

# Foundation details

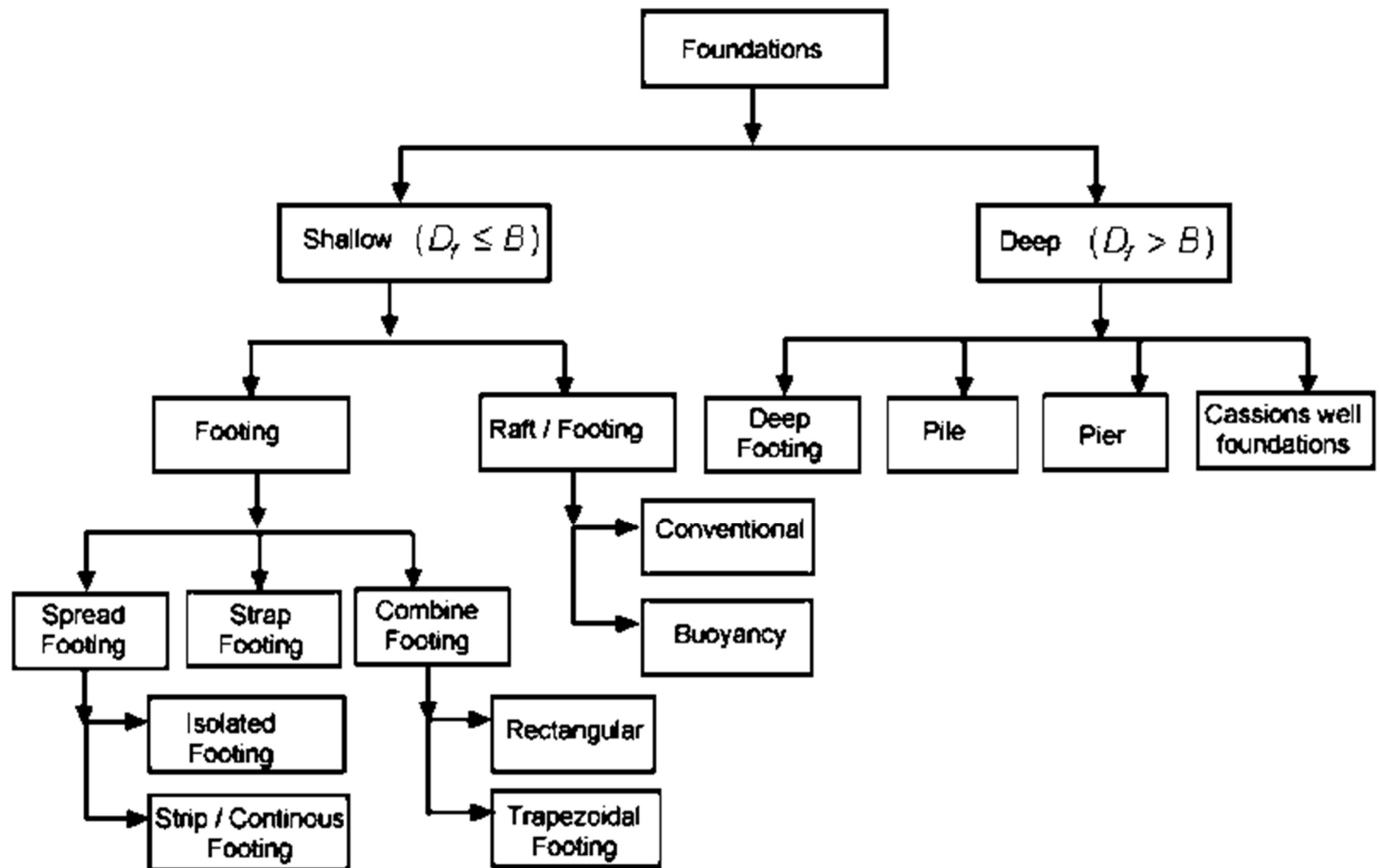
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**Chapter 3  
Section**

**3.2**

# Foundation Types

A foundation is an integral part of the structure which transfers the load of the superstructure to the soil. The different types of foundations are shown below

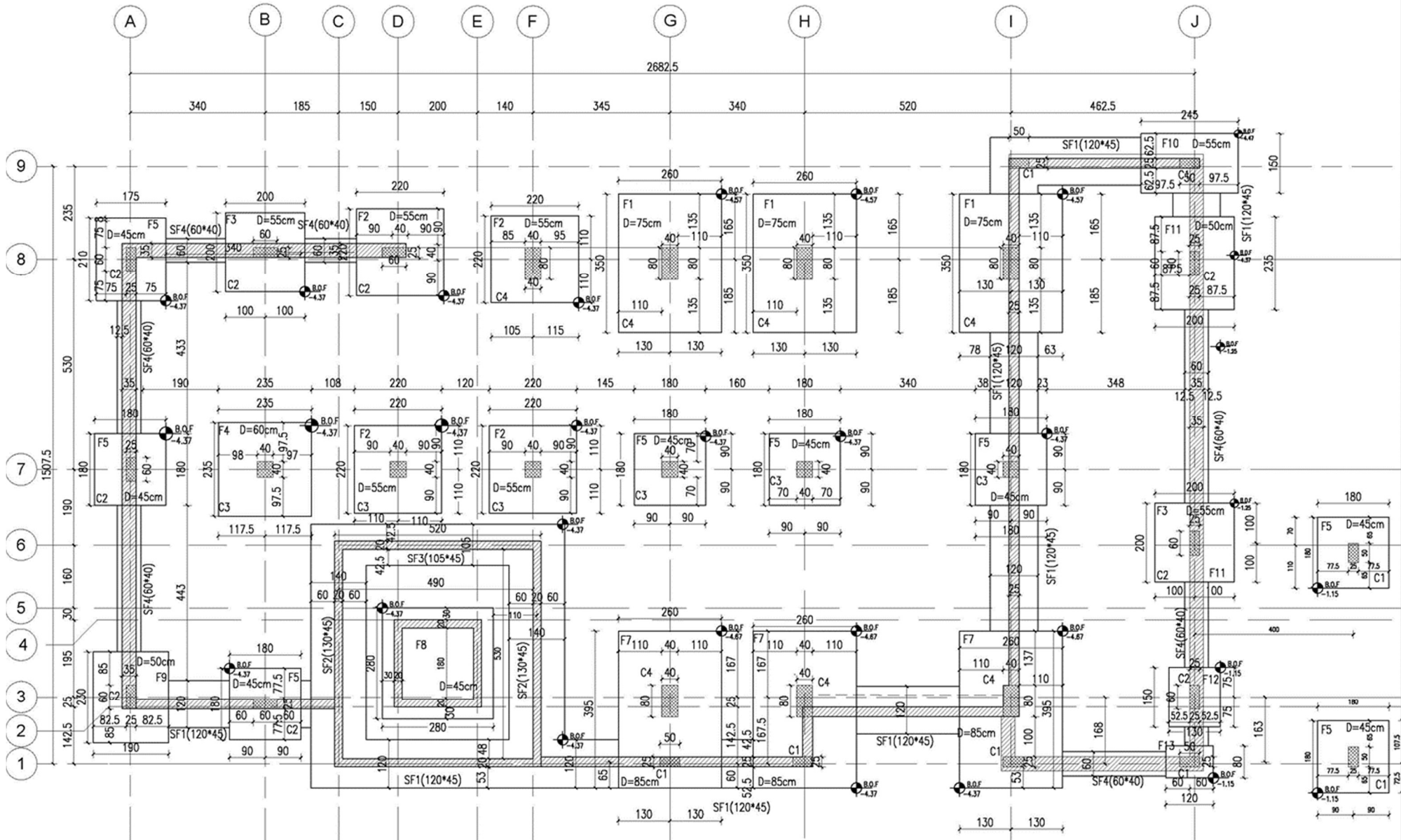


# Foundation plan

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- The foundation plan is a plan showing the location and size of footings, piers, columns, foundation walls, and supporting beams. A foundation plan ordinarily includes the following:
  - Footings for walls, piers, and columns
  - Piers and Columns
  - Details of foundation and footing construction
  - Complete dimensions, sections and notes.
- The foundation plan is drawn from information presented on the floor plan, site plan, and elevation plan drawings. The scale for the drawing is usually 1:100.

# Sample Foundation Plan



# Shallow Foundations

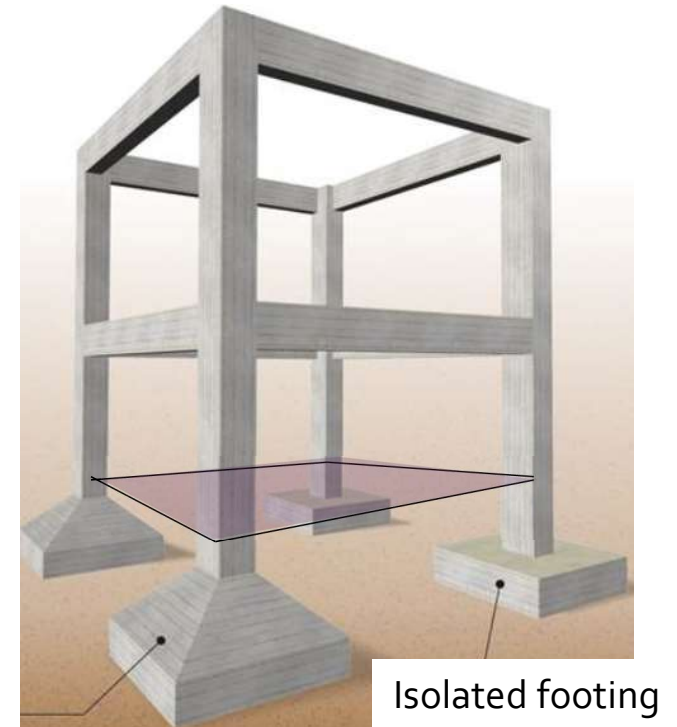
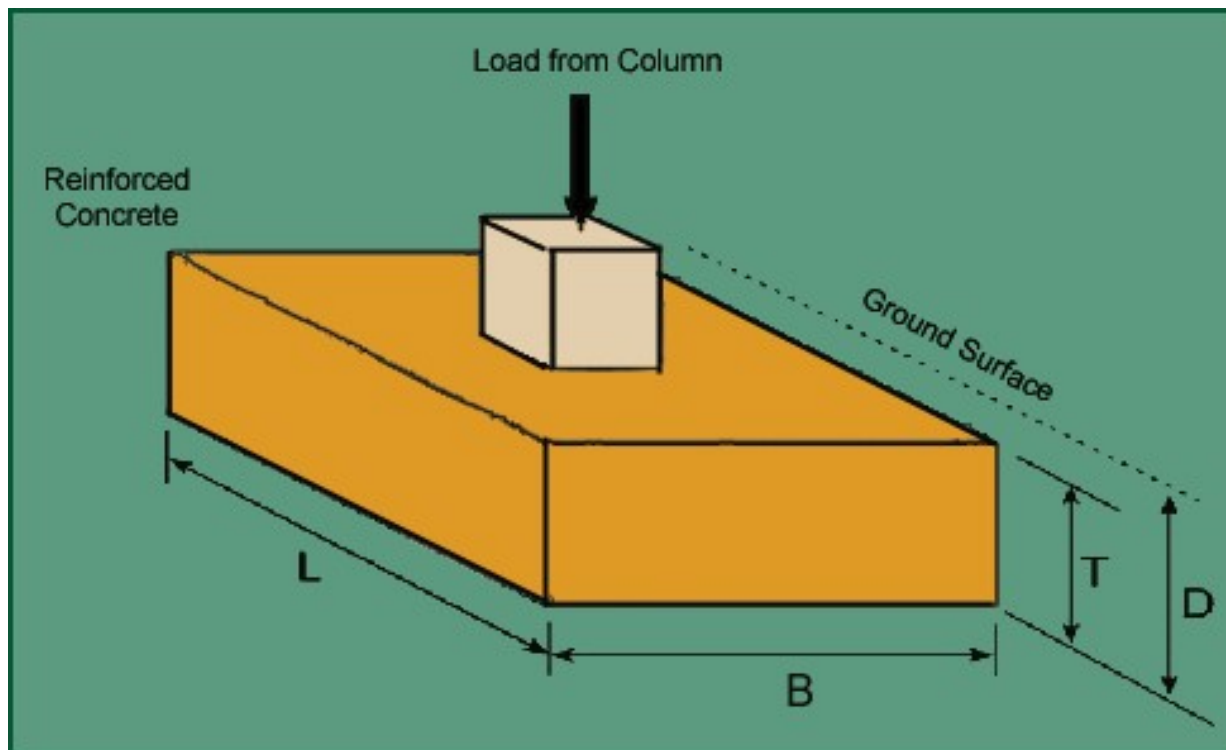
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## Design Considerations:

- Must not settle excessively.
- Must be placed at depth sufficient to prevent damage from surface environmental effects (frost, swelling and shrinkage, erosion and scour).
- Must not cause failure of supporting soil (Bearing Capacity criteria).

