



# RC CONSTRUCTION SYSTEMS

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# LECTURE CONTENT

## STRUCTURAL SYSTEMS

- Buildings Main Concepts
- Loads on Structural Systems
- Types, Materials and Design

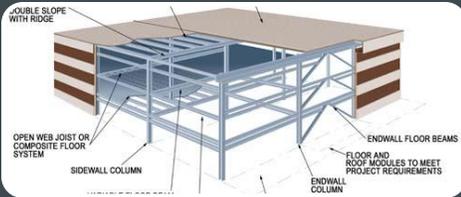
## CONCRETE AS A CONSTRUCTION

- Properties of Concrete as a construction material
- Concrete Work Process
- RC construction systems

## CAST IN PLACE SYSTEM

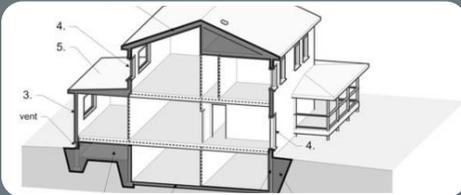
- RC Columns
- RC Beams
- **RC Slabs**

# BUILDINGS MAIN CONCEPTS



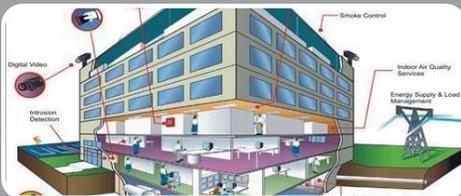
## STRUCTURAL SYSTEM

- Building's elements used to support and transmit loads to the ground, and construct the main form of the building such as: **Foundations, Columns, Beams and Slabs.**



## ENCLOSURE SYSTEM

- Building outer skin or envelope such as: **Roof, Exterior walls, Base floor.**

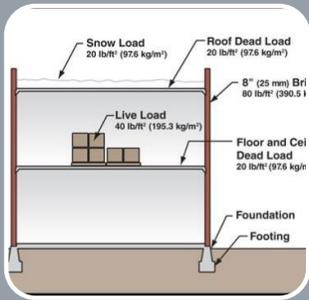


## MECHANICAL SYSTEM

- Building essential services such as: **HVAC systems, Water supply, Sewage disposal, Electricity, Fire fighting system, Vertical transportation systems.**

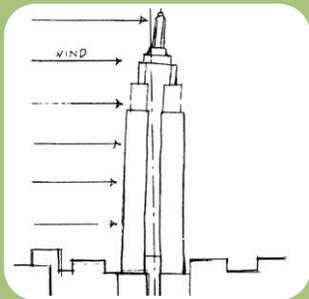
# LOADS ON STRUCTURAL SYSTEMS

## STATIC LOADS

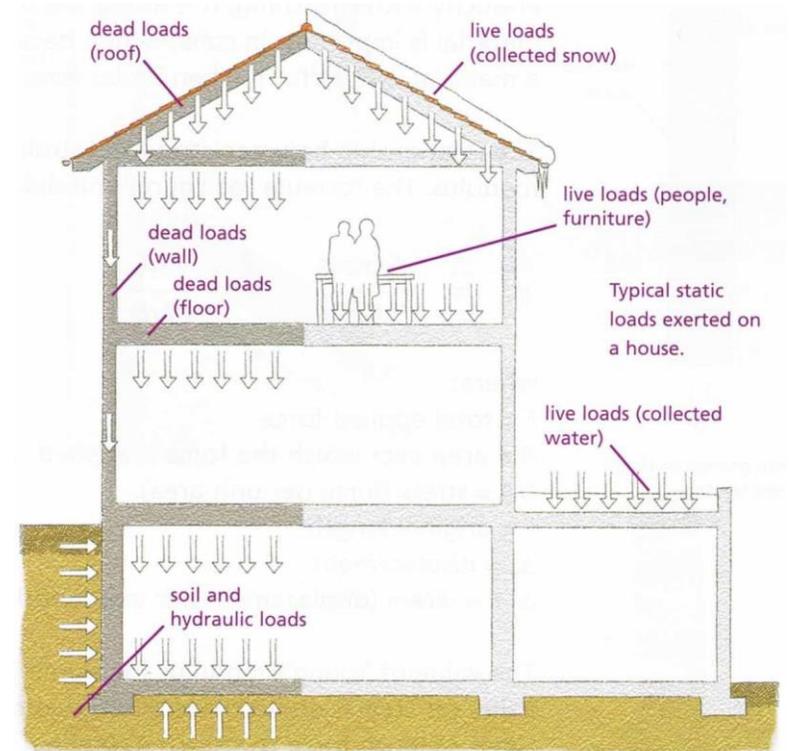


- Loads that are applied slowly to a structure and do not change quickly such as: **Dead loads and Live Loads**

