# Verification of reinforced masonry wall

## Verification No. 1

### Active pressure behind the structure - partial results

| Layer No. | Thickness [m] | $\alpha$ [°] | $\phi_d$ [°] | $c_d$ [kPa] | $\gamma$ [kN/m³] | $\delta_d$ [°] | $K_a$ | Comment |
|---|---|---|---|---|---|---|---|---|
| 1 | 0.16 | 21.59 | 30.68 | 2.11 | 18.60 | 30.68 | 0.698 | |
| 2 | 1.84 | 21.59 | 30.68 | 2.11 | 18.60 | 30.68 | 0.698 | |
| 3 | 1.90 | 21.59 | 30.68 | 2.11 | 18.60 | 30.68 | 0.698 | |
| 4 | 0.40 | 0.00 | 30.68 | 2.11 | 18.60 | 20.16 | 0.359 | |
| 5 | 0.10 | 0.00 | 25.16 | 3.52 | 19.60 | 16.49 | 0.457 | |
| 7 | 0.30 | 0.00 | 25.16 | 3.52 | 19.60 | 16.49 | 0.457 | |

### Active pressure distribution behind the structure (without surcharge)

| Layer No. | Start [m] End [m] | $\sigma_z$ [kPa] | $\sigma_w$ [kPa] | Pressure [kPa] | Hor. comp. [kPa] | Vert. comp. [kPa] |
|---|---|---|---|---|---|---|
| 1 | -0.19 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | -0.04 | 2.89 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2 | -0.04 | 2.89 | 0.00 | 0.00 | 0.00 | 0.00 |
| | 1.80 | 37.02 | 0.00 | 23.83 | 14.58 | 18.85 |
| 3 | 1.80 | 37.02 | 0.00 | 23.83 | 14.58 | 18.85 |
| | 3.70 | 72.36 | 0.00 | 48.50 | 29.68 | 38.36 |
| 4 | 3.70 | 72.36 | 0.00 | 23.78 | 22.33 | 8.20 |
| | 4.10 | 79.80 | 0.00 | 26.46 | 24.84 | 9.12 |
| 5 | 4.10 | 79.80 | 0.00 | 32.22 | 30.89 | 9.14 |
| | 4.20 | 81.76 | 0.00 | 33.11 | 31.75 | 9.40 |
| 6 | 4.20 | 81.76 | 0.00 | 33.11 | 31.75 | 9.40 |
| | 4.50 | 87.64 | 0.00 | 35.80 | 34.33 | 10.16 |

### Forces acting on construction

| Name | $F_{hor}$ [kN/m] | App.Pt. Z [m] | $F_{vert}$ [kN/m] | App.Pt. X [m] | Design coefficient |
|---|---|---|---|---|---|
| Weight - wall | 0.00 | -0.92 | 72.73 | 1.49 | 0.800 |
| FF resistance | -24.42 | -0.02 | 0.00 | 0.00 | 0.800 |
| Weight - earth wedge | 0.00 | -2.15 | 94.90 | 2.08 | 0.800 |
| Active pressure | 77.90 | -1.26 | 78.97 | 2.92 | 1.250 |
| Surch.1 - surface | 14.69 | -2.06 | 16.87 | 1.96 | 1.000 |
| Base anchorage | 0.00 | 0.00 | 1.26 | 1.80 | 1.000 |

### Verification of complete wall

**Check for overturning stability**
Resisting moment $M_{res}$ = 568.18 kNm/m
Overturning moment $M_{ovr}$ = 150.37 kNm/m

