

# BuildingTcl

## a Real-Time Interface for Numerical Simulation in OpenSees

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<http://neesforge.nees.org/projects/buildingtcl/>



NEESforge

PACIFIC EARTHQUAKE ENGINEERING RESEARCH CENTER

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San Francisco



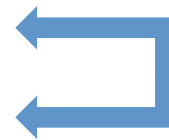
# BuildingTcl & BuildingTclViewer

- **BuildingTcl** and **BuildingTclViewer** provide a library of Tcl/Tk procedures that can be used within OpenSees to
  - build a simulation-model library via scripting modules or interactively
  - run simulations via scripting modules or interactively
  - visualize real-time structural response during numerical simulation

## Interactive OpenSees simulation via:

➡ **Scripting Interface**

➡ **Graphical User Interface**



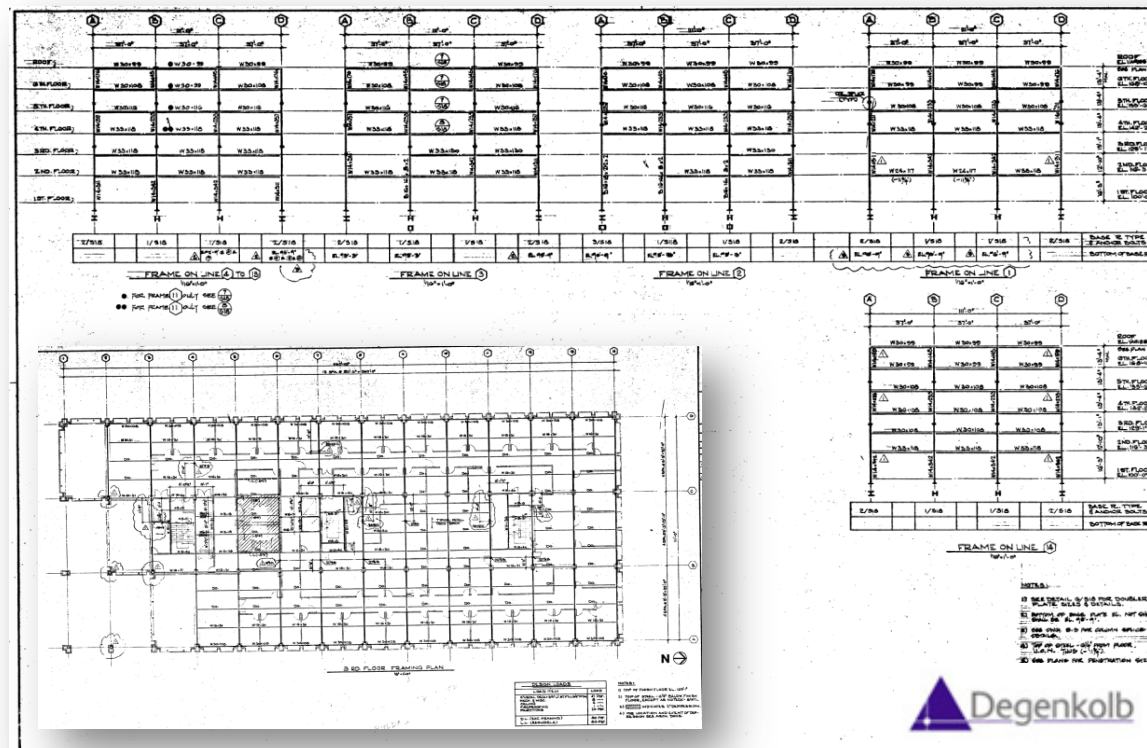
build a database for  
, sections, elements,  
s database. Structural  
**Interchangeable**  
using OpenSees. The

OpenSees recorder data is post-processed into more accessible format.

- **BuildingTclViewer** is a Tcl/Tk widget (program) that provides a graphical user interface to create the BuildingTcl database interactively, run the numerical simulations using OpenSees interactively, and view the results interactively.
- While BuildingTcl and BuildingTclViewer were developed on a Windows platform, they can be made to work on other platforms, even Mac.

# Objective of BuildingTcl & BuildingTclViewer

- Generate numerical-simulation input in a manner consistent with architectural/structural drawings
- Create a database of all structure and simulation data
- The implementation of OpenSees to do the analysis is natural here, but not restrictive
- Be able to run on a number of platforms, just as OpenSees can



# Features

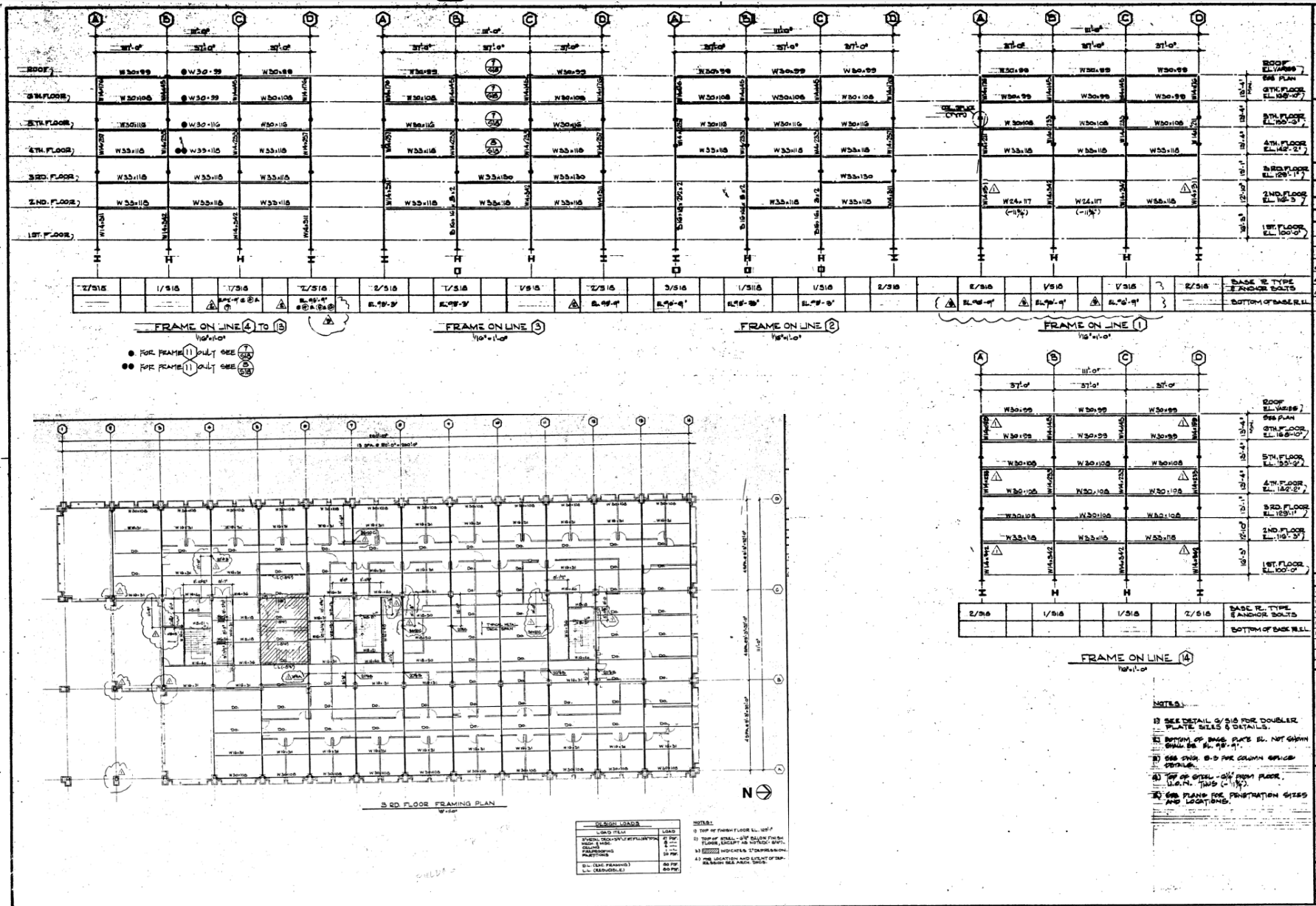
## BuildingTcl:

- High-level scripting tool
- Generate building-model data
  - Materials
  - Sections
  - Element Types
  - Analysis Models
  - Loads (Gravity & Lateral)
  - Load Combinations
  - Models
    - Elevations
    - Plan
    - 3D Frames
- Generate analysis-model data
- Generate loading and load-combination data
- Generate OpenSees model of building
- Perform OpenSees numerical simulations
- Post-Process OpenSees recorder output into formatted data
- Generate OpenSees input files

## BuildingTclViewer:

- Graphical User Interface (GUI) for BuildingTcl
- generate and/or visualize ALL BuildingTcl input graphically
- Save ALL input into BuildingTcl script
- Perform numerical simulations using OpenSees interactively
- Visualize OpenSees simulation real-time
- Pause and/or stop OpenSees analysis real-time
- Visualize simulation results interactively
- Export simulation results

# Drawings: Elevations & Plans

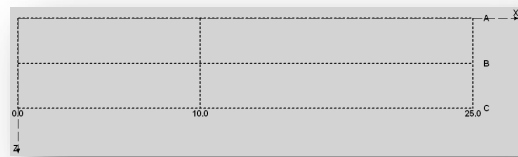
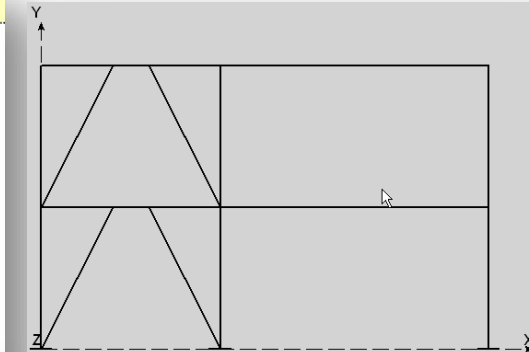


# Model Input

## # Elevation

```

addModelData ModelLabel RCTestFrame2Story2BayBbraced
addModelData ModelDescription "RC MRF, 2-Story, 2-Bay"
addModelData ModelTypeLabel Elevation
addModelData -Geometry Height 16*\$ft StoryRange "1 2"
addModelData -Geometry Width 20*\$ft Bay 1
addModelData -Geometry Width 30*\$ft Bay 2
addModelData -Columns SectionLabel 30x30RCRectangularFiber ColumnLineRange "1 3" StoryRange "1 2" Orient Rotated
addModelData -Beams SectionLabel 30x60RCRectangularFiber BayRange "1 2" FloorRange "2 3"
addModelData -ChevronBraces SectionLabel W12x16 BayRange "1 1" Story "1 2" Eccentricity 4.*\$ft
addModelData SupportBC fix
addModelData OutOfPlaneSupportBC pin
addModelData RigidFloor Off
addModelData JointOffsetsSwitch on
addModelData TributaryWidth 5.*\$ft
addModelData -GravityLoad LoadLabel DL1 FloorRange "2 3" DistributedLoad 100.*\$psf
addModelData -GravityLoad LoadLabel LL1 FloorRange "2 3" DistributedLoad 74.*\$psf
addModel
    
```



## # Plan

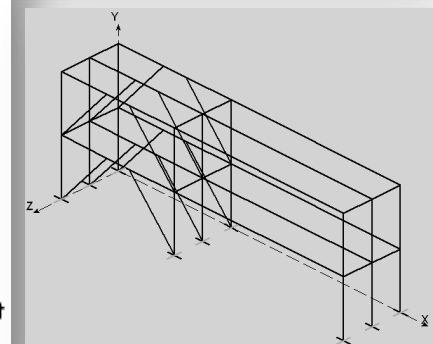
```

addModelData ModelLabel 2x2Floor
addModelData ModelDescription "1-Bay by 1-Bay Floor Plan"
addModelData ModelTypeLabel Plan
addModelData iVerticalGridLineLabel "0.0 10.0 25.0"
addModelData iHorizontalGridLineLabel "A B C"
addModelData -HorizontalBayWidth Bay 1 Width 20*\$ft
addModelData -HorizontalBayWidth Bay 2 Width 30*\$ft
addModelData -VerticalBayWidth BayRange "1 2" Width 5*\$ft
addModel
    
```

## # 3D Frame

```

addModelData ModelLabel 3DBuildingFrameRC
addModelData ModelDescription "Let's try It"
addModelData ModelTypeLabel 3DFrame
addModelData PlanModelLabel 2x2Floor
addModelData RigidFloor Off
addModelData -addElevation ElevationModelLabel RCTestFrame2Story2BayA iGridLineLabel "0.0"
addModelData -addElevation ElevationModelLabel RCTestFrame2Story2BayA iGridLineLabel "10.0" TributaryWidth 12.5*\$ft
addModelData -addElevation ElevationModelLabel RCTestFrame2Story2BayA iGridLineLabel "25.0" TributaryWidth 7.5*\$ft
addModelData -addElevation ElevationModelLabel RCTestFrame2Story2BayBbraced iGridLineLabel "A C" TributaryWidth 2.5*\$ft
addModelData -addElevation ElevationModelLabel RCTestFrame2Story2BayBbraced iGridLineLabel "B" TributaryWidth 5.*\$ft
addModel
    
```



# Material, Section & Element Models

```
# MATERIALS -----
# Core Concrete (Default confinement effects)
addMaterialData MaterialLabel 4ksiConfinedConcrete
addMaterialData MaterialModelLabel ConfinedConcrete
addMaterialData Fc 4000.*$psi;
addMaterial
```

```
# ELEMENT SECTION -----
addSectionData SectionLabel 30x30RCRectFiber
addSectionData SectionDescription "Square Rectangular RC Section"
addSectionData SectionModelLabel RCRectFiber;
addSectionData H 30*$in;
addSectionData B 30*$in;
addSectionData NBarBot 6; # number of bottom longitudinal
addSectionData NBarTop 6; # number of top longitudinal
addSectionData NBarInt 6; # total number of intermediate
addSectionData BarSizeBot #9;
addSectionData BarSizeTop #9;
addSectionData BarSizeInt #9;
addSectionData CoverBot 2.6*$in;
addSectionData CoverTop 2.6*$in;
addSectionData CoverInt 2.6*$in;
addSectionData CoreMaterialLabel 4ksiConfinedConcrete;
addSectionData CoverMaterialLabel 4ksiUnconfinedConcrete;
addSectionData ReinforcementMaterialLabel 60ksiReinforcingSteel;
addSection
```

```
# RC Column ElementType | I
addElementTypeData ElementTypeLabel RCColumn;
addElementTypeData ElementModelLabel beamWithHinges;
addElementTypeData PlasticHingeLengthModelLabel Priestley96
addElementTypeData TransformationType Linear
addElementType ; # -----
```

# Analysis Models

## # Gravity Analyses

```
addAnalysisModelData AnalysisModelLabel GravityAnalysis;  
addAnalysisModelData AnalysisTypeLabel LoadControl;  
addAnalysisModelData Tolerance 1e-8;  
addAnalysisModelData Nstep 12;  
addAnalysisModel;
```

## # Pushover Analyses

```
addAnalysisModelData AnalysisModelLabel PushoverAnalysisVerySmallSteps  
addAnalysisModelData AnalysisTypeLabel DisplacementHistory  
addAnalysisModelData DisplacementIncrement 0.01*\$in  
addAnalysisModel # -----  
  
addAnalysisModelData AnalysisModelLabel PushoverAnalysisSmallSteps  
addAnalysisModelData AnalysisTypeLabel DisplacementHistory  
addAnalysisModelData DisplacementIncrement 0.1*\$in  
addAnalysisModel # -----
```