# Isolated footing

- It is circular, square or rectangular slab of uniform thickness usually used to provide support for individual column.
- Sometimes, it is stepped or hunched to spread the load over a larger area.



## Dimensions:

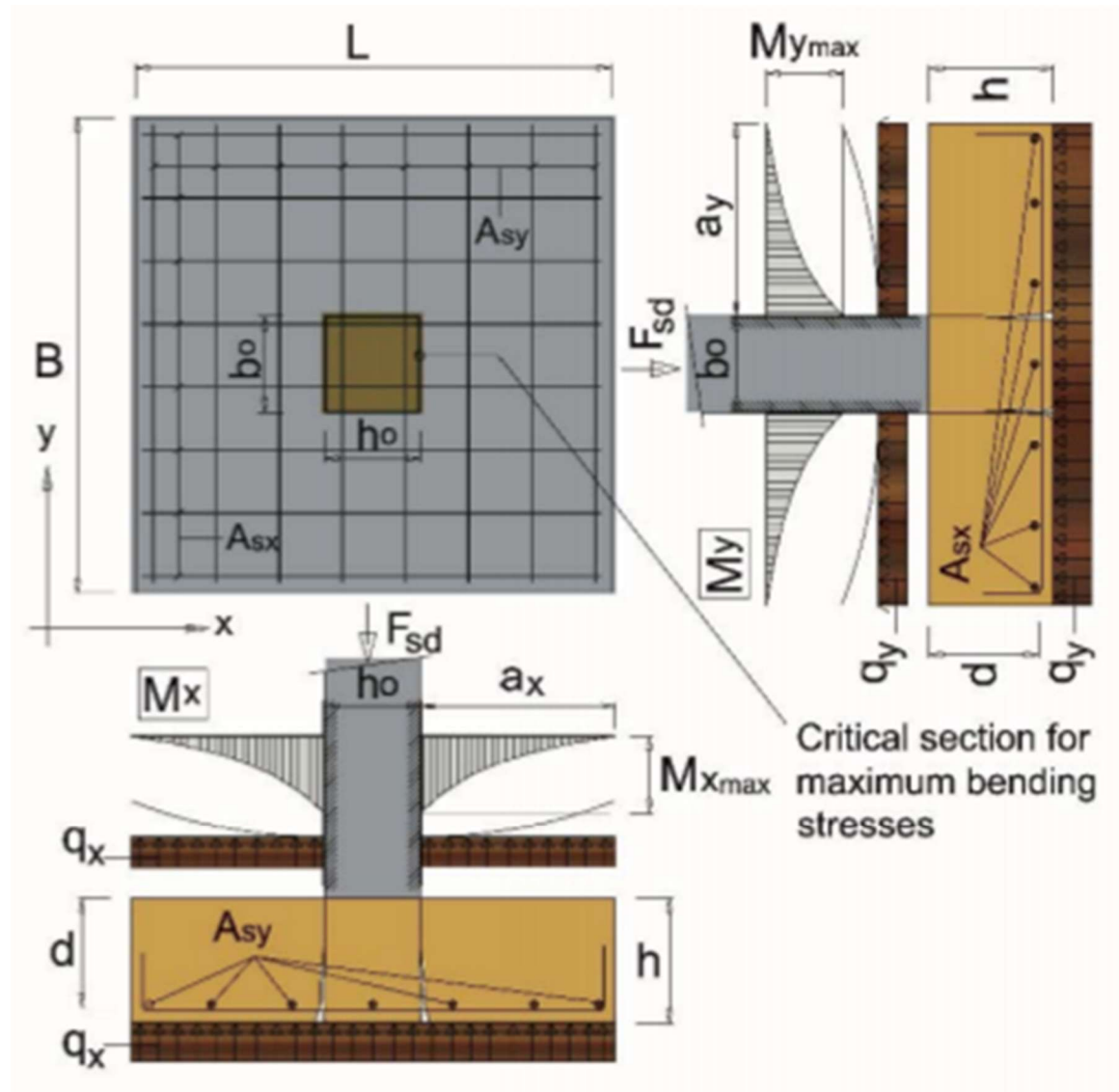
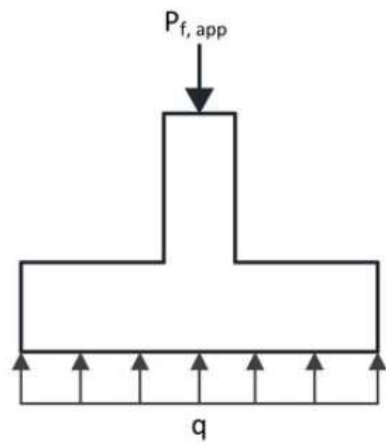
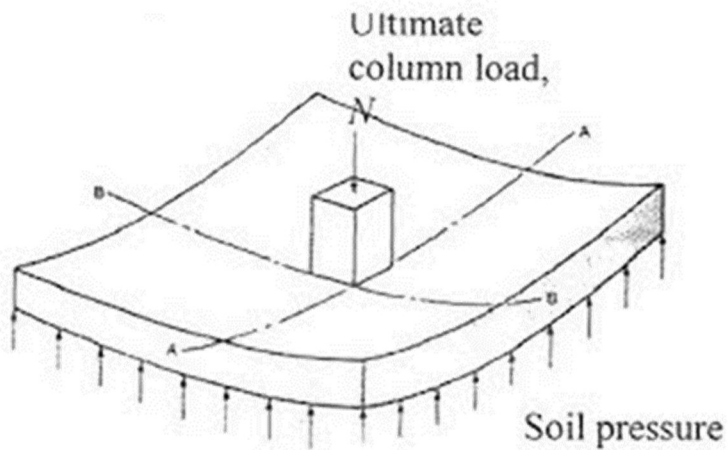
$L, B \rightarrow$  load and soil bearing

$T \rightarrow$  structural, moment and shear

$D \rightarrow$  Geotechnical; site Characteristics

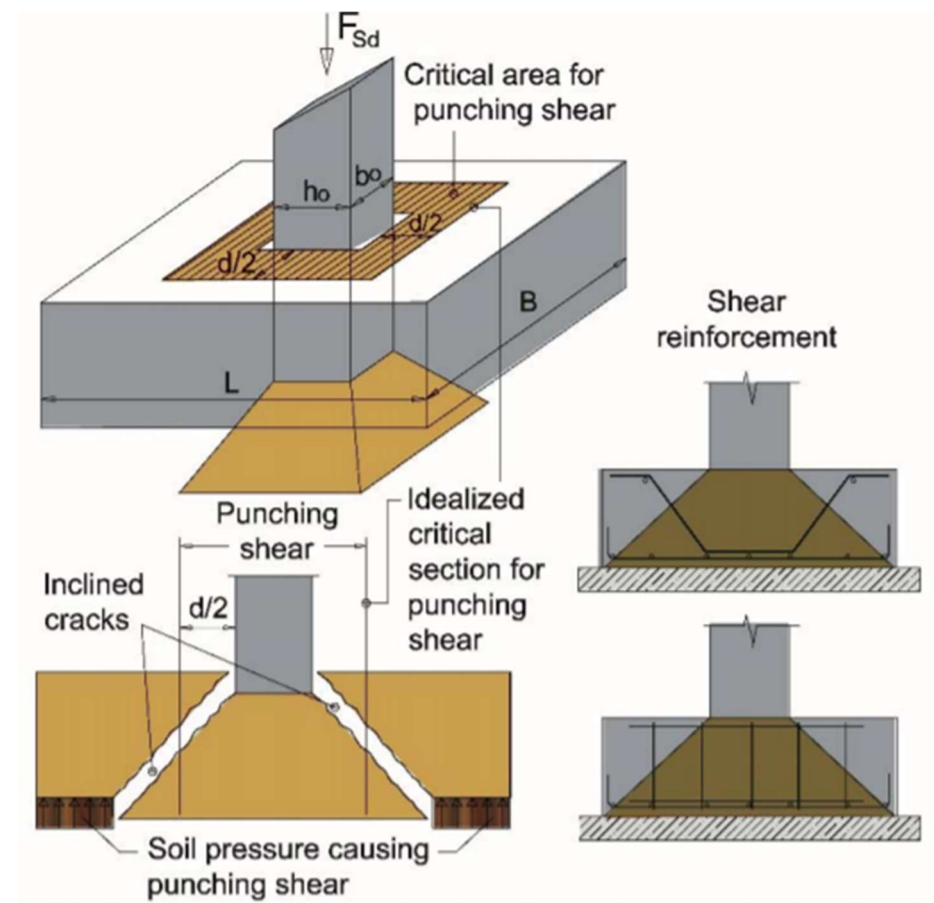
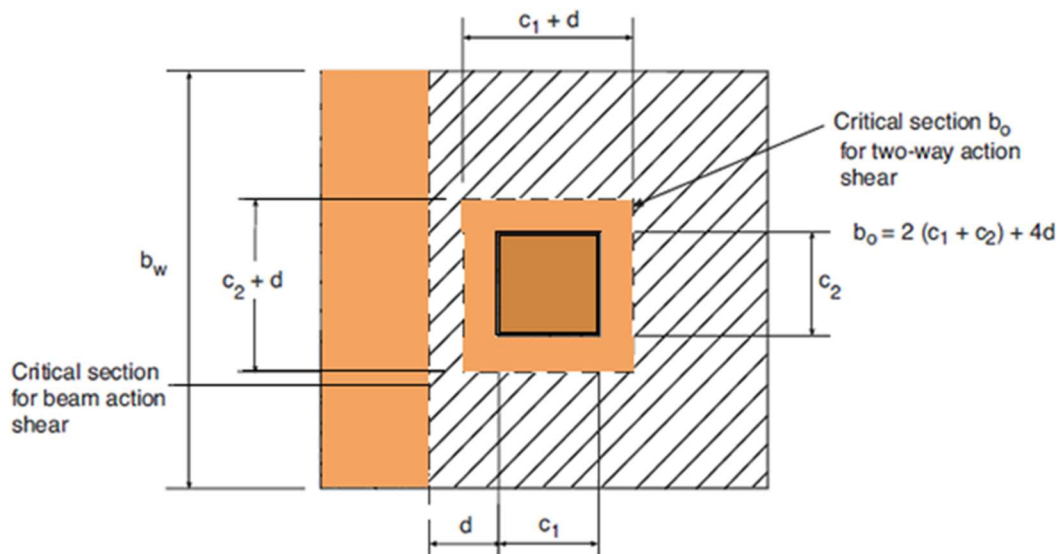
# Isolated footing - Typical reinforcement

## 1. Flexural reinforcement



# Isolated footing - Typical reinforcement

**2. Shear reinforcement** .Usually, is not used in footing as designers prefers more rigid footing to ensure linear soil pressure distribution under the footing.

