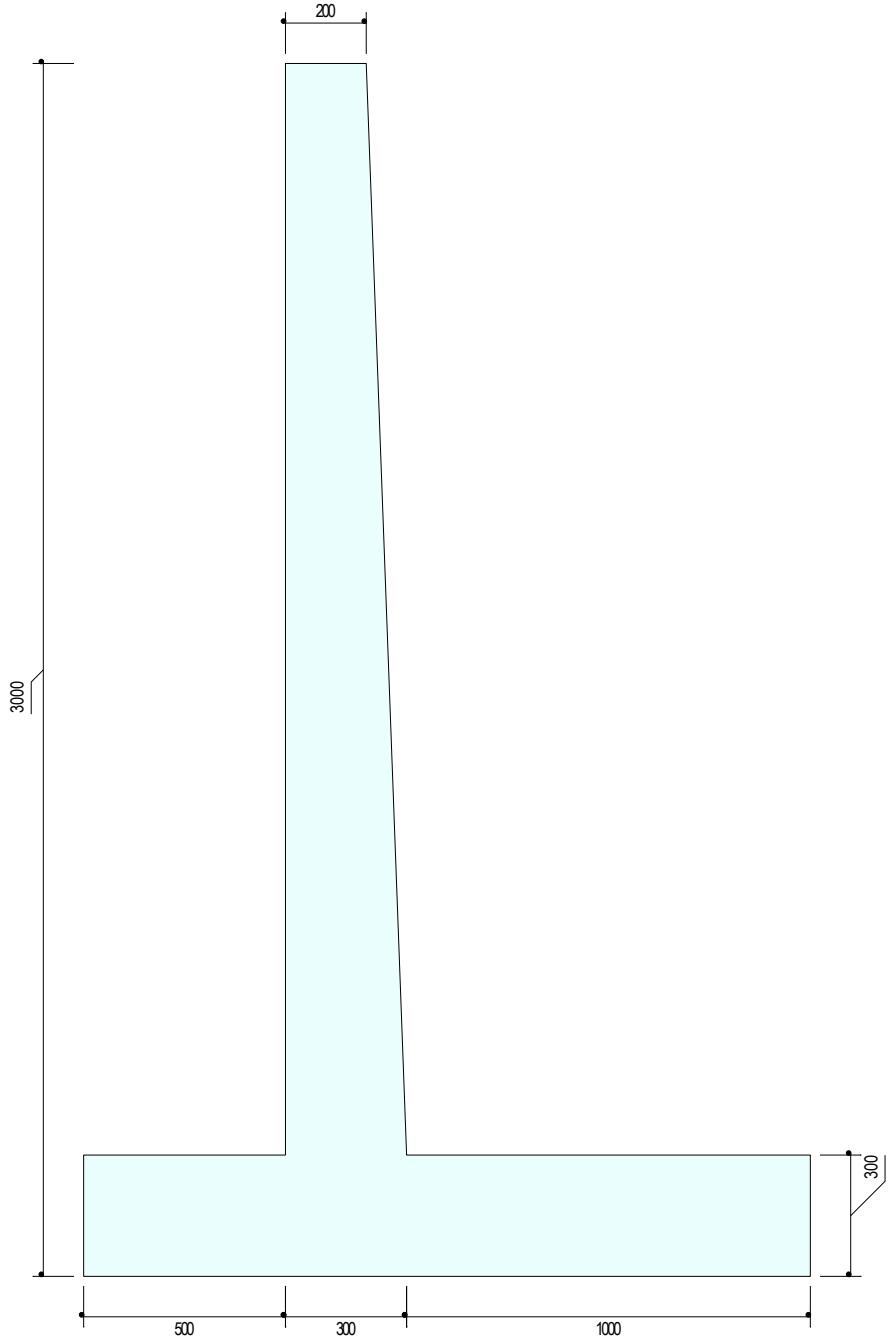
■ MEMBER NAME : Muro 3 metros

1. General Information

(1) Design Code : NSR-10
(2) Unit System : N, mm

2. Material

(1) F'_c : 20.59MPa
(2) F_y : 412MPa
(3) F_{ys} : 412MPa


200
3000
300
500
300
1000

3. Soil and Load

(1) Back Fill

- Inclined Back Fill : Yes
- Back Fill Slope : 2.000
- Back Fill Height : 0.000m
- Internal Friction Angle : 30.00
- Unit Density : 17.65kN/m³

