Structural Design for Non-Structural Engineers

Introduction: Construction is the world’s largest industry, and structural engineering is a critical field within it, ensuring the safety, functionality, and economy of constructed structures. Before anything is built, it must first be designed, which is where structural engineers come in. They work closely with architects and other specialists to create structures that meet safety standards and are viable to build.

This **structural design course** provides an introduction to the fundamental concepts of structural design, specifically for non-structural engineers. Participants will gain a solid understanding of materials, their behavior under load, and the basic principles of structural design. The course emphasizes reinforced cement concrete (RCC) and steel structures, while also providing a brief overview of masonry and timber structures.

Targeted Groups

This course is aimed at professionals in various construction and design-related roles, including:

- **Building Inspectors**: Understanding structural safety and integrity.
- **Project Managers**: Collaborating with structural engineers and ensuring projects meet design specifications.
- **Construction Supervisors**: Overseeing the construction process and ensuring adherence to structural designs.
- **Municipal Officials**: Understanding the structural aspects of building codes and approvals.
- **Architects**: Collaborating with structural engineers in the design and planning stages.
- **Quantity Surveyors**: Estimating material quantities based on structural design.
- **Insurance Surveyors**: Assessing risk based on structural integrity.
- **Concrete Technologists**: Ensuring the appropriate use of concrete materials in construction.
- **Reinforcement Detailers**: Detailing reinforcement layouts in structural designs.
- **Structural Fabricators**: Fabricating components based on structural designs.
- **Building Maintenance Personnel**: Maintaining the structural integrity of existing buildings.
- **Structural Rehabilitation Staff**: Assessing and repairing damaged structures.

Course Objectives

At the end of this **structural design training**, participants will be able to:

- Understand the role of a structural engineer and their contribution to construction projects.
- Comprehend the behavior of structural members under load and how different materials react to tension, compression, shear, and bending.
- Apply basic concepts for analyzing statically determinate and indeterminate structures.
- Analyze the deformation of structural members under loading.
- Understand the significance of material properties in the structural design process.
- Undertake the basic design of **Reinforced Cement Concrete (RCC)** structures.
- Undertake the basic design of **Steel Structures**.
- Learn the basics of designing **Masonry** and **Timber** structural members.

Targeted Competencies

By the end of the course, participants will have the following competencies:

- An understanding of **structural engineering principles** and the **strength of materials**.
- Basic knowledge of **structural analysis** for determining stress and deformation.
- Familiarity with **design philosophies** and the design procedures for various types of structures.
- Ability to design **reinforced cement concrete (RCC)** structures.
- Ability to design **steel structures**.
- Ability to design **masonry** and **timber** structural members.

Understanding Structural Design for Non-Structural Engineers

This course provides an **introduction to structural engineering** principles, focusing on key concepts such as material strength, analysis techniques, and design methods. By participating, non-structural engineers will gain the knowledge to engage in the design and analysis processes. They will also learn about **structural design tools** and **methods** that are used to create safe, functional structures.

Participants will be encouraged to explore strategic design methods, which will provide them with the ability to engage with structural design processes in their respective roles, even if they are not directly involved in the engineering work.

Additionally, the course provides an overview of **non-engineered structures**, offering insight into the importance of structural design for all types of construction.

Course Content

Unit 1: Introduction to Structural Engineering Principles of Strength of Material

- **Theory of elasticity**: Understanding the fundamental principles behind how materials deform under stress.
- **Stress-strain characteristics**: The relationship between applied force and material deformation.
- **Sectional properties**: Analyzing the shape and properties of structural sections.
- **Deflection and deformation**: How structural members deflect and deform under various loading conditions.

Unit 2: Structural Analysis

- **Principles of Mechanics**: Understanding how forces interact with structures.
- **Determinate and indeterminate structures**: Analyzing simple (determinate) and complex (indeterminate) structures.
- **Determination of stress functions**: Calculating stresses in structures under direct, bending, and shear forces.
- **Analysis of statically determinate structures**: Using simple methods for analyzing structures with known loading.
- **Analysis of statically indeterminate structures**: Techniques for analyzing more complex structures with additional unknowns.
- **Deformation analysis**: Understanding how structures deform under different types of loading.

Unit 3: Design Philosophies

- **Material behavior under stress**: How different materials respond to forces and loads.
- **Working stress design**: A traditional approach to design based on allowable stresses.
- **Limit state design**: A more modern design philosophy focused on ensuring structures meet safety and serviceability requirements.
- **Types of loads**: Understanding the different loads that affect structures, including live, dead, wind, and seismic loads.

Unit 4: Design Procedure of Reinforced Cement Concrete (RCC) Structures

- **Materials and components**: Understanding the materials used in RCC and their properties.
- **Stress behavior**: How RCC members behave under different loading conditions.
- **Ultimate and permissible stresses**: Determining the maximum allowable stresses in RCC members.
- **Design of beams and slabs**: Key considerations for designing structural elements.
- **Design of walls, columns, and frames**: Fundamental techniques for designing these essential components of RCC structures.

- **Prestressed concrete design**: An introduction to prestressed concrete and its applications.

Unit 5: Design Procedure of Steel Structures

- **Materials and properties**: Understanding the key properties of steel used in construction.
- **Stress behavior**: How steel reacts to stress and the factors that influence its strength.
- **Design methods and fastenings**: Techniques for designing steel members and their connections.
- **Design of beams, columns, and struts**: An introduction to the design of common steel components.
- **Design of trusses and built-up sections**: Structural analysis of trusses and the design of built-up steel sections.
- **Limit state design**: Applying the limit state design approach to steel structures.

Unit 6: Design of Masonry & Wooden Structures

- **Properties of masonry**: The behavior of brick, stone, and block masonry under load.
- **Design of masonry walls and columns**: Techniques for designing structural masonry elements.
- **Construction of arches**: Principles of arch design and how to ensure their stability.
- **Material and properties of wood**: Understanding the properties of timber used in structural applications.
- **Preservation methods**: Techniques for preserving and maintaining wooden structures.
- **Design of timber columns and beams**: Design principles for wooden structural members.

Conclusion

This **structural design course** provides non-structural engineers with the foundational knowledge needed to understand and participate in the structural design process. By learning about material behavior, stress functions, and the design of key structural elements, participants will be equipped with the tools to engage effectively in construction projects. Whether you’re a building inspector, architect, or project manager, this course will help you better understand structural principles and communicate more effectively with structural engineers on your projects.