

Proposed New Parking Area

**70 Brecon Rise, Pant, Dowlais,
Merthyr Tydfil**

Structural Calculations

June 2020

CALCULATION SHEET

Project No: 237

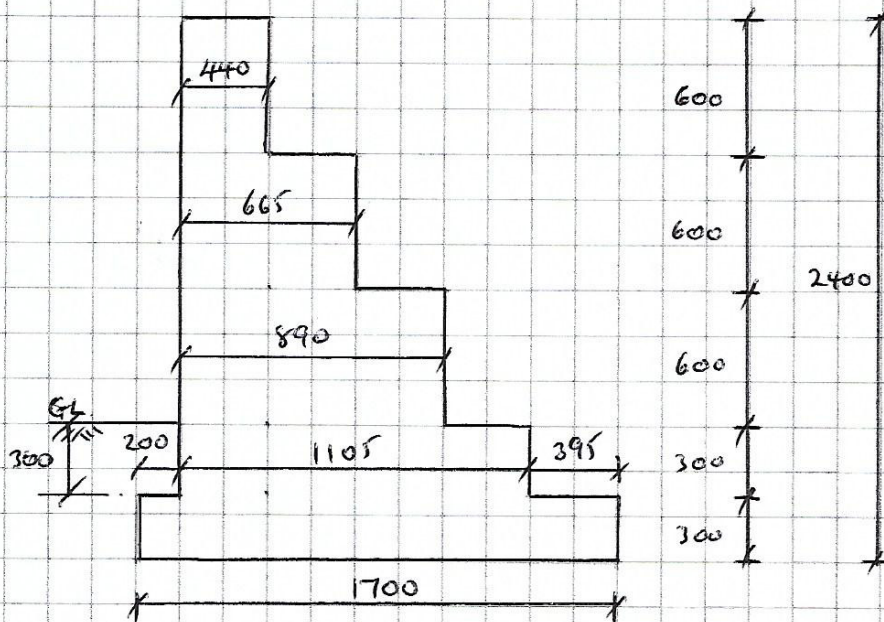
Calculations by:

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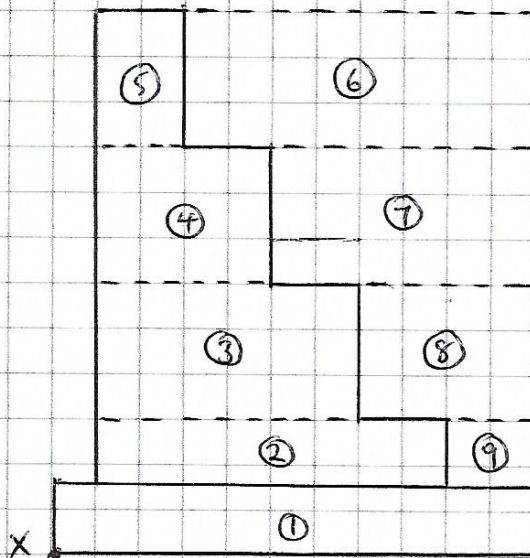
PROJECT NAME: PROPOSED NEW PARKING AREA - TO BRECON RISE, PANT, DOWLAIS

SECTION: RETAINING WALL



MAX RETAINED HEIGHT = 1.8m
DEPTH TO U/S OF WALL BASE = 2.4m

CHECK STABILITY



CONSIDER 1m LENGTH OF WALL

CALCULATION SHEET

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PROJECT NAME:

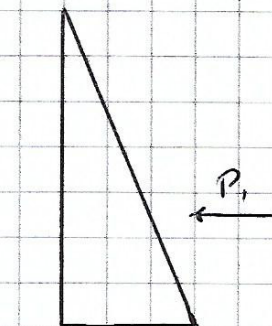
SECTION:

AREA	VOL (m ³)	DENSITY (kN/m ³)	MASS (kN)	LEVER ARM (m) [from x]	MOMENT (kN-m) from x
1	0.51	24	12.24	0.850	10.404
2	0.3315	20	6.63	0.7525	4.989
3	0.534	20	10.68	0.645	6.889
4	0.399	20	7.98	0.5325	4.249
5	0.264	20	5.28	0.420	2.218
6	0.636	19	12.084	1.170	14.138
7	0.501	19	9.519	1.2825	12.208
8	0.366	19	6.954	1.395	9.701
9	0.1185	19	2.2515	1.5025	3.383
			ΣW 73.619		ΣM 68.179

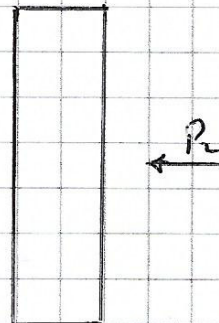
RESULTANT ACTS $\frac{68.179}{73.619} = 0.926$ m FROM X

ASSUME A DESIGN ϕ' OF 35°

$$K_a = \frac{1 - \sin 35}{1 + \sin 35} = 0.27$$



Soil
($\gamma = 19 \text{ kN/m}^3$)



SURCHARGE
(10 kN/m^2)

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SECTION:

$$P_1 = 19 \times 0.27 \times 2.4 = 12.31$$

$$P_2 = 10 \times 0.27 = 2.70$$

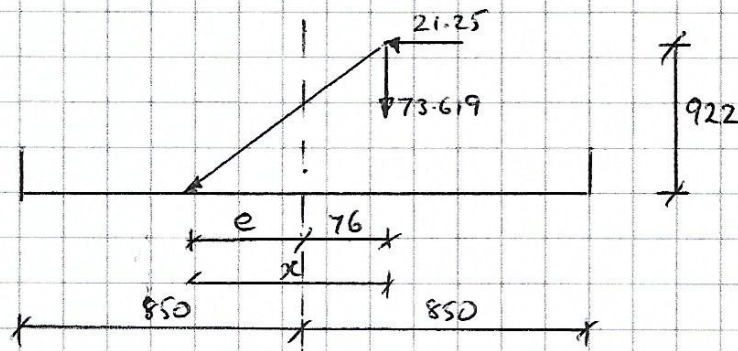
$$P_1 = 12.31 \times \frac{2.4}{2} = 14.77 \times \frac{2.4}{3} = 11.82 = M_1$$

$$P_2 = 2.70 \times 2.4 = 6.48 \times \frac{2.4}{2} = 7.78 = M_2$$

$$\Sigma P \ 21.25$$

$$\Sigma M \ 19.60$$

RESULTANT ACTS AT A DISTANCE OF $\frac{19.60}{21.25} = 0.922$ FROM X



By SIMILAR TRIANGLES

$$\frac{x}{21.25} = \frac{922}{73.619}$$

$$x = 266 \text{ mm}$$

$$e = 266 - 76 = 190 \text{ mm}$$

$$\text{MIDDLE THIRD} = \frac{1700}{6} = 283 \text{ mm}$$

RESULTANT LIES WITHIN MIDDLE THIRD

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SECTION:

CHECK STABILITY

1. OVERTURNING

$$\text{FACTORED VERTICAL LOAD} = 0.9 \times 73.619 = 66.257 \text{ kN}$$

$$\text{FACTORED O/T MOMENT} = 1.4 (11.82 + 7.78) = 27.44 \text{ kN-m}$$

$$\therefore \text{F.O.S.} = \frac{66.257}{27.44} = 2.4 \quad \text{OK}$$

2. SLIDING

$$\mu = 0.75 \tan \phi = 0.525$$

$$\therefore \text{FOS} = \frac{\mu V}{H} = \frac{0.525 \times 73.619}{21.25} = 1.8$$

IDEALLY THE FACTOR OF SAFETY AGAINST SLIDING SHOULD BE 2. HOWEVER THE CONFIGURATION OF THE WALL IS CONSIDERED SUCH THAT THE FLANK WALLS WILL OFFER A DEGREE OF RESISTANCE TO THE FRONT SECTION AGAINST SLIDING. CONSEQUENTLY IT IS CONSIDERED THAT THE CALCULATED FACTOR OF SAFETY OF 1.8 IS CONSERVATIVE & THAT SLIDING STABILITY IS ACCEPTABLE.

