



Mastering S-FRAME II - Course Description

The course is designed for users of S-FRAME and S-STEEL and assumes a level of familiarity commensurate with having completed the **Structural Office – Mastering S-FRAME I** course. The format is ‘hands-on’ with maximum time devoted to undertaking practical tutorials, enabling attendees to build understanding through experience and investigation. Attendees work at individual PC’s and full course notes are provided. While a number of complex topics such as Finite Element Analysis and Response Spectrum Analysis are discussed, this is **not** a theory course, rather the focus is on the practice of implementation.

Course Topics

➤ **P-Delta and Buckling Analysis**

- Differences between Linear and P-Delta analysis; performing P-Delta Analysis
- Performing buckling analysis and results; buckling modes and load factors
- Types of P-Delta effects and modeling to expose them; “detailed analysis” and steel design; U_1 second order force factors and P-Delta analysis forces; determining Euler buckling load

➤ **Nonlinear Analysis – Tension-only bracing**

- Methods of modeling tension only bracing; inactive and truss elements
- Non-convergence of Nonlinear analysis; analysis options and solver run-time output
- Discussion of nonlinear model behaviour; application of Notional Loads for nonlinear stability

➤ **Vibration Analysis**

- Fundamental of Vibration Analysis; analysis convergence options and settings; viewing mode shapes; animating mode shapes; mode frequencies and Mass Participation; importance of mass modeling
- Mass modeling options; converting loads to mass; using panel diaphragm mass; using lumped mass
- Types of Vibration Analysis; stressed and unstressed vibration analysis comparison
- Vibration analysis for Response Spectrum Analysis; Determining Peak Modes, modal mass and cumulative modal mass

➤ **Response Spectrum Analysis (RSA)**

- Creating and generating Response Spectrum Curves
- Assigning a Response Spectrum Curve and RSA Analysis and Modal Combination options
- RSA results; Individual Modal and Modal Combination results

➤ **Finite Element Analysis (FEA) Fundamentals**

- Introduction to triangular and quadrilateral 2D elements; applications of thin/thick shell elements; building confidence in FEA and interpretation of results. good practice and rules of thumb
- Comparison of Triangular and Quadrilateral FE’s; applications and limitations; example of bad modeling and meshing
- Element axes systems; result conventions and interpreting results; understanding contour diagrams and interpolation options; determining overall element forces; S-Frame FE strip integration tool; slab forces and wall forces
- Mesh density and convergence testing; effective FE models for shear applications and bending applications; viewing shell stresses; principle stresses and von-mises stresses

➤ **Application of Finite Elements: Shear Walls**

- Methods of modeling for; single walls; walls and beams; coupled walls; core walls
- Single wall example; beam vs. FE models; determining wall forces using strip tool; using Wall Integration Lines; meshing with quad’ elements
- Beam and wall example; modeling effective connection between beam elements and FE meshes; using rigid link modeling elements; drilling degree of freedom option
- Core wall example; beam element vs. FE core; use of diaphragms panels for rigid diaphragm action and loading

➤ **Application of Finite Elements: Slabs**

- Using Panel Elements and Auto-meshing parameters and settings. Loading FE mesh slabs; creating line loads on FE mesh slabs
- Determining design moments; use of slab design strip tool and Strip Integration Line elements; Wood and Armer slab design moments; RC design settings, minimum steel area calculations and contours
- Effective FE modeling issues, singularities and stress concentrations

➤ **Nonlinear Analysis of Cable Structures**

- Fundamentals of cable models; effective use of cable elements in S-Frame; good practice and analysis requirements
- Form finding in cable analysis; prestress and updating geometry options; practical application to cable stayed tower example