Concrete and Structures for Interior Design Engineering

Lecture -5-

Structural Elements: Foundations

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Contents

1. Foundation relevance to Interior Design

1. Avoid placing heavy interior loads incorrectly

Example: heavy stone cladding or a large water feature may require stronger floor support.

2. Coordinate with architects & engineers

Example: locating partition walls, staircases, kitchens, bathtubs.

3. Understand cracks and moisture problems

Interior designers often help diagnose:

- Wall cracks
- Dampness
- Floor settlement

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2. What is a foundation?

- A *foundation* is the bottom part of a building that sits under the walls, columns, or structure. It works like the feet of a building- it carries all the weight and keeps the building stable.

3. Why Do We Need Foundations?

Buildings need foundations because:

1. To hold the building's weight
2. To prevent the building from sinking into the ground
3. To stop cracking caused by uneven soil
4. To protect the building during rains or earthquakes
5. To keep the building stable and safe

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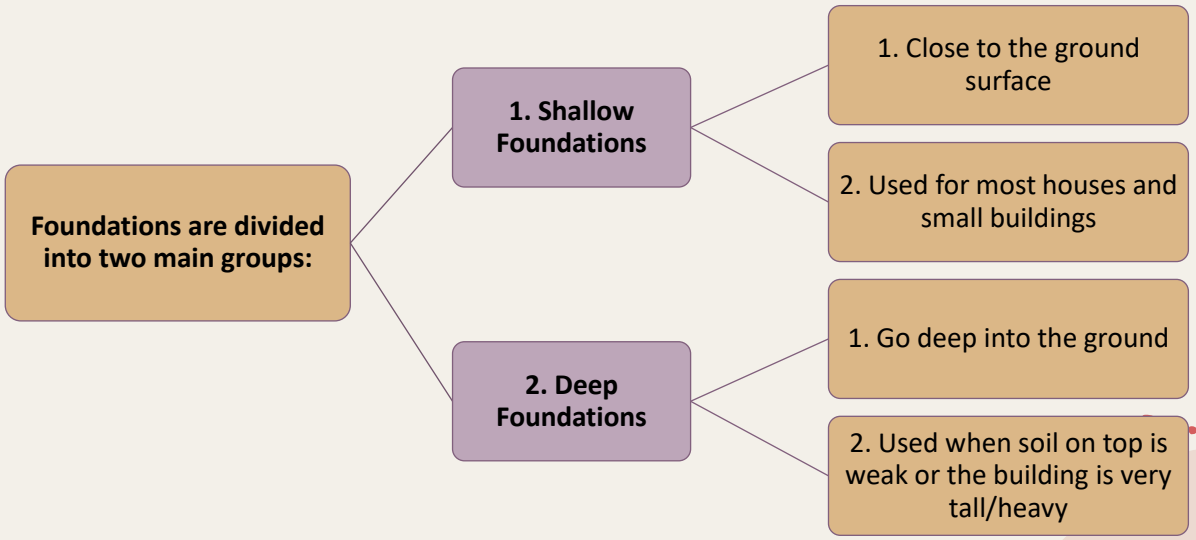
4. Types of foundations



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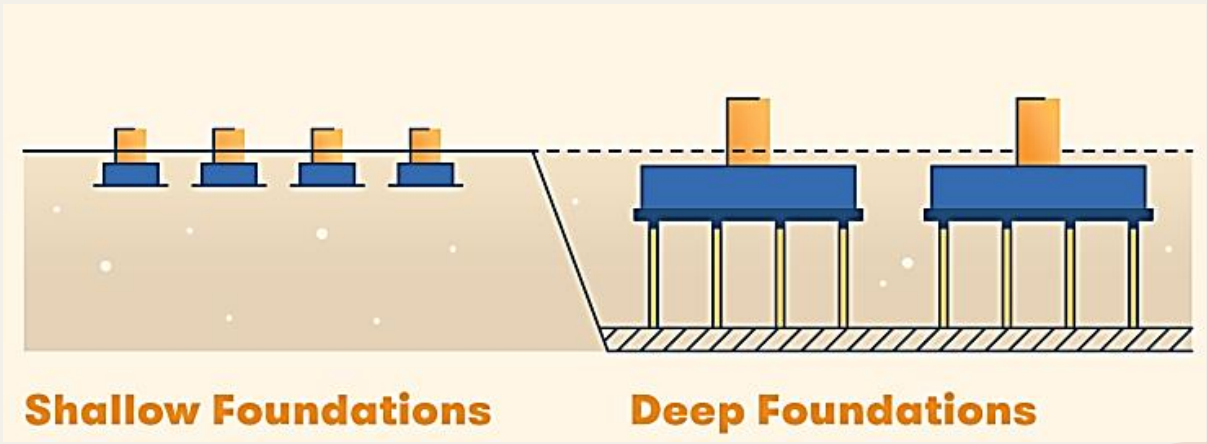
4. Types of foundations



