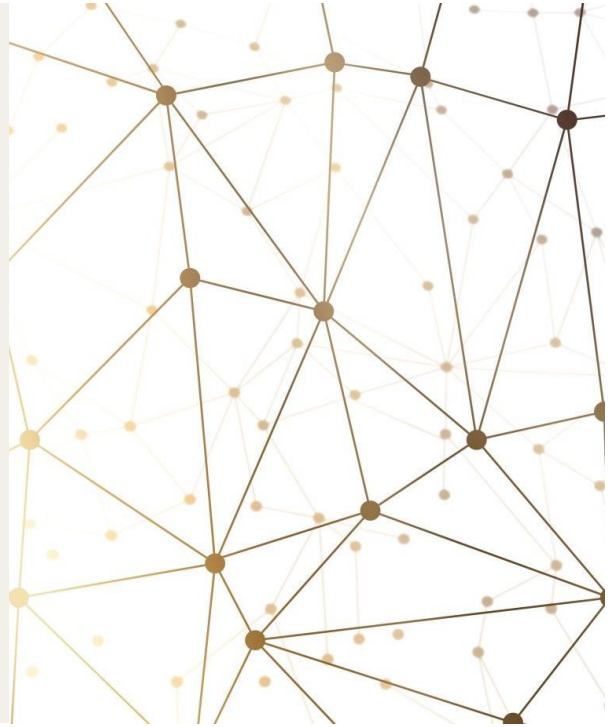




# Concrete and Structures for Interior Design Engineering

## Lecture -7- Structural Elements: Vertical Systems

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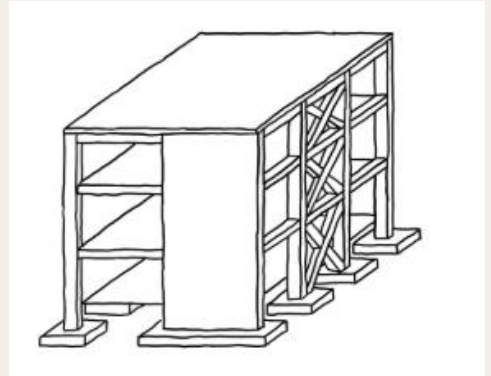
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# 1. Introduction to Vertical Structural Systems



- ✓ Vertical structural systems are the parts of a building that stand upright and are responsible for carrying loads downward from the upper parts of the building to the ground.
- ✓ They form the main support framework of a building and work together with horizontal systems such as slabs and beams.
- ✓ Without vertical members, a building **cannot stand**.



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## How loads act in a building:

Buildings are constantly subjected to loads such as:

- Self-weight of slabs, beams, and walls
- Weight of furniture and interior finishes
- Weight of people using the building
- Environmental loads (wind, earthquake)

## Role of vertical members:

- Columns and walls resist compression forces
- They ensure that loads move safely and continuously to the ground
- They prevent excessive deformation or collapse



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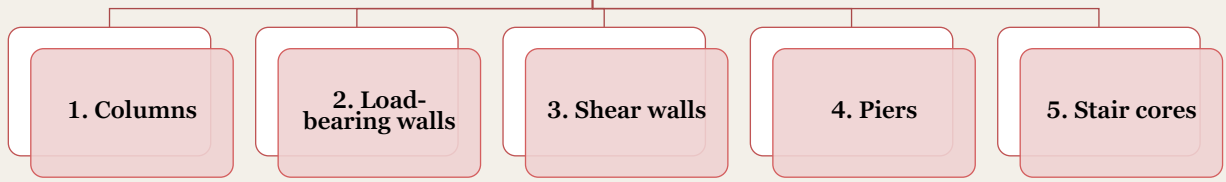
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## 2. Types of Vertical Structural Members



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## 3. Difference Between Vertical and Horizontal Structural Systems

Aspect	Vertical Structural Systems	Horizontal Structural Systems
Direction	Vertical (up–down)	Horizontal (left–right)
Main function	Carry loads downward	Collect and distribute loads
Examples	Columns, walls, shear walls	Slabs, beams, floors, roofs
Load type	Mainly compression	Mainly bending and shear
Role in interiors	Fix space planning	Affect ceilings and layouts

### Simple explanation:

- ❖ Horizontal systems collect loads
- ❖ Vertical systems carry loads to the ground

