STRUCTURAL DESIGN

COURSE PROSPECTUS

Methodical investigation of the stability, strength, and rigidity of structures.

INTRODUCTION

Structural design is the methodical investigation of the stability, strength and rigidity of structures. The basic objective in structural analysis and design is to produce a structure capable of resisting all applied loads without failure during its intended life. The primary purpose of a structure is to transmit or support loads. If the structure is improperly designed or fabricated, or if the actual applied loads exceed the design specifications, the device will probably fail to perform its intended function, with possible serious consequences. A well-engineered structure greatly minimizes the possibility of costly failures.

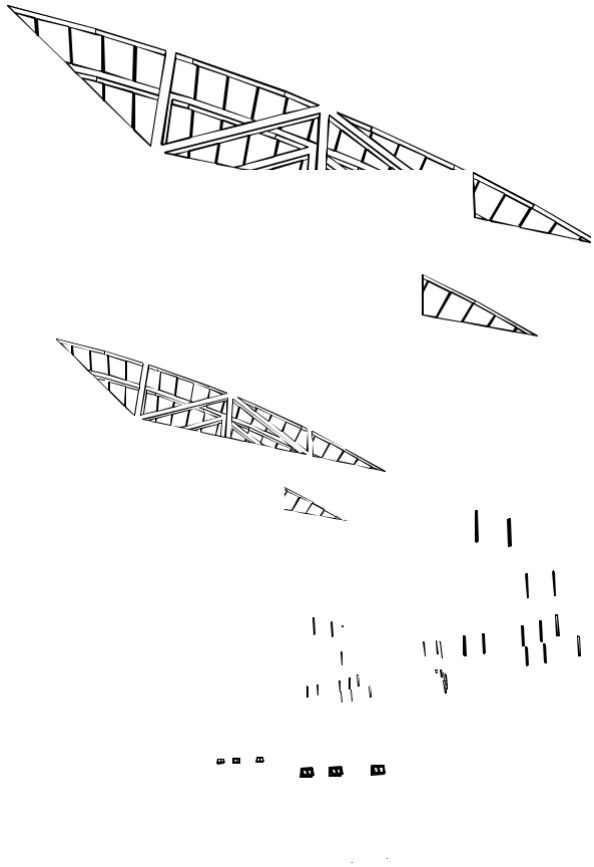
STRUCTURAL DESIGN PROCESS

A structural design project may be divided into three phases, i.e., planning, design and construction.

This phase involves consideration of the various requirements and factors affecting the general layout and dimensions of the structure and results in the choice of one or perhaps several alternative types of structure, which offer the best general solution. The primary consideration is the function of the struc-ture. Secondary considerations such as aesthetics, sociology, law, economics and the environment may also be taken into

account. In addition, there are structural and constructional re-quirements and limitations, which may affect the type of struc-ture to be designed.

Design



This phase involves a detailed consideration of the alternative solutions defined in the planning phase and results in the de-termination of the most suitable proportions, dimensions and details of the structural elements and connections for con-structing each alternative structural arrangement being con-sidered.

Construction

This phase involves mobilization of personnel; procurement of materials and equipment, including their transportation to the site, and actual on-site erection. During this phase, some rede-sign may be required if unforeseen difficulties occur, such as unavailability of specified materials or foundation problems.

Overview\

Buildings owe both their aesthetics and strength to their underlying structures. Structural engineering, a subset of civil engineering, is con-cerned with designing and analysing the ability of the structures to withstand various kinds of force and loads that will be acting on them. This course will teach you the basics of structural design using different materials including concrete and steel, and the applications of CAD soft-ware in designing structures for different infrastructure projects and subjecting them to various simulations and analytical tests to check their strength.

