



جامعة أبو بكر بلقايد  
كلية التكنولوجيا  
UNIVERSITÉ DE TLEMCEM  
Faculté de Technologie



## **A3 ARCHITECTURE**

### **SUBJECT: STRUCTURE IN ARCHITECTURE 1**

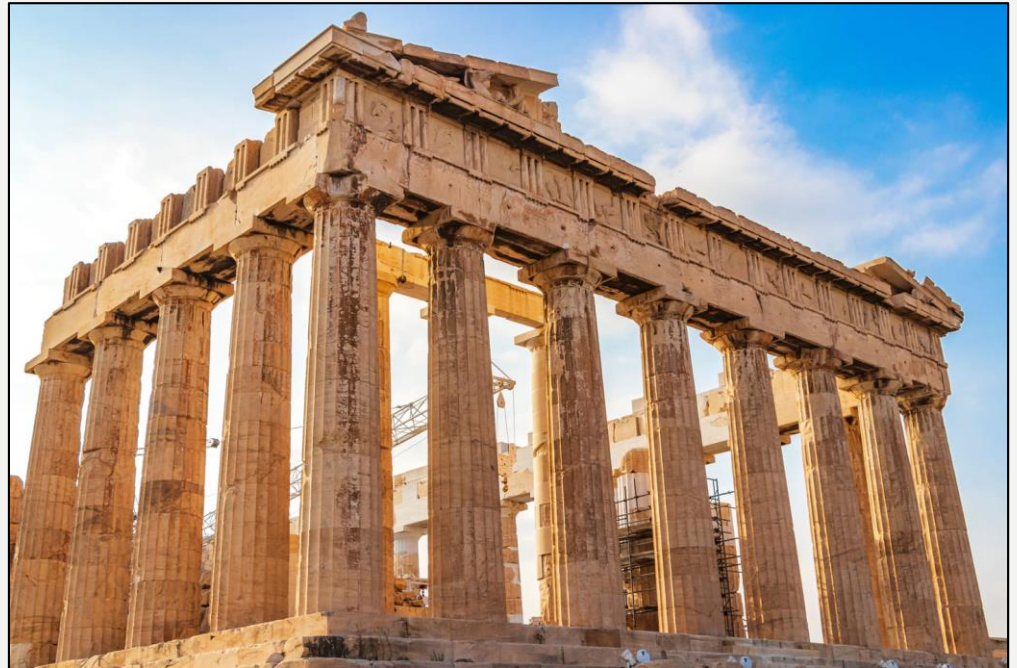
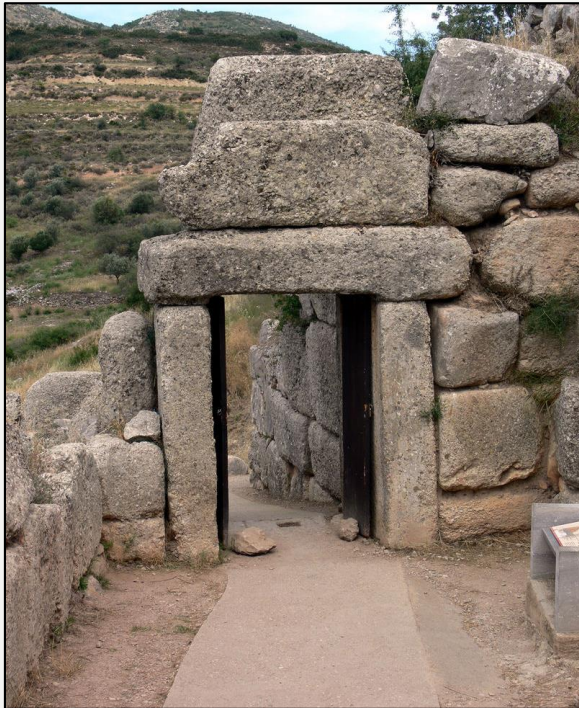
# **CHAPTRE 1: CONSTRUCTION SYSTEMS**

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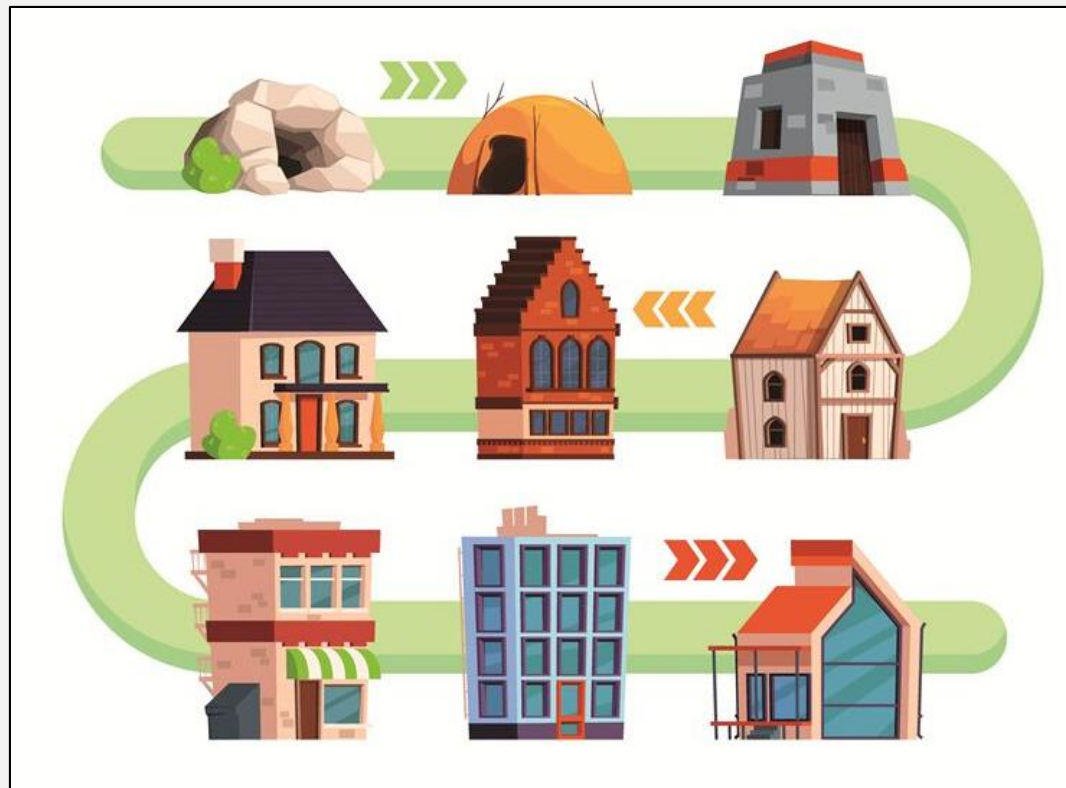
# INTRODUCTION

