

Proposed Retaining Wall at:

**Hillcrest
Troedyrhlw, Merthyr Tydfil**

Oct-23

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
	Vehicle Surcharge =	10.00 <g/m ³
	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}	5.98 Kn/m ²
	P _A + P _{A1}	15.54 Kn/m ²
		Lf 0.100
		Lb 0.200
		W1= 0.225
		W2= 0.225
		W3= 0.225
		W4= 0.225
		W5= 0.000
		H1= 1.800
		H2= 1.400
		H3= 1.200
		H4= 1.000
		H5= 0.000
		B1= 1.200
		B2= 0.300
		O 0.500

Overturning Moment due to P_{A1}

$$= 5.98 \times 0.700$$

$$= 4.18 \text{ Knm}$$

4.18 Knm

Overturning Moment due to P_A

$$= 9.56 \times 0.700$$

$$= 6.69 \text{ Knm}$$

6.69 Knm

Total Overturning Moment

10.88 Knm

Balancing Moments

							Kn				Knm
C1	0.225	x	1.80	x	19	=	7.695	x	0.213	=	1.635
C2	0.225	x	1.40	x	19	=	5.985	x	0.438	=	2.618
C3	0.225	x	1.20	x	19	=	5.130	x	0.663	=	3.399
C4	0.225	x	1.00	x	19	=	4.275	x	0.888	=	3.794
C5	0.000	x	0.00	x	19	=	0.000	x	1.000	=	0.000
S1	0.225	x	0.40	x	16	=	1.440	x	0.438	=	0.630
S2	0.225	x	0.60	x	16	=	2.160	x	0.663	=	1.431
S3	0.225	x	0.80	x	16	=	2.880	x	0.888	=	2.556
S4	0.000	x	1.80	x	16	=	0.000	x	1.000	=	0.000
S5	0.200	x	1.80	x	16	=	5.760	x	1.100	=	6.336
B1	1.200	x	0.30	x	24	=	8.640	x	0.600	=	5.184
							<u>43.965</u>				<u>27.583</u>

Therefore

Factor of Safety (Overturning) =

2.54

Satisfactory

Position of Ground Reaction

$$\frac{27.583}{43.965} - \frac{6.692}{43.965} = 0.48 \text{ m}$$

Middle third range 0.400 and 0.800

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

$$\begin{aligned} R_s &= W \tan \theta \\ &= \mathbf{21.98 \text{ Kn}} \end{aligned}$$

Factor of Safety against Sliding =

1.41

Unsatisfactory

Check Ground Bearing Pressure

Eccentricity (e) = **0.125 m**

Therefore

$$\begin{aligned} q_a &= \frac{W}{A} + \frac{(W) \times (e)}{(bd^2/6)} \\ &= \mathbf{59.50 \text{ Kn/m}^2} \end{aligned}$$

$$\begin{aligned} \text{or } q_b &= \frac{W}{A} - \frac{(W) \times (e)}{(bd^2/6)} \\ &= \mathbf{13.77 \text{ Kn/m}^2} \end{aligned}$$

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

Factor of Safety = **2.52** **Satisfactory**

CHECK EACH SECTION

SECTION 1--1

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

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

$$\begin{aligned} Pa1 &= 0.5 \times 0.271 \times 10.00 \times 0.160 \\ &= \underline{0.217} \text{ Kn} \end{aligned}$$

$$\text{O.T.M} = \underline{0.029} \text{ Knm}$$

$$\text{Total OTM} = \underline{0.08} \text{ Knm}$$

Balancing Moments

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

$$\text{Therefore F.O.S (Overturning)} = \frac{0.19}{0.08} = \boxed{2.56} \quad \textbf{\underline{Satisfactory}}$$

Sliding

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

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

SECTION 2--2

$$\begin{aligned} Pa &= 0.5 \times 0.271 \times 16.00 \times 0.4 \\ &= \underline{0.78} \text{ Kn} \end{aligned}$$

$$\text{O.T.M} = \underline{0.16} \text{ Knm}$$

$$\begin{aligned} Pa1 &= 0.5 \times 0.271 \times 10.00 \times 0.4 \\ &= \underline{0.49} \text{ Kn} \end{aligned}$$

$$\text{O.T.M} = \underline{0.10} \text{ Knm}$$

$$\text{Total OTM} = \underline{0.25} \text{ Knm}$$

Balancing Moments

$$\begin{array}{llll} S1 & 0.225 \times 0.4 \times 16 & = & 1.440 \times 0.338 = 0.486 \\ C1 & 0.225 \times 0.6 \times 19 & = & 2.565 \times 0.113 = 0.289 \\ C2 & 0.225 \times 0.200 \times 19 & = & \underline{0.855} \times 0.338 = \underline{0.289} \\ & & & \underline{4.860} \text{ Kn} \quad \underline{1.063} \text{ Knm} \end{array}$$

$$\text{Therefore F.O.S (Overturning)} = \frac{1.063}{0.254} = \boxed{4.19} \quad \textbf{\underline{Satisfactory}}$$

