

RETAINING WALL MERTHYR TYDFIL RUGBY CLUB, MERTHYR TYDFIL STRUCTURAL CALCULATIONS

WALL 1.5 m HIGH

Maximum height of wall = 1.5 m

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

Angle of shearing resistance = 35°

$$\text{horizontal component} \\ k_a = \frac{1 - \sin \phi}{1 + \sin \phi} = 0.27$$

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 = 20kN/m³

Allow for surcharge = 10.0 kN/m²

Introduce free draining material to rear of wall.

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

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

200217

MTCBC
PLANNING DEPARTMENT

10 SEP 2020

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REMOVE

Wall 1.5 m High

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	0.6 x 0.900	20	10.800	0.550	5.940
	0.6 x 0.450	20	5.40	0.425	2.295
	0.3 x 0.225	20	1.35	0.312	0.421
Earth	0.200 x 1.5	18	5.40	1.000	5.400
	0.225 x 1.2	18	4.86	0.788	3.830
	0.225 x 0.6	18	2.43	0.563	1.369
Surcharge	10 x 1.000		10.000	0.600	6.000
			50.800		31.063

$$\text{c.g. from A} = \frac{31.063}{50.800} = 0.611$$

MERTHYR TYDFIL
COUNTY BOROUGH COUNCIL
Town & Country Planning Act 1990
PERMISSION GRANTED SUBJECT TO CONDITIONS

21 JUN 2021

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Horizontal Loads

$$P_{\text{earth}} = 18.00 \times 0.5 \times 1.9^2 \times 0.27 = 8.772$$

Moments about A

$$8.772 \times \frac{1.9}{3} = 5.556 \text{ kN m}$$

$$P_{\text{surchage}} = 10 \times 1.9 \times 0.27 = 5.13$$

Moments about A

$$5.13 \times \frac{1.9}{3} = 3.249 \text{ kN m}$$

$$\text{Total Moment} = 5.556 + 3.249 = 8.805 \text{ kN m}$$

Overturning

$$\begin{aligned} \text{F of S against overturning} &= \frac{31.063}{8.805} \\ &= 3.527 \quad \text{Therefore OK} \end{aligned}$$

Resultant of Forces

$$\begin{aligned} x &= \frac{8.805}{50.800} \\ &= 0.173 \end{aligned}$$

$$\text{Distance from A} = 0.611 - 0.173 = 0.438$$

Eccentricity of load

$$e = 0.550 - 0.438 = 0.112 \quad L/6 = 1.5/6 = 0.250$$

Lies within middle third O.K.

Check Sliding

$$\text{FOS} = \frac{50.800 \times 0.5}{8.805} = 2.884 \quad \text{Therefore OK}$$

Bearing

Resultant of forces

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

$$= \frac{31.063 - 8.805}{50.800} = 0.438$$

$$e = \text{Base} / 2 - \text{offset from A} = 1100 / 2 - 438$$

$$= 112 \text{ lies within middle third O.K.}$$

Bearing Pressure / metre run

$$\frac{50.800}{1 \times 1.100} + \frac{50.800 \times 0.112}{1 \times 1.100^2} \times 6$$

$$46.181 \quad +/\quad 28.212$$

$$\text{Max} = 74.394 < 100 \text{ OK}$$

Check wall tension at each step (BS5628 Pt 1)

$$m = 3.5 f_k x = 0.25 \text{ N/mm}^2$$

Design moment of resistance = $(f_k x / m) Z$

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

At 0.6 below top of wall

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

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

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

$$= (0.07 + 0.0097) \frac{1000 \times 225^2}{6} \times 10^{-6}$$

$$= 0.672 \text{ kNm} > 0.244 \text{ kNm} \quad \text{OK}$$

At 1.2 below top of wall

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

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

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

$$= (0.07 + 0.019) \frac{1000 \times 450^2}{6} \times 10^{-6}$$

$$= 3.004 \text{ kNm} > 1.953 \text{ kNm} \quad \text{OK}$$

At 1.5 below top of wall

$$BM = 1.13 (1.5)^3 = 6.590$$

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

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

$$= (0.07 + 0.029) \frac{1000 \times 675^2}{6} \times 10^{-6}$$

$$= 7.518 \text{ kNm} > 6.590 \text{ kNm} \quad \text{OK}$$

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