ETABS

Three Dimensional Static and Dynamic Analysis and Design of Buildings
ETABS

The Most Comprehensive Software for the Modeling, Analysis and Design of Buildings
Key Features

- Fully integrated interface within Windows 95/98/NT/2000
- Optimized for modeling of multistory buildings
- 3D perspective, plan, elevation, developed elevation, and custom views
- 3D model generation using plans and elevations
- CAD drawing/editing for fast, intuitive framing layout
• **Extensive Analysis Capabilities**
  - *Linear Static Analysis*
  - *Linear Dynamic Analysis*
  - *Static and Dynamic P-Delta Analysis*
  - *Static Non-Linear Analysis*
  - *Dynamic Non-Linear Analysis*
  - *Pushover Analysis*
  - *Multiple Response Spectrum Analysis*
  - *Multiple Time History Analysis*
  - *Construction sequence loading analysis*
Key Features

- Fast generation of model using the concept of similar stories
- Automated templates for typical structures
- Easy editing with move, merge, mirror and replicate
Key Features

- Multiple views in 3D perspective with zooming and snapping
- Onscreen assignment of properties, loading and supports
- Powerful grouping, selection and Display options
- Cut, copy and paste options
Key Features

- Unlimited levels of undo and redo
- Cut/Paste geometry to and from spreadsheets
- Import and export of .DXF file for model geometry
- Detailed context-sensitive online help
- Analysis integrated with post-processing and design
Interactive Model Creation
Fully Graphical Interface
Interactive Modeling

Realistic Modeling
Powerful Viewing Options

Interactive Modeling
ETABS
Interactive Modeling
Powerful Viewing Options
Interactive Modeling

- Convenient dividing and meshing of design objects
- Multiple simultaneous rectangular and cylindrical grid systems
- Accurate dimensioning with guidelines and snapping
- Quick-draw options to create objects with one mouse click
• Automated model generation for typical structures using powerful templates
  – **Steel Deck**
  – **Flat Slab**
  – **Two-way Slab**
  – **Waffle Slab**
  – **Ribbed Slab**
Interactive Modeling

- Time saving Story definitions using the concept of similar Stories
- Common labeling of Objects between similar Stories
Object Based Modeling

- **Area objects for**
  - Walls, Slabs/Decks, Opening, Springs, Mass, Loads

- **Line objects for**
  - Columns, Beams, Braces, Links, Springs, Mass, Loads

- **Point objects for**
  - Supports, Springs, Mass, Loads
• Define Rigid Diaphragms to effectively model floor slabs and to constrain deformations
Interactive Modeling

• Built-in database of steel sections
Interactive Modeling

• Graphical Section Designer for defining custom sections
Interactive Modeling

- Right button click for element or design information
- Customized display of parameters and attributes
• No limit on number of independent load cases
• Gravity loads specified as point, line or area loads
• Wind and Seismic Load Generator for several codes
Interactive Modeling

- **Automatic wind load generation**
  - *UBC, BOCA, ASCE, NBCC*

![Diagram of building loads](image)

**UBC 94 Wind Loading**

- **Direction:** 0
- **Exposure Height:** 2ND
- **Exposure Type:** B
- **Importance Factor:** 1.
- **Wind Speed (mph):** 70.
Interactive Modeling

• **Automatic Seismic Load Generation**
  - *UBC, BOCA, NBCC*

![Diagram of ETABS software interface showing Automatic Seismic Load Generation features for UBC, BOCA, NBCC codes.](image-url)
Interactive Modeling

- Built-in response spectrum and time history input
- User-defined response spectrum functions
- User defined time history functions

Building Loads

Response Spectrum Function Definition

<table>
<thead>
<tr>
<th>Function Name</th>
</tr>
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<tbody>
<tr>
<td>RSFUNC1</td>
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Define Function

