



Eaton Richards

Tan Lan Barn
Loggerheads Road
Mold. CH7 5PG

Tel: 01352 810777
E mail: er@ser-uk.com

Job ref : 2709E
Date : Jan 21
Checked : SER
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31 WREXHAM ROAD GARDEN WALL

MASONRY WALL 1.8 M HIGH

In accordance with BS5628-1:2005

Tedds calculation version 1.2.15

Masonry panel details

Single-leaf wall example - Unreinforced masonry wall without openings

Panel length; $L = 14000$ mm

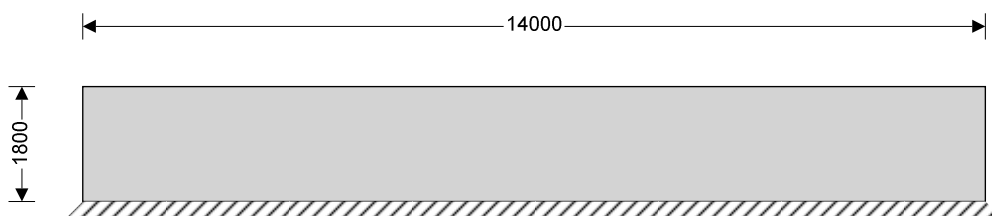
Panel height; $h = 1800$ mm

Panel support conditions

; **Bottom only supported continuously**

Effective panel length; $L_{ef} = 2.5 \times L = 35000$ mm

Effective panel height; $h_{ef} = 2.0 \times h = 3600$ mm



Pier details

Thickness of pier; $t_p = 560$ mm

Breadth of pier; $b_p = 225$ mm

Spacing between piers; $s_p = 1400$ mm

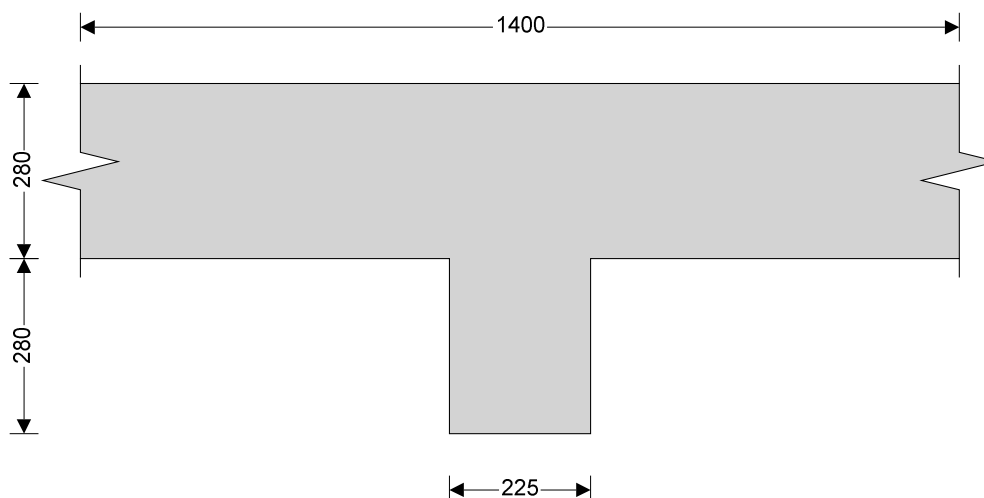
From BS5628-1 Table 5 - Stiffness coefficient for walls stiffened by piers

Stiffness coefficient; $K = 1.39$

Single-leaf wall construction details

Wall thickness; $t = 280$ mm

Effective wall thickness; $t_{ef} = t \times K = 389$ mm



Masonry details

Masonry type; **Natural stone masonry**



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Compressive strength of unit;

$$p_{unit} = 17.5 \text{ N/mm}^2$$

Mortar strength Class/Designation;

M4 / (iii)

