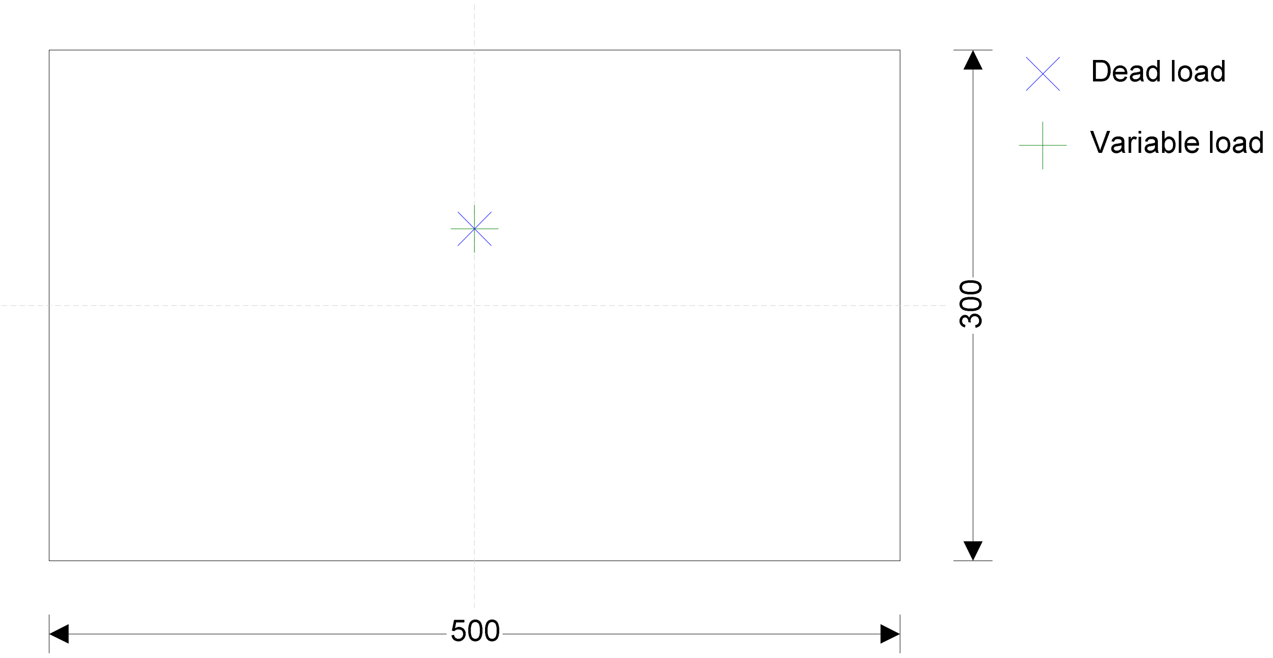
MASONRY COLUMN DESIGN

In accordance with EN1996-1-1:2005 incorporating corrigenda February 2006 and July 2009 and the recommended values

Geometry

Width of column;	b = **500** mm
Thickness of column;	t = **300** mm
Height of column;	h = **3600** mm
Reduction factor for effective height;	ρ_2 = **1.0**
Effective height of column (cl 5.5.1.2);	$h_{eff} = h \times \rho_2$ = **3600** mm



Plan on column

Loading

Vertical dead load;	G_k = **50.0** kN
Eccentricity of dead load in x-direction;	e_{Gb} = **0** mm
Eccentricity of dead load in y-direction;	e_{Gt} = **45** mm
Vertical live load;	Q_k = **25.0** kN

