16.5) Wall Footings
A wall footing is a continuous slab strip (of width $B$) along the length of a wall (of thickness $t$.) Wall footings are normally used around building perimeters, and the walls they support may be made of either reinforced concrete or masonry.
Under the action of wall load, a uniform soil pressure develops, which tends to bend the footing in single curvature in the short direction, B, perpendicular to the wall direction. The segment of the wall footing extending beyond the wall acts like a cantilever beam and bends upward. Main steel required is placed at the bottom of the footing along the short direction (i.e. perpendicular to the wall direction).

Design is identical to that of a one-way slab where a strip of the footing, 1 m wide, is chosen:

Load per strip (kN) = Wall Load x 1 m (kN/m)
Given the following information:

- Wall thickness, \( t \) (mm.)
- Service wall dead and live loads, DL & LL (kN/m.)
- Allowable soil bearing pressure, \( q_a \) (kN/m².)
- Depth of footing below finished ground line, \( h \) (m.) \( h \) must be below the zone of soil that is subject to freezing.
- Unit weight of soil, \( w_s \) (kN/m³.)
- Unit weight of concrete, \( w_o \) (kN/m³.)
- Surcharge paving (kN/m².)

It is required to determine:

- Width of the footing, \( B \).
- Thickness of the footing, \( h_c \).
- Main steel and temperature & shrinkage steel.
• If bending moments were computed from forces acting on wall footings, the maximum moment is found to occur at the middle of the width.

• For concrete walls, the maximum moment is taken at the face of wall as:

\[ M_u = \frac{1}{8} q_u (b - a)^2 \]  
(16.5)

• The required area of steel can be interpolated from Graph A.1b with \( \frac{M_u}{\phi bd^2} \).

• Vertical shear force is computed at a distance \( d \) from the face of the wall from:

\[ V_u = q_u \left( \frac{b-a}{2} - d \right) \]  
(16.6)

• The shear governs the depth of the footing. The design shear strength by unit length is:

\[ \phi V_c = \phi \left( 0.17\lambda \sqrt{f'_c bd} \right) \]  
(4.12)

\[ \Rightarrow \phi V_c = V_u \Rightarrow d = \frac{V_u}{\phi \left( 0.17\lambda \sqrt{f'_c bd} \right)} \]

• The ACI Code 7.7.1 calls for a 75 mm clear cover on bars.
- The calculation of development length is based on the maximum moment with Table A.10

- Temperature and shrinkage steel is given by ACI Code 7.12 with minimum $\rho = 0.0018$. 
Example 1

A 400 mm concrete wall supports a dead load $w_D = 200 \text{ kN/m}$ and a live load $w_L = 150 \text{ kN/m}$. The allowable bearing pressure is $215 \text{ kN/m}^2$ at the level of the bottom of the footing, which is $1.3 \text{ m}$ below grade. Design a footing for the wall using $f'_c = 28 \text{ MPa}$ concrete and Grade 420 steel.