Since ancient times, humans have sought to design structures capable of supporting loads and protecting living or working spaces. Over time, different construction systems have developed based on the materials available, technical expertise, and architectural needs.



# INTRODUCTION

The evolution of construction has been marked by technical advancements, new materials, material innovations, and changes in social and economic needs.



# HISTORIQUE

## 1. The First Constructions (Prehistory – Ancient Antiquity)

- The very first dwellings were built using the most readily available materials: raw earth, uncut stone, and wood. These constructions primarily served the immediate needs for protection and stability.



# HISTORIQUE

## 1. The First Constructions (Prehistory – Ancient Antiquity)

- **Materials** : earth, uncut stone, tree trunks.
- **Mortar** : clay soils used as a binder and coating.



# HISTORIQUE

## 1. The First Constructions (Prehistory – Ancient Antiquity)

- **Systems:** massive load-bearing walls, wooden pillars, rudimentary vaults.



# HISTORIQUE

## 1. The First Constructions (Prehistory – Ancient Antiquity)

- **Exemple :** Houses of Harran in Mesopotamia (Turkey)



# HISTORIQUE

## 1. The First Constructions (Prehistory – Ancient Antiquity)

- **Exemple :** le village troglodytique de Rochemenier (France)



# HISTORIQUE

## 2. The Great Ancient Civilizations (Egypt, Greece, Rome, ...)

- With the great ancient civilizations, construction took on a monumental dimension. Cut stone, brick, and lime mortar were perfected, enabling the creation of durable and imposing structures.



# HISTORIQUE

## 2. The Great Ancient Civilizations (Egypt, Greece, Rome, ...)

- **Materials:** dressed stone, raw and fired bricks.
- **Mortar:** lime and pozzolana (used by the Romans).



# HISTORIQUE

## 2. The Great Ancient Civilizations (Egypt, Greece, Rome, ...)

- **Systems:** massive load-bearing walls, stone arches and vaults, columns.



# HISTORIQUE

## 2. The Great Ancient Civilizations (Egypt, Greece, Rome, ...)

- **Exemple** : Colosseum of Rome (Italy)



# HISTORIQUE

## 2. The Great Ancient Civilizations (Egypt, Greece, Rome, ...)

- **Exemple :** Pyramides of Gizeh (Egypte)



# HISTORIQUE

## 2. The Great Ancient Civilizations (Egypt, Greece, Rome, ...)

- **Exemple :** Temple of Athens (Greece)



# HISTORIQUE

## 3. The Middle Ages

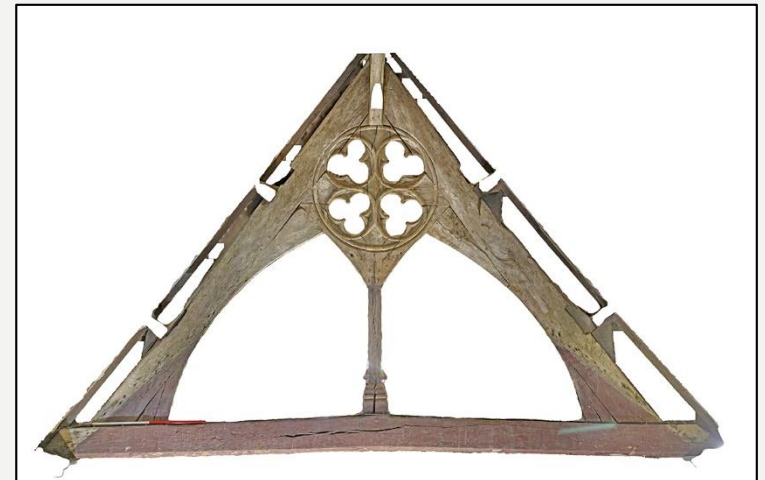
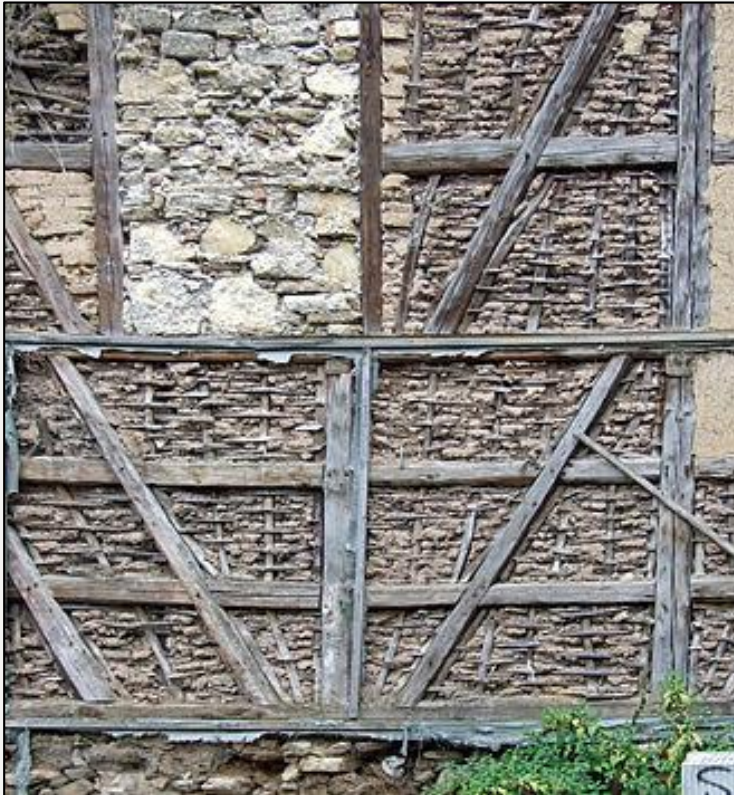
- The Middle Ages perfected the techniques inherited from Antiquity, particularly the use of stone and brick. Gothic architecture introduced new forms (pointed arches, ribbed vaults) that allowed for greater height and increased light within structures.