(2) Surcharge Load

- Surcharge Load (Flat) : 0.000kN/m²
- Surcharge Load (Slope) : 0.000kN/m²

(3) Foundation Ground

- Internal Friction Angle : 30.00
- Cohesion : 0.000KPa
- Bearing Capacity : 98.07KPa

(4) Load

- Soil Factor : 1.600
- Water Factor : 1.600

4. Section

(1) Section Information

- Type : T
- Total Height : 3.000m

(2) Stem

- Top Thickness : 200mm
- Bottom Thickness : 300mm
- Back Horizontal Distance : 100mm
- Cover (Front) : 50.00mm
- Cover (Back) : 50.00mm

(3) Foundation

- Depth : 300mm
- Slope Depth : 0.000mm
- Toe Length : 0.500m
- Heel Length : 1.000m
- Cover : 50.00mm

(4) Shear Key

- Use Shear Key : No

5. Rebar

(1) Stem Rebar (Stem at Bot)

- Vertical Bar (Front) : #4@300
- Vertical Bar (Back) : #4@300 + @0.000
- Horizontal Bar : #3@200

(2) Stem Rebar (Stem at Half)

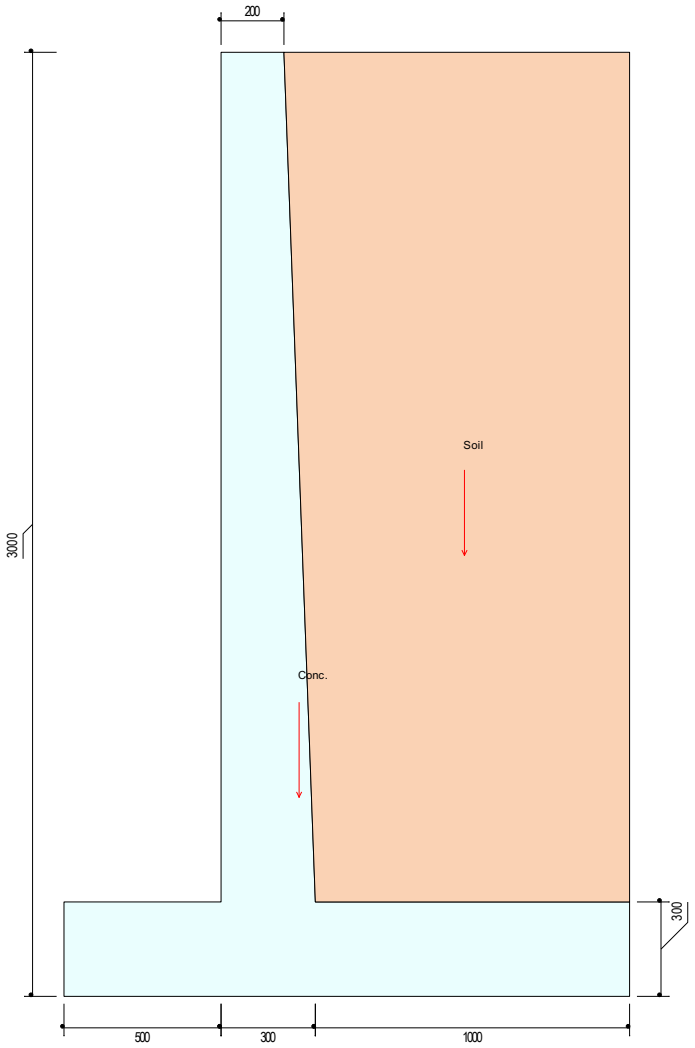
- Vertical Bar (Front) : #4@300
- Vertical Bar (Back) : #4@300 + @0.000
- Horizontal Bar : #3@200

(3) Foundation Rebar (Heel)

- Main Rebar : #4@300 + @0.000
- Distribution Bar : #4@300

(4) Foundation Rebar (Toe)

- Main Rebar : #4@300 + @0.000
- Distribution Bar : #4@300



6. Calculate Soil Pressure for stability

(1) Applied active soil pressure

- Trial wedge method

(2) Calculate coefficient of active soil pressure

- Friction angle of backfill earth ø : 30.00
- Friction angle of Wall δ : 0.000

Wedge Angle	Friction Angle	Wedge Weight (kN/m)	P_A (kN/m)	Active Coeff.
57.50	0.000	50.60	28.20	0.355
58.00	0.000	49.64	28.21	0.355
58.50	0.000	48.68	28.21	0.355
59.00	0.000	47.73	28.20	0.355
59.50	0.000	46.79	28.19	0.355

(3) Active soil pressure

- Horizontal P_{AH} : 28.21kN/m
- Vertical P_{AV} : 0.000kN/m

7. Check Overturning

(1) Calculate overturning moment

- $M_o = \frac{1}{3} P_A H = 28.21 kN \cdot m/m$

(2) Calculate resistance Moment

Part	W (kN/m)	Dist (m)	Resist. M (kN·m/m)
Concrete Self Weight	28.60	0.748	21.39
BackFill Soil Self Weight	50.04	1.275	63.79
Surcharge Load (Flat)	0.000	1.250	0.000
Surcharge Load (Slope)	0.000	0.700	0.000
Summation	78.64	-	85.18

(3) Check Overturning

- $M_r / M_o = 3.019 > 2.000$

8. Check Bearing

(1) Calculate eccentricity

- $e = \left| \frac{L}{2} \frac{M_r - M_o}{\sum W} \right| = 176mm < \frac{L}{6} = 300mm$

(2) Check Bearing

- $q_{max} = \frac{\sum W}{L}\left(1 + \frac{6e}{L}\right) = 69.26KPa < q_a = 98.07KPa$

9. Check Sliding

(1) Applied passive soil pressure

- Rankine's passive soil pressure

(2) Calculate coefficient of passive soil pressure

- $K_p = \frac{1 + \sin \phi}{1 - \sin \phi} = 3.000$

(3) Calculate friction coefficient

- $\mu = MIN[\ 0.6, \tan \phi_b\ ] = 0.577$

(4) Calculate sliding force

- $H_h = P_{AH} = 28.21 kN/m$

(5) Calculating Resistance Force

- $H_r = \mu \sum W = 45.40 kN/m$

(6) Check Sliding

- $H_r / H_h = 1.609 > 1.500$

10. Calculate Soil Pressure for section design

(1) Applied active soil pressure

- Trial wedge method

(2) Calculate coefficient of active soil pressure

- Friction angle of backfill earth ø : 30.00
- Friction angle of Wall δ : 10.00
- Wall back face inclined angle θ : 2.121

Wedge Angle	Friction Angle	Active Coeff.	Wedge Weight (kN/m)	P_A (kN/m)
58.00	0.175	0.327	42.59	21.02
58.50	0.175	0.327	41.81	21.04
59.00	0.175	0.327	41.04	21.04
59.50	0.175	0.327	40.28	21.04
60.00	0.175	0.327	39.53	21.03

11. Calculate capacity of Stem - Bottom

(1) Calculate design forces

- $p_{AH} = K_{ah}\,\gamma\,H = 0.0154MPa$
- $p_{AHs} = K_{ah}\,\gamma\,w_s = 0.000MPa$
- $V_u = p_{AH}\,\frac{H}{2} + p_{AHs}\,H = 33.16kN/m$
- $M_u = p_{AH}\,\frac{H}{2}\,\frac{H}{3} + p_{AHs}\,H\,\frac{H}{2} = 29.84kN{\cdot}m/m$

(2) Calculate minimum rebar area required

- $A_{s.min} = 540mm^2$
- $A_s = 430mm^2$

(3) Calculate minimum rebar space required

- $s_{req} = 450mm$
- $s = 300mm < s_{req}$

(4) Check moment capacity

- $d_{eff} = 244mm$
- $\phi = 0.900$
- $M_u = 29.84kN{\cdot}m/m$
- $\phi M_n = 38.04kN{\cdot}m/m$
- $M_u / \phi M_n = 0.785$

(5) Check Shear Capacity

- $\phi = 0.750$
- $V_u = 33.16kN/m$
- $\phi V_c = \phi\ 0.17\ \sqrt{f'_c}\ b_w\ d = 141kN/m$
- $V_u / \phi V_c = 0.235$

(6) Calculate distribution bar

- $A_{s.dist} = 0.2 * A_s = 86.02mm^2$
- $s_{dist} = 450mm$

12. Calculate capacity of Stem - Middle

(1) Calculate design forces

- $p_{AH} = K_{ah}\,\gamma\,H = 0.00768MPa$
- $p_{AHs} = K_{ah}\,\gamma\,w_s = 0.000MPa$
- $V_u = p_{AH}\,\frac{H}{2} + p_{AHs}\,H = 8.290kN/m$
- $M_u = p_{AH}\,\frac{H}{2}\,\frac{H}{3} + p_{AHs}\,H\,\frac{H}{2} = 3.730kN{\cdot}m/m$

(2) Calculate minimum rebar area required

- $A_{s.min} = 450mm^2$
- $A_s = 430mm^2$

(3) Calculate minimum rebar space required

- $s_{req} = 450mm$
- $s = 300mm < s_{req}$

(4) Check moment capacity

- $d_{eff} = 194mm$
- $\phi = 0.900$
- $M_u = 3.730kN{\cdot}m/m$
- $\phi M_n = 30.07kN{\cdot}m/m$
- $M_u / \phi M_n = 0.124$

(5) Check Shear Capacity

- $\phi = 0.750$
- $V_u = 8.290kN/m$
- $\phi V_c = \phi\ 0.17\ \sqrt{f'_c}\ b_w\ d = 112kN/m$
- $V_u / \phi V_c = 0.0740$

(6) Calculate distribution bar

- $A_{s.dist} = 0.2 * A_s = 86.02mm^2$
- $s_{dist} = 450mm$

13. Calculate capacity of toe

(1) Calculate design forces

Part	Shear (kN/m)	Dist (m)	Moment (kN·m/m)	Load Factor
Concrete Self Weight	-4.236	0.250	-1.059	1.200
Foundation Reaction	42.03	0.262	11.01	1.000
Summation	37.79	-	9.956	-

(2) Calculate minimum rebar area required

- $A_{s.min}$ = 540mm²
- A_s = 430mm²

(3) Calculate minimum rebar space required

- s_{req} = 450mm
- s = 300mm < s_{req}

(4) Check moment capacity

- d_{eff} = 244mm
- ø = 0.900
- M_u = 9.956kN·m/m
- øM_n = 38.04kN·m/m
- M_u / øM_n = 0.262

(5) Check Shear Capacity

- ø = 0.750
- V_u = 37.79kN/m
- øV_c = ø 0.17 $\sqrt{f'_c}$ b_w d = 141kN/m
- V_u / øV_c = 0.268

(6) Calculate distribution bar

- $A_{s.dist}$ = 0.2 * A_s = 86.02mm²
- s_{dist} = 450mm

14. Calculate capacity of heel

(1) Calculate design forces

Part	Shear (kN/m)	Dist (m)	Moment (kN·m/m)	Load Factor
Concrete Self Weight	8.473	0.500	4.236	1.200
Soil Self Weight	57.19	0.500	28.60	1.200
Surcharge Flat	0.000	0.500	0.000	1.600
Surcharge Slope	0.000	0.000	0.000	0.000
Soil Pressure	0.000	0.000	0.000	1.600
Foundation Reaction	-32.96	0.377	-12.42	1.000
Summation	32.71	-	20.41	-

(2) Calculate minimum rebar area required

- $A_{s.min}$ = 540mm²
- A_s = 430mm²

(3) Calculate minimum rebar space required

- s_{req} = 450mm
- s = 300mm < s_{req}

(4) Check moment capacity

- d_{eff} = 244mm
- ø = 0.900
- M_u = 20.41kN·m/m
- øM_n = 38.04kN·m/m
- M_u / øM_n = 0.537

(5) Check Shear Capacity

- ø = 0.750
- V_u = 32.71kN/m
- øV_c = ø 0.17 $\sqrt{f'_c}$ b_w d = 141kN/m
- V_u / øV_c = 0.232

(6) Calculate distribution bar

- $A_{s.dist}$ = 0.2 * A_s = 86.02mm²
- s_{dist} = 450mm

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