

Proposed Retaining Wall at:

**Westward House
Mountain Hare, Merthyr Tydfil**

Jun-20

Ref	Calculations	Output
	Weight of Soil =	16 Kg/m ³
	Weight of Concrete Block =	19 Kg/m ³
	Weight of Concrete =	24 Kg/m ³
	Height of Retaining Wall =	2.10 m
	Horizontal Thrust Pa =	βgh
	Pa =	9.11 Kn/lin m
	Rankines Coefficient (Ka) =	$\frac{1 - \sin \theta}{1 + \sin \theta}$
	Where $\theta =$	35 °
	=	0.271
	Active Pressure P _A =	0.50 K _A gh ²
	P _A =	9.56 Kn/m ²
	Surcharge Pres P _{A1}	3.88 Kn/m ²
	P _A + P _{A1}	13.44 Kn/m ²

Overturning Moment due to P_{A1}

$$= 3.88 \times 0.700$$

$$= 2.72 \text{ Knm}$$

2.72 Knm

Overturning Moment due to P_A

$$= 9.56 \times 0.700$$

$$= 6.69 \text{ Knm}$$

6.69 Knm

Total Overturning Moment

9.41 Knm

Balancing Moments

							Kn			Knm
C1	0.225	x	1.80	x	19	=	7.695	x	0.163	= 1.250
C2	0.225	x	1.40	x	19	=	5.985	x	0.388	= 2.319
C3	0.225	x	0.90	x	19	=	3.848	x	0.613	= 2.357
C4	0.225	x	0.60	x	19	=	2.565	x	0.838	= 2.148
C5	0.000	x	0.00	x	19	=	0.000	x	0.950	= 0.000
S1	0.225	x	0.40	x	16	=	1.440	x	0.388	= 0.558
S2	0.225	x	0.90	x	16	=	3.240	x	0.613	= 1.985
S3	0.225	x	1.20	x	16	=	4.320	x	0.838	= 3.618
S4	0.000	x	1.80	x	16	=	0.000	x	0.950	= 0.000
S5	0.150	x	1.80	x	16	=	4.320	x	1.025	= 4.428
B1	1.100	x	0.30	x	24	=	<u>7.920</u>	x	0.550	= <u>4.356</u>
							<u>41.333</u>			<u>23.019</u>

Therefore

Factor of Safety (Overturning) =

2.45

Satisfactory

Position of Ground Reaction

$$\frac{23.019}{41.333} - \frac{6.692}{41.333} = 0.40 \text{ m}$$

Middle third range 0.367 and 0.733

This is within the middle third, therefore no tension in the joints

$$\begin{aligned} R_s &= W \tan \theta \\ &= \underline{20.67} \text{ Kn} \end{aligned}$$

Factor of Safety against Sliding =

1.54

Satisfactory

Check Ground Bearing Pressure

Eccentricity (e) = **0.155** m

Therefore

$$\begin{aligned} q_a &= \frac{W/A + (W)x(e)/(bd^2/6)}{1} \\ &= \underline{69.34} \text{ Kn/m}^2 \end{aligned}$$

$$\begin{aligned} \text{or } q_b &= \frac{W/A - (W)x(e)/(bd^2/6)}{1} \\ &= \underline{5.81} \text{ Kn/m}^2 \end{aligned}$$

Assume an allowable ground bearing pressure = **150** Kn/m²

Factor of Safety = **2.16**

Satisfactory

CHECK EACH SECTION

SECTION 1--1

$$\begin{aligned} Pa &= 0.5 \times 0.271 \times 16 \times 0.160 \\ &= \underline{\underline{0.347}} \text{ Kn} \end{aligned}$$

$$\text{O.T.M} = \underline{\underline{0.046}} \text{ Knm}$$

$$\begin{aligned} Pa1 &= 0.5 \times 0.271 \times 6.50 \times 0.160 \\ &= \underline{\underline{0.141}} \text{ Kn} \end{aligned}$$

$$\text{O.T.M} = \underline{\underline{0.019}} \text{ Knm}$$

$$\text{Total OTM} = \underline{\underline{0.07}} \text{ Knm}$$

Balancing Moments

$$0.225 \times 0.4 \times 19 \times 0.11 = 0.192$$

$$\text{Therefore F.O.S (Overturning)} = \frac{0.19}{0.07} = \boxed{2.96} \quad \underline{\underline{\text{Satisfactory}}}$$