## # Dynamic Analyses

```
addAnalysisModelData AnalysisModelLabel ShortDynamicTimeHistoryAnalysis;  
addAnalysisModelData AnalysisTypeLabel TimeHistory  
addAnalysisModelData Tolerance 1e-6;  
addAnalysisModelData DtAnalysis 0.1*\$sec  
addAnalysisModelData TmaxAnalysis 10*\$sec  
addAnalysisModel; # -----
```



# Lateral Loads

```
addLoadData LoadLabel StaticPushover; # STATIC PUSHOVER
addLoadData LoadTypeLabel LateralPushover; # options: LateralPushover, UniformEQ, UniformSine
addLoadData DMax 1.*\${in}; # maximum displacement
addLoadData ControlNodeFloor top;
```

```
addLoadData LoadLabel StaticCyclic; # STATIC REVERSED CYCLIC LOADING
addLoadData LoadTypeLabel LateralPushover;
addLoadData CycleType Full; # full cycles. Options: Push, Full, Half
addLoadData DMax "0.005 0.01 0.05 0.075 0.1"; # List of peaks, set as a factor of
addLoadData DMaxFactor BuildingHeight; # building height
addLoadData ControlNodeFloor top;
```

```
addLoadData LoadLabel EQ1; # EQ TIME-HISTORY
addLoadData LoadTypeLabel UniformEQ;
addLoadData GMfactor \${g}; # ground-motion input-u
addLoadData GMdirectory "GMfiles"; # directory where ground
addLoadData FileType "PEER"; # ground-motion file type
addLoadData GMfilename "H-E12140.at2"; # ground-motion filename
addLoadData GMdirection X; # lateral dof for ground m
addLoadData GMfactor 1; # scaling of ground motion
addLoad
```

```
addLoadData LoadLabel EQ1Bidirect; # EQ T
addLoadData LoadTypeLabel UniformEQ2D;
addLoadData GMfactor \${g}; # gro
addLoadData GMdirectory "GMfiles"; # direct
addLoadData FileType "PEER"; # ground
addLoadData GMfilenameX H-E01140.at2; # ground-motion filename for input
addLoadData GMfilenameZ H-E01140.at2; # ground-motion filename for input
addLoadData GMfactorX -15; # scaling of ground motion for input
addLoadData GMfactorZ 10; # scaling of ground motion for input
addLoad
```

NOTE: Gravity Loads are defined within the model

# Pushover LoadCombinations

```
# STATIC PUSHOVER LOAD COMBINATIONS -----
```

```
addLoadCombinationData LoadCombinationLabel ReallyShortStaticPushover  
addLoadCombinationData LoadCombinationDescription "This is my favorite one!!!"  
addLoadCombinationData -GravityLoad LoadLabel DL1  
addLoadCombinationData -GravityLoad LoadLabel DL2  
addLoadCombinationData -LateralLoad LoadLabel StaticPushover DMax 0.02*\$in  
addLoadCombination
```

```
addLoadCombinationData LoadCombinationLabel InterestingStaticPushover  
addLoadCombinationData LoadCombinationDescription "This is my favorite one!!!"  
addLoadCombinationData -GravityLoad LoadLabel DL1  
addLoadCombinationData -GravityLoad LoadLabel DL2  
addLoadCombinationData -LateralLoad LoadLabel StaticPushover DMax 0.1*\$in DMaxFactor 1.  
addLoadCombinationData -LateralLoad LoadLabel StaticPushover DMax 1.9*\$in DMaxFactor 1. \  
DisplacementIncrement 0.25  
addLoadCombinationData -LateralLoad LoadLabel StaticPushover DMax 10*\$in DMaxFactor 1. \  
DisplacementIncrement 0.5  
addLoadCombination
```

```
addLoadCombinationData LoadCombinationLabel PushToTenPercentDriftZ  
addLoadCombinationData LoadCombinationDescription "This is my favorite one!!!"  
addLoadCombinationData -GravityLoad LoadLabel DL1  
addLoadCombinationData -GravityLoad LoadLabel DL2  
addLoadCombinationData -GravityLoad AnalysisModelLabel GravityAnalysis  
addLoadCombinationData -LateralLoad LoadLabel StaticPushover AnalysisModelLabel PushoverAnalysisLargeSteps\  
LateralDirection Z DMax 0.1 DMaxFactor BuildingHeight  
addLoadCombination
```

# EQ Load Combinations

## # DYNAMIC LOAD COMBINATIONS

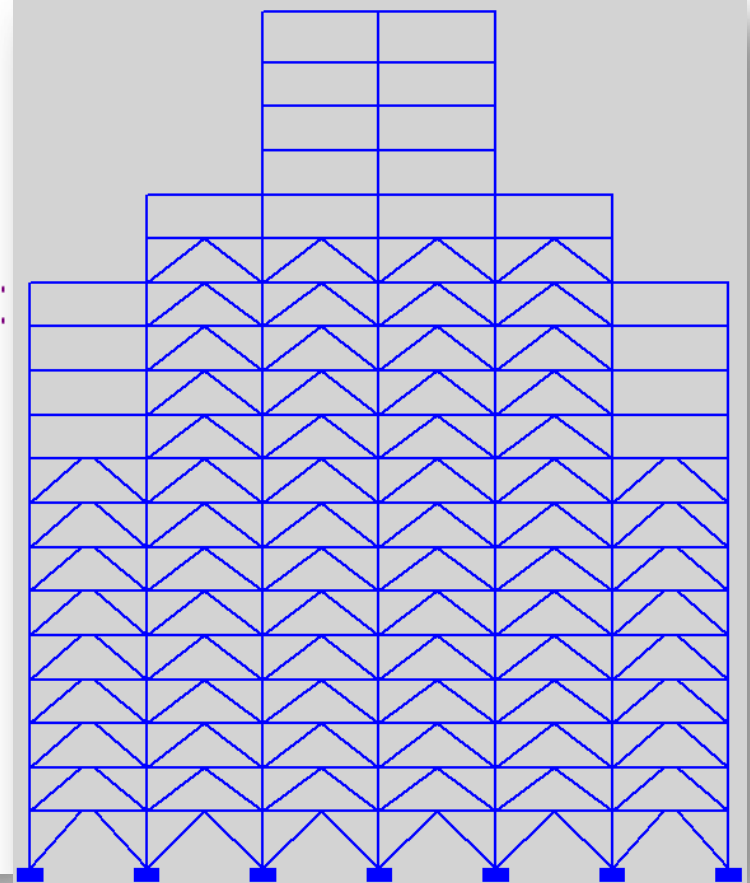
```
addLoadCombinationData LoadCombinationLabel DesignEQ1
addLoadCombinationData -GravityLoad LoadLabel DL1 LoadFactor 0.9
addLoadCombinationData -GravityLoad LoadLabel DL2 LoadFactor 0.9
addLoadCombinationData -LateralLoad LoadLabel EQ1
addLoadCombination
```

```
addLoadCombinationData LoadCombinationLabel MaxEQ1shorter
addLoadCombinationData -GravityLoad LoadLabel DL1 LoadFactor 1.
addLoadCombinationData -LateralLoad LoadLabel EQ1 AnalysisModelLabel ShortDynamicTimeHistoryAnalysis LoadFactor 3
addLoadCombination
```

```
addLoadCombinationData LoadCombinationLabel MaxEQ2bidirect10sec
addLoadCombinationData -GravityLoad LoadLabel DL1 LoadFactor 0.9
addLoadCombinationData -LateralLoad LoadLabel EQ2 GMfilenameX H-E01140.at2 GMfilenameZ H-E12140.at2 \
    TmaxAnalysis 10.*\ $sec
addLoadCombination
```

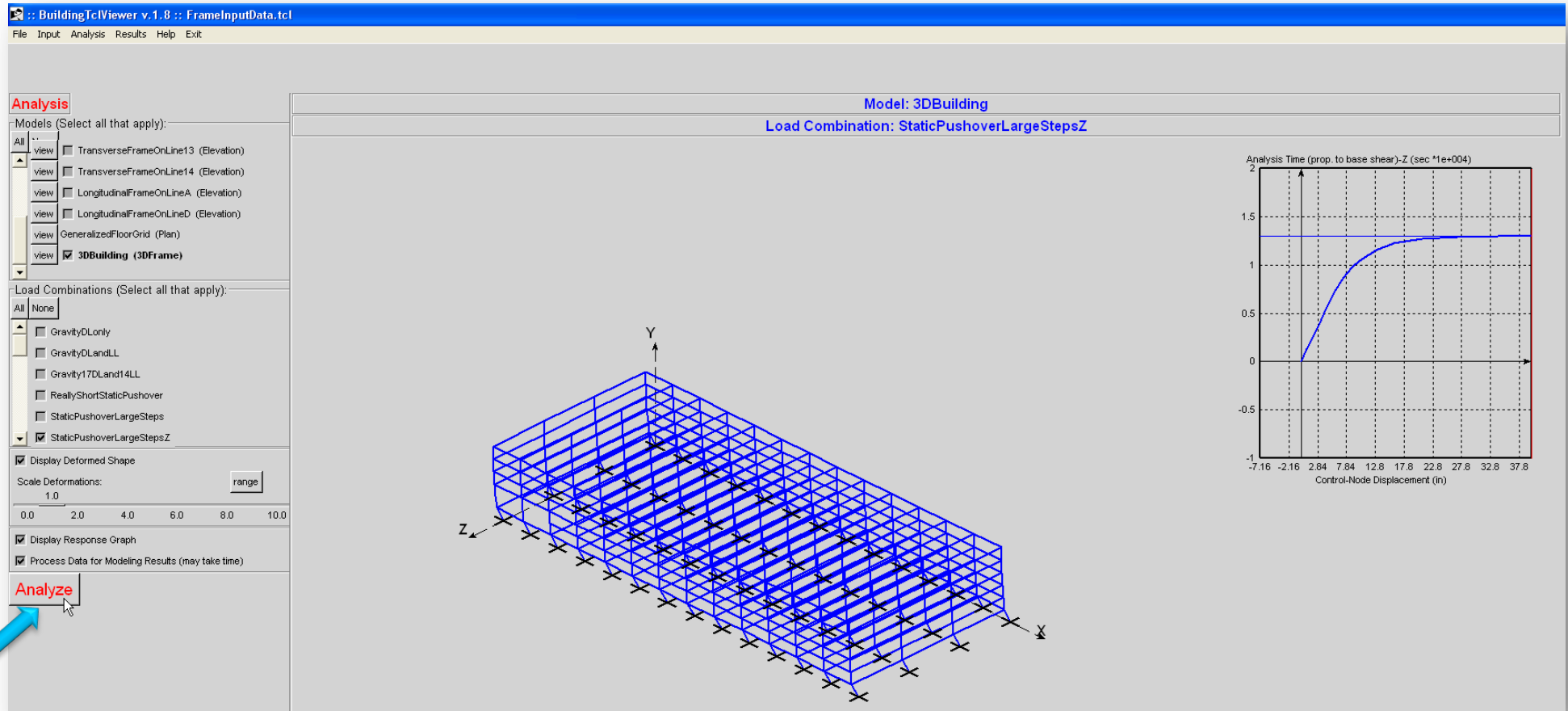
# Interesting Example

```
addModelData ModelLabel "SMRFsetbacks"
addModelData ModelDescription "SMRF Elevation at Grid Line A and D with Setbacks"
addModelData ModelPlaneType Elevation
addModelData -GridLines GridLine "A" GridColumnLines "3.5 4.5 5.5 6.5 7.5 8.5 9.5"
addModelData -GridLines GridLine "D" GridColumnLines "9.5 8.5 7.5 6.5 5.5 4.5 3.5"
addModelData -Geometry Height 18*"$ft" Story "1"
addModelData -Geometry Height 14*"$ft" StoryRange "2 18"
addModelData -Geometry Height 16*"$ft" Story "19"
addModelData -Geometry Width 40*"$ft" BayRange "1 6"
addModelData -Columns SectionLabel W24x370 ColumnLine "1 7" Story "1"
addModelData -Columns SectionLabel W24x335 ColumnLine "1 7" StoryRange "2 13"
addModelData -Columns SectionLabel W24x279 ColumnLine "2 6" Story "1"
addModelData -Columns SectionLabel W24x250 ColumnLine "2 6" StoryRange "2 15"
addModelData -Columns SectionLabel W24x279 ColumnLineRange "3 5" Story "1"
addModelData -Columns SectionLabel W24x250 ColumnLineRange "3 5" StoryRange "2 18"
addModelData -Columns SectionLabel W24x192 ColumnLineRange "3 5" Story "19"
addModelData -Beams SectionLabel "W30x124 W30x173 W30x173 W30x173 W30x173 W30x108" FloorRange "2 4"
addModelData -Beams SectionLabel "W30x124 W30x173 W30x173 W30x173 W30x173 W30x124" FloorRange "5 7"
addModelData -Beams SectionLabel "W30x173 W30x173 W30x173 W30x173 W30x173 W30x124" Floor "8 9"
addModelData -Beams SectionLabel W30x132 BayRange "1 6" FloorRange "10 14"
addModelData -Beams SectionLabel W30x132 BayRange "2 5" FloorRange "15 16"
addModelData -Beams SectionLabel W30x148 BayRange "3 4" FloorRange "17 19"
addModelData -Beams SectionLabel W30x148 BayRange "3 4" Floor "20"
addModelData -ChevronBraces SectionLabel "W30x148" Bay "1 6" StoryRange "1 9" Eccentricity "5.*"$ft"
addModelData -ChevronBraces SectionLabel "W12x14" BayRange "2 5" StoryRange "1 14"
addModelData SupportBC fix
addModelData TributaryWidth 7*"$ft"
addModelData -GravityLoad LoadLabel DL1 Floor "2 3" DistributedLoad 74*"$psf"
addModelData -GravityLoad LoadLabel DL1 FloorRange "4 19" DistributedLoad 74*"$psf"
addModelData -GravityLoad LoadLabel DL1 Floor "20" DistributedLoad 60*"$psf"
addModelData -GravityLoad LoadLabel DL2 FloorRange "2 19" DistributedLoad 74*"$psf"
addModelData -GravityLoad LoadLabel DL2 Floor "20" DistributedLoad 60*"$psf"
addModelData -GravityLoad LoadLabel LL1 FloorRange "2 19" DistributedLoad 74*"$psf"
addModelData -GravityLoad LoadLabel LL1 Floor "20" DistributedLoad 60*"$psf"
addModel
```



# Objective of BuildingTclViewer

- Provide a graphical user interface for BuildingTcl input
- Provide capability of running OpenSees real-time
- Visualization of Input / real-time response / output
- Save graphically-generated input into BuildingTcl script file



# Materials

### New Material

Default Units:  
Lenth: in; Force: kip; Time: sec

Material Model Label:

- Elastic
- Steel
- ConfinedConcrete**
- UnconfinedConcrete
- TrilinearHysteretic
- Steel02

### Edit Material

Default Units:  
Lenth: in; Force: kip; Time: sec

Material Label:

Material Model Label:

Input Arguments

Required Arguments

-Fc: nominal strength

Optional Arguments

rPc: Ratio of maximum strength to nominal strength -- confine

rFu: Ratio of residual strength to maximum strength -- confin

E: Elastic Modulus

epsU: strain at crushing strength

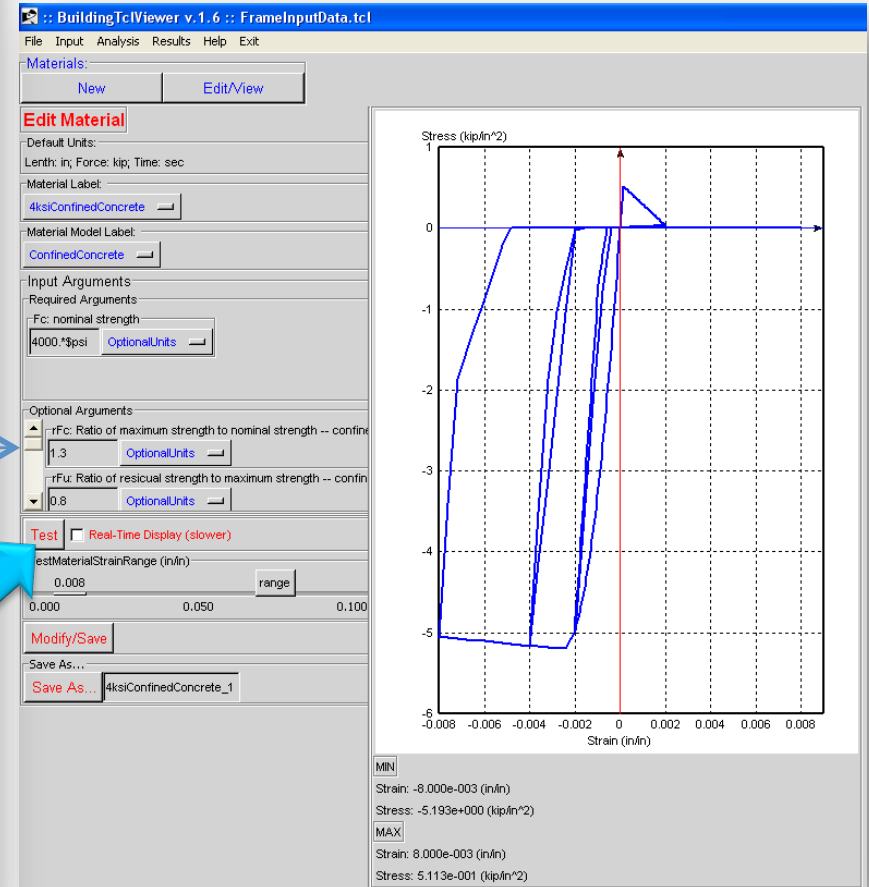
lambda: ratio between unloading slope at epscu and initial sl

rT: tensile strength

Real-Time Display (slower)

TestMaterialStrainRange (in/in)  
   
0.000 0.050 0.100

Save As...



# Sections

**New Section**

Default Units:  
Lenth: in; Force: kip; Time: sec

Section Model Label:

Select Section:

- Elastic
- ElasticRectangular
- RCRectangularFiber**
- AISCWideFlangeElastic
- AISCWideFlangeFiber
- CustomWideFlangeElastic
- CustomWideFlangeFiber

**Edit Section**

Default Units:  
Lenth: in; Force: kip; Time: sec

Section Label:  
30x60RCRectangularFiber

Section Model Label:  
RCRectangularFiber

Input Arguments

Required Arguments

B: Section Width  
30\*in

H: Section Depth  
60\*in

CoverMaterialLabel: Previously-Defined Material Label for Co  
4ksiUnconfinedConcrete

CoreMaterialLabel: Previously-Defined Material Label for Cov  
4ksiConfinedConcrete

ReinMaterialLabel: Previously-Defined Material Label for Rei  
60ksiReinforcingSteel

Optional Arguments

NBarTop: Number of Reinf. Bars in Top Layer  
4

NBarBot: Number of Reinf. Bars in Bottom Layer  
6

NBarInt: Number of Reinf. Bars in Each Intermediate Layer  
6

BarSizeTop: Size Label of Reinf. Bars in Top Layer  
#11

BarSizeBot: Size Label of Reinf. Bars in Bottom Layer  
#9

BarSizeInt: Size Label of Reinf. Bars in Intermediate Layer  
#6

Test  Real-Time Display (slower)

TestSectionAxialForce (kip)  
0.0

Modify/Save

Save As...  
30x60RCRectangularFibe

Building/Viewer v.1.6 :: FrameInputData.tcl

File Input Analysis Results Help Exit

Sections: New Edit/View

**Edit Section**

Default Units:  
Lenth: in; Force: kip; Time: sec

Section Label:  
rcC1

Section Model Label:  
RCRectangularFiber

Input Arguments

Required Arguments

b: 30.0

h: 30.0

CoverMaterialLabel: 4ksiUnconfinedConcrete

CoreMaterialLabel: 4ksiConfinedConcrete

ReinMaterialLabel: 60ksiSteel

Optional Arguments

nBarTop: 8

nBarBot: 8

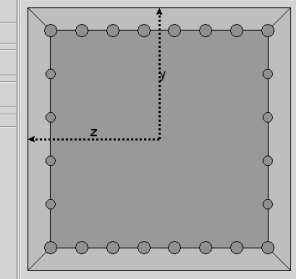
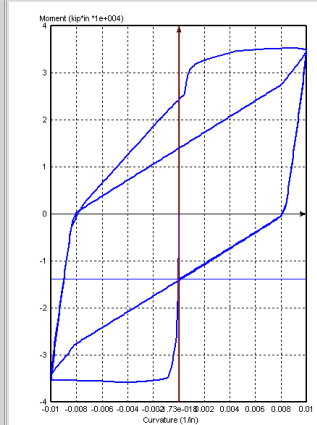
nBarInt: 8

Test  Real-Time Display (slower)

TestSectionAxialForce (kip)  
0 range 1000

Modify/Save

Save As...  
rcC1\_1

Axial Load = 0.0 (kip)

MIN  
Curvature: -1.000e-002 (1/in)  
Moment: -3.580e+004 (kip/in)

MAX  
Curvature: 1.000e-002 (1/in)  
Moment: 3.520e+004 (kip/in)

Building/Viewer v.1.6 :: FrameInputData.tcl

File Input Analysis Results Help Exit

Sections: New Edit/View

**Edit Section**

Default Units:  
Lenth: in; Force: kip; Time: sec

Section Label:  
W33x130

Section Model Label:  
AISCWideFlangeFiber

Input Arguments

Required Arguments

MaterialLabel: A36Steel

Optional Arguments

nBarTop: 4

nBarBot: 4

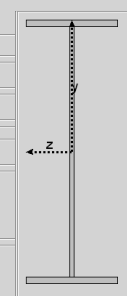
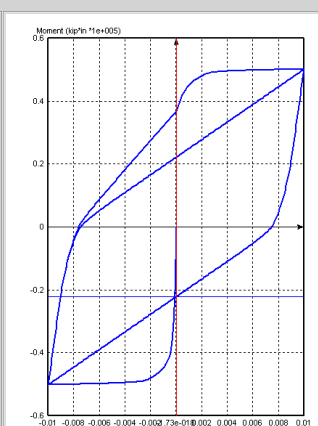
nBarInt: 4

Test  Real-Time Display (slower)

TestSectionAxialForce (kip)  
0.0 range 10.0

Modify/Save

Save As...  
W33x130\_1

Axial Load = 0.0 (kip)

MIN  
Curvature: -1.000e-002 (1/in)  
Moment: -5.014e+004 (kip/in)

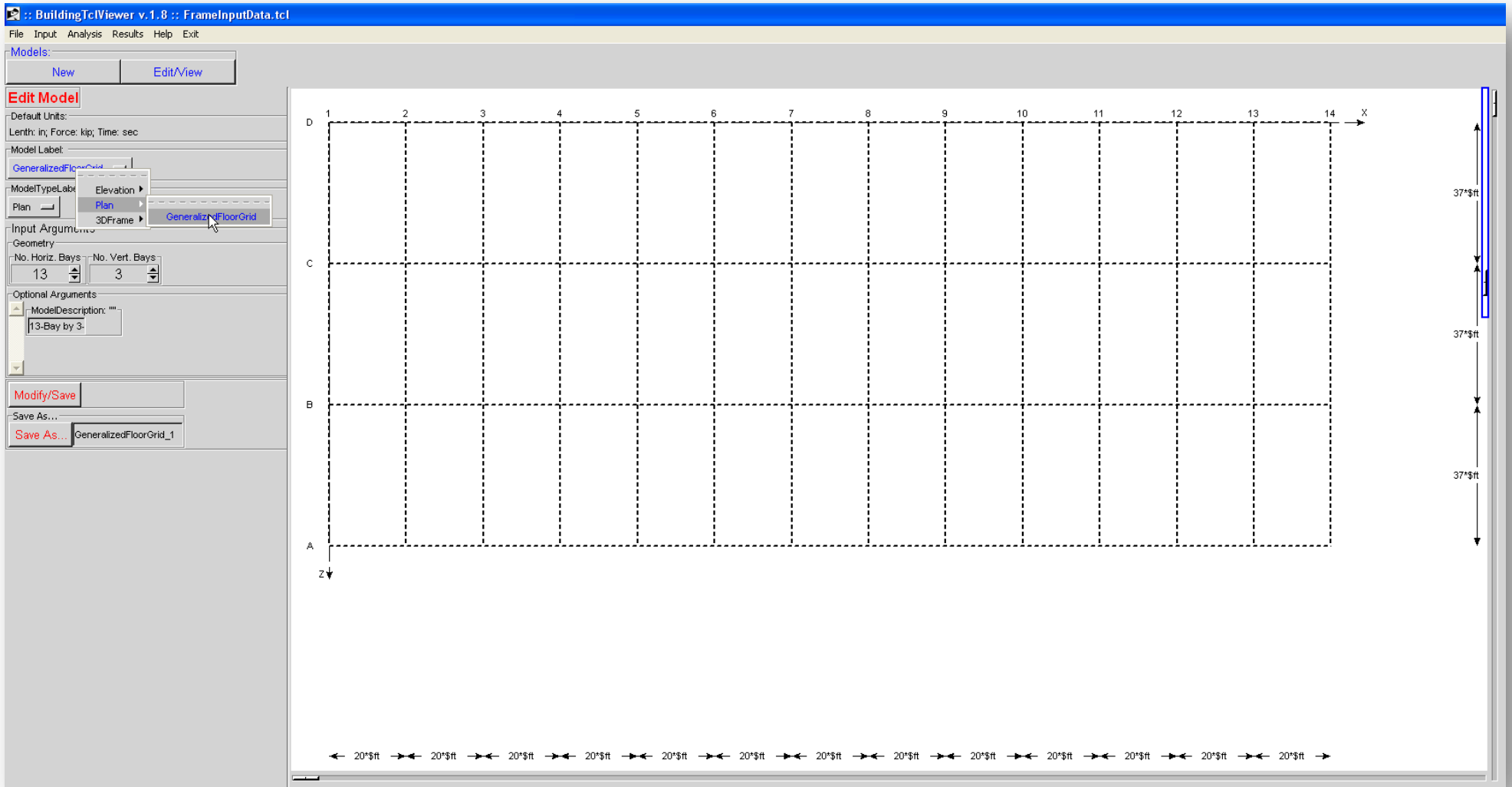
MAX  
Curvature: 1.000e-002 (1/in)  
Moment: 5.014e+004 (kip/in)

# Elevation-Model Input

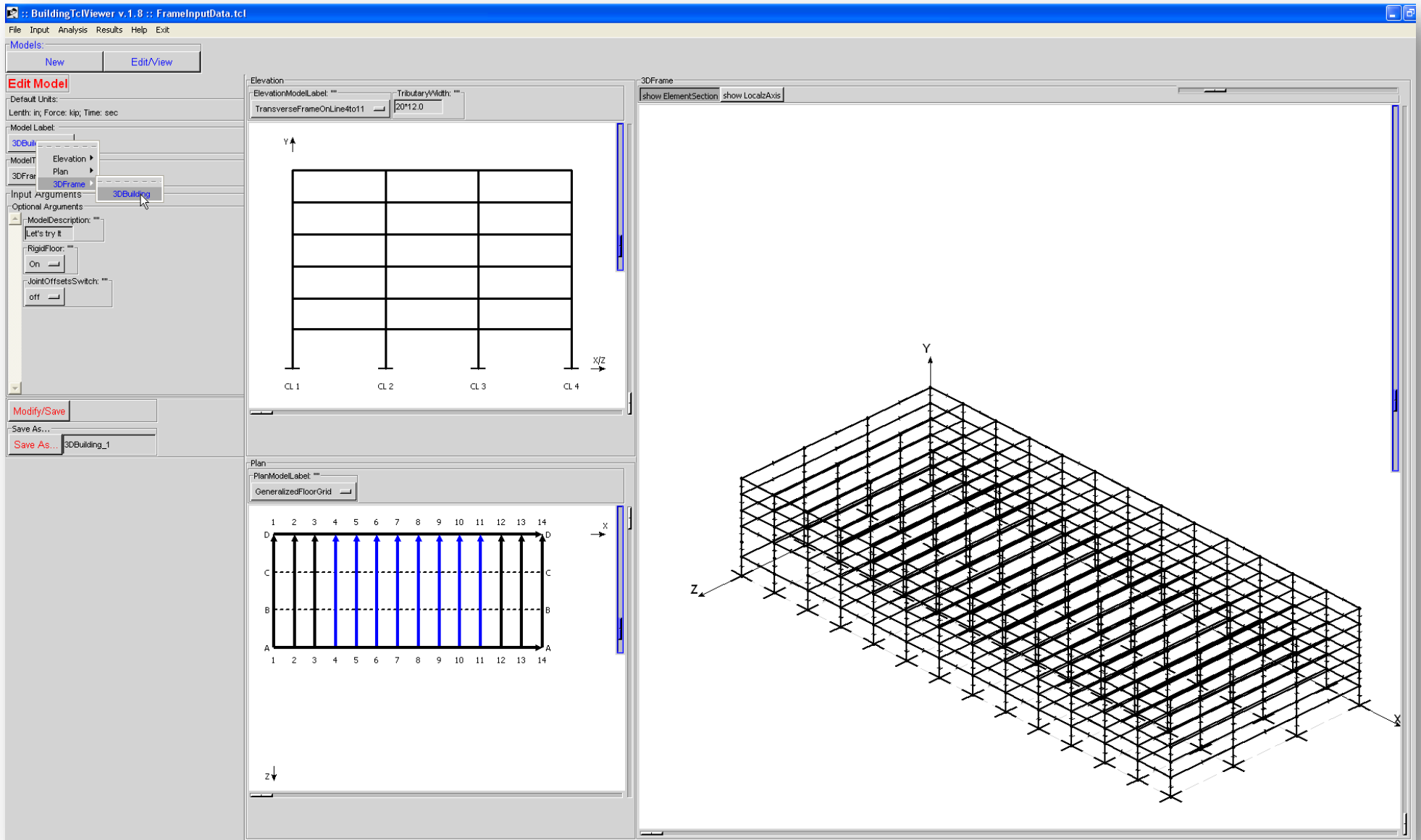
The screenshot displays the BuildingTclViewer v.1.8 interface. The main window shows a structural frame model in elevation view. The model consists of a grid of columns and beams. The columns are labeled W14-176, W14-145, W14-233, W14-211, W14-311, W14-342, and W14-311. The beams are labeled W30-159, W30-108, W33-118, and W24-117. The frame is supported by a foundation labeled CL1. The model is divided into three bays (Bay 1, Bay 2, Bay 3) and seven stories (Floor 1 to Floor 7). The dimensions are: Bay 1 width 37'3ft, Bay 2 width 37'3ft, Bay 3 width 37'3ft. The story heights are: Floor 1 to 2: 16'3ft + 3"; Floor 2 to 3: 12'3ft + 10"; Floor 3 to 4: 13'3ft + 11"; Floor 4 to 5: 13'3ft + 4"; Floor 5 to 6: 13'3ft + 4"; Floor 6 to 7: 13'3ft + 4". The software interface includes a menu bar (File, Input, Analysis, Results, Help, Exit), a toolbar (New, Edit/View), and a command line (Edit Model). The current selection (Element) is W14x176, HorizAxisBending, with a GravityLoad Value of 1000.0psf. The View Tools section includes View Ghost Data, View Data, View Labels, and a legend for SectionLabel, ElementType, Orient, and GravityLoad.