3. CHECK BEARING PRESSURE

$$\text{BP} = \frac{W}{A} \pm \frac{W e}{Z}$$

$$= \frac{73.619}{1 \times 1.7} \pm \frac{73.619 \times 0.190}{1 \times \frac{1.7^2}{6}} = 43.31 \pm 29.04$$

$$= 72.35 \text{ kN/m}^2 \text{ MAX}$$

$$+ 14.27 \text{ kN/m}^2 \text{ MIN}$$

OK

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PROJECT NAME:

SECTION:

CHECK RESISTANCE OF MASONRY

1. 1105 SECTION $D = 2.1 \text{ m}$

$$\text{UNFACTORED } \Sigma W = 45.62 \text{ kN} \\ \Sigma M = 13.87 \text{ kN-m}$$

$$\text{FACTORED } \Sigma W = 0.9 \times 45.62 = 41.06 \text{ kN} \\ \text{FACTORED } \Sigma M = 1.4 \times 13.87 = 19.42 \text{ kN-m}$$

MOMENT OF RESISTANCE - $f_{kx} = 0.25 \text{ N/mm}^2$

$$g_d = \frac{41.06}{1105} = 0.037 \text{ N/mm}^2$$

$$Z = \frac{1000 \times 1105^2}{6} = 2.04 \times 10^8 \text{ mm}^3$$

$$M_R = \left(\frac{0.25}{3.0} + 0.037 \right) \times 2.04 \times 10^8 = 24.55 \text{ kN-m} \\ (> 19.42 \text{ kN-m}) \therefore \text{OK}$$

2. 890 SECTION $D = 1.8 \text{ m}$

$$\text{UNFACTORED } \Sigma W = 31.64 \text{ kN} \\ \Sigma M = 9.36 \text{ kN-m}$$

$$\text{FACTORED } \Sigma W = 0.9 \times 31.64 = 28.48 \text{ kN} \\ \Sigma M = 1.4 \times 9.36 = 13.10 \text{ kN-m}$$

$$g_d = \frac{28.48}{890} = 0.032 \text{ N/mm}^2$$

$$Z = \frac{1000 \times 890^2}{6} = 1.32 \times 10^8$$

$$M_R = \left(\frac{0.25}{3.0} + 0.032 \right) \times 1.32 \times 10^8 = 15.22 \text{ kN-m} (> 13.10) \text{ OK}$$

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SECTION:

3. 665 SECTION $D = 1.2m$

$$\text{UNFACTORED } \Sigma W = 15.83 \text{ kN} \\ \Sigma M = 3.42 \text{ kN-m}$$

$$\text{FACTORED } \Sigma W = 0.9 \times 15.83 = 14.25 \text{ kN} \\ \Sigma M = 1.4 \times 3.42 = 4.79 \text{ kN-m}$$

$$g_d = \frac{14.25}{665} = 0.021 \text{ N/mm}^2 \quad Z = 1000 \times \frac{665^2}{6} = 0.74 \times 10^8$$

$$M_R = \left(\frac{0.25}{3.0} \times 0.021 \right) \times 0.74 \times 10^8 = 7.72 \text{ kN-m} > 4.79 \text{ OK}$$

4. 440 SECTION $D = 0.6m$

$$\text{UNFACTORED } \Sigma W = 5.28 \text{ kN} \\ \Sigma M = 0.67 \text{ kN-m}$$

$$\text{FACTORED } \Sigma W = 0.9 \times 5.28 = 4.75 \text{ kN} \\ \Sigma M = 1.4 \times 0.67 = 0.94 \text{ kN-m}$$

$$g_d = \frac{4.75}{440} = 0.011 \text{ N/mm}^2 \quad Z = 1000 \times \frac{440^2}{6} = 0.32 \times 10^8$$

$$M_R = \left(\frac{0.25}{3.0} \times 0.011 \right) \times 0.32 \times 10^8 = 3.02 \text{ kN-m} > 0.94 \therefore \text{OK}$$

