Structures de batiments

Building structures

Chapter 1

Generality

Semestre 3

Unité d'enseignement fondamental : UEF3	*Semestre :3*	*Crédits : 5*	**VH : 45**			
			CM	***TD***	***TP***	***Autre***
Intitulé matière 1	**Structures de bâtiment**		**18**	**18**	**9**	

Objectifs	**Ce module est composé de deux parties :** • Il est basé sur les fondements du béton armé. On y aborde les principes fondamentaux du fonctionnement du béton armé : comportement du béton, des aciers et de l'association acier-béton. • Il est basé sur les fondements de la construction métallique. A l'issue de ce module, l'étudiant peut exploiter les bases théoriques et réglementaires des calculs d'ouvrages courants en acier dans le domaine élasto-plastique.
Compétences visées	**Être en mesure de :** • Décrire le principe de fonctionnement du béton armé, • Définir le principe de ferraillage d'éléments simples en béton armé, • Dimensionner des sections droites rectangulaires sous sollicitations normales et de flexion, • Décrire les dispositions constructives, • Réaliser un schéma d'armatures avec sa nomenclature. • Décrire une charpente, avec stabilité et contreventement du bâtiment, • Définir le modèle mécanique des porteurs horizontaux et verticaux, et des systèmes de contreventement simples, • Pré-dimensionner les éléments simples de la structure. • Vérifier les éléments simples de la structure.

		Niveau d'exigence
Contenu	Béton armé : • Loi de comportement des matériaux (béton, acier), • Association acier béton, notion de durabilité des structures en béton armé, • Poutres isostatiques, • Ferraillage et dispositions constructives, • Exploitation des plans détaillés de béton armé Structure métallique : • Etude des systèmes de contreventement simples, • Introduction au problème d'instabilité, • Etude des poutres (résistance de section, déplacement, instabilité), • Etude des poteaux (résistance de section, instabilité), • Assemblages, • Exploitation des plans détaillés en construction métallique.	**2** **2**

Reinforced concrete structure

Objective of Dimensioning

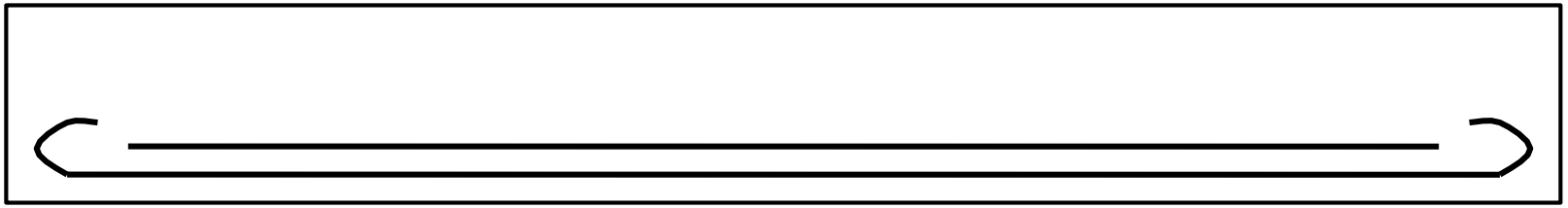
- Ensure structural elements are sized to safely support applied loads while maintaining stability.

Load Considerations

- Types of Loads:
- - Dead Loads (Permanent)
- - Live Loads (Temporary)
- - Environmental Loads (Wind, Earthquake, etc.)
- - Dynamic Loads (Moving machinery, traffic)

Beams

- Beams transfer loads to columns or walls.
- Dimensioning criteria: Bending Moment, Shear Force, and Deflection.



Columns

- Columns resist axial loads and prevent buckling.
- Dimensioning criteria: Axial Load Capacity and Buckling Resistance.

Material Properties

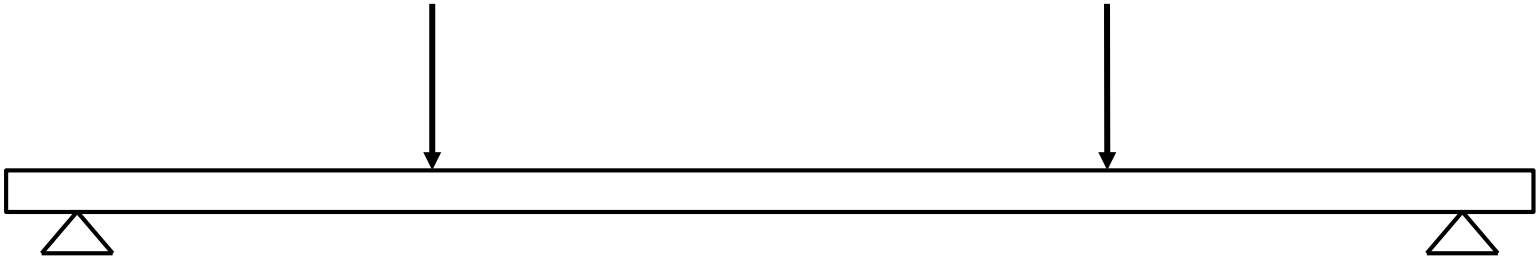
- Common Materials: Concrete, Steel, Timber, Composite Materials.
- Concrete: High compressive strength but low tensile strength.
- Steel: Strong in both tension and compression.