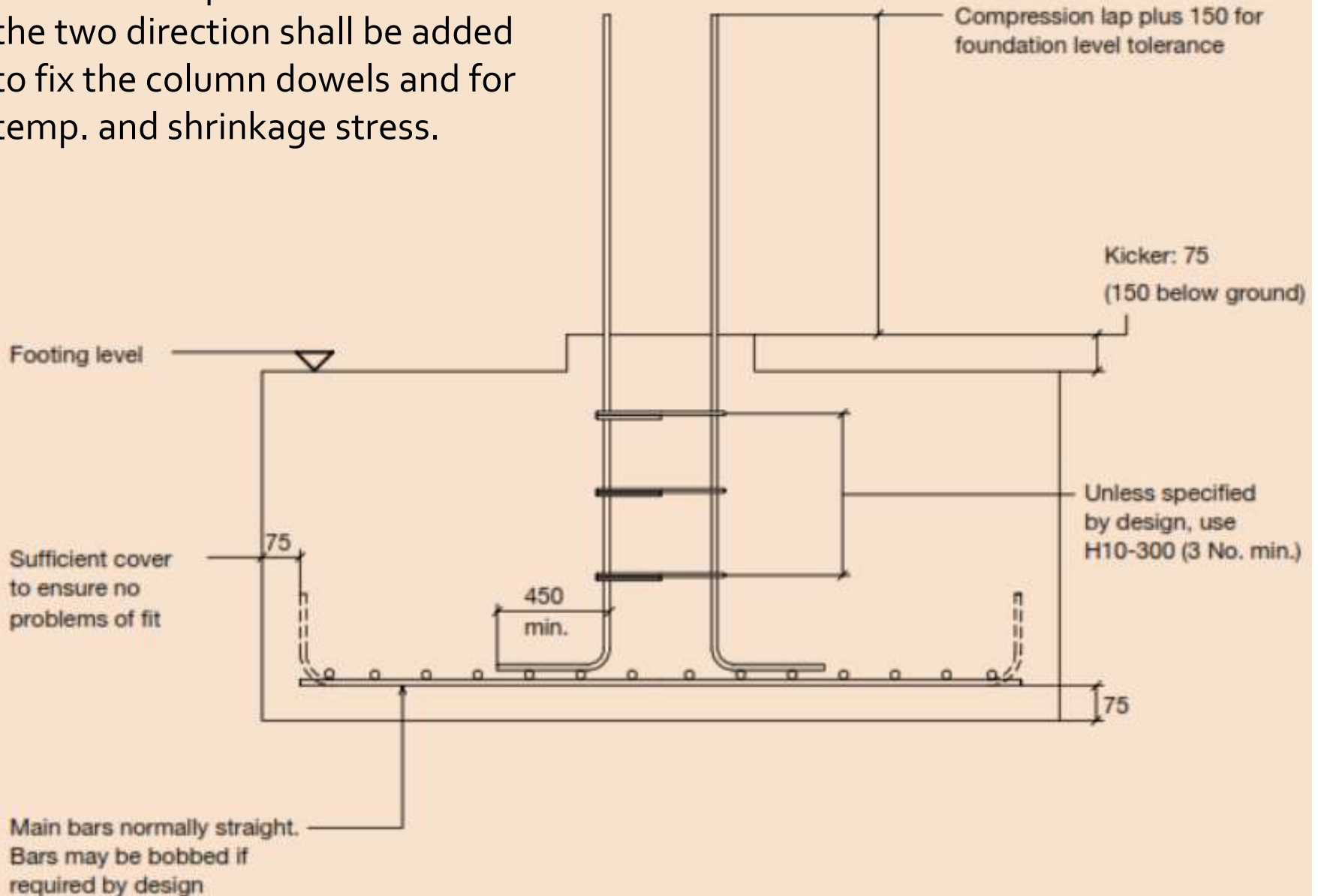


## Beam and Punching shear check



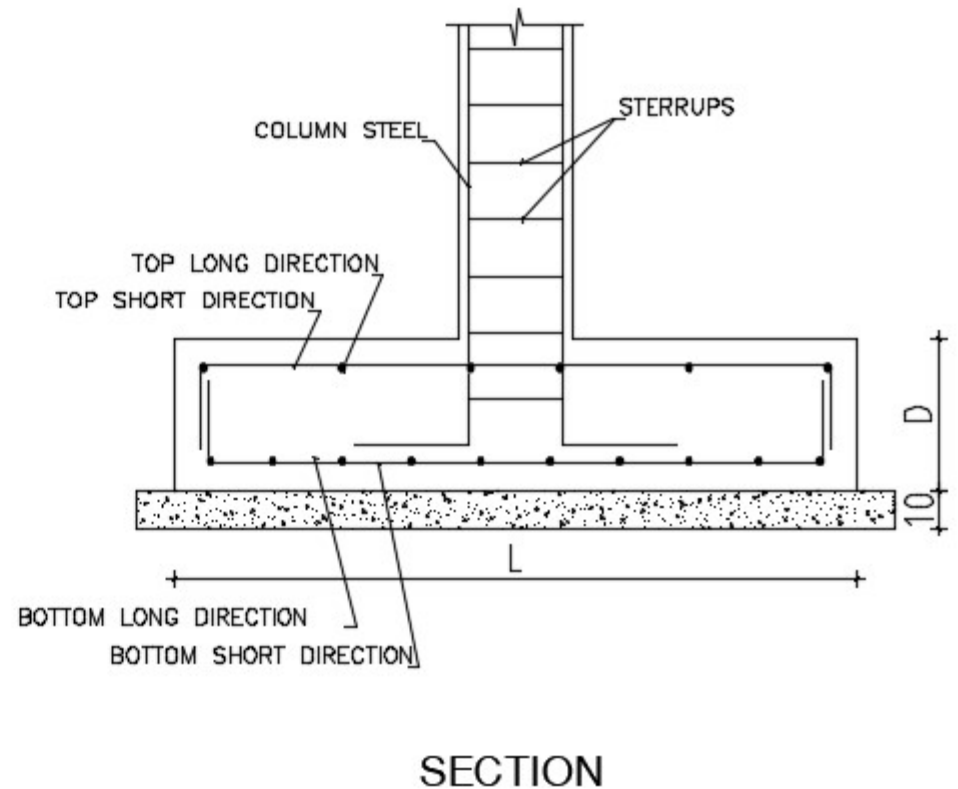
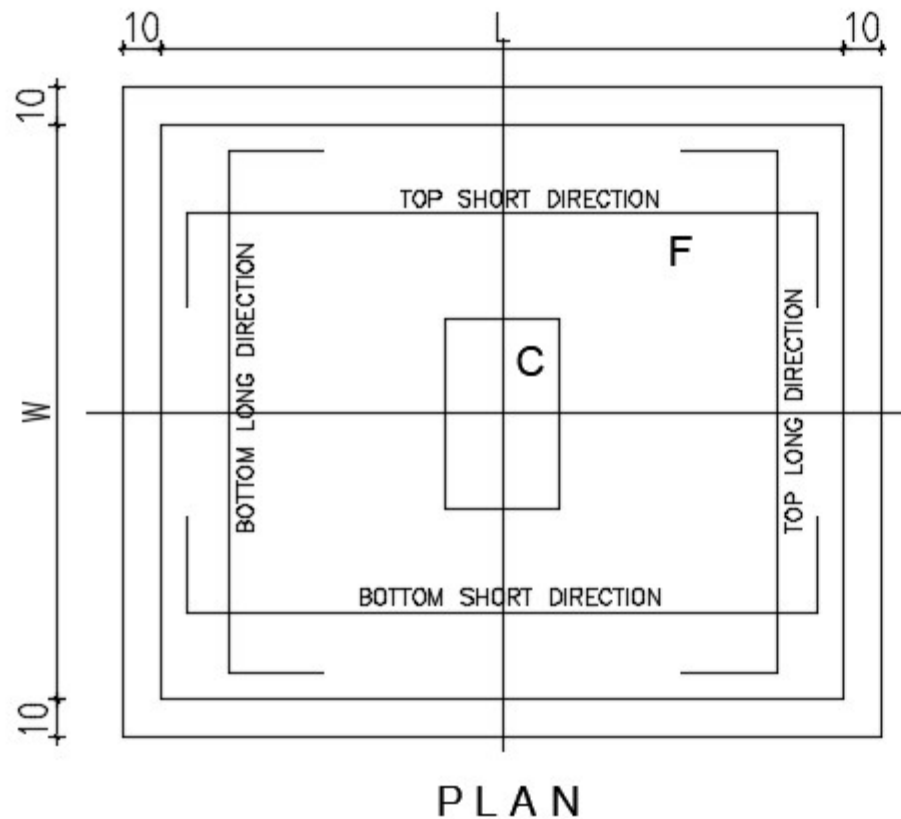
# Typical Isolated footing Details

Additional top reinforcement in the two direction shall be added to fix the column dowels and for temp. and shrinkage stress.



# Isolated footing Presentation

Isolated footing in the structural drawings can be represented by a typical section and a footing schedule.



