

[Print Calculation Sheet](#)

### COMBINED FOUNDATION DESIGN (ACI 318-14) - Metric

### Result Summary

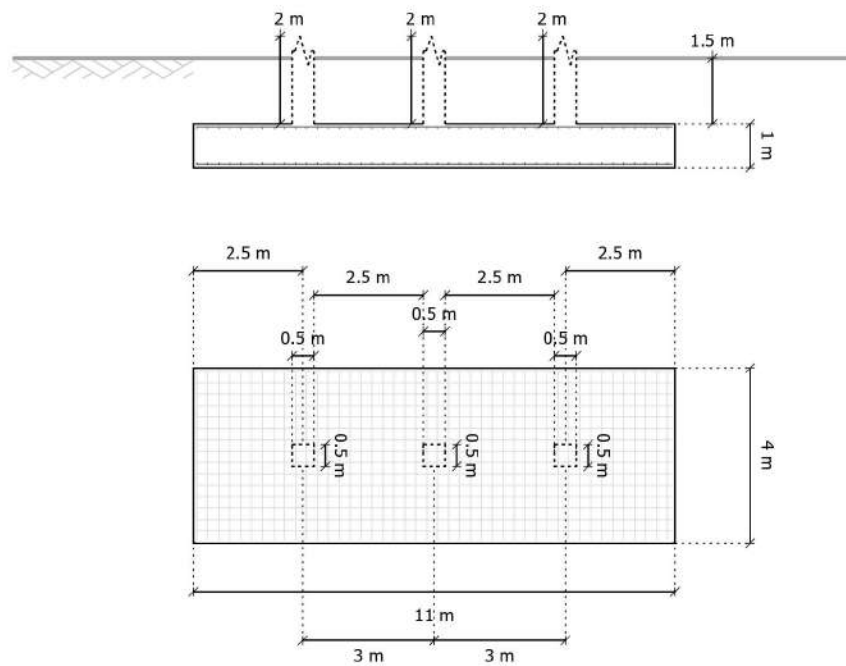
| Footing No. | Left Overhang<br>(m) | Right Overhang<br>(m) | Length<br>(m) | Width<br>(m) | Thickness<br>(m) |
|-------------|----------------------|-----------------------|---------------|--------------|------------------|
| 1           | 2.50                 | 2.50                  | 11.00         | 4.00         | 1.00             |

| Footing No. | Footing Reinforcement |                   |                     |                        |
|-------------|-----------------------|-------------------|---------------------|------------------------|
| -           | Main Steel Top        | Main Steel Bottom | Secondary Steel Top | Secondary Steel Bottom |
| 1           | 16 - $\phi$ 25        | 16 - $\phi$ 25    | 44 - $\phi$ 25      | 44 - $\phi$ 25         |

### Combined Footing 1

#### Input Data



#### Geometry of Footing

##### For Column 1

#### Column Dimensions

Column Shape : Rectangular  
 Column Length - X ( $D_{col}$ ) : 0.50 m  
 Column Width - Z ( $B_{col}$ ) : 0.50 m

#### Pedestal

Include Pedestal : No

Pedestal Shape : N/A

#### Eccentricity

Column Offset in : 0.00 m  
Transverse Direction

#### **For Column 2**

#### Column Dimensions

Column Shape : Rectangular  
Column Length - X ( $D_{col}$ ) : 0.50 m  
Column Width - Z ( $B_{col}$ ) : 0.50 m

#### Pedestal

Include Pedestal : No  
Pedestal Shape : N/A

#### Eccentricity

Column Offset in : 0.00 m  
Transverse Direction

#### **For Column 3**

#### Column Dimensions

Column Shape : Rectangular  
Column Length - X ( $D_{col}$ ) : 0.50 m  
Column Width - Z ( $B_{col}$ ) : 0.50 m

