Structural Analysis Software: Frame Modelling, Load Combinations and Code Checks

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Amsterdam - Zuidas business district hotel



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Introduction:

Structural analysis software produces results in seconds, yet many frame models released for design carry hidden faults: unintended member releases, missing load combinations, unstable supports, rotated sections or a seismic mass nobody checked. This Core Concept course takes civil and structural engineers through the full software workflow for frame analysis: geometry, supports, sections, load cases and combinations, linear static, P-delta and modal runs, results review, steel code checks and concrete design output. Participants finish with an analysed and code-checked model of a steel pipe rack and a reinforced concrete building frame, supported by a model check report.

Course Objectives:

- Build 2D and 3D frame models with correct geometry, supports, member releases, materials and section orientation
- Define dead, live, wind, seismic, thermal and equipment load cases and generate strength and serviceability load combinations to the governing design code
- Run linear static, P-delta and modal analyses and interpret solver warnings, natural periods and mass participation
- Extract and judge deflections, storey drift, support reactions and member force envelopes against serviceability limits
- Configure steel member code checks and read concrete design output to identify overstressed or under-reinforced members
- Detect and correct modelling errors through hand cross-checks and a model check report before results are issued for design

Target Audience:

- Structural engineers who build and run frame analysis models for buildings and industrial facilities
- Civil engineers moving from hand calculation to software-based frame analysis on project work
- Checking engineers who review analysis models, load combinations and code check results submitted by others
- Engineers in engineering, procurement and construction teams who model pipe racks, equipment structures and platforms
- Graduate and junior design engineers who prepare analysis input and output for calculation packages

Course Outline:

Day 1: Frame Model Set-Up: Geometry, Supports and Member Properties

- Direct Stiffness Method Behind Frame Analysis Programs: Nodes, Elements and Degrees of Freedom
- Grid Lines, Node Numbering and Member Incidence for 2D and 3D Frame Geometry
- Support Idealisation: Fixed, Pinned, Roller and Spring Supports
- Member End Releases, Rigid Offsets and Beta Angle Section Orientation
- Material Definitions and Section Library Assignment for Steel and Concrete Members

Day 2: Load Cases, Load Generation and Code Load Combinations

- Primary Load Case Set-Up: Self-Weight, Dead, Superimposed Dead and Live Loads
- Wind Load Generation on Open Frames and Clad Buildings
- Equivalent Static Seismic Load Definition and Seismic Mass Source
- Thermal, Equipment Operating and Pipe Anchor Loads as Member and Nodal Loads
- Strength and Serviceability Load Combination Tables Generated from Design Code Factors

Day 3: Running Analyses and Reviewing Results

- Linear Static Analysis Run and Solver Warning Log Interpretation
- P-Delta Second-Order Analysis Option: Iteration Settings and Sway Amplification Review
- Modal Analysis Output: Natural Periods, Mode Shapes and Mass Participation Ratios
- Deflected Shape, Storey Drift and Member Deflection Checks Against Serviceability Limits
- Support Reaction Tables and Bending Moment, Shear and Axial Force Envelope Diagrams

Day 4: Code Checks, Design Output and Model Error Diagnosis

- Steel Member Code Check Parameters: Unbraced Lengths, Effective Length Factors and Utilisation Ratios
- Concrete Beam and Column Design Output: Required Reinforcement Areas and Interaction Ratios
- Instability and Singular Matrix Diagnosis: Mechanisms, Unconnected Nodes and Zero-Stiffness Members
- Hand Calculation Cross-Checks: Applied Load Sum Versus Reaction Sum and Simple Span Moments
- Common Modelling Errors Checklist: Duplicate Nodes, Unit Mismatch, Rotated Sections and Missing Combinations

Day 5: Lab Capstone: Steel Pipe Rack and RC Building Frame Models

- Steel Pipe Rack Model Build: Bents, Longitudinal Struts, Bracing and Pipe Load Application
- Pipe Rack Code Check Run and Utilisation Ratio Review for Governing Members
- Multi-Storey RC Building Frame Model with Rigid Floor Diaphragms and Lateral Load Cases
- Concrete Design Output Extraction and Storey Drift Verification for the Building Frame
- Analysis Report Assembly and Model Check Report Presentation to a Peer Review Panel

Skills You Will Gain:

- Frame Model Idealisation
- Load Case and Combination Set-Up
- Second-Order and Modal Analysis Interpretation
- Analysis Output Review
- Steel Code Check Configuration
- Concrete Design Output Reading
- Model Error Diagnosis
- Analysis Report Preparation

Why Attend This Course:

- Leave with an analysed and code-checked model of a steel pipe rack and a reinforced concrete building frame, with its model check report
- Spend each day hands-on in frame analysis software rather than on design theory alone
- Learn the checks that expose releases, supports and load combination faults before a model is used for design
- Compare modelling practice with engineers from building, oil and gas, power and industrial projects

Conclusion:

Analysis software is only as reliable as the model behind it. Day one sets up geometry, supports, releases and sections; day two builds load cases and code combinations; day three runs linear static, P-delta and modal analyses and reviews results; day four configures steel code checks, reads concrete design output and diagnoses modelling errors. The final day applies the workflow to a steel pipe rack and a multi-storey building frame, producing an analysed, code-checked model and model check report ready for technical review.