

University of Engineering and Technology, Taxila
Department of Civil Engineering

Course Title: CE-307 Design of Steel Structures

Course Objectives:

The objective of this course is to introduce students to the fundamental design process of steel as a structural member. The emphasis is on the general theory and performance of structural steel, as well as design and analysis of structural members subjected to various loading conditions based on the current Load and Resistance Factor Design (LRFD) code.

Course Contents:

Introduction to steel as a structural material, hot rolled, cold formed and built up sections; objectives of designer and selection design criteria; introduction to various methods of design, **Fundamentals of allowable stress design**: Strength analysis and design of simple tension, compression, flexural members.

LRFD Method of Design: Factor of safety, loads and load combination. Concept of load and resistance factors, plastic design and limits on design; Analysis and design of tension members, calculation of net area; Analysis and design of columns, lacing and stay plates, residual stresses, local and overall stability, Euler's buckling load in columns; analysis and design of beams, compact, non-compact and slender sections, lateral torsional buckling, beam-column and axial-flexure interaction, second order effects, moment magnification; plate girder proportioning and stiffener including drawings; welded, bolted and riveted truss connections, brackets, moment and shear connections; design and drawing of a truss, purlin, roof sheet, end bearing plate, uplift of truss due to wind.

Course Learning Outcomes:

At the end of this course, the student will:

- CLO 1: Understand the design criteria, ASD, LRFD design philosophy and behaviour of structural steel.
- CLO 2: Able to analyse and design tension members, columns (compression members), built-up sections, beams (flexural members) and plate girders.
- CLO 3: Able to analyse and design simple connections between structural members including riveted and welded connections.

Mapping of Program Learning Outcomes (PLO's) and Course Learning Outcomes (CLO's)

CLO's PLO's	CLO 1	CLO 2	CLO 3
PLO 1 (Engineering Knowledge)	✓	✓	✓
PLO 2 (Problem Analysis)		✓	✓
PLO 3 (Design/Development of Solutions)		✓	✓
PLO 4 (Investigation)		✓	
PLO 5 (Modern Tool Usage)			
PLO 6 (The Engineer and Society)			
PLO 7 (Environment and Sustainability)			
PLO 8 (Ethics)			
PLO 9 (Individual and Team work)			
PLO 10 (Communication)			
PLO 11 (Project Management)			
PLO 12 (Lifelong Learning)	✓	✓	✓

Course Title: CE-307 Design of Steel Structures-Lab/design class

Lab/design class Objectives:

The objective of the lab/design class is to introduce students to the fundamental design process of steel as a structural member. The emphasis is on the analysis and design of structural members and related components of a roof truss subjected to dead, live and wind loading conditions based on the current Load and Resistance Factor Design (LRFD) code and American Institute of Steel Construction (AISC) specifications.

Lab/design class contents:

- **Design work 1:** Panel load calculation considering different load combinations for a roof truss, every student has different set of calculations based upon his Registration number.
- **Design work 2:** Analysis of the truss for calculating the member forces and developing table of forces for panel dead, live and wind loads calculated in the previous assignments.
- **Design work 3:** Design members of the truss based upon the forces calculated in the previous assignments.
- **Design work 4:** Design of Purlins and corrugated sheet for the roof truss, every student has different set of calculations based upon his Registration number.
- **Design work 5:** Design of connections for the roof truss designed in Design work 3.
- **Design work 6:** Preparing a drawing sheet for the roof truss showing elevation, sections, different components designed in the previous assignments according to scale and AISC standards.

Lab/design class Learning Outcomes:

At the end of this course, the student will:

- CLO 1: Able to analyse and design members of a roof truss under gravity (dead and live) loads and wind uplifts.
- CLO 2: Able to analyse and design simple connections between structural members.
- CLO 3: Able to analyse and design purlins and corrugated G.I. sheets as roofing in roof trusses.
- CLO 4: Ability to act in a professional manner by designing a complete project individually, covering analysis, design and detailing of a steel roof truss under gravity (dead and live) loads and wind uplift.