#### Pedestal

Include Pedestal : No  
Pedestal Shape : N/A

#### Eccentricity

Column Offset in : 0.00 m  
Transverse Direction

Length of left overhang : 1.00 m  
Length of right overhang : 1.00 m  
Is the length of left overhang fixed : No  
Is the length of right overhang fixed : No  
Minimum width of footing ( $W_o$ ) : 1.00 m  
Minimum Thickness of footing ( $D_o$ ) : 0.50 m  
Maximum Width of Footing ( $W_o$ ) : 5.00 m  
Maximum Thickness of Footing ( $D_o$ ) : 1.00 m  
Maximum Length of Footing ( $L_o$ ) : 15.00 m  
Length Increment : 0.50 m  
Depth Increment : 0.50 m

#### Cover and Soil Properties

Pedestal Clear Cover : 50.00 mm

|                                       |                        |       |
|---------------------------------------|------------------------|-------|
| Footing Clear Cover :                 | 75.00                  | mm    |
| Unit Weight of soil :                 | 19.00                  | kN/m3 |
| Base Value of Soil Bearing Capacity : | 200.00                 | kN/m2 |
| Soil Bearing Capacity Type :          | Gross Bearing Capacity |       |
| Soil Surcharge :                      | 0.00                   | kN/m2 |
| Depth of Soil above Footing :         | 1.50                   | m     |
| Type of Depth :                       | Fixed Top              |       |
| Depth of Water Table :                | 10.00                  | m     |

#### Concrete and Rebar Properties

|                                    |        |       |
|------------------------------------|--------|-------|
| Unit Weight of Concrete :          | 23.00  | kN/m3 |
| Compressive Strength of Concrete : | 21.00  | N/mm2 |
| Yield Strength of Steel :          | 320.00 | N/mm2 |
| Minimum Bar Size :                 | #25    |       |
| Maximum Bar Size :                 | #25    |       |
| Minimum Pedestal Bar Size :        | #10    |       |
| Maximum Pedestal Bar Size :        | #29    |       |
| Minimum Bar Spacing :              | 100.00 | mm    |
| Maximum Bar Spacing :              | 500.00 | mm    |

#### Design Calculations

##### Footing Size Calculations

Reduction of force due to buoyancy = 0.000 kN  
 Buoyancy force reported above is unfactored.  
 Whether it would affect bearing pressure or  
 not depends upon Global Setting

$$\text{Area from initial length and width, } A_o = L_o \times W_o = 33.00 \text{ m}^2$$

$$\text{Min. area required from bearing pressure, } A_{\min} = \frac{P}{q_{\max}} = 33.72 \text{ m}^2$$

**Note:**  $A_{\min}$  is an initial estimation.

**P = Critical Factored Axial Load (without self weight/buoyancy/soil).**

**$q_{\max}$  = Respective Factored Bearing Capacity.**

#### **Final footing dimensions are:**

|  |         |                |
|--|---------|----------------|
| Length of footing, L :                                   | 11.00   | m              |
| Width of footing, W :                                    | 4.00    | m              |
| Depth of footing, Do :                                   | 1.00    | m              |
| Governing Load Case For Left Overhang :                  | 3       |                |
| Governing Load Case For Right Overhang :                 | 3       |                |
| Governing Load Case For Width :                          | 3       |                |
| Governing Load Case For Depth :                          | 4       |                |
| Area, A :  | 44.00   | m <sup>2</sup> |
| Length of left overhang, $L_{\text{left\_overhang}}$ :   | 2.50    | m              |
| Length of right overhang, $L_{\text{right\_overhang}}$ : | 2.50    | m              |
|  | 1011.96 | kN             |

Footing self weight(including pedestal weight):

Soil weight on top of footing : 1232.58 kN

### Load Combinations

| Load Combination Number | Load Combination Title | Load Case Multiplier | Soil Bearing Factor | Self Weight Factor | Co |
|-------------------------|------------------------|----------------------|---------------------|--------------------|----|
| 3                       | DL+LL                  | 1.00                 | 1.00                | 1.00               | -  |
| Load Combination Number | Load Combination Title | Load Case Multiplier | Soil Bearing Factor | Self Weight Factor | Co |
| 4                       | 1.4DL                  | 1.00                 | 1.00                | 1.40               | -  |
| 5                       | 1.2DL + 1.6LL          | 1.00                 | 1.00                | 1.20               | -  |

