OpenSees Navigator

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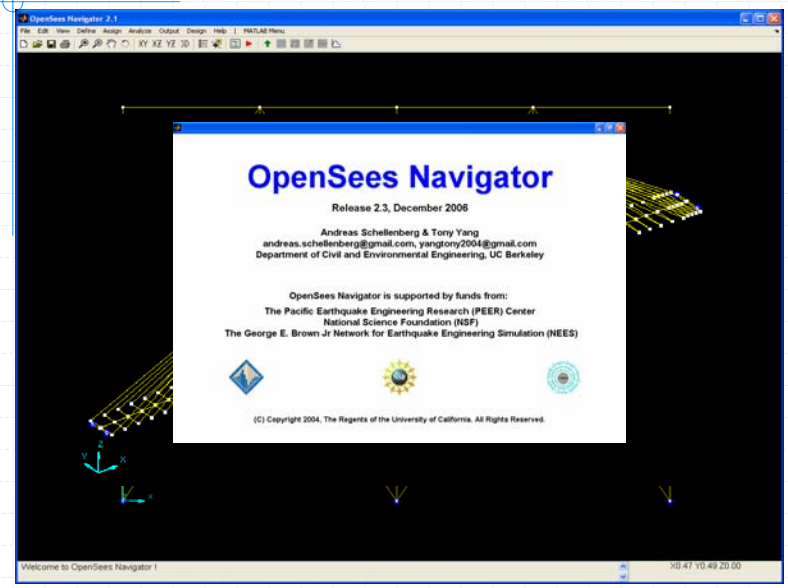
Introduction

- MATLAB based graphical user interface (GUI).
- Pre- and post-processing for OpenSees and OpenFresco.
- Design toolboxes: NSP, PBEE, AISC design checks, AISC database, response spectra for linear and bilinear systems and signal filtering.
- Both MATLAB Pcode and self-executable versions are available.
- Being used by researchers from Asia, US, Canada, south America and Europe.

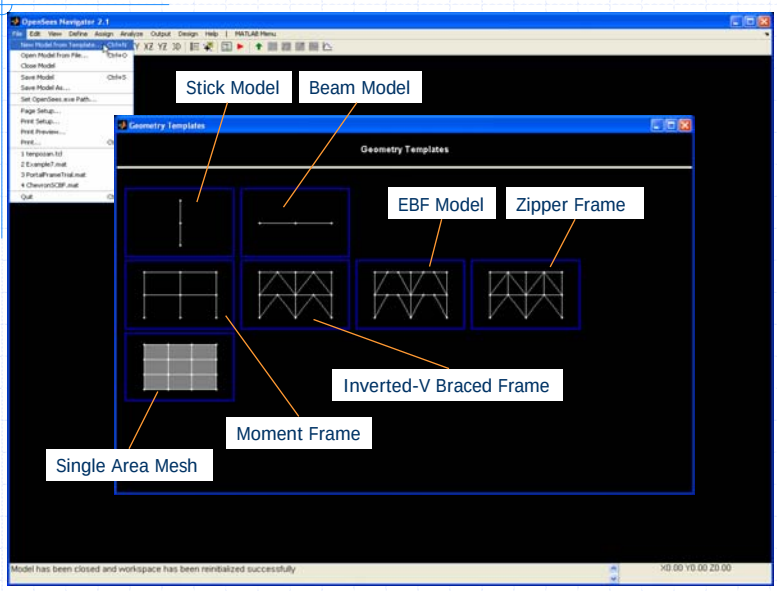
Motivations

- Graphical input is more flexible than TCL text input.
- Most researchers use MATLAB to do the post-processing, and MATLAB/Simulink is the typical framework for implementing hybrid simulation tests.
- OpenSees Navigator will create the OpenSees (analytical/hybrid) model and graphically display the results before, during or after a test.
- Flexible to use and requires no programming skill.