Sliding

$$\begin{aligned} Rs &= 1.710 \times 0.50 \\ &= \underline{\underline{0.86}} \text{ Kn} \end{aligned}$$

$$\text{Therefore F.O.S (Sliding)} = \boxed{2.46} \quad \underline{\underline{\text{Satisfactory}}}$$

SECTION 2--2

$$\begin{aligned} Pa &= 0.5 \times 0.271 \times 16.00 \times 0.8 \\ &= \underline{\underline{1.76}} \text{ Kn} \end{aligned}$$

$$\text{O.T.M} = \underline{\underline{0.53}} \text{ Knm}$$

$$\begin{aligned} Pa1 &= 0.5 \times 0.271 \times 6.50 \times 0.8 \\ &= \underline{\underline{0.71}} \text{ Kn} \end{aligned}$$

$$\text{O.T.M} = \underline{\underline{0.21}} \text{ Knm}$$

$$\text{Total OTM} = \underline{\underline{0.74}} \text{ Knm}$$

Balancing Moments

$$\begin{array}{llllllll} S1 & 0.225 \times & 0.4 \times & 16 & = & 1.440 \times & 0.338 & = & 0.486 \\ C1 & 0.225 \times & 0.9 \times & 19 & = & 3.848 \times & 0.113 & = & 0.433 \\ C2 & 0.225 \times & 0.4 \times & 19 & = & \underline{\underline{1.710}} \times & 0.338 & = & \underline{\underline{0.577}} \\ & & & & & \underline{\underline{6.998}} \text{ Kn} & & & \underline{\underline{1.496}} \text{ Knm} \end{array}$$

$$\text{Therefore F.O.S (Overturning)} = \frac{1.496}{0.741} = \boxed{2.02} \quad \underline{\underline{\text{Satisfactory}}}$$

Sliding

$$\begin{aligned} R_s &= 7.00 \times 0.500 \\ &= \underline{\underline{3.50}} \text{ Knm} \end{aligned}$$

$$\text{Therefore F.O.S (Sliding)} = \frac{3.499}{1.756} = \boxed{1.99} \quad \textbf{\underline{Satisfactory}}$$

SECTION 3--3

$$\begin{aligned} Pa &= 0.5 \times 0.271 \times 16 \times 1.440 \\ &= \underline{\underline{3.12}} \text{ Kn} \end{aligned}$$

$$\text{O.T.M} = 1.249 \text{ Knm}$$

$$\begin{aligned} Pa1 &= 0.5 \times 0.271 \times 6.50 \times 1.440 \\ &= \underline{\underline{1.27}} \text{ Kn} \end{aligned}$$

$$\text{O.T.M} = 0.507 \text{ Knm}$$

$$\text{Total OTM} = \underline{\underline{1.756}} \text{ Knm}$$

Balancing Moments

S1	0.225	x	0.40	x	16	=	1.44	x	0.338	=	0.486
S2	0.225	x	0.90	x	16	=	3.24	x	0.563	=	1.823
C1	0.225	x	1.20	x	19	=	5.13	x	0.113	=	0.577
C2	0.225	x	0.80	x	19	=	3.42	x	0.338	=	1.154
C3	0.225	x	0.30	x	19	=	<u>1.28</u>	x	0.563	=	<u>0.721</u>
							<u>14.51</u>	Kn			<u>4.761</u> Knm

$$\text{Therefore F.O.S (Overturning)} = \frac{4.761}{1.756} = \boxed{2.71} \quad \textbf{\underline{Satisfactory}}$$

Sliding

$$\begin{aligned} R_s &= 14.51 \times 0.500 \\ &= \underline{\underline{7.26}} \end{aligned}$$

$$\text{Therefore F.O.S (Sliding)} = \frac{7.256}{3.12} = \boxed{2.32} \quad \textbf{\underline{Satisfactory}}$$

