

**BLOCKWORK RETAINING WALL
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STRUCTURAL CALCULATIONS**

Maximum height of wall = 2.0 m

Density of earth = 18 kN / m³. Well drained cohesionless.

Angle of shearing resistance = 35°
horizontal component
 $k_a = \frac{1 - \sin \phi}{1 + \sin \phi} = 0.27$

Co-efficient of friction between base and earth = 0.5

Safe ground bearing capacity = 100 kN / m²

Wall to be built of dense concrete blockwork = 20 kN / m³

Allow for surcharge = 10.0 kN/m²

Introduce free draining material to rear of wall.

Base of well compacted 30N/mm² concrete = 24 kN / m³

Factor of Safety for Sliding to be minimum of 1.5 and Overturning to be minimum of 2.00

Vertical Loads

Part	Area m ²	density (kN / m ³)	Wt (kN)	lever arm	Moments about A
Base	0.4 x 1.100	24	10.56	0.550	5.808
Wall	0.8 x 0.900	20	14.40	0.550	7.920
	0.6 x 0.450	20	5.40	0.425	2.295
	0.6 x 0.225	20	2.70	0.312	0.842
Earth	0.100 x 2.0	18	3.60	1.050	3.600
	0.550 x 1.2	18	5.28	0.825	4.356
	0.775 x 0.6	18	8.37	0.713	5.968
Surcharge	10 x 1.000		10.000	0.600	6.000
			60.310		36.789
c.g. from A	=	$\frac{36.789}{60.310}$	= 0.610		

Horizontal Loads

$$P_{\text{earth}} = 18.00 \times 0.5 \times 2.4^2 \times 0.27 = 14.000$$

Moments about A

$$14.000 \times \frac{2.4}{3} = 11.200 \text{ kN m}$$

$$P_{\text{surcharge}} = 10 \times 2.4 \times 0.27 = 6.48$$

Moments about A

$$6.48 \times \frac{2.4}{3} = 5.184 \text{ kN m}$$

$$\text{Total Moment} = 11.200 + 5.184 = 16.384 \text{ kN m}$$

Overturning

$$\begin{aligned} \text{F of S against overturning} &= \frac{36.789}{16.384} \\ &= 2.245 \quad \therefore \text{OK} \end{aligned}$$

Check Sliding

$$\text{F of S} = \frac{60.310 \times 0.5}{16.384} = 1.840 \quad \therefore \text{OK}$$

Bearing

Resultant of forces

$$\text{Distance from A} = \frac{\text{Restoring moment} - \text{Overturning moment}}{\text{Total Weight}}$$

$$= \frac{36.789 - 16.384}{60.310} = 340$$

$$e = \text{Base} / 2 - \text{offset from A} = 1100 / 2 - 340$$

$$= 210 \text{ slightly outside middle third} \quad \text{Check overall Bearing Pressure.}$$

Bearing Pressure / metre run

$$\frac{60.310}{1 \times 1.100} + \frac{60.310 \times 0.068}{1 \times 1.100^2} \times 6$$

$$54.827 \quad +/\quad 20.336$$

$$\text{Max} = 75.163 < 100 \quad \therefore \text{OK}$$

Check wall tension at each step (BS5628 Pt 1)

$$m = 3.5 f_{kx} = 0.25 \text{ N/mm}^2$$

Design moment of resistance = $(f_{kx}/m) Z$

$$\text{Overturning moment} = 1/2 \times 0.27 \times 18 \times h^2 \times h/3 \times 1.4 = 1.13 h^3$$

At 0.6 below top of wall

$$BM = 1.13 (0.6)^3 = 0.244 \text{ kNm}$$

$$gd = \frac{0.225 \times 0.6 \times 18 \times 0.9}{225} = 0.0097$$

$$\text{Des Moment} = (0.25/3.5 + gd) Z = (0.07 + gd) Z$$

$$\begin{aligned} &= (0.07 + 0.0097) \frac{1000 \times 225^2}{6} \times 10^{-6} \\ &= 0.672 \text{ kNm} > 0.244 \text{ kNm} \quad \text{OK} \end{aligned}$$

At 1.2 below top of wall

$$BM = 1.13 (1.2)^3 = 1.953 \text{ kNm}$$

$$gd = \frac{0.450 \times 1.2 \times 18 \times 0.9}{450} = 0.019$$

$$\text{Des Moment} = (0.25/3.5 + gd) Z = (0.07 + gd) Z$$

$$\begin{aligned} &= (0.07 + 0.019) \frac{1000 \times 450^2}{6} \times 10^{-6} \\ &= 3.004 \text{ kNm} > 1.953 \text{ kNm} \quad \text{OK} \end{aligned}$$

At 1.8 below top of wall

$$BM = 1.13 (1.8)^3 = 6.590$$

$$gd = \frac{0.675 \times 1.8 \times 18 \times 0.9}{675} = 0.029$$

$$\text{Des Moment} = (0.25/3.5 + gd) Z = (0.07 + gd) Z$$

$$\begin{aligned} &= (0.07 + 0.029) \frac{1000 \times 675^2}{6} \times 10^{-6} \\ &= 7.518 \text{ kNm} > 6.590 \text{ kNm} \quad \text{OK} \end{aligned}$$

Value of 18 for density of earth may also be considered conservative an average value of 19 ensures compliance