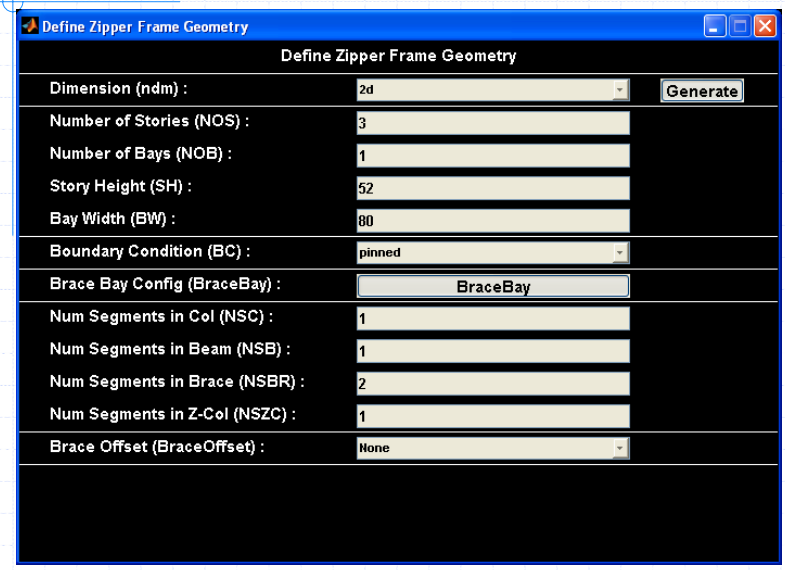
OpenSees Navigator



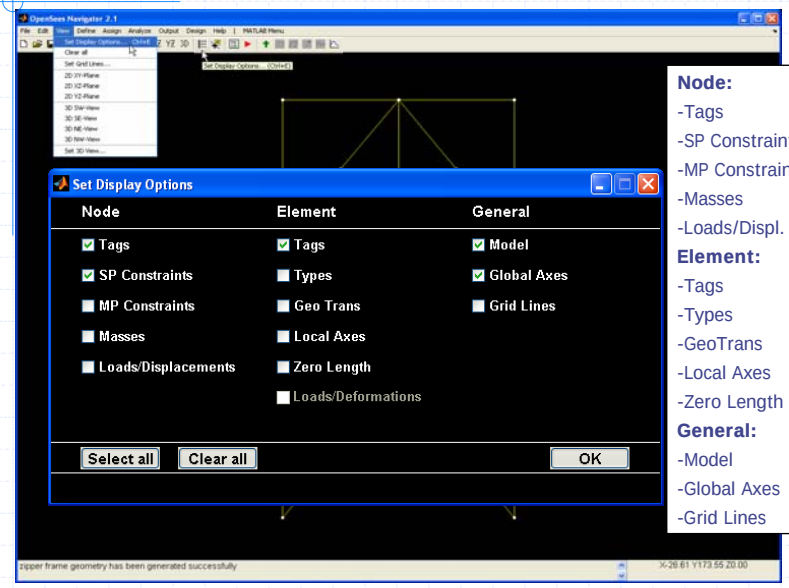
Define geometry: new model template



Define geometry: Zipper braced frame

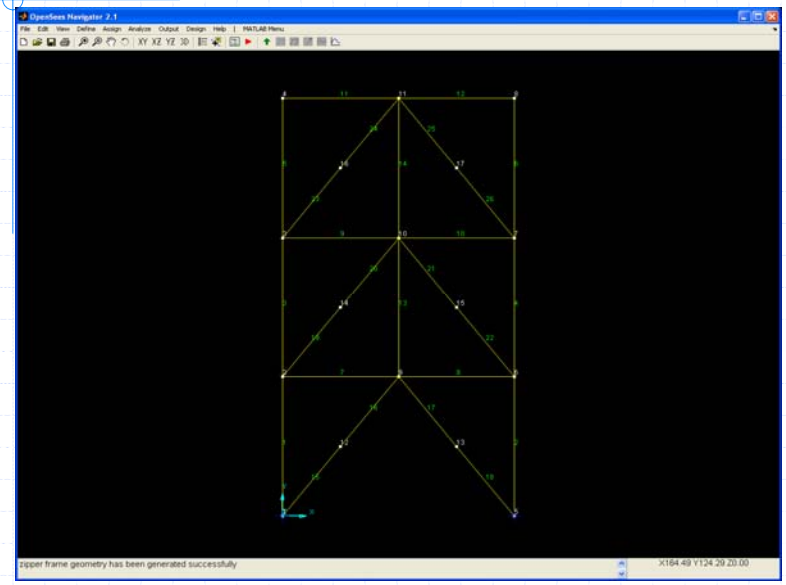


View geometry: set display options

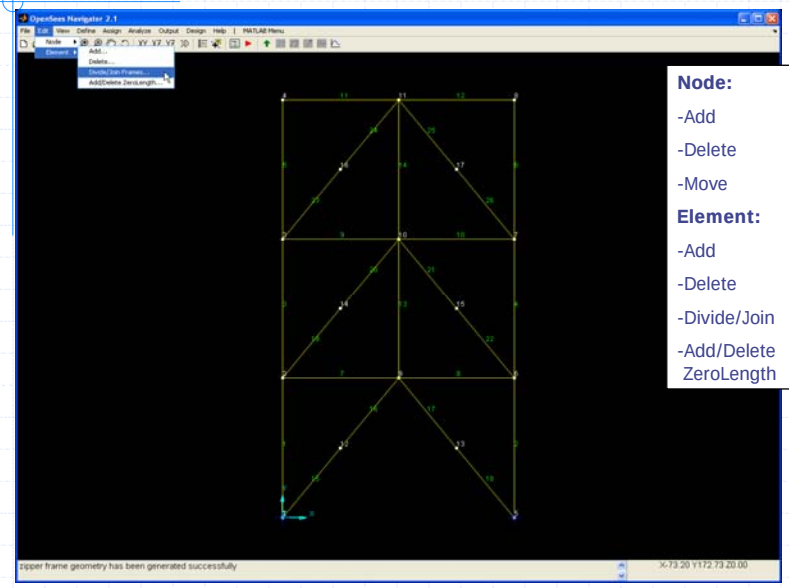


Node:
-Tags
-SP Constraints
-MP Constraints
-Masses
-Loads/Displ.
Element:
-Tags
-Types
-GeoTrans
-Local Axes
-Zero Length
General:
-Model
-Global Axes
-Grid Lines

