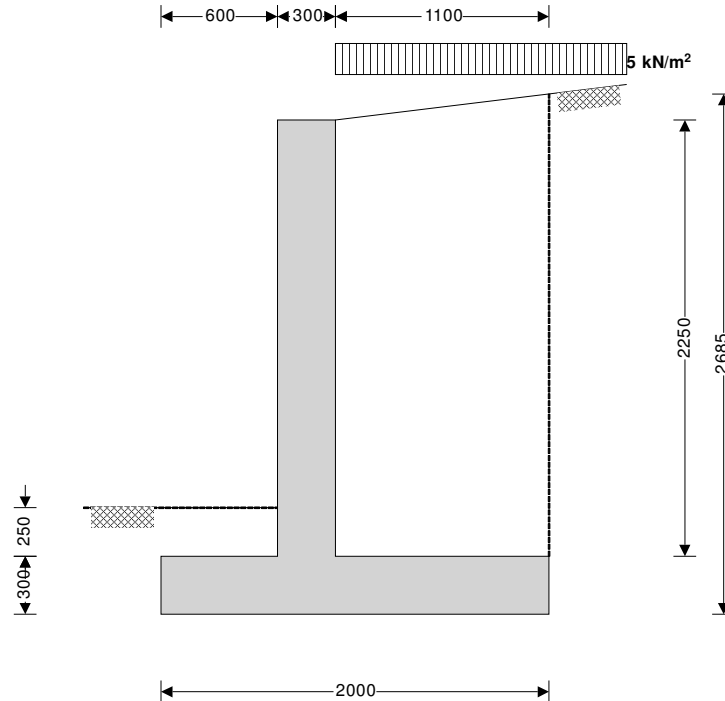


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|                                                                    | Calcs for<br><b>Max Retained Height - 2.0m, 1 in 8 Slope</b> |                                 |                         |                                   | Start page no./Revision<br><b>1</b> |                                    |
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## RETAINING WALL ANALYSIS (BS 8002:1994)