Module Training Learnings

- Drafting and Modifying Drawings using AutoCAD
- Blocks and Attributes, Xref and OLE concepts
- Slab Creation with Surface distribution
- RCC Detailing of Drawing Preparation
- Bar Bending Schedule
- Concrete, Steel and Foundation Design
- Bridge deck design
- Static and Dynamic analysis
- P-Delta and Buckling analysis
- Creating Structure Models and Plans of Structures
- Creating Analytical Model of Structures
- Work Breakdown Structure
- Assembly & Validate Takeoff Data
- Report Generation & Export

PART 1

TRAINING MODULLE

Module Teaching Objectives

- Knowledge of structural engineering principles and concepts.
- Ability to analyze and design structural systems.
- Understanding of building codes and regulations. Proficiency in using structural design software.
- Ability to interpret and analyze structural drawings.
- Understanding of structural materials and their properties.
- Ability to develop cost-effective solutions.
- Knowledge of seismic design principles.
- Ability to identify and solve structural problems.
- Understanding of construction methods and techniques.

Introduction to Limit State Design

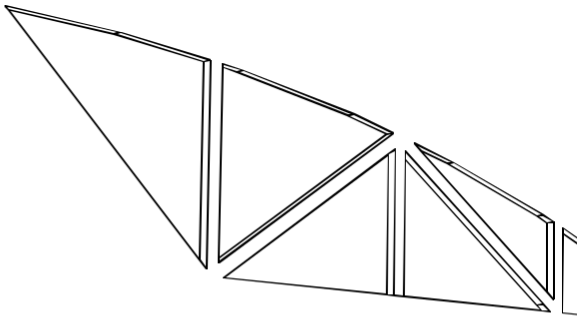
- **Ultimate limit state:** considering Strength, stability and robustness
- **Serviceability limit state:** Deflection, Durability (fire and corrosion resistance), Vibration
- Material properties for steel and concrete and partial safety factor for materials.

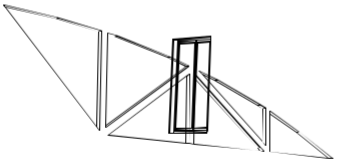
- **Design Standards:** Historical review, Elastic Analysis; CP114, Limit state Design; CP110 and BS 8110, EC2
- **Loading:** dead, wind, imposed and notional loads, load combinations and Partial safety factors for loads

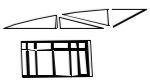
- Robustness & Design of ties, Importance of robustness in explosions and terrorist’s attack.
- Analysis of framed structures using moment distribution and computer applications

Shear, Bond & Torsion

- Shear strength of reinforced concrete beam without links Shear
- resistance of links
- Shear resistance of bent up bars
- Shear in slabs
- Local bond, Anchorage bond and length
- Hooks, bends, laps, joints
- Torsion analysis, Torsion shear stress & reinforcement