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5. Shallow Foundations

Shallow foundations are used when the soil near the surface is strong enough.

Common shallow foundations:

1.Isolated Footing (Single Footing)

1. Supports one column
2. Very common in residential buildings

2.Strip Footing – Continuous wall footing

1. Supports long walls (like load-bearing walls)
2. Looks like a continuous strip under the wall

3.Combined Footing

1. Supports two columns together
2. Used when one column is near the property line

4.Raft / Mat Foundation

1. Big slab covering the whole building area
2. Used when soil is weak



Isolated Footing (Single Footing)

Combined Footing

Mat or Raft Footing

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6. Deep foundations

Deep foundations go far underground when surface soil is weak.

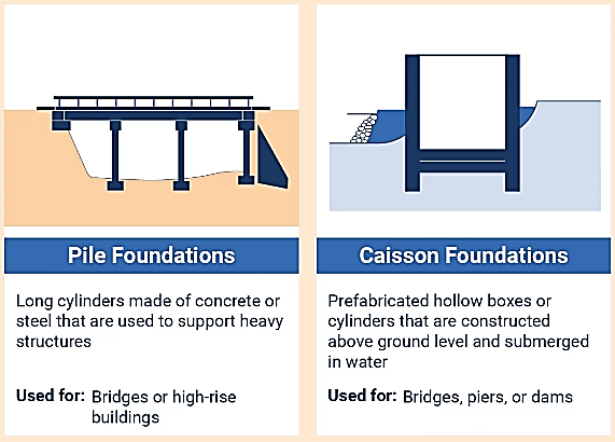
Two common types:

1.Pile Foundation

- Long columns made of concrete or steel
- Hold the building deep in the ground

2.Caisson (Well) Foundation

- Large hollow cylinders
- Used for bridges and underwater works



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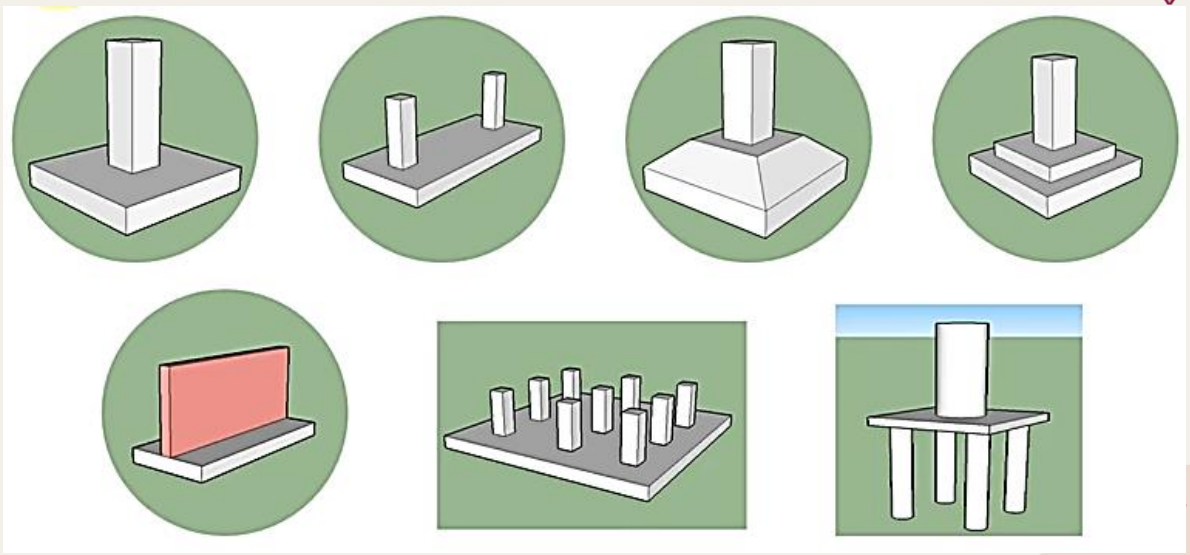
Common shallow foundations