View geometry: display



Edit geometry



Node:

-Add

-Delete

-Move

Element:

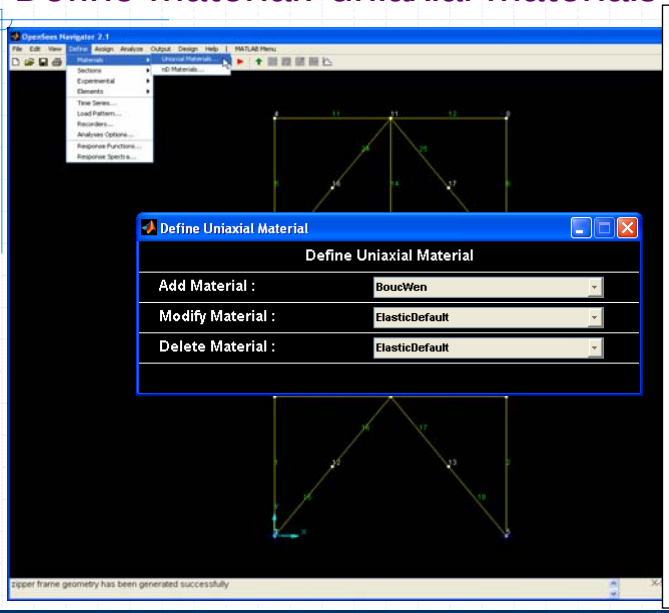
-Add

-Delete

-Divide/Join

-Add/Delete ZeroLength

Define material: uniaxial materials



Templates:

-BoucWen

-Concrete01

-Concrete02

-Concrete03

-Elastic

-ElasticNoTension

-ElasticPP

-ElasticPPGap

-Fatigue

-Hardening

-Hysteretic

-MinMax

-Parallel

-Series

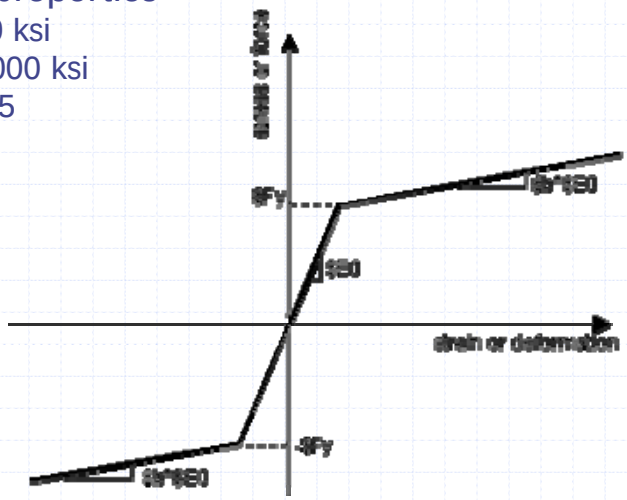
-Steel01

-Steel02

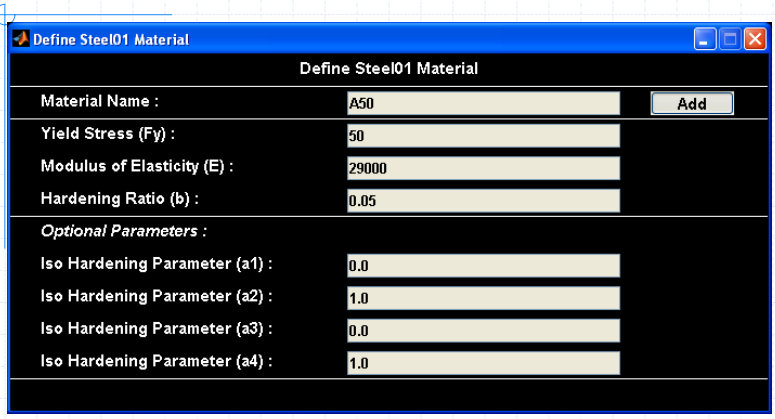
-Viscous

Define uniaxial material: Steel01

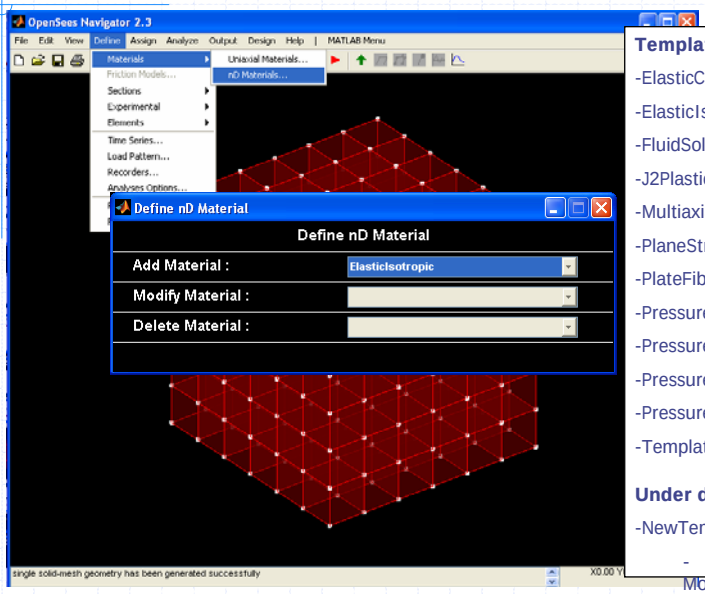
- Material properties
  - Fy = 50 ksi
  - E = 29000 ksi
  - b = 0.05