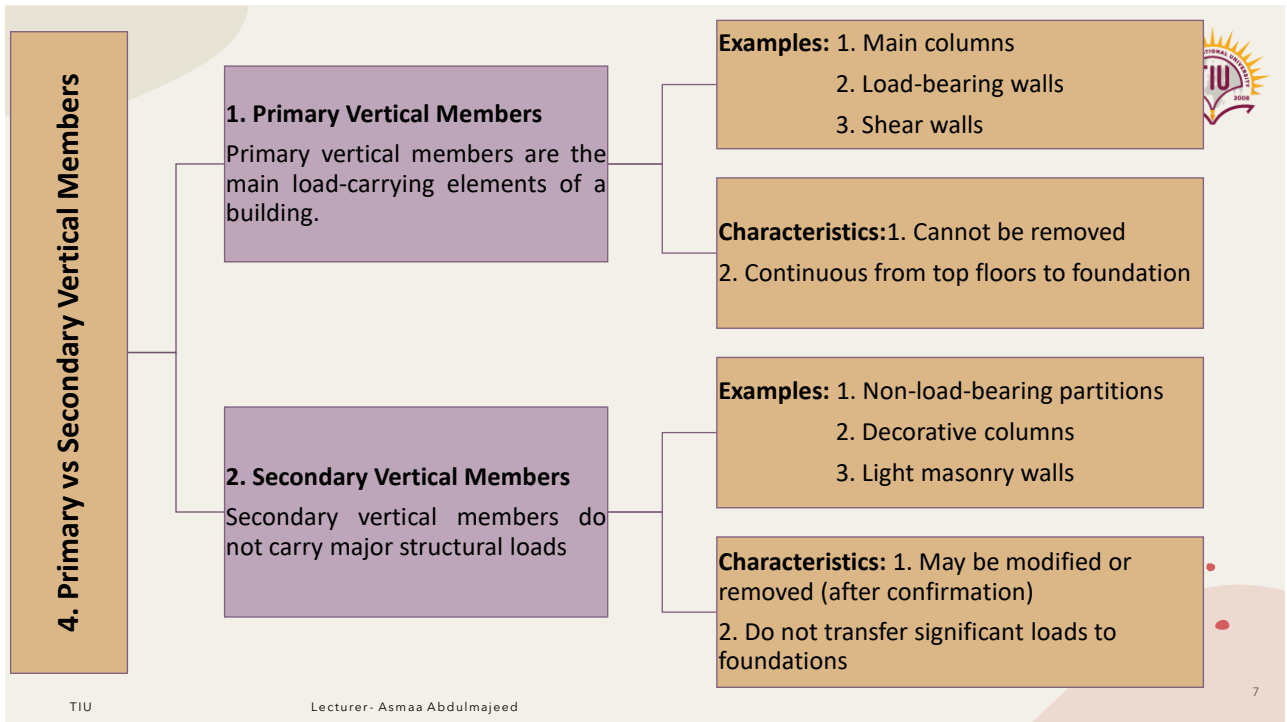
Both systems must work together for a building to be stable.

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## 5. Columns



- A column is a vertical structural member designed primarily to carry compressive loads from slabs and beams above and transfer them safely to the foundation.
- Columns are one of the most important structural elements in any building. They act as the main vertical supports.

