

WHY SOFTWARE???



CIVIL ENGINEERING SOFTWARE

PLANNING SOFTWARE

- ✓ **AUTOCAD**

MODELING SOFTWARE

- ✓ **REVIT ARCHITECTURE**
- ✓ **3DS MAX DESIGN**

STRUCTURAL DESIGN & ANALYSIS SOFTWARE

- ✓ **STAAD.PRO**
- ✓ **ETABS**
- ✓ **SAFE**
- ✓ **ANSYS CIVIL**

PROJECT MANAGEMENT SOFTWARE

- ✓ **PRIMAVERA**
- ✓ **MS PROJECT**

ETABS



ETABS

3D Modeling, Analysis, Design & Detailing
Software

by

Sekhar Babu

20+ Years Experienced
Structural Consultant

SPACE CADD

Tambaram, Velachery , Guduvanchery

ETABS

Key Features

Key Features

- Fully integrated interface within Windows XP/2000/7/8
- 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

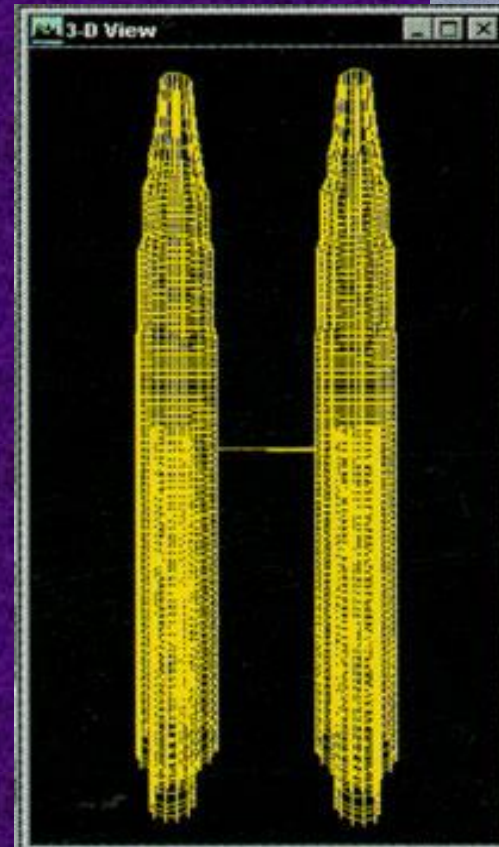


- Extensive Analysis Capabilities
 - *Linear Static Analysis*
 - *Linear Dynamic Analysis*
 - *Static and Dynamic P-Delta Analysis*
 - *Static Non-Linear Analysis*
 - *Dynamic Non-Linear Analysis*
 - *Pushover Analysis*
 - *Response Spectrum Analysis*
 - *Time History Analysis*
 - *Construction sequence loading analysis*

Key Features

Key Features

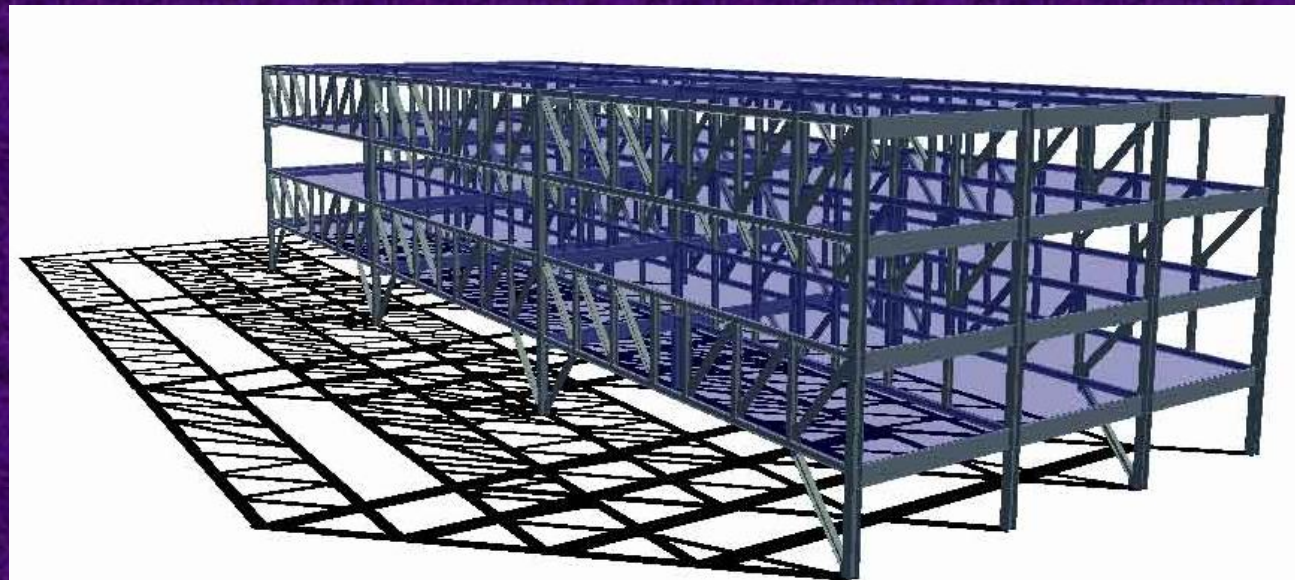
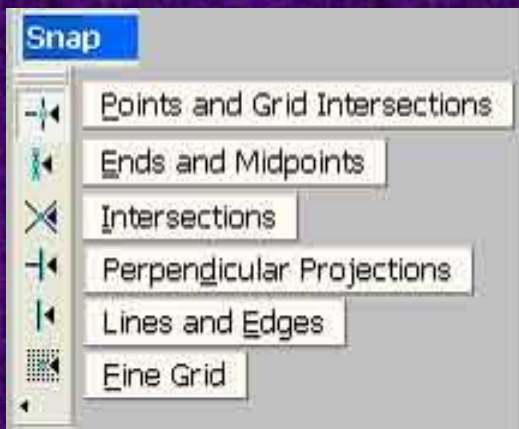
- Fast generation of model using the concept of similar stories
- Automated templates for typical structures
- Easy editing with move, merge, mirror and replicate



Key Features

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

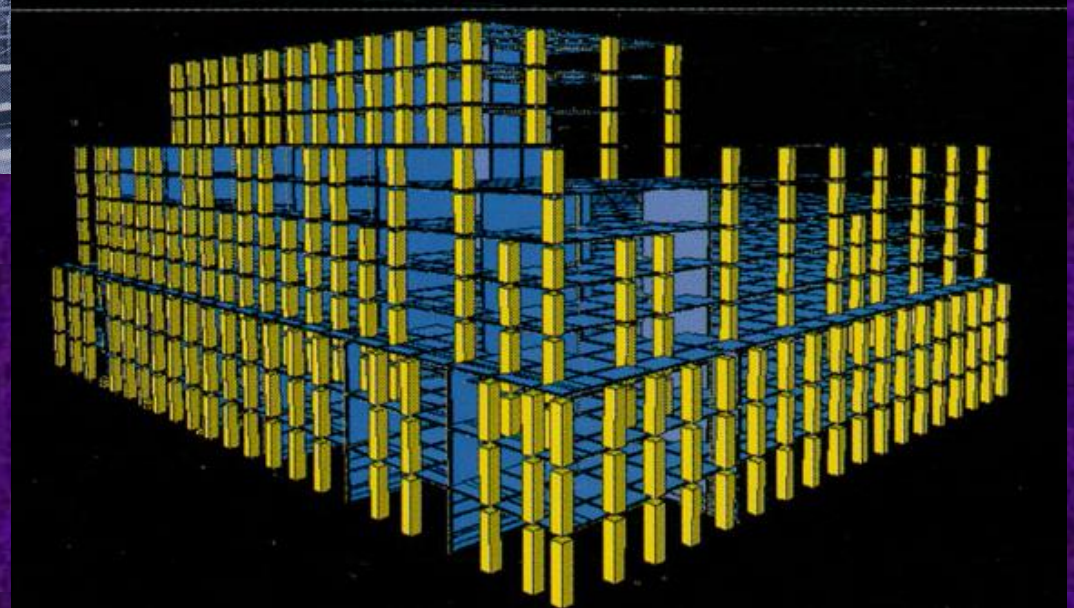


The image features a blue background with a glowing green grid pattern. Two lines of 3D, yellow-gold text are positioned diagonally across the frame. The top line reads "Interactive Model Creation" and the bottom line reads "Fully Graphical Interface". The text has a slight shadow and a metallic sheen.