Mapping of Program Learning Outcomes (PLO's) and Lab-design class Learning Outcomes (CLO's)

CLO's PLO's	CLO 1	CLO 2	CLO 3	CLO 4
PLO 1 (Engineering Knowledge)	✓	✓	✓	✓
PLO 2 (Problem Analysis)	✓	✓	✓	✓
PLO 3 (Design/Development of Solutions)	✓	✓	✓	✓
PLO 4 (Investigation)	✓	✓	✓	
PLO 5 (Modern Tool Usage)	✓	✓		✓
PLO 6 (The Engineer and Society)				
PLO 7 (Environment and Sustainability)				
PLO 8 (Ethics)				
PLO 9 (Individual and Team work)				✓
PLO 10 (Communication)				
PLO 11 (Project Management)				
PLO 12 (Lifelong Learning)	✓	✓	✓	✓

CE-307 DESIGN OF STEEL STRUCTURES

Weekly Schedule Lectures, Lab/Design work, Quiz/Tests and Assignments plan

Week No.	Lecture	Design Class	Tests/Quizzes/Home assignments	Lab/Design work
	Topic	Topic		
01	Introduction to steel as a structural material, hot rolled, cold formed and built up sections.			
02	Introduction to various methods of design, fundamentals of allowable stress design (ASD) Methods Objectives of designer and selection design criteria.	Introduction to trusses, behaviour, and comparison with frames and beams.		
03	LRFD Method of Design: Factor of safety, loads and load combination. Concept of load and resistance factors, plastic design and limits on design.	Types of Trusses, Loads on trusses	Home assignment 1: Problems related with load combinations according to ASD and LRFD	
04	Analysis and design of tension members, calculation of net area.	Panel load calculations,		Design work 1: Panel load calculation considering different load combinations for a roof truss, every student has different set of calculations based upon his Registration number.
05	Problem workshop related with Analysis and design of tension members and calculation of net area.	Analysis of truss, Table of forces		Design work 2: Analysis of the truss for calculating the member forces and developing table of forces for panel dead, live and wind loads calculated in the previous assignments
06	Introduction to compression members, Residual stresses, Slenderness ratio, local and overall stability		Quiz 1: Steel as a structural member, design philosophy, load factors, Analysis and design of tension members	
07	Euler's buckling load in columns, Problem workshop related with analysis and design of compression members			
08	Design of lacing and stay plates with problems workshop		Home Assignment 2: Analysis and design of tension and compression members	Design work 3: Design members of the truss based upon the forces calculated in the previous assignments

Mid Semester Exam				
09	Introduction and types of beams, compact, non-compact and slender sections, Lateral torsional buckling.	Introduction to connections, types and behaviour		
10	Basic design philosophy, Flexural behaviour of compact sections, Analysis and design of beams	Stresses in connections, Welded connection introduction and relevant terminologies		
11	Problems workshops related with analysis and design of beams	Design of a welded connection, Problems workshops	Home assignment 3 : Problems related with analysis and design of beams	Design work 4: Design of Purlins and corrugated sheet for the roof truss, every student has different set of calculations based upon his Registration number.
12	Introduction to beam-column and axial-flexure interaction	Introduction to riveted and bolted connections, stresses in fasteners		Design work 5: Design of welded connections for the designed roof truss
13	Moment magnification, Problems workshop	Design of riveted and bolted connections		
14	Introduction to Plate girder, types and proportioning of plate girder, problems workshop	Problems workshop related with design of riveted and bolted connections	Quiz 2: Analysis and design of beams, beam columns	Design work 6: Preparing a drawing sheet for the roof truss showing elevation, sections, different components designed in the previous assignments according to scale and AISC standards
15	Proportioning of Stiffeners and weld design, problems workshop			
16	Course review, problems workshop		Quiz 3: Review of the design concepts of tension, compression members, beams, plate girders	
End Semester Exam				