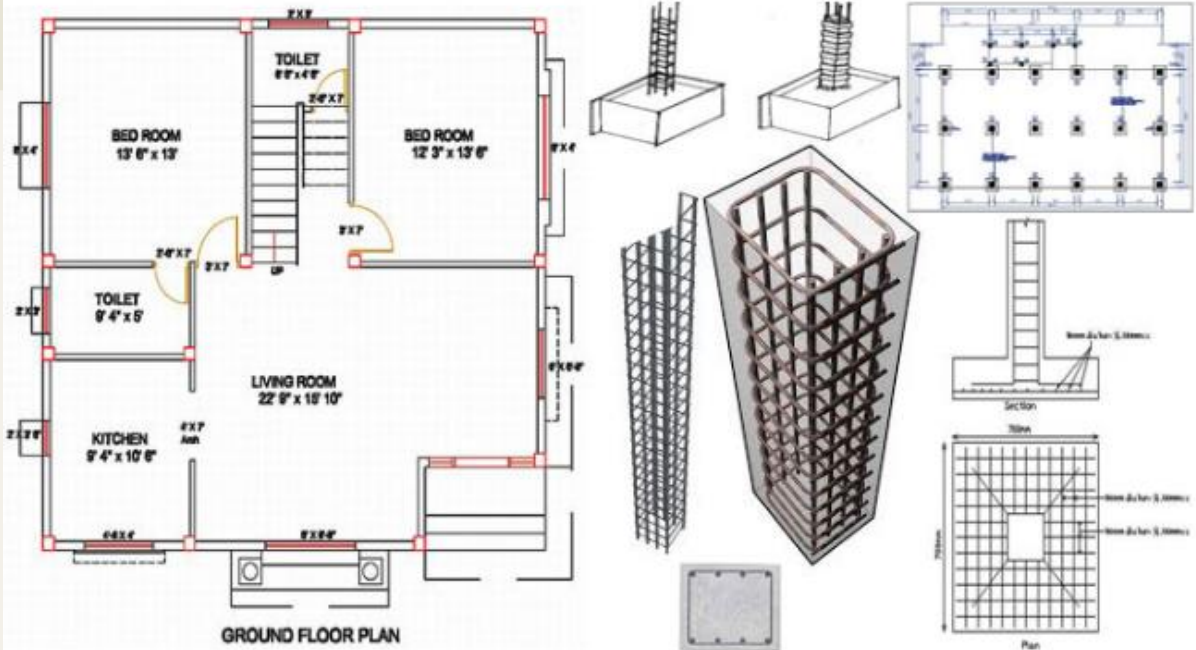


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## Common Materials Used for Columns



### 1. Reinforced Concrete (RC) Columns

- Most common in residential and commercial buildings
- Made of concrete with steel reinforcement
- Durable, fire-resistant, and strong

#### Interior design impact:

- Often large in size
- Can be boxed, clad, or integrated into walls

### 2. Steel Columns

- Used in high-rise or industrial buildings
- Slimmer than concrete columns
- Faster construction

#### Interior design impact:

- Often exposed for industrial aesthetics
- Require fire protection covering

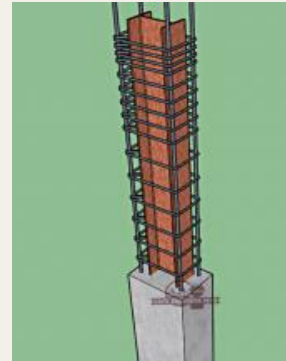
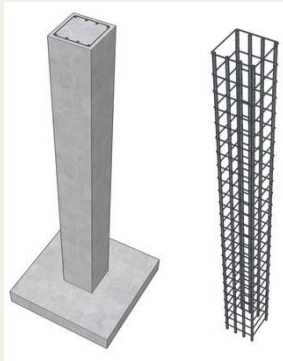


### 3. Composite Columns

- Combination of steel and concrete
- High strength with smaller size

#### Interior design impact:

- Efficient space usage
- Mostly seen in large commercial projects



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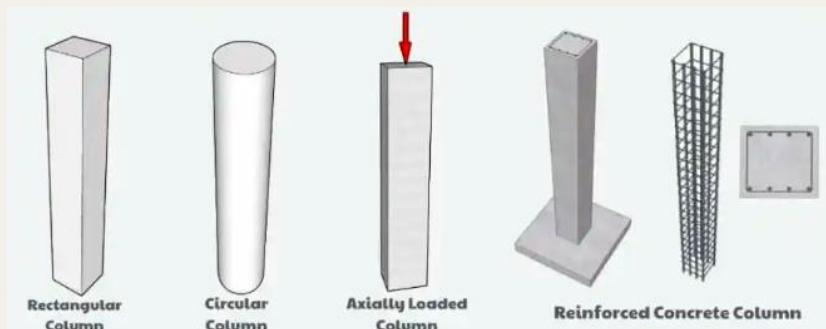
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### Typical Column Shapes and Sizes



#### Common shapes:

1. **Square** – most common
2. **Rectangular** – used when space is limited
3. **Circular** – architectural or special design



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## Column Placement and Spacing in Building Plans



- Columns are placed according to a structural grid.
- Typical spacing: 3–6 m
- Columns must align vertically from floor to floor
- Column locations strongly influence: Room sizes, Furniture layout



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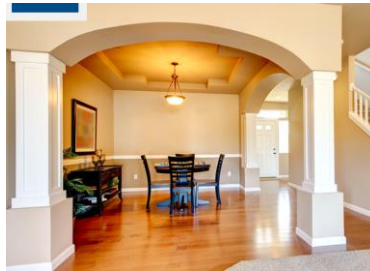