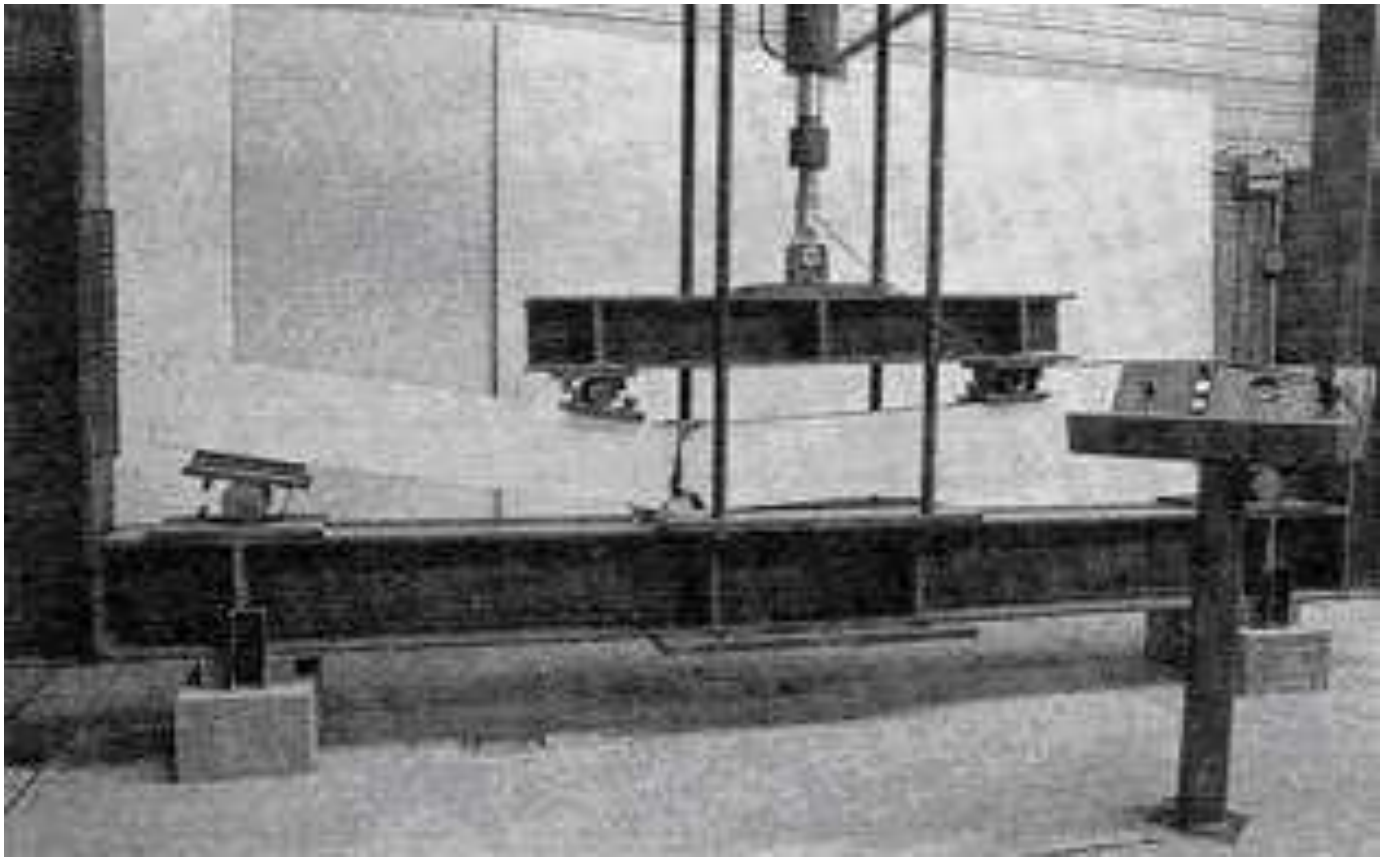
Load Transfer Mechanisms

- Load paths transfer forces through the structure from slabs to beams, beams to columns, and columns to foundation.