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7. When to use each type

Use Shallow Foundations When:

- Soil at the top is strong
- Building is small or medium sized
- Construction budget is normal
- No basement is needed

Use Deep Foundations When:

- Soil at the surface is weak
- Building is tall (high-rise)
- Heavy loads like malls or hospitals
- Basement or underground parking is needed

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9. Basic Construction Steps of Foundations

1. Site Preparation
Clear the ground, remove topsoil.
2. Excavation
Dig the required depth based on foundation type.
3. Placing Reinforcement
Steel bars placed to strengthen concrete.
4. Pouring Concrete
Concrete is poured into the foundation area.
5. Compaction
Vibrating or tamping to remove air gaps.
6. Curing
Keep concrete moist for several days so it gains strength.

9. Simple foundation calculations

Example -1-

Footing size: 1.2 m × 1.2 m × 0.4 m (length × width × depth). Find the volume of concrete.

Solution;

Volume = L×W×H

Volume = 1.2×1.2×0.4

= 0.576 m^3

👉 **Concrete volume = 0.576 cubic meters**

Example -2-

A single column carries a load of 200 kN. The building uses a square footing with dimensions 1.5 m × 1.5 m.

The soil at the site can safely support 100 kN/m².

- Calculate the area of the footing.
- Calculate the soil pressure under the footing.
- Check whether the footing is safe or not using:

$$\text{Soil Pressure} = \frac{\text{Load on Footing}}{\text{Footing Area}}$$

Solution;

Step 1 — Calculate the area of the footing

Given:

✓Length = 1.5 m

✓Width = 1.5 m

Area=1.5×1.5=2.25 m²

👉 Footing area = 2.25 m²

Step 2 — Calculate soil pressure

Given:

Column load = 200 kN

Footing area = 2.25 m²

Soil Pressure=2002.25=88.9 kN/m²

👉 Soil pressure under footing = 88.9 kN/m²

Step 3 — Check safety

- Safe soil bearing capacity (SBC) = **100 kN/m²**
- Calculated soil pressure = **88.9 kN/m²**

Compare:

- 88.9kN/m2 <100kN/m2

👉 Soil pressure is LESS than the safe limit. The footing is SAFE. Because the actual soil pressure (88.9 kN/m²) is lower than the soil's safe capacity (100 kN/m²).

Example -3-

A column in a building carries a load of 250 kN. The footing provided is a square footing of size 1.4 m × 1.4 m. The soil at the site can safely support 120 kN/m².

Required;

1. Calculate the area of the footing.
2. Calculate the soil pressure under the footing.
3. Check whether the footing is safe or unsafe.

Solution;

1. Area of the footing

$$\text{Area} = 1.4 \times 1.4 = 1.96\ m^2$$

👉 **Footing area = 1.96 m²**

2. Soil pressure under the footing

Given:

Load = 250 kN

Area = 1.96 m²

$$\text{Soil } Pressure = \frac{250}{1.96} \approx 127.6\ kN/m^2$$

👉 **Soil pressure ≈ 127.6 kN/m²**

3. Safety check

Safe soil capacity = **120 kN/m²**

Actual soil pressure = **127.6 kN/m²**

Compare:

$$127.6\ kN/m^2 > 120\ kN/m^2$$

❌ **Conclusion:**

The footing is **NOT SAFE**.

The actual pressure is **higher** than the soil's safe capacity, so:

- Either the **footing size must be increased**,
- Or the **load reduced**,
- Or a **better (stronger) soil layer** must be used.

References

1. A. M. Neville, *Properties of Concrete*, 5th ed. Harlow, UK: Pearson Education Limited, 2011.
2. P. K. Mehta and P. J. M. Monteiro, *Concrete: Microstructure, Properties, and Materials*, 4th ed. New York, NY, USA: McGraw-Hill Education, 2014.
3. K. Janamian and J. Aguiar, *Concrete Materials Technology: A Practical Guide*, Abingdon, UK: Routledge / Taylor & Francis, 2023.