Interactive Model Creation
Fully Graphical Interface

Realistic Modeling

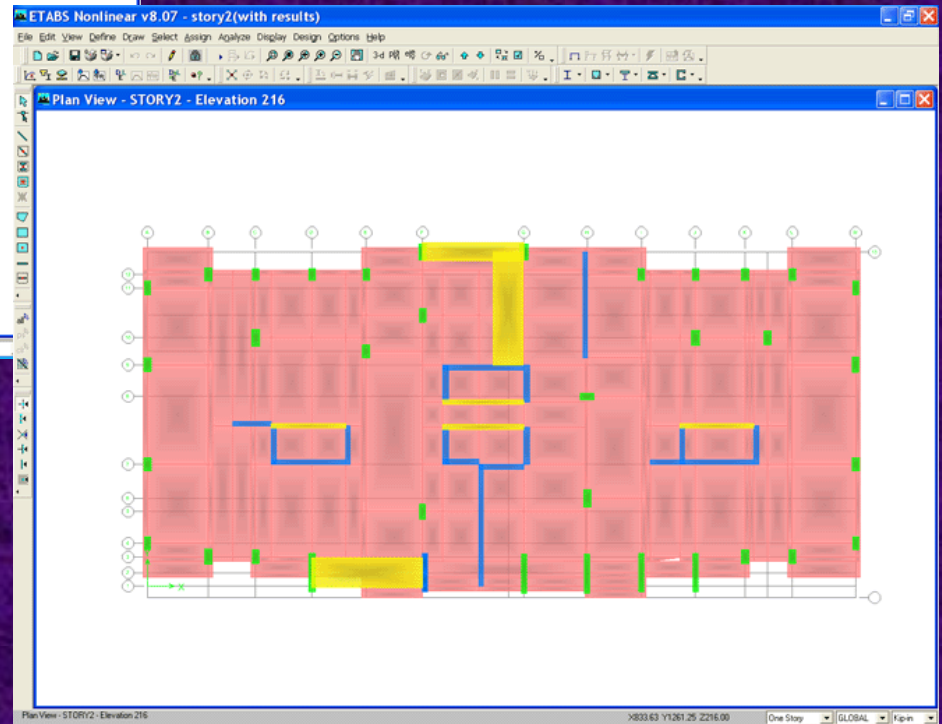
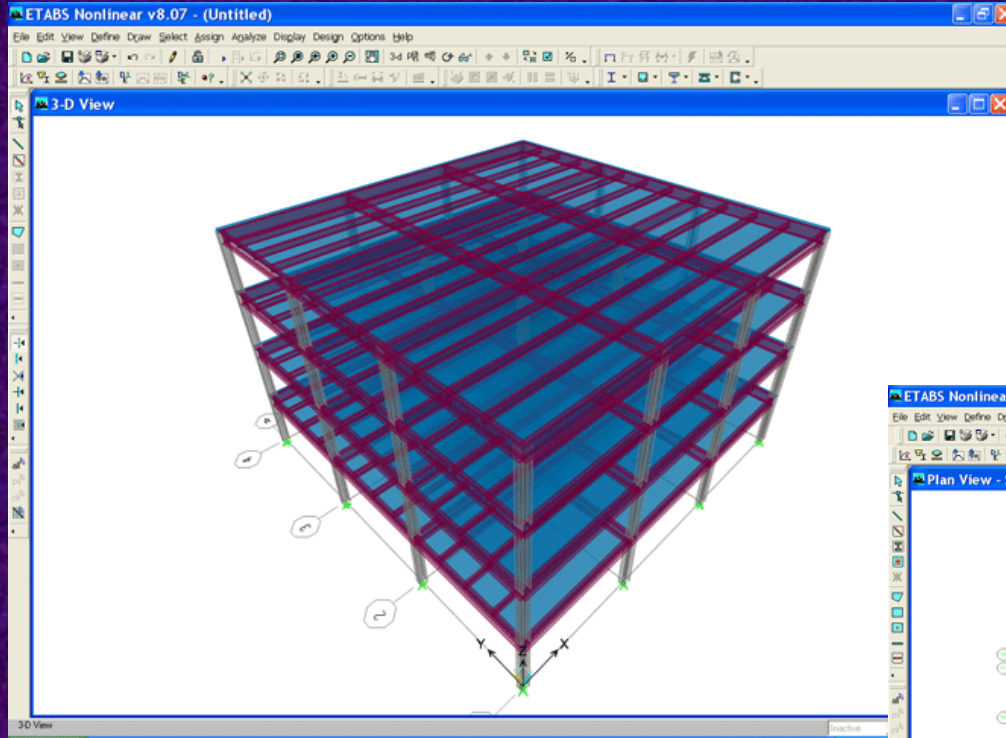
Interactive
Modeling



ETABS

Interactive
Modeling

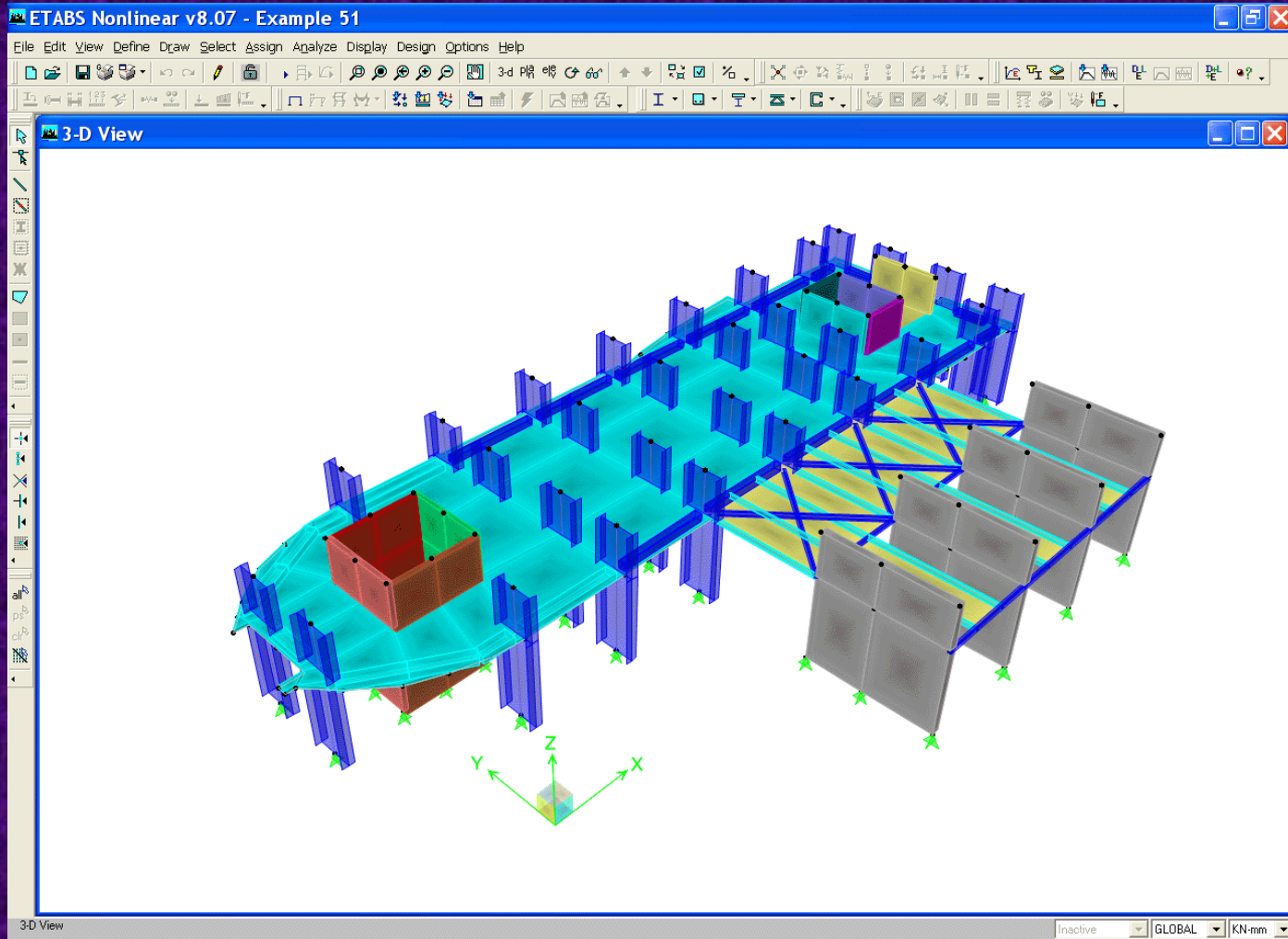
Powerful Viewing Options



ETABS

Interactive
Modeling

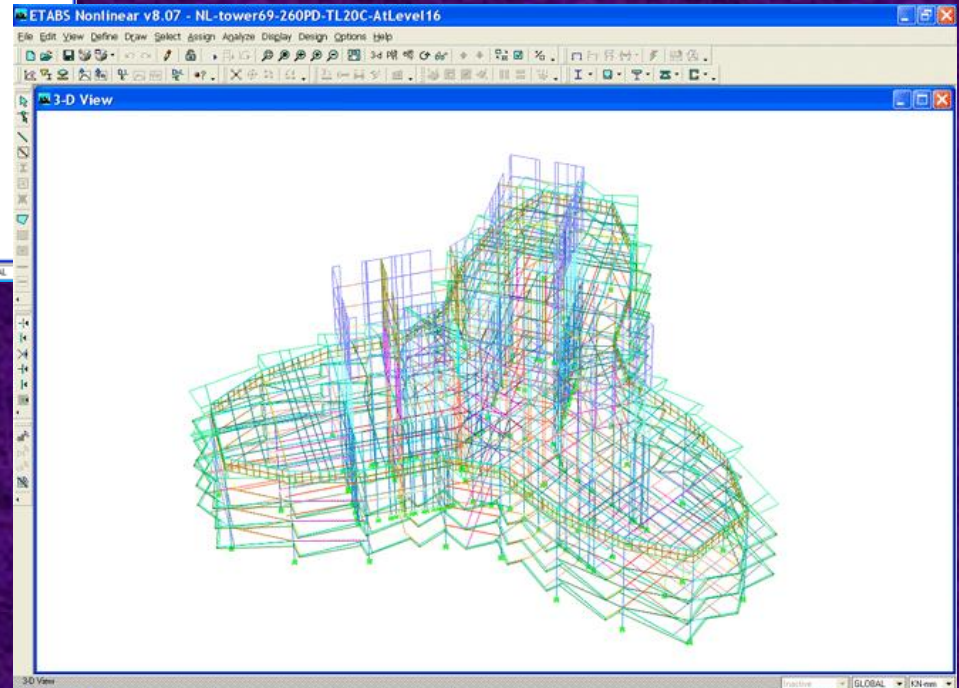
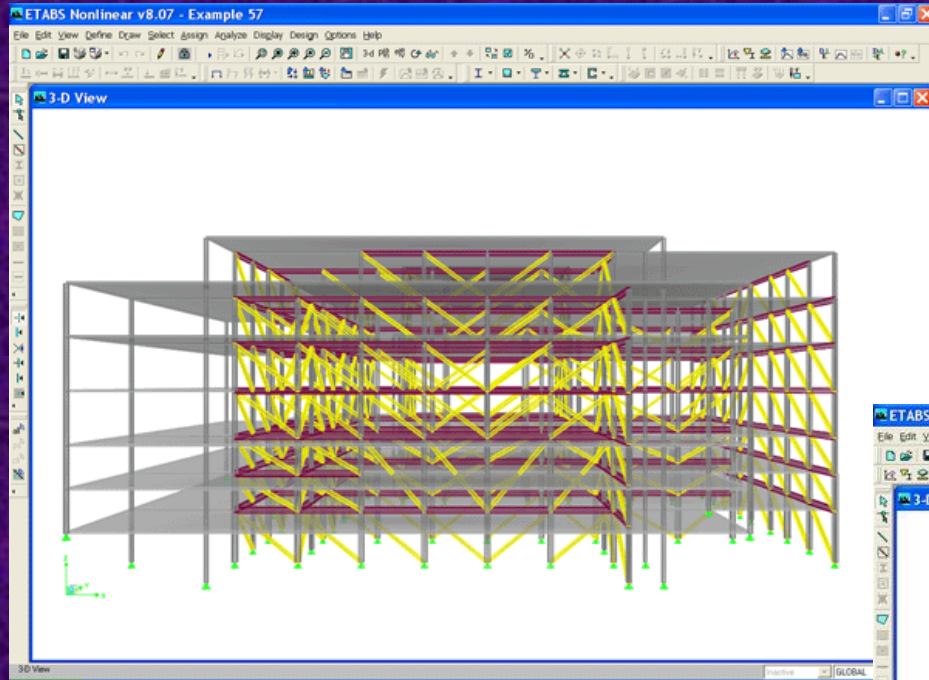
Powerful Viewing Options



