

Proposed Retaining Wall at:	Hillcrest Troedyrhiw, Merthyr Tydfil	Revised	Aug-24
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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 Kg/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= 0.225
		H1= 1.800
		H2= 1.400
		H3= 1.200
		H4= 0.900
		H5= 0.100
		B1= 1.425
		B2= 0.300
		O 0.500

Overturning Moment due to P_{A1}

$$= 5.98 \times 0.700$$

$$= 4.18 \text{ Knm} \quad \mathbf{4.18 \text{ Knm}}$$

Overturning Moment due to P_A

$$= 9.56 \times 0.700$$

$$= 6.69 \text{ Knm} \quad \mathbf{6.69 \text{ Knm}}$$

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	0.90	x	19	=	3.848	x	0.888	= 3.415
C5	0.225	x	0.10	x	19	=	0.428	x	1.113	= 0.476
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	0.90	x	16	=	3.240	x	0.888	= 2.876
S4	0.225	x	1.70	x	16	=	6.120	x	1.113	= 6.809
S5	0.200	x	1.80	x	16	=	5.760	x	1.325	= 7.632
B1	1.425	x	0.30	x	24	=	<u>10.260</u>	x	0.713	= <u>7.310</u>
							<u>52.065</u>			<u>38.230</u>

Therefore

Factor of Safety (Overturning) =

3.52

Satisfactory

Position of Ground Reaction

$$\frac{38.230}{52.065} - \frac{6.692}{52.065} = 0.61 \text{ m}$$

Middle third range 0.475 and 0.950

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

$$\begin{aligned} R_s &= W \tan \theta \\ &= \underline{26.03} \text{ Kn} \end{aligned}$$

Factor of Safety against Sliding =

1.68

Satisfactory

Check Ground Bearing Pressure

Eccentricity (e) = 0.107 m

Therefore

$$\begin{aligned} q_a &= W/A + (W)x(e)/(bd^2/6) \\ &= \underline{52.96} \text{ Kn/m}^2 \end{aligned}$$

$$\begin{aligned} \text{or } q_b &= W/A - (W)x(e)/(bd^2/6) \\ &= \underline{20.11} \text{ Kn/m}^2 \end{aligned}$$

Assume an allowable ground bearing pressure = 120 Kn/m²

Factor of Safety

=

2.27

Satisfactory

CHECK EACH SECTION

SECTION 1--1

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

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

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

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

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

Balancing Moments

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

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

Sliding

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

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

SECTION 2--2

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

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

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

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

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

Balancing Moments

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

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

Sliding

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

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

SECTION 3--3

$$\begin{aligned} Pa &= 0.5 \times 0.271 \times 16 \times 0.810 \\ &= \underline{\underline{1.76}} \text{ Kn} \end{aligned}$$

$$\text{O.T.M} = \underline{\underline{0.527}} \text{ Knm}$$

$$\begin{aligned} Pa1 &= 0.5 \times 0.271 \times 10.00 \times 0.810 \\ &= \underline{\underline{1.10}} \text{ Kn} \end{aligned}$$

$$\text{O.T.M} = \underline{\underline{0.329}} \text{ Knm}$$

$$\text{Total OTM} = \underline{\underline{0.856}} \text{ Knm}$$

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	0.90	x	19	=	3.85	x	0.113	=	0.433
C2	0.225	x	0.50	x	19	=	2.14	x	0.338	=	0.721
C3	0.225	x	0.30	x	19	=	1.28	x	0.563	=	0.721
							<u>10.87</u>				<u>3.577</u> Knm

$$\text{Therefore F.O.S (Overturning)} = \frac{3.577}{0.856} = \boxed{4.18} \quad \underline{\underline{\text{Satisfactory}}}$$

Sliding

$$\begin{aligned} R_s &= 10.87 \times 0.500 \\ &= \underline{\underline{5.43}} \end{aligned}$$

$$\text{Therefore F.O.S (Sliding)} = \frac{5.434}{1.76} = \boxed{3.09} \quad \underline{\underline{\text{Satisfactory}}}$$

SECTION 4--4

$$\begin{aligned} Pa &= 0.5 \times 0.271 \times 16 \times 2.890 \\ &= \underline{\underline{6.27}} \text{ Kn} \end{aligned}$$

$$\text{O.T.M} = \underline{\underline{3.550}} \text{ Knm}$$

$$\begin{aligned} Pa1 &= 0.5 \times 0.271 \times 10.00 \times 2.890 \\ &= \underline{\underline{3.92}} \text{ Kn} \end{aligned}$$

$$\text{O.T.M} = \underline{\underline{2.219}} \text{ Knm}$$

$$\text{Total OTM} = \underline{\underline{5.769}} \text{ Knm}$$

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	0.90	x	16	=	3.24	x	0.788	=	2.552
C1	0.225	x	1.70	x	19	=	7.27	x	0.113	=	0.818
C2	0.225	x	1.30	x	19	=	5.56	x	0.338	=	1.876
C3	0.225	x	1.10	x	19	=	4.70	x	0.563	=	2.645
C4	0.225	x	0.80	x	19	=	<u>3.42</u>	x	0.788	=	<u>2.693</u>
							<u>27.79</u>	Kn		<u>12.28</u>	Knm

Therefore F.O.S (Overturning) = $\frac{12.284}{5.769} = \boxed{2.13}$ **Satisfactory**

Sliding

$$\begin{aligned} R_s &= 27.79 \times 0.500 \\ &= \underline{13.89} \text{ Kn} \end{aligned}$$

Therefore F.O.S (Sliding) = $\frac{13.89}{6.27} = \boxed{2.22}$ **Satisfactory**

SECTION 5--5 (Interface concrete & blockwork)

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

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

$$\begin{aligned} P_{a1} &= 0.5 \times 0.271 \times 10.00 \times 3.24 \\ &= 4.39 \text{ Kn} \end{aligned}$$

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

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

Balancing Moments

S1	0.225	x	0.400	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	0.900	x	16	=	3.240	x	0.788	=	2.552
S4	0.225	x	1.700	x	16	=	6.120	x	1.013	=	6.197
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	0.900	x	19	=	3.848	x	0.788	=	3.030
C5	0.225	x	0.100	x	19	=	<u>0.428</u>	x	1.013	=	<u>0.433</u>
							<u>36.05</u>	Kn		<u>19.68</u>	Knm

Therefore F.O.S(Overturning) = $\frac{19.683}{6.848} = \boxed{2.87}$ **Satisfactory**

Sliding

$$\begin{aligned} R_s &= 36.05 \times 0.500 \\ &= \underline{\underline{18.02}} \text{ Kn} \end{aligned}$$

$$\text{Therefore F.O.S(Sliding)} = \frac{18.023}{7.02} =$$

2.57**Satisfactory**