Sample Footing Section

# Isolated footing Presentation

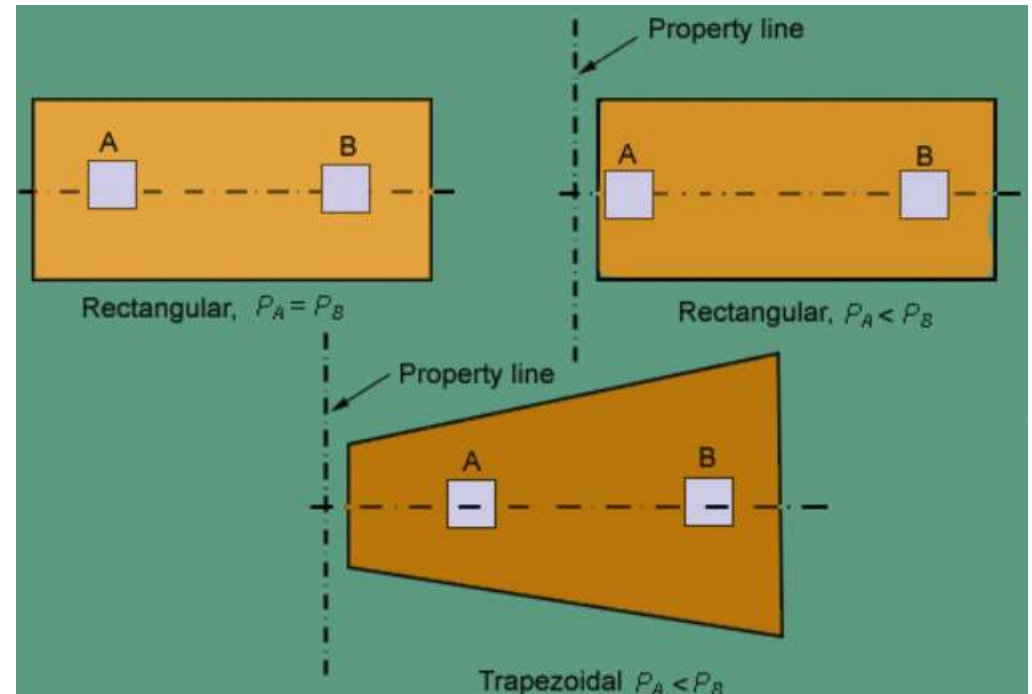
## Sample footing schedule

### SCHEDULE OF FOOTINGS

FOOT No.	DIMENSION	BOTTOM REINFORCEMENT		TOP REINFORCEMENT		NOTES
	L X W X D	LONG DIR.	SHORT DIR.	LONG DIR.	SHORT DIR.	
<b>F1</b>	350 x 260 x 75	27 $\phi$ 16	20 $\phi$ 16	4 $\phi$ 12	4 $\phi$ 12	
<b>F2</b>	220 x 220 x 55	13 $\phi$ 16	13 $\phi$ 16	4 $\phi$ 12	4 $\phi$ 12	
<b>F3</b>	200 x 200 x 55	10 $\phi$ 16	10 $\phi$ 16	4 $\phi$ 12	4 $\phi$ 12	
<b>F4</b>	235x 235 x 60	16 $\phi$ 16	16 $\phi$ 16	4 $\phi$ 12	4 $\phi$ 12	
<b>F5</b>	210x175x 45	10 $\phi$ 16	9 $\phi$ 16	4 $\phi$ 12	4 $\phi$ 12	
<b>F6</b>	210 x155 x40	10 $\phi$ 16	9 $\phi$ 16	4 $\phi$ 12	4 $\phi$ 12	
<b>F7</b>	395 x 260 x 85	36 $\phi$ 16	24 $\phi$ 16	4 $\phi$ 12	4 $\phi$ 12	
<b>F8</b>	280 x 280 x 45	14 $\phi$ 14	14 $\phi$ 14	14 $\phi$ 14	14 $\phi$ 14	
<b>F9</b>	230 x 190 x 50	15 $\phi$ 14	13 $\phi$ 14	4 $\phi$ 12	4 $\phi$ 12	
<b>F10</b>	245 x 150 x 55	18 $\phi$ 14	11 $\phi$ 14	4 $\phi$ 12	4 $\phi$ 12	
<b>F11</b>	235 x200x 50	16 $\phi$ 14	14 $\phi$ 14	4 $\phi$ 12	4 $\phi$ 12	
<b>F12</b>	150x130x 40	9 $\phi$ 14	7 $\phi$ 14	4 $\phi$ 12	4 $\phi$ 12	
<b>F13</b>	120 x80x 40	7 $\phi$ 14	5 $\phi$ 14	3 $\phi$ 12	3 $\phi$ 12	

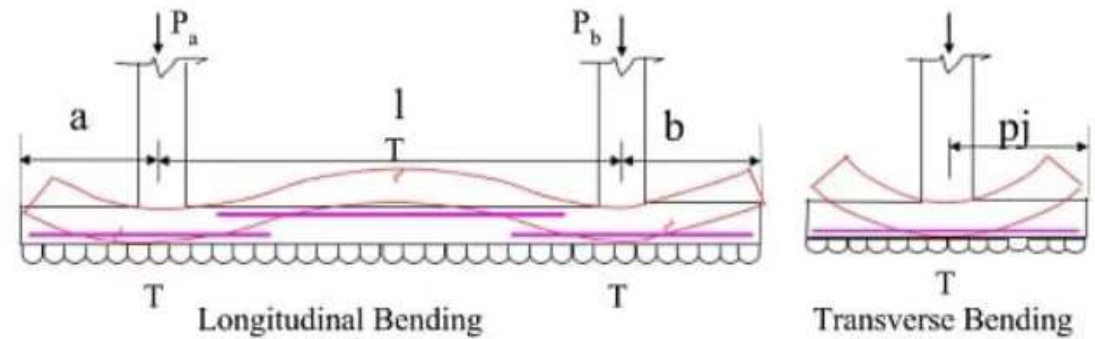
# Compinged Footing

- It is used when
  - two columns are so close to each other.
  - when the property line is so close to one column
- A combine footing may be rectangular or trapezoidal in plan. Trapezoidal footing is provided when the load on one of the columns is larger than the other column.



# Compinged footing behavior and design

## Deflected Shape

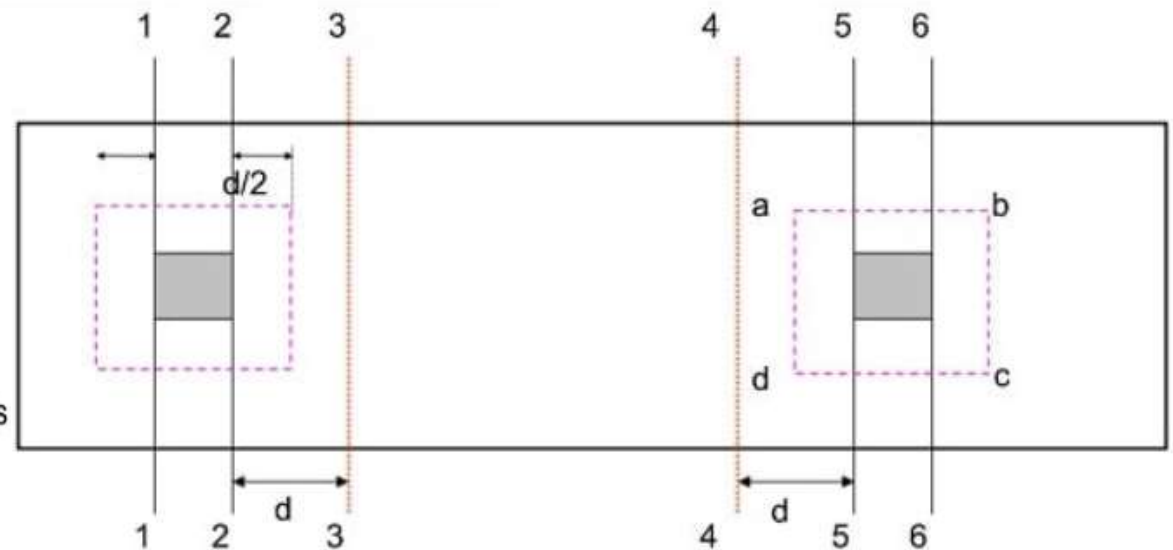


## Design Sections

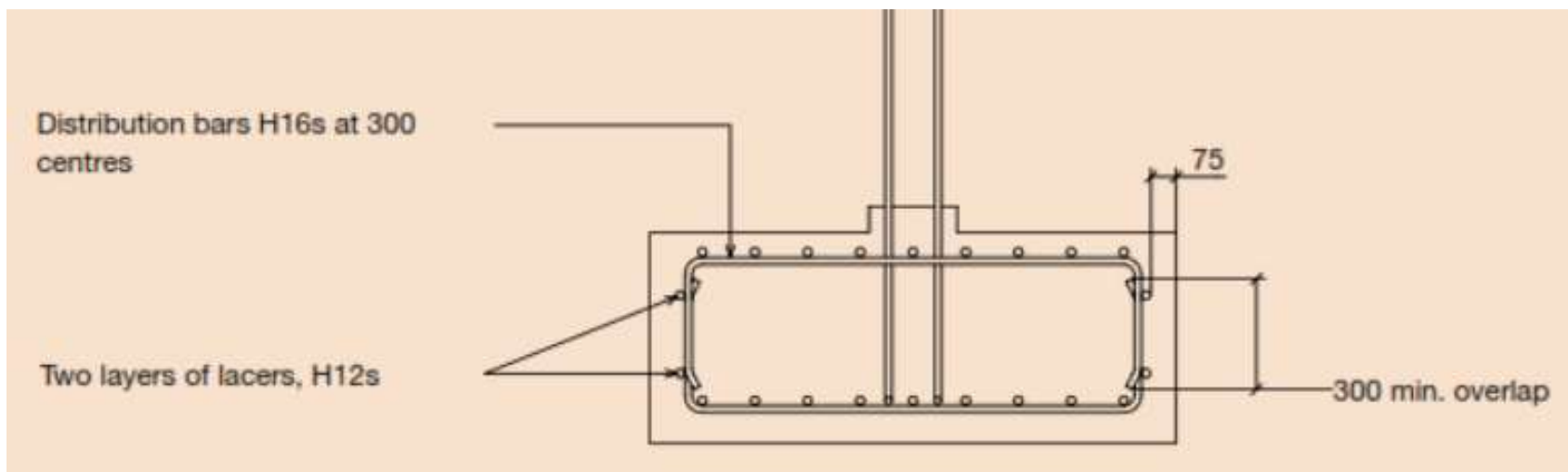
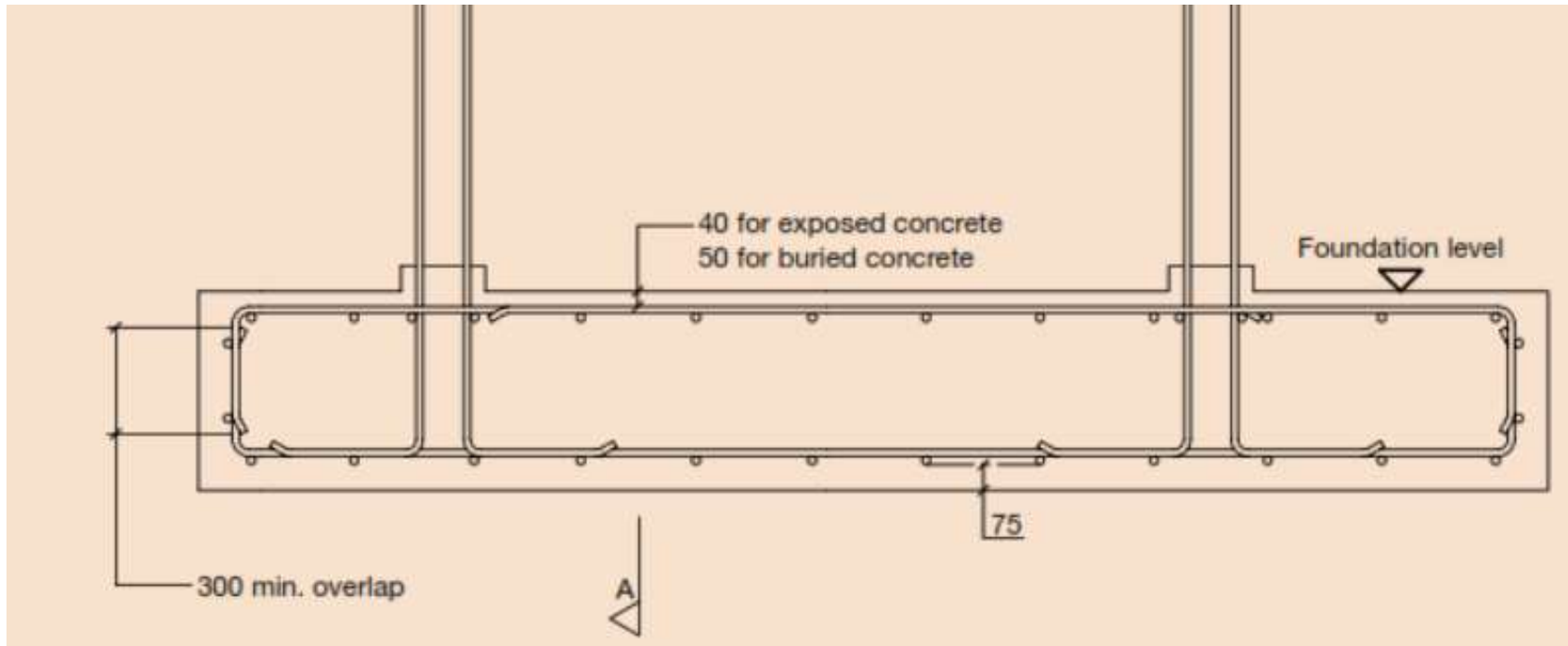
Section 1-1, 2-2, 5-5, and 6-6 are sections for critical moments