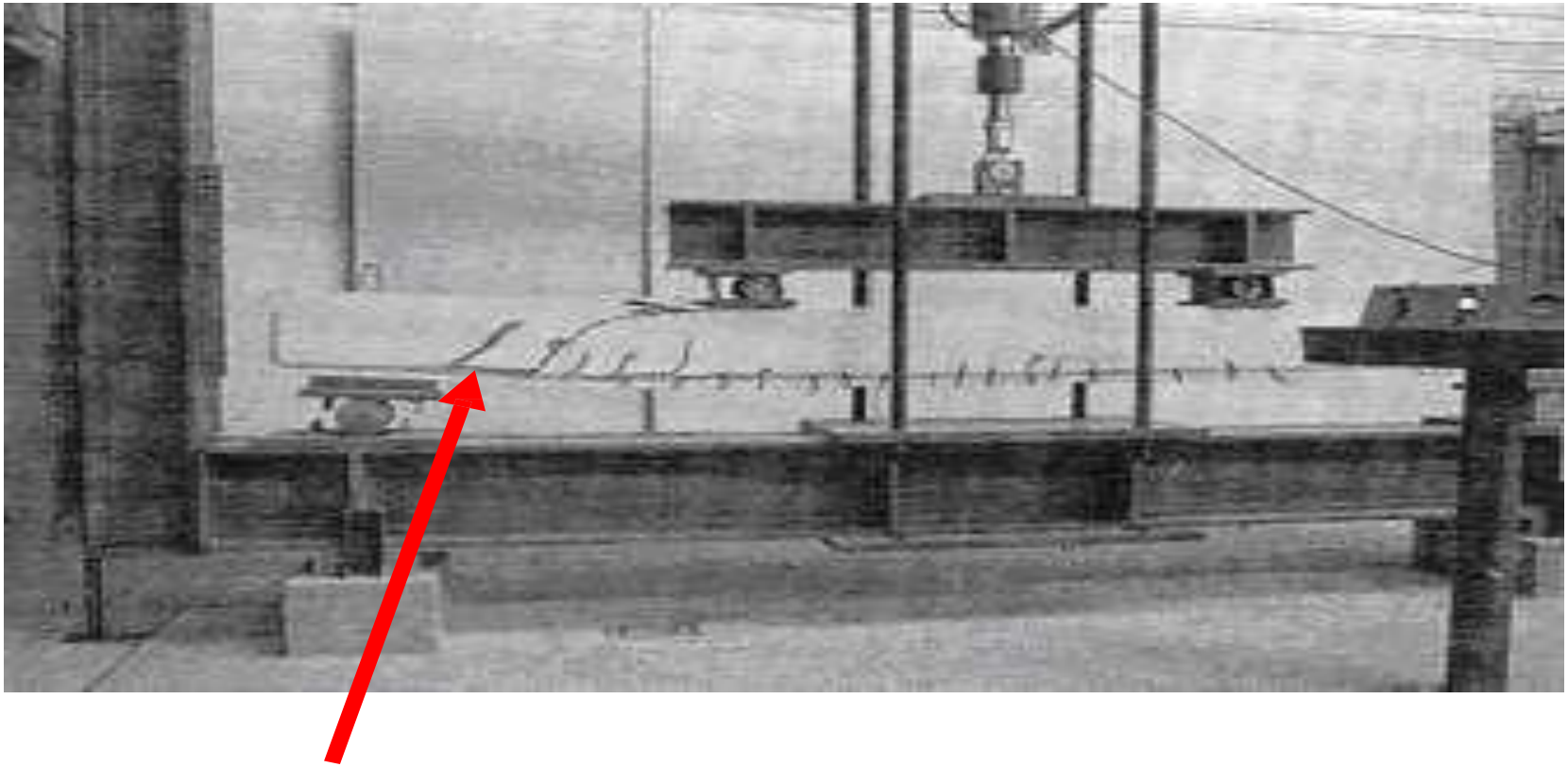
Stability and Safety Considerations

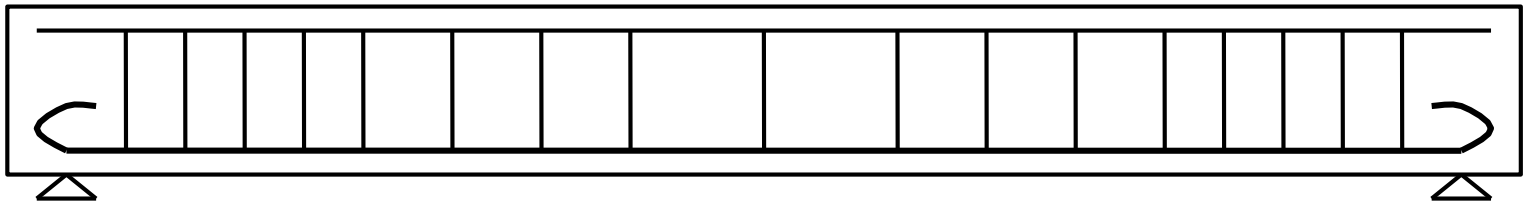
- Dimensioning ensures the structure is stable and prevents failure due to overloading or instability.
- Apply safety factors to ensure design resilience under various load conditions.