<table>
<thead>
<tr>
<th>Period</th>
<th>Acceleration</th>
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<tbody>
<tr>
<td>0.0</td>
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<tr>
<td>0.1</td>
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<td>0.798</td>
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<tr>
<td>0.333</td>
<td>0.8806</td>
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</tbody>
</table>

Function Graph

Add | Modify | Delete
Interactive Modeling

- Temperature and thermal-gradient loads
- Algebraic, absolute, SRSS, and enveloping load combination
- Mass directly specified or calculated from gravity load
Modeling Elements
Beams, Columns, Walls, Slabs
Powerful Object Based Elements

- **Area objects**
  - Walls
  - Slabs/Decks
  - Opening
  - Mass
  - Loads

- **Lines objects**
  - Columns
  - Beams
  - Braces
  - Links
  - Springs
  - Mass
  - Loads
  - Plastic Hinge
  - Non-linear Link

- **Point objects**
  - Supports
  - Springs
  - Mass
  - Loads
Beam, Column and Brace Elements

- Axial, bending, torsional and shear deformations
- Multiple non-prismatic segments over element length
- Ends offset from reference nodes in any direction
- Automated evaluation of offsets for joint size
Beam, Column and Brace Elements

- Moment and shear releases and partial-fixity
- Point, uniform and trapezoidal loading in any direction
- Temperature and thermal-gradient loading
Wall, Slab, Deck Elements

- Shell, plate or membrane action
- General quadrilateral or triangular element
- Six degree of freedom per joint
- Uniform load in any direction
- Temperature and thermal-gradient loading
Wall, Slab and Deck Elements

- Use these Elements to Model
  - Shear Walls
  - Bearing Walls
  - Wall Panels
  - Concrete Slabs
  - Diaphragms
  - Metal Decks
- For modeling of Support
- Coupled or uncoupled grounded springs
- Force loads
- Ground-displacement loads
- Inclined Supports
Plastic Hinge Element

- Used as Spring, Link, Panel zone or inside Frame Elements
- Axial, flexural, shear and torsional behavior
- Axial-load/ biaxial-moment interaction
- Multilinear behavior including softening
- Tabulated and Graphical display of hinge status
Nonlinear Link Elements

- Used with the Dynamic Nonlinear Analysis option
- Used as Link, Spring or as Panel zone
- Viscous damper with nonlinear exponent on velocity term
- Gap (compression only) and Hook (tension only)
Nonlinear Link Elements

- Uniaxial plasticity (all 6 degree of freedom)
- Base isolator with biaxial-plasticity behavior
- Base isolator with friction and/or pendulum behavior
- Force or displacement vs. time plots
- Force vs. deformation plots
\[ [K - \Omega^2 M] \Phi = 0 \]

\[ Ku(t) + M u(t) = r(t) = p \cos(\omega t) \]
Main Analysis Options

- Linear Static Analysis
- Linear Dynamic Analysis
- Static and Dynamic P-Delta Analysis
- Static Non-Linear Analysis
Main Analysis Options

- Dynamic Non-Linear Analysis
- Pushover Analysis
- Multiple Response Spectrum Analysis
- Multiple Time History Analysis
- Construction sequence loading analysis
Special Analysis Options

- Explicit Panel-zone deformations
- Automatic tributary-area calculations for Live-Load reduction factors
- Construction sequence loading analysis
- Automated center of rigidity calculations
Special Analysis Options

- Automatic transfer of loads on decks/slabs to beams and walls
- Automatic meshing of frame members into analysis elements
- Automatic meshing of decks/slabs for flexible diaphragm analysis
Dynamic Analysis Options

- Static and dynamic response combinations by ABS or SRSS method
- Eigen and load-dependent Ritz vector determination
- Model combination by SRSS, CQC or GMC (Gupta) method
- Combination of three direction by ABS or SRSS method
Dynamic Analysis Options