TEDDS calculation version 1.2.01.08



### Wall details

Retaining wall type

Height of wall stem

Length of toe

Overall length of base

Height of retaining wall

Depth of downstand

Position of downstand

Depth of cover in front of wall

Height of ground water

Density of wall construction

Angle of soil surface

Mobilisation factor

Moist density

Design shear strength

Design shear strength

Moist density

### Using Coulomb theory

Active pressure

At-rest pressure

### Loading details

Surcharge load

Vertical dead load

Horizontal dead load

### Cantilever

$h_{\text{stem}} = 2250$  mm

$l_{\text{toe}} = 600$  mm

$l_{\text{base}} = 2000$  mm

$h_{\text{wall}} = 2550$  mm

$d_{\text{ds}} = 0$  mm

$l_{\text{ds}} = 750$  mm

$d_{\text{cover}} = 250$  mm

$h_{\text{water}} = 0$  mm

$\gamma_{\text{wall}} = 23.6$  kN/m<sup>3</sup>

$\beta = 7.0$  deg

$M = 1.5$

$\gamma_m = 18.0$  kN/m<sup>3</sup>

$\phi' = 35.0$  deg

$\phi'_b = 35.0$  deg

$\gamma_{mb} = 18.0$  kN/m<sup>3</sup>

$K_a = 0.290$

$K_0 = 0.426$

Surcharge = **5.0** kN/m<sup>2</sup>

$W_{\text{dead}} = 0.0$  kN/m

$F_{\text{dead}} = 0.0$  kN/m

Wall stem thickness

Length of heel

Base thickness

Thickness of downstand

Unplanned excavation depth

Density of water

Density of base construction

Effective height at back of wall

Saturated density

Angle of wall friction

Design base friction

Allowable bearing

Passive pressure

Vertical live load

Horizontal live load

$t_{\text{wall}} = 300$  mm

$l_{\text{heel}} = 1100$  mm

$t_{\text{base}} = 300$  mm

$t_{\text{ds}} = 300$  mm

$d_{\text{exc}} = 0$  mm

$\gamma_{\text{water}} = 9.81$  kN/m<sup>3</sup>

$\gamma_{\text{base}} = 23.6$  kN/m<sup>3</sup>

$h_{\text{eff}} = 2685$  mm

$\gamma_s = 21.0$  kN/m<sup>3</sup>

$\delta = 0.0$  deg

$\delta_b = 18.6$  deg

$P_{\text{bearing}} = 50$  kN/m<sup>2</sup>

$K_p = 7.759$

$W_{\text{live}} = 0.0$  kN/m

$F_{\text{live}} = 0.0$  kN/m

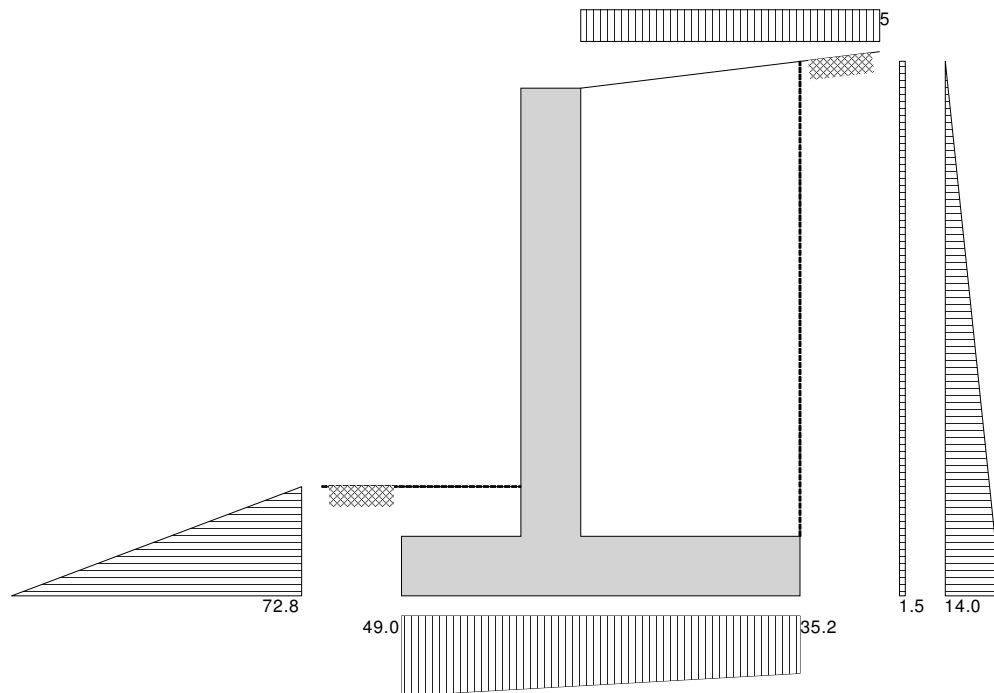
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Position of vertical load

$l_{load} = 0 \text{ mm}$

Height of horizontal load

$h_{load} = 0 \text{ mm}$



Loads shown in kN/m, pressures shown in kN/m<sup>2</sup>

#### Check stability against sliding

Total horizontal load on wall  $F_{total} = 22.7 \text{ kN/m}$

Resistance to sliding  $F_{res} = 45.6 \text{ kN/m}$

**PASS - Resistance force is greater than sliding force**

#### Check stability against overturning

Overturning moment  $M_{ot} = 22.1 \text{ kNm/m}$

Restoring moment  $M_{rest} = 92.9 \text{ kNm/m}$

**PASS - Restoring moment is greater than overturning moment**

#### Check bearing pressure

Total vertical reaction  $R = 84.2 \text{ kN/m}$

Distance to reaction  $x_{bar} = 946 \text{ mm}$

Eccentricity of reaction  $e = 54 \text{ mm}$

**Reaction acts within middle third of base**

Bearing pressure at toe  $p_{toe} = 49.0 \text{ kN/m}^2$

Bearing pressure at heel  $p_{heel} = 35.2 \text{ kN/m}^2$

**PASS - Maximum bearing pressure is less than allowable bearing pressure**

|                                                                                                                                                       |                                                              |                                 |                         |                                   |                                     |                                    |
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|                                                                                                                                                       | Calcs for<br><b>Max Retained Height - 2.0m, 1 in 8 Slope</b> |                                 |                         |                                   | Start page no./Revision<br><b>3</b> |                                    |
|                                                                                                                                                       | Calcs by<br><b>WW</b>                                        | Calcs date<br><b>27/08/2021</b> | Checked by<br><b>PG</b> | Checked date<br><b>27/08/2021</b> | Approved by<br><b>PG</b>            | Approved date<br><b>27/08/2021</b> |