Section 3-3, 4-4 are sections for critical shear (one way)

Section for critical two way shear is abcd



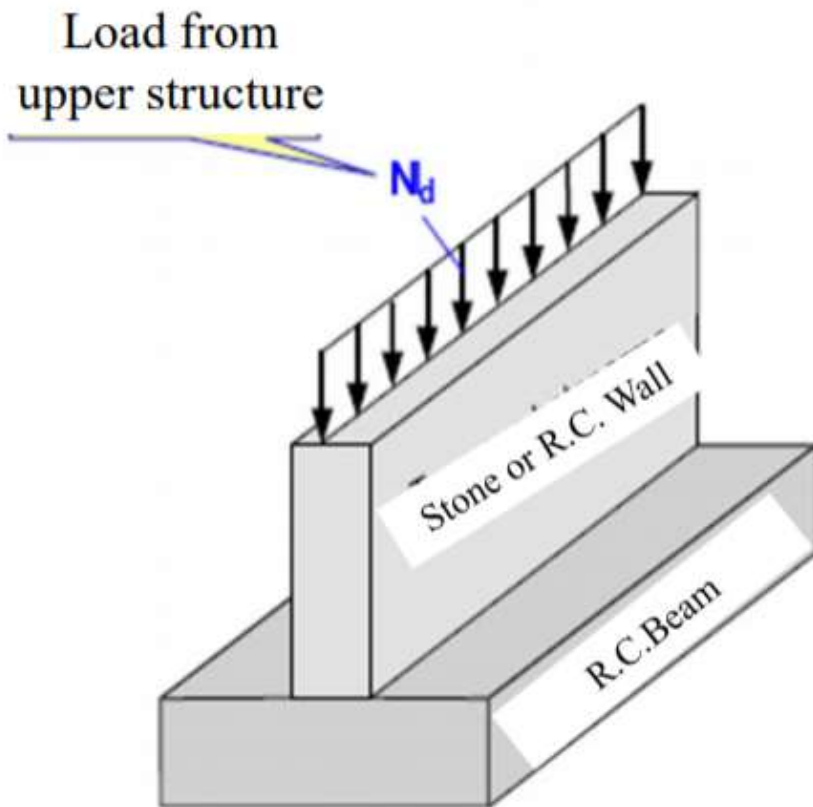
# Typical Compinged Footing Detail



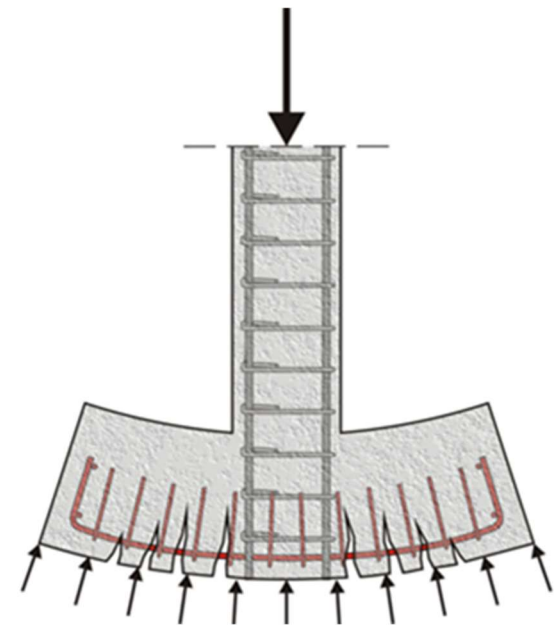
Section A

# Strip (Wall) Footing

- Provided for a load bearing wall or for a row of columns which are so closely spaced that their spread footings overlap or nearly touch each other.
- A strip footing is also known as “continuous footing”.



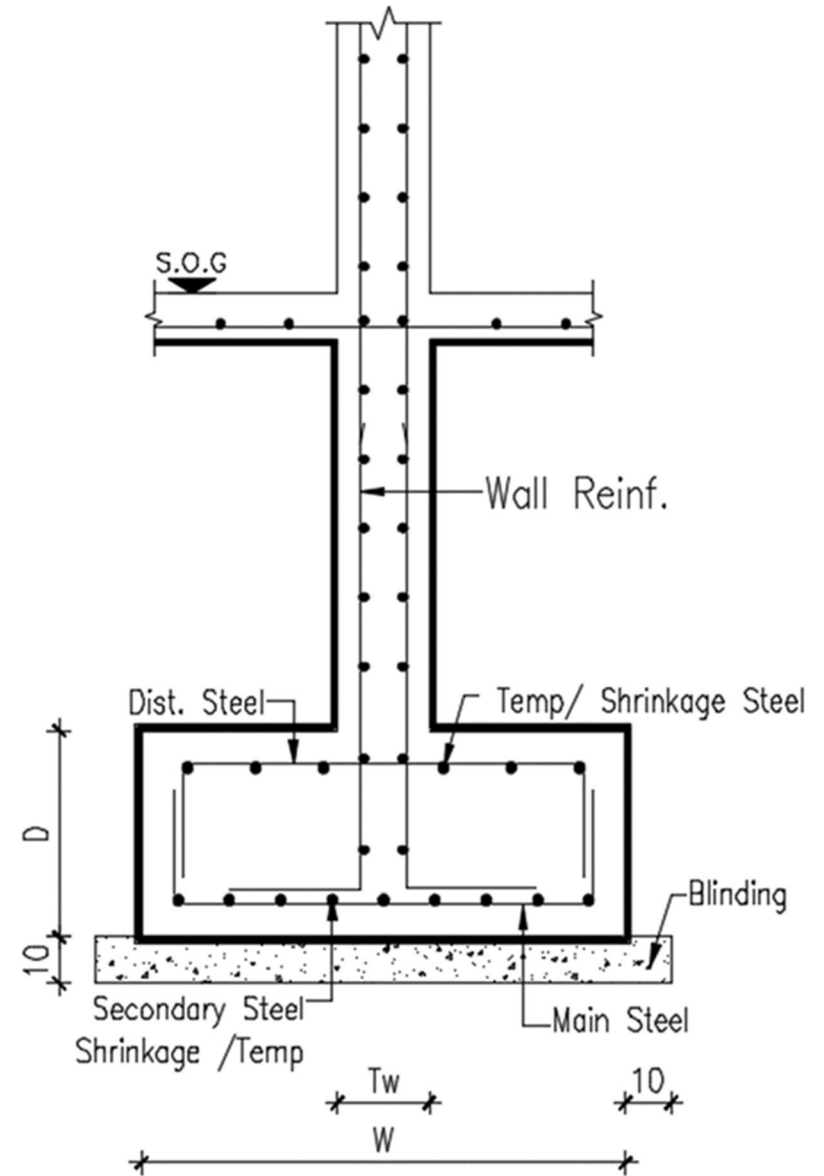
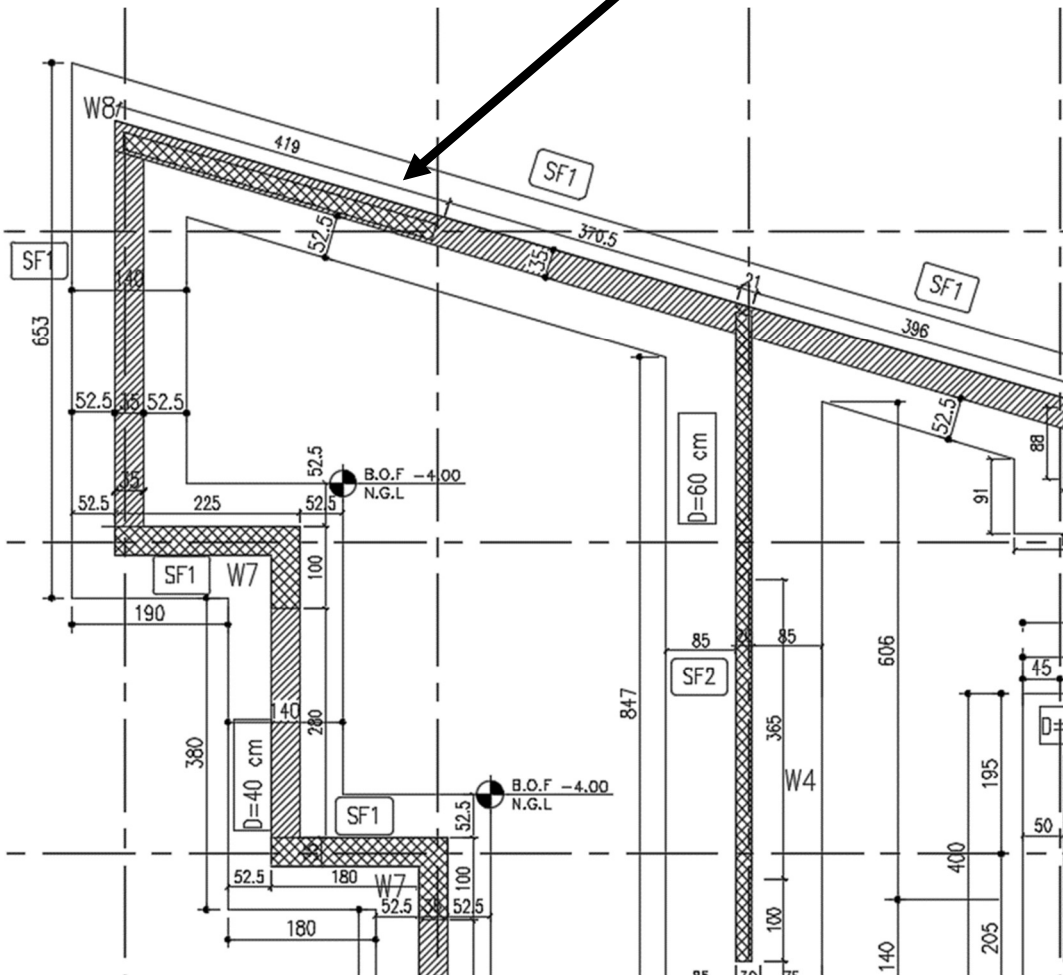
Perspective View



