

# **Structural Engineering**

**Structures III / 3<sup>rd</sup> year of Architecture Engineering Department/  
College of Engineering/ Al-Muthanna University**

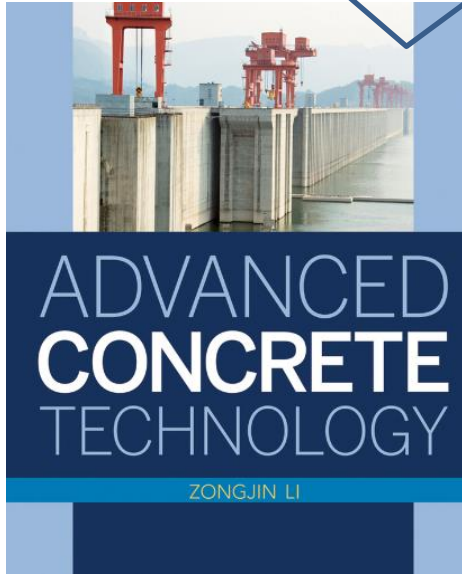
# Syllabus

## Structures III / Year 3 / First Semester

Week No.	Subject
1+2	Introduction about the structures, types of applied forces and load distribution on structural members
3+4+5	Determinant and indeterminate structures
7+6	Introduction about concrete design and stress-strain curves for concrete and steel
8+9+10+11	Analysis and design of the reinforced concrete beams under flexural loading
12+13+14	Design of the reinforced concrete beams under shear

# Recommended Text Books

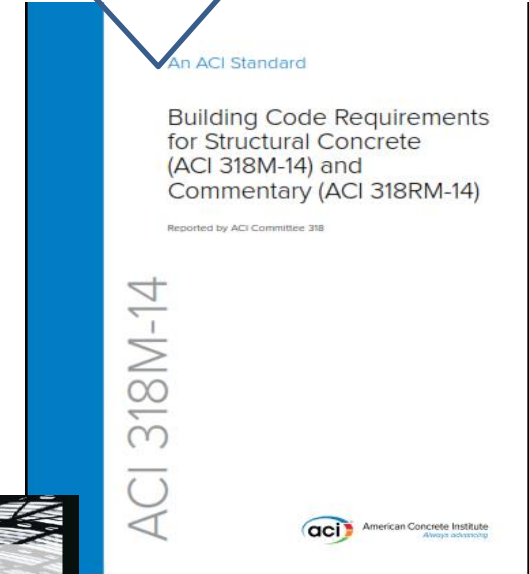
For Concrete Materials



For Structural Analysis

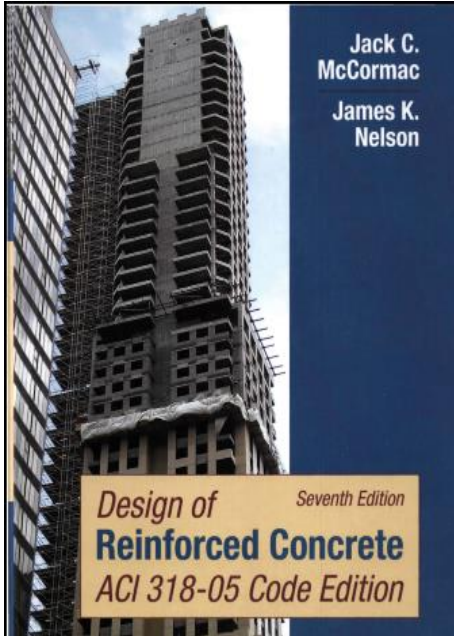


For Design of Concrete Structures



# Recommended Text Books

For Concrete  
Structures



For Steel Structures



# **Design Process in Structural Engineering**

- **Select material for construction.**
- **Determine appropriate structural system for a particular case.**
- **Determine forces acting on a structure.**
- **Calculate size of members and connections to avoid failure (collapse) or excessive deformation.**

# STRUCTURES

- **Structures** = Things with a definite size and shape, which serve a definite purpose or function.
- To perform its function, every part of the structure must resist **forces** (stresses such as pushes or pulls) that could change its shape or size.
- The structure must also be able to support a **load**.
- **Load** = The weight carried or supported by a structure.