ETABS

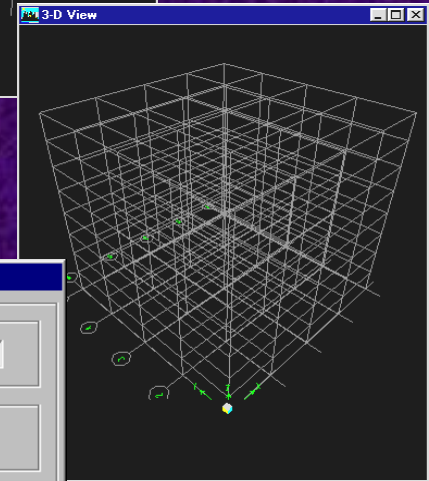
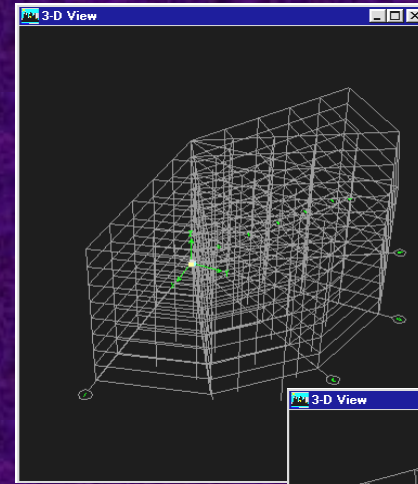
Interactive
Modeling

Powerful Viewing Options



ETABS

- 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



Coordinate System Definition

System: CSYS2

Cartesian Cylindrical

Number of Grid Lines:

X Direction: 4

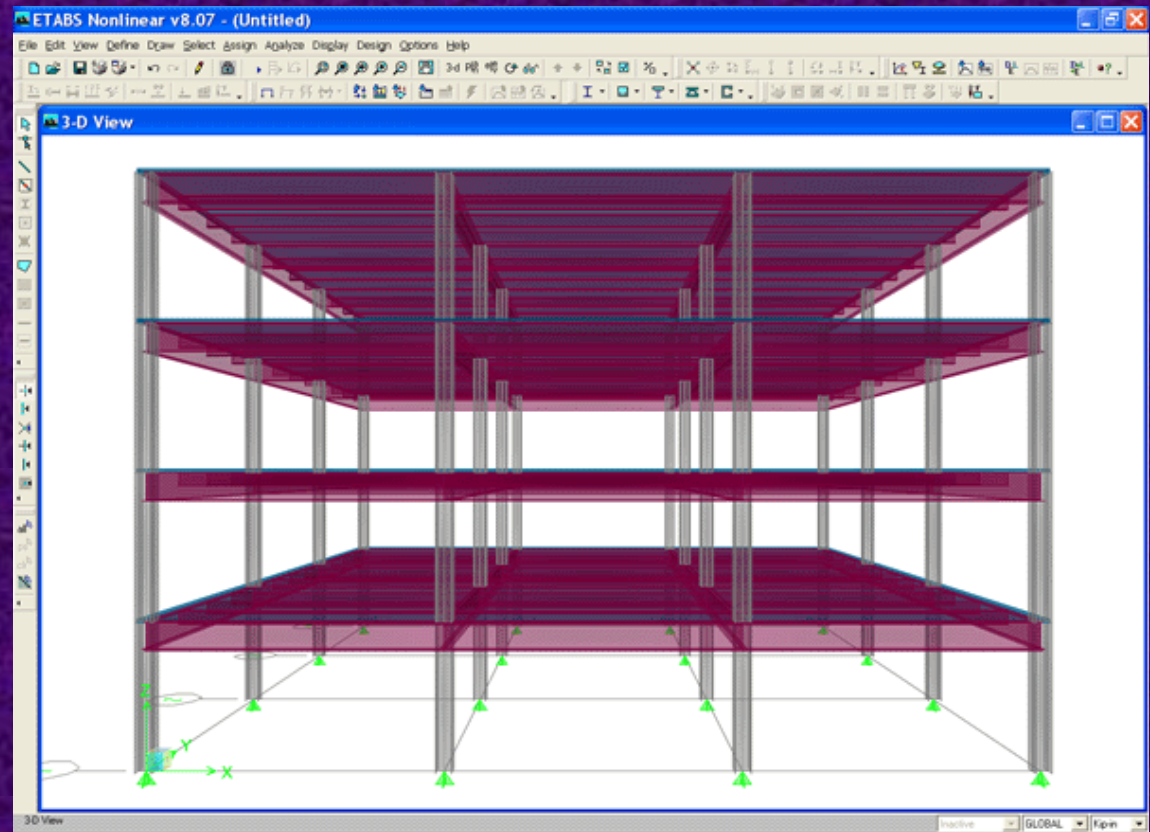
Y Direction: 4

Grid Spacing:

X Direction: 288

Y Direction: 288

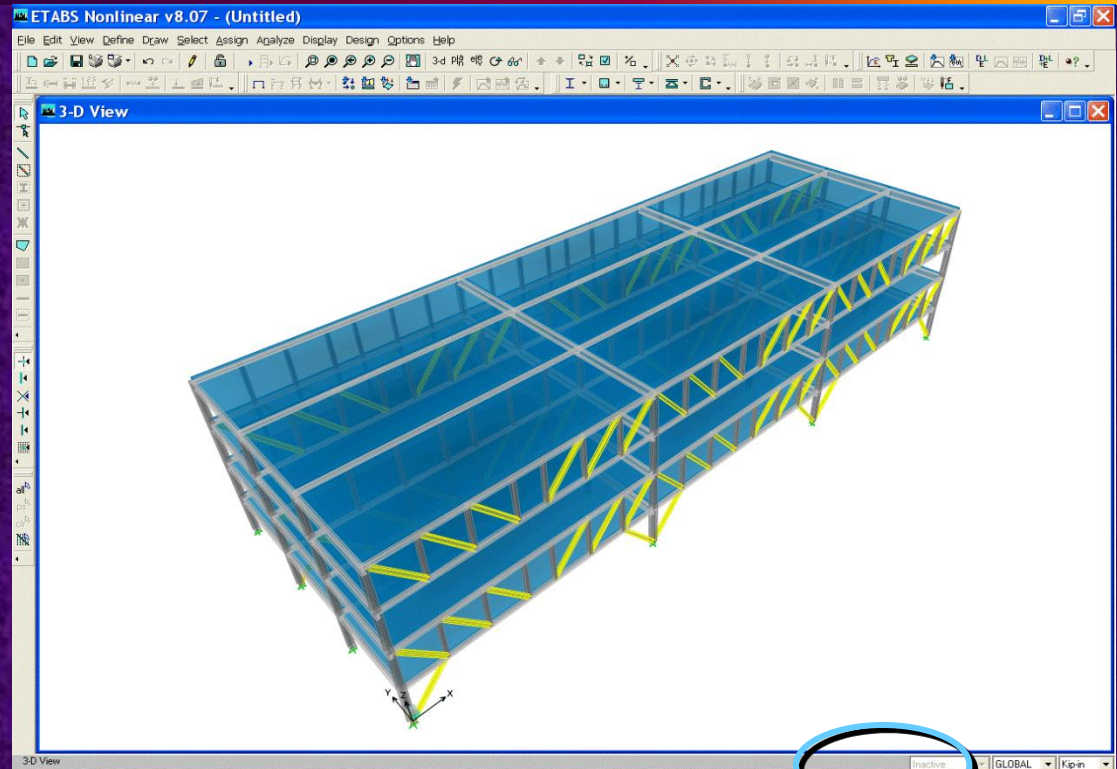
- Automated model generation for typical structures using powerful templates
 - *Steel Deck*
 - *Flat Slab*
 - *Two-way Slab*
 - *Waffle Slab*
 - *Ribbed Slab*



Interactive Modeling

“Similar” Story Concept

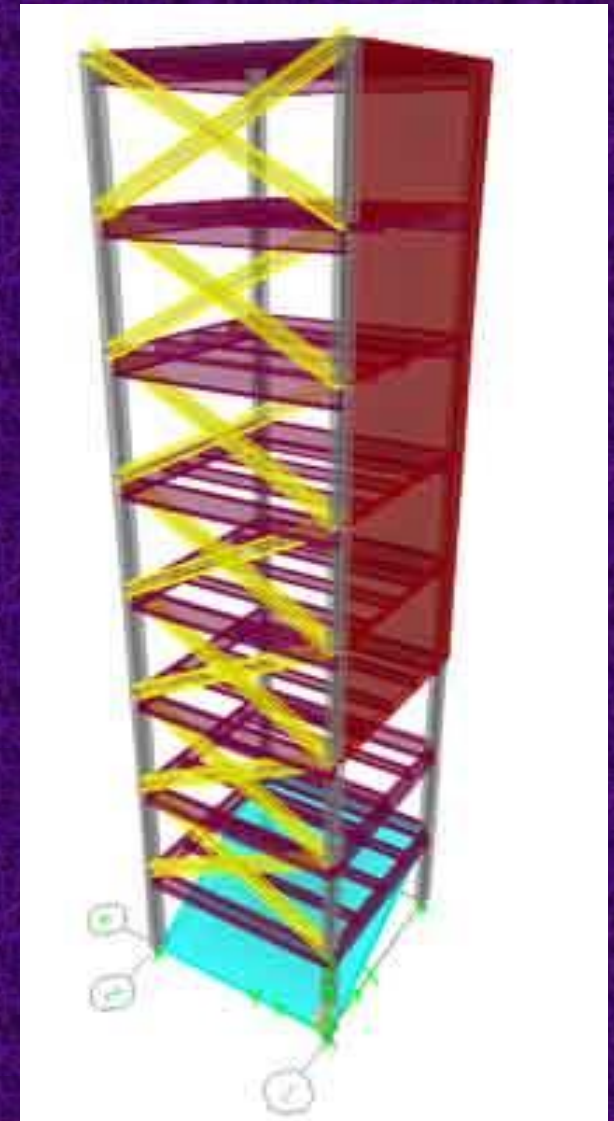
- Time saving Story definitions using the concept of similar Stories
- Common labeling of Objects between similar Stories