### Applied Loads on Top of Pedestal

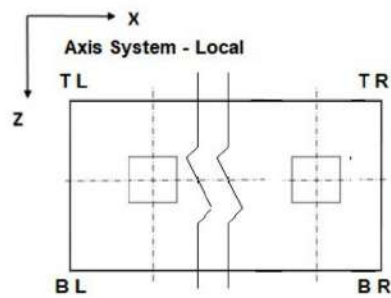
Before consideration of self weight and load multiplier table

For the loads shown in this table, the sign convention is the same as that for JOINT LOADS in STAAD.Pro when global Y is the vertical axis

| Applied Loads - Service Stress Level |                        |   |                        |                         |                         |
|--------------------------------------|------------------------|---|------------------------|-------------------------|-------------------------|
| Load Case                            | F <sub>x</sub><br>(kN) | F <sub>y</sub><br>(kN)<br>Downwards is<br>negative Upwards<br>is positive | F <sub>z</sub><br>(kN) | M <sub>x</sub><br>(kNm) | M <sub>z</sub><br>(kNm) |
| -                                    |                        |   |                        |                         |                         |
| Column Number : 1                    |                        |   |                        |                         |                         |
| 3                                    | 0.00                   | -1500.00  | 0.00                   | 0.00                    | 0.00                    |
| -                                    |                        |   |                        |                         |                         |
| Column Number : 2                    |                        |   |                        |                         |                         |
| 3                                    | 0.00                   | -1500.00  | 0.00                   | 0.00                    | 0.00                    |
| -                                    |                        |   |                        |                         |                         |
| Column Number : 3                    |                        |   |                        |                         |                         |
| 3                                    | 0.00                   | -1500.00  | 0.00                   | 0.00                    | 0.00                    |

| Applied Loads - Strength Level |                        |   |                        |                         |                         |
|--------------------------------|------------------------|---|------------------------|-------------------------|-------------------------|
| Load Case                      | F <sub>x</sub><br>(kN) | F <sub>y</sub><br>(kN)<br>Downwards is<br>negative Upwards<br>is positive | F <sub>z</sub><br>(kN) | M <sub>x</sub><br>(kNm) | M <sub>z</sub><br>(kNm) |
| -                              |                        |   |                        |                         |                         |
| Column Number : 1              |                        |   |                        |                         |                         |
| 4                              | 0.00                   | -1400.00  | 0.00                   | 0.00                    | 0.00                    |
| 5                              | 0.00                   | -2000.00  | 0.00                   | 0.00                    | 0.00                    |
| -                              |                        |   |                        |                         |                         |
| Column Number : 2              |                        |   |                        |                         |                         |
| 4                              | 0.00                   | -1400.00  | 0.00                   | 0.00                    | 0.00                    |
| 5                              | 0.00                   | -2000.00  | 0.00                   | 0.00                    | 0.00                    |
| -                              |                        |   |                        |                         |                         |
| Column Number : 3              |                        |   |                        |                         |                         |
| 4                              | 0.00                   | -1400.00  | 0.00                   | 0.00                    | 0.00                    |
| 5                              | 0.00                   | -2000.00  | 0.00                   | 0.00                    | 0.00                    |

### Gross Pressures at 4 Corners



| Load Case | Pressure at top left corner (kN/m <sup>2</sup> ) | Pressure at top right corner (kN/m <sup>2</sup> ) | Pressure at bottom right corner (kN/m <sup>2</sup> ) | Pressure at bottom left corner (kN/m <sup>2</sup> ) | Area of footing in uplift (A <sub>u</sub> ) (sq. m) | Gross Bearing Capacity (kN/m <sup>2</sup> ) |
|-----------|--|---|--|---|---|---|
| 3         | <b>153.2851</b>                                  | 153.2851  | 153.2851   | 153.2851  | 0.00  | 200.0000                                    |
| 3         | 153.2851   | <b>153.2851</b>                                   | 153.2851   | 153.2851  | 0.00  | 200.0000                                    |
| 3         | 153.2851   | 153.2851  | <b>153.2851</b>                                      | 153.2851  | 0.00  | 200.0000                                    |
| 3         | 153.2851   | 153.2851  | 153.2851   | <b>153.2851</b>                                     | 0.00  | 200.0000                                    |

If A<sub>u</sub> is zero, there is no uplift and no pressure adjustment is necessary. Otherwise, to account for uplift, areas of negative pressure will be set to zero and the pressure will be redistributed to remaining corners.

