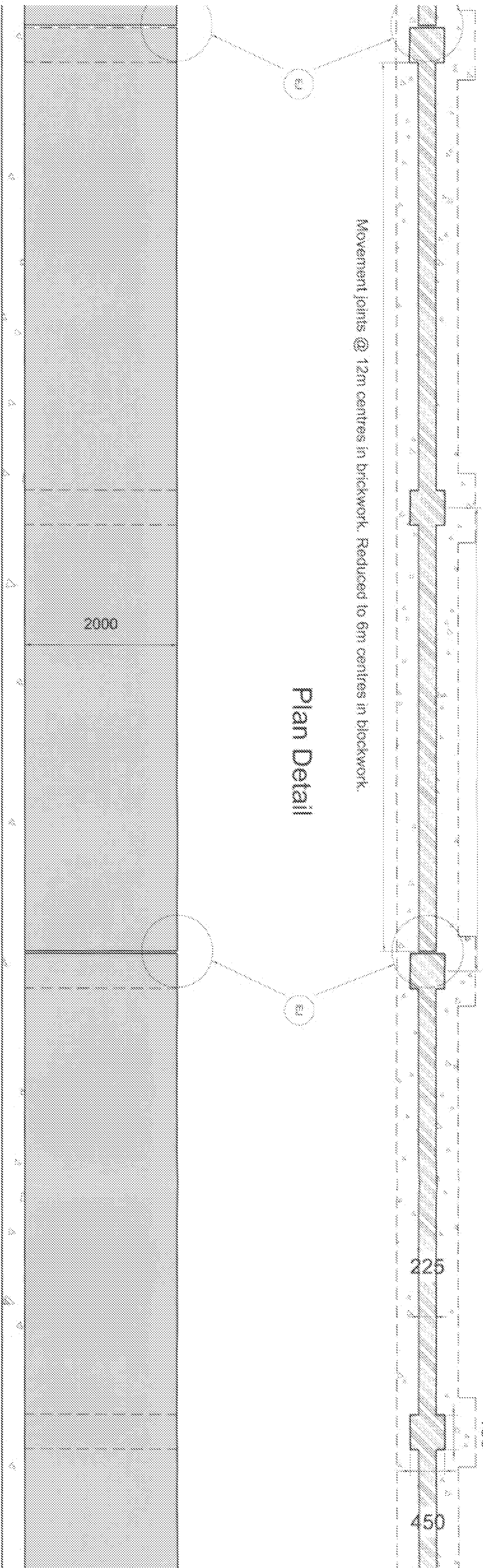
10 dia. bars @ 200 c/c btm



Max 6m spacing between piers.

Movement joints @ 12m centres in brickwork. Reduced to 6m centres in blockwork.

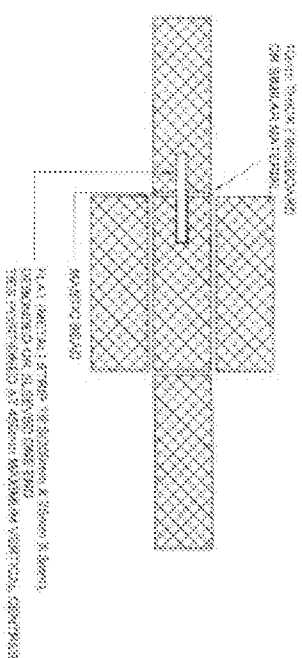
Plan Detail



Elevation Detail



Strip Foundation Detail



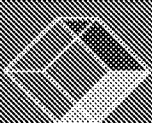
Expansion joint



Notes

Do not scale from this drawing.
All dimensions to be checked on site.
Any discrepancies found between site conditions and these drawings to be reported to Elite Designers.

Rev	Description	Checked	Date
1	1 Botany Close Rushmore West Sussex BN16 2BH		
Client			
Mr & Mrs Woods			
Drawing Title			
Proposed feasibility details			
Drawn	Checked	Drawing No.	
JGF	NJR	2012-035-FEAS-04	
Date	Job No.	Scale	Rev
18/08/12	2012-035	1:50 at A1 1:100 at A3	



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