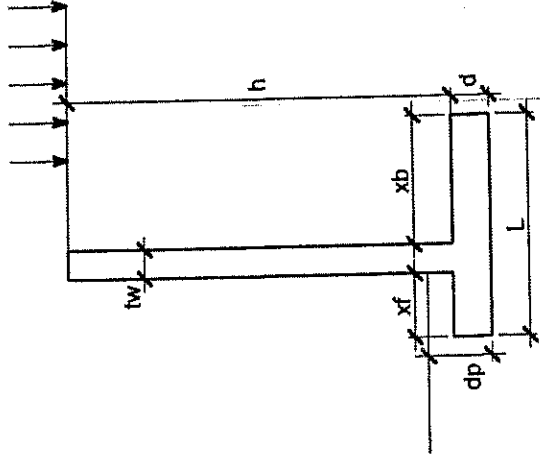


Retaining Wall  
18, Heol Corn Du  
Merthyr Tydfil



**Geometry** (All dimension in metres)  
 $t_w = 0.23$ ;  $d = 0.3$ ;  $h = 3$ ;  $x_b = 1$ ;  $x_f = 0.5$ ;  $h_p = 0$ ;  $w_k = 0$ ;  $h_k = 0$ ;  $d_p = 0.5$ ;  $L = 1.73$

**Additional loads** (kN and m)  
 $p = 5$ ;  $V_a = 0$ ;  $H_a = 0$ ;  $h_h = 0$   
 Restoring effect of surcharge - Considered

| Soil properties                   | Retained soil           | Passive soil       | Unit                 |
|-----------------------------------|-------------------------|--------------------|----------------------|
| Unit weight of drained/moist soil | 19                      | 19                 | kN/m <sup>3</sup>    |
| Internal friction angle of soil   | 40                      | 40                 | degrees              |
| <b>Foundation soil properties</b> |                         |                    |                      |
| Angle of base friction            | = 30 degrees            | Overturning = 2    | (including passive)  |
| Cohesion                          | = 0 kN/m <sup>2</sup>   | Sliding = 2        | (excluding passive)  |
| Base adhesion                     | = 0 kN/m <sup>2</sup>   | Sliding = 1.5      | (passive resistance) |
| Allowable bearing pressure        | = 200 kN/m <sup>2</sup> | Redn. factor = 0.5 |                      |
| Check sliding below               | - Base slab             |                    |                      |
| Pressure coefficient by           | - Rankine theory        |                    |                      |
| Pressure resultant angle          | - 0 degrees             |                    |                      |

**Result summary**

Active pressure coefficient = 0.22

FOS against overturning = 3.15 > 2 - OK

Combined vertical load in middle third

Pressure at heel = 26.47 kN/m<sup>2</sup>

Pressure at toe = 80.25 kN/m<sup>2</sup>

Maximum pressure beneath base < allowable ( 200 ) - OK

FOS sliding (including passive) = 2.25 > 2 - OK

FOS sliding (excluding passive)  
Stability check status - Passed

= 2.04 > 1.5 - OK

| Unfactored forces     | Shear (kN) | Moment (kNm) |
|-----------------------|------------|--------------|
| Stem base             | 21.85      | 23.48        |
| Base slab - toe side  | 30.79      | 8.02         |
| Base slab - heel side | 27.02      | 16.11        |

### WALL STEM

BENDING MOMENT AT BASE OF STEM = 23.48 kNm

ULTIMATE BENDING MOMENT =  $23.48 \times 1.4 = 32.87 \text{ kNm}$

$$\frac{M}{f_{ck} b d^2} = \frac{32.87 \times 10^6}{35 \times 10^3 \times 180^2} = 0.029$$

$$z = 180 \left[ 0.5 + \sqrt{0.25 - 0.029 \times 0.9} \right] = 174 \text{ mm}$$

$$\text{AREA OF STEEL - } A_s = \frac{32.87 \times 10^6}{0.87 \times 500 \times 174} = 434 \text{ mm}^2/\text{m}$$

$$\text{MINIMUM } A_s = \frac{0.13 b h}{100} = \frac{0.13 \times 10^3 \times 225}{100} = 293 \text{ mm}^2/\text{m}$$

MAIN REINFORCEMENT USE:- 12mm  $\phi$  BARS AT 150 c/c ON FRONT AND REAR FACE - 754 mm<sup>2</sup>/m

DISTRIBUTION REINFORCEMENT:- 10mm BARS @ 200 c/c ON BOTH

FACES - 390 mm<sup>2</sup>/m.