Reinforced Concrete





General Information

- What is concrete?
- Concrete is a complex material obtained by mixing in suitable proportions:
- - Gravel or stones
  - Aggregates (sand, crushed gravel)
  - A binder (usually cement)
  - Water
- The mixture sets (solidifies) and hardens (gains strength).

Advantages and Disadvantages

- Advantages of concrete in civil engineering:
- - Cheap and durable
  - Easy and quick to prepare
  - Easy to mold
  - Excellent compressive strength (20-60 MPa)
- Main disadvantage:
- Low tensile strength (1/10 of its compressive strength).

Solutions for Weaknesses in Concrete

- Two solutions to address concrete's low tensile strength:
- - Reinforced concrete: Place steel reinforcements in tensile zones.
- - Pre-stressed concrete: Pre-stress using internal forces to neutralize tensile stresses.

Reinforced Concrete Principle

- Reinforcements absorb tensile forces, concrete absorbs compressive forces.
- Steel reinforcements are added to compensate for concrete's low tensile strength.

Notions of safety
Principles of regulation

What criteria should a structure meet?

- A structure must be designed and built in such a way that :

✓ it remains adapted to the use for which it was designed,

✓ it is resistant to all actions and influences which may occur during its construction and use.

❑ safety is an important criterion in construction  but not absolute safety.

But why not? How can we solve the problem?

The limit states method is the basis for calculations in accordance with the BAEL and Eurocodes regulations.

Principle of the limit states method

- Like most international codes, the French BAEL 91 regulations and Eurocode are semi-probabilistic regulations based on the concept of limit states.

What does this method consist of?

The limit states method consists of :

- ❖ Defining the phenomena (known as limit states) to be avoided
- ❖ Estimating the gravity of the risks associated with these phenomena
- ❖ defining safety criteria

Dimensioning the building components in such a way that the probability of one of these phenomena occurring is limited to a value low enough to be acceptable in terms of risk and cost.

The different limit states

- In practice, each phenomenon to be avoided has a corresponding **limit state**. Depending on the severity of the risks associated with them, these limit states can be divided into two main categories:

- The limit states method consists of :

❖ **The ultimate limit states**, which are considered to be reached when the structure or one of its elements would be **ruined**.

❖ **The service limit states**, which are considered to compromise the use of the structure **without causing ruin**.

Ultimate limit states (ELU)

- **A distinction can be made between**

➢ the ultimate limit state of static equilibrium, which concerns **the stability of the structure**

➢ the ultimate limit state of resistance, which concerns **the non-failure of the structure**.

➢ the ultimate limit state of **shape stability**, which concerns the slender parts subjected to an axial compressive stress

Service limit states (ELS)

- **A distinction can be made between**

➢ **The compression limit state of the concrete**:

Serious defects may appear in the elements.

➢ **The limit state of fissure opening** :

Corrosion of insufficiently protected rebars compromises the durability of the structure.

➢ **The limit state of deformation**:

Excessive deformation of the structure can cause damage.

Conduct of justifications

The approach is as follows

1. **Make an inventory of the actions applied to the various elements of the structure**
2. **Determine their intensities**
3. **Calculate the stresses generated by the actions**
4. **Determine the design loads**
5. **Make the necessary justifications**

Actions

All the forces and moments applied to a structure.

A distinction is made between :

- ✓ **permanent actions (G)**
- ✓ **variable actions, (Q)**
- ✓ **accidental actions, (A) or (FA)**

Representative values

The nature and intensity of the actions to be included in the calculations are fixed :

1. **Either by the contractor**

2. **By reference to standards, codes or regulations in effect,**

3. **Directly when they are specific to the structure.**

For example

Standard DTR B.C .2.2: operating loads for buildings.

Solicitations

- Loads = forces (normal and shear) or moments (bending and torsion) in each section of the structure.
- For most justifications, loads are calculated using a linear elastic model for the structure as a whole. In this way, R.D.M procedures are used wherever the shape of the parts allows.
- Design loads

  These are the result of combinations of actions, i.e. all the actions that need to be considered simultaneously.