# HISTORIQUE

## 3. The Middle Ages

- **Materials:** cut stone, fired brick, wood for the framework.
- **Mortar:** air lime widely used for masonry.



# HISTORIQUE

## 3. The Middle Ages

- **Systems:** massive load-bearing walls, stone arches and vaults, stone or wooden columns, and wooden roofs.



# HISTORIQUE

## 3. The Middle Ages

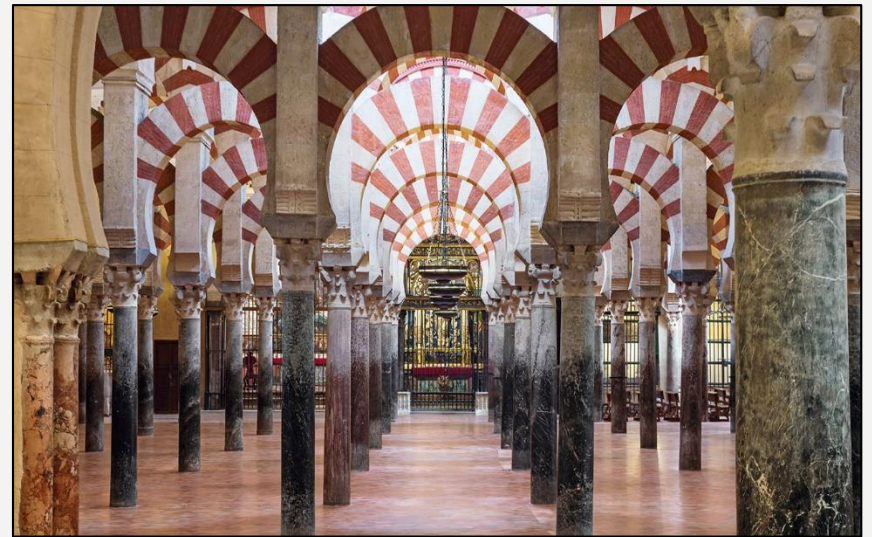
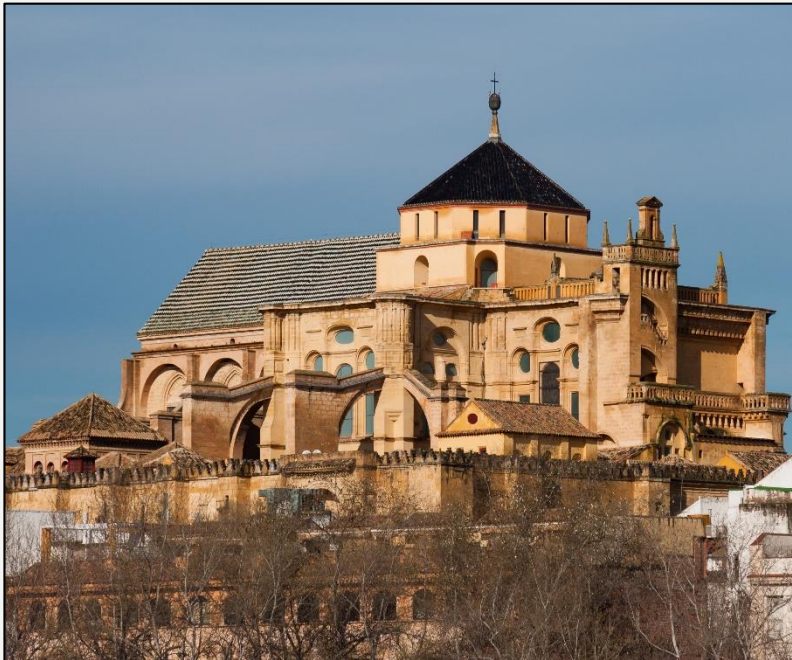
- **Exemple** : Gothic Cathedral of Notre-Dame de Paris (France)



# HISTORIQUE

## 3. The Middle Ages

- **Exemple :** Mosque of Cordoba (Spain)



# HISTORIQUE

## 3. The Middle Ages

- **Exemple :** Houses of colombages in Alsace (France)



# HISTORIQUE

## 4. Modern Era (Metal Construction)

- The emergence of iron, cast iron, and later steel radically transformed construction. Metal frameworks made it possible to span large distances and lighten the overall structure of buildings.



# HISTORIQUE

## 4. Modern Era (Metal Construction)

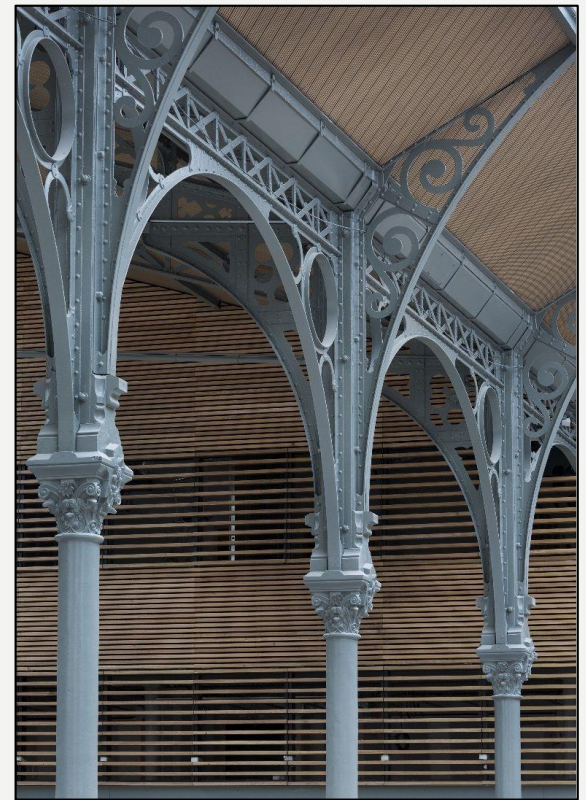
- **Materials:** iron, cast iron, steel, with bricks used for infill.
- **Mortar:** modern cement used only for masonry.