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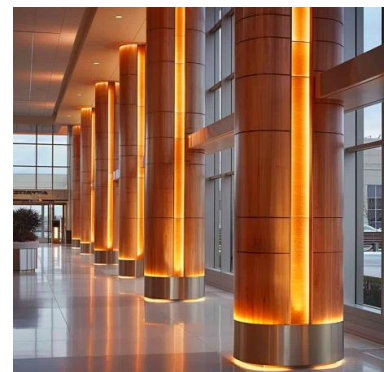
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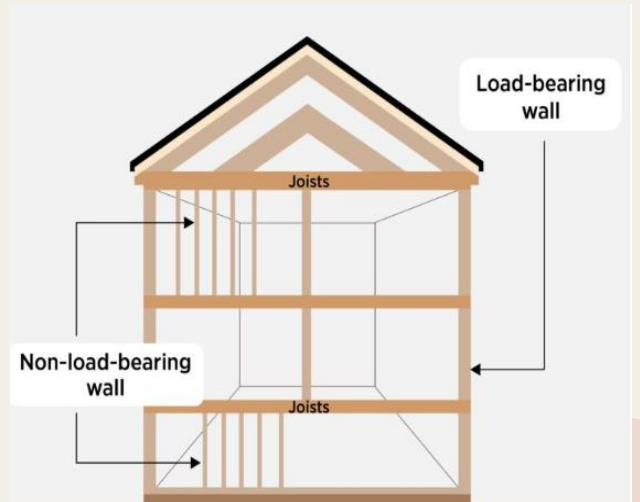
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## 6. Load-Bearing Walls



A load-bearing wall is a wall that:

- Supports its own weight
- Carries loads from slabs, beams, or roofs above
- Transfers loads directly to the foundation



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## Materials Used in Load-Bearing Walls



- Reinforced concrete
- Brick masonry
- Stone masonry
- Concrete block masonry

### Difference Between Load-Bearing Walls and Partition Walls

Aspect	Load-Bearing Wall	Partition Wall
<b>Structural role</b>	Carries loads	Carries no structural load
<b>Can be removed</b>	No	Usually yes
<b>Thickness</b>	Thicker	Thinner
<b>Designed by</b>	Structural engineer	Interior designer

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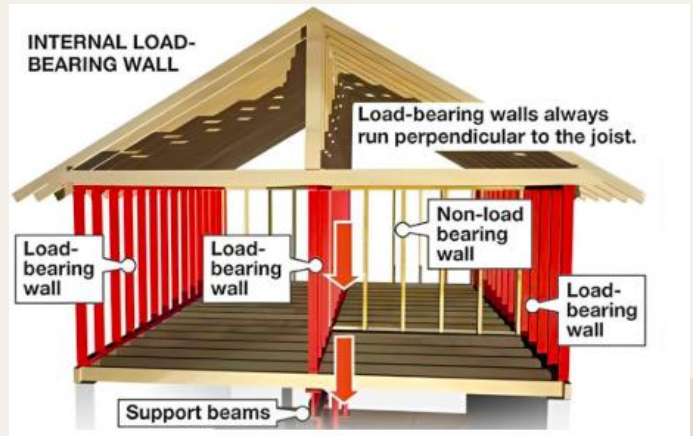


## Identification of Load-Bearing Walls in Drawings



Load-bearing walls can be identified by:

- ❖ Thicker wall lines
- ❖ Continuous alignment across floors
- ❖ Located under beams or slabs
- ❖ Marked as “structural” in drawings



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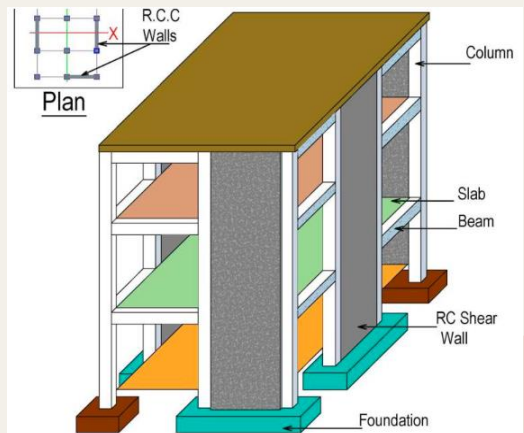
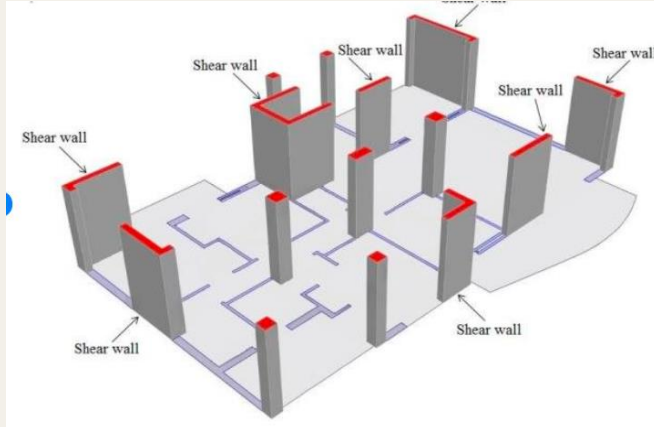
## 7. Shear Walls