Define uniaxial material: Steel01



Define material: nD materials



Templates:

-ElasticCrossAnisotropic3D

-ElasticIsotropic

-FluidSolidPorous

-J2Plasticity

-MultiaxialCyclicPlasticity

-PlaneStress

-PlateFiber

-PressureDependMultiYield

-PressureDependMultiYield02

-PressureDependentElastic3D

-PressureIndependMultiYield

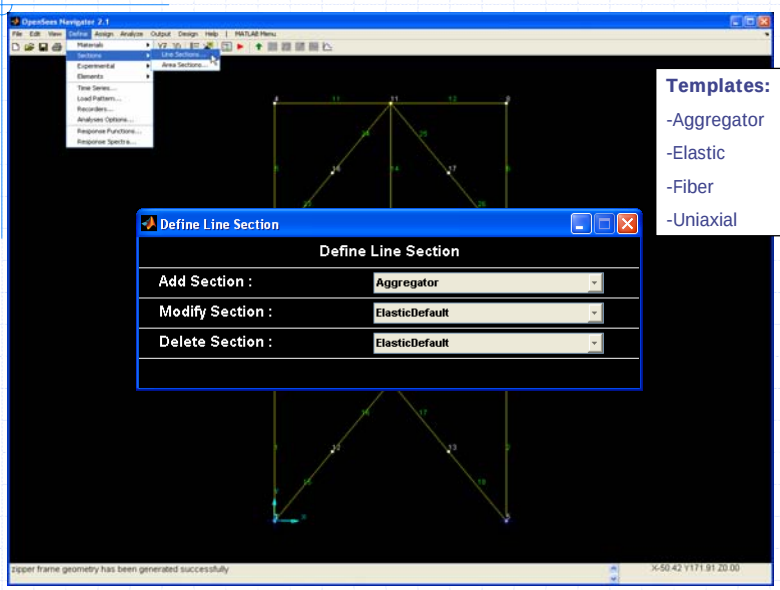
-Template3DElastoPlastic

Under development:

-NewTemplate3DElastoPlastic

-ModelsLargeDeformatio

Define section: line sections



Templates:

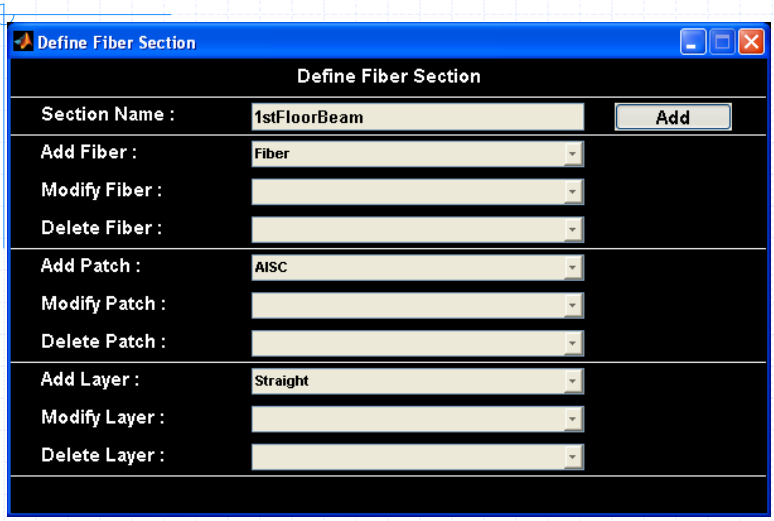
-Aggregator

-Elastic

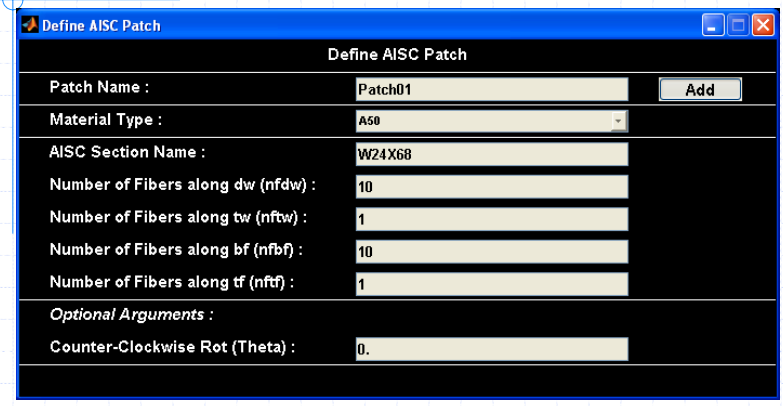
-Fiber

-Uniaxial

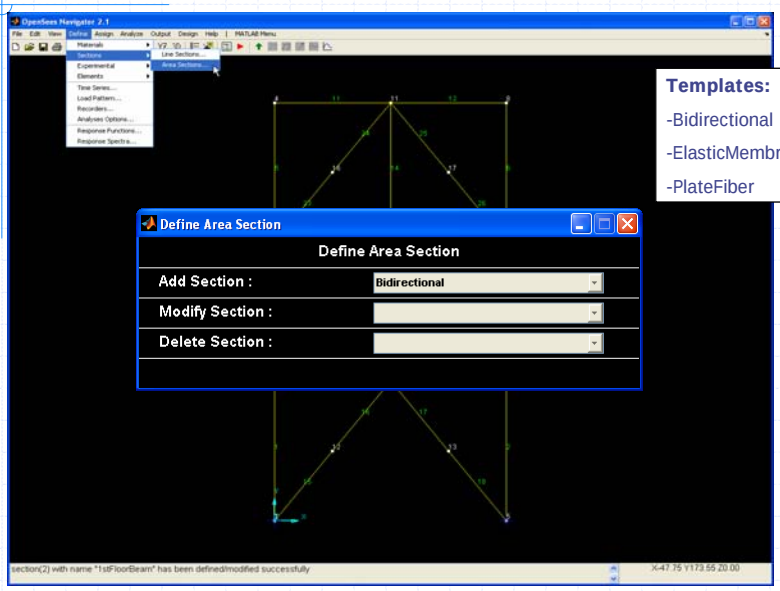
Define line section: fiber section



Define fiber section: AISC patch



Define section: area section



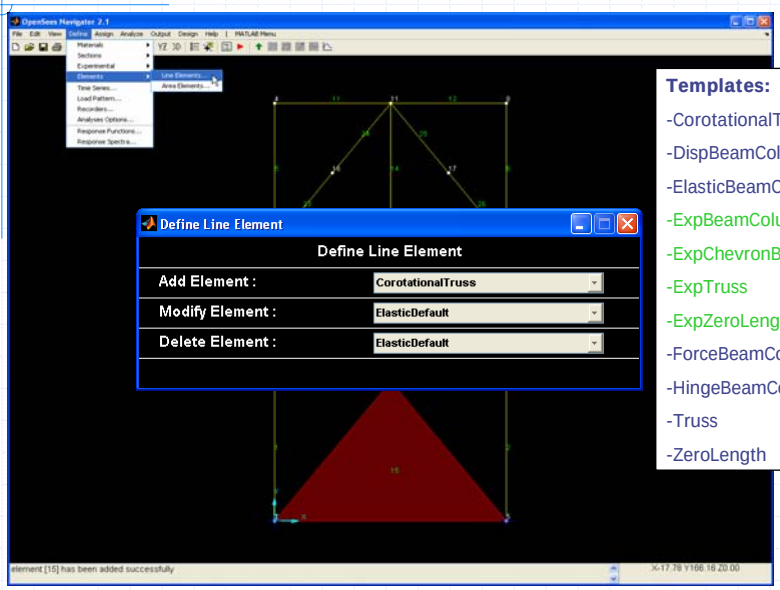
Templates:

-Bidirectional

-ElasticMmembranePlate

-PlateFiber

Define element: line element



Templates:

-CorotationalTruss

-DispBeamColumn

-ElasticBeamColumn

-ExpBeamColumn

-ExpChevronBrace

-ExpTruss

-ExpZeroLength

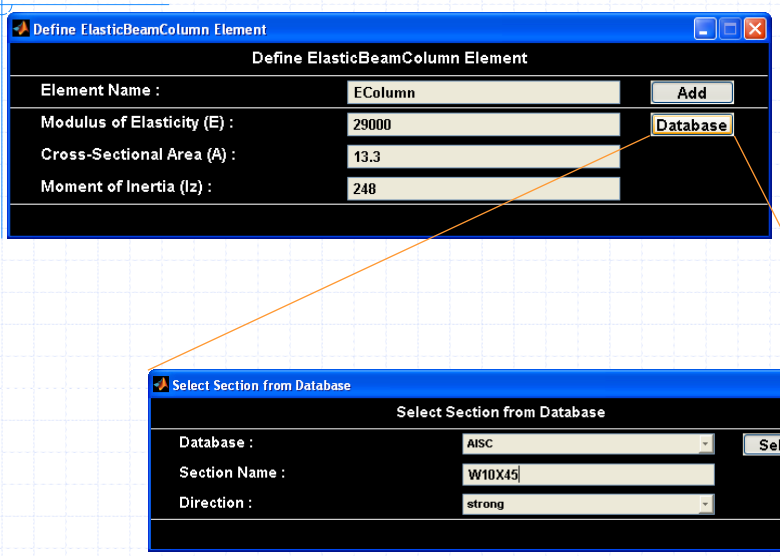
-ForceBeamColumn

-HingeBeamColumn

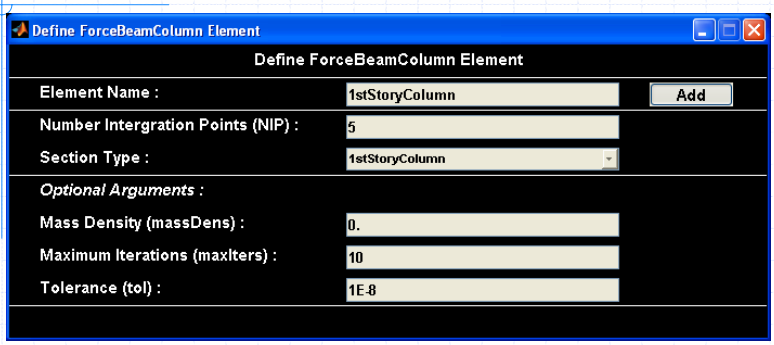
-Truss

-ZeroLength

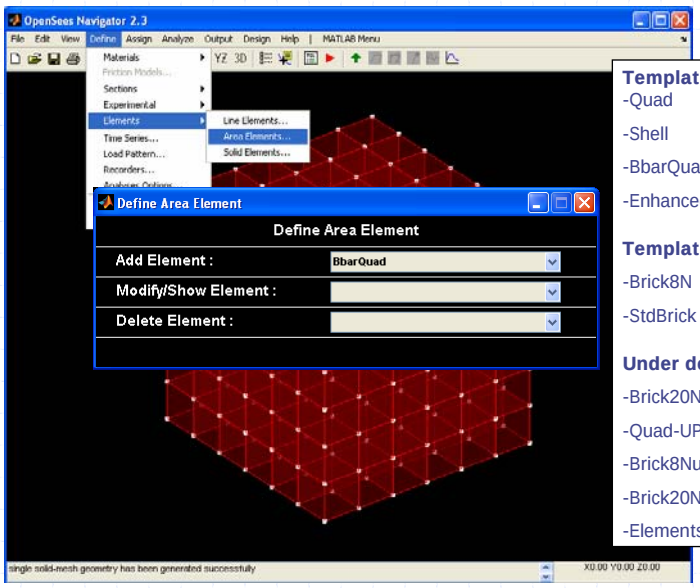
Define line element: ElasticBeamColumn



Define line element: ForceBeamColumn



Define element: area and solid elements

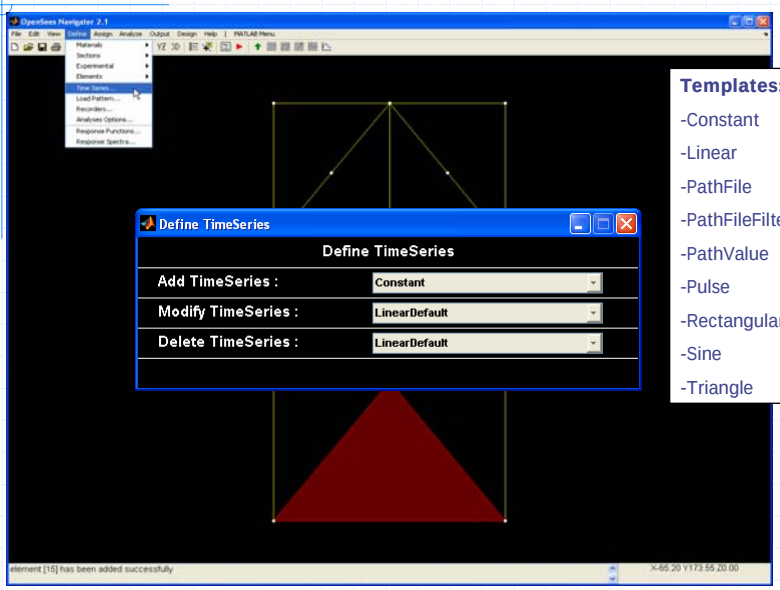


Templates (area):
-Quad
-Shell
-BbarQuad
-EnhancedQuad

Templates (solid):
-Brick8N
-StdBrick

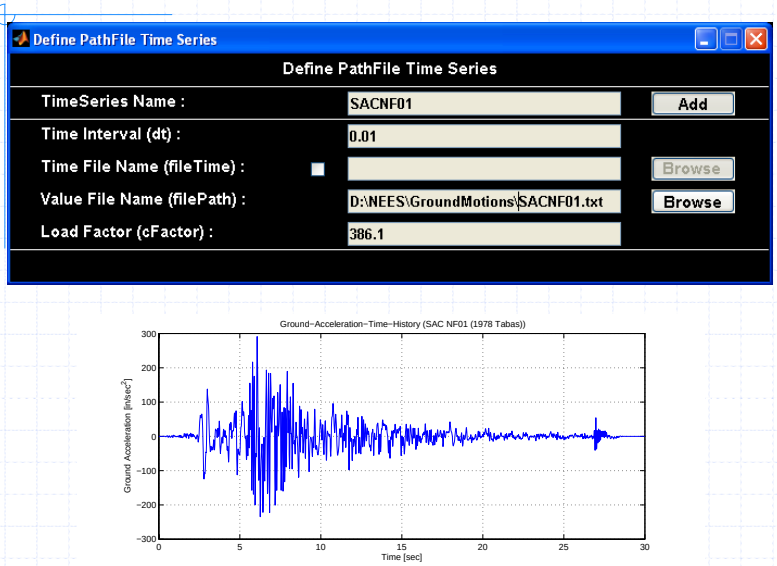
Under development:
-Brick20N
-Quad-UP
-Brick8Nu-p-U
-Brick20Nu-p-U
-ElementsLargeDeformation