PART 2

Design of structural elements

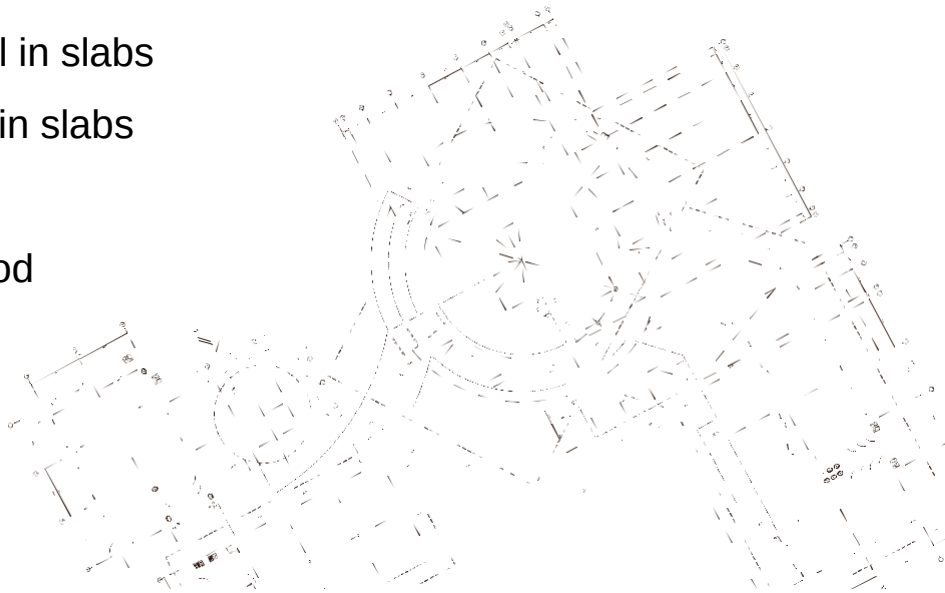
Design of Beams

- Simply supported & continuous beams; (loading, analysis, moment redistribution)
- Analysis of beams: Assumptions, parabolic & Rectangular Stress blocks Singly
- reinforced beams: Moments of resistance, balanced, under and over reinforced section, Design of section using analytical & design charts.

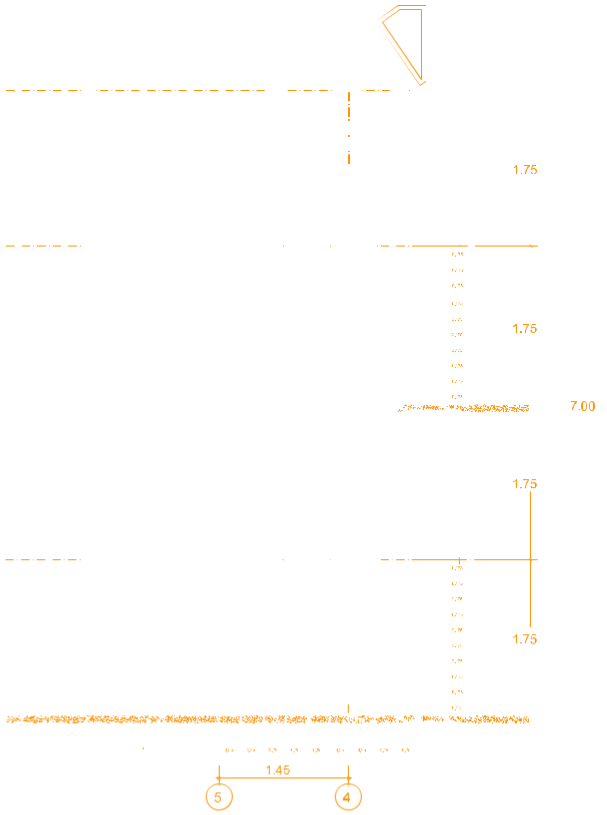
- Design of Doubly Reinforced beams
- Design of Flanged beams; with Neutral axis in the in web or flange

Design of slabs

- Classification of slabs based on: Nature of support (simply supported, continuous, flat slabs), Direction of support (One way and two-way supporting), Type of section (solid, hollow blocks, ribbed slabs),
- Design of main and secondary slab reinforcement in one way (solid & ribbed/hollow block) slab, and two-way slab
- Checking for Shear control in slabs
- Checking for Deflection control in slabs
- Checking for Cracking control in slabs
- Anchorage and detailing
- Introduction to Yield line method



Design of Staircases; A special type of slopping slabs



- Classification of stairs into transverse and longitudinal spanning,
- Relevant Building regulations, determination of staircase loading and analysis of staircases, Design
- of main and provision of distribution steel, checking for shear, deflection, cracking. Detailing of and
- anchorage.

Design of Columns

- Classification: (short & slender columns, Braced & unbraced columns)
- Section analysis
- Design of short Columns subjected to only to axial loads
- Design of short column subjected to axial loads & uniaxial bending using charts.
- Design of short columns subjected to axial loads & biaxial Bending; (Analyti-cal use of charts)
- Design of slender columns
- Checking columns for shear strength.