A shear wall is a vertical structural element designed to resist horizontal forces such as:

- Wind loads
- Earthquake loads

Shear walls improve the stability and rigidity of buildings.



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## Role in Resisting Wind and Earthquake Loads



- Prevent excessive sideways movement
- Reduce building sway
- Protect structural and non-structural elements

## Typical Locations of Shear Walls

- Stair cores
- Lift shafts
- Building perimeter walls
- Central core of buildings

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## 8. Stairs as Vertical Structural Elements



Stairs are vertical circulation elements that allow movement between different floors of a building.

They are both:

- ❖ Functional (movement)
- ❖ Structural (load-bearing)

Structural Role of Stairs in Buildings;

- ❖ Carry self-weight and live loads
- ❖ Act as rigid vertical elements
- ❖ Often connected to slabs and beams
- ❖ In some buildings, stairs act as shear walls

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## Components of Stairs



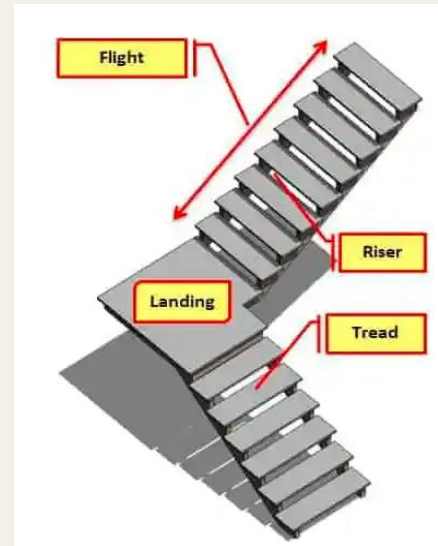
1. Tread: Horizontal part where foot rests
2. Riser: Vertical part between treads
3. Flight: Series of steps
4. Landing: Flat resting area between flights
5. Handrail: Safety component

## Types of Stairs

- ✓ Straight stairs
- ✓ L-shaped stairs
- ✓ U-shaped stairs
- ✓ Spiral stairs

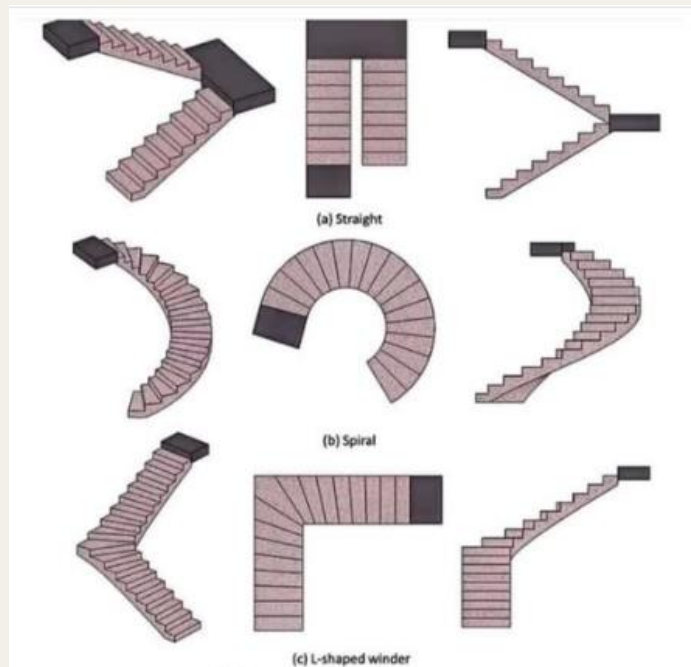
Stair type affects:

- ✓ Space planning
- ✓ Safety
- ✓ Visual design



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## 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.