### RETAINING WALL DESIGN (BS 8002:1994)

TEDDS calculation version 1.2.01.08

#### Ultimate limit state load factors

Dead load factor  $\gamma_{f_d} = 1.4$

Live load factor  $\gamma_{f_l} = 1.6$

Earth pressure factor  $\gamma_{f_e} = 1.4$

#### Design of reinforced concrete retaining wall toe (BS 8002:1994)

##### Material properties

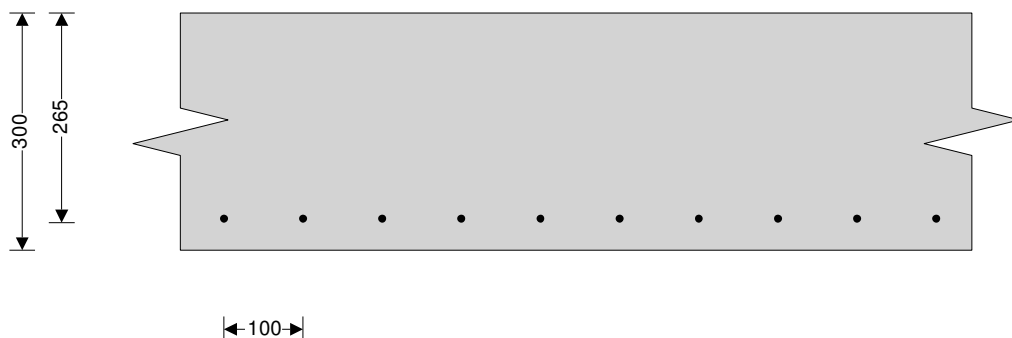
Strength of concrete  $f_{cu} = 35 \text{ N/mm}^2$

Strength of reinforcement  $f_y = 500 \text{ N/mm}^2$

##### Base details

Minimum reinforcement  $k = 0.13 \%$

Cover in toe  $c_{toe} = 30 \text{ mm}$



#### Design of retaining wall toe

Shear at heel  $V_{toe} = 39.8 \text{ kN/m}$

Moment at heel  $M_{toe} = 19.2 \text{ kNm/m}$

**Compression reinforcement is not required**

#### Check toe in bending

Reinforcement provided **B785 mesh**

Area required  $A_{s\_toe\_req} = 390.0 \text{ mm}^2/\text{m}$

Area provided  $A_{s\_toe\_prov} = 785 \text{ mm}^2/\text{m}$

**PASS - Reinforcement provided at the retaining wall toe is adequate**

#### Check shear resistance at toe

Design shear stress  $v_{toe} = 0.150 \text{ N/mm}^2$

Allowable shear stress  $v_{adm} = 4.733 \text{ N/mm}^2$

**PASS - Design shear stress is less than maximum shear stress**

Concrete shear stress  $v_{c\_toe} = 0.522 \text{ N/mm}^2$

**$v_{toe} < v_{c\_toe}$  - No shear reinforcement required**

#### Design of reinforced concrete retaining wall heel (BS 8002:1994)

##### Material properties

Strength of concrete  $f_{cu} = 35 \text{ N/mm}^2$

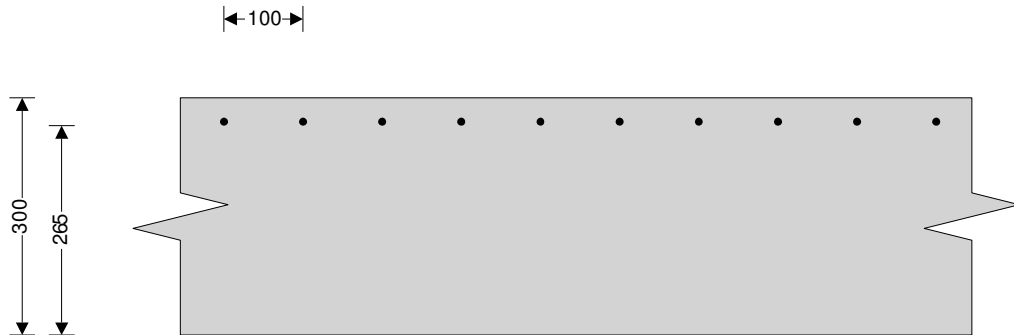
Strength of reinforcement  $f_y = 500 \text{ N/mm}^2$