## DYNAMIC LOADS

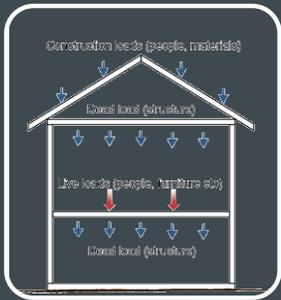


- Loads that are applied suddenly to a structure, often with rapid changes in magnitude and point of application such as: **Wind loads and Earthquakes Loads**



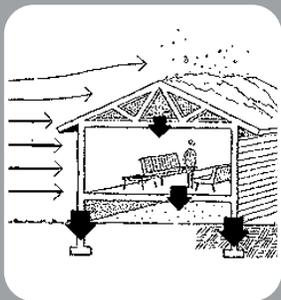
# STATIC LOADS ON STRUCTURAL SYSTEMS

## DEAD LOADS

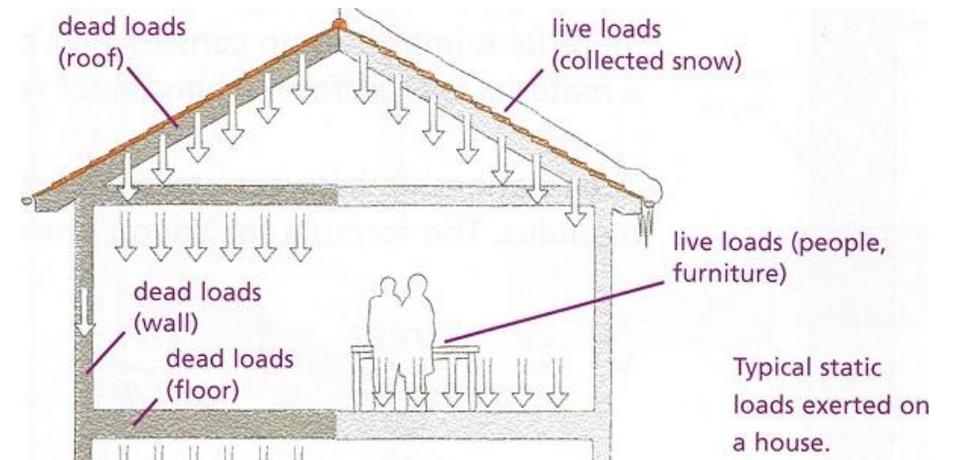


- Weight of Structural Members such as: **Columns, Beams and slabs.**
- Weight of Permanently Attached Objects to the Structure such as: **Walls, Windows and Doors and Mechanical systems.**
- Weight of Fixed Furniture such as: **Laboratories equipment.**

## LIVE LOADS



- Weight of Objects Temporarily Placed such as: Movable Furniture and People.
- Rain and Snow Loads.