# HISTORIQUE

## 4. Modern Era (Metal Construction)

- **Systems:** metal frame with columns and beams, lattice metal trusses.



# HISTORIQUE

## 4. Modern Era (Metal Construction)

- **Exemple :** The Crystal Palace of London (United Kingdom)



# HISTORIQUE

## 4. Modern Era (Metal Construction)

- **Exemple :** Golden Gate Bridge, San Francisco (United States)



# HISTORIQUE

## 4. Modern Era (Metal Construction)

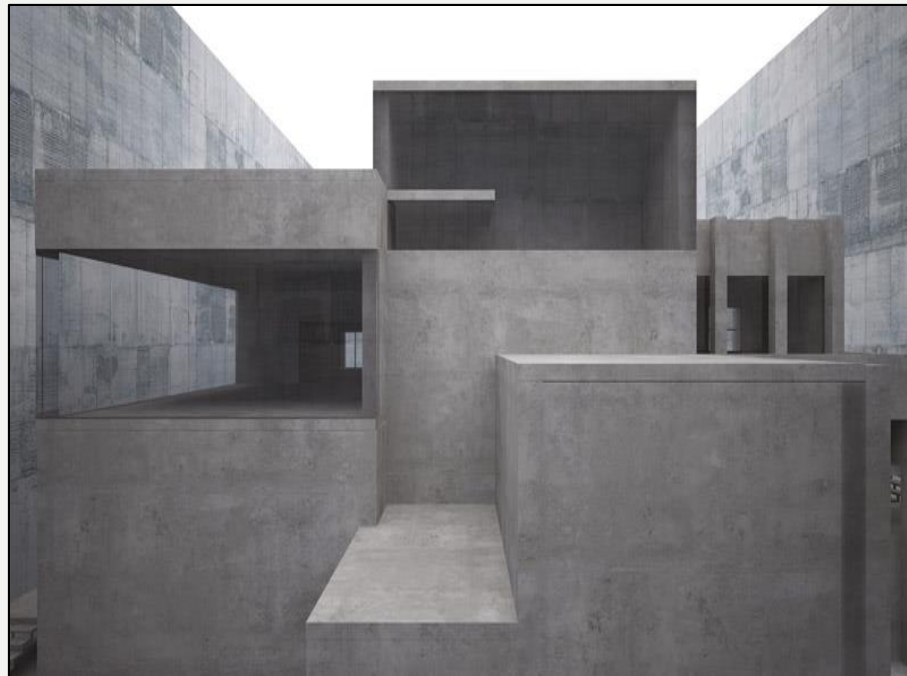
- **Exemple :** Lyon TGV Station (France)



# HISTORIQUE

## 5. Modern Era (Reinforced Concrete Construction)

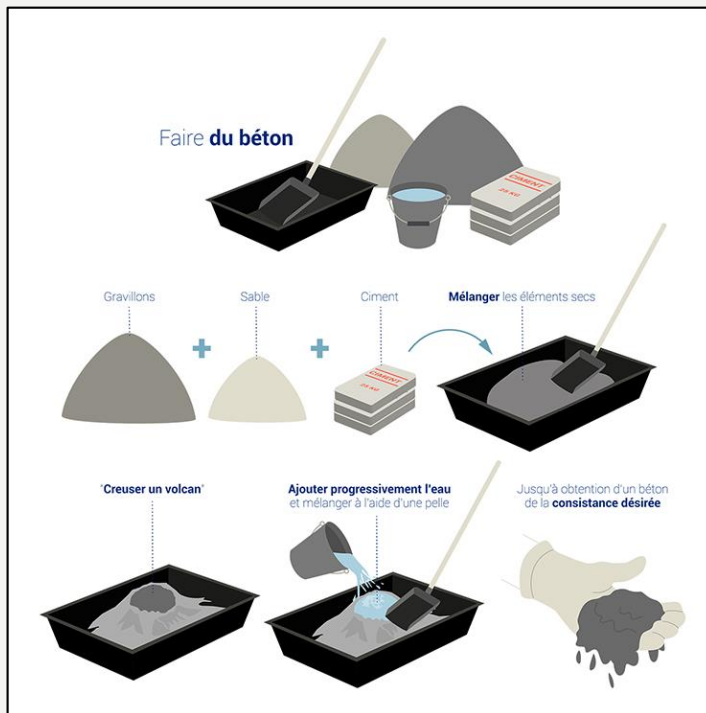
- With the invention of Portland cement and reinforced concrete, a new universal material emerged. It combined the compressive strength of concrete with the tensile strength of steel, revolutionizing structures and architecture.