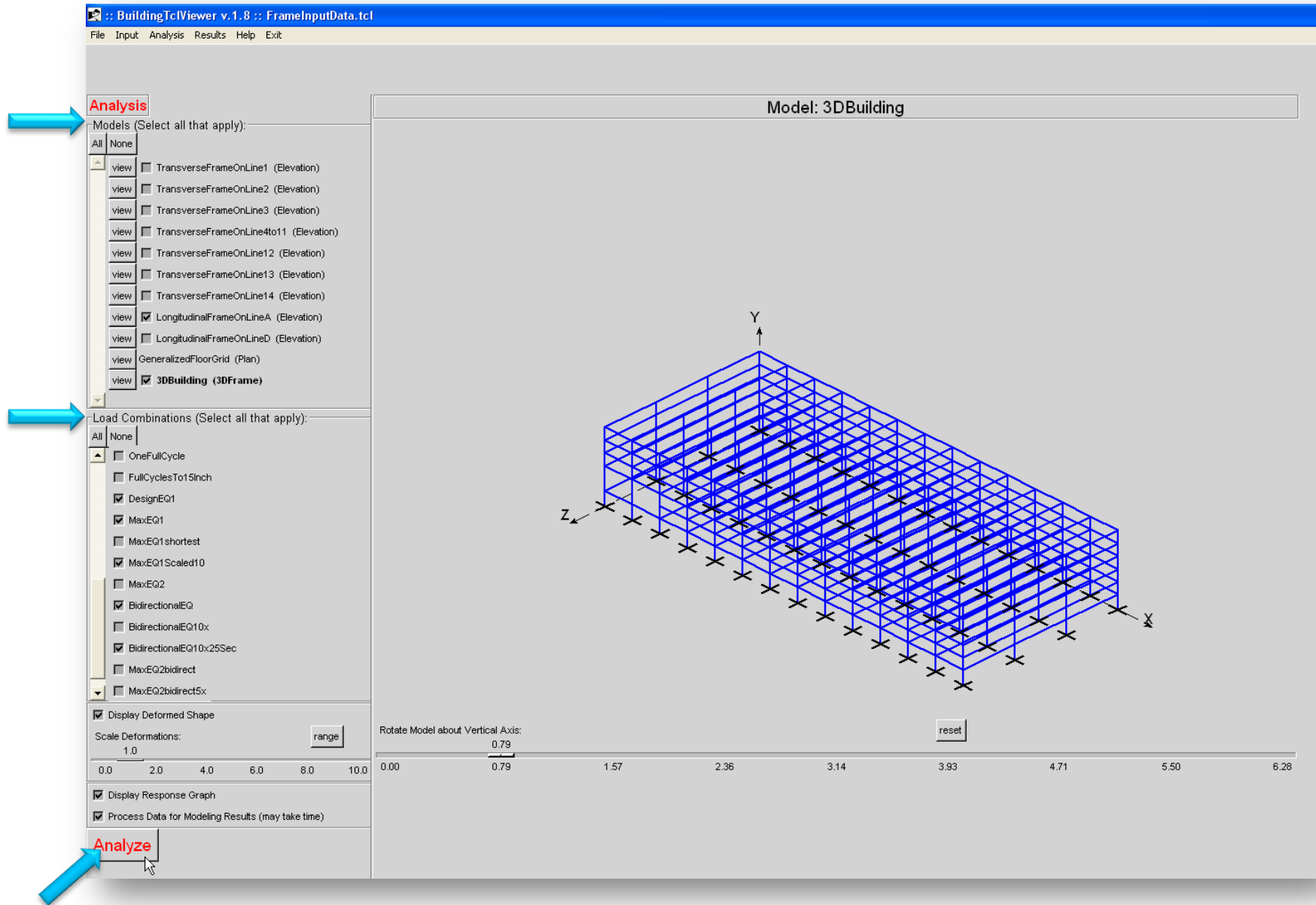
# Plan Input



# 3D-Frame-Model Input

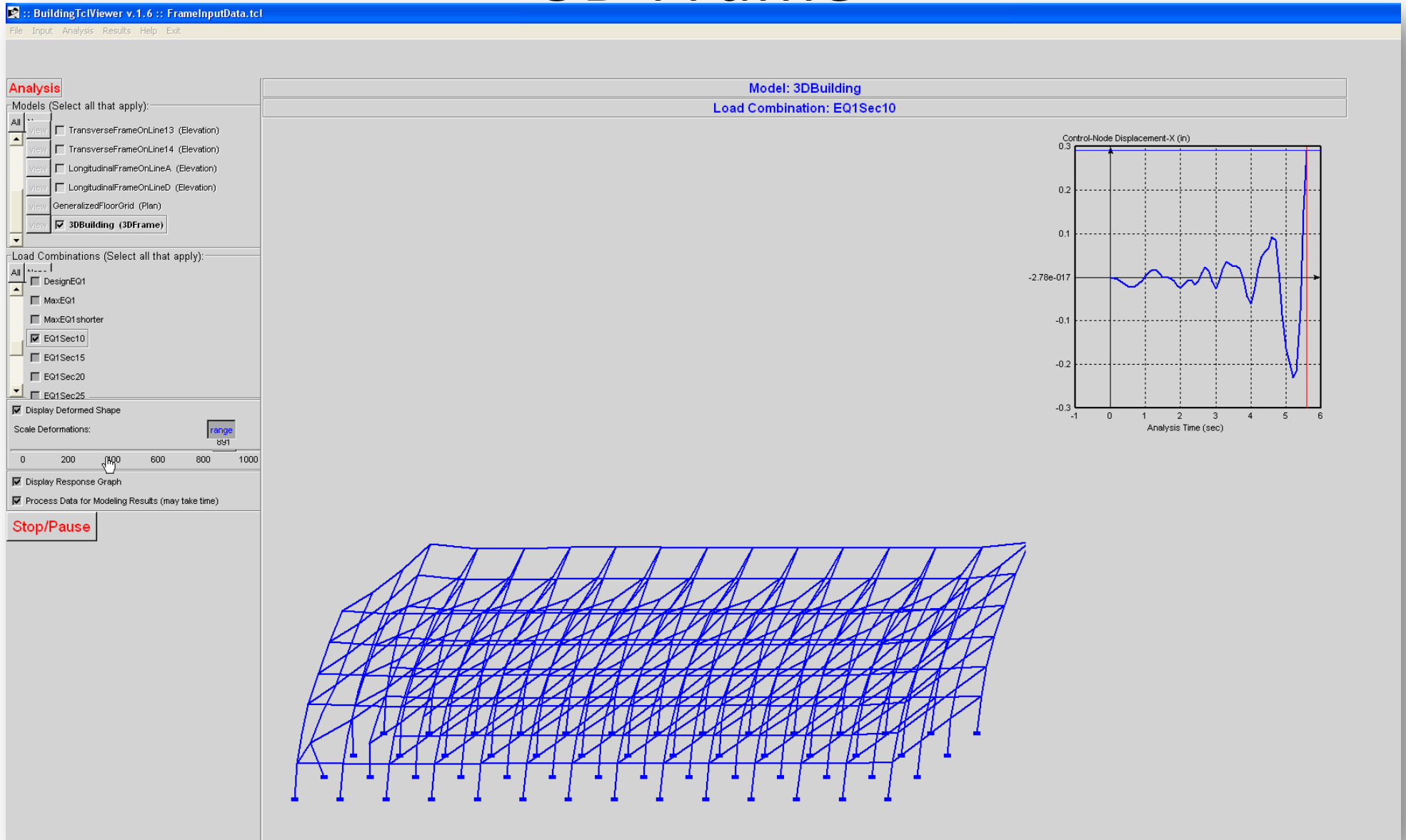


# Run Simulation(s)



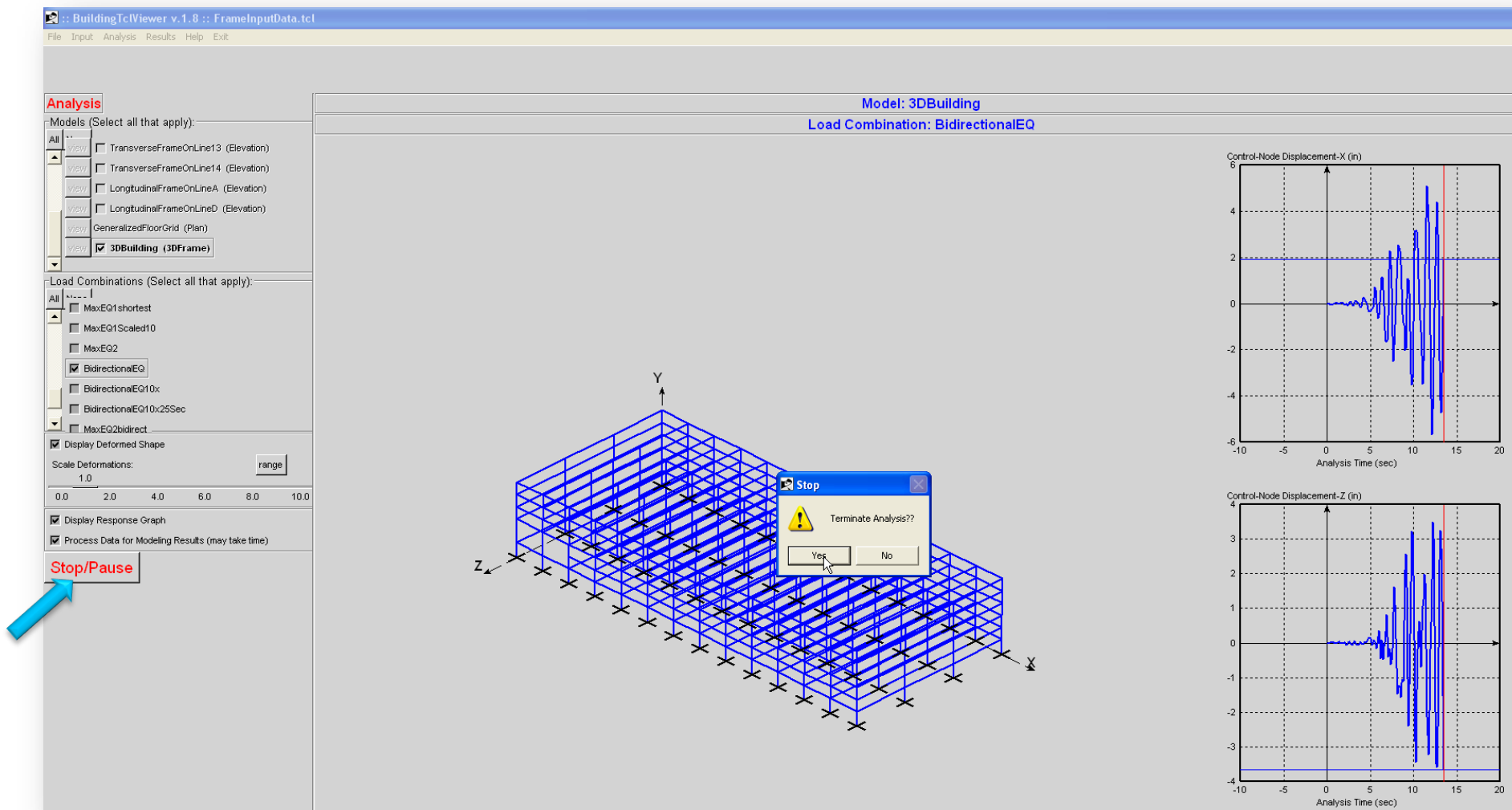
# Real-Time OpenSees Simulation

## 3D Frame

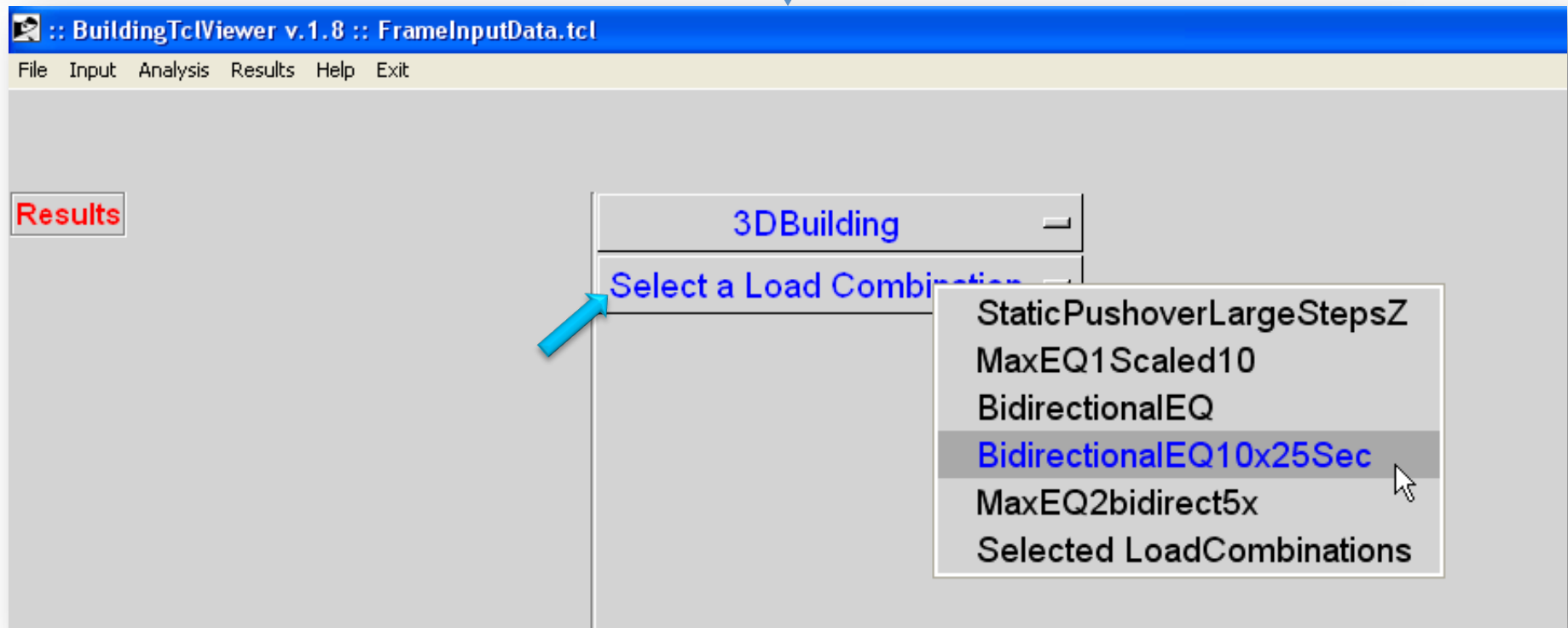
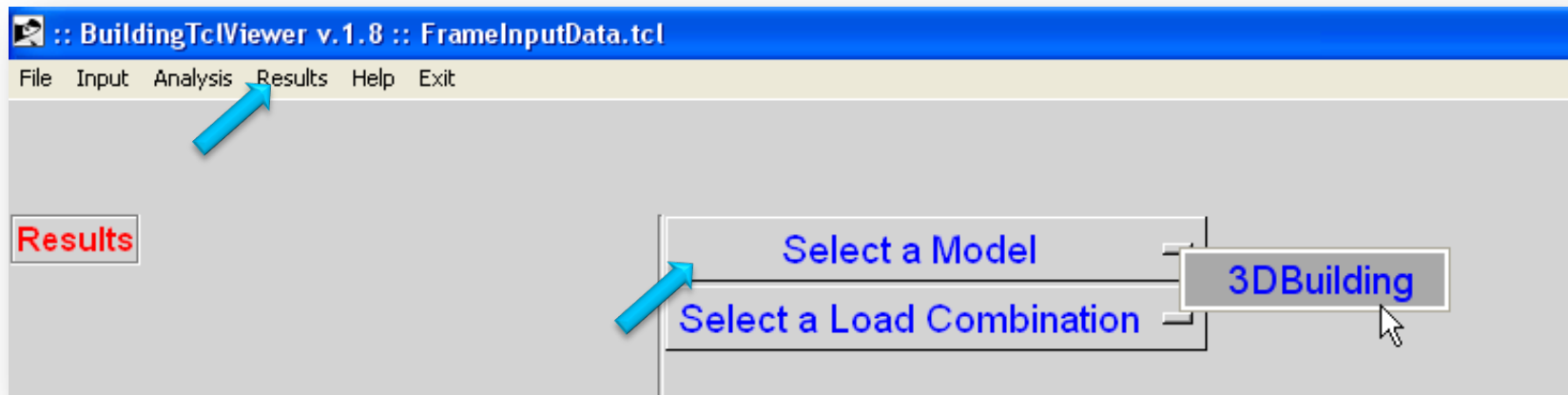