# TYPES, MATERIALS AND DESIGN



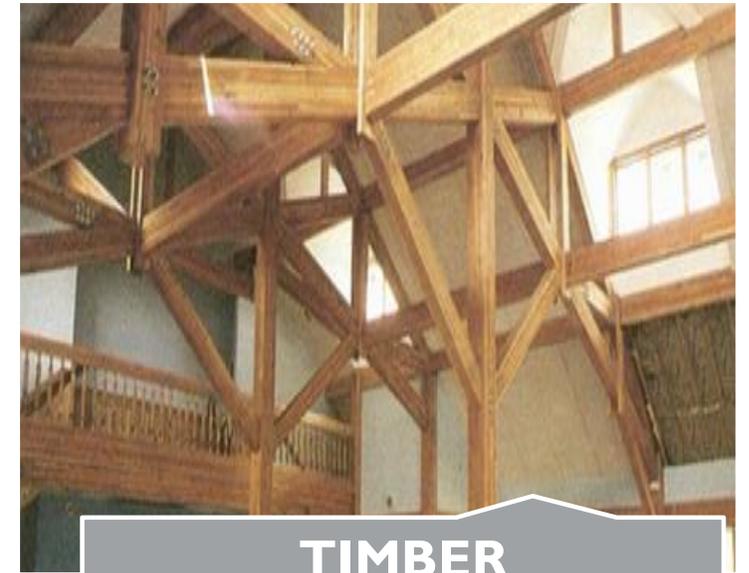
## CONCRETE

One-way slabs and Two-way slabs



## STEEL

Steel Framing and Trusses



## TIMBER

Joist and Beams

## 10 MINS. EXERCISE

On A4 paper, draw a sketch to the class hall you are in determining:

- Its Structural System
- Its Enclosure System
- Its Mechanical System
- Dead Loads
- Live Loads



# CONCRETE AS A CONSTRUCTION MATERIAL

## CONCRETE:

A mixture of a natural and artificial materials formed into any shape with a variety of surface finishes and textures.



Cement

Water

Aggregate  
(Fine, Coarse)