# TYPES OF STRUCTURES

- **Natural Structures:** Structures not made by people.
- Examples: feathers, sand dunes...
- **Manufactured Structures:** Structures that have been built by people.
- Examples: buildings, bridges, umbrellas, airplane

# CLASSIFYING STRUCTURES BY DESIGN...

- **Design** = How a structure is put together, how it is shaped and the materials used in the structure.

## 1) Mass Structure

A mass structure can be made by piling up or forming similar materials into a particular shape or design.

Examples:

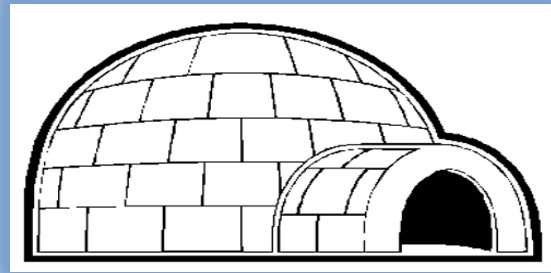


# MASS STRUCTURES...

- **Natural Mass Structures**



## Manufactured Mass Structures



# TYPES OF STRUCTURES - CONTINUED...

## 2) Frame Structures

Frame structures have a skeleton made from very strong materials, which supports the weight of the roof and covering materials.

- Some frame structures are simple and consist only of a frame. Examples: ladders, spider webs...
- Some frame structures are more complex with added parts. Examples: bicycles, umbrellas...

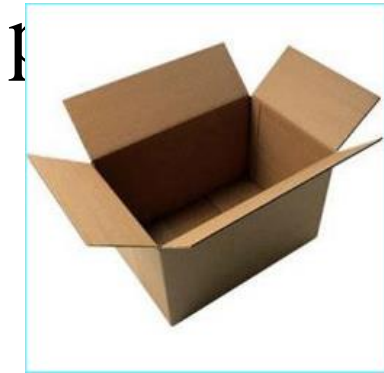
# FRAME STRUCTURES...



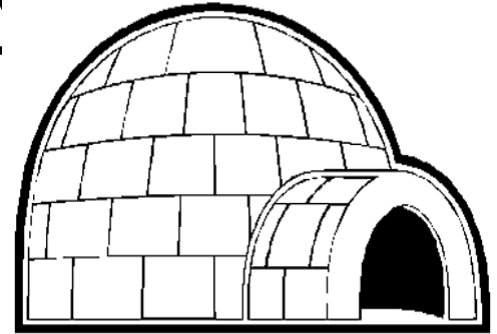
# TYPES OF STRUCTURES - CONTINUED...

- **Shell Structures**

Shell Structures are objects that use a thin, carefully shaped outer layer of material to