Design of Walls

- Functions Types & loads on walls
- Design of Reinforced concrete walls
- Design of plane concrete walls

Design of foundations

- Design of axially loaded pad bases; determination of pad size and depth,
- Design for moment steel, checking for Vertical and punching shear.
- Discussion of Eccentrically loaded pad bases
- Discussion of Design of Raft, strip and combined foundations ●

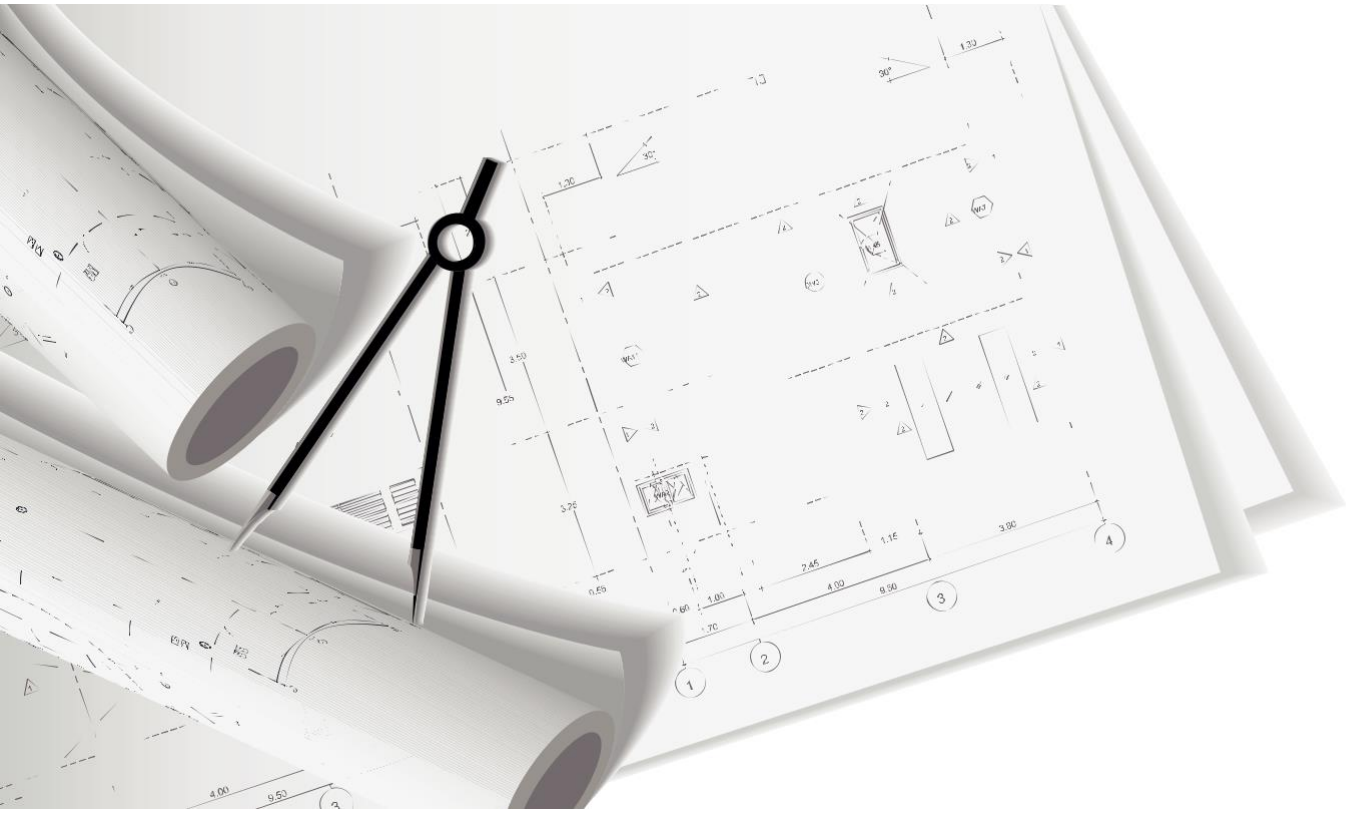
Discussion of Pile foundations

Design of Retaining wall structures

- Earth Pressure and Types of retaining walls ●

Discussion of design of cantilever walls

- Discussion of design of Counterfort retaining walls Introduction to Prestressed Concrete



PART 3

Detailing of structural elements and structural report generation

- Bar Bending Schedules
- Detailing and curtailment of bars Evaluation of Concrete

