Fayoum University
Faculty of Engineering
Department of Civil Engineering

CE 402: Part A
Shallow Foundation Design
Lecture No. (2): Wall Footing

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Wall Footing
Design of Wall Footing

- Plain concrete footing (P.C.)

\[ \text{Area} = B \times 1.00 = \frac{P_{F.L}}{q_a} \rightarrow \text{Get: } B \]

Assume thickness of P.C., \( t = (0.25 \text{ to } 0.50) \)

\[ \text{Dim. of P.C.} = B \times t \]
Design of Wall Footing

- Reinforced concrete footing (R.C.)

\[ X = (0.80 \rightarrow 1.00) \times t \]
\[ B_1 = B - 2X \]

\[ p_n = \frac{P_{G.s}}{B_1} \]
\[ M_l = p_n \left[ \frac{(B_1 - b_b)/2}{2} \right]^2 \]
\[ d = C \sqrt{\frac{M}{b \times F_{cu}}} \]
\[ t = d + \text{cover} \]

Steel cover = 5.0 to 7.0 cm

\[ \text{Dim. of R.C.} = B_l \times t_l \]
Design of Wall Footing

• **Shear Stress:**

\[ Q_s = p_n \times \left( \frac{B_1 - b_b}{2} - d \right) \]

\[ q_s = \frac{Q_s}{b \times d} \leq q_{su} \]

\[ q_{su} = 0.75 \sqrt{\frac{f_{cu}}{\gamma_c}} \]

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**If** \( q_s > q_{su} \), **Increase** \( d \)

**Notes:**

• No shear RFT in Footing.

• For no footing beam, critical locates at distance \( d \) from wall face.

\( Q_s \): shear force at critical sec. (II).

\( q_s \): shear stress.

\( q_{su} \): ultimate shear strength.
No Punching stress check
why?
Is there a check for punching of columns in solid slab? why?
Design of Wall Footing

- **Footing Reinforcement:**

  **Which is required?**
  Top or bottom RFT
  **why?**

  \[ A_s = \frac{M_l}{f_y \cdot d \cdot j} \]

  **Notes:**
  - Minimum number of bars per meter is five.
  - Minimum diameter for main RFT is 12mm.
  - Minimum diameter for secondary RFT is 10mm.
  - Number of bars may be taken 5 to 8.
  - Diameter of bars may be selected from 12 to 18mm.
**Example(1):**

A 0.30 m thick masonry wall exerts 20t/m’ at ground surface and is to be supported on a strip footing. The foundation level is 1.50m below ground surface. The soil below the base has a gross allowable bearing capacity of 1.0 kg/cm². It is required to give a complete design and neat sketches for the strip footing.

\[
\begin{align*}
  b_w &= 0.30m. \\
  p_{G.S} &= 20t/m' \\
  q_a &= 1.0kg/cm^2 = 10t/m^2. \\
  f_{cu} &= 250kg/cm^2. \\
  f_y &= 3600kg/cm^2.
\end{align*}
\]
Design of Wall Footing

- Plain concrete footing (P.C.)

\[ \text{Area} = B \times 1.00 = \frac{1.15 \times 20}{10} = 2.30 \text{m} \]

\[ B = 2.30 \text{m} \]

Assume thickness of P.C., \( t = 0.30 \text{m} \)

**Dim. of P.C. = 2.30 \times 0.30**
Design of Wall Footing

- Reinforced concrete footing (R.C.)

\[ X = (0.80 \rightarrow 1.00) \times t = 0.30m \]

\[ B_1 = B - 2X = 2.30 - 2 \times 0.30 = 1.60m \]

\[ p_n = \frac{P_{G.S}}{B_1} = \frac{20 \times 1.50}{1.60} = 18.75t/m^2 \]

\[ M_I = p_n \left( \frac{(B_1 - b_b)/2}{2} \right)^2 \]

\[ M_I = 18.75 \times \frac{(1.60 - 0.30)/2}{2} = 3.96 mt/m' \]

\[ d = C \sqrt{\frac{M}{b * F_{cu}}} = 5.0 \sqrt{\frac{3.96 \times 10^5}{100 \times 250}} = 20cm \]

\[ t = d + \text{cover} = 20 + 5.0 = 25cm \]

\[ \text{Dim. of R.C.} = 1.60 \times 0.30m \]
Design of Wall Footing

- **Shear Stress:**

  \[ Q_s = p_n \left( \frac{B_1-b_w}{2} - d \right) \]

  \[ Q_s = 18.75 \left( \frac{1.60 - 0.30}{2} - 0.25 \right) = 7.50 \text{t/m}^3 \]

  \[ q_s = \frac{Q_s}{b \times d} = \frac{7.50 \times 1000}{25 \times 100} = 3 \text{kg/cm}^2 \]

  \[ q_{su} = 0.75 \sqrt{\frac{f_{cu}}{\gamma_c}} = 0.75 \sqrt{\frac{250}{1.5}} = 9.68 \text{kg/cm}^2 \]

  \[ q_s \leq q_{su} \text{ safe shear.} \]

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\( Q_s \): shear force at critical sec. (II).

\( q_s \): shear stress.

\( q_{su} \): ultimate shear strength.
Design of Wall Footing

• Footing Reinforcement:

\[ A_s = \frac{M_I}{f_y \cdot d \cdot j} = \frac{3.96 \times 10^5}{3600 \times 25 \times 0.695} = 6.33 \text{cm}^2 \]

- \( A_s \) (main) = 6φ12mm/m’
- \( A_s \) (sec.) = 5φ10mm/m’