$\therefore$ MASONRY SECTIONS STABLE

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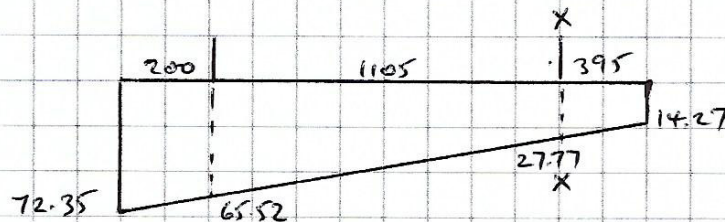
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SECTION:

CHECK BASE REINFORCEMENT



CHECK HEEL REINFORCEMENT

$$\begin{aligned} W_t \text{ OF SOIL} &= 0.395 \times 2.1 \times 19.0 = 15.76 \text{ kN} \\ \text{SURCHARGE} &= 10 \times 0.395 = 3.95 \text{ kN} \\ W_t \text{ OF BASE} &= 0.395 \times 0.3 \times 24 = 2.84 \text{ kN} \\ &= 22.55 \text{ kN} \end{aligned}$$

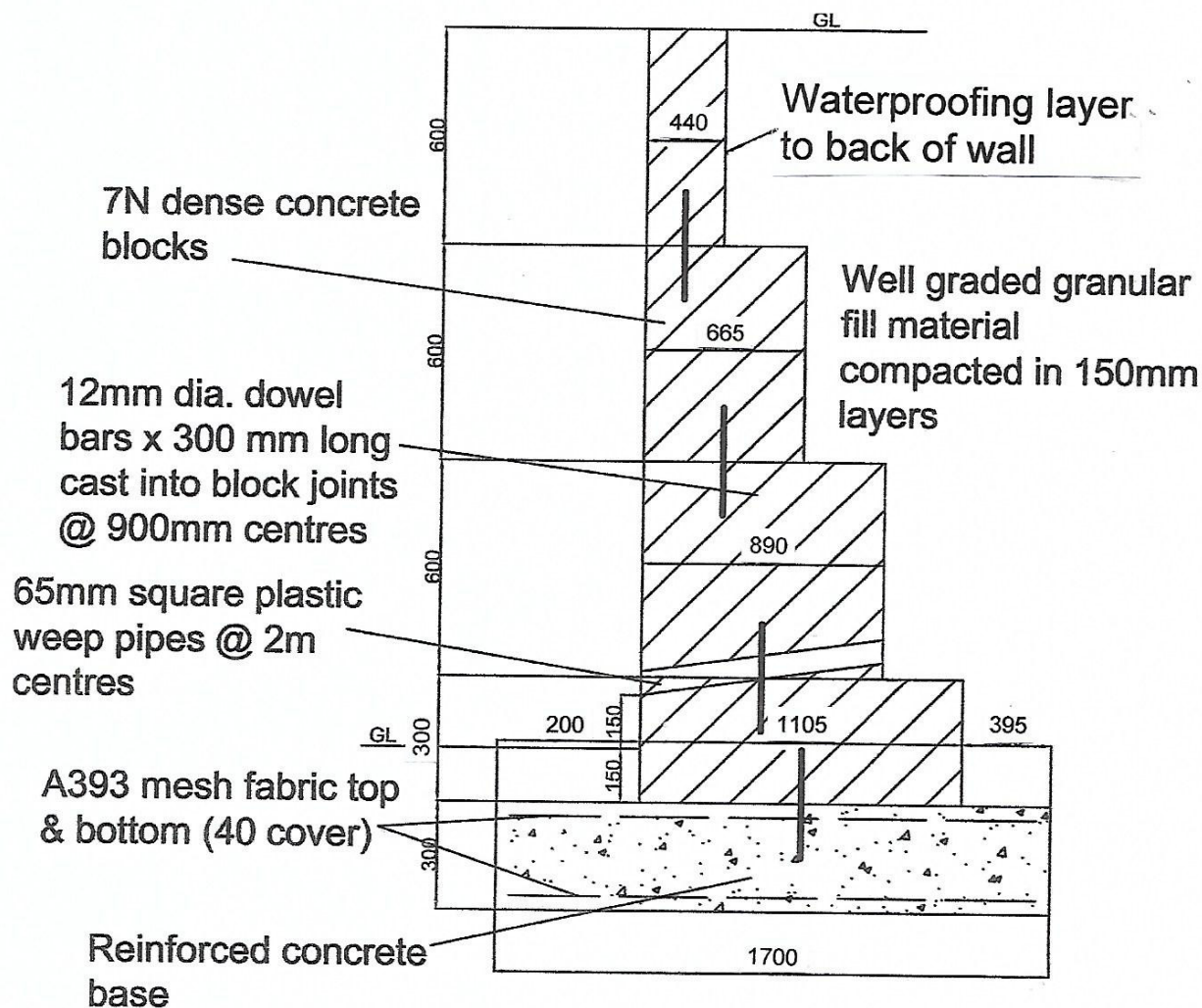
$$\begin{aligned} M_{xx} &= 22.55 \times \frac{0.395}{2} - 14.27 \times 0.395 \times \frac{0.395}{2} - \frac{(27.77 - 14.27) \times 0.395 \times 0.395}{3} \\ &= 4.45 - 1.11 - 0.35 \\ &= 2.99 \text{ kN-m} \end{aligned}$$