# Real-Time OpenSees Simulation

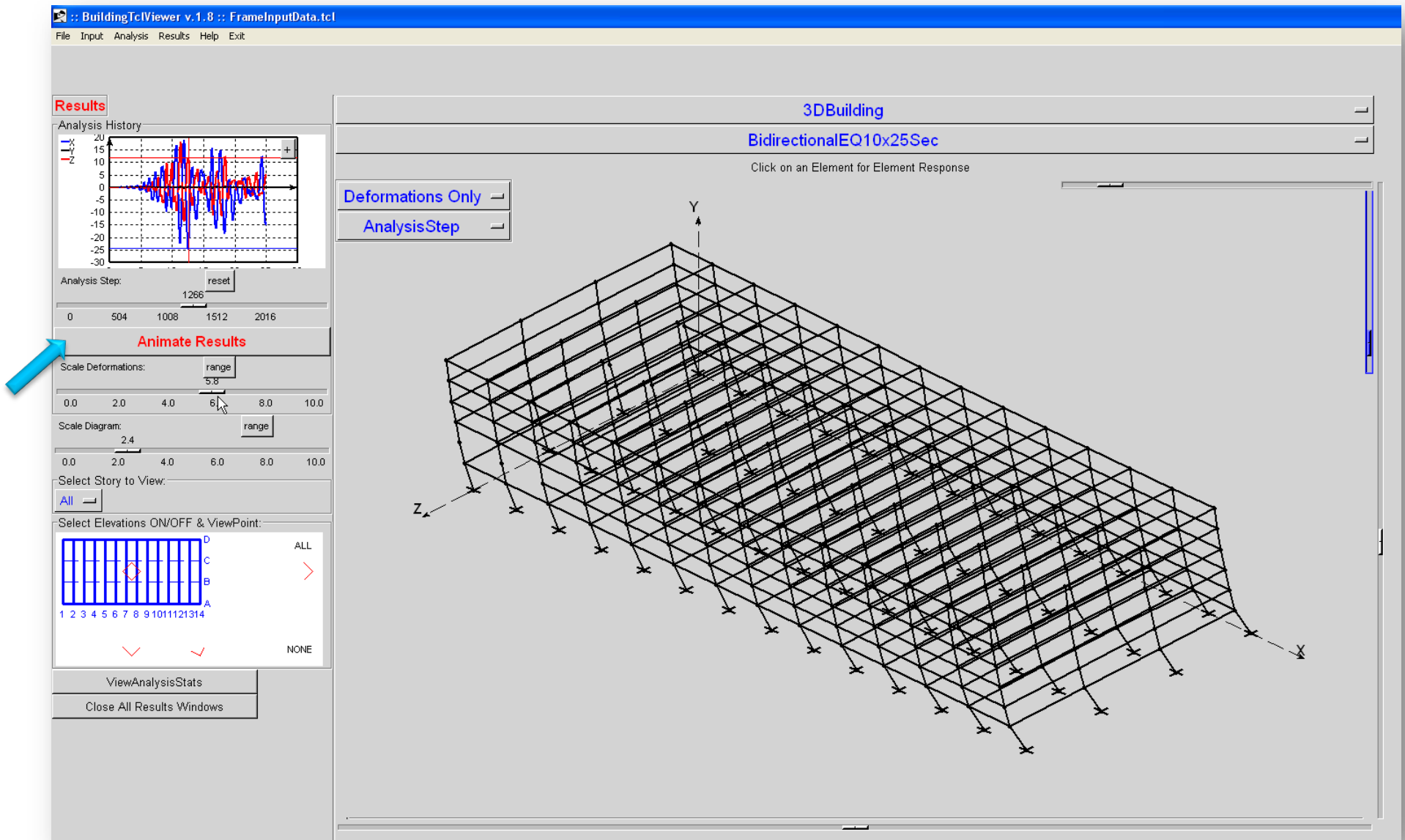
## *Real-Time Pause/Stop*



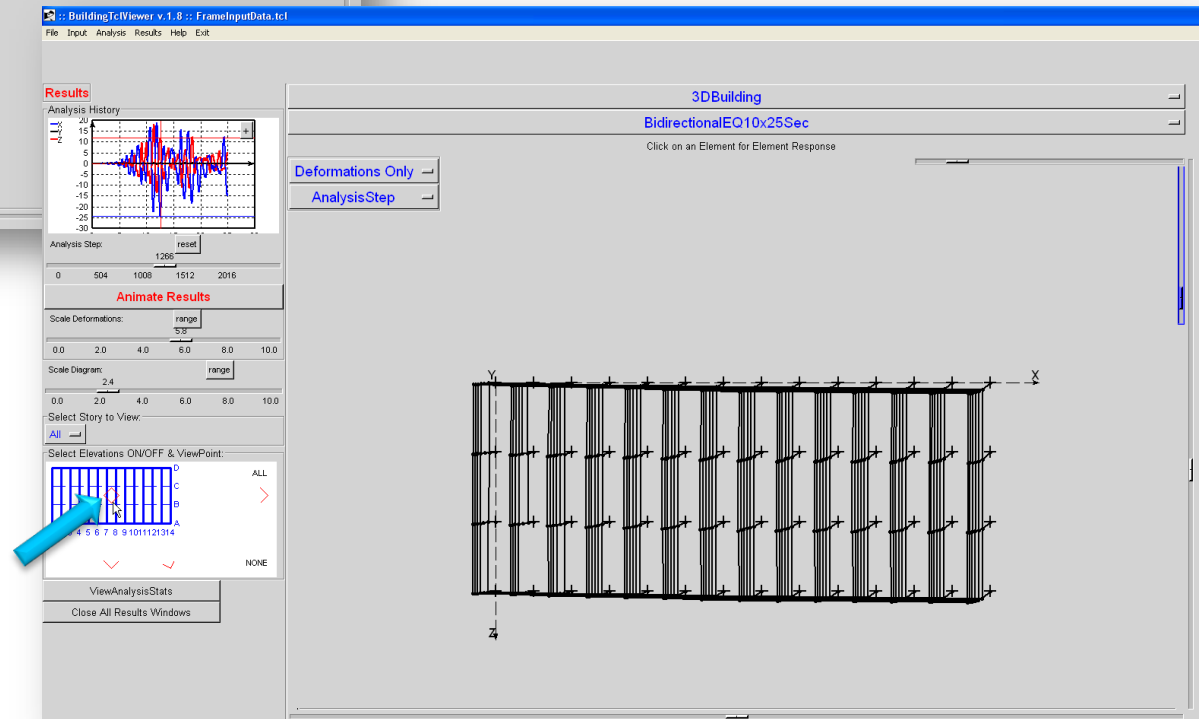
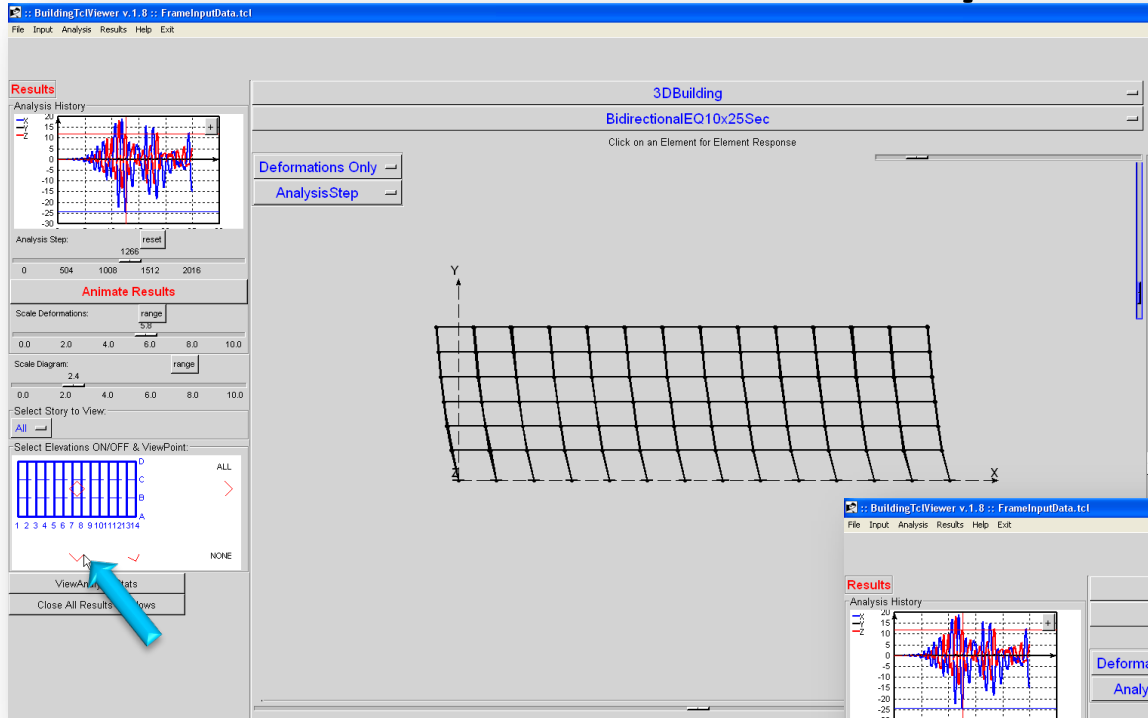
# Visualization of Simulation Results



# Visualization of Structural Response *animation*



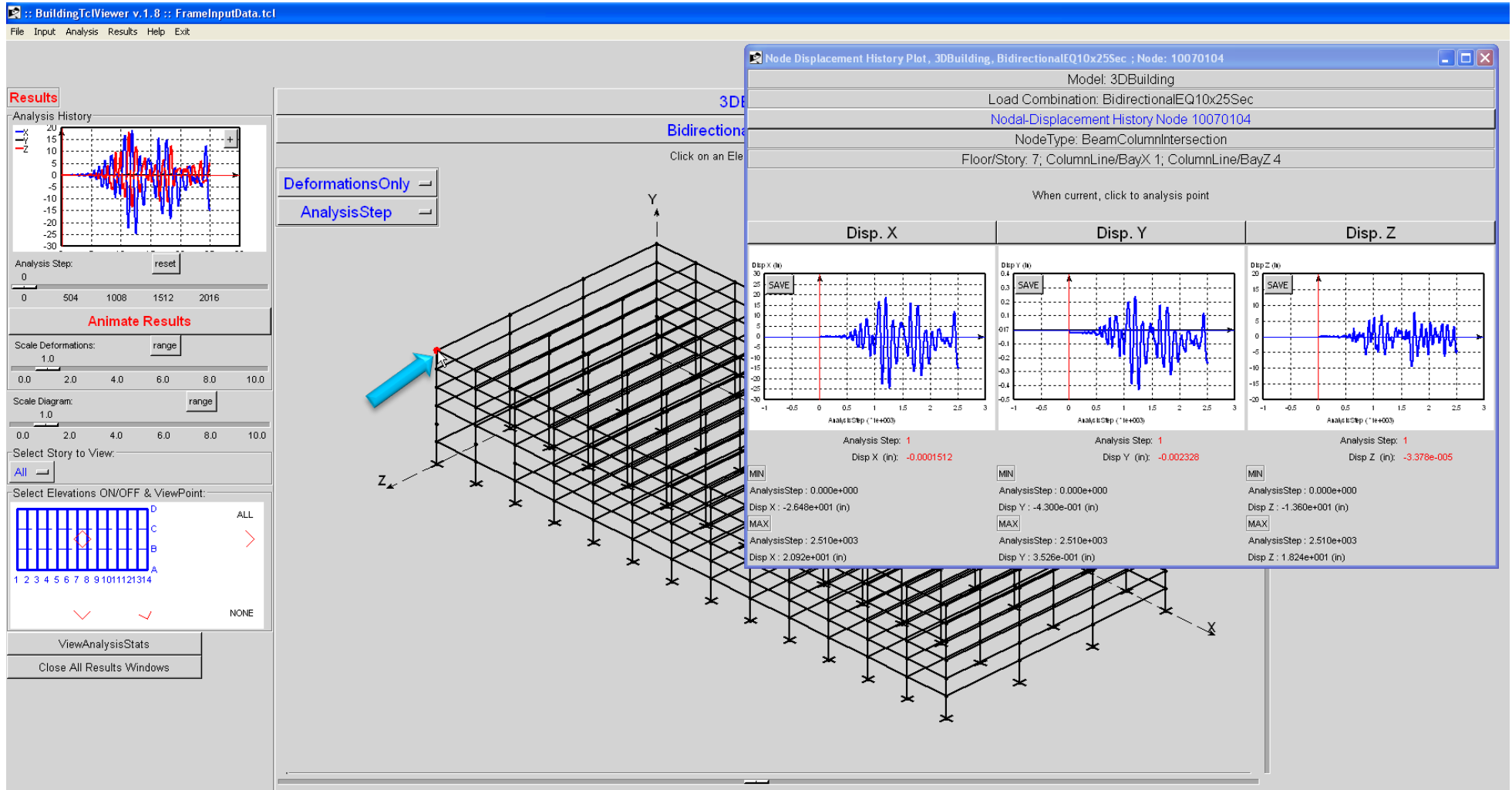
# Visualization of Structural Response *viewpoints*