# HISTORIQUE

## 5. Modern Era (Reinforced Concrete Construction)

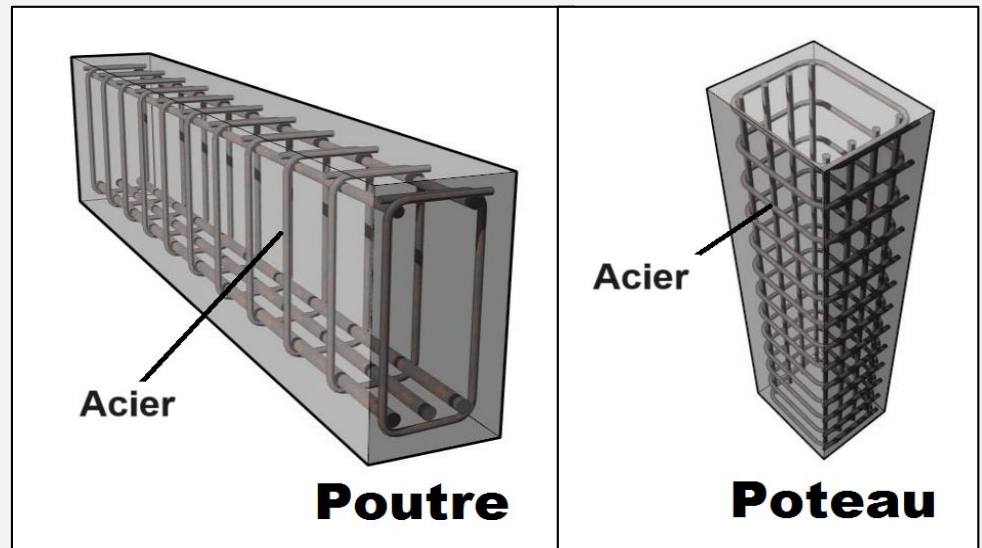
- **Materials:** concrete (gravel + sand + cement + water) and steel (reinforcement bars).
- **Mortar:** modern cement used only for masonry.



# HISTORIQUE

## 5. Modern Era (Reinforced Concrete Construction)

- **Systems:** Reinforced concrete frame with columns and beams, slabs, and shear walls.



# HISTORIQUE

## 5. Modern Era (Reinforced Concrete Construction)

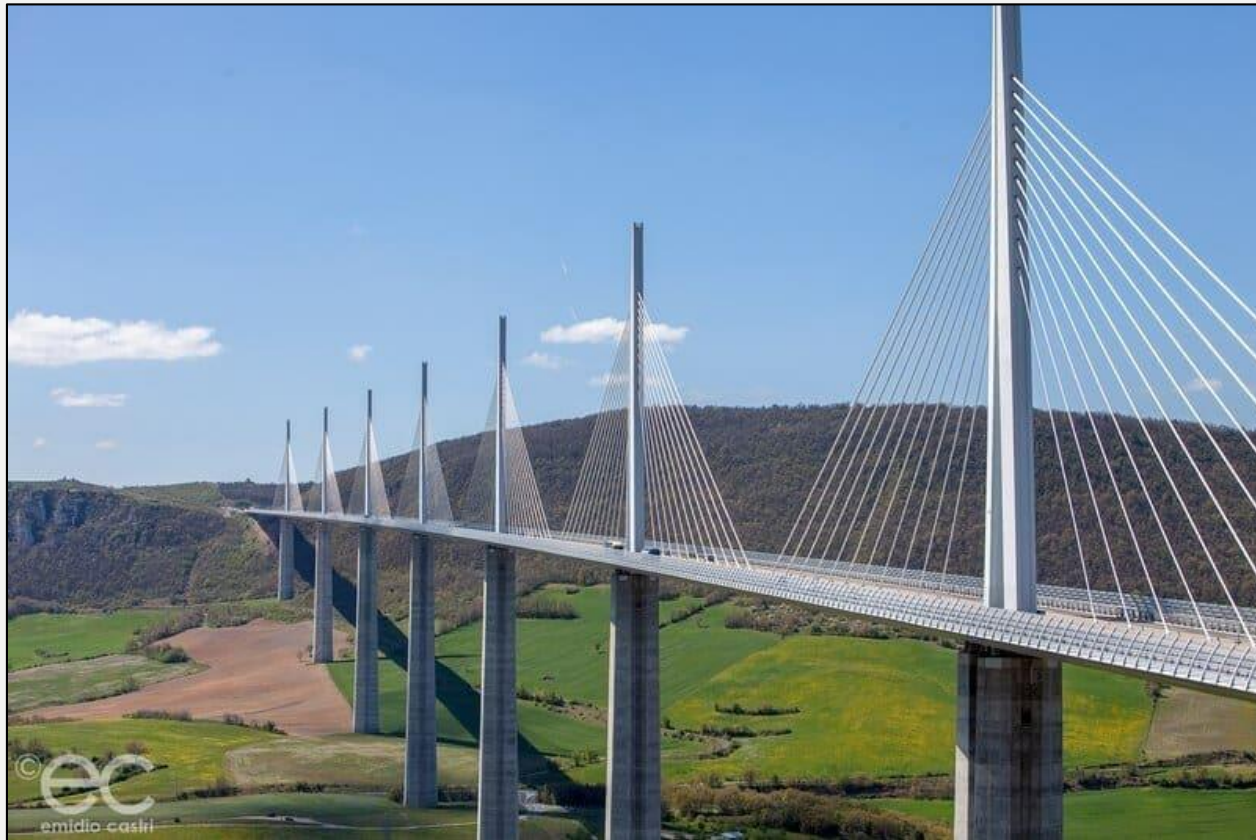
- **Exemple :** “Perret” Buildings in Paris (France)



# HISTORIQUE

## 5. Modern Era (Reinforced Concrete Construction)

- **Exemple :** Millau Viaduct (France)



# HISTORIQUE

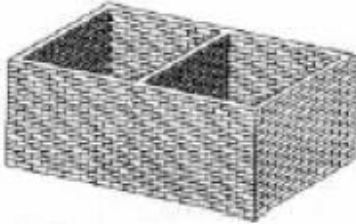
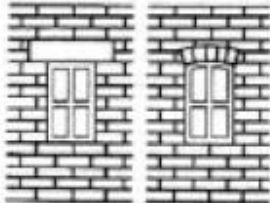
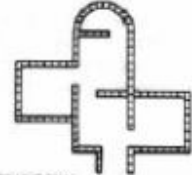
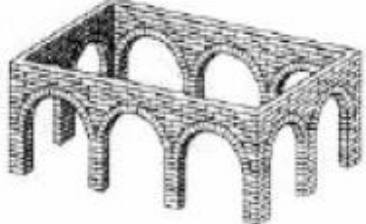
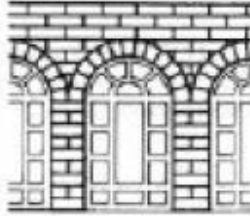
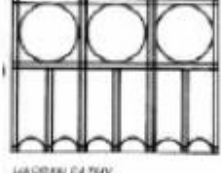
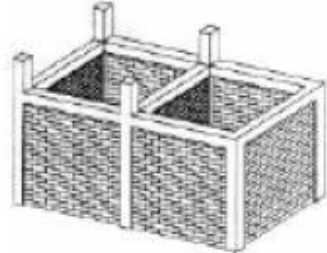
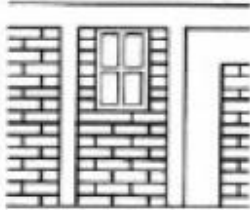
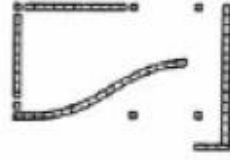
## 5. Modern Era (Reinforced Concrete Construction)