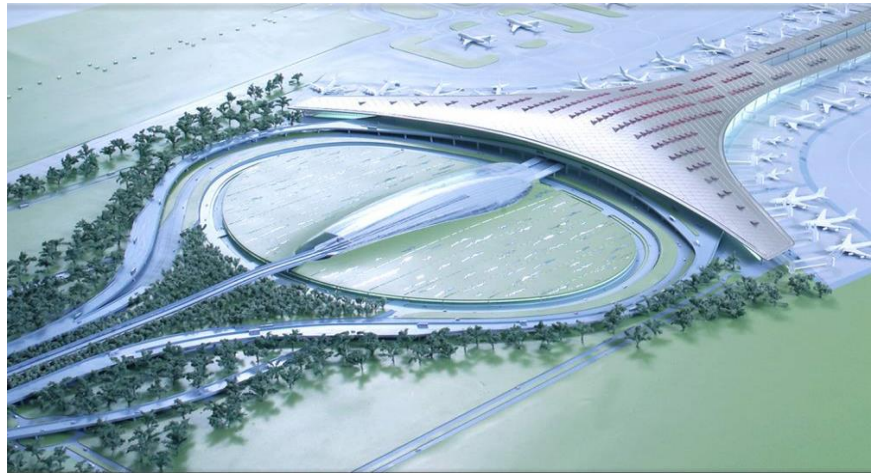


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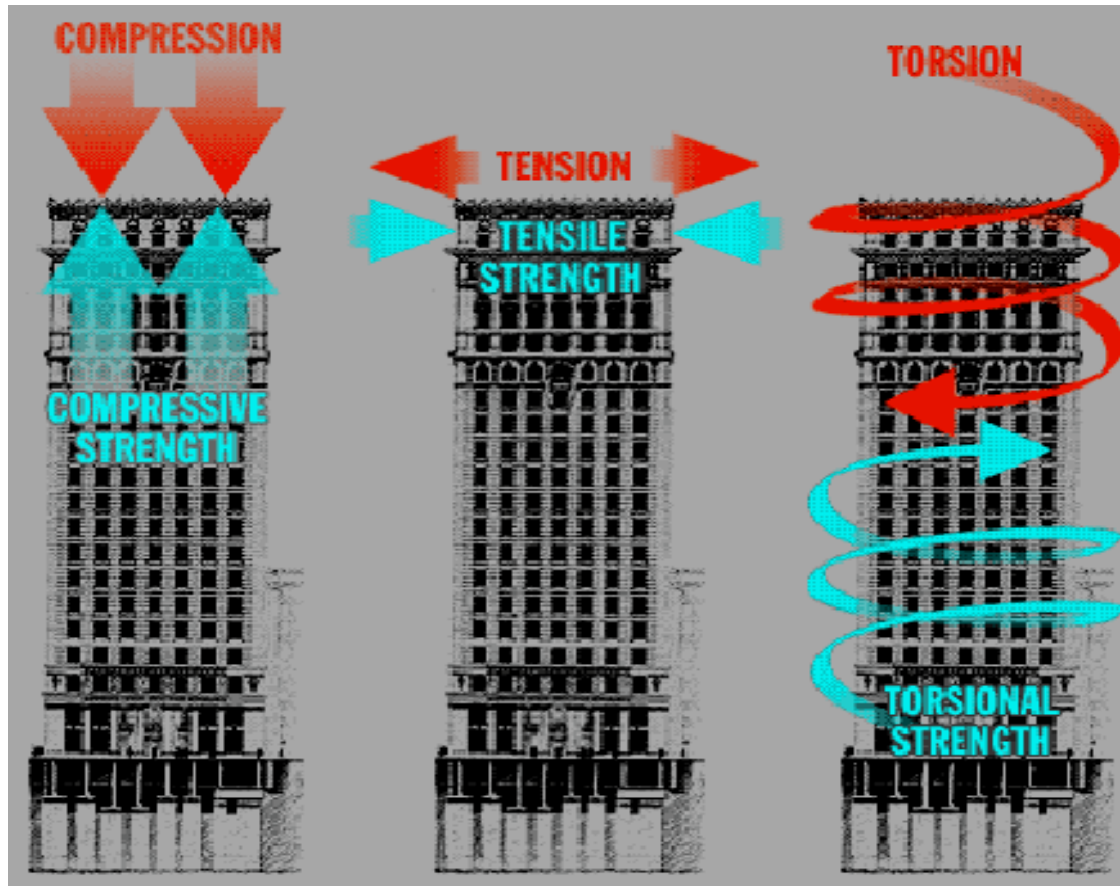
# Examples of Typical Structures





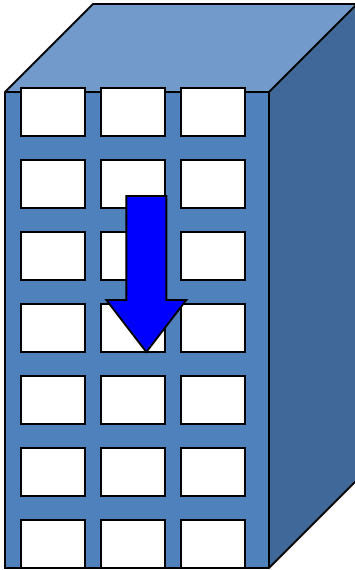
# Forces Acting in Structures

- Forces induced by gravity
  - Dead Loads (permanent): self-weight of structure and attachments
  - Live Loads (transient): moving loads (e.g. occupants, vehicles)
- Forces induced by wind
- Forces induced by earthquakes
- Forces induced by rain/snow
- Fluid pressures
- Others