Admixtures

# CONCRETE AS A CONSTRUCTION MATERIAL



**Ordinary/ Plain Concrete**  
Handling COMPRESSION loads



**Reinforced Concrete**  
Handling TENSILE and SHEAR stresses

# CONCRETE WORK PROCESS



**1. Mixing**  
In Site, Outside Site



**2. Transporting**



**3. Formwork**  
Pouring, Spraying

# CONCRETE WORK PROCESS



**4. Surface Settlement/  
Smoothing**



**5. Curing**

# ADVANTAGES AND DISADVANTAGES OF CONCRETE



# RC CONSTRUCTION SYSTEMS



**Cast in Place Concrete Systems**

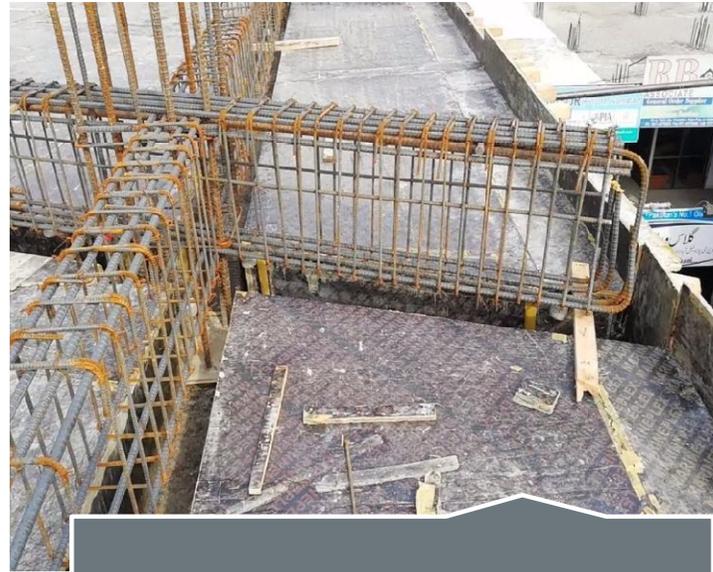


**Pre-Cast Concrete Systems**

# CAST IN PLACE SYSTEM COMPONENTS



**RC SLABS**



**RC BEAMS**

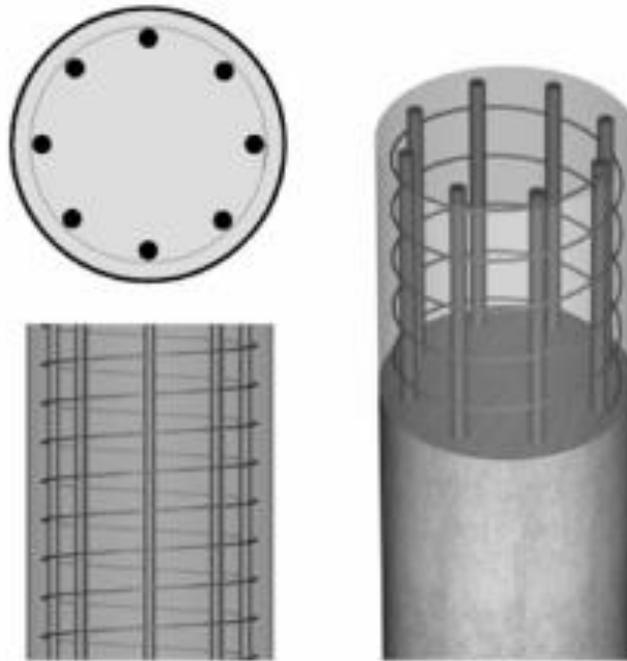


**RC COLUMNS**

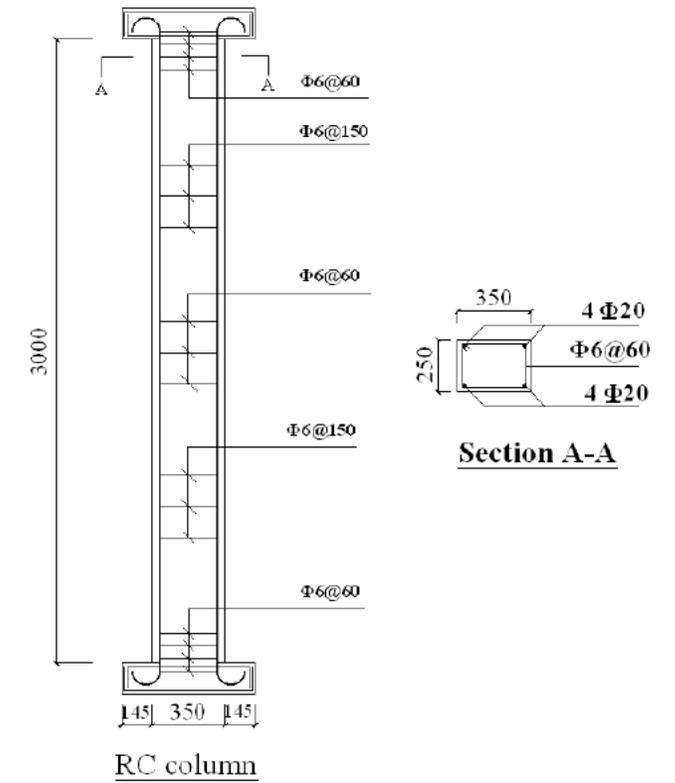
# RC COLUMNS



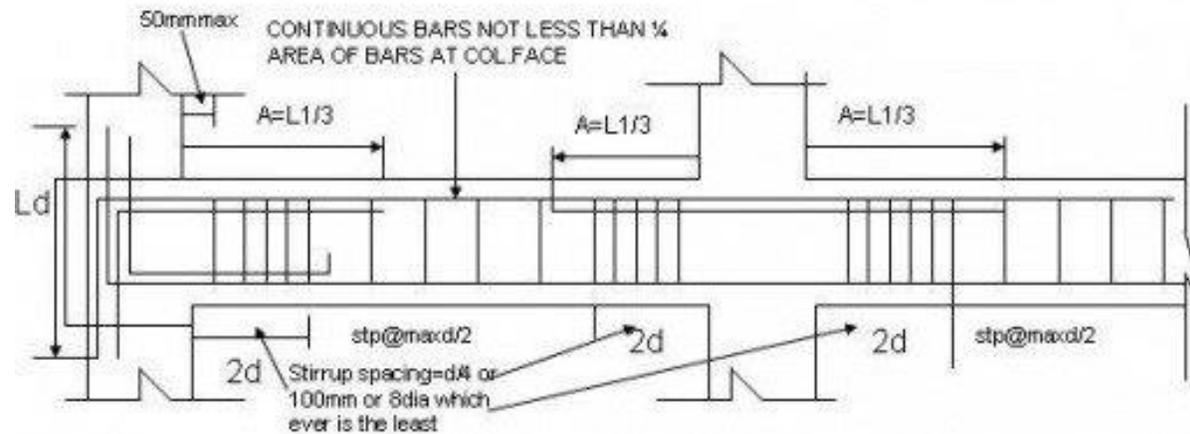
(a) Rectangular tied Column



(b) Round spiral Column



# RC BEAMS



## ■ RC BEAMS:

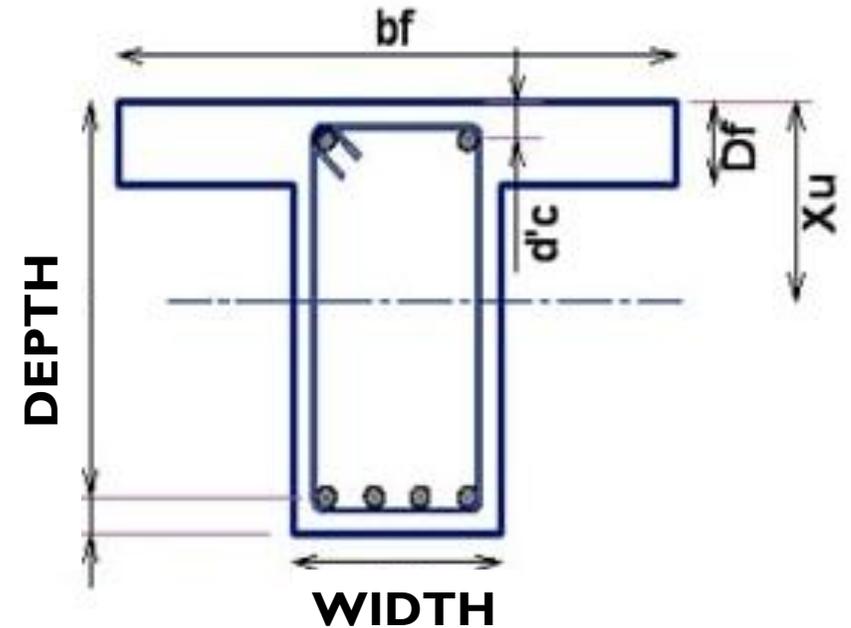
Reinforcement bars extended into and down column support for structural continuity and for suitable anchorage and to minimize bending moment at building connections.

# RC BEAMS

Beam DEPTH = **Span/ 16**

Beam WIDTH = **Beam Depth/ 2 or 3**

Concrete COVER = **4-5 cm**