Characteristic compressive strength;

$$f_k = 0.35 \times p_{unit} = 6.1 \text{ N/mm}^2$$

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

Plane of failure parallel to bed joints;

$$f_{kx_para} = 0.25 \text{ N/mm}^2$$

Plane of failure perpendicular to bed joints;

$$f_{kx_perp} = 0.90 \text{ N/mm}^2$$

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;

$$G_k = 1.2 \text{ kN/m};$$

Imposed load on top of wall;

$$Q_k = 1.6 \text{ kN/m}; \text{ at an eccentricity of 20 mm}$$

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;

$$SR = h_{ef} / t_{ef} = 9.3$$

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;

$$\gamma_{FG} = 1.40$$

Partial safety factor for design imposed load;

$$\gamma_{FQ} = 1.60$$

Check vertical loads at top of wall

Design vertical load on wall;

$$F_v = G_k \times \gamma_{FG} + Q_k \times \gamma_{FQ} = 4.2 \text{ kN/m}$$

Design vertical load stress on wall;

$$f_v = F_v / t = 0.015 \text{ N/mm}^2$$

Design bending moment;

$$M_v = G_k \times \gamma_{FG} \times e_G + Q_k \times \gamma_{FQ} \times e_Q = 0.1 \text{ kNm/m}$$

Resultant eccentricity at the top of the wall;

$$e_x = M_v / F_v = 12 \text{ mm}$$

From BS5628-1 Table 7 - Capacity reduction factor

Capacity reduction factor;

$$\beta = 1.00$$

Allowable stress capacity;

$$f_{cap} = \beta \times f_k / \gamma_{mc} = 1.750 \text{ N/mm}^2$$

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

Horizontal loading (cl 32)

Limiting dimensions (cl 32.3)

Limiting wall height;

$$h_{max} = 12 \times t_{ef} = 4667 \text{ mm}$$

PASS - Limiting wall height is not exceeded

Partial safety factors for design loads

Partial safety factor for design wind load;

$$\gamma_{FW} = 1.40$$

Partial safety factor for design dead load;

$$\gamma_{FG} = 0.90$$

Design moments of resistance in panels (cl 32.4.2)

Self weight of wall at base;

$$S_{wt} = h \times t \times \gamma = 10.08 \text{ kN/m}$$

Design vertical compressive stress;

$$g_d = \gamma_{FG} \times (G_k + S_{wt}) / t = 0.04 \text{ N/mm}^2$$

Enhanced flexural strength of masonry;

$$f_{ka_para} = f_{kx_para} + \gamma_{mf} \times g_d = 0.36 \text{ N/mm}^2$$



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Flange width;

$$b_f = \min(s_p, b_p + 12 \times t) = \mathbf{1400 \text{ mm}}$$

Neutral axis depth;
mm

$$y_2 = [(b_f \times t^2/2) + (b_p \times (t_p - t) \times (t_p + t)/2)] / (b_f \times t + b_p \times (t_p - t)) = \mathbf{179}$$

Moment of inertia;

$$y_1 = t_p - y_2 = \mathbf{381 \text{ mm}}$$

$$I = b_f \times t^3/12 + b_f \times t \times (y_2 - t/2)^2 + b_p \times (t_p - t)^3/12 + b_p \times (t_p - t) \times (y_1 - (t_p - t)/2)^2$$

$$I = \mathbf{7227977436 \text{ mm}^4}$$

Section modulus of pier and flange;

$$Z = I / (\max(y_1, y_2) \times s_p) = \mathbf{13542561 \text{ mm}^3/\text{m}}$$

Parallel design moment of resistance;

$$M_{para} = f_{ka_para} \times Z / \gamma_{mf} = \mathbf{1.620 \text{ kNm/m}}$$

Section modulus of wall;

$$Z = t^2 / 6 = \mathbf{13066667 \text{ mm}^3/\text{m}}$$

Perpendicular design moment of resistance;

$$M_{perp} = f_{kx_perp} \times Z / \gamma_{mf} = \mathbf{3.920 \text{ kNm/m}}$$

Elastic design moment of resistance;

$$M_d = M_{para} = \mathbf{1.620 \text{ kNm/m}}$$

Design moment in panels (cl 32.4.2)

Using elastic analysis to determine bending moment coefficients for a freestanding panel

Bending moment coefficient;

$$\alpha = \mathbf{0.500}$$

Design moment in wall;

$$M = \alpha \times W_k \times \gamma_{fW} \times h^2 = \mathbf{1.588 \text{ kNm/m}}$$

PASS - Resistance moment exceeds design moment