Deflected shape of a strip footing

# Typical Strip (Wall) Footing detail

**Strip Footing in plan**



**Typical Wall Footing**

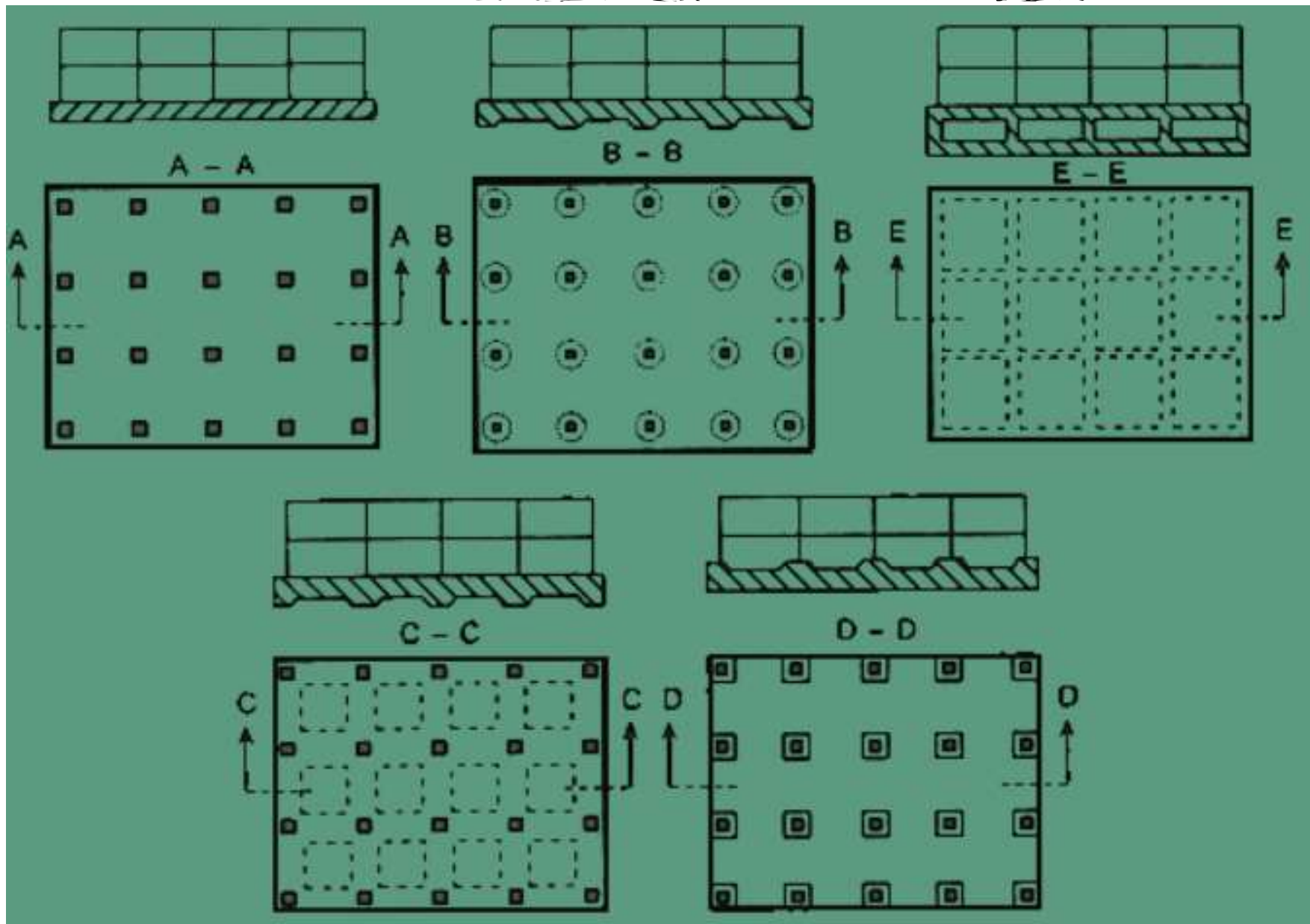


# Mat footings

It is a large slab supporting a number of columns and walls under entire structure or a large part of the structure.



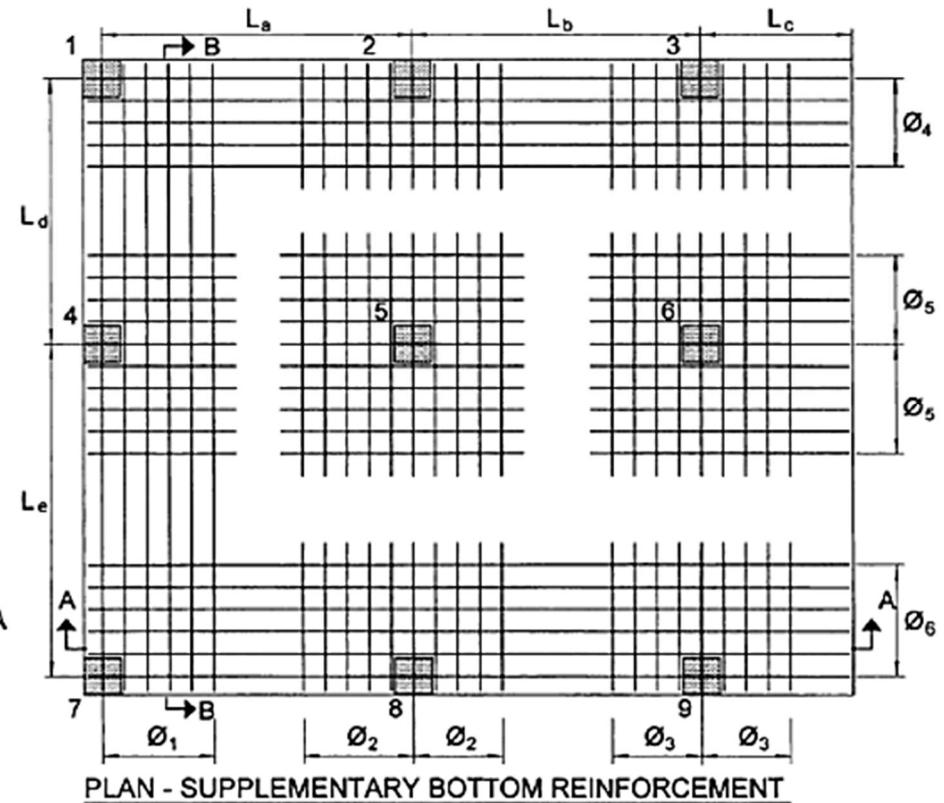
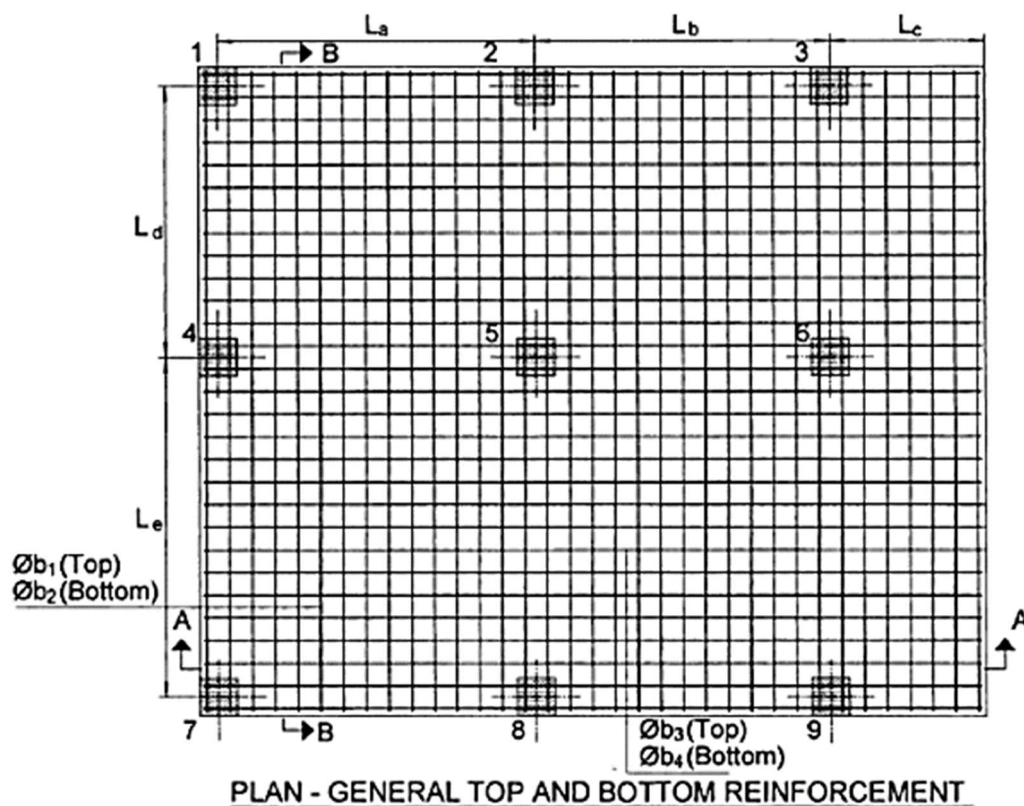
# Foundation Details- Mat Footings Types



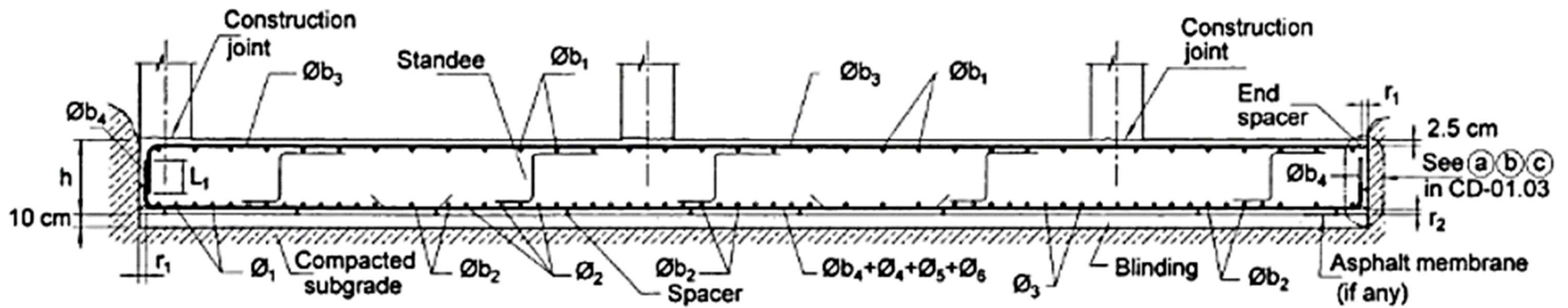
Typical Mat Foundations

# Mat Footings Details

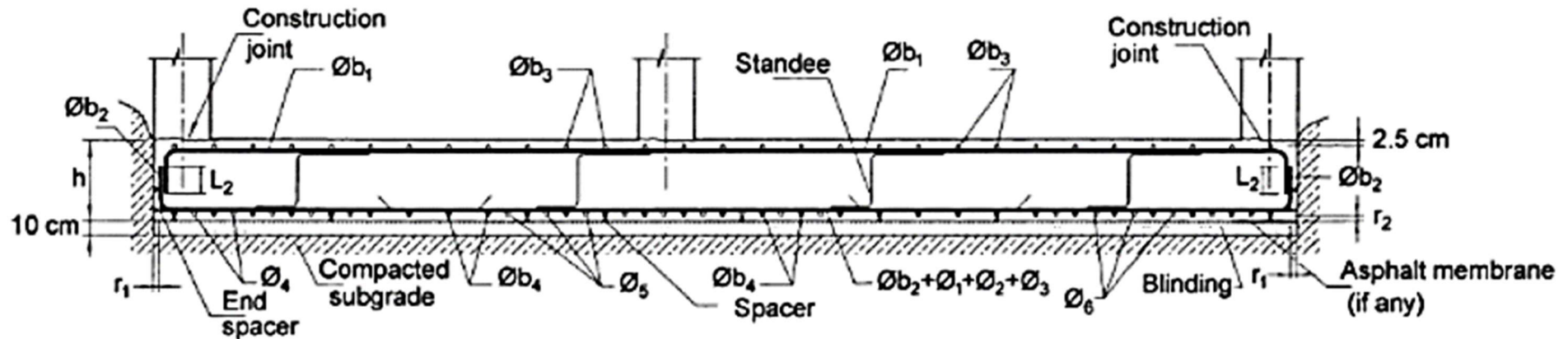
The stress and reinforcement of a mat footing is calculated and detailed as for the flat plate slab. It can be considered as inverted slab.