##### Base details

Minimum reinforcement  $k = 0.13 \%$

Cover in heel  $c_{heel} = 30 \text{ mm}$

|                                                                                                                                                       |                                                              |                                 |                         |                                   |                                     |                                    |
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|                                                                                                                                                       | Calcs by<br><b>WW</b>                                        | Calcs date<br><b>27/08/2021</b> | Checked by<br><b>PG</b> | Checked date<br><b>27/08/2021</b> | Approved by<br><b>PG</b>            | Approved date<br><b>27/08/2021</b> |



### Design of retaining wall heel

Shear at heel  $V_{heel} = 34.8 \text{ kN/m}$

Moment at heel

$M_{heel} = 27.8 \text{ kNm/m}$

**Compression reinforcement is not required**

### Check heel in bending

Reinforcement provided

**B785 mesh**

Area required

$A_{s\_heel\_req} = 390.0 \text{ mm}^2/\text{m}$

Area provided

$A_{s\_heel\_prov} = 785 \text{ mm}^2/\text{m}$

**PASS - Reinforcement provided at the retaining wall heel is adequate**

### Check shear resistance at heel

Design shear stress

$V_{heel} = 0.131 \text{ N/mm}^2$

Allowable shear stress

$V_{adm} = 4.733 \text{ N/mm}^2$

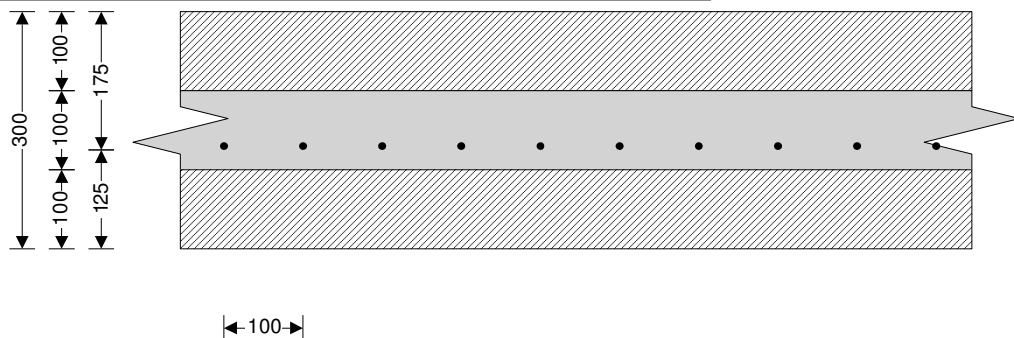
**PASS - Design shear stress is less than maximum shear stress**

Concrete shear stress

$V_{c\_heel} = 0.522 \text{ N/mm}^2$

**$V_{heel} < V_{c\_heel}$  - No shear reinforcement required**

### Design of cavity reinforced masonry retaining wall stem - BS5628-2:2000



### Wall details

Thickness of outer leaf of wall  $t_{outer} = 100 \text{ mm}$

Thickness of inner leaf of wall  $t_{inner} = 100 \text{ mm}$

Thickness of reinforced cavity  $t_{cavity} = 100 \text{ mm}$

### Masonry details

Masonry type  
units

**Aggregate concrete blocks no voids**  
 $p_{unit} = 10.0 \text{ N/mm}^2$

Compressive strength of

Mortar designation

**ii**

Char. compressive strength

$f_k = 8.1 \text{ N/mm}^2$

Manufacture control of units

**Normal**

Material strength safety factor

$\gamma_{mm} = 2.3$

### Design of retaining wall stem

Shear at base of stem

$V_{stem} = 38.7 \text{ kN/m}$

Moment at base of stem

$M_{stem} = 39.3 \text{ kNm/m}$

### Check maximum design moment

Maximum design moment

$M_{d\_stem} = 43 \text{ kNm/m}$

|                                                                                                                                                       |                                                       |                          |                  |                            |                              |                             |
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|                                                                                                                                                       | Calcs for<br>Max Retained Height - 2.0m, 1 in 8 Slope |                          |                  |                            | Start page no./Revision<br>5 |                             |
|                                                                                                                                                       | Calcs by<br>WW                                        | Calcs date<br>27/08/2021 | Checked by<br>PG | Checked date<br>27/08/2021 | Approved by<br>PG            | Approved date<br>27/08/2021 |