#### Summary of Adjusted Gross Pressures at Four Corners

| Load Case | Pressure at top left corner (kN/m <sup>2</sup> ) | Pressure at top right corner (kN/m <sup>2</sup> ) | Pressure at bottom right corner (kN/m <sup>2</sup> ) | Pressure at bottom left corner (kN/m <sup>2</sup> ) | Gross Bearing Capacity (kN/m <sup>2</sup> ) |
|-----------|--|---|--|---|---|
| 3         | <b>153.2851</b>                                  | 153.2851  | 153.2851   | 153.2851  | 200.0000                                    |
| 3         | 153.2851   | <b>153.2851</b>                                   | 153.2851   | 153.2851  | 200.0000                                    |
| 3         | 153.2851   | 153.2851  | <b>153.2851</b>                                      | 153.2851  | 200.0000                                    |
| 3         | 153.2851   | 153.2851  | 153.2851   | <b>153.2851</b>                                     | 200.0000                                    |

#### Stability Check

| Load Case | Shear X (kN) | Shear Z (kN) | Resultant Shear (kN) | Resisting Sliding Force (kN) | Ratio X | Ratio Z | Resultant Ratio | Required FOS |
|-----------|--------------|--------------|----------------------|------------------------------|---------|---------|-----------------|--------------|
| 3         | 0.000        | 0.000        | 0.000                | 2697.818                     | N/A     | N/A     | N/A             | 1.500        |

#### Check for stability against overturning (Moments printed against Local axis)

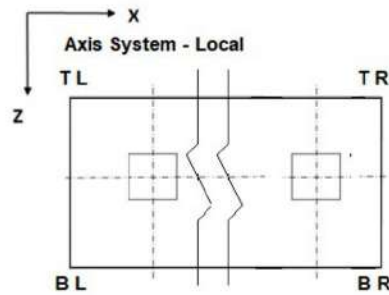
| Load Case | Moment X (kNm) | Moment Z (kNm) | Resisting Moment X (kNm) | Resisting Moment Z (kNm) | Ratio X | Ratio Z              | Required FOS |
|-----------|----------------|----------------|--------------------------|--------------------------|---------|----------------------|--------------|
| <b>3</b>  | 0.000          | 0.000          | 13488.845                | 37094.324                | N/A     | <b>339863340.527</b> | 1.500        |

#### Calculations of Footing Thickness

Footing thickness is calculated based on the ultimate load cases

#### Ultimate Gross Pressures

The base pressures reported in this table include the effect of buoyancy (if any).



| Load Case / Load Combination ID | Pressure at top left corner (kN/m <sup>2</sup> ) | Pressure at top right corner (kN/m <sup>2</sup> ) | Pressure at bottom right corner (kN/m <sup>2</sup> ) | Pressure at bottom left corner (kN/m <sup>2</sup> ) | Factored Gross Bearing capacity for Ultimate Load Cases (kN/m <sup>2</sup> ) |
|---------------------------------|--|---|--|---|--|
| 4                               | 166.8719   | 166.8719  | 166.8719   | 166.8719  | 200.0000   |
| 5                               | <b>197.5785</b>                                  | <b>197.5785</b>                                   | <b>197.5785</b>                                      | <b>197.5785</b>                                     | 200.0000   |

### Punching Shear Check

#### For Column 1

Critical Load case for Punching Shear Check : 5

Total Footing Depth,  $D_o = 1.00$  m

Calculated Effective Depth,  $d = 0.90$  m

For rectangular column,  $\beta = \frac{B_{col}}{D_{col}} : 1.00$

Considering the particular column as interior column,  
Slab Edge Factor  $\alpha_s : 40.0$

Effective depth,  $d$ , increased until  $0.75 \cdot V_c \geq$  Punching Shear Force