- **Exemple :** Queen Alia International Airport (Jordan)



# construction systèmes

- There are mainly three types of construction systems:

	MURS	OUVERTURES	PLANS	
Enveloppe monolithique				Espace contenu, lumière ponctuelle, murs continus
Structure maçonnerie + remplissage			 <small>HASSAN FATMI</small>	Espace tramé, lumière ponctuelle, murs épais symétriques
Ossature porteuse + remplissage			 <small>LE COMBUSTIER</small>	Espace tramé, lumière uniforme, murs = cloisons

# Construction Systems (Vertical Elevation)

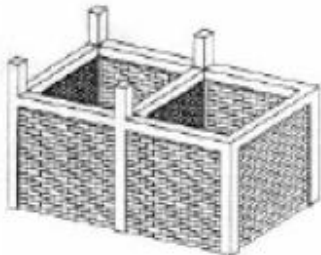
- There are mainly three construction systems:



- Load-bearing wall system (made of stone or brick).



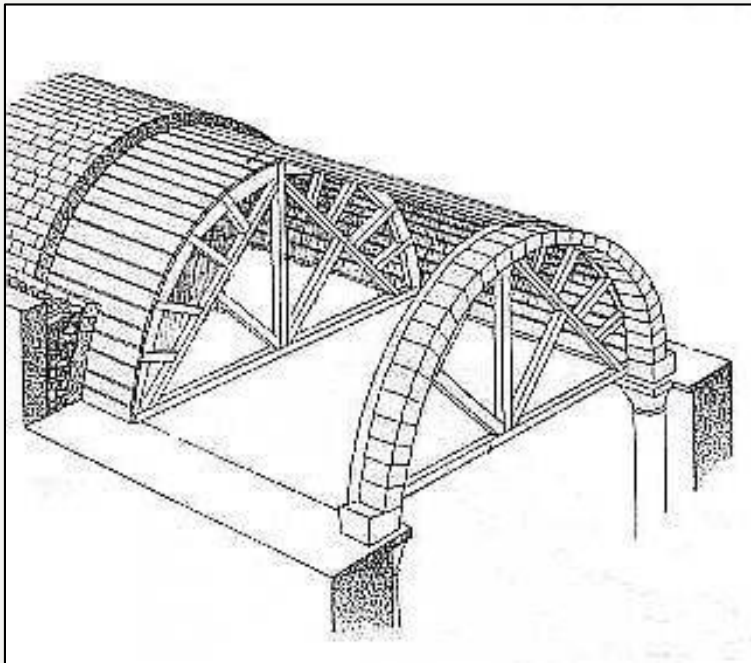
- Traditional column-based system (made of stone or brick).



- Modern column-based system (using reinforced concrete, timber frames, or steel structures).

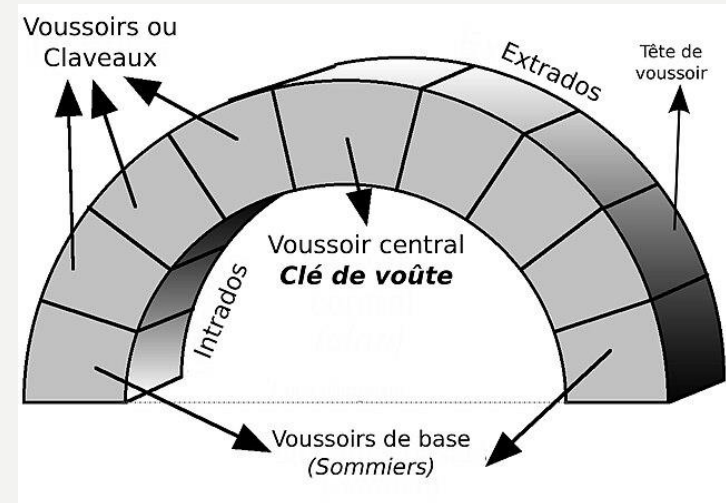
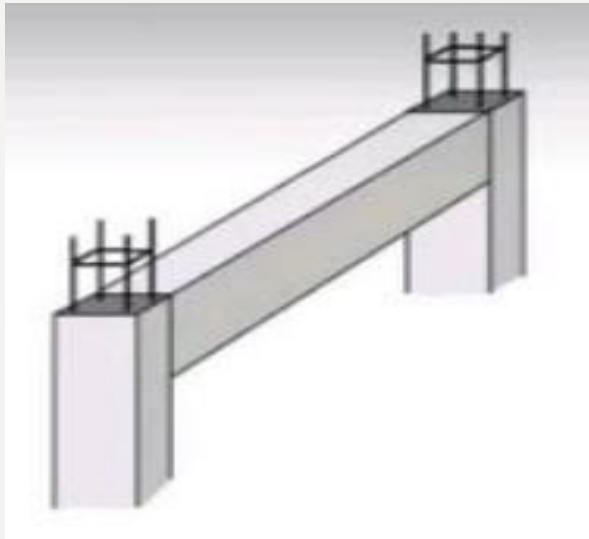
# Construction Systems (Horizontal Spanning)

- In architecture and civil engineering, the term \*spanning\* refers to the act of bridging from one vertical element to another (walls, columns, or pillars) using various construction methods and structural systems.