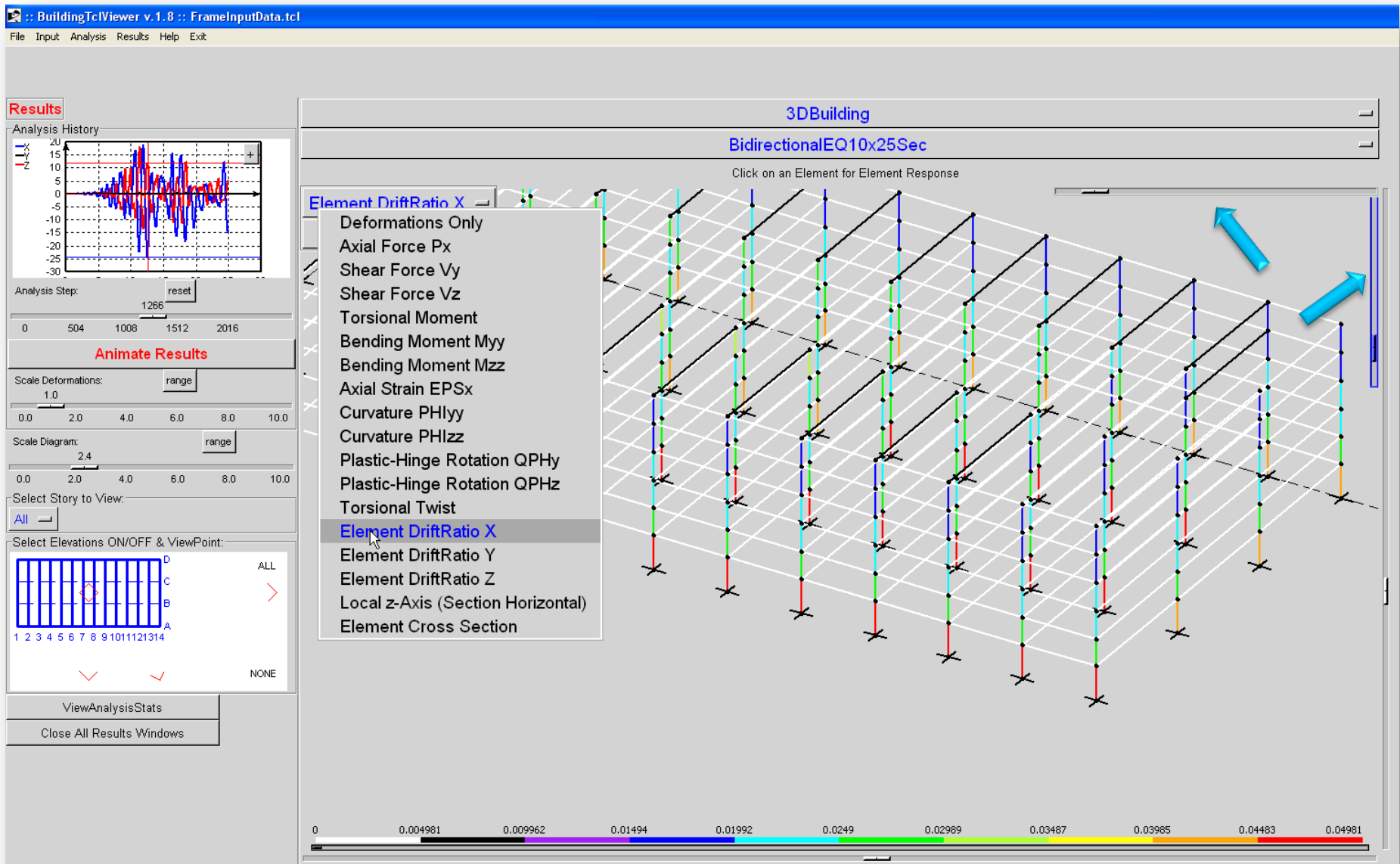
# Visualization of Structural Response

## *nodal-displacement response*

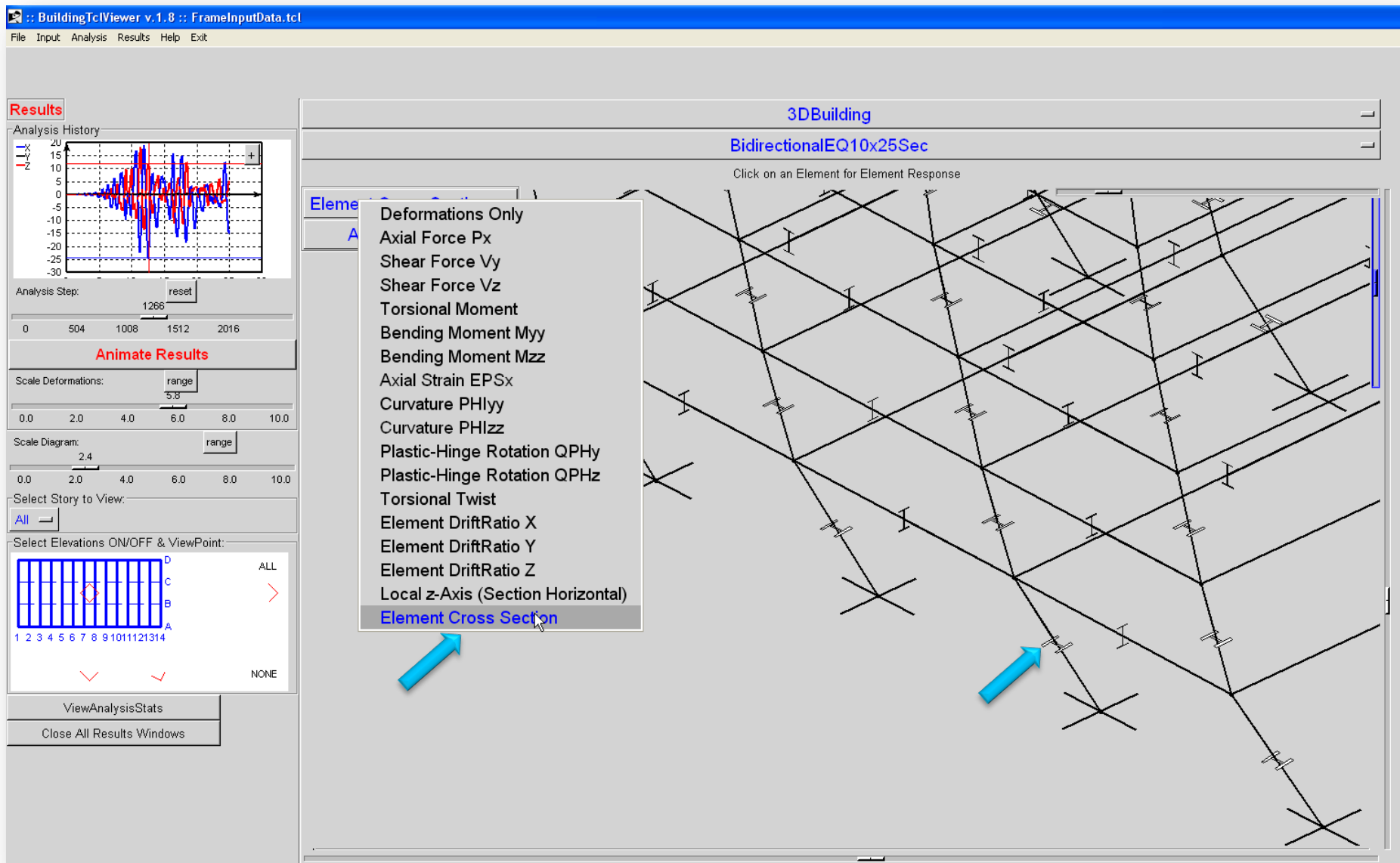


# Visualization of Structural Response

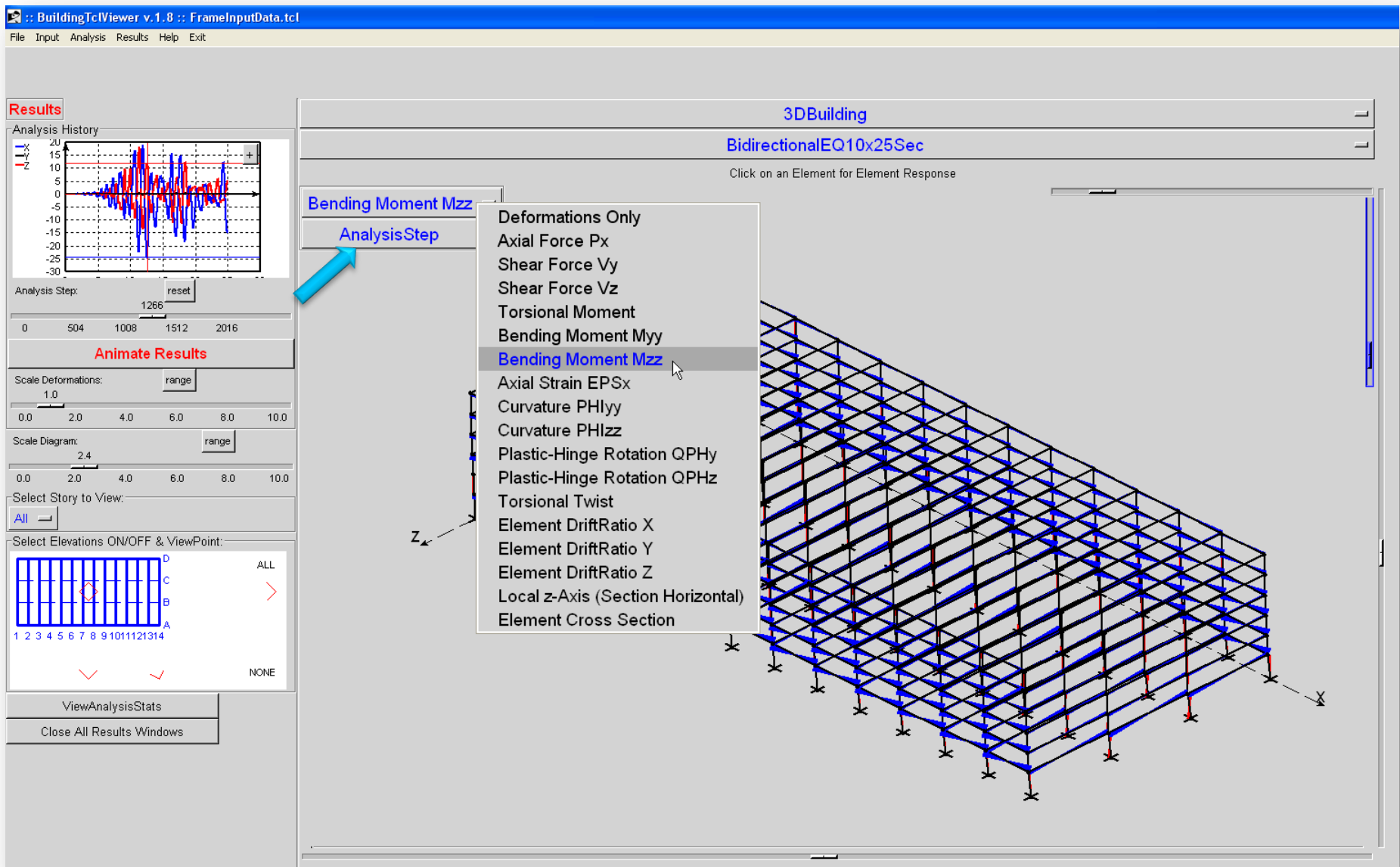
## *zoom & rotate*



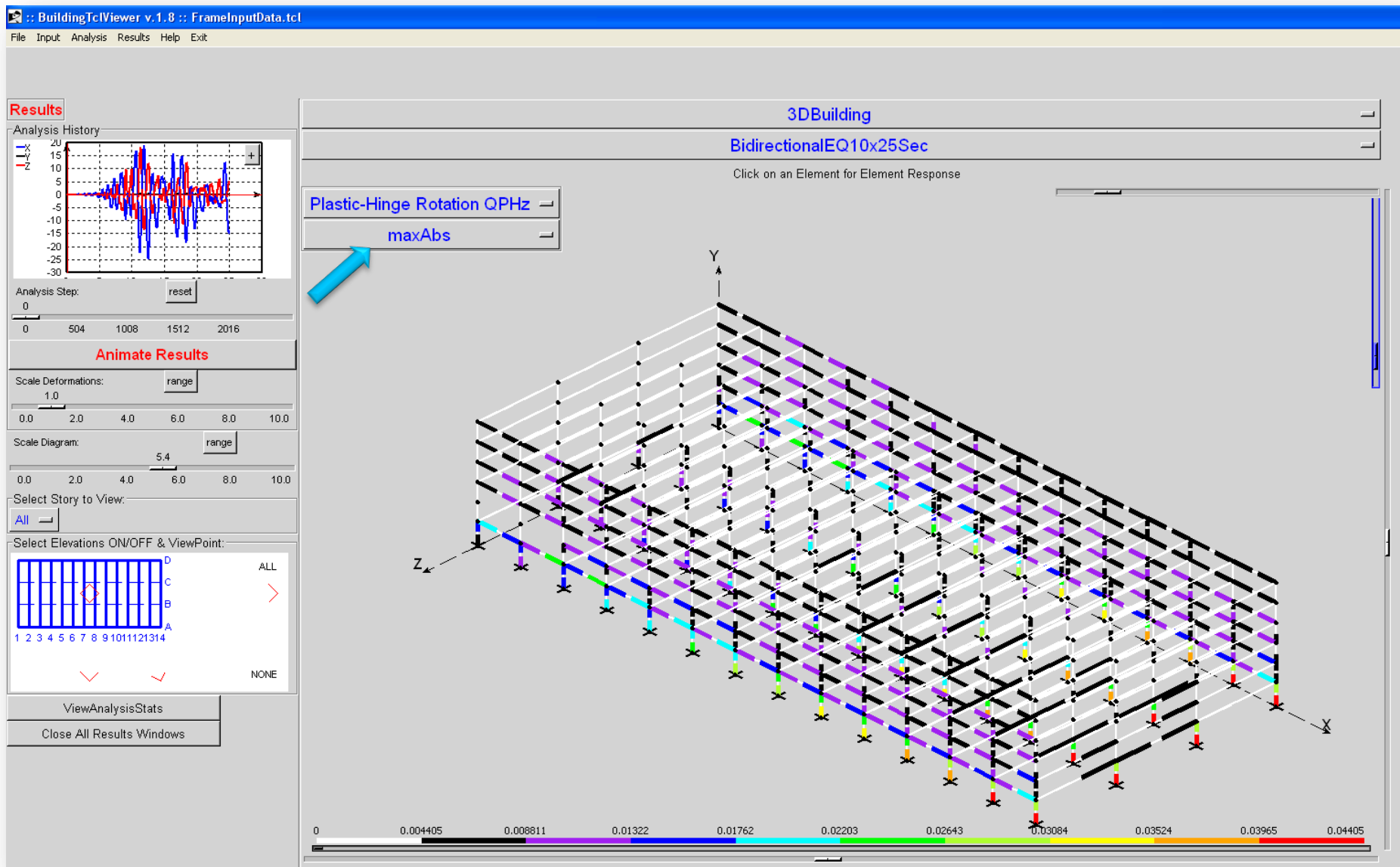
# Visualization of Structural Response *element section*