**Wall for overturning is SATISFACTORY**

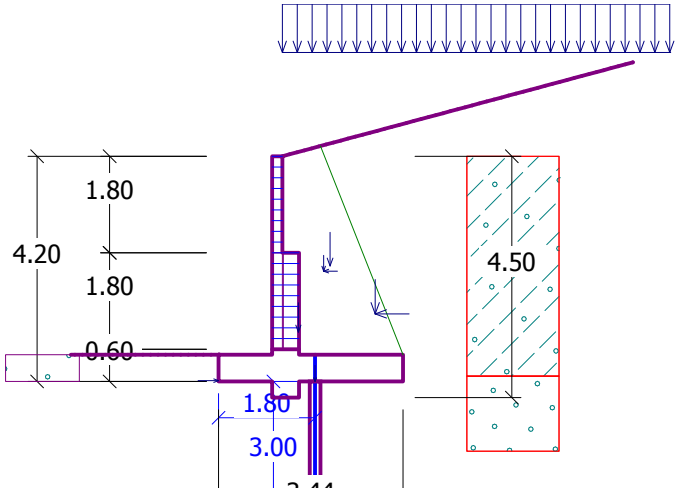
**Check for slip**
Resisting horizontal force $H_{res}$ = 129.60 kN/m
Active horizontal force $H_{act}$ = 92.53 kN/m

**Wall for slip is SATISFACTORY**

**Forces acting at the centre of footing bottom**
Overall moment M = 13.81 kNm/m
Normal force N = 250.94 kN/m
Shear force Q = 92.53 kN/m

**Overall check - WALL is SATISFACTORY**

**Name : Verification** | **Stage : 1; Analysis : 1**




## Bearing capacity of foundation soil

### Forces acting at the centre of the footing bottom

| No. | Moment [kNm/m] | Norm. force [kN/m] | Shear Force [kN/m] | Eccentricity [m] | Stress [kPa] |
|---|---|---|---|---|---|
| 1 | 13.81 | 250.94 | 92.53 | 0.06 | 75.36 |

## Dimensioning No. 1

### Active pressure behind the structure - partial results

| Layer No. | Thickness [m] | $\alpha$ [°] | $\phi_d$ [°] | $c_d$ [kPa] | $\gamma$ [kN/m³] | $\delta_d$ [°] | $K_a$ | Comment |
|---|---|---|---|---|---|---|---|---|
| 1 | 0.16 | 21.59 | 30.68 | 2.11 | 18.60 | 30.68 | 0.698 | |
| 2 | 1.84 | 21.59 | 30.68 | 2.11 | 18.60 | 30.68 | 0.698 | |
| 3 | 1.90 | 21.59 | 30.68 | 2.11 | 18.60 | 30.68 | 0.698 | |
| 4 | 0.40 | 0.00 | 30.68 | 2.11 | 18.60 | 20.16 | 0.359 | |
| 5 | 0.10 | 0.00 | 25.16 | 3.52 | 19.60 | 16.49 | 0.457 | |
| 7 | 0.30 | 0.00 | 25.16 | 3.52 | 19.60 | 16.49 | 0.457 | |

### Active pressure distribution behind the structure (without surcharge)

| Layer No. | Start [m] / End [m] | $\sigma_z$ [kPa] | $\sigma_w$ [kPa] | Pressure [kPa] | Hor. comp. [kPa] | Vert. comp. [kPa] |
|---|---|---|---|---|---|---|
| 1 | -0.19 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | -0.04 | 2.89 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2 | -0.04 | 2.89 | 0.00 | 0.00 | 0.00 | 0.00 |
| | 1.80 | 37.02 | 0.00 | 23.83 | 14.58 | 18.85 |
| 3 | 1.80 | 37.02 | 0.00 | 23.83 | 14.58 | 18.85 |
| | 3.70 | 72.36 | 0.00 | 48.50 | 29.68 | 38.36 |

| Layer No. | Start [m] End [m] | $\sigma_z$ [kPa] | $\sigma_w$ [kPa] | Pressure [kPa] | Hor. comp. [kPa] | Vert. comp. [kPa] |
|---|---|---|---|---|---|---|
| 4 | 3.70 | 72.36 | 0.00 | 23.78 | 22.33 | 8.20 |
| | 4.10 | 79.80 | 0.00 | 26.46 | 24.84 | 9.12 |
| 5 | 4.10 | 79.80 | 0.00 | 32.22 | 30.89 | 9.14 |
| | 4.20 | 81.76 | 0.00 | 33.11 | 31.75 | 9.40 |
| 6 | 4.20 | 81.76 | 0.00 | 33.11 | 31.75 | 9.40 |
| | 4.50 | 87.64 | 0.00 | 35.80 | 34.33 | 10.16 |

