

Structural Analysis, Design & Foundation Engineering

Using CSI ETABS and SAFE

Course Objective

This course is designed to provide participants with a comprehensive understanding of structural analysis, design, and foundation engineering using CSI ETABS and SAFE. Learners will develop practical skills in creating analytical models, applying structural loads, performing analysis, and designing reinforced concrete and steel structures. The course also covers slab and foundation design, post-tensioning concepts, and integration between ETABS and SAFE workflows. Through hands-on exercises and real-world projects, participants will gain industry-relevant experience in delivering complete structural engineering solutions.

Course Outcomes

Upon successful completion of this course, participants will be able to model, analyze, and design multi-storey buildings using ETABS. They will be capable of designing slabs, mat foundations, and footings in SAFE while understanding load transfer between superstructure and foundation systems. Participants will confidently interpret analysis results, verify structural performance, and generate professional design reports. They will also be able to integrate BIM workflows, exchange data between software platforms, and apply automation techniques to improve engineering productivity.

Target Audience

This course is intended for Civil Engineers, Structural Engineers, Design Engineers, and Project Engineers involved in building design and construction projects. It is suitable for undergraduate and postgraduate students seeking practical structural engineering skills. BIM professionals and CAD technicians looking to expand into structural analysis and foundation design will also benefit from this program. The course is ideal for engineering consultants, construction professionals, and anyone interested in mastering ETABS and SAFE for real-world structural design applications.

Course Outline

The course comprises **40**-hours of theory and labs and is divided into **12** different Modules. Each chapter will be followed by hands-on lab exercises to reinforce learning and gauge understanding of the topics covered.

Table of Contents: -

Module 1: Introduction to CSI Structural Design Workflow

- Introduction to ETABS and SAFE
- Building Analysis and Foundation Design Workflow
- Physical Model vs Analytical Model Concepts
- CSI Software Ecosystem
- Structural Design Process Overview
- Understanding BIM-Based Structural Engineering
- Industry Applications and Project Lifecycle

Module 2: User Interface, Navigation & Project Setup

- ETABS User Interface and Workspace
- SAFE User Interface and Workspace
- Model Explorer and Data Management
- Multiple Views and Window Management
- Display Settings and Visualization Tools
- Interactive Database Editing
- Units and Project Preferences
- Starting New Projects Using Templates
- Story Data and Building Configuration
- View Customization and Navigation Tools

Module 3: Grid Systems, Drafting & Modeling Fundamentals

- Cartesian, Cylindrical and Free-Form Grid Systems
- Multiple Grid Systems
- Drawing Tools and Intelligent Snaps
- Architectural Background Import (DWG/DXF)
- Story-Based Modeling Workflow
- Developed Elevation Modeling
- Physical and Analytical Object Connectivity
- Automatic and Manual Meshing Techniques
- Mesh Refinement and Quality Control

Module 4: Structural Components, Materials & Section Properties

- Material Definition and Libraries
- Concrete, Steel and Composite Materials
- Frame Section Properties
- Slabs, Decks and Floor Systems
- Walls, Piers and Spandrels

- Foundations, Footings and Basemats
- Columns and Drop Panels
- Ramps and Special Structural Elements
- Link Elements and Support Conditions

Module 5: Structural Loading & Load Combinations

- Load Patterns and Load Cases
- Dead, Live and Superimposed Loads
- Point, Line and Area Loads
- Uniform, Trapezoidal and Concentrated Loads
- Temperature and Thermal Loads
- Live Load Reduction
- Wind Load Generation
- Seismic Load Generation
- Load Combinations and Design Combinations
- Auto Live Load Patterning
- Settlement and Displacement Loads

Module 6: ETABS Building Modeling & Structural Analysis

- Modeling Multi-Storey Buildings
- Floor Diaphragms
- Shear Wall Systems
- Shell Elements and Area Objects
- Linear Static Analysis
- P-Delta Analysis
- Modal Analysis
- Response Spectrum Analysis
- Time History Analysis
- Staged Construction Analysis
- Nonlinear Static Analysis
- Pushover Analysis

Module 7: SAFE Modeling for Slabs & Foundations

- Flat Slab Modeling
- Ribbed and Waffle Slab Systems
- Mat Foundations and Raft Foundations
- Isolated and Combined Footings
- Soil Support and Subgrade Modulus
- Zero-Tension Soil Models
- Uplift Analysis
- Design Strips Fundamentals
- Slab Panels and Support Lines

Module 8: Post-Tensioning & Advanced Foundation Design

- Fundamentals of Post-Tensioned Structures
- Tendon Layout Concepts
- Banded and Distributed Tendons
- Tendon Profile Creation
- Precompression and Balancing Ratios
- Tendon Stress Loss Calculations
- Transfer and Long-Term Stress Checks
- Foundation Performance Evaluation

Module 9: Structural Design Using ETABS

- Design Code Configuration
- Concrete Frame Design
- Steel Frame Design
- Composite Beam and Column Design
- Shear Wall Design
- Slab Design Concepts
- Member Optimization Techniques
- Performance-Based Design (PBD)
- Demand-Capacity Ratio Evaluation
- Fiber Models and Hinge Assignments

Module 10: SAFE Design & Foundation Verification

- Strip-Based Slab Design
- FEM-Based Slab Design
- Reinforcement Contour Interpretation
- Concrete Beam Design
- Punching Shear Design
- Post-Tensioning Stress Verification
- Composite Beam Design
- Bearing Pressure Verification
- Soil Reaction Evaluation
- Foundation Design Optimization
- Design Code Applications

Module 11: Results Interpretation, Reporting & Documentation

- Deformed Shapes and Animations
- Force and Moment Diagrams
- Shell Stress and Force Contours
- Story Drift and Displacement Results

- Reaction and Bearing Pressure Results
- Section Cut Analysis
- Tabular Output Management
- Custom Report Generation
- Design Summary Reports
- Excel, Word and Database Export
- Construction Documentation Workflow

Module 12: BIM Integration

- ETABS–SAFE Workflow Integration
- ETABS to SAFE Model Transfer
- Revit Integration using CSiXRevit
- AutoCAD and DWG-Based Workflows
- IFC Open BIM Collaboration
- Tekla Structures Integration