# Construction Systems (Horizontal Spanning)

- The three types of horizontal spanning systems:
  1. **Linear spanning:** connects two parallel supports.
    - **Example:** beam, lintel, arch.



# Reinforced Concrete Beams



# Steel Beams

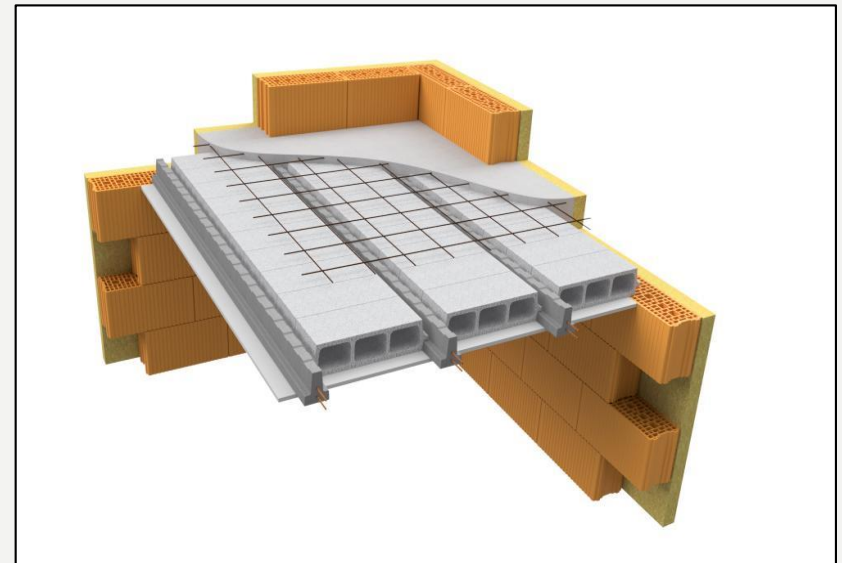
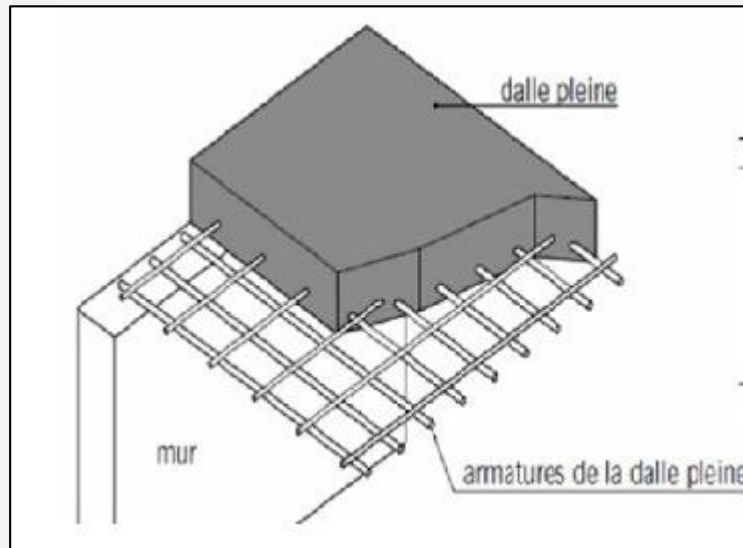


# Arches



# Construction Systems (Horizontal Spanning)

- The three types of horizontal spanning systems:
  1. **Beam spanning:** covers a horizontal surface between two supports.
  2. **Plane spanning:** covers a horizontal surface between multiple supports.
    - **Example:** slab, floor.



# Solid Reinforced Concrete Slabs



# Hollow-Core Reinforced Concrete Slabs



## Floors on Steel Joists



## Floors on Timber Frameworks

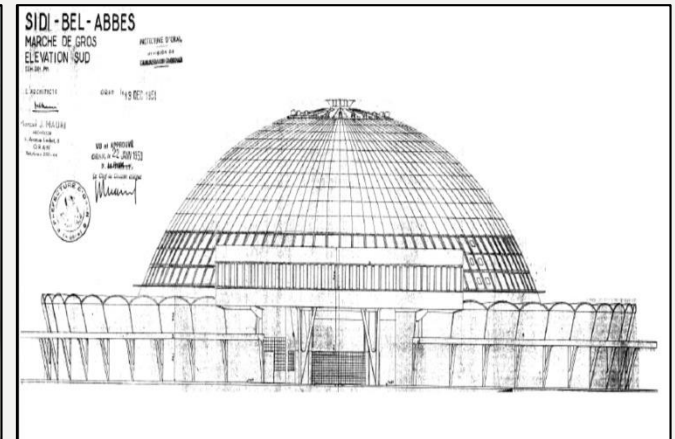
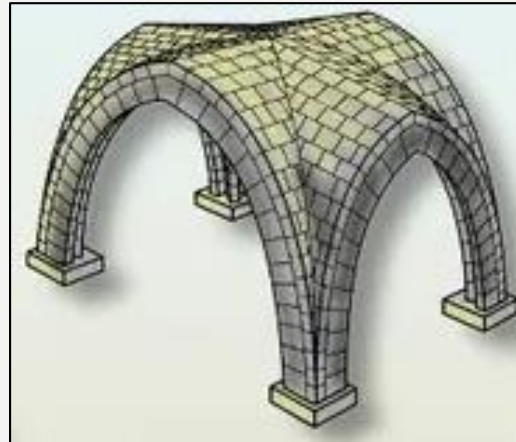
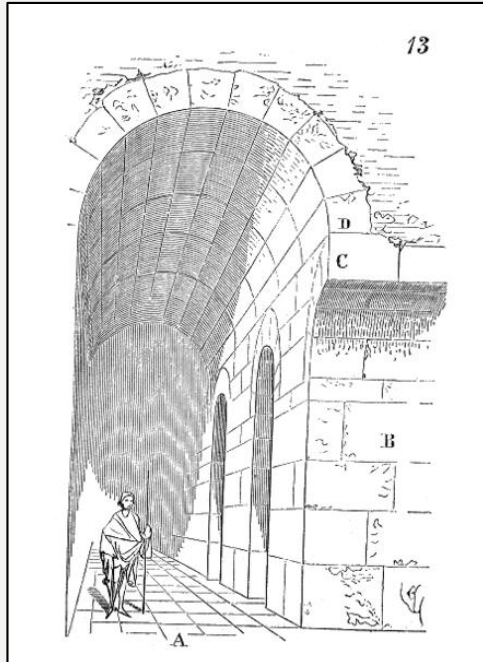


# Construction Systems (Horizontal Spanning)

- The three types of horizontal spanning systems:

**3. Spatial spanning:** covers a three-dimensional volume

- **Example:** vault, ribbed vault, dome.