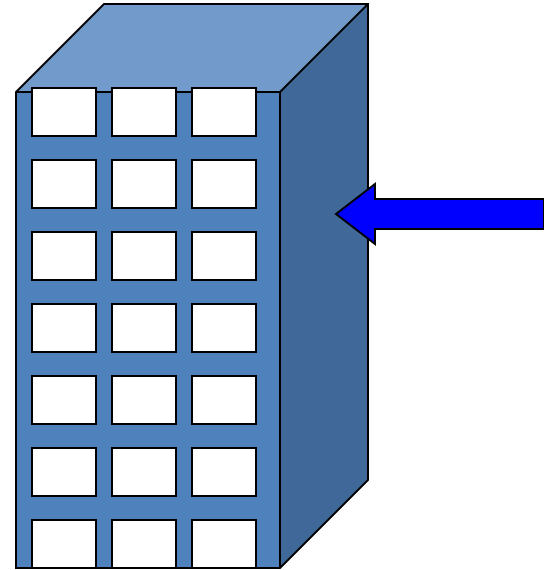




# Forces Acting in Structures

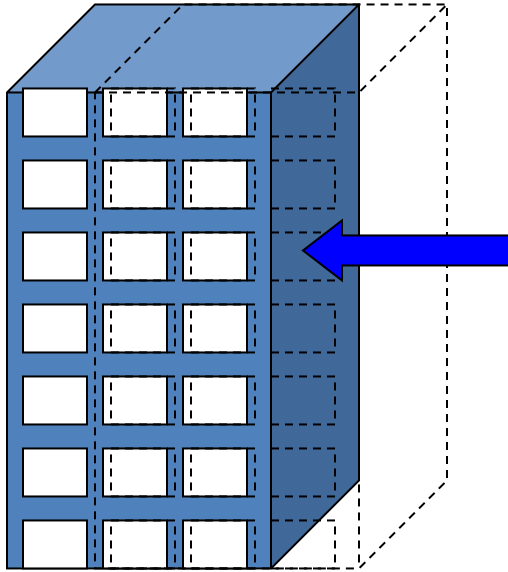


Vertical: Gravity

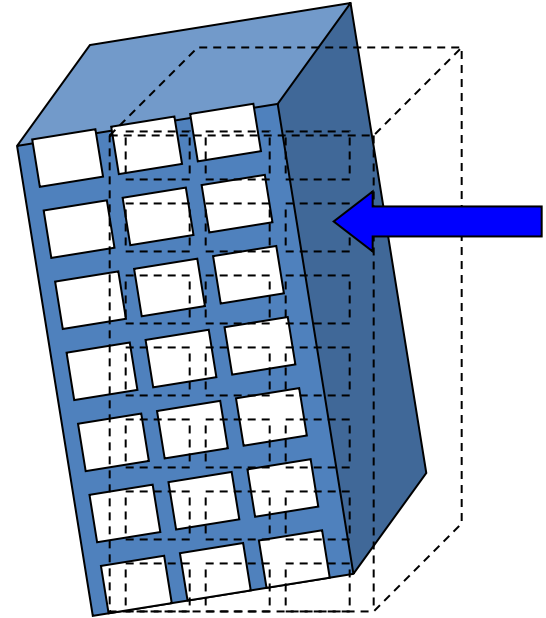


Lateral: Wind, Earthquake

# Global Stability

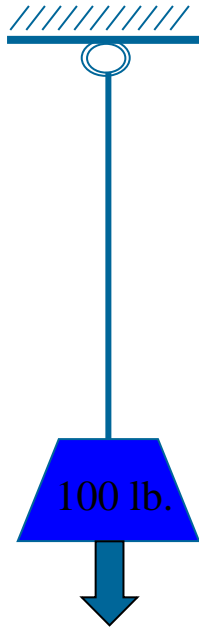


Sliding