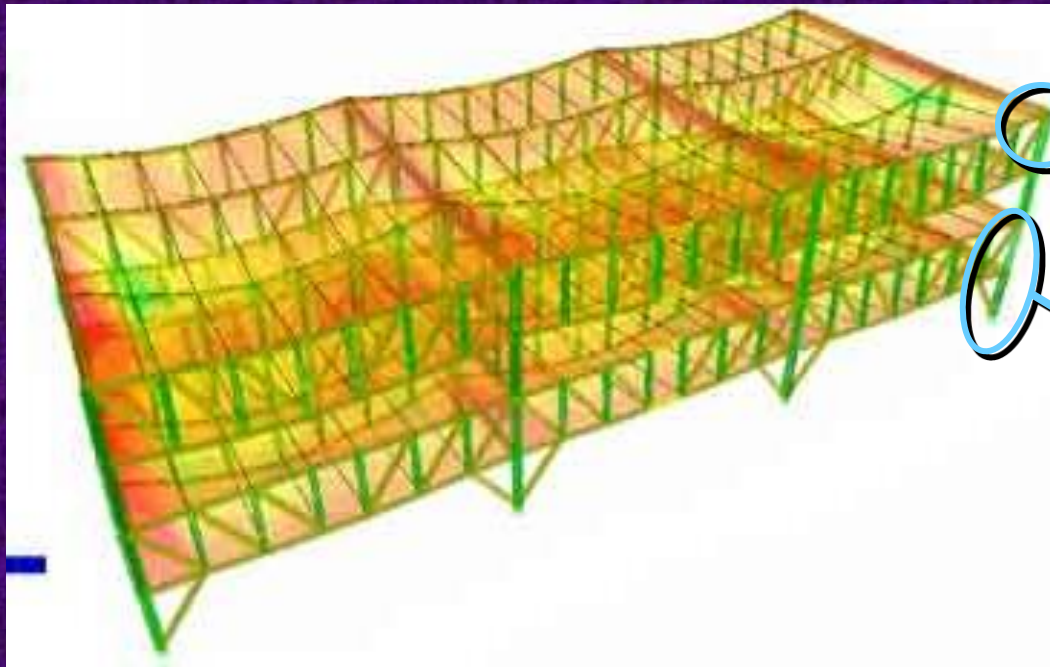
Story Data

	Label	Height	Elevation	Similar To
9	STORY8	144.	1152.	NONE
8	STORY7	144.	1008.	STORY8
7	STORY6	144.	864.	STORY8
6	STORY5	144.	720.	STORY8

- 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*



- Right button click for element or design information
- Customized display of parameters and attributes



Point Information

Location | Assignments | Loads

Identification

Label: 19

Story: STORY8

X	816.
Y	-6.
Delta Z	0.
Connectivity	
Area	F18
Area	F19

Line Information

Location | Assignments | Loads

Identification

Label: C4 | Line Type: []

Story: STORY8 | Design Procedure: []

Section Property	CSECT1
Releases	None
Partial Fixity Springs	None
End Length Offsets	Automatic
End I Length Offset	0.
End J Length Offset	0.
Rigid Zone Factor	0.
Joint Offsets	None
Min. Number Stations	3
Local axis 2 Angle	Default
Property Modifiers	None
Link Properties	None
Nonlinear Hinges	None
Pier	No
Spandrel	No
Line Springs	None
Line Mass	None

Building Loads

Interactive Modeling

- 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

Define Static Load Case Names

Load	Type	Self Weight Multiplier	Auto Lateral Load
WINDY	WIND	0	ASCE 7-88
DEAD	DEAD	1	
LIVE	LIVE	0	
SUPERDL	SUPER DEAD	0	
WINDX	WIND	0	ASCE 7-88
WINDY	WIND	0	ASCE 7-88
EQX	QUAKE	0	UBC 97 Isolated
EQY	QUAKE	0	UBC 97 Isolated
SNOW	SNOW	1	

Click To:

Add New Load

Modify Load

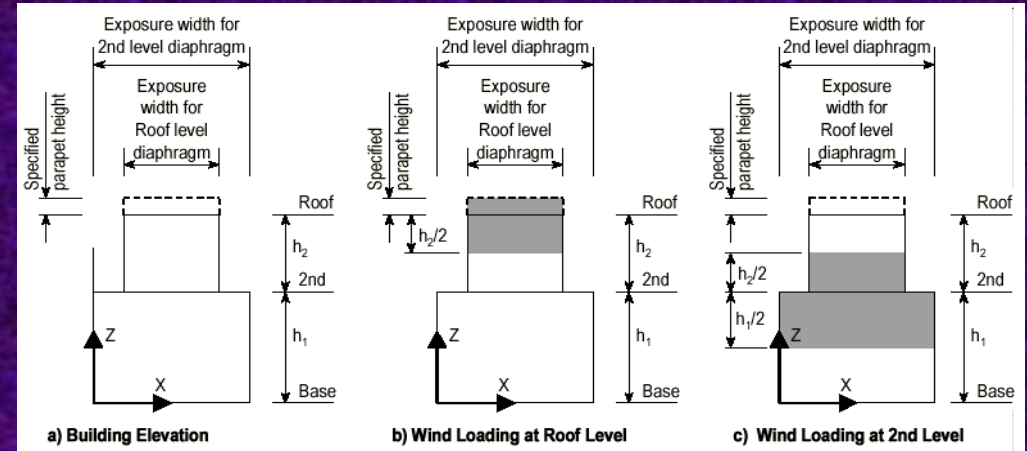
Modify Lateral Load...

Delete Load

OK

Cancel

- Automatic wind load generation
– *Indian IS 875*



Type	Self Weight Multiplier	Auto Lateral Load
WIND	0	UBC 94
DEAD	0	UBC 94
		UBC 97
		BOCA 96
		NBCC 95
		ASCE 7-95
		User Defined
		None

UBC 94 Wind Loading

Direction
Angle:

Exposure Height
Top Story:
Bottom Story:

Include Parapet
Parapet Height:

Wind Coefficients
Wind Speed (mph):
Exposure Type:
Importance Factor:

Story	Diaphragm
2ND	
1ST	

- Automatic Seismic Load Generation
– *Indian IS 1893*

Type	Self Weight Multiplier	Auto Lateral Load
QUAKE	0	UBC 94
QUAKE	0	UBC 94

1994 UBC Seismic Loading

Directional Data

Direction and Eccentricity

X Dir Y Dir

X Dir + Eccen Y Y Dir + Eccen X

X Dir - Eccen Y Y Dir - Eccen X

% Eccen (all Diaphragms)

Override Eccentricities

Time Period

Method A Ct =

Program Calculated Ct =

User Defined T =

Story Range

Top Story

Bottom Story

Factors

Numerical Coefficient, R_w



Modeling Elements

Beams, Columns, Walls, Slabs ...

Powerful Object Based Elements

- **Area objects**

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

- **Lines objects**

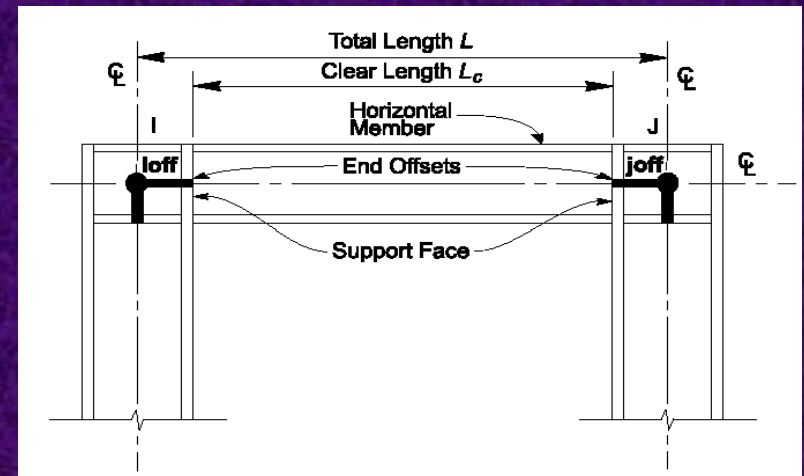
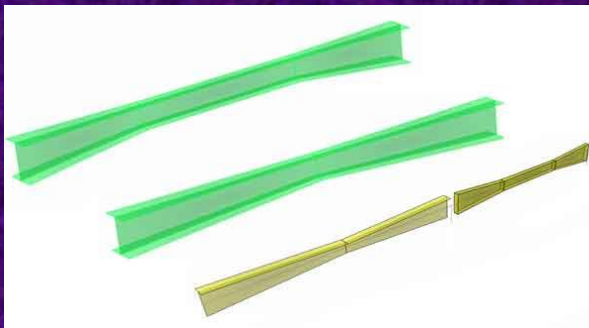
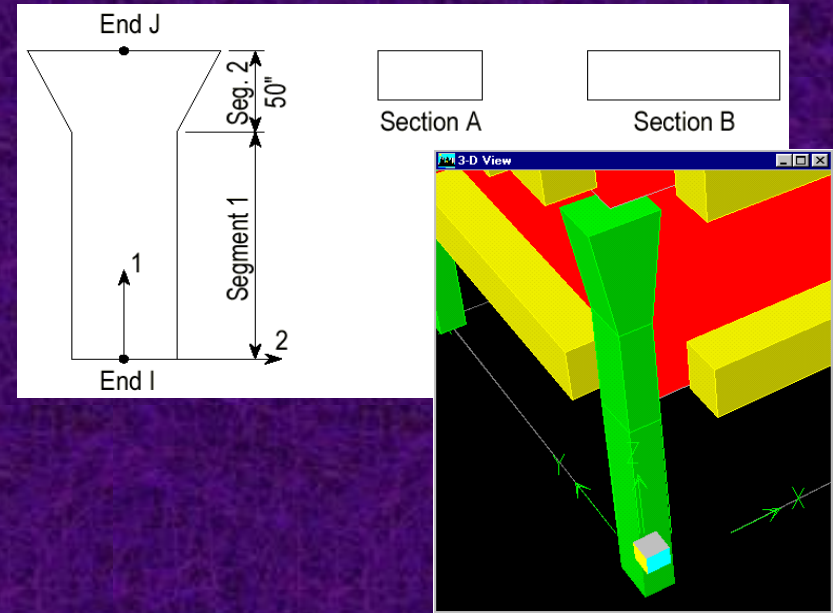
- *Columns*
- *Beams*
- *Braces*
- *Links*
- *Springs*
- *Mass*
- *Loads*
- *Plastic Hinge*
- *Non-linear Link*