Eccentricity of variable load in x-direction; e_{Qb} = **0** mm

Eccentricity of variable load in y-direction; e_{Qt} = **45** mm

Characteristic wind loading; W_k = **0.0** kN/m^2

Vertical wind loading; W_v = **0.0** kN

Masonry details

Masonry type; **Aggregate concrete - Group 2**

Mean compressive strength of masonry unit; f_b = **7.3** N/mm^2

Density of masonry; γ = **18** kN/m^3

Mortar type; **M6 - General purpose mortar**

Compressive strength of masonry mortar; f_m = **6** N/mm^2

Compressive strength factor - Table 3.3; K = **0.45**

Characteristic compressive strength of masonry - eq 3.2

$f_k = K \times f_b^{0.7} \times f_m^{0.3}$ = **3.097** N/mm^2

Characteristic flexural strength of masonry having a plane of failure parallel to the bed joints - cl 3.6.3

f_{xk1} = **0.1** N/mm^2

Partial factors for material strength

Category of manufacturing control; **Category I**

Class of execution control; **Class 1**

Partial factor for masonry in compressive flexure; γ_{Mc} = **2.30**

Slenderness ratio

Slenderness ratio minor axis (cl.5.5.2.1); $\lambda_t = h_{eff} / t$ = **12.00**

Slenderness ratio major axis (cl.5.5.2.1); $\lambda_b = h_{eff} / b$ = **7.20**

Maximum slenderness; $\lambda = \max(\lambda_t, \lambda_b)$ = **12.00**

PASS - Slenderness ratio is less than 27

Reduction factor for slenderness and eccentricity about the major axis - Section 6.1.2.2

Design bending moment top or bottom of column; $M_{idb} = \text{abs}(\gamma_{fGv} \times G_k \times e_{Gb} + \gamma_{fQv} \times Q_k \times e_{Qb})$ = **0.0** kNm

Design vertical load at top or bottom of column; $N_{idb} = \text{abs}(\gamma_{fGv} \times G_k + \gamma_{fQv} \times Q_k)$ = **83.6** kN

Initial eccentricity - cl.5.5.1.1; $e_{init} = h_{eff} / 450$ = **8.0** mm

Conservativley assume moment due to wind load at the top of the column is equal to that at mid height

Eccentricity due to horizontal load; e_{hb} = **0.0** mm

Eccentricity at top or bottom of column - eq.6.5; $e_{ib} = \max(M_{idb} / N_{idb} + e_{hb} + e_{init}, 0.05 \times b)$ = **25.0** mm

Reduction factor top or bottom of column - eq.6.4; $\Phi_{ib} = \max(1 - 2 \times e_{ib} / b, 0)$ = **0.9**

Ratio of top and middle mnts due to eccentricity; α_{mdb} = **1.0**

Design bending moment at middle of column; $M_{mdb} = \alpha_{mdb} \times abs(\gamma_{fGv} \times G_k \times e_{Gb} + \gamma_{fQv} \times Q_k \times e_{Qb})$ = **0.0** kNm

Design vertical load at middle of column; $N_{mdb} = \gamma_{fGv} \times G_k + \gamma_{fQv} \times Q_k + \gamma_{fGv} \times t \times b \times \gamma \times h / 2$ = **89.2** kN

Eccentricity due to horizontal load; e_{hmb} = **0.0** mm

Eccentricity middle of column due to loads - eq.6.7; $e_{mb} = M_{mdb} / N_{mdb} + e_{hmb} + e_{init}$ = **8.0** mm

Eccentricity at middle of column due to creep; e_{kb} = **0.0** mm

Eccentricity at middle of column - eq.6.6; $e_{mkb} = max(e_{mb} + e_{kb}, 0.05 \times b)$ = **25.0** mm

From eq.G.2; $A_{1b} = 1 - 2 \times e_{mkb} / b$ = **0.9**

Short term secant modulus of elasticity factor; K_E = **1000**

Modulus of elasticity - cl.3.7.2; $E = K_E \times f_k$ = **3097** N/mm^2

Slenderness - eq.G.4; $\lambda_b = (h_{eff} / b) \times \sqrt{(f_k / E)}$ = **0.228**

From eq.G.3; $u_b = (\lambda_b - 0.063) / (0.73 - 1.17 \times e_{mkb} / b)$ = **0.245**