# RC SLABS



**Solid Slab**  
One way, Two way



**Flat Slab**  
Flat Plate, Flat Slab



**Hollow Block**



**Waffle Slab**

# ONE-WAY SLAB VS. TWO-WAY SLAB

One-way Slab	Two-way slab
One way slab is supported by beams in only <b>2 sides.</b>	Two way slab is supported by beams in <b>all four sides</b>
The ratio of longer span panel (L) to shorter span is equal or greater than 2. Thus, $L/B \geq 2$	The ratio of longer span panel (L) to shorter span Panel (B) is less than 2. Thus, $L/B < 2$
Main reinforcement is provided in <b>only one</b> direction one way slabs.	Main reinforcement is provided in <b>both</b> the direction for two way slabs

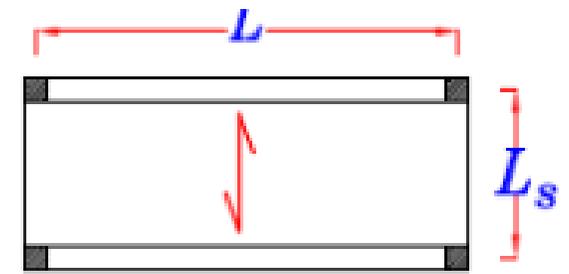
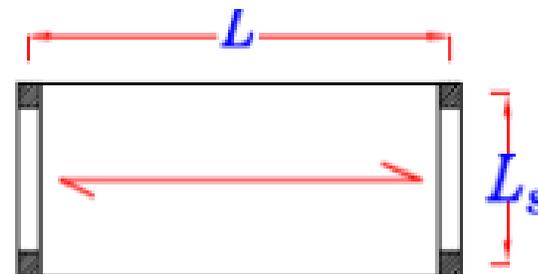
# ONE-WAY SOLID SLAB

- **ONE-WAY SOLID SLAB:**

Slab is supported on two sides by beams or bearing walls, and these beams are supported by columns or girders.

Suitable for light to moderate loads over span of:

**1.8 – 5.5 m**



# TWO-WAY SOLID SLAB

## ■ TWO-WAY SOLID SLAB:

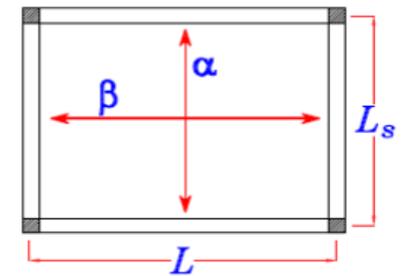
A slab of a uniform thickness reinforced in two directions supporting on beams and columns on all four sides. Efficient when spanning square or nearly square bays.