Punching Shear Force,  $V_u = 1725.47$  kN

From ACI Cl. 22.6.5.2,  $b_o$  for column = 5.60 m

$$\text{Table 22.6.5.2, (b), } V_{c1} = 0.17 \times \lambda \times \left(1 + \frac{2}{\beta}\right) \times b_o \times d \times \sqrt{f'_c} = 11770.45 \text{ kN}$$

$$\text{Table 22.6.5.2, (c), } V_{c2} = 0.083 \times \lambda \times \left(\frac{a_s d}{b_o} + 2\right) \times b_o \times d \times \sqrt{f'_c} = 16143.68 \text{ kN}$$

$$\text{Table 22.6.5.2, (a), } V_{c3} = 0.33 \times \lambda \times b_o \times d \times \sqrt{f'_c} = 7616.18 \text{ kN}$$

$$\text{Punching shear strength, } V_c = 0.75 \times \text{minimum of } (V_{c1}, V_{c2}, V_{c3}) = 5712.13 \text{ kN}$$

$0.75 \cdot V_c > V_u$  hence, OK

#### For Column 2

Critical Load case for Punching Shear Check : 5

Total Footing Depth,  $D_o = 1.00$  m

Calculated Effective Depth,  $d = 0.90$  m

For rectangular column,  $\beta = \frac{B_{col}}{D_{col}} : 1.00$

Considering the particular column as interior column,  
Slab Edge Factor  $\alpha_s : 40.0$

Effective depth,  $d$ , increased until  $0.75 \cdot V_c \geq$  Punching Shear Force

Punching Shear Force,  $V_u = 1725.47$  kN

From ACI Cl. 22.6.5.2,  $b_o$  for column = 5.60 m

$$\text{Table 22.6.5.2, (b), } V_{c1} = 0.17 \times \lambda \times \left(1 + \frac{2}{\beta}\right) \times b_o \times d \times \sqrt{f'_c} = 11770.45 \text{ kN}$$

$$\text{Table 22.6.5.2, (c), } V_{c2} = 0.083 \times \lambda \times \left(\frac{a_s d}{b_o} + 2\right) \times b_o \times d \times \sqrt{f'_c} = 16143.68 \text{ kN}$$

$$\text{Table 22.6.5.2, (a), } V_{c3} = 0.33 \times \lambda \times b_o \times d \times \sqrt{f'_c} = 7616.18 \text{ kN}$$

$$\begin{aligned} \text{Punching shear strength, } V_c &= 0.75 \times \text{minimum of } (V_{c1}, V_{c2}, V_{c3}) = 5712.13 \text{ kN} \\ &0.75 * V_c > V_u \quad \text{hence, OK} \end{aligned}$$

#### For Column 3

Critical Load case for Punching Shear Check : 5

Total Footing Depth,  $D_0 = 1.00 \text{ m}$

Calculated Effective Depth,  $d = 0.90 \text{ m}$

For rectangular column,  $\beta = \frac{B_{col}}{D_{col}} : 1.00$

Considering the particular column as interior column,  
Slab Edge Factor  $\alpha_s : 40.0$

Effective depth,  $d$ , increased until  $0.75 * V_c \geq \text{Punching Shear Force}$

Punching Shear Force,  $V_u = 1725.47 \text{ kN}$

From ACI Cl. 22.6.5.2,  $b_o$  for column = 5.60 m

$$\text{Table 22.6.5.2, (b), } V_{c1} = 0.17 \times \lambda \times \left(1 + \frac{2}{\beta}\right) \times b_o \times d \times \sqrt{f'_c} = 11770.45 \text{ kN}$$

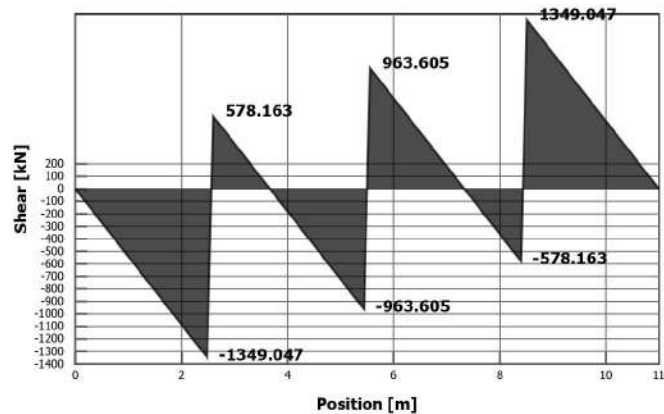
$$\text{Table 22.6.5.2, (c), } V_{c2} = 0.083 \times \lambda \times \left(\frac{a_s d}{b_o} + 2\right) \times b_o \times d \times \sqrt{f'_c} = 16143.68 \text{ kN}$$

