PROKON	Job Number		Sheet
Software Consultants (Pty) Ltd Internet: http://www.prokon.com E-Mail : mail@prokon.com	Job Title		
	Client		
	Calcs by	Checked by	Date

Column Base Design :

C15

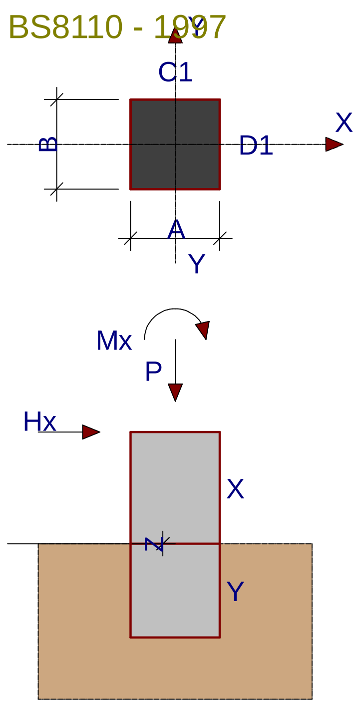
Input Data

Base length A (m)	0.8	
Base width B (m)	0.8	
Column(s)	Col 1	Col 2
C (m)	0.8	
D (m)	0.8	
E (m)		
F (m)		
Stub column height X (m)	1	
Base depth Y (m)	0.84	
Soil cover Z (m)		
Concrete density (kN/m^3)	25	
Soil density (kN/m^3)	18	
Soil friction angle (°)	22	
Base friction constant	0.33	
Rebar depth top X (mm)	50	
Rebar depth top Y (mm)	50	
Rebar depth bottom X (mm)	50	
Rebar depth bottom Y (mm)	50	
ULS ovt. LF: Self weight	1.2	
ULS LF: Self weight	1.2	
Max. SLS bearing pr. (kN/m^2)	150	
S.F. Overturning (ULS)	1	
S.F. Slip (ULS)	1	
fcu base (MPa)	40	
fcu columns (MPa)	40	
fy (MPa)	460	

Loading Data

Load Case	Col no.	LF ULS ovt	LF ULS	P (kN)	Hx (kN)	Hy (kN)	Mx (kNm)	My (kNm)
		Unfactored Loads						
UDL	1			3.093	1.022			4.077

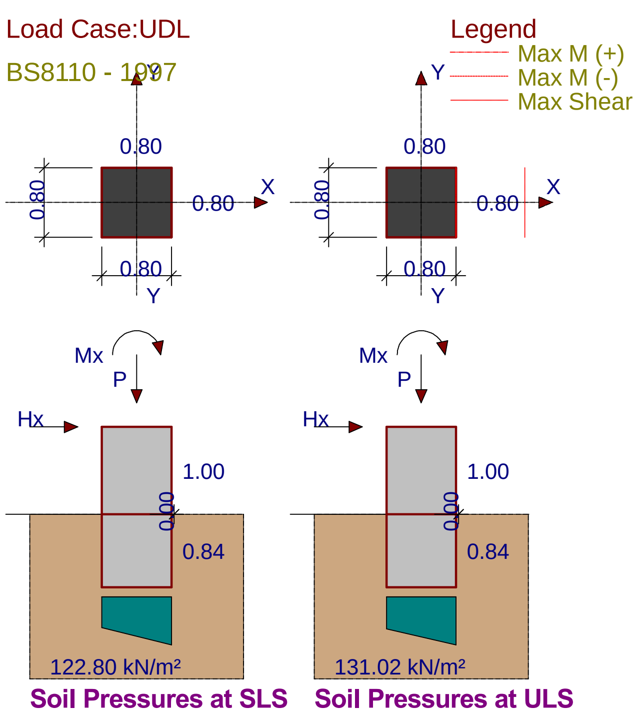
Sketch of Base



Output for Load Case UDL

Note: The calculated flexural reinforcement was used in the calculations.