# Vaults



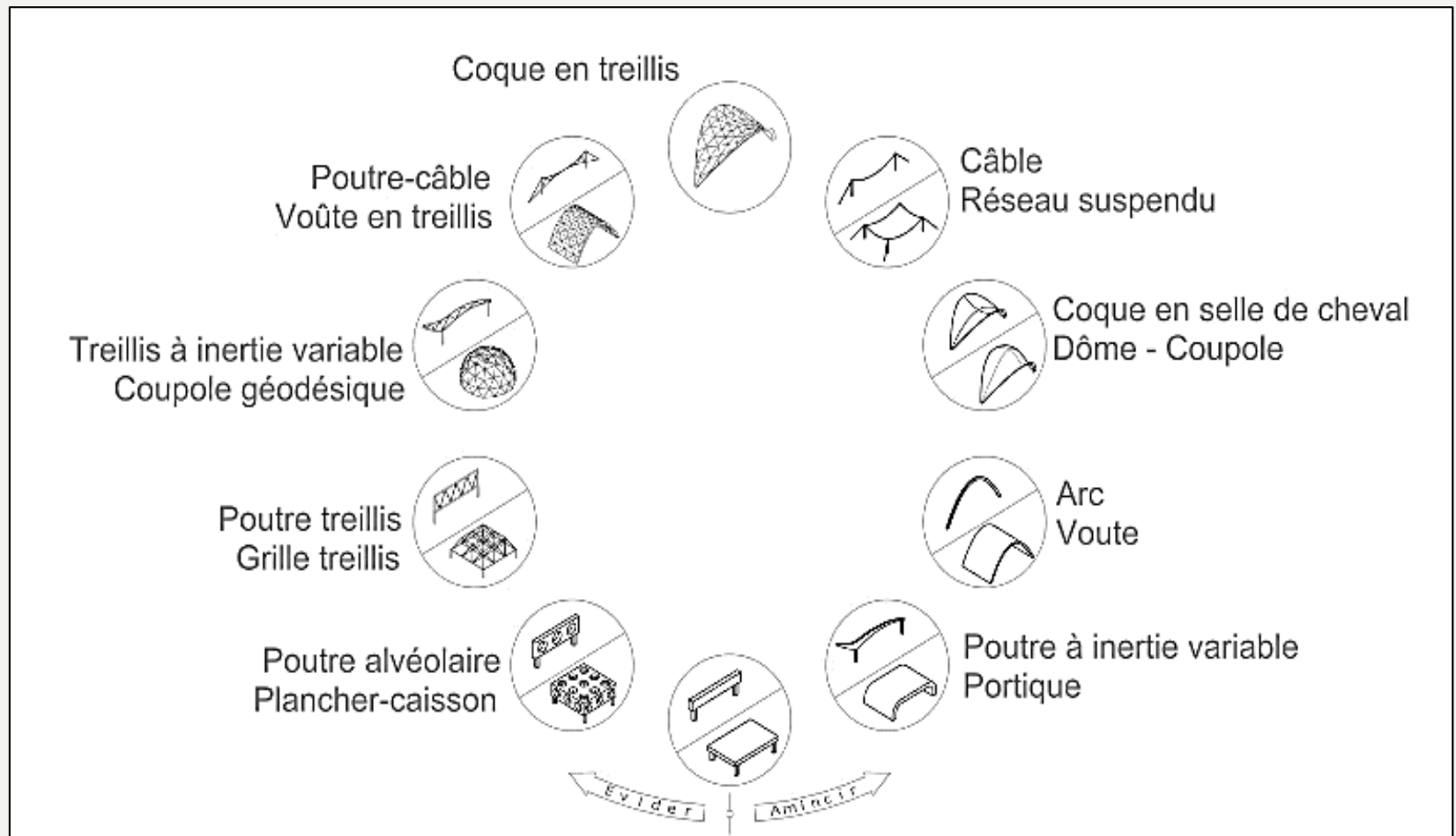
# Ribbed Vaults



# Domes



# Construction Systems (Horizontal Spanning)



# Traduction de quelques mots clés

- Acier: **steel**
- Béton: **concrete**
- Masse: **mass**
- Volume: **volume**
- Poids: **weight**
- Epaisseur: **thikness**
- Bâtiment: **building**
- Poteau: **colomn**
- Poutre: **beam**
- Ferme: **truss**
- Plancher: **roof**
- Etage: **floor**
- Réservoir: **tank**
- Pont: **bridge**
- Corrosion: **corrosion**
- Feu: **fire**
- Incendie: **fire, burning**
- Sol: **soil**
- Effondrement: **collapse**
- Mur : **Wall**
- Constructions métallique: **steel structure**
- Arc : **arch**
- Voute : **Vaults**
- Dalle pleine : **Solid Reinforced Concrete Slabs**
- Dalle en corps creux : **Hollow-Core Reinforced Concrete Slabs**
- Ogive : **Ribbed Vaults**
- Coupole : **Dome**
- Charge permanente: **Permanent Load**
- Charge d'exploitation: **Live Load**
- Surcharge climatique: **Environmental Load**
- Action accidentelle: **Accidental Load**
- Vent: **wind**
- Neige: **snow**
- Température: **temperature**
- Séisme: **earthquake**
- Contrainte: **stress**
- Dimensionnement: **design**
- Déplacement: **displacement**
- Déformation: **deformation, strain**