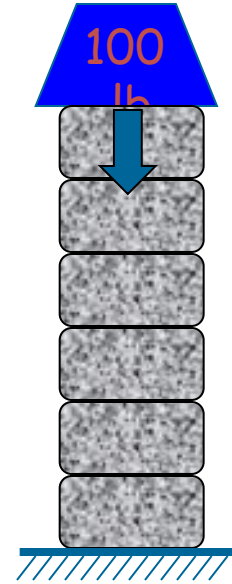


Overturning

# Forces in Structural Elements



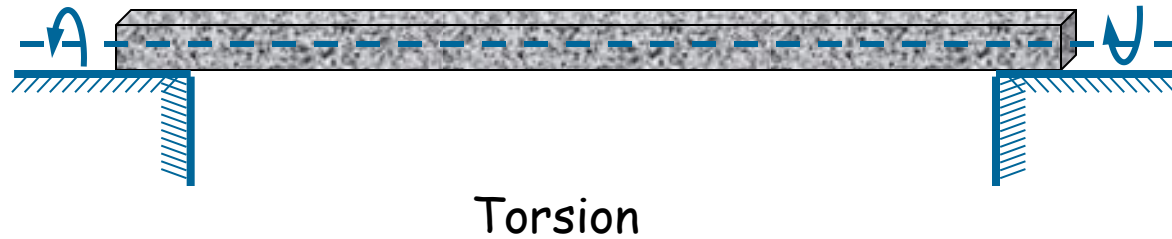
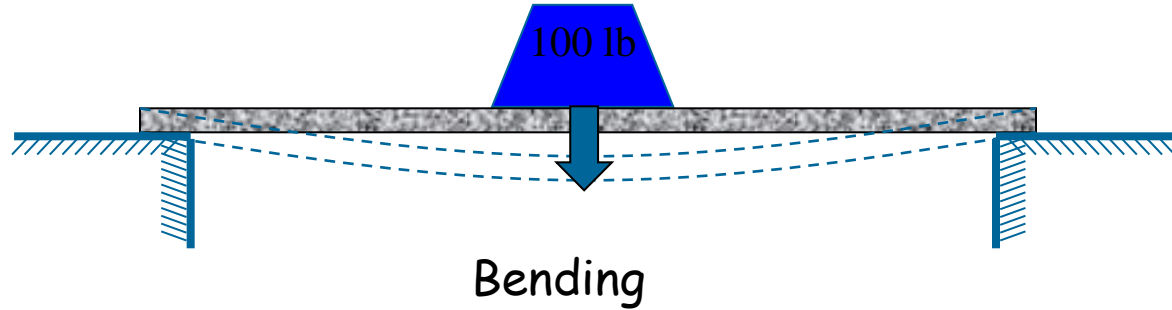
Tension



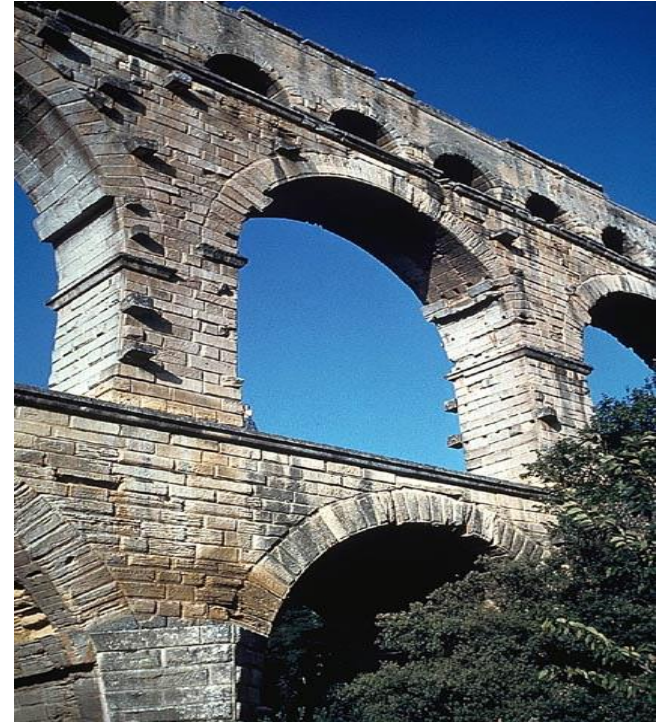
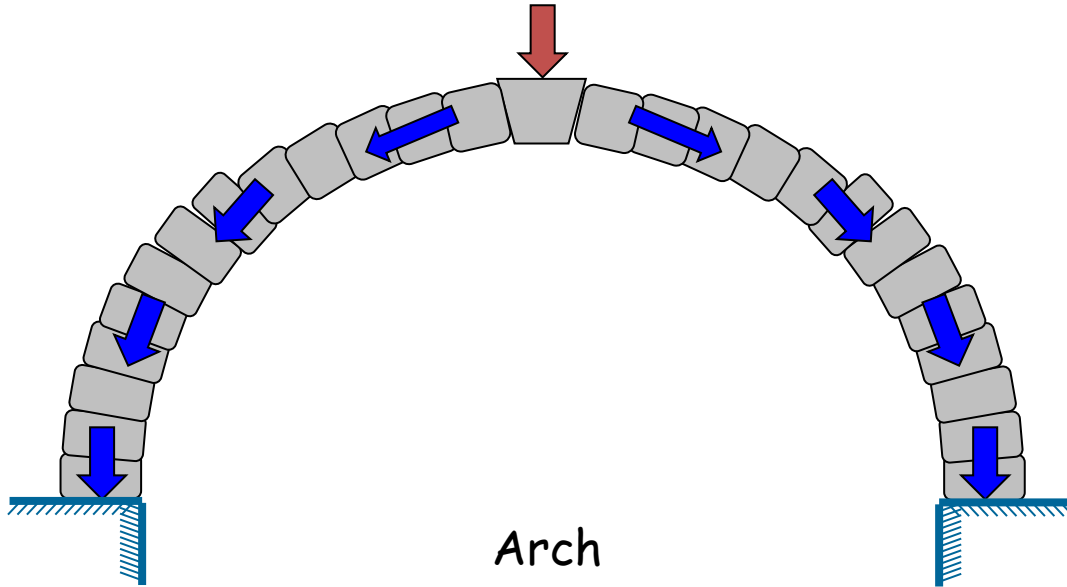
Compression