Output for Load Case UDL	
Soil pressure (ULS) (kN/m²)	131.02
Soil pressure (SLS) (kN/m²)	122.80
SF overturning (SLS)	2.90
SF overturning (ULS)	3.42
Safety Factor slip (ULS)	23.33
Safety Factor uplift (ULS)	>100
Bottom	
Design moment X (kNm/m)	0.00
Reinforcement X (mm²/m)	0
Design moment Y (kNm/m)	0.00
Reinforcement Y (mm²/m)	0
Top	
Design moment X (kNm/m)	0.00
Reinforcement X (mm²/m)	0
Design moment Y (kNm/m)	0.00
Reinforcement Y (mm²/m)	0
Linear Shear X (MPa)	0.000
vc (MPa)	0.393
Linear Shear Y (MPa)	0.000
vc (MPa)	0.393
Linear Shear Other (MPa)	0.000
Punching Shear (MPa)	N.A.
vc (MPa)	N.A.
vcu (MPa)	5.00
v col face (MPa)	0.01
Cost	0.00



Reinforcement Calculation for X-direction:Positive Moments

Load Case UDL

Design moment:0.00 kNm/m

Calculation of the maximum steel strain:

$$e_{st} = \frac{f_{st}}{E_s}$$

$$= \frac{438.1}{200000}$$

$$= 0.0022$$

Balanced neutral axis

$$x_b = \frac{d}{1 + \frac{e_{st}}{e_c}}$$

$$= \frac{790}{1 + \frac{.00219}{.0035}}$$

$$= 485.940 \text{ mm}$$

$$b_b = 1 - \frac{\%_{redis}}{100}$$

$$= 1 - \frac{0}{100}$$

$$= 1.0000$$

Maximum allowed neutral axis depth: **3.2.2.1**

$$\boldsymbol{x = \min(d/(1+e st/e c)\ ,\ (b b-0.4)*d) = 485.900 \text{ mm}}$$

Depth of rectangular stress block:

$$a = b \cdot x$$

$$= .9 \times 395$$

$$= 355.500 \text{ mm}$$

Concrete moment capacity: **3.4.4.4**

$$M_u = a \cdot \left[d - \frac{a}{2}\right] \cdot b \cdot \alpha \cdot \phi \cdot f_{cu} \cdot 1\times10^{-6}$$

$$= 355.5 \times \left[790 - \frac{355.5}{2}\right] \times 1000 \times .66667 \times .66667 \times 40 \times 1 \times 10^{-6}$$

$$= 3\,869.459 \text{ kNm}$$

Lever arm **3.4.4.4**

$$z = d \cdot \left[0.5 + \sqrt{0.25 - \frac{M}{2 \cdot \alpha \cdot \phi \cdot b \cdot d^2 \cdot f_{cu}}}\right]$$

$$= 790 \times \left[0.5 + \sqrt{0.25 - \frac{0}{2 \times .66667 \times .66667 \times 1000 \times 790^2 \times 40}}\right]$$

$$= 790.000 \text{ mm}$$

Lever arm limitation **3.4.4.4**

z = min(*790.000 , 0.95*790.000*) = 750.500 mm

Tension steel **3.4.4.4**

$$A_{st} = \frac{M}{f_{st} \cdot z}$$

$$= \frac{0}{438.1 \times 750.5}$$

$$= 0.0000 \times 10^{0} \text{ mm}^2$$

Neutral axis depth **3.4.4.4**

$$Neutralaxis = \frac{2 \cdot (d - z)}{\mathrm{b}}$$

$$= \frac{2 \times (790 - 750.5)}{.9}$$

$$= 87.778 \text{ mm}$$

Reinforcement Calculation for Y-direction:Positive Moments

Load Case UDL

Design moment:0.00 kNm/m

Calculation of the maximum steel strain:

$$\varepsilon_{st} = \frac{f_{st}}{E_s}$$

$$= \frac{438.1}{200000}$$

$$= 0.0022$$

Balanced neutral axis

$$x_b = \frac{d}{1 + \frac{\varepsilon_{st}}{\varepsilon_c}}$$

$$= \frac{790}{1 + \frac{.00219}{.0035}}$$

$$= 485.940 \text{ mm}$$

$$\beta_b = 1 - \frac{\%_{redis}}{100}$$

$$= 1 - \frac{0}{100}$$

$$= 1.0000$$

Maximum allowed neutral axis depth: 3.2.2.1

$$\boldsymbol{x = \min(d/(1+\varepsilon st/\varepsilon c)\ ,\ (\beta b\text{-}0.4)*d) = 485.900 \text{ mm}}$$

