

DESIGN AND CONSTRUCTION OF STEEL BUILDINGS

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Course Details

Course Code L T P C
SB8003 1 0 2 2

PRE-REQUISITE

?Analytical skill on determinate & indeterminate structures and design knowledge of steel members
?Exposure to relevant codes and standards (Indian standard codes for Steel, wind and earthquake design)

COURSE LEARNING OBJECTIVES

The course aims to:

- ?Impart practical aspects of structural steel building design
- ?Introduce various aspects like selection and planning of structural system and its components, evaluation of actual loads, integration of architectural and services requirements
- ?Explore the structural modelling, analysis & design, fabrication, execution and inspection of a structural steel building

KEY JOB ROLES

- ?Design engineer
- ?Site planning engineer
- ?Construction engineer
- ?R&D Engineer
- ?Design Consultant

OVERVIEW

This course provides the practical aspects in design of a small to medium rise steel building starting from the selection of the appropriate structural system based on building functionality, to the design and detailing of its various components. This course covers the assessment of different loads in the building, application of the same in analysis and design software models, various vertical and lateral load-resisting systems and the basis of its selection, integration of various services in the building, design and detailing of elements and connections, etc. This course also covers the different stages in design to execution of steel buildings briefly.

SYLLABUS

UNIT I - ANALYSIS & DESIGN PHILOSOPHIES, CODES OF PRACTICE AND GENERAL DESIGN ASPECTS (3T+6P)

- Structural steel and its Mechanical Properties, Hot Rolled steel sections, Structural Steel sections and section classification. Analysis and design of buildings as per Codes of Practice, design philosophies, Advantages of steel buildings in comparison with other types of structures
- Inputs for the design of a steel building - Design Basis Report covering Site location, Site Specific aspects, building functionality, Construction planning, Geometric parameters of the building, Structural systems, Special geometries and its structural systems, Functional requirements necessary for the end user, Material specifications.
- Methods of designing a steel building, Design life of a building, Exposure conditions and corrosion protection, Gravity and lateral load resisting elements and systems, Concrete and reinforcement, Block work, floors and Roofs, Structural steel, bolts, welds, fire proofing and Painting materials

UNIT II - COMPUTATION OF VERTICAL, LATERAL & SPECIAL LOADS AND LOAD COMBINATIONS (3T+6P)

- Calculating the various loads acting on a steel building - Vertical & lateral loads - Effects of each loads separately and in combination ? Dead, superimposed dead, live, temperature, MEP service loads - Lateral loads due to wind and seismic effects
- Design of wind speed and pressure, Pressure and Force coefficient method, Deflection and drift limits, Drag, interference and dynamic effects Floor Vibration, Fire resistance, Analysis and design methods, Wind load calculation for an example steel building.

UNIT III - SELECTION OF LOAD RESISTING SYSTEMS, STRUCTURAL MODELLING, ANALYSIS & DESIGN (3T+6P)

- Studying the layout plans of the structure ? Codes and Reference drawings, Selection of load resisting systems - Load flow in each system -Satisfying stability & strength of the structure - Vertical and lateral load resisting systems, Integration of MEP services and its supporting structures in buildings
- Overview of BIM and its importance in structural modelling
- Computer aided modelling, analysis & design (STAAD Pro) - Geometric & structural parameters of the structure - Loading the structure - Interpretation of the results of the software ? Analysis & design of a multistoried building from a project for comprehending the design from a practical standpoint. A sample of Structural Design Basis report

UNIT IV - DESIGN OF VARIOUS ELEMENTS & CONNECTIONS OF A STEEL BUILDING (3T+6P)

- Manual & software aided design ? Beams, columns, floors, bracings, purlins/girts & facades, base plates & anchor bolts ?different conditions of supports, exposure, and purpose of use - Design of connections between the members ? Bolted and welded, moment and shear connections to be adopted in various locations of a building
- Tension members in buildings ? Types and grades of tension members, Design of mullions and transoms. Special connections for equipment and other services like staircases, roof, terrace, and other special elements. Project based on excel spreadsheet development.

UNIT V - DESIGN OF AN INDUSTRIAL BUILDING & DETAILING, FABRICATION AND ERECTION ASPECTS (3T+6P)

- Design of an industrial building - Selection of sections as per requirements - Configuration of the elements and their connectivity - Functional requirements
- Beam design Approach for buildings ? Manual and software Design of beams- Cantilever beams and built-up beam, torsion in beams and back up beam concept, Service integration in beams, Simplified floor vibration analysis Column Design Approach for buildings -Manual and software design of column, *Addressing failures and optimization in column design
- Beam-Column design approach for buildings- Design of beam-columns, Base plate and anchor bolts, Planning and design approach of terrace floor, architecturally exposed steel.
- Study of General Assembly drawings, Fabrication drawings and procedures - Fabrication processes

- Transportation for structural Steel construction and erection - Sequence of erection - Inspection of a completed structure

- Good Design, Detailing and construction Practices. Design summary of Example building

TOTAL: 45 PERIODS

CASE STUDIES

A commercial building with multiple storeys with varying load conditions for each storey. The project work is design of the complete structure given in the case study, from the study of the structural DBR, till the final design output, resulting in a structure satisfying the architectural & structural requirements.

ATTAINMENT OF LEARNING OUTCOMES STUDENT ASSESSMENT PLAN

1. The conceptualisation and comprehension level of learning outcomes intended through the course is measured through assessments conducted in multiple stages.
2. The understanding of concepts & principles, evolution of practices, codes & guidelines, emerging trends etc. are tested through assessment questions.
3. The skill outcome related to design, computation, workflow, report & work plan

preparation, implementation etc. are assessed through assignments. Such assignment questions & answer keys will be shared to the college SPOC for enabling evaluation by respective faculties.

STUDENT ASSESSMENT 1

Preparation of a Design Basis Report for a medium rise steel building considering site specific parameters and loading due to functionality, computation of wind speed and pressure, seismic parameters, load combinations, grid planning and structural systems.

STUDENT ASSESSMENT 2

Analysis and design of a medium rise building containing various structural & non-structural elements, contributing to the loads acting on the building, finally serving the intended functional requirements.

SOFTWARE EXPOSURE

Learners are exposed to STAAD Pro software for 35% of course duration for analysis and design of steel framed building structure including modelling, specifications, loads, and combination of loads. The students can use free student version of this software post completion of the course.

LEARNING OUTCOMES

On completion of the course, the students will be able to perform the following operations for the given architectural drawing

?**LO.1:** Design a low to medium industrial steel building using STAAD PRO Software

?**LO.2:** Examine site specific aspects of the structure like geotechnical investigations, project requirements

?**LO.3:** Develop Design basis requirements like building functionalities, durability and Materials

?**LO.4:** Compute loads (Dead, Superimposed, Live, Wind, Seismic) of various elements & services

?**LO.5:** Understand proper selection and design of vertical & lateral load resisting systems for the various loads acting on the building

?**LO.6:** Integrate non-structural elements like facades, service supports, etc., to the structure

?**LO.7:** Create an optimized design of the building, adhering to the codal requirements & functional aspects, using a modeling software.

?**LO.8:** Interpret structural drawings, fabrication & erection aspects