Reduction factor at middle of column - eq.G.1; $\Phi_{mb} = max(A_{1b} \times e\,e^{-(u_b \times u_b)/2}, 0)$ = **0.873**

Reduction factor for slenderness and eccentricity; $\Phi_b = min(\Phi_{ib}, \Phi_{mb})$ = **0.873**

Reduction factor for slenderness and eccentricity about the minor axis - Section 6.1.2.2

Design bending moment top or bottom of column; $M_{idt} = abs(\gamma_{fGv} \times G_k \times e_{Gt} + \gamma_{fQv} \times Q_k \times e_{Qt})$ = **3.8** kNm

Design vertical load at top or bottom of column; $N_{idt} = abs(\gamma_{fGv} \times G_k + \gamma_{fQv} \times Q_k)$ = **83.6** kN

Initial eccentricity - cl.5.5.1.1; $e_{init} = h_{eff} / 450$ = **8.0** mm

Conservativley assume moment due to wind load at the top of the column is equal to that at mid height

Eccentricity due to horizontal load; e_{ht} = **0.0** mm

Eccentricity at top or bottom of column - eq.6.5; $e_{it} = max(M_{idt} / N_{idt} + e_{ht} + e_{init}, 0.05 \times t)$ = **53.0** mm

Reduction factor top or bottom of column - eq.6.4; $\Phi_{it} = max(1 - 2 \times e_{it} / t, 0)$ = **0.647**

Ratio of top and middle mnts due to eccentricity; α_{mdt} = **1.0**

Design bending moment at middle of column; $M_{mdt} = \alpha_{mdt} \times abs(\gamma_{fGv} \times G_k \times e_{Gt} + \gamma_{fQv} \times Q_k \times e_{Qt})$ = **3.8** kNm

Design vertical load at middle of column; $N_{mdt} = \gamma_{fGv} \times G_k + \gamma_{fQv} \times Q_k + \gamma_{fGv} \times t \times b \times \gamma \times h / 2$ = **89.2** kN

Eccentricity due to horizontal load; e_{hmt} = **0.0** mm

Eccentricity middle of column due to loads - eq.6.7; $e_{mt} = M_{mdt} / N_{mdt} + e_{hmt} + e_{init}$ = **50.2** mm

Eccentricity at middle of column due to creep; e_{kt} = **0.0** mm

Eccentricity at middle of column - eq.6.6; $e_{mkt} = max(e_{mt} + e_{kt}, 0.05 \times t)$ = **50.2** mm

From eq.G.2; $A_{1t} = 1 - 2 \times e_{mkt} / t$ = **0.665**

Short term secant modulus of elasticity factor; K_E = **1000**

Modulus of elasticity - cl.3.7.2; $E = K_E \times f_k$ = **3097** N/mm^2

Slenderness - eq.G.4; $\lambda_t = (h_{eff} / t) \times \sqrt{(f_k / E)}$ = **0.379**

From eq.G.3; $u_t = (\lambda_t - 0.063) / (0.73 - 1.17 \times e_{mkt} / t)$ = **0.592**

Reduction factor at middle of column - eq.G.1; $\Phi_{mt} = \max(A_{1t} \times e_e^{-(u_t \times u_t)/2}, 0)$ = **0.558**

Reduction factor for slenderness and eccentricity; $\Phi_t = \min(\Phi_{it}, \Phi_{mt})$ = **0.558**

Columns subjected to mainly vertical loading - Section 6.1.2

Design value of the vertical load; $N_{Ed} = \max(N_{idb}, N_{mdb}, N_{idt}, N_{mdt})$ = **89.202** kN

Design compressive strength of masonry; $f_d = f_k / \gamma_{Mc}$ = **1.347** N/mm^2

Vertical resistance of column - eq.6.2; $N_{Rd} = \min(\Phi_t, \Phi_b) \times t \times b \times f_d$ = **112.786** kN

PASS - Design vertical resistance exceeds applied design vertical load