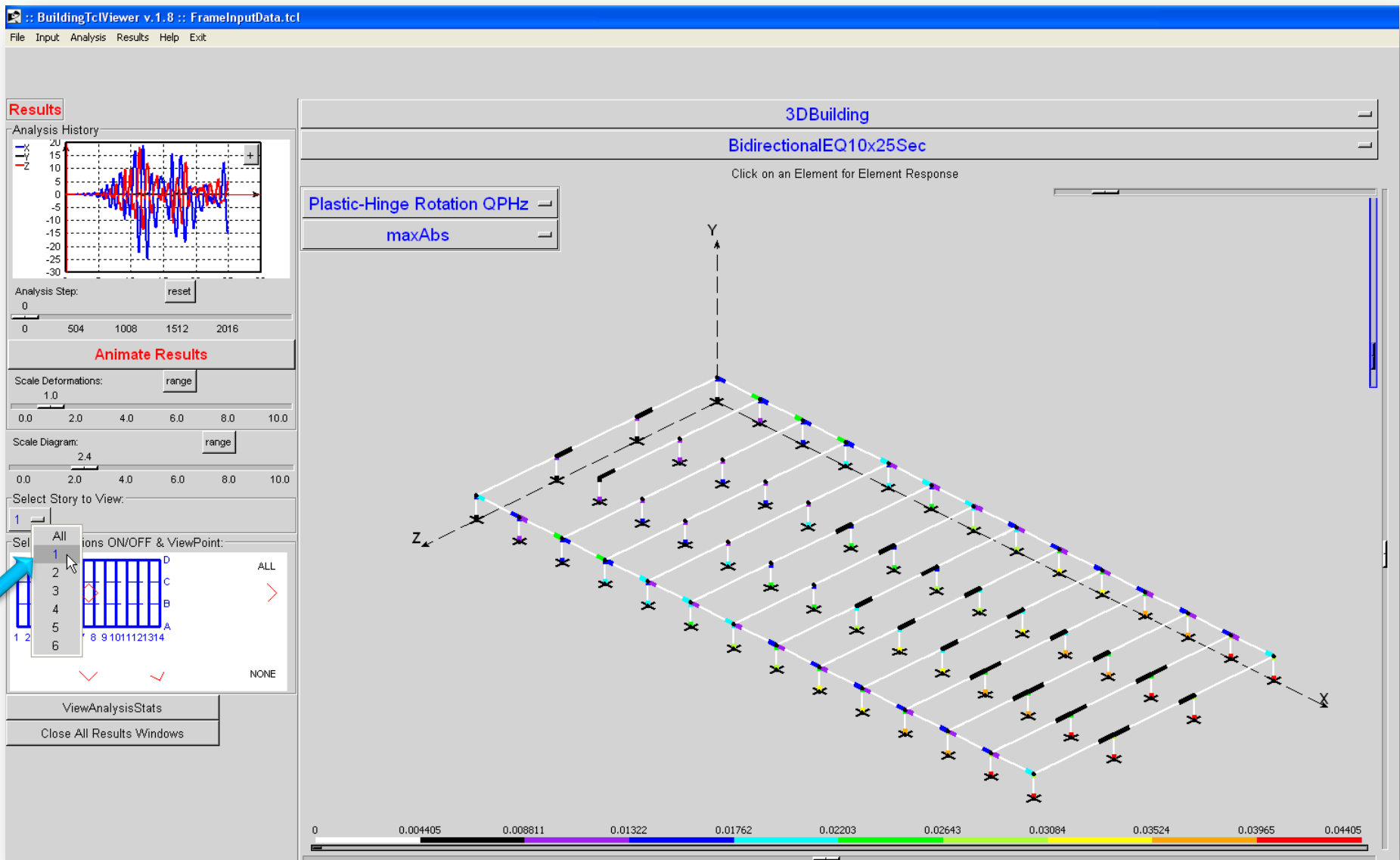
# Visualization of Structural Response @ Analysis Steps



# Visualization of Structural Response *envelope values*

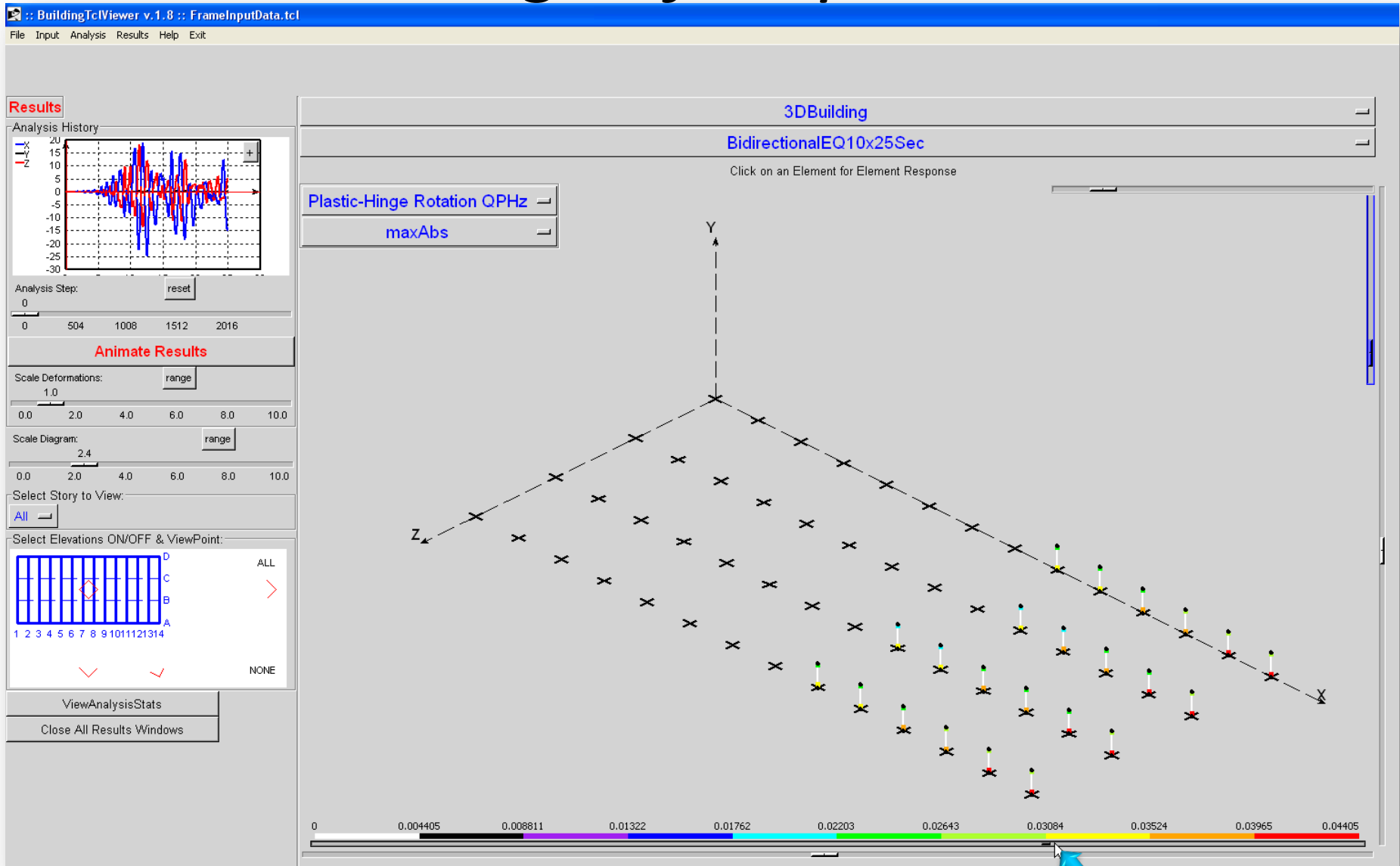


# Visualization of Structural Response *individual story*



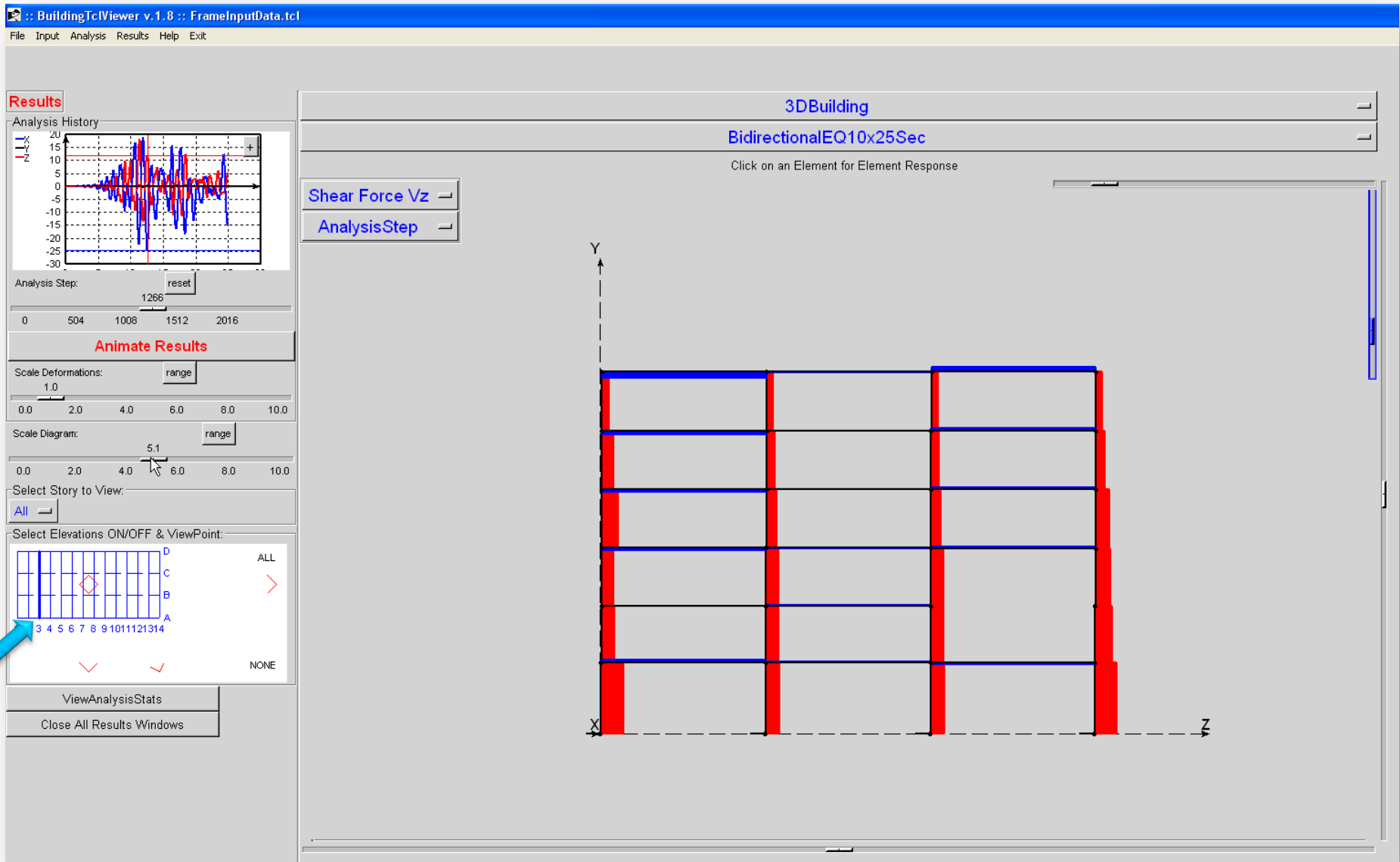
# Visualization of Structural Response

## *range of response*



# Visualization of Structural Response

## *individual-elevation response*





# Visualization of Structural Response

## N-LoadCombinations *envelope*

Load Combinations (Select all that apply):

All None

- StaticPushoverLargeStepsZ
- MaxEQ1 Scaled10
- BidirectionalEQ
- BidirectionalEQ10x25Sec
- MaxEQ2bidirect5x

Scale Diagram:

0.0 2.0 4.0 6

Select Story to View:

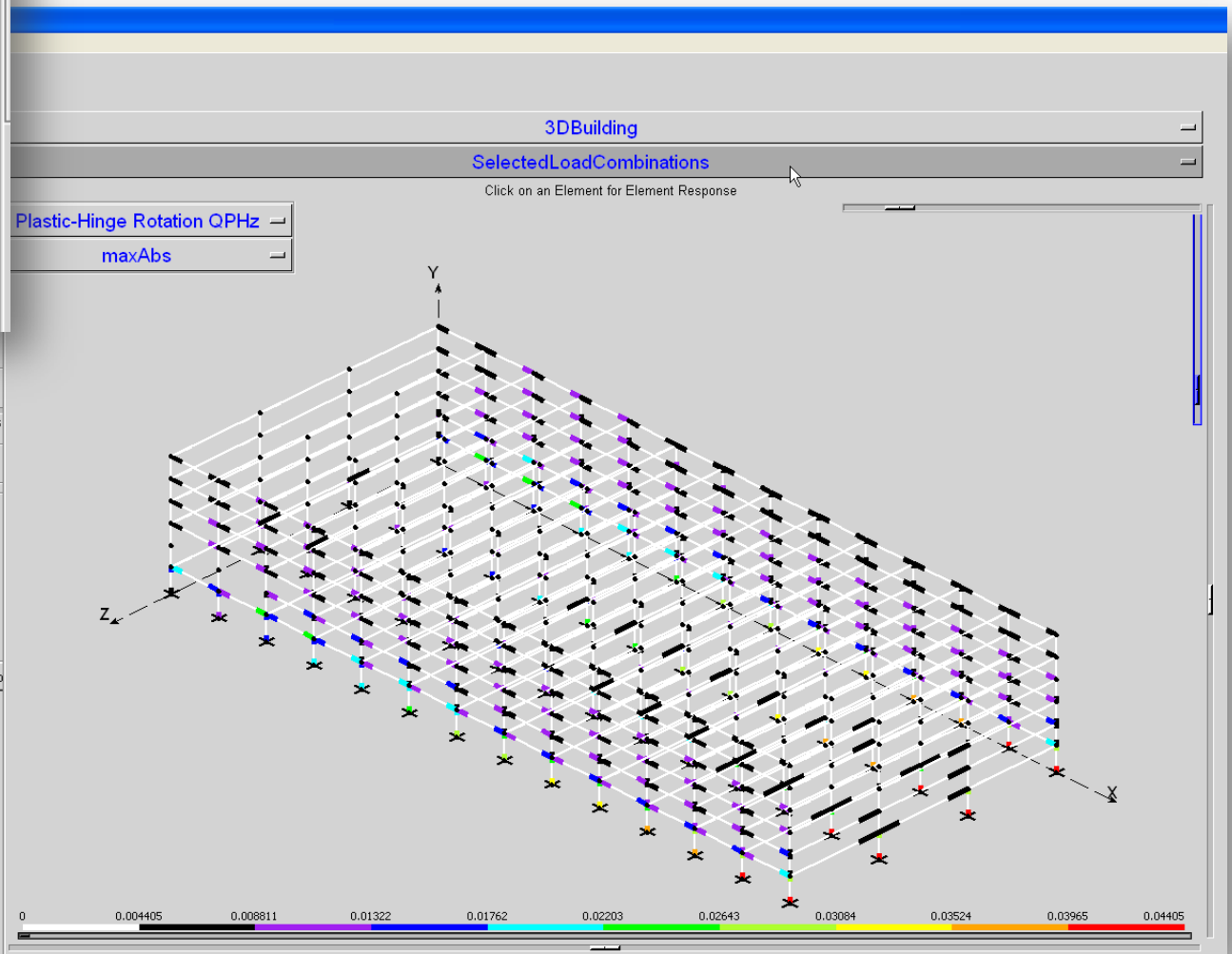
All

Select Elevations ON/OFF & ViewPoint:

1 2 3 4 5 6 7 8 9 10 11 12 13 14

ALL >

NONE



# Visualization of Structural Response

## *selected-element response*

The screenshot displays the BuildingTclViewer v.1.0 interface. The main window shows a 3D wireframe model of a building frame. A blue arrow points to a specific element in the structure, and a context menu is open, listing various response plots for that element. The menu is titled "Section-Fiber Response" and includes options for plotting forces, moments, drift ratios, and twists against time or analysis steps.

**Results Panel (Left):**

- Analysis History:** A graph showing a curve starting at 0 and rising to approximately 1.5 over 53 analysis steps.
- Analysis Step:** 53, with a "reset" button.
- Animate Results:** A section with "Scale Deformations" and "Scale Diagram" sliders, both set to 1.0.
- Select Story to View:** A grid showing stories 1 through 14, with story 10 selected.
- Select Elevations ON/OFF & ViewPoint:** A grid showing elevations A, B, C, and D, with elevation B selected.
- ViewAnalysisStats** and **Close All Results Windows** buttons.