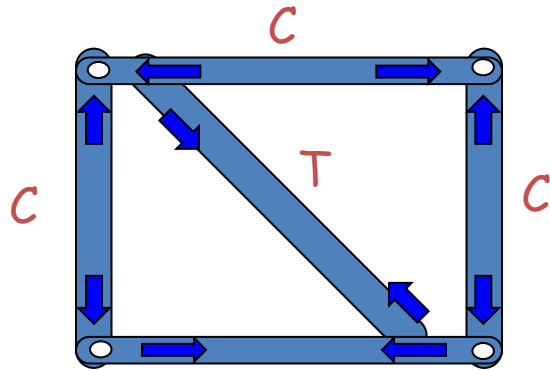
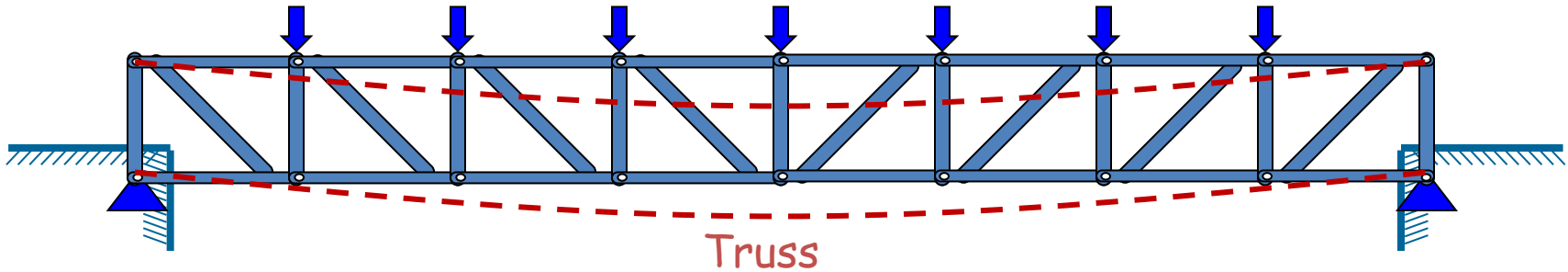
# Forces in Structural Elements (cont.)



# Typical Structural Systems (1)



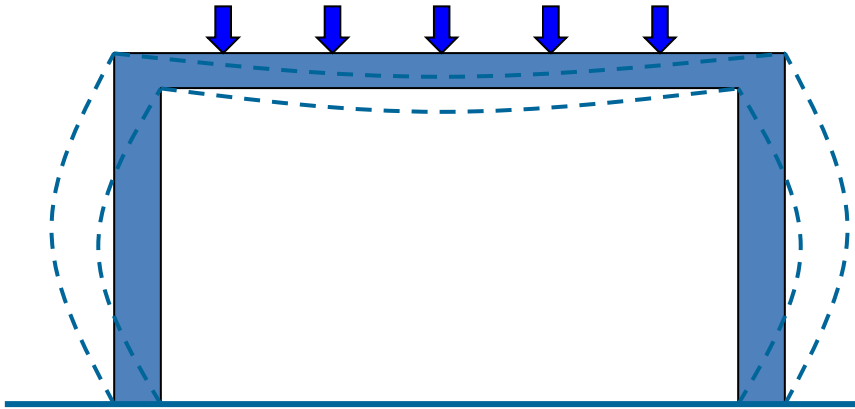
# Typical Structural Systems (2)