### CHECK SHEAR

MAXIMUM SHEAR AT BASE OF STEM = 21.85 kNm

ULTIMATE SHEAR =  $21.85 \times 1.4 = 30.59 \text{ kNm}$

### DESIGN SHEAR STRESS

$$v = \frac{30.59 \times 10^3}{10^3 \times 174} = 0.175 \text{ N/mm}^2$$

DESIGN CONCRETE SHEAR STRESS -  $\frac{100 A_s}{bd}$

$$= \frac{100 \times 754}{1000 \times 225} = 0.335$$

FROM TABLE 3.8 BS 8110  $V_c = 0.578$

$$0.578 \times 1.0 = 0.578 \text{ N/mm}^2$$

$$0.578 \text{ N/mm}^2 > 0.207 \text{ N/mm}^2 \therefore \text{SATISFACTORY.}$$

#### CHECK DEFLECTION

##### TENSION REINFORCEMENT

$$\frac{M}{bd^2} = \frac{32.87 \times 10^6}{10^3 \times 225^2} = 0.65$$

FROM TABLE 3.10 BS 8110 MODIFICATION FACTOR = 2.0

##### COMPRESSION REINFORCEMENT

$$\frac{100 A_s}{bd} = \frac{100 \times 754}{10^3 \times 225} = 0.335$$

FROM TABLE 11 BS 8110 MODIFICATION FACTOR = 1.09

$$\text{ALLOWABLE DEFLECTION} = 7.0 \times 2.0 \times 1.09 = 15.3 \text{ mm}$$

$$\text{ACTUAL DEFLECTION} = \frac{3000}{225} = 13.3 \text{ mm}$$

$$13.3 \text{ mm} < 15.3 \text{ mm} \therefore \text{SATISFACTORY.}$$

### BASE OF WALL

MAXIMUM BENDING MOMENT ON WALL =  $16.11 \text{ kNm/m}$

ULTIMATE BENDING MOMENT =  $16.11 \times 1.4 = 22.6 \text{ kNm/m}$

$$k = \frac{M}{f_{cu} b d^2} = \frac{22.6 \times 10^6}{35 \times 10^3 \times 255^2} = 0.012$$

$$Z = 255 \left[ 0.5 + \sqrt{0.25 - 0.012} \right] = 252 \text{ mm}$$

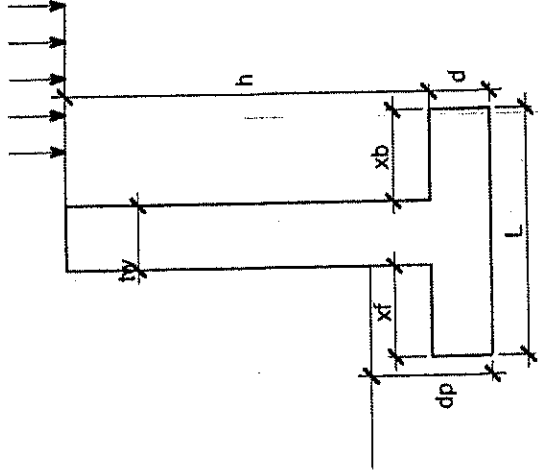
$$\text{AREA OF REINFORCEMENT AS} = \frac{M}{0.87 f_y Z}$$

$$= \frac{22.6 \times 10^6}{0.87 \times 500 \times 252} = 206 \text{ mm}^2/\text{m}$$

$$\begin{aligned} \text{MINIMUM REINFORCEMENT} &= \frac{0.13 b h}{100} = \frac{0.13 \times 10^3 \times 300}{100} \\ &= 390 \text{ mm}^2/\text{m} \end{aligned}$$

MAIN REINFORCEMENT USE:- 12mm  $\phi$  BARS @ 150mm TOP  
+ BOTTOM OF BASE.

DISTRIBUTION REINFORCEMENT USE:- 10mm  $\phi$  BARS @ 200mm TOP  
+ BOTTOM OF BASE.



### Geometry (All dimension in metres)

$h_w = 0.21$  ;  $d = 0.2$  ;  $h = 1.2$  ;  $x_b = 0.3$  ;  $x_f = 0.3$  ;  $h_p = 0$  ;  $w_k = 0$  ;  $h_k = 0$  ;  $d_p = 0.4$  ;  $L = 0.81$

### Additional loads (kN and m)

$p = 1.5$  ;  $V_a = 0$  ;  $H_a = 0$  ;  $h_h = 0$

Restoring effect of surcharge - Considered

### Soil properties

Unit weight of drained/moist soil

Internal friction angle of soil

Retained soil

19

35

Passive soil

19

35

Unit

kN/m<sup>3</sup>

degrees

### Foundation soil properties

Angle of base friction

Cohesion

Base adhesion

Allowable bearing pressure

Check sliding below

Pressure coefficient by

Pressure resultant angle

= 30 degrees

= 0 kN/m<sup>2</sup>

= 0 kN/m<sup>2</sup>

= 200 kN/m<sup>2</sup>

- Base slab

- Rankine theory

- 0 degrees

### Factor of safety

Overturning = 2

Sliding = 2

Sliding = 1.5 (excluding passive)