- **Point objects**

- *Supports*
- *Springs*
- *Mass*
- *Loads*

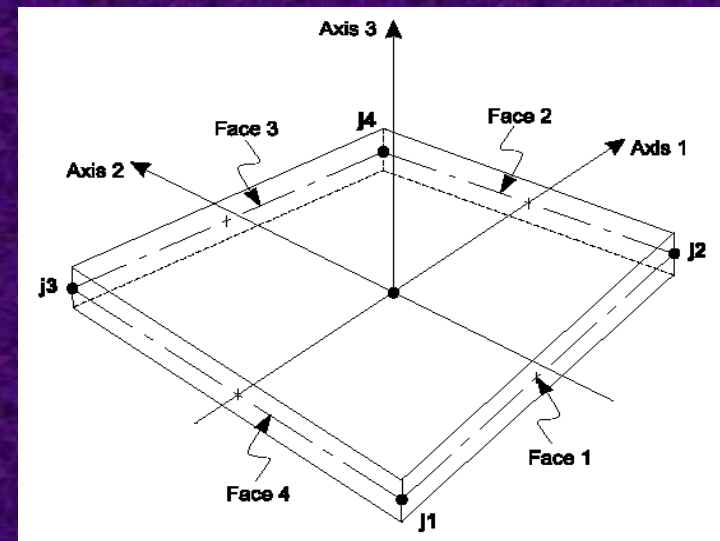
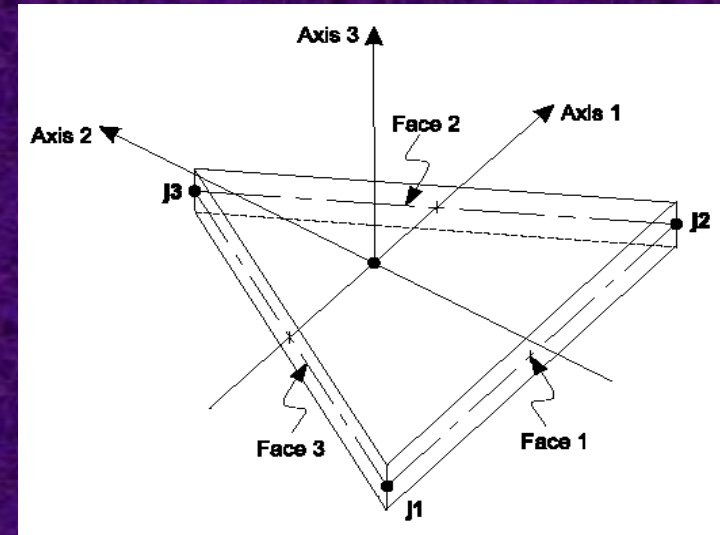
Beam, Column and Brace Elements

- 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



Wall, Slab, Deck Elements

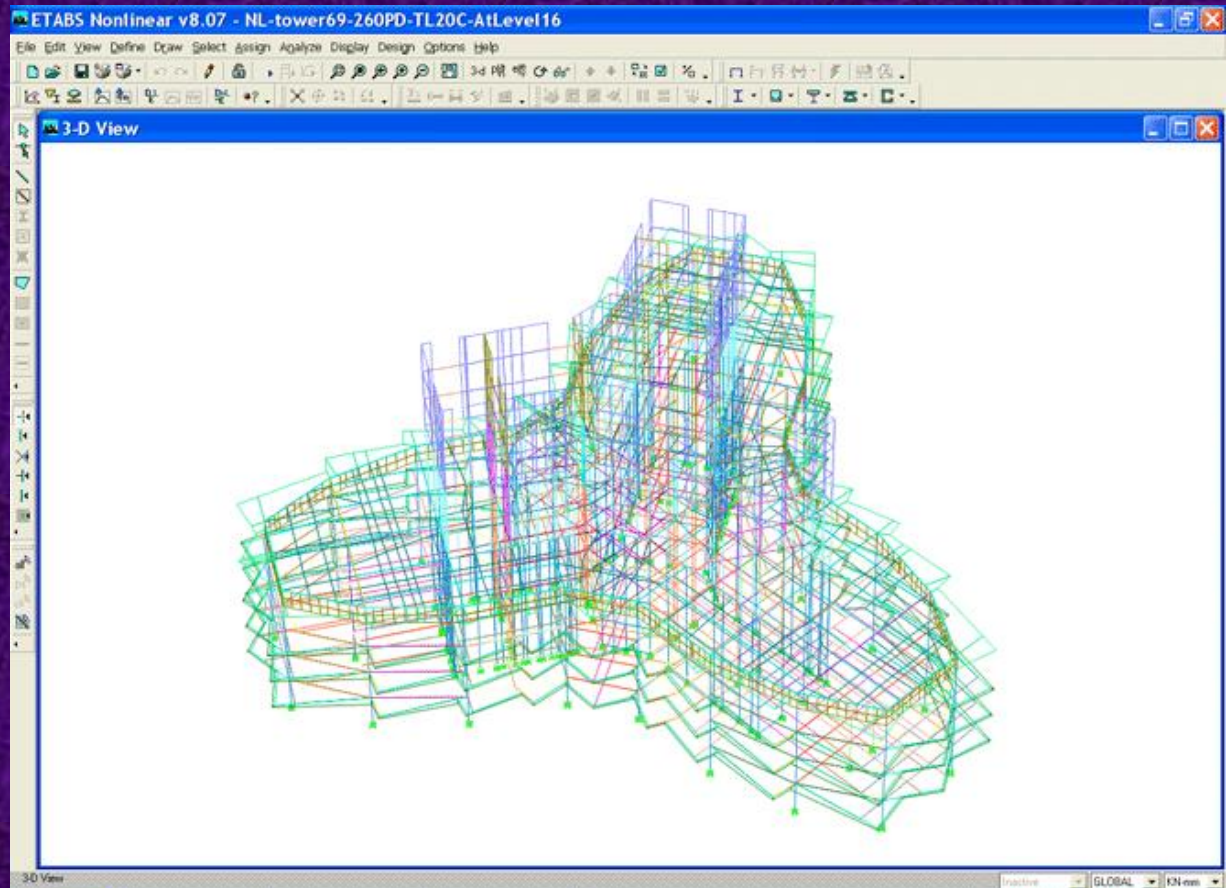
- Shell, plate or membrane action
- General quadrilateral or triangular element
- Six degree of freedom per joint
- Uniform load in any direction
- Temperature and thermal-gradient loading



Wall, Slab and Deck Elements

Modeling Elements

- Use these Elements to Model
 - *Shear Walls*
 - *Bearing Walls*
 - *Wall Panels*
 - *Concrete Slabs*
 - *Diaphragms*
 - *Metal Decks*



Analysis Options

$$[K - \Omega^2 M] \ddot{\Phi} = 0$$

$$Ku(t) + M \ddot{u}(t) = r(t) = p \cos(\omega t)$$

Analysis Options

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

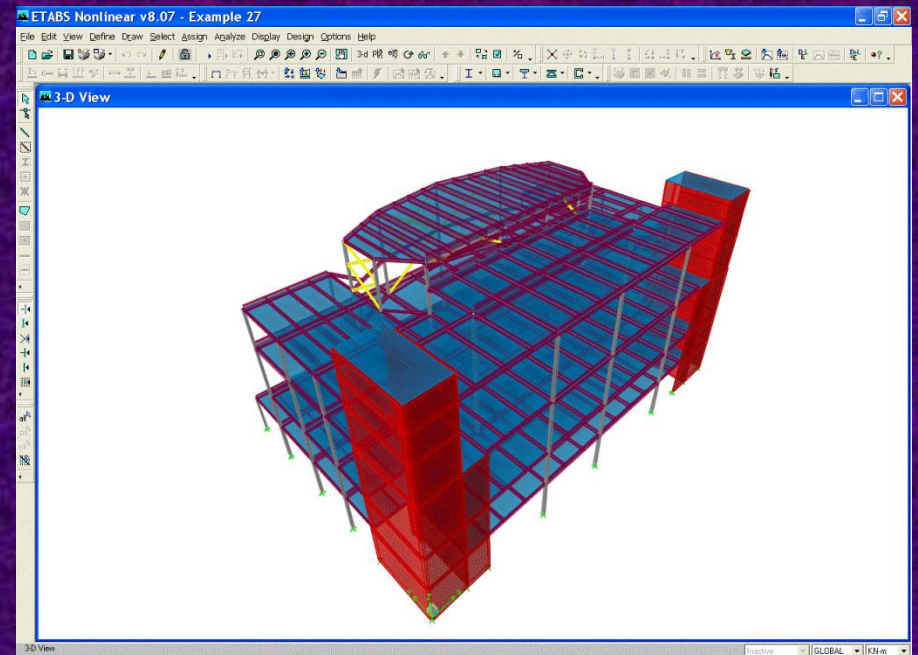
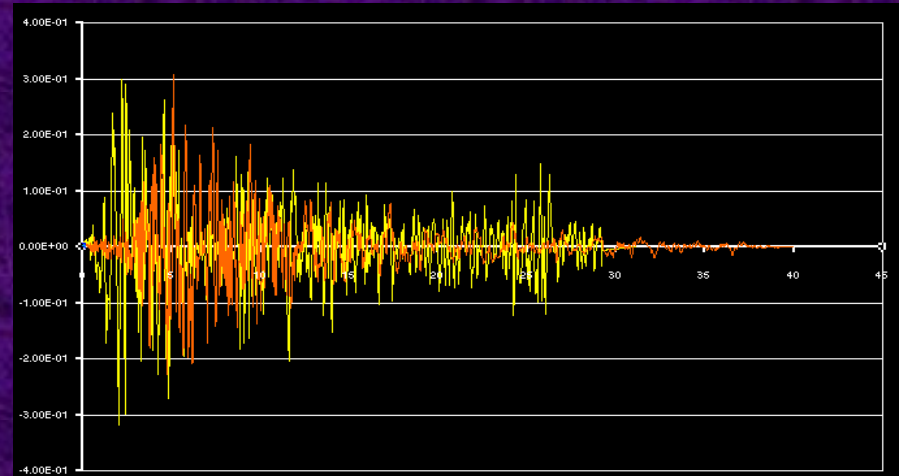
The screenshot shows the 'Dynamic Analysis Parameters' dialog box. It contains the following fields and options:

- Number of Modes:** 12
- Type of Analysis:** Eigenvalues Ritz Vectors
- EigenValue Parameters:**
 - Frequency Shift (Center): 0
 - Cutoff Frequency (Radius): 0
 - Relative Tolerance: 1.000E-07
 - Include Residual Mass Modes
- Starting Ritz Vectors:**
 - List of Loads:** DEAD, LIVE
 - Ritz Load Vectors:** ACCEL X, ACCEL Y, ACCEL Z
 - Buttons: [Add Load], [Remove Load]
- Buttons:** [OK], [Cancel]

Dynamic Analysis Options

Analysis Options

- Static and dynamic response combinations by ABS or SRSS method
- Eigen and load-dependent Ritz vector determination



Analysis Options

Pushover Analysis

PUSHOVER CURVE - CASE PUSH1

File

Spectral Displacement

Y-axis: Spectral Acceleration / m/s² (Scale: $\times 10^{-3}$)

X-axis: Spectral Displacement / m (Scale: $\times 10^{-3}$)

Cursor Location: (7.692E-01 , 1.659E-01)

Performance Point (V,D): (493.488 , 0.167)

Performance Point (Sa,Sd): (0.144 , 0.134)

Performance Point (Teff,βeff): (1.940 , 0.170)

Static Pushover Case PUSH1

Plot Type

- Resultant Base Reaction vs Monitored Displacement
- Capacity Spectrum Color █

Demand Spectrum

Seismic Coefficient Ca: 0.4

Seismic Coefficient Cv: 0.4

- Show Family of Demand Spectra Color █

Damping Ratios: 0.05 0.1 0.15 0.2

- Show Single Demand Spectrum (Variable Damping) Color █
- Show Constant Period Lines at Color █

0.5 1. 1.5 2.

Damping Parameters

Inherent + Additional Damping: 0.05

Structural Behavior Type: A B C User Modify/Show

Override Axis Labels/Range
Display
Done
Reset Default Colors

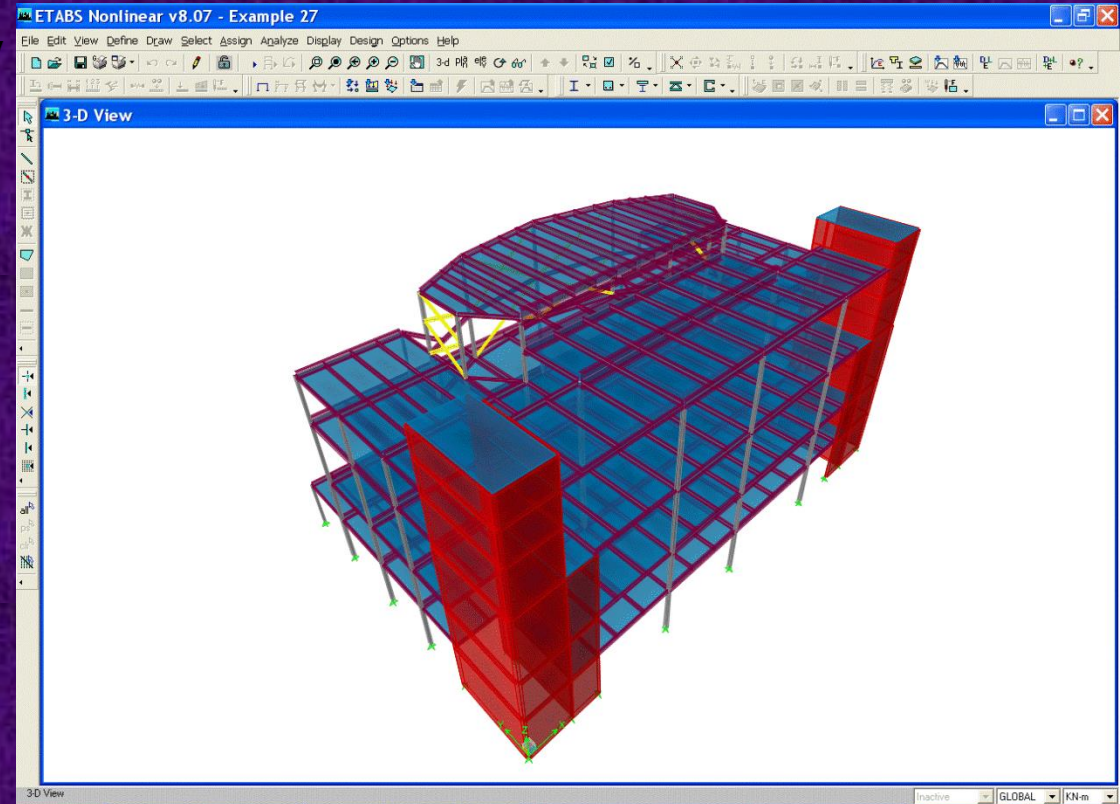


Viewing Results

Analysis Results

Analysis Results

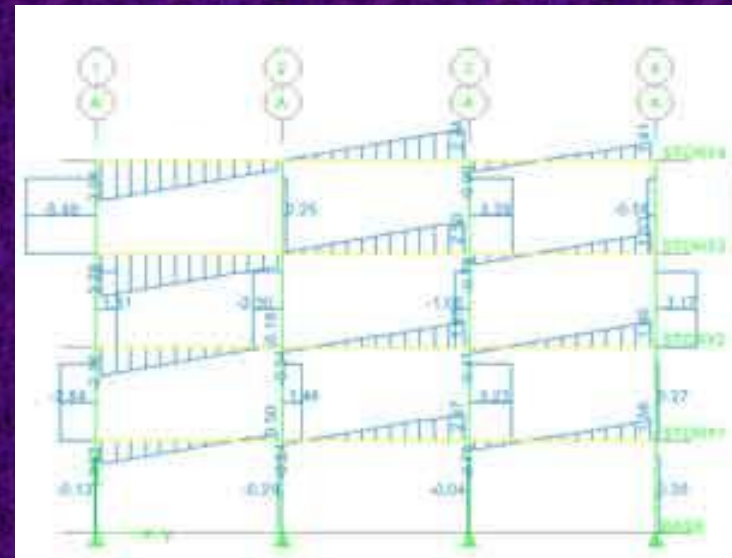
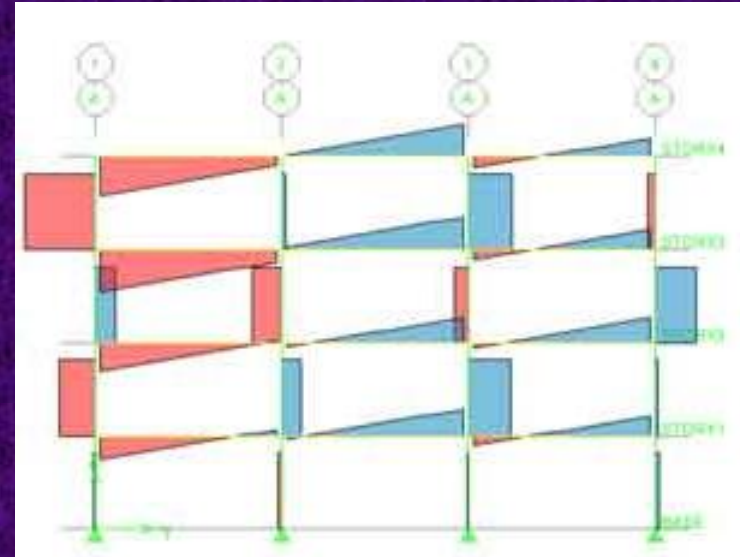
- Deformed and Un-deformed geometry in 3D perspective
- Animation of deformed shapes



Analysis Results

Analysis Results

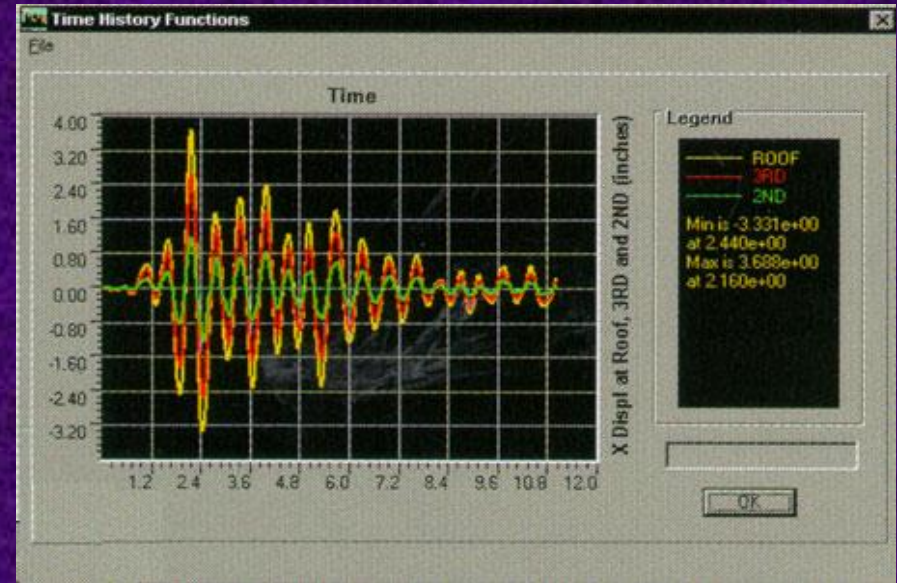
- Bending-Moment and Shear-Force diagrams for Frames
- Instantaneous on-screen results output with right-button click on element
- Integrated-force diagrams for Wall Piers and Spandrels