$$M_{ult} \leq 1.5 M_{xx} = 1.5 \times 2.99 = 4.49 \text{ kN-m}$$

$$A_s = \frac{4.49 \times 10^6}{0.87 \times 460 \times 0.95 \times 300} = 39 \text{ mm}^2/\text{m}$$

$$Min \% = 0.13\% \times 300 \times 100 = 390 \text{ mm}^2/\text{m}$$

∴ PROVIDE A393 MESH FABRIC TOP & BOTTOM.



1.8m Retaining Wall

Section
(not to scale)

70 Brecon Rise, Pant, Dowlais

CALCULATION SHEET

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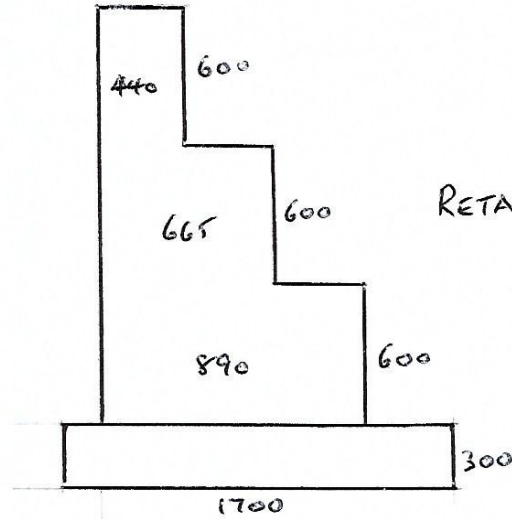
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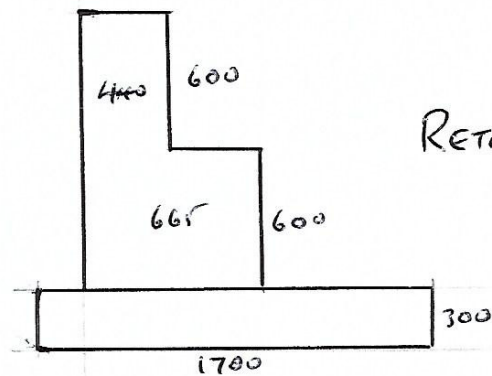
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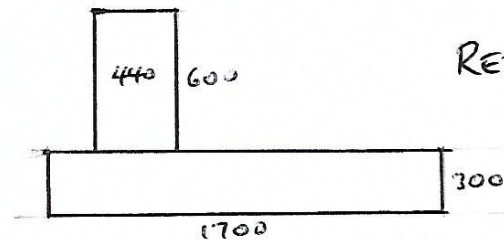
SECTION:



RETAINED HEIGHT = 1.5m

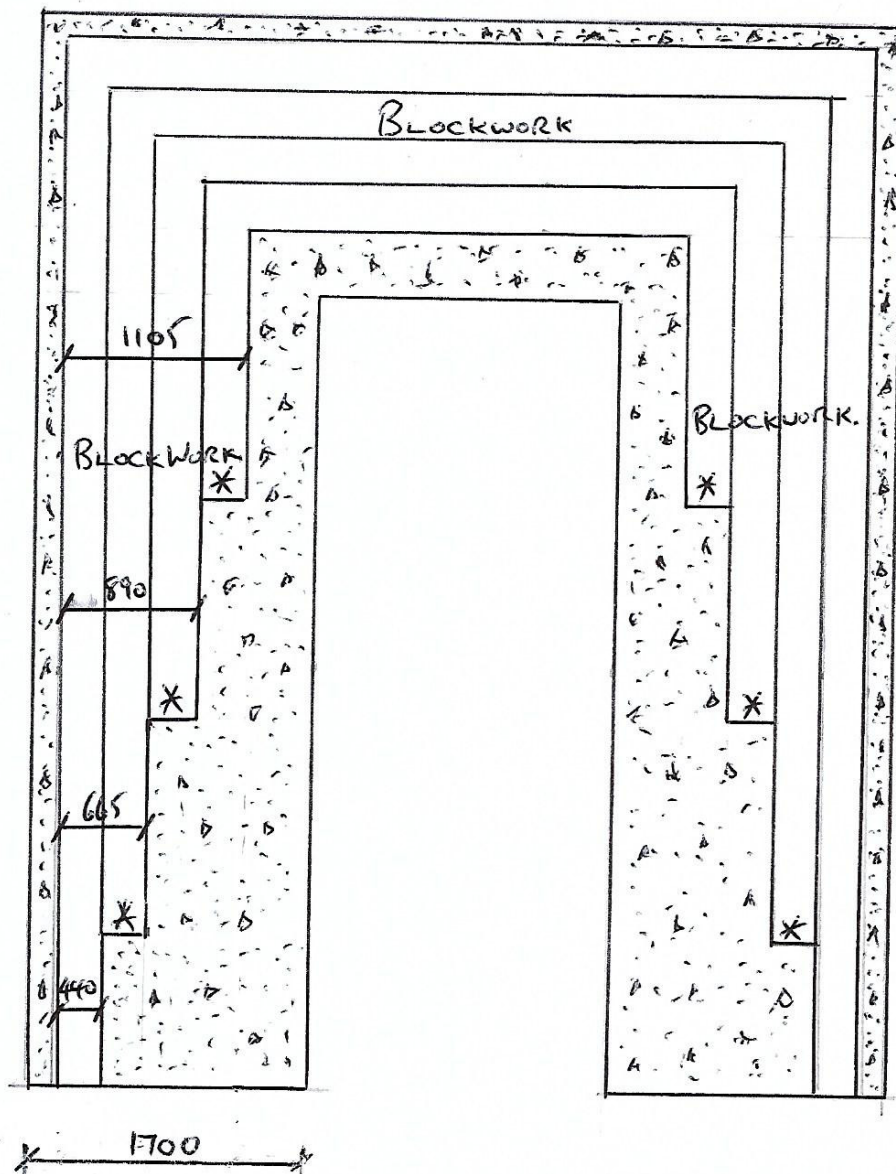


RETAINED HEIGHT = 0.9m



RETAINED HEIGHT = 0.3m

REDUCTION OF WALL THICKNESS / RETAINED HEIGHT



PLAN

POINTS MARKED X SUBJECT TO RETAINED HEIGHTS
SHOWN ON PAGE 9 OF THE CALCULATIONS