- Multiple Response Spectrum cases
- Multiple Time history cases
- Sequential Time History cases
- Seismic acceleration or displacement excitation
- Wind-load forcing functions
- Transient or steady-state excitation
- Envelope or step-by-step design for Time-History loads
Non-Linear Analysis Options

- **Static Nonlinear Analysis**
  - Large displacement option
  - Sequential loading option

- **Dynamic Nonlinear Analysis Options**
  
  The nonlinear dynamic analysis option extends the capabilities of the Linear Time History option by allowing for nonlinearity in predefined nonlinear elements.
Static Pushover Analysis

Analysis Options

- Considers FEMA 273, ATC-40 provisions
- Automated force-deformation relations for steel and concrete hinges
- Modal uniform, or user-defined lateral load patterns
- Start from applied gravity load
- Capacity Spectrum conversions
- Effective damping calculation
- Demand Spectrum comparisons
- Performance point calculation
- Summary reports including plastic-hinge deformations
Viewing Results
Analysis Results

- Deformed and undeformed geometry in 3D perspective
- Animation of deformed shapes
- Bending-Moment and Shear-Force diagrams for Frames
- Instantaneous on-screen results output with right-button click on element
- Integrated-force diagrams for Wall Piers and Spandrels
Analysis Results

- Loading diagrams
- Stress contours for shells
- Interactive Section-force results using Groups
Dynamic Analysis Results

- Time-History deformed shapes as real time AVI file
- Displays of nodal and element time-history records
- Time History displays of function vs. time or function vs. function
- Response spectrum curves for any joint from Time History response
- Selective or complete tabulated output for all output quantities
- Graphics output to screen, printer, DXF file, or Windows Metafile
- Tabulated output to screen, printer, or Access Database
Fully Integrated Element Design

- Design of Steel Beams, and Columns
- Design of Concrete Beams and Columns
- Design of Composite Beams
- Design of Concrete Shear Walls
Steel Frame Design

- Fully integrated steel frame design
- AISC-ASD, AISC-LRFD, UBC, Canadian and Euro codes
- Design for static and dynamic loads
- Graphical display of stress ratios
- Interactive design and review
- Summary and detailed reports including database formats
• Optimizations for strength and lateral drift
• Seismic design of special moment-resisting frames
• Seismic design of concentric and eccentric braced frames
• Check of panel zones for stiffener and continuity plates
Concrete Frame Design

- Fully integrated concrete frame design
- ACI, UBC, Canadian and Euro codes
- Design for static and dynamic loads
- Seismic design of intermediate/special moment-resisting frames
- Seismic design of beam/column joints
- Seismic check for strong-column/weak-beam design
Concrete Frame Design

- Graphical Section Designer for concrete rebar location
- Biaxial-moment/axial-load interaction diagrams
- Graphical display of reinforcement and stress ratios
- Interactive design and review
- Summary and detail reports including database formats

*Idealization of Stress and Strain Distribution in a Column Section*
Composite Beam Design

Member Design
Composite Beam Design

- AISC-ASD and AISC-LRFD Specifications
- Automatic calculation of effective slab widths
- Numerous user-specified constraints
- Shored and un-shored design
- Optimal design for strength and deflections
- Camber calculation
- Floor Vibration analysis
Shear Wall Design
Concrete Shear Wall Design

- **Fully integrated wall pier and spandrel design**
- **ACI, UBC and Canadian Codes**
- **Design for static and dynamic loads**
- **Automatic integration of forces for piers and spandrel**

**Member Design**

- #5@12" o.c., each face, except as noted

- f'c = 4 ksi
- fy = 60 ksi
Concrete Shear Wall Design

- 2D wall pier design and boundary-member checks
- 2D wall spandrel design
- 3D wall pier check for provided reinforcement
- Graphical Section Designer for concrete rebar location
- Graphical display of reinforcement and stress ratios
- Interactive design and review
- Summary and detailed reports including database formats
ETABS
V7 – Non Linear
The Most Comprehensive Software for the Modeling, Analysis and Design of Buildings