$$\text{Table 22.6.5.2, (a), } V_{c3} = 0.33 \times \lambda \times b_o \times d \times \sqrt{f'_c} = 7616.18 \text{ kN}$$

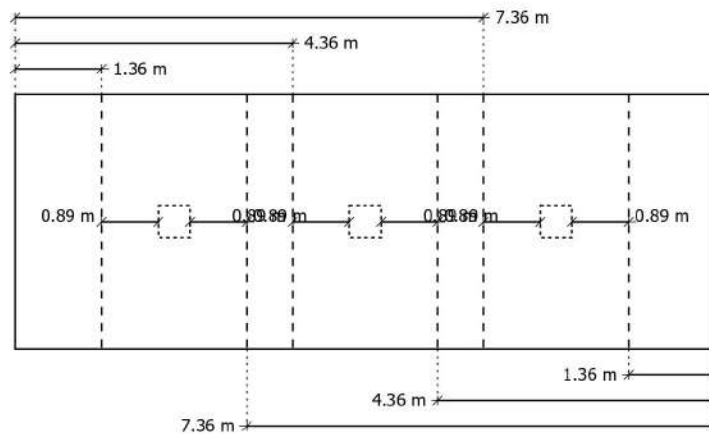
$$\begin{aligned} \text{Punching shear strength, } V_c &= 0.75 \times \text{minimum of } (V_{c1}, V_{c2}, V_{c3}) = 5712.13 \text{ kN} \\ &0.75 * V_c > V_u \quad \text{hence, OK} \end{aligned}$$

#### One-Way Shear

##### Shear Diagram



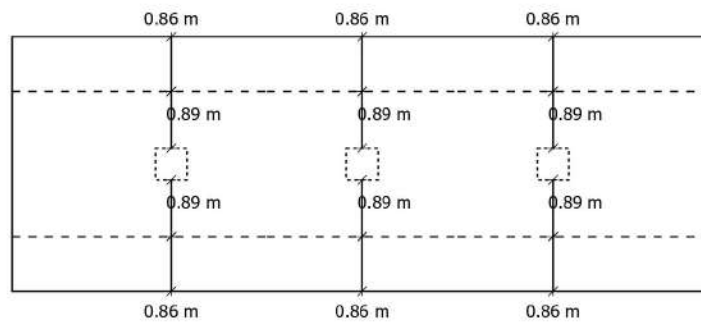




#### Shear Plane Parallel to Foundation Width

Critical load case for maximum shear force along the length of footing : 5

|   |  |              |
|---|--|--------------|
| Critical Shear force, $V_u$ :           | =  | 757.43 kN    |
| Point of occurrence of $V_u$ :          | =  | 9.64 m       |
| From ACI Cl. 22.5.5.1, $V_c$ :          | $0.17 \times \lambda \times b_w \times d \times \sqrt{f'_c}$ | = 2763.71 kN |
|   | $0.75 \times V_c =$  | 2072.79 kN   |
| Since $0.75 \times V_c > V_u$ hence, OK |  |              |