# Mat Footings Details



CROSS-SECTION A-A

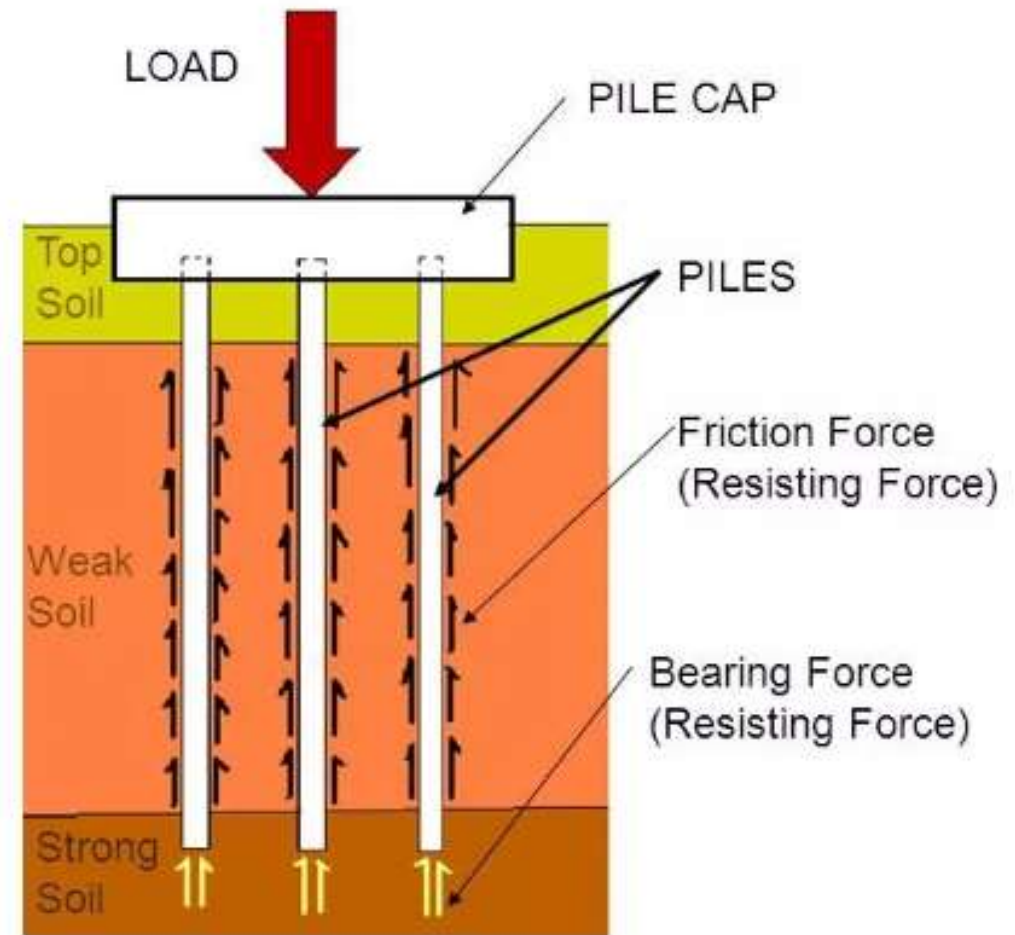


CROSS-SECTION B-B

NOTES:

# Deep foundations - Piles

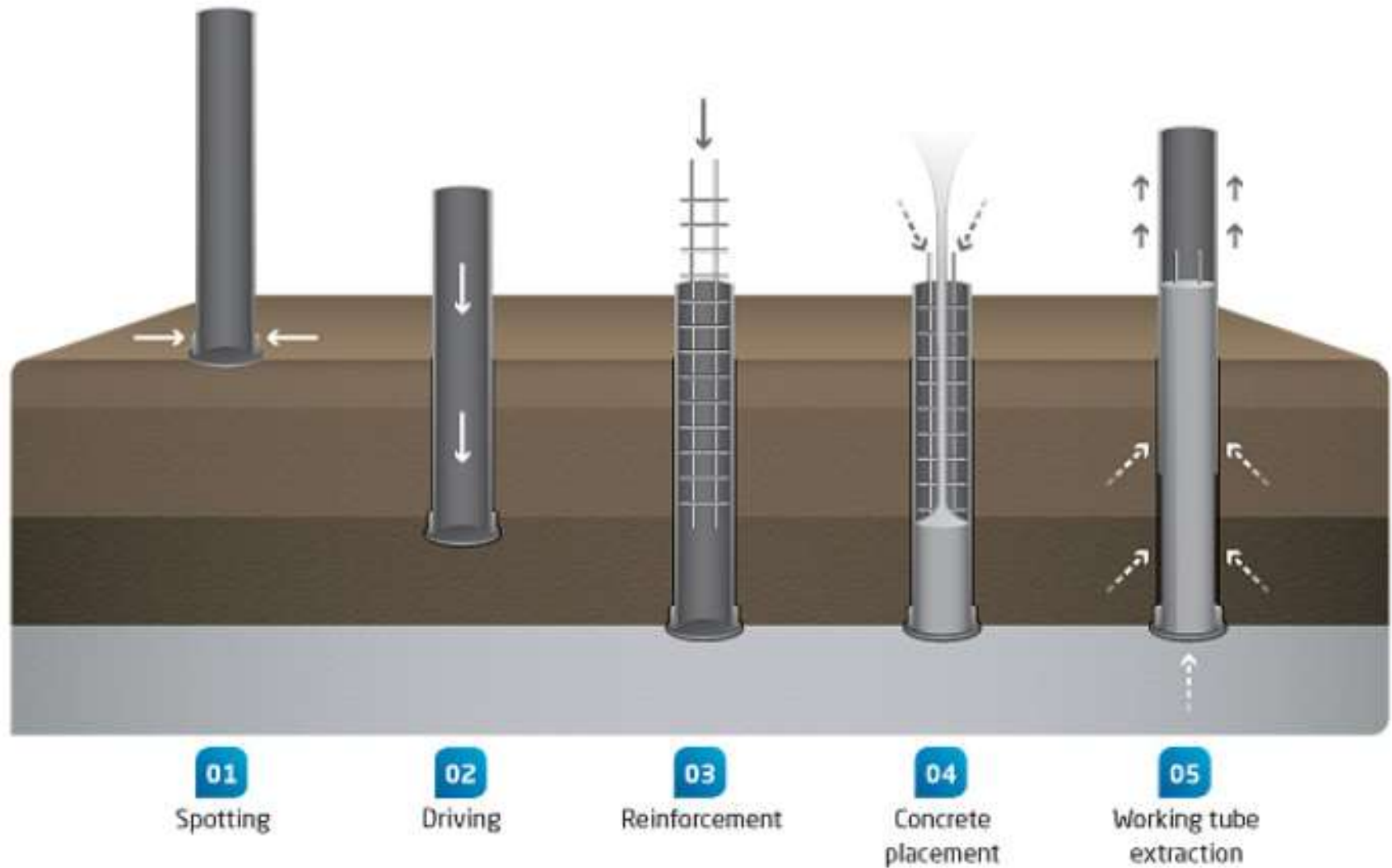
- Deep foundations such as piles are used when the soil at foundation level is inadequate to support the imposed loads with the required settlement criterion.
- If no soil layer is available, the pile is driven to a depth such that the load is supported through the surface friction of the pile.
- Piles may be square, circular or other shapes can be used.