Forces in Truss Members



# Typical Structural Systems (3)



Frame



# Typical Structural Systems (4)



Flat Plate

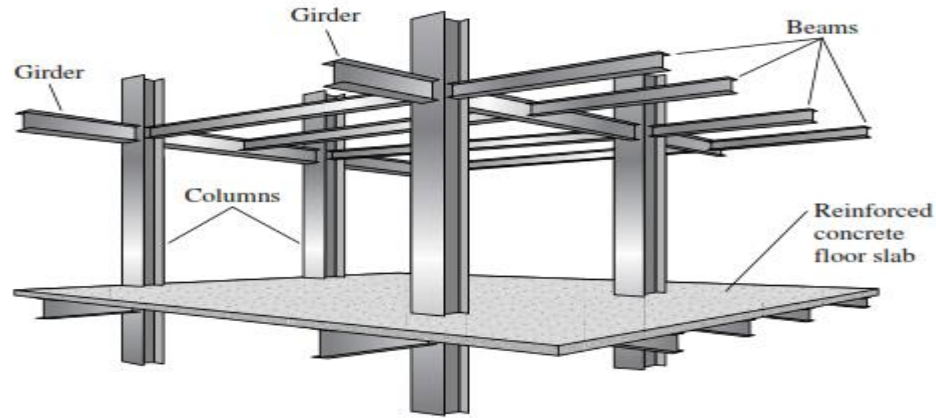


# Typical Structural Systems (5)

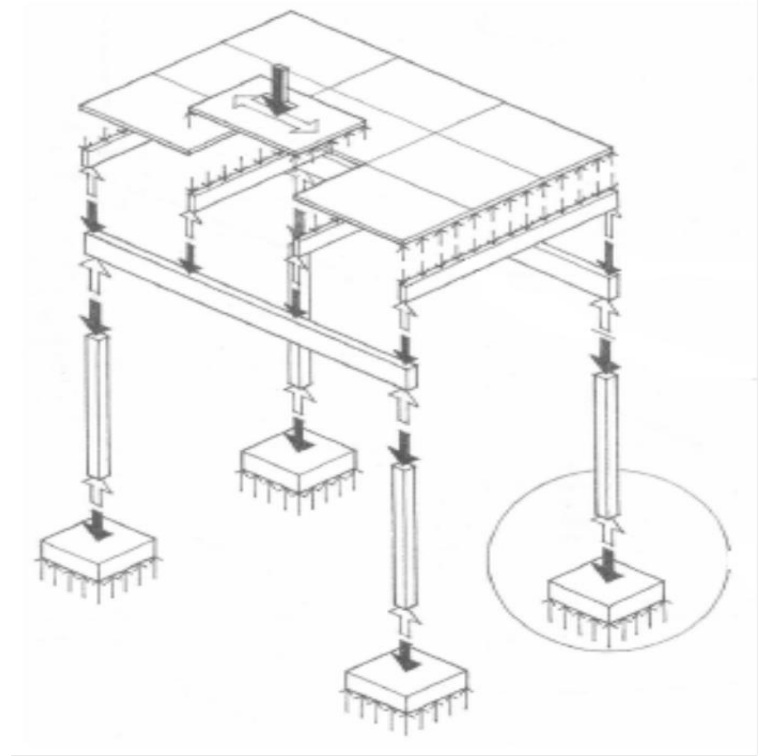


Folded Plate

# Mechanism of Load Transfer between elements of structure



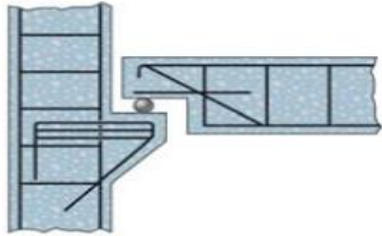
A typical building frame



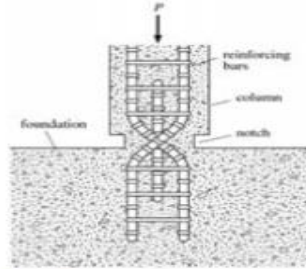
# Types of Supports



pin support



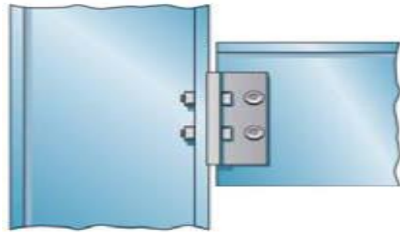
Pin support



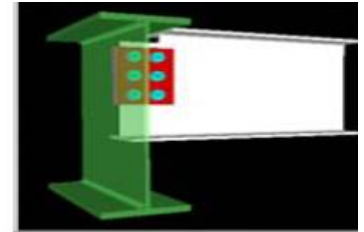
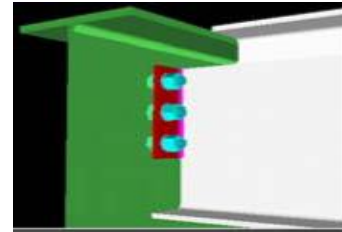
(b)



pin-connected joint



Pin support

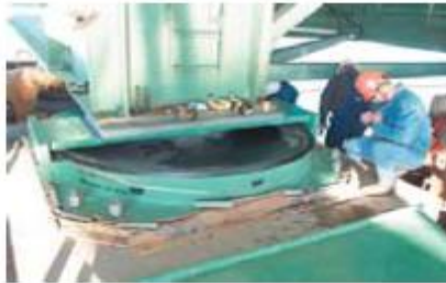
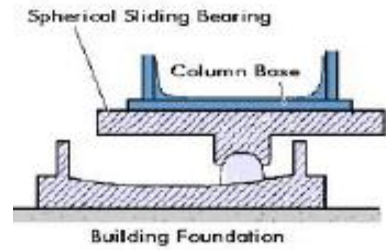


Pin support

Smooth pin



Smooth pin



■ Smooth hinge



Smooth hinge



Smooth hinge



Roller support



Roller support