Dynamic Analysis Results

Analysis Results

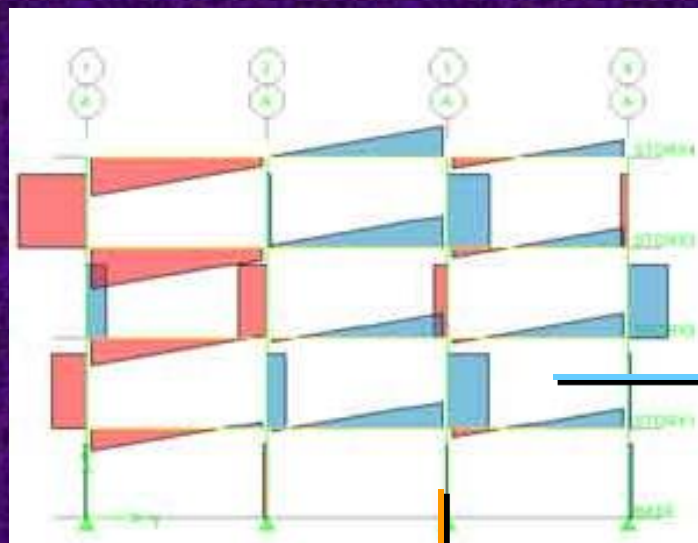
- Time-History deformed shapes as real time AVI file
- Displays of nodal and element time-history records
- Time History displays of function vs. time or function vs. function
- Response spectrum curves for any joint from Time History response



Analysis Results

Analysis Output

- 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



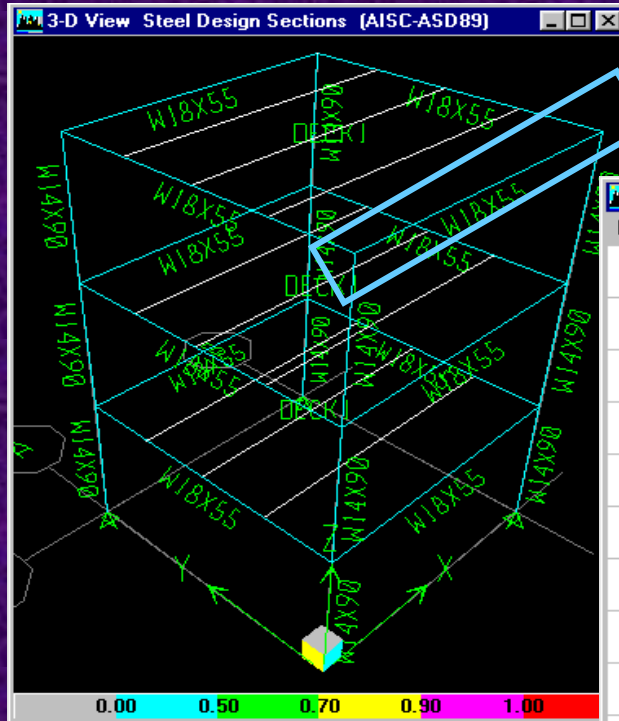
Beam Forces						
	Story	Beam	Load	Loc	P	V2
▶	STORY4	B1	DEAD	12	0	-9.919177
	STORY4	B1	DEAD	30	0	-9.469206
	STORY4	B1	DEAD	48	0	-9.019235
	STORY4	B1	DEAD	48	0	-5.107079
	STORY4	B1	DEAD	72	0	-4.507117
	STORY4	B1	DEAD	96	0	-3.907155
	STORY4	B1	DEAD	96	0	-1.694391

Member Design

A 3D digital graphic featuring the text "Member Design" in a bold, red, sans-serif font. The text is rendered with a slight perspective, appearing to float above a blue, reflective surface. Surrounding the text is a grid of numerous grey, rectangular 3D blocks, some of which are slightly offset or tilted, creating a sense of depth and movement. The background is a gradient of blue, with a bright light source at the bottom center, casting a glow and creating a lens flare effect. The overall composition is dynamic and modern.

Member Design

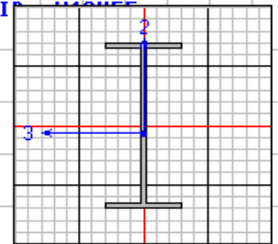
Steel Frame Design



Analysis Model

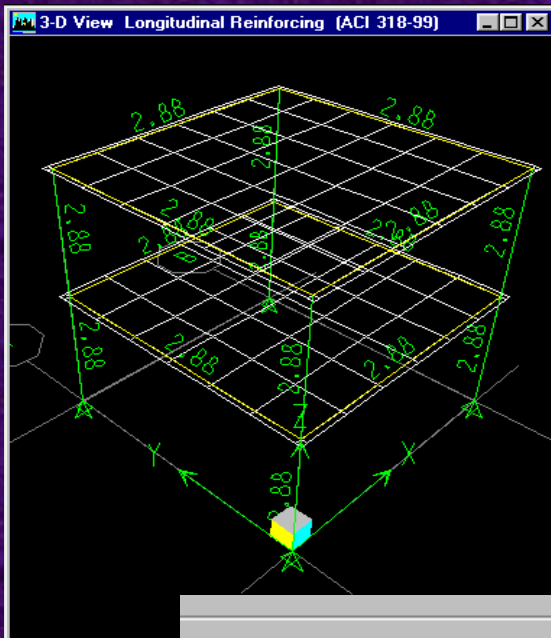
Design Output

Steel Stress Check Information AISC-ASD89									
File									
AISC-ASD89 STEEL SECTION CHECK Units: Kip-in									
Level: STORY3 Element: B3 Station Loc: 144.000 Section I									
Element Type: Moment Resisting Classification: Compact									
L=288.000									
A=16.200 i22=44.900 i33=890.000									
s22=11.926 s33=98.288 r22=1.665 r33=7.412									
E=29000.000 Fy=36.000									
RLLF=0.947 EQF=1.000									
P-M33-M22 Demand/Capacity Ratio is 0.302 = 0.000 + 0.302 + 0.000									
STRESS CHECK FORCES & MOMENTS									
		P	M33	M22	U2	U3			
Combo	DSTL2	0.000	706.294	0.000	-3.209	0.000			
AXIAL FORCE & BIAxIAL MOMENT DESIGN (BENDING)									
		Fa	Fa	Ft					
		Stress	Allowable	Allowable					
Axial		0.000	18.926	21.600					
		Fb	Fb	Fe	Cm	K	L		
		Stress	Allowable	Allowable	Factor	Factor	Factor	Factor	Fact
Major Bending		7.186	23.760	110.726	1.000	1.000	0.945	1.0	
Minor Bending		0.000	27.000	79.839	1.000	1.000	0.250		
SHEAR DESIGN									
		Fv	Fv	Stress					



Concrete Frame Design

Member Design



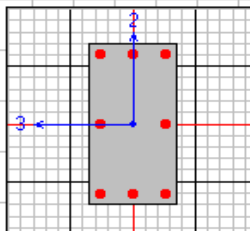
Concrete Design Information ACI 318-99

File

ACI 318-99 COLUMN SECTION DESIGN Type: Sway Special Units: Kip-in

Level: STORY2 Element: C2
 Station Loc 120.000
 Section ID CSEC1
 Combo ID DCON2

L=144.000
 B=12.000 D=24.000 dc=1.500
 E=3600.000 fy=60.000 fc=4.000 Light Wt. Shr. Fac.=1.000
 RLLF=0.995 EQF=1.000



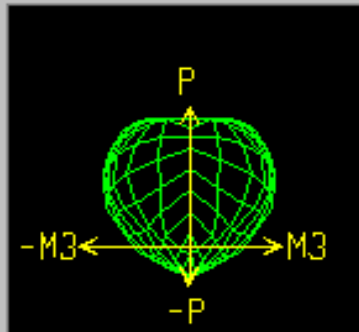
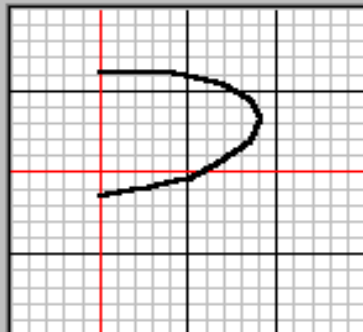
AXIAL FORCE & BIAXIAL MOMENT DESIGN FOR PU, M2, M3

	Rebar Area	Design Pu	Design M2	Design M3	Minimum M2	Minimum M3
	2.880	43.730	369.087	-667.306	41.981	57.723

SLIP FACTORS

	Cm Factor	Delta_ns Factor	Delta_s Factor	K Factor	L Length
	0.400	1.000	1.000	1.000	120.000
	0.400	1.000	1.000	1.000	120.000

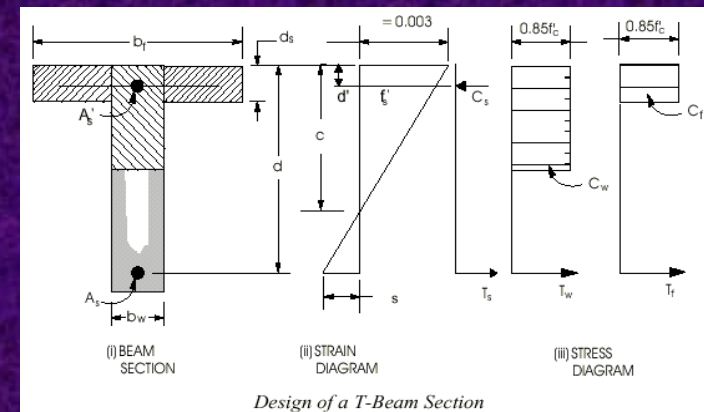
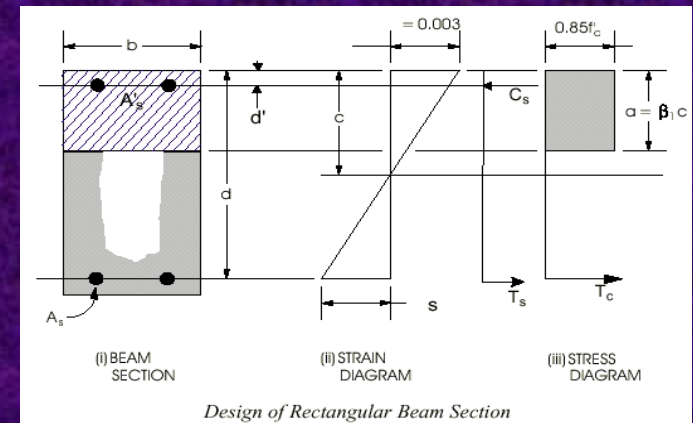
	Design Rebar	Shear Uu	Shear phi*Uc	Shear phi*Us	Shear Up
	0.032	36.452	0.000	36.452	36.452
	0.068	36.445	0.000	36.445	36.445