#### Shear Plane Parallel to Foundation Length

Critical load case for maximum shear force along the width of footing : 5

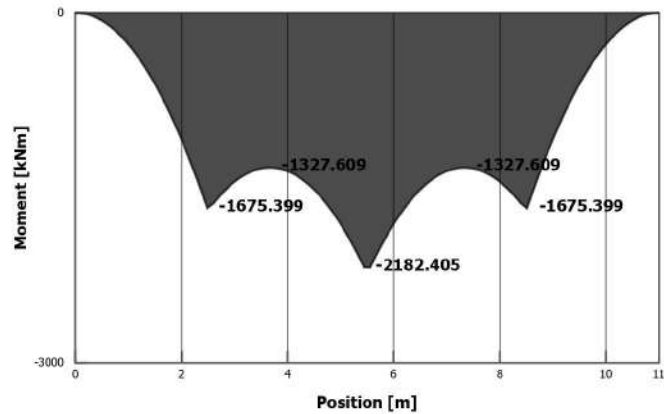
|   |  |              |
|---|--|--------------|
| Critical Shear force, $V_u$ :           | =  | 1314.76 kN   |
| Point of occurrence of $V_u$ :          | =  | 3.14 m       |
| From ACI Cl. 22.5.5.1, $V_c$ :          | $0.17 \times \lambda \times b_w \times d \times \sqrt{f'_c}$ | = 7600.22 kN |
|   | $0.75 \times V_c =$  | 5700.16 kN   |
| Since $0.75 \times V_c > V_u$ hence, OK |  |              |

[Design for Flexure](#)

[Design of flexure](#)

[Moment Diagram](#)





#### Bottom Reinforcement

Critical load case : 5

Required Effective Depth : 0.89 m

$$\beta_1, \text{ from ACI Cl. 22.2.2.4.3} = \begin{cases} 0.85, & f'_c \leq 28 \text{ Mpa} \\ \max \left[ 0.65, 0.85 - \frac{0.05}{7} (f'_c - 28 \text{ Mpa}) \right], & f'_c > 28 \text{ Mpa} \end{cases} = 0.8500$$

$$\text{From ACI318-2011 Appendix B, } \rho_{bal} = \frac{0.85 \times \beta_1 \times f'_c}{f_y} \times \left( \frac{600}{600 + f_y} \right) = 0.03092$$

$$\text{From ACI318-2011 Appendix B 10.3.3, } \rho_{max} = 0.75 \times \rho_{bal} = 0.02319$$

$$\text{From ACI Cl. 7.6.1.1, } \rho_{min} = \begin{cases} 0.0020 & f_y < 420 \text{ Mpa} \\ \max \left[ 0.0014, \frac{0.0018 \times 420}{f_y} \right] & f_y \geq 420 \text{ Mpa} \end{cases} = 0.00200$$

$$\text{Modular Ratio, } m = \frac{f_y}{0.85 \times f'_c} = 17.9272$$

Ultimate Moment ( $M_z$ ) : 2008.39 kNm

Point of occurrence of the ultimate moment along the length of footing : 5.25 m

Nominal Moment Capacity : 2231.54 kNm

Required  $\rho$  (based on effective depth) : 0.0023

$\rho \times d$  / Depth (based on gross depth) : 0.0020

Area of main steel required,  $A_s = \rho \times W \times d$  : 8025.74 mm<sup>2</sup>

Note - "Area of Steel required" reported here is the larger value between the calculated area of steel and minimum steel required as per code stipulations

#### Top Reinforcement

Critical load case : 4

Required Effective Depth : 0.89 m

$$\beta_1, \text{ from ACI Cl. 22.2.2.4.3} = \begin{cases} 0.85, & f'_c \leq 28 \text{ Mpa} \\ \max \left[ 0.65, 0.85 - \frac{0.05}{7} (f'_c - 28 \text{ Mpa}) \right], & f'_c > 28 \text{ Mpa} \end{cases} = 0.8500$$

$$\text{From ACI318-2011 Appendix B, } \rho_{bal} = \frac{0.85 \times \beta_1 \times f'_c}{f_y} \times \left( \frac{600}{600 + f_y} \right) = 0.03092$$

$$\text{From ACI318-2011 Appendix B 10.3.3, } \rho_{max} = 0.75 \times \rho_{bal} = 0.02319$$

$$\text{From ACI Cl. 7.6.1.1, } \rho_{min} = \begin{cases} 0.0020 & f_y < 420 \text{ Mpa} \\ \max \left[ 0.0014, \frac{0.0018 \times 420}{f_y} \right] & f_y \geq 420 \text{ Mpa} \end{cases} = 0.00200$$

$$\text{Modular Ratio, } m = \frac{f_y}{0.85 \times f'_c} = 17.9272$$

|  |                         |
|--|-------------------------|
| Ultimate Moment (M <sub>z</sub> ) :                                      | 0.00 kNm                |
| Point of occurrence of the ultimate moment along the length of footing : | 11.00 m                 |
| Nominal Moment Capacity :  | 0.00 kNm                |
| Required $\rho$ (based on effective depth):                              | 0.0023                  |
| $\rho \times d$ / Depth (based on gross depth) :                         | 0.0020                  |
| Area of main steel required, $A_s = \rho \times W \times d$ :            | 8000.00 mm <sup>2</sup> |