Suitable for medium spans and heavy loads over:

**4.5 – 12.0 m**



$$L \leq 2L_s$$



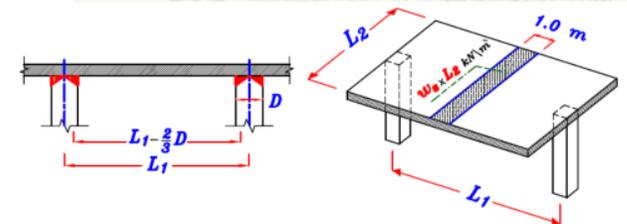
# FLAT SLAB

## ■ TWO-WAY FLAT PLATE:

A concrete slab with a uniform thicknesses reinforced in two or more directions supported directly by columns without beams.

Suitable for light to moderate loads and over short spans of:

**3.6 – 7.0 m**



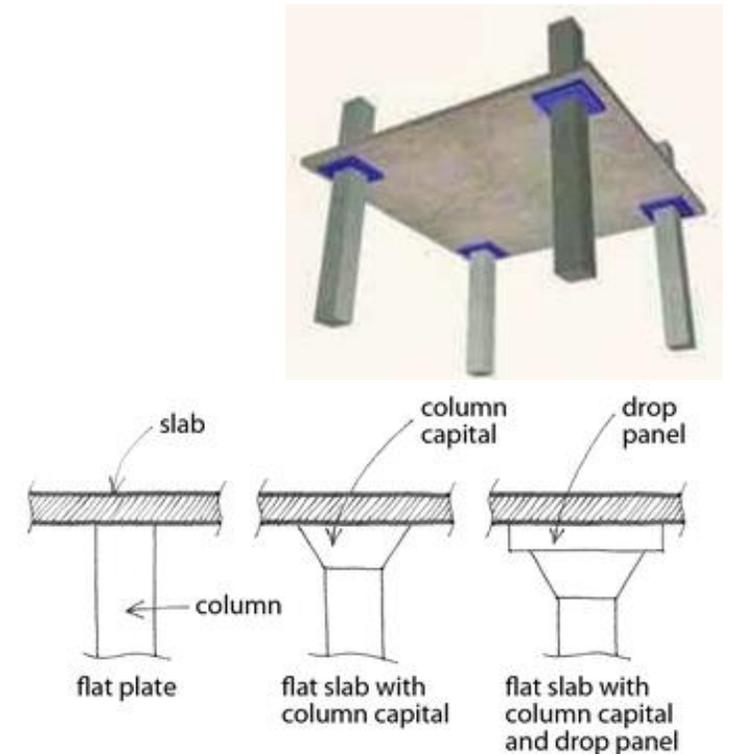
# FLAT SLAB

## ■ TWO-WAY FLAT SLAB:

It's a flat plate thickened at its columns supports to increase its shear strength and moment resistance

Suitable for heavy loads and spans of:

**6.0 – 12.0 m**



# HOLLOW BLOCK

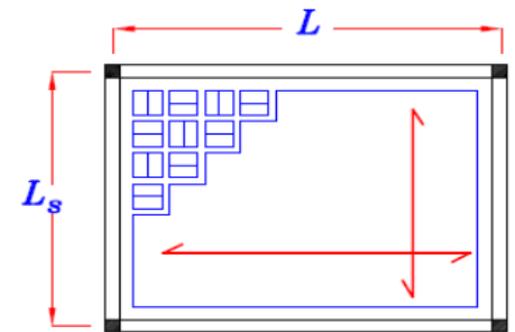
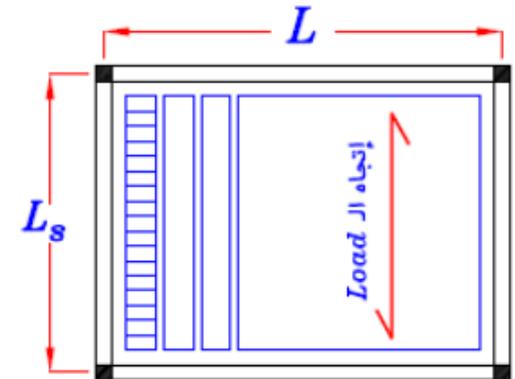
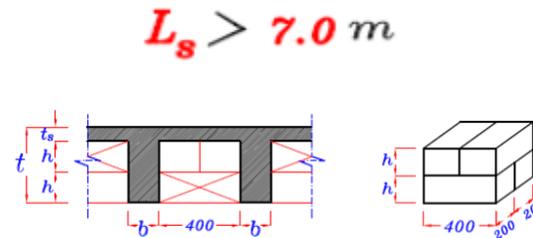
## ■ HOLLOW BLOCK SLAB:

Also known as a voided slab, hollow core plank or simply a concrete plank is a precast slab of prestressed concrete typically used in the construction of floors in multi-story apartment buildings.

Able to carry heavy loads and long spans

**5.0 – 12.0 m**

$$5.0 \text{ m} < L_s \leq 7.0 \text{ m}$$



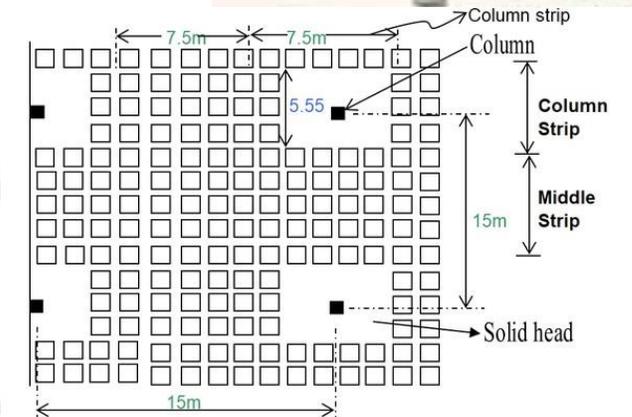
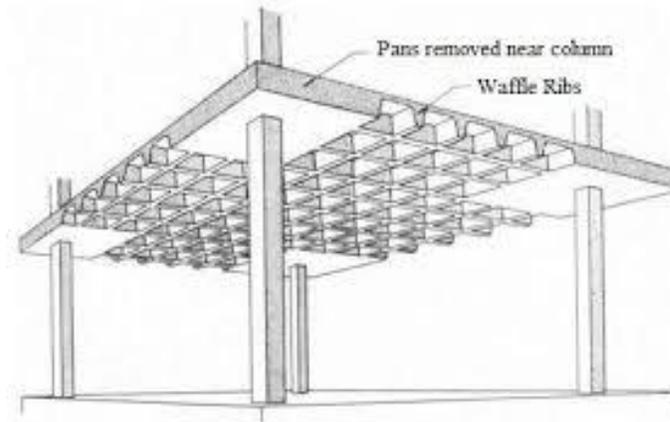
# WAFFLE SLAB

## ■ TWO-WAY WAFFLE SLAB:

A two way slab reinforced by ribs in two directions

Able to carry heavy loads and long spans

**7.0 – 16.0 m**



# SUMMARY

Slab Type		Loads Transferring	Slab Thickness	Maximum Efficiency	Span
Solid Slab	One-way Solid slab	One way only	Floors: Span/ 30 Roofs: Span/ 36 (10 cm min.)		1.8-5.5 m
	Two-way Solid slab	Two ways	Slab perimeter/ 180 (10 cm min.)	Square/ nearly square bays	4.5-12 m
Flat Slab	Two-way flat plate	Two ways	Span/ 33	Regular column grid with some flexibility in placement	3.6-7 m
	Two-way flat slab	Two ways	Span/ 36		6-12 m
Hollow Block	Two-way Hollow Block	Two ways	Span/ 24		5-12 m
Waffle Slab	Two-way waffle slab	Two ways	Span/ 24		7-16 m

# ASSIGNMENT #7

On 50x70 cm paper, draw the required sketches for each type of slabs according to the following table:

	Slab Type	Plan	Looking up Plan	3D sketch	Examples
Solid Slab	One-way Solid slab				
	Two-way Solid slab				
Flat Slab	Two-way flat plate				
	Two-way flat slab				
Hollow Block	Two-way Hollow Block				
Waffle Slab	Two-way waffle slab				

# CONTACTS



<http://bu.edu.eg/staff/sameir.hammad>



Saturday, Sunday and Tuesday ... 9:00 am to 2:00 pm



Sameir M. Hammad