Introduction to software for Design, analysis and detailing

- Prota structure
- Tedds
- Autocad
- Ms word

PART 4

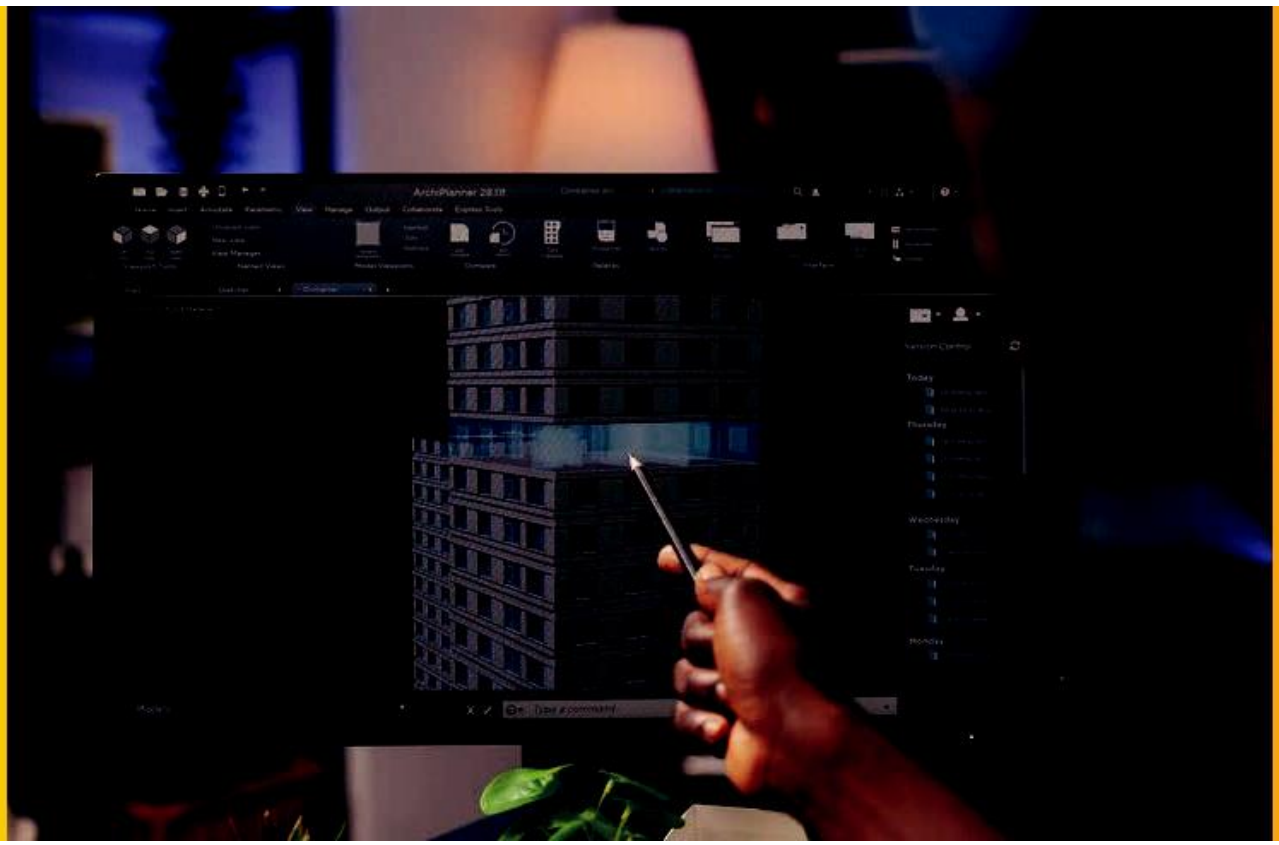
ASSESSEMENT

The trainees will be assessed for

- **Theoretical knowledge** that is to say basic analysis of both determi- nate and indeterminate structures, design of the basic elements of a structure (Ribbed slab, waffle slab, beam, column, stair case, pad foundation).

Practical

- o integration of a basic architectural drawing into a structural drawing o what is required
  o All structural layouts (Foundation, slab, ring beam layouts) o Other details (Footing, beams, ring beam, stair case etc)
  o Structural report including analysis from the required software



Bridging the Gap

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