## Forces acting on construction

| Name | $F_{hor}$ [kN/m] | App.Pt. Z [m] | $F_{vert}$ [kN/m] | App.Pt. X [m] | Design coefficient |
|---|---|---|---|---|---|
| Weight - wall | 0.00 | -0.92 | 72.73 | 1.49 | 1.000 |
| FF resistance | -24.42 | -0.02 | 0.00 | 0.00 | 1.000 |
| Weight - earth wedge | 0.00 | -2.15 | 94.90 | 2.08 | 1.000 |
| Active pressure | 77.90 | -1.26 | 78.97 | 2.92 | 1.250 |
| Surch.1 - surface | 14.69 | -2.06 | 16.87 | 1.96 | 1.000 |
| Base anchorage | 0.00 | 0.00 | 1.26 | 1.80 | 1.000 |

## Verification of base key

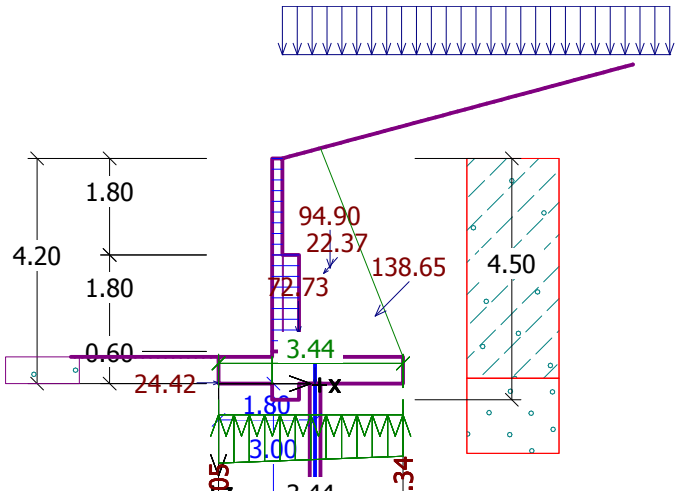
Stress at the footing bottom for wall jump dimensioning is assuemd as uniform.
Reinforcement of cross section
Diameter = 10.0 mm
Number of bars = 20
Reinforcement cover = 30.0 mm
Cross-section width = 1.00 m
Cross-section depth = 0.50 m

Reinforcement ratio $\rho = 0.34\ \% > 0.14\ \% = \rho_{min}$
Position of neutral axis $k_u = 0.10 < 0.40$
Ultimate moment $\phi M_{uo} = 277.65\ kNm > 50.69\ kNm = M_x$

**Cross-section is SATISFACTORY.**

Shear capacity :
Ultimate shear force $\phi V_u = 165.52\ kN/m > 93.59\ kN/m = V_x$
**Cross-section is SATISFACTORY.**

**Name : Dimensioning** | **Stage : 1; Dimensioning : 1**




## Dimensioning No. 2

### Forces acting on construction

| Name | $F_{hor}$ [kN/m] | App.Pt. Z [m] | $F_{vert}$ [kN/m] | App.Pt. X [m] | Design coefficient |
|---|---|---|---|---|---|
| Weight - wall | 0.00 | -1.40 | 28.57 | 0.21 | 1.000 |
| Weight - earth wedge | 0.00 | -2.06 | 2.26 | 0.29 | 1.250 |
| Active pressure | 36.02 | -1.16 | 20.45 | 0.42 | 1.000 |
| Surch.1 - surface | 9.29 | -1.76 | 5.86 | 0.36 | 1.000 |

### Verification of the joint, 0.50 m from the top.

Back face reinforcement :
Diameter = 16.0 mm
Spacing = 400.0 mm
Cover = 57.0 mm

There is no reinforcement on the front face.

**Verification of cross section in compression:**
Ultimate normal force $\phi N_{uo}$ = 2728.01 kN/m > 57.69 kN/m = N
**Cross section is SATISFACTORY**

**Verification of cross section in bending:**
Ultimate bending momenti $\phi M_{uo}$ = 79.28 kNm/m > 55.17 kNm/m = $M_x$
**Cross section is SATISFACTORY.**

**Verification of cross section in shear:**
Ultimate shear force $\phi V_u$ = 120.78 kN/m > 45.31 kN/m = $V_x$
**Cross section is SATISFACTORY.**