Depth of rectangular stress block:

$$a = \beta \cdot x$$

$$= .9 \times 395$$

$$= 355.500 \text{ mm}$$

Concrete moment capacity: 3.4.4.4

$$M_u = a \cdot \left[d - \frac{a}{2}\right] \cdot b \cdot \alpha \cdot \phi \cdot f_{cu} \cdot 1\times10^{-6}$$

$$= 355.5 \times \left[790 - \frac{355.5}{2}\right] \times 1000 \times .66667 \times .66667 \times 40 \times 1\times10^{-6}$$

$$= 3\,869.459 \text{ kNm}$$

Lever arm **3.4.4.4**

$$z = d\cdot\left[0.5 + \sqrt{0.25 - \frac{M}{2\cdot \mathrm{a}\cdot \mathrm{f}\cdot b\cdot d^2\cdot f_{cu}}}\right]$$

$$= 790\times\left[0.5 + \sqrt{0.25 - \frac{0}{2\times.66667\times.66667\times1000\times790^2\times40}}\right]$$

$$= 790.000 \text{ mm}$$

Lever arm limitation **3.4.4.4**

***z* = min(*790.000 , 0.95*790.000*) = 750.500 mm**

Tension steel **3.4.4.4**

$$A_{st} = \frac{M}{f_{st}\cdot z}$$

$$= \frac{0}{438.1\times750.5}$$

$$= 0.0000\times10^0 \text{ mm²}$$

Neutral axis depth **3.4.4.4**

$$Neutralaxis = \frac{2\cdot(d - z)}{\mathrm{b}}$$

$$= \frac{2\times(790 - 750.5)}{.9}$$

$$= 87.778 \text{ mm}$$

Punching Shear Stress/Reinforcement Calculation

Load Case UDL

Column number:1

Shear Stress/Reinforcement Calculation for Y-direction

Load Case UDL

Design shear force:0.00 kN

Based on flexural reinforcement of: 0 mm²/m

Shear Calculations:

Area used for shear calculations:

$$A_{sh} = b_w \cdot d_e - (b_w - b_f) \cdot b_f$$
$$= 1000 \times 790 - (1000 - 0) \times 0$$
$$= 790.0 \times 10^3 \text{ mm}^2$$

Reinforcement ratio 3.4.5.4-6

$$F_1 = \frac{A_{st}}{A_{sh}}$$
$$= \frac{0}{790000}$$
$$= 0.0000 \times 10^0$$

$$f_1 = f_{1i} \cdot 100$$
$$= 0 \times 100$$
$$= 0.0000 \times 10^0$$

$$F_1 = \min(3, F_1) = 0.000$$

$$F_1 = \max(0.15, F_1) = 0.150$$ 3.4.5.4-6

$$f_2 = 1$$

$$v_c = \frac{0.79}{1.25} \cdot F_1^{0.33333} \cdot F_2^{0.25}$$
$$= \frac{0.79}{1.25} \times .15^{0.33333} \times 1^{0.25}$$
$$= 0.3358 \text{ MPa}$$

$$F_3 = \left[\frac{f_{cu}}{25}\right]^{0.33333}$$
$$= \left[\frac{40}{25}\right]^{0.33333}$$
$$= 1.170$$

$$v_C = v_{c1} \cdot F_3$$
$$= .3358 \times 1.1696$$
$$= 0.3928 \text{ MPa}$$

Maximum allowable shear stress

$$v_{cu} = 0.8 \cdot \sqrt{f_{cu}}$$
$$= 0.8 \times \sqrt{40}$$
$$= 5.060 \text{ MPa}$$

$$v_{cu} = \min(5 , v_{cu}) = 5.000$$

Actual Shear stress:

$$v = \frac{V \cdot 1 \times 10^3}{A_{sh}}$$
$$= \frac{0 \times 1 \times 10^3}{790000}$$
$$= 0.0000 \times 10^0 \text{ MPa}$$

Shear force capacity

$$V_{co} = v_C \cdot A_{sh} \cdot 1 \times 10^{-3}$$
$$= .39276 \times 790000 \times 1 \times 10^{-3}$$
$$= 310.280 \text{ kN}$$

Shear reinforcement — Table 3.16

$$A_{sv/sv} = \frac{(v - v_C) \cdot b}{0.95 \cdot f_{yv}}$$
$$= \frac{(0 - .39276) \times 1000}{0.95 \times 460}$$
$$= -0.8988$$

Minimum links — Table 3.16

$$A_{sv/svn} = \frac{0.40 \cdot b}{0.95 \cdot f_{yv}}$$
$$= \frac{0.40 \times 1000}{0.95 \times 460}$$
$$= 0.9153$$

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