System components and resisting forces

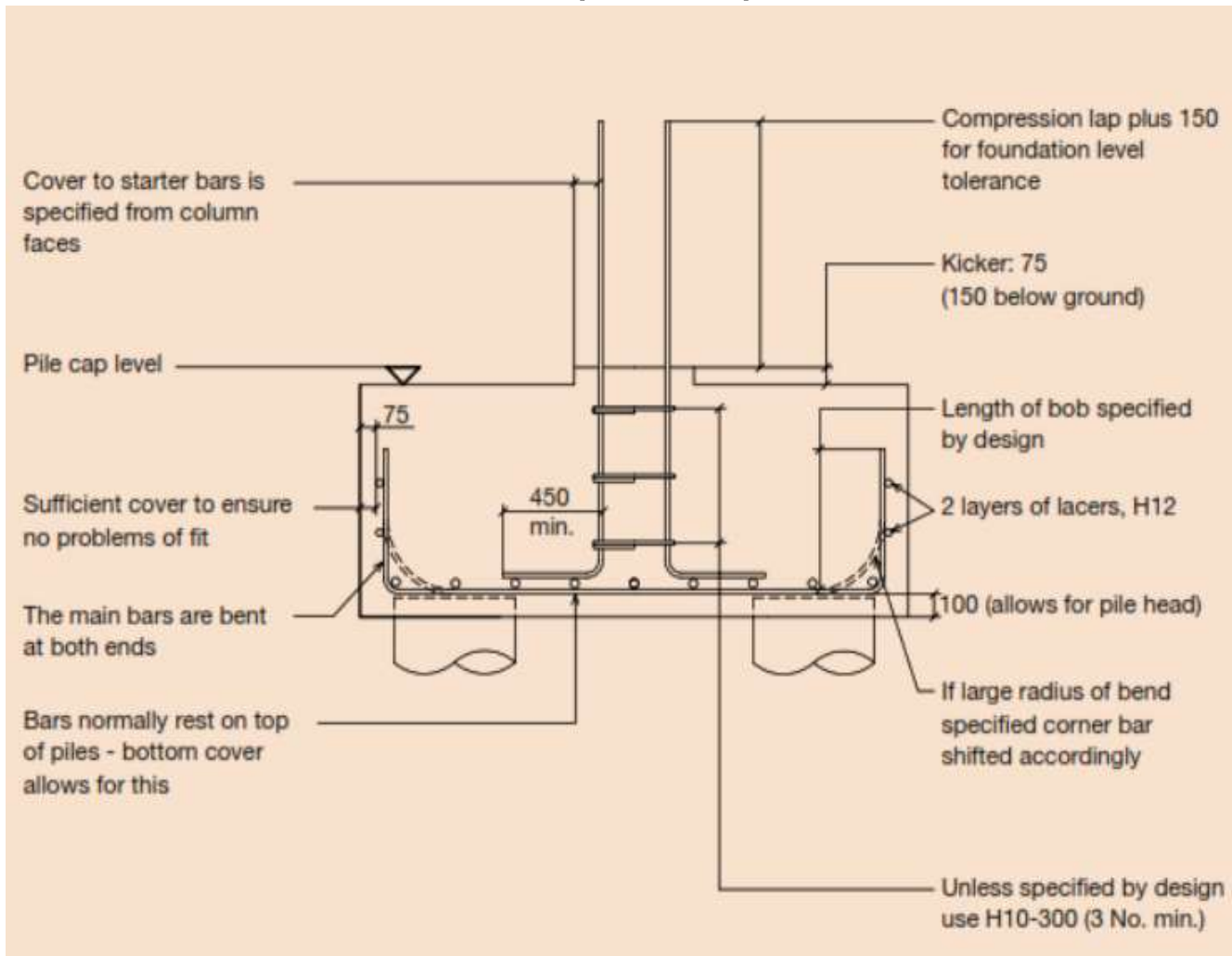
# Pile foundations

## Piles Construction Process

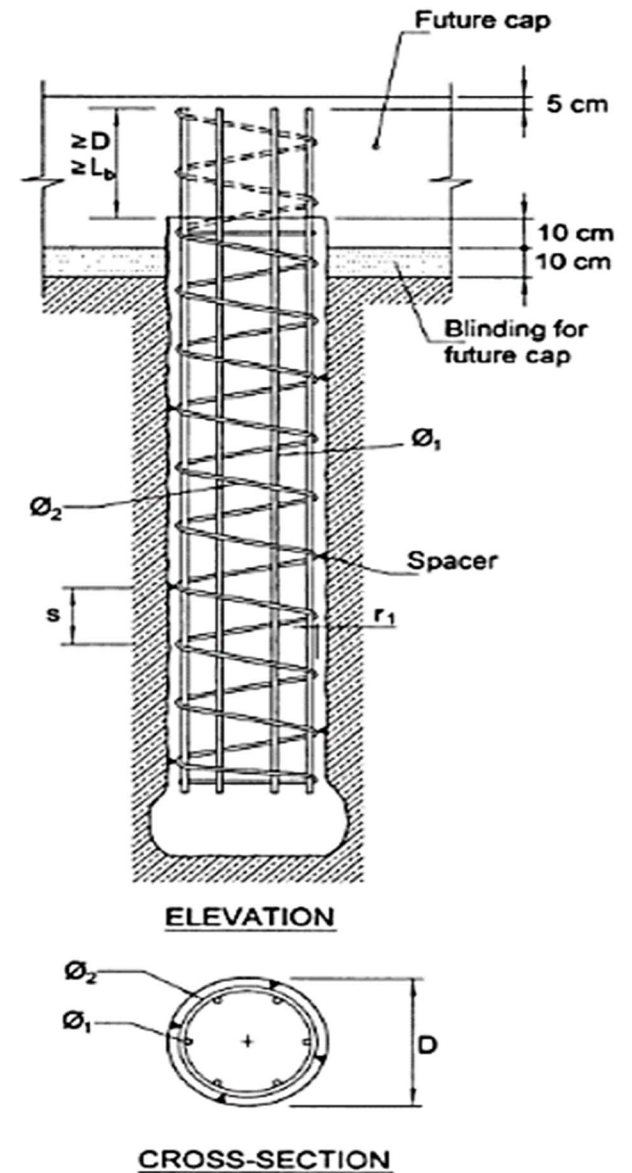


# Typical Pile Foundation Details

## Two-pile Cap



## The Pile



# Pile foundations

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## Pile and Pile Cap Reinforcement



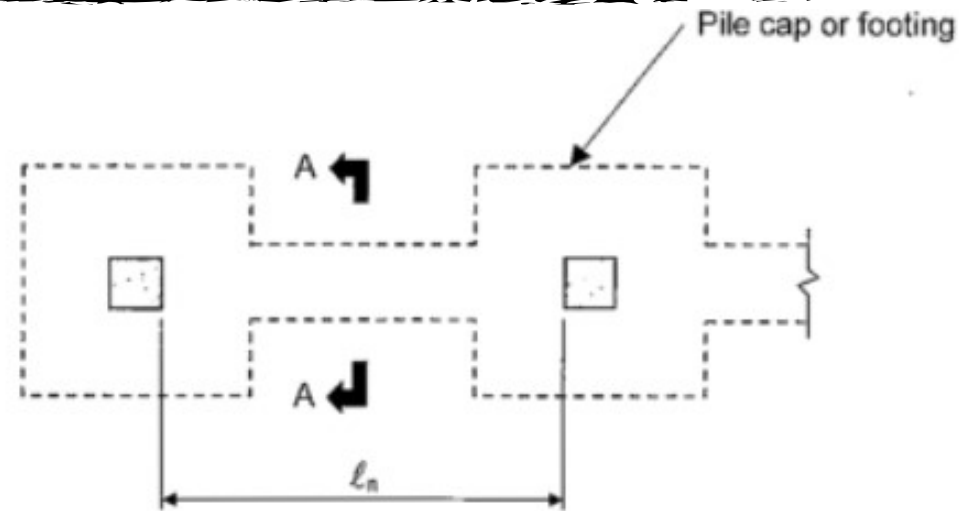


# Ground beams & slab on ground

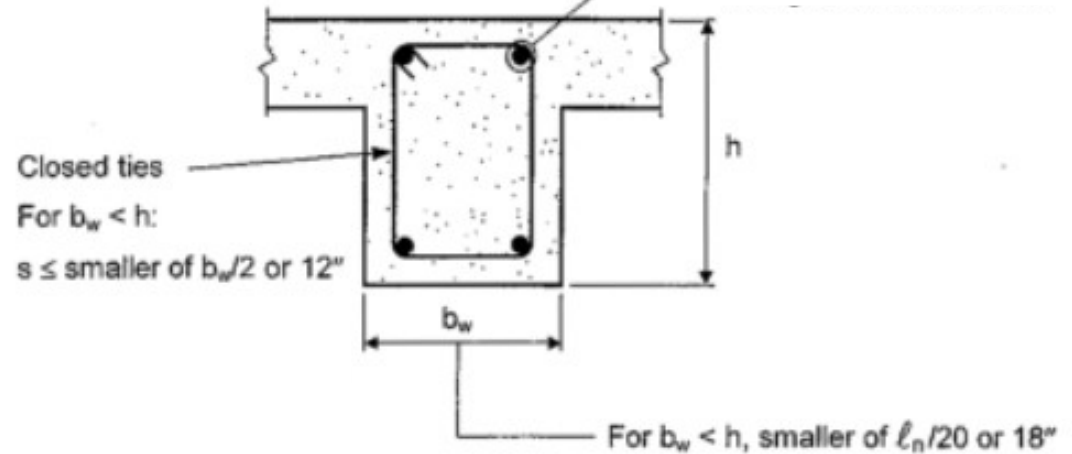
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- Slabs-on-ground and ground beam often act as a diaphragm to hold the building together at the ground level (provide structural integrity) .
- Additional ground beams area also used to minimize differential settlement of foundation and counterbalance the eccentric loads especially when located at footing level.
- In these cases, the slab-on-ground should be adequately reinforced and detailed. The contract documents should clearly state that these slabs-on-ground are structural members so as to prohibit saw cutting of the slab.
- Ground beam is usually designed for axial force of the order 10% of the maximum axial load to be transmitted by either of the two adjacent columns

# Ground beams – ACI requirements

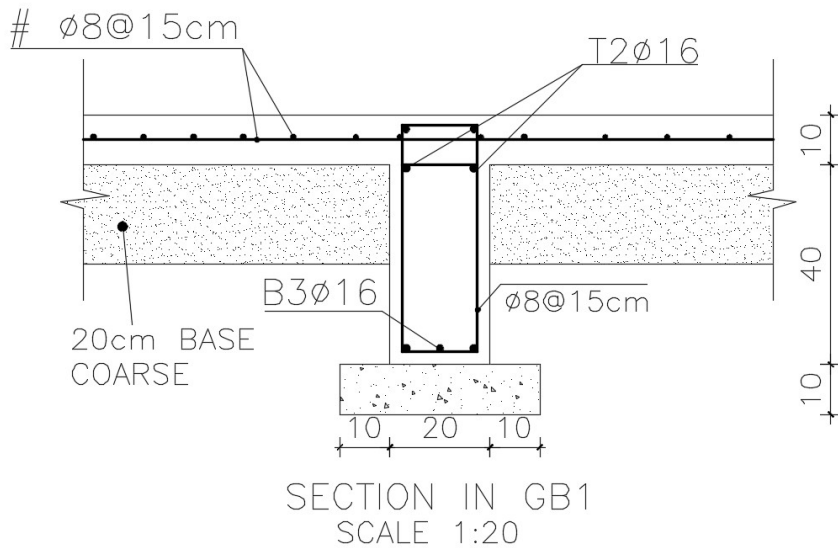


Longitudinal reinforcement developed within or beyond supported column, and anchored within pile cap or footing at all discontinuities

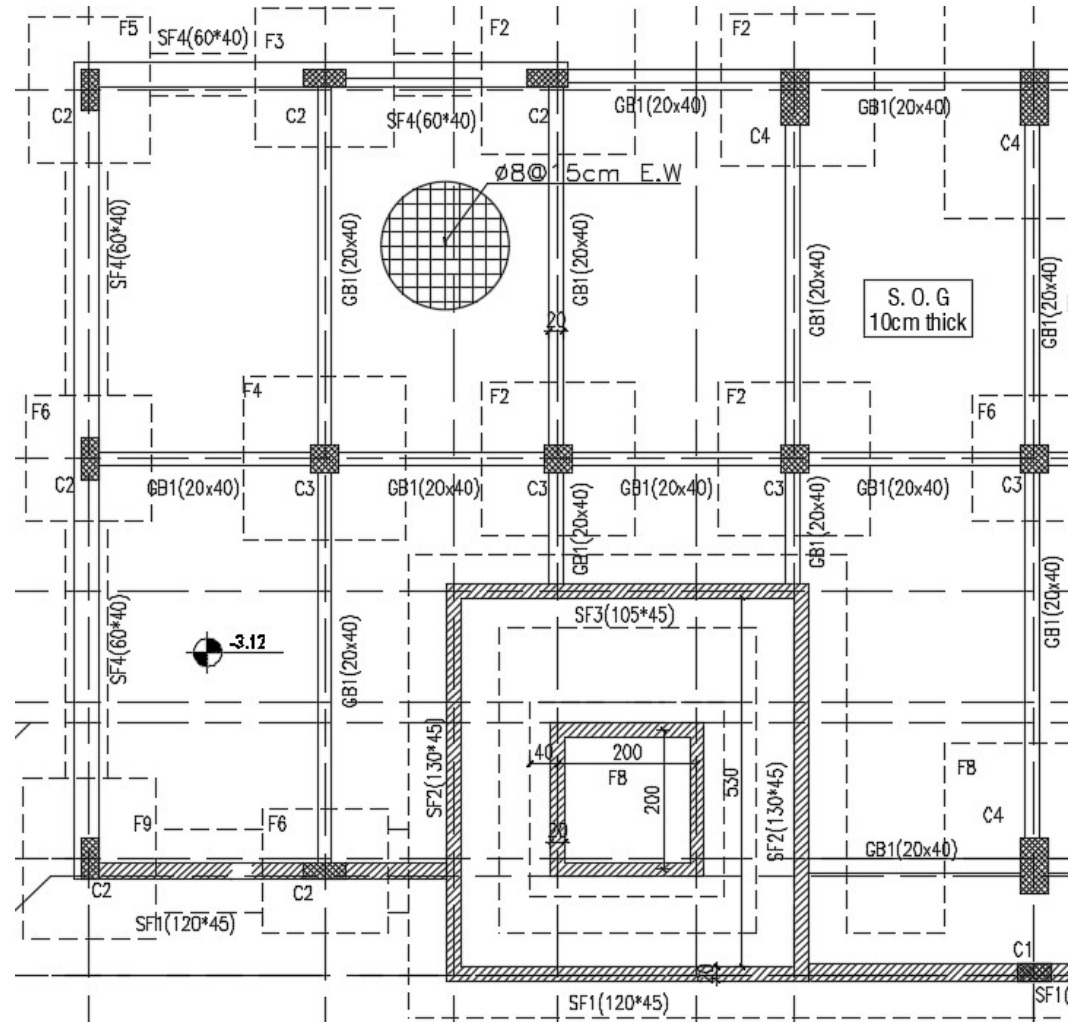


Section A-A

# Ground beams presentation



Cross section



Ground beams plan