Redn. factor = 0.5 (passive resistance)

### Result summary

Active pressure coefficient

FOS against overturning

Combined vertical load in middle third

Pressure at heel

Pressure at toe

Maximum pressure beneath base < allowable ( 200 ) - OK

FOS sliding (including passive)

= 0.27

= 3.27 > 2 - OK

= 11.77 kN/m<sup>2</sup>

= 33.22 kN/m<sup>2</sup>

= 2.38 > 2 - OK

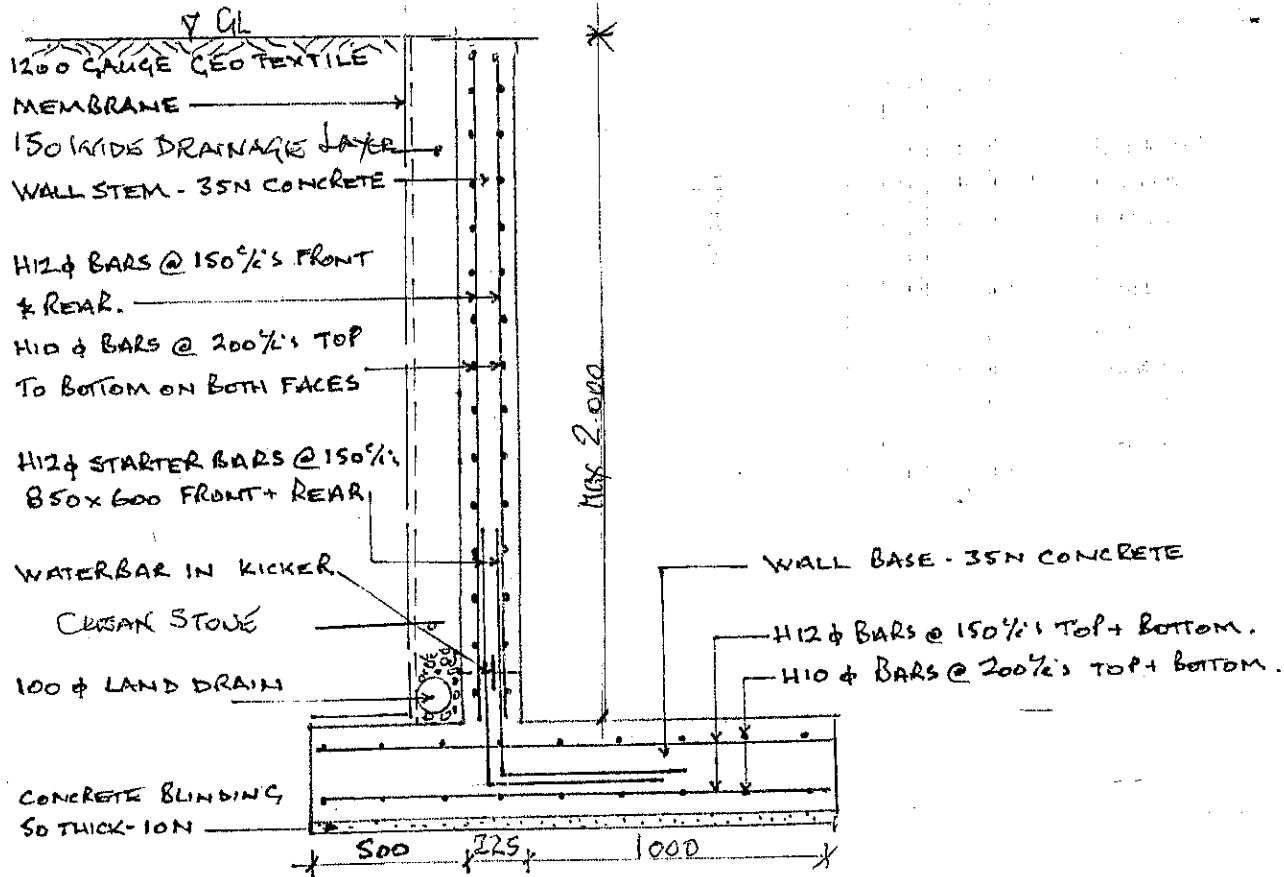
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FOS sliding (excluding passive)  
Stability check status - Passed

= 1.88 > 1.5 - OK

| Unfactored forces     | Shear (kN) | Moment (kNm) |                       |
|-----------------------|------------|--------------|-----------------------|
| Stem base             | 4.19       | 1.78         | (at the face of stem) |
| Base slab - toe side  | 6.22       | 0.99         | (at the face of stem) |
| Base slab - heel side | 3.99       | 0.66         |                       |

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EXPANSION JOINTS REQUIRED AT 6000mm CENTRES MAXIMUM.