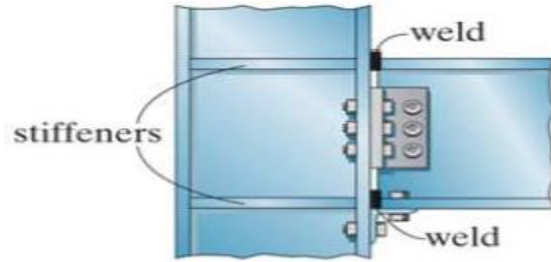




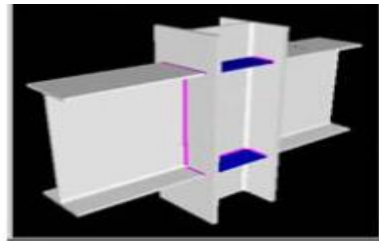
fixed support



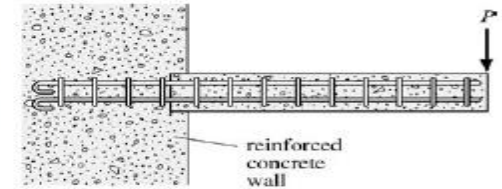
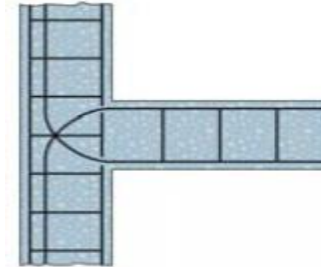
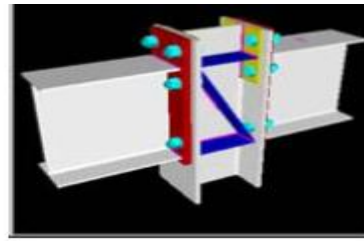
fixed-connected joint



Fixed support



Fixed support

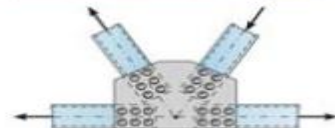


Fixed support

## Fixed support



### ■ Examples of gusset plates.



## **Summary:**

The application of loads to a structure causes the structure to deform. Due to the deformation, various forces are produced in the components that rise the structure. **Calculating the magnitude of these forces, and the deformations that caused them is referred to as Structural Analysis.**

**Structural design** : includes the arrangement and proportioning of structures and their parts so they will satisfactorily support the loads to which they may be subjected.