SECTION 4--4

$$\begin{aligned} Pa &= 0.5 \times 0.271 \times 16 \times 3.240 \\ &= 7.02 \text{ Kn} \end{aligned}$$

$$\text{O.T.M} = \underline{\underline{4.214}} \text{ Knm}$$

$$\begin{aligned} Pa1 &= 0.5 \times 0.271 \times 6.50 \times 3.240 \\ &= 2.85 \text{ Kn} \end{aligned}$$

$$\text{O.T.M} = \underline{\underline{1.712}} \text{ Knm}$$

$$\text{Total OTM} = \underline{\underline{5.927}} \text{ Knm}$$

Balancing Moments

S1	0.225	x	0.40	x	16	=	1.44	x	0.338	=	0.486
S2	0.225	x	0.90	x	16	=	3.24	x	0.563	=	1.823
S3	0.225	x	1.20	x	16	=	4.32	x	0.788	=	3.402
C1	0.225	x	1.80	x	19	=	7.70	x	0.113	=	0.866
C2	0.225	x	1.40	x	19	=	5.99	x	0.338	=	2.020
C3	0.225	x	0.90	x	19	=	3.85	x	0.563	=	2.164
C4	0.225	x	0.60	x	19	=	<u>2.57</u>	x	0.788	=	<u>2.020</u>
								<u>29.09</u>	Kn	<u>12.78</u>	Knm

Therefore F.O.S (Overturning) = $\frac{12.780}{5.927} =$ **2.16** **Satisfactory**

Sliding

$$\begin{aligned} R_s &= 29.09 \times 0.500 \\ &= \mathbf{14.55} \text{ Kn} \end{aligned}$$

Therefore F.O.S (Sliding) = $\frac{14.55}{7.02} =$ **2.07** **Satisfactory**

SECTION 5--5 (Interface concrete & blockwork)**Not Applicable**

$$\begin{aligned} P_a &= 0.5 \times 0.271 \times 16 \times 3.24 \\ &= 7.02 \text{ Kn} \end{aligned}$$

$$\text{O.T.M} = \mathbf{4.214} \text{ Knm}$$

$$\begin{aligned} P_{a1} &= 0.5 \times 0.271 \times 6.50 \times 3.24 \\ &= 2.85 \text{ Kn} \end{aligned}$$

$$\text{O.T.M} = \mathbf{1.712} \text{ Knm}$$

$$\text{Total OTM} = \mathbf{5.927} \text{ Knm}$$

Balancing Moments

S1	0.225	x	0.400	x	16	=	1.440	x	0.338	=	0.486
S2	0.225	x	0.900	x	16	=	3.240	x	0.563	=	1.823
S3	0.225	x	1.200	x	16	=	4.320	x	0.788	=	3.402
S4	0.000	x	1.800	x	16	=	0.000	x	0.900	=	0.000
C1	0.225	x	1.800	x	19	=	7.695	x	0.113	=	0.866
C2	0.225	x	1.400	x	19	=	5.985	x	0.338	=	2.020
C3	0.225	x	0.900	x	19	=	3.848	x	0.563	=	2.164
C4	0.225	x	0.600	x	19	=	2.565	x	0.788	=	2.020
C5	0.000	x	0.000	x	19	=	<u>0.000</u>	x	0.900	=	<u>0.000</u>
								<u>29.09</u>	Kn	<u>12.78</u>	Knm

Therefore F.O.S(Overturning) = $\frac{12.780}{5.927} =$ **Not Applicable**

Sliding

$$\begin{aligned} \text{Rs} &= 29.09 \times 0.500 \\ &= \underline{\underline{14.55}} \text{ Kn} \end{aligned}$$

$$\text{Therefore F.O.S(Sliding)} = \frac{14.546}{7.02} =$$

Not Applicable



Vehicle Surcharge = 6.50 Kg/m³

Lf	0.050
Lb	0.150
W1=	0.225
W2=	0.225
W3=	0.225
W4=	0.225
W5=	0.000
H1=	1.800
H2=	1.400
H3=	0.900
H4=	0.600
H5=	0.000
B1=	1.100
B2=	0.300
O	0.500