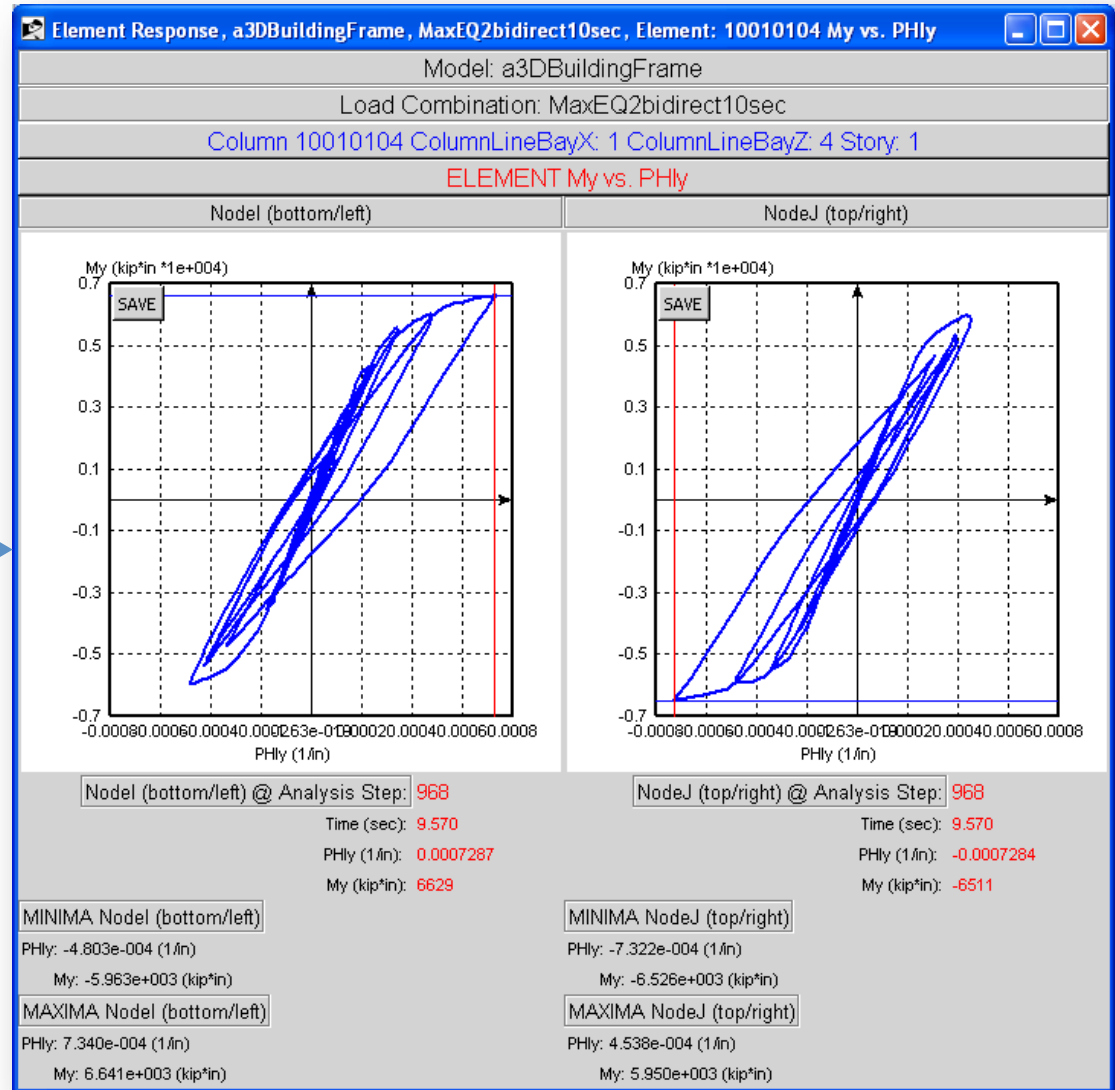
**3D Building Panel (Center):**

- Title:** 3DBuilding
- Analysis Type:** StaticPushoverLargeStepsZ
- Instruction:** Click on an Element for Element Response
- Buttons:** DeformationsOnly, AnalysisStep
- Context Menu (Section-Fiber Response):**
  - Plot Fx vs. EPSx
  - Plot Fx vs. Time
  - Plot EPSx vs. Time
  - Plot Fx vs. Analysis Step
  - Plot EPSx vs. Analysis Step
  - Plot Fy vs. DriftRatio
  - Plot Fy vs. Time
  - Plot DriftRatio vs. Time
  - Plot Fy vs. Analysis Step
  - Plot DriftRatio vs. Analysis Step
  - Plot Fz vs. DriftRatio
  - Plot Fz vs. Time
  - Plot DriftRatio vs. Time
  - Plot Fz vs. Analysis Step
  - Plot DriftRatio vs. Analysis Step
  - Plot Mx vs. Twist
  - Plot Mx vs. Time
  - Plot Twist vs. Time
  - Plot Mx vs. Analysis Step
  - Plot Twist vs. Analysis Step
  - Plot My vs. PHly
  - Plot My vs. Time
  - Plot PHly vs. Time
  - Plot My vs. Analysis Step
  - Plot PHly vs. Analysis Step
  - Plot My vs. QPHy
  - Plot QPHy vs. Time
  - Plot QPHy vs. Analysis Step
  - Plot Mz vs. PHz
  - Plot Mz vs. Time
  - Plot PHz vs. Time
  - Plot Mz vs. Analysis Step
  - Plot PHz vs. Analysis Step
  - Plot Mz vs. QPHz
  - Plot QPHz vs. Time
  - Plot QPHz vs. Analysis Step

# Element-Section Response

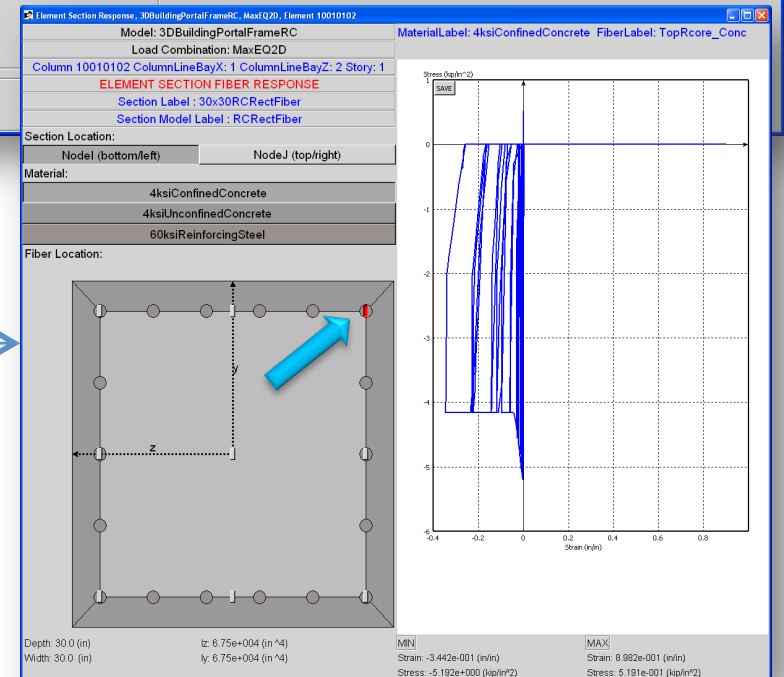
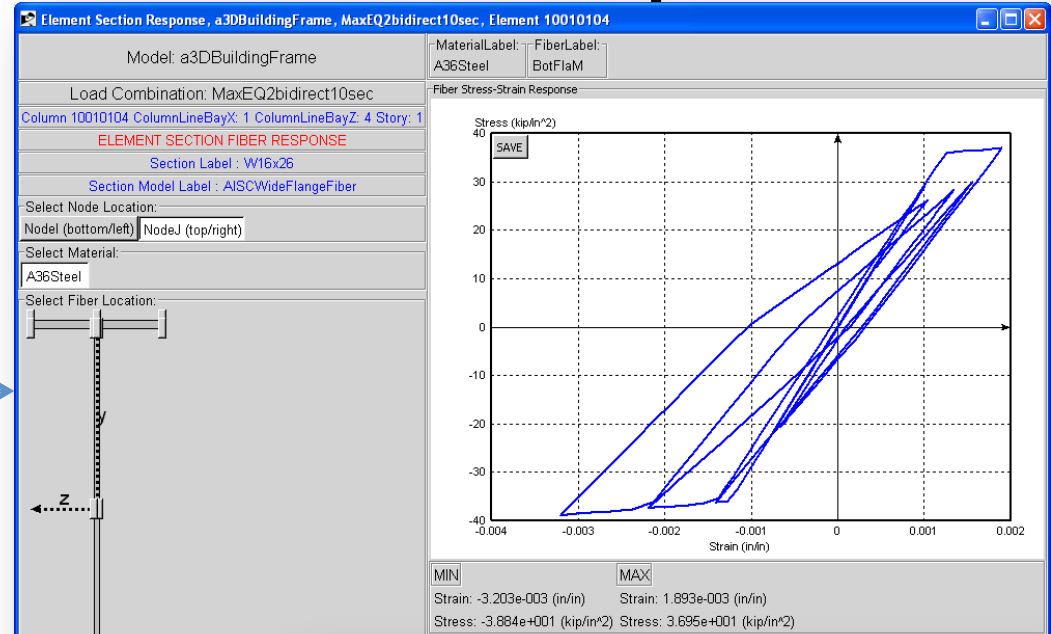
Section-Fiber Response

- Plot Fx vs. EPSx
- Plot Fx vs. Time
- Plot EPSx vs. Time
- Plot Fx vs. Analysis Step
- Plot EPSx vs. Analysis Step
- Plot Fy vs. DriftRatio
- Plot Fy vs. Time
- Plot DriftRatio vs. Time
- Plot Fy vs. Analysis Step
- Plot DriftRatio vs. Analysis Step
- Plot Fz vs. DriftRatio
- Plot Fz vs. Time
- Plot DriftRatio vs. Time
- Plot Fz vs. Analysis Step
- Plot DriftRatio vs. Analysis Step
- Plot Mx vs. Twist
- Plot Mx vs. Time
- Plot Twist vs. Time
- Plot Mx vs. Analysis Step
- Plot Twist vs. Analysis Step
- Plot My vs. PHly
- Plot My vs. Time
- Plot PHly vs. Time
- Plot My vs. Analysis Step
- Plot PHly vs. Analysis Step
- Plot My vs. QPHy
- Plot QPHy vs. Time
- Plot QPHy vs. Analysis Step
- Plot Mz vs. PHlz
- Plot Mz vs. Time
- Plot PHlz vs. Time
- Plot Mz vs. Analysis Step
- Plot PHlz vs. Analysis Step
- Plot Mz vs. QPHz
- Plot QPHz vs. Time
- Plot QPHz vs. Analysis Step



# Section-Fiber Response

- Section-Fiber Response
- Plot Fx vs. EPSx
- Plot Fx vs. Time
- Plot EPSx vs. Time
- Plot Fx vs. Analysis Step
- Plot EPSx vs. Analysis Step
- Plot Fy vs. DriftRatio
- Plot Fy vs. Time
- Plot DriftRatio vs. Time
- Plot Fy vs. Analysis Step
- Plot DriftRatio vs. Analysis Step
- Plot Fz vs. DriftRatio
- Plot Fz vs. Time
- Plot DriftRatio vs. Time
- Plot Fz vs. Analysis Step
- Plot DriftRatio vs. Analysis Step
- Plot Mx vs. Twist
- Plot Mx vs. Time
- Plot Twist vs. Time
- Plot Mx vs. Analysis Step
- Plot Twist vs. Analysis Step
- Plot My vs. PHly
- Plot My vs. Time
- Plot PHly vs. Time
- Plot My vs. Analysis Step
- Plot PHly vs. Analysis Step
- Plot My vs. QPHy
- Plot QPHy vs. Time
- Plot QPHy vs. Analysis Step
- Plot Mz vs. PHlz
- Plot Mz vs. Time
- Plot PHlz vs. Time
- Plot Mz vs. Analysis Step
- Plot PHlz vs. Analysis Step
- Plot Mz vs. QPHz
- Plot QPHz vs. Time
- Plot QPHz vs. Analysis Step



# Conclusions: *BuildingTcl* combines the power of scripting input with a GUI

```
# MODELS -----
1 # MODELS -----
2 addModelData ModelLabel TransverseFrameOnLine1
3 addModelData ModelDescription "Transverse Frame On Line 1"
4 addModelData ModelTypeLabel Elevation
5 addModelData -Geometry Height "16*\$ft +3*\$in" Story 1
6 addModelData -Geometry Height "12*\$ft +10*\$in" Story 2
7 addModelData -Geometry Height "13*\$ft +1*\$in" Story 3
8 addModelData -Geometry Height "13*\$ft +4*\$in" StoryRange "4 6"
9 addModelData -Geometry Width 37*\$ft BayRange "1 3"
10 addModelData -Columns ElementTypeLabel Column SectionLabel "W14x311" ColumnLine "1 4" StoryRange "1 3" Orient Rotated
11 addModelData -Columns ElementTypeLabel Column SectionLabel "W14x211" ColumnLine "1 4" Story "4 5" Orient Rotated
12 addModelData -Columns ElementTypeLabel Column SectionLabel "W14x176" ColumnLine "1 4"
13 addModelData -Columns ElementTypeLabel Column SectionLabel "W14x342" ColumnLine "2 3"
14 addModelData -Columns ElementTypeLabel Column SectionLabel "W14x233" ColumnLine "2 3"
15 addModelData -Columns ElementTypeLabel Column SectionLabel "W14x145" ColumnLine "2 3"
16 addModelData -Beams ElementTypeLabel Beam SectionLabel "W24x117 W24x117 W22x118"
287 addModelData ModelLabel 3DBuilding
288 addModelData ModelDescription "Let's try It"
289 addModelData SupportBC fix
290 addModelData ModelTypeLabel 3DFrame
291 addModelData RigidFloor On
292 addModelData PlanModelLabel GeneralizedFloorGrid
293 addModelData -addElevation ElevationModelLabel TransverseFrameOnLine1 iGridLineLabel "12" CrossGridLineLabel "A B C D"
294 addModelData -addElevation ElevationModelLabel TransverseFrameOnLine2 iGridLineLabel "13" CrossGridLineLabel "A B C D"
295 addModelData -addElevation ElevationModelLabel TransverseFrameOnLine3 iGridLineLabel "14" CrossGridLineLabel "A B C D"
296 addModelData -addElevation ElevationModelLabel TransverseFrameOnLine4 iGridLineLabel "12" CrossGridLineLabel "A B C D"
297 addModelData -addElevation ElevationModelLabel TransverseFrameOnLine12 iGridLineLabel "12" CrossGridLineLabel "A B C D"
298 addModelData -addElevation ElevationModelLabel TransverseFrameOnLine13 iGridLineLabel "13" CrossGridLineLabel "A B C D"
299 addModelData -addElevation ElevationModelLabel TransverseFrameOnLine14 iGridLineLabel "14" CrossGridLineLabel "A B C D"
300 addModelData -addElevation ElevationModelLabel LongitudinalFrameOnLineA iGridLineLabel "A"
301 addModelData -addElevation ElevationModelLabel LongitudinalFrameOnLineD iGridLineLabel "D"
302 addModel
```