Define TimeSeries:

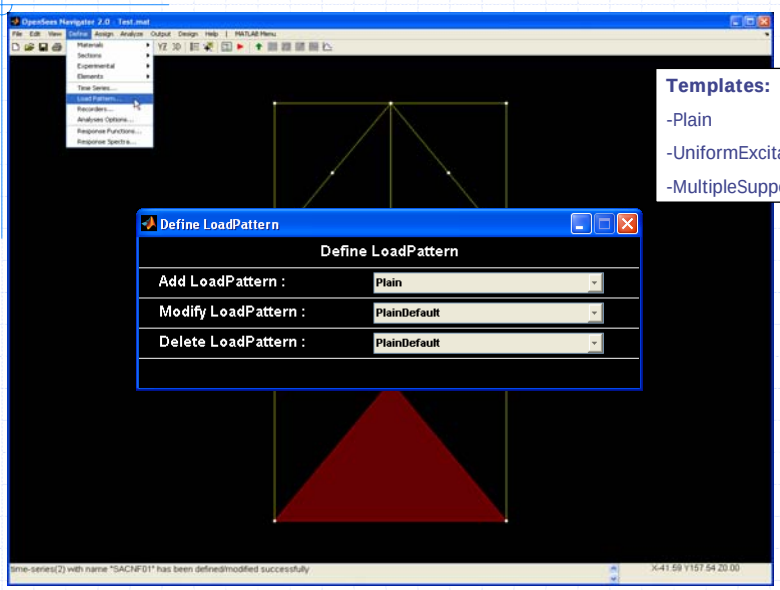


Templates:
-Constant
-Linear
-PathFile
-PathFileFiltered
-PathValue
-Pulse
-Rectangular
-Sine
-Triangle

Define TimeSeries: PathFile



Define LoadPattern:



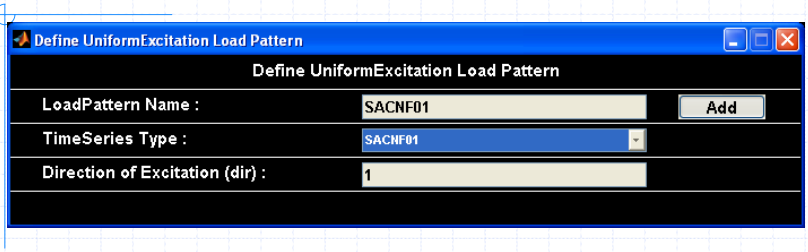
Templates:

-Plain

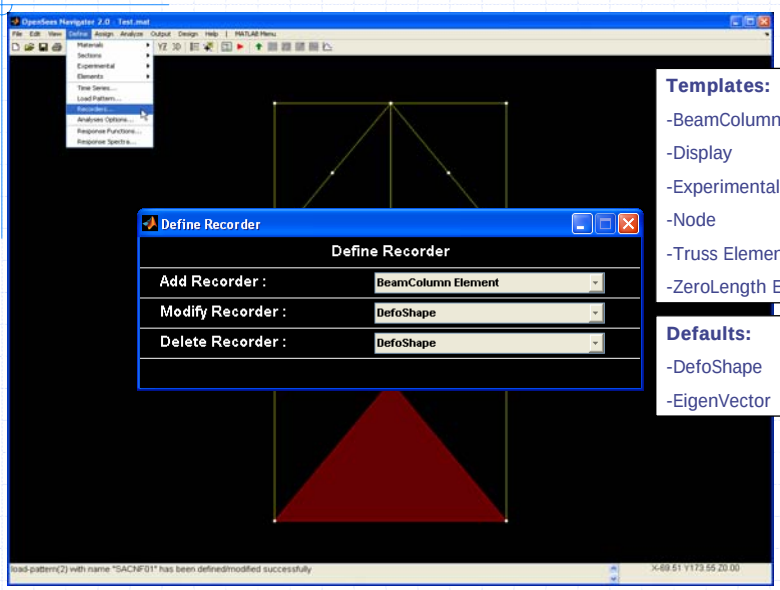
-UniformExcitation

-MultipleSupport

Define LoadPattern: UniformExcitation



Define recorder



Templates:

-BeamColumn Element

-Display

-Experimental Element

-Node

-Truss Element

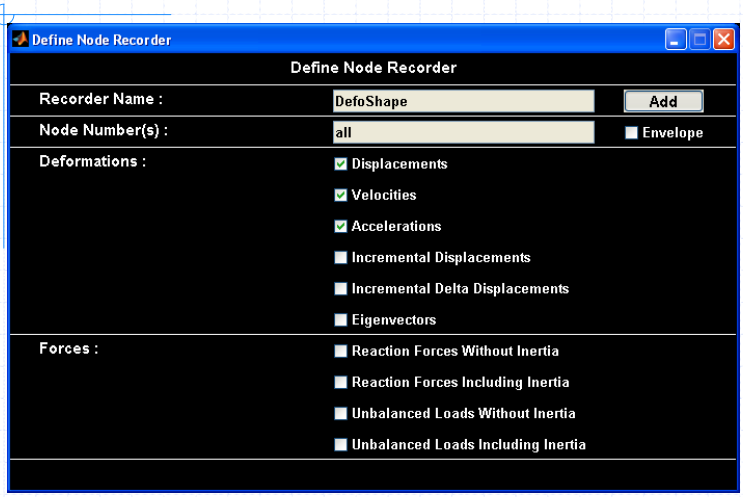
-ZeroLength Element

Defaults:

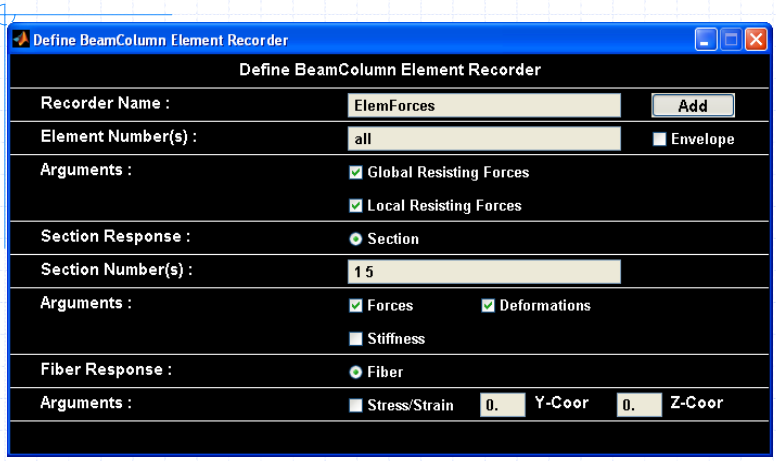
-DefoShape

-EigenVector

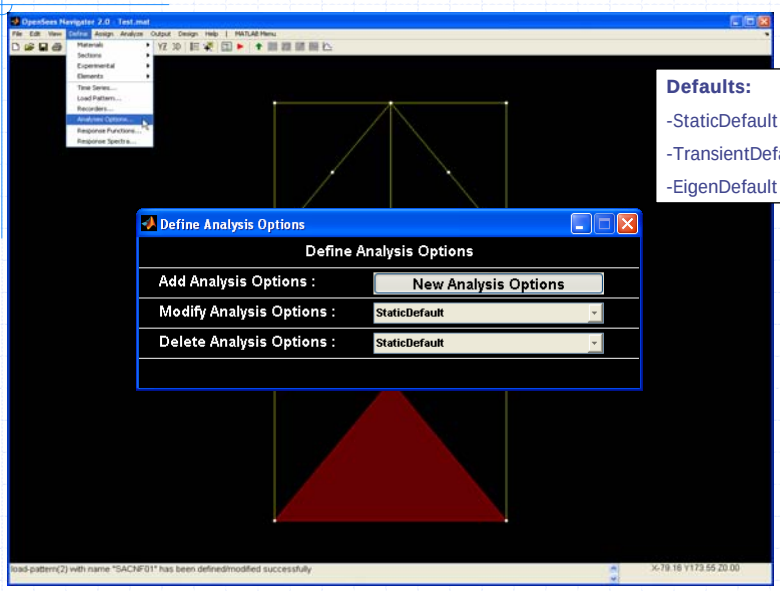
Define recorder: node recorder



Define recorder: BeamColumn recorder



Define analysis options



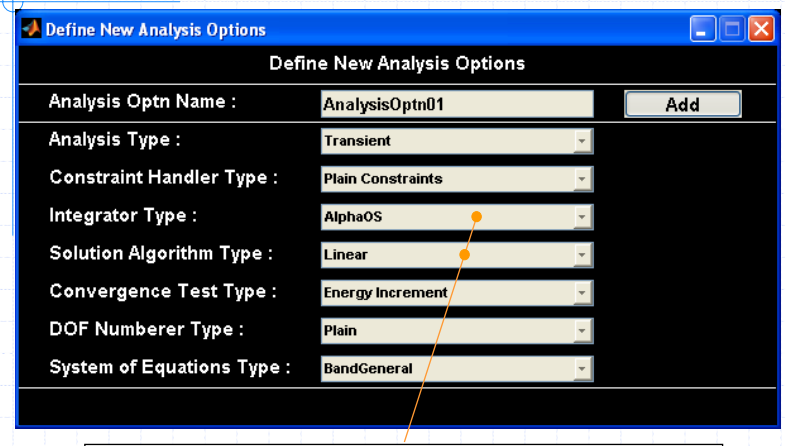
Defaults:

-StaticDefault

-TransientDefault

-EigenDefault

Define analysis options: new analysis