**PASS - Applied moment is less than maximum design moment**

**Check wall stem in bending**

Reinforcement provided

**B785 mesh**

Area required

$A_{s\_stem\_req} = 676.6 \text{ mm}^2/\text{m}$

Area provided

$A_{s\_stem\_prov} = 785 \text{ mm}^2/\text{m}$

**PASS - Reinforcement provided at the retaining wall stem is adequate**

**Check shear resistance at wall stem**

Design shear stress

$v_{stem} = 0.221 \text{ N/mm}^2$

Allowable shear stress

$v_{adm} = 0.225 \text{ N/mm}^2$

**PASS - Design shear stress is less than maximum shear stress**

**Check limiting dimensions**

Limiting span/eff.depth ratio

$ratio_{max} = 18.00$

Actual span/eff.depth ratio

$ratio_{act} = 13.36$

**PASS - Span to depth ratio is acceptable**

**Axial load check**

Factored axial load on wall

$N_{wall} = 22.3 \text{ kN/m}$

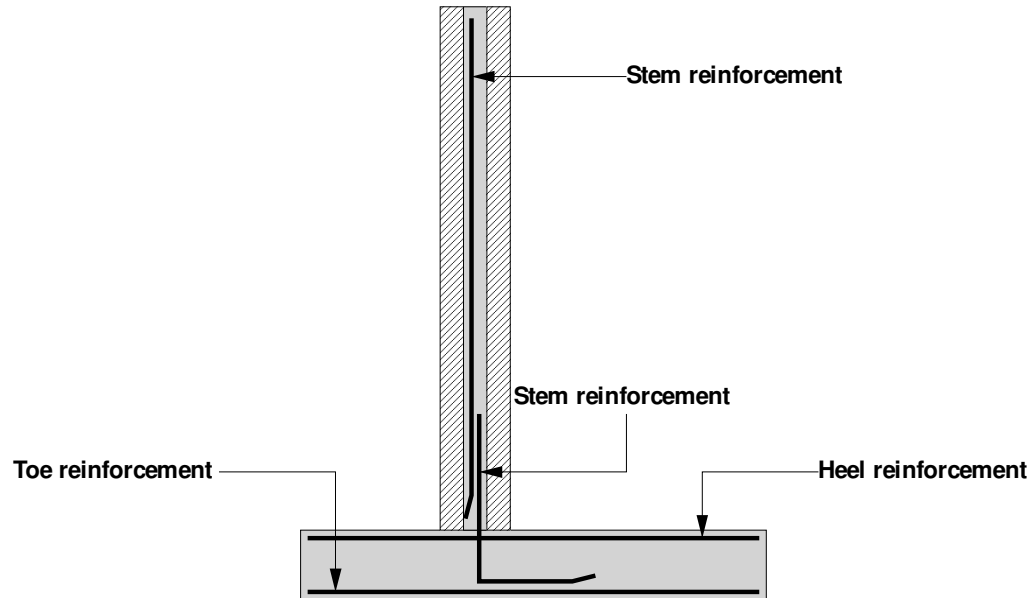
Limiting axial load

$N_{limit} = 244.3 \text{ kN/m}$

**Applied axial load may be ignored - calculations valid**

|                                                                                                                                                       |                                                       |                          |                  |                            |                              |                             |
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|                                                                                                                                                       | Calcs for<br>Max Retained Height - 2.0m, 1 in 8 Slope |                          |                  |                            | Start page no./Revision<br>6 |                             |
|                                                                                                                                                       | Calcs by<br>WW                                        | Calcs date<br>27/08/2021 | Checked by<br>PG | Checked date<br>27/08/2021 | Approved by<br>PG            | Approved date<br>27/08/2021 |

**Indicative retaining wall reinforcement diagram**



Toe mesh - B785 - (785 mm<sup>2</sup>/m)  
 Heel mesh - B785 - (785 mm<sup>2</sup>/m)  
 Stem mesh - B785 - (785 mm<sup>2</sup>/m)