Sliding

$$\begin{aligned} \text{Rs} &= 4.86 \times 0.500 \\ &= \underline{2.43} \text{ Knm} \end{aligned}$$

$$\text{Therefore F.O.S (Sliding)} = \frac{2.430}{0.780} = \boxed{3.11} \quad \textbf{\underline{Satisfactory}}$$

SECTION 3-3

$$\begin{aligned} \text{Pa} &= 0.5 \times 0.271 \times 16 \times 0.640 \\ &= \underline{1.39} \text{ Kn} \end{aligned}$$

$$\text{O.T.M} = \underline{0.370} \text{ Knm}$$

$$\begin{aligned} \text{Pa1} &= 0.5 \times 0.271 \times 10.00 \times 0.640 \\ &= \underline{0.87} \text{ Kn} \end{aligned}$$

$$\text{O.T.M} = \underline{0.231} \text{ Knm}$$

$$\text{Total OTM} = \underline{0.601} \text{ Knm}$$

Balancing Moments

S1	0.225	x	0.40	x	16	=	1.44	x	0.338	=	0.486
S2	0.225	x	0.60	x	16	=	2.16	x	0.563	=	1.215
C1	0.225	x	0.80	x	19	=	3.42	x	0.113	=	0.385
C2	0.225	x	0.40	x	19	=	1.71	x	0.338	=	0.577
C3	0.225	x	0.20	x	19	=	<u>0.86</u>	x	0.563	=	<u>0.481</u>
							<u>9.59</u>	Kn			<u>3.144</u> Knm

$$\text{Therefore F.O.S (Overturning)} = \frac{3.144}{0.601} = \boxed{5.23} \quad \textbf{\underline{Satisfactory}}$$

Sliding

$$\begin{aligned} \text{Rs} &= 9.59 \times 0.500 \\ &= \underline{4.79} \end{aligned}$$

$$\text{Therefore F.O.S (Sliding)} = \frac{4.793}{1.39} = \boxed{3.45} \quad \textbf{\underline{Satisfactory}}$$

SECTION 4-4

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

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

$$\begin{aligned} \text{Pa1} &= 0.5 \times 0.271 \times 10.00 \times 3.240 \\ &= \underline{4.39} \text{ Kn} \end{aligned}$$

$$\text{O.T.M} = \underline{2.634} \text{ Knm}$$

$$\text{Total OTM} = \underline{6.848} \text{ Knm}$$

Balancing Moments

S1	0.225	x	0.40	x	16	=	1.44	x	0.338	=	0.486
S2	0.225	x	0.60	x	16	=	2.16	x	0.563	=	1.215
S3	0.225	x	0.80	x	16	=	2.88	x	0.788	=	2.268
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	1.20	x	19	=	5.13	x	0.563	=	2.886
C4	0.225	x	1.00	x	19	=	4.28	x	0.788	=	3.367
							<u>29.57</u>	Kn		<u>13.11</u>	Kn

Therefore F.O.S (Overturning) = $\frac{13.107}{6.848} = \boxed{1.91}$ **Unsatisfactory**
Considered ok

Sliding

$$R_s = 29.57 \times 0.500$$

$$= \underline{14.78} \text{ Kn}$$

Therefore F.O.S (Sliding) = $\frac{14.78}{7.02} = \boxed{2.10}$ **Satisfactory**

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

$$P_a = 0.5 \times 0.271 \times 16 \times 3.24$$

$$= 7.02 \text{ Kn}$$

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

$$P_{a1} = 0.5 \times 0.271 \times 10.00 \times 3.24$$

$$= 4.39 \text{ Kn}$$

$$O.T.M = \underline{2.634} \text{ Knm}$$

$$\text{Total OTM} = \underline{6.848} \text{ Knm}$$

Balancing Moments

S1	0.225	x	0.400	x	16	=	1.440	x	0.338	=	0.486
S2	0.225	x	0.600	x	16	=	2.160	x	0.563	=	1.215
S3	0.225	x	0.800	x	16	=	2.880	x	0.788	=	2.268
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	1.200	x	19	=	5.130	x	0.563	=	2.886
C4	0.225	x	1.000	x	19	=	4.275	x	0.788	=	3.367
C5	0.000	x	0.000	x	19	=	0.000	x	0.900	=	0.000
							<u>29.57</u>	Kn		<u>13.11</u>	Kn

Therefore F.O.S(Overturning) = $\frac{13.107}{6.848} = \boxed{}$ **Not Applicable**

Sliding

$$\begin{aligned} \text{Rs} &= 29.57 \times 0.500 \\ &= \underline{14.78} \text{ Kn} \end{aligned}$$

Therefore F.O.S(Sliding) =

$$\frac{14.783}{7.02}$$

Not Applicable