Concrete Frame Design

Member Design

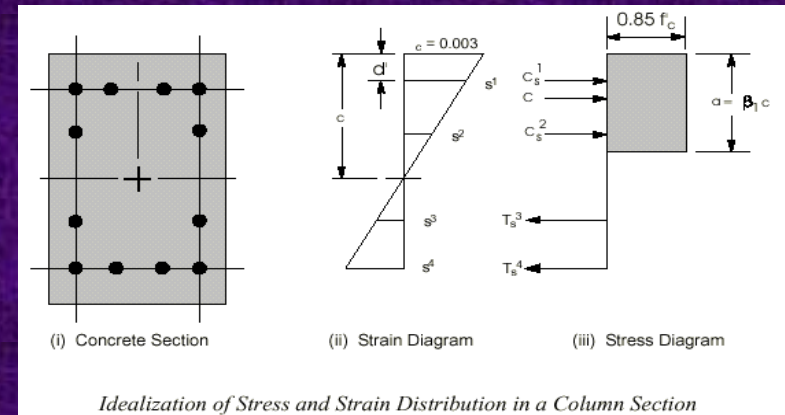
- Fully integrated concrete frame design
- Indian, ACI, UBC, Canadian and Euro codes
- Design for static and dynamic loads
- Seismic design of intermediate/special moment-resisting frames
- Seismic design of beam/column joints
- Seismic check for strong-column/weak-beam design



Concrete Frame Design

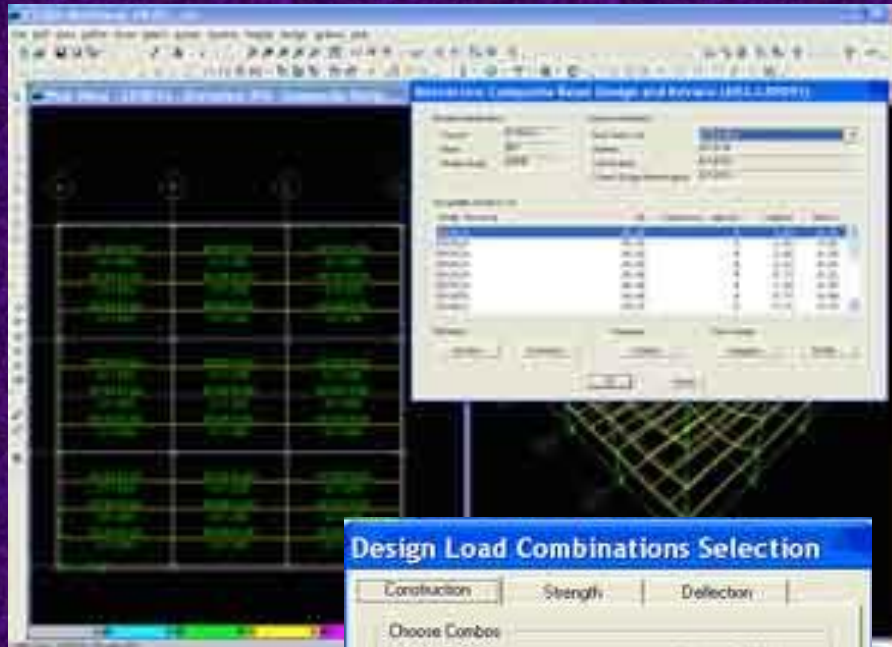
Member Design

- 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



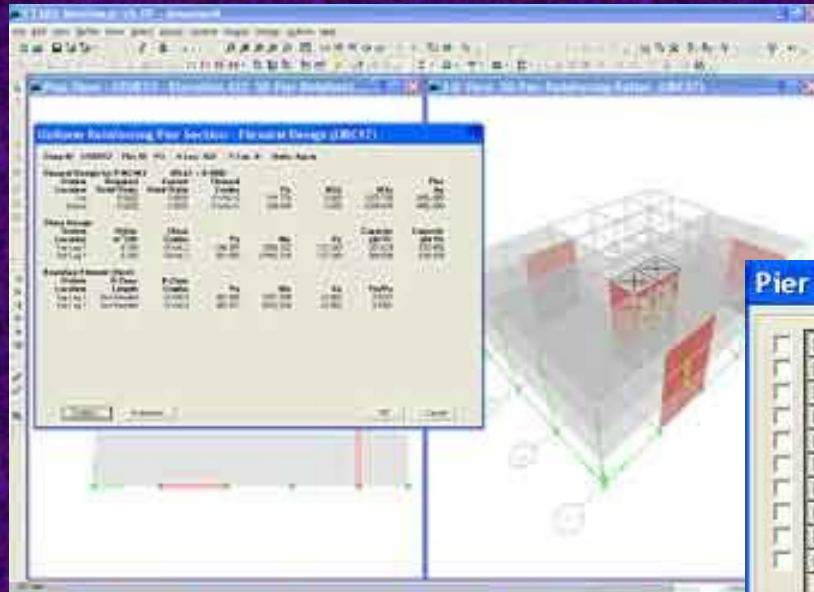
Composite Beam Design

Member Design



Member Design

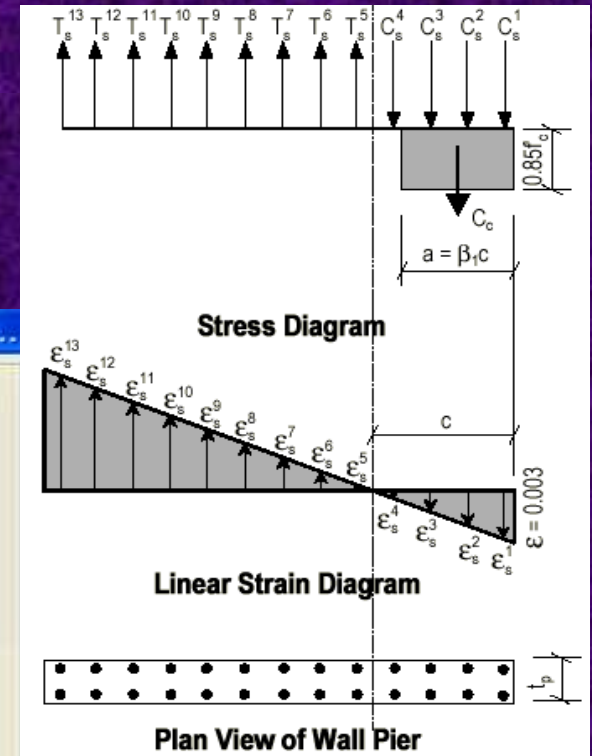
Shear Wall Design



Pier Design Overwrites - Uniform Rei...

Design this Pier	Yes
LL Reduction Factor	0.4
Design is Seismic	Yes
Pier Section Type	Uniform Reinforcing
Edge Bar Name	#7
Edge Bar Spacing	12
End/Corner Bar Name	#9
Clear Cover	1
Material	CONC
Check/Design Reinforcing	Design

OK Cancel



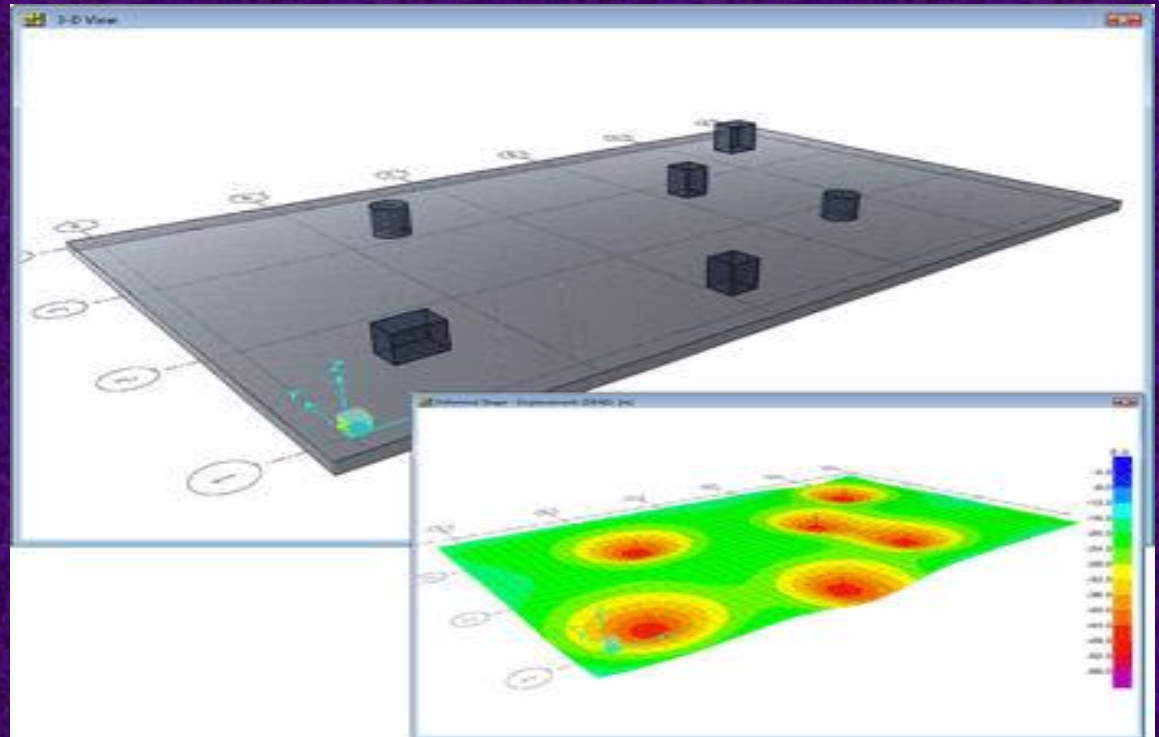
ETABS



SAFE

- ✓ Ultimate tool for designing Concrete floor and Foundation System
- ✓ Comprehensive & Customizable
- ✓ Detailed Plan, Section, Elevation, Schedule & table may generate and export to Cad Packages

Only tool for:
**Designing & Detailing of
Concrete slab system &
Foundation**



Detailing & Reports

- Detailing can be done and drawings can be exported to AutoCAD
- Reports can be viewed in MS-word

Other Courses

- **SAFE**
- **SAP2000**
- **Staad.Pro**
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