Note - "Area of Steel required" reported here is the larger value between the calculated area of steel and minimum steel required as per code stipulation.

#### Distribution Reinforcement

|  |                          |
|--|--------------------------|
| Critical load case :   | 5                        |
| Critical Moment for distribution steel (M <sub>x</sub> ) :   | 2287.0144 kNm            |
| Nominal moment Capacity :  | 2541.1271 kNm            |
| Point of occurrence of the critical moment along length:   | 2.2500 m                 |
| Required $\rho$ (based on effective depth):  | 0.0023                   |
| $\rho \times d$ / Depth (based on gross depth) :   | 0.0020                   |
| Area of distribution steel required, $A_s = \rho \times W \times d$ :  | 22000.00 mm <sup>2</sup> |
| Note - "Area of Steel required" reported here is the larger value between the calculated area of steel and minimum steel required as per code stipulations |                          |

#### Top surface distribution reinforcement

|  |                          |
|--|--------------------------|
| Moment at column face :  | 859.2245 kNm             |
| Provided Area for distribution steel along Z(Top reinforcement): | 22000.00 mm <sup>2</sup> |

#### Provided Reinforcement

|                                     |           |
|-------------------------------------|-----------|
| Main bar no. for top Reinforcement: | #25       |
| Spacing of top reinforcement bar :  | 256.67 mm |

**Based on spacing reinforcement increment; provided reinforcement is**

**#25 @ 255mm o.c.**

|  |           |
|--|-----------|
| Main bar no. for bottom Reinforcement: | #25       |
| Spacing of bottom reinforcement bar :  | 256.67 mm |

**Based on spacing reinforcement increment; provided reinforcement is**

**#25 @ 255mm o.c.**

|  |           |
|--|-----------|
| Distribution bar no. (Bottom):         | #25       |
| Spacing of distribution bars (Bottom): | 252.33 mm |

**Based on spacing reinforcement increment; provided reinforcement is**

**#25 @ 250mm o.c.**

|                                     |           |
|-------------------------------------|-----------|
| Distribution bar no.(Top):          | #25       |
| Spacing of distribution bars(Top) : | 251.73 mm |

**Based on spacing reinforcement increment; provided reinforcement is**

**#25 @ 250mm o.c.**

#### Material Take Off

#### Footing Reinforcement

| Direction         | Size  | Number | Total Length (m) | Weight (kg) |
|-------------------|-------|--------|------------------|-------------|
| Along X on Bottom | 25 mm | 16     | 173.60           | 689.78      |
| Along Z on Bottom | 25 mm | 44     | 169.40           | 673.09      |
| Along X on Top    | 25 mm | 16     | 173.60           | 689.78      |
| Along Z on Top    | 25 mm | 44     | 169.40           | 673.09      |

Total Reinforcement Weight : 2725.75 kg

#### Concrete

|         | Length (m) | Width (m) | Thickness (m) | Volume (m <sup>3</sup> ) |
|---------|------------|-----------|---------------|--------------------------|
| Footing | 11.00      | 4.00      | 1.00          | 44.00                    |

Total Concrete Volume : 44.00 m<sup>3</sup>

#### Formwork

Footing : 30.00 m<sup>2</sup>

Total : 30.00 m<sup>2</sup>

#### Soil Excavation

Pit Depth : 2.50 m

Pit Slope (a : b) : 1 : 1 (Assumed)

Side Distance, s : 0 (Assumed)

Excavation Volume : 223.00 m<sup>3</sup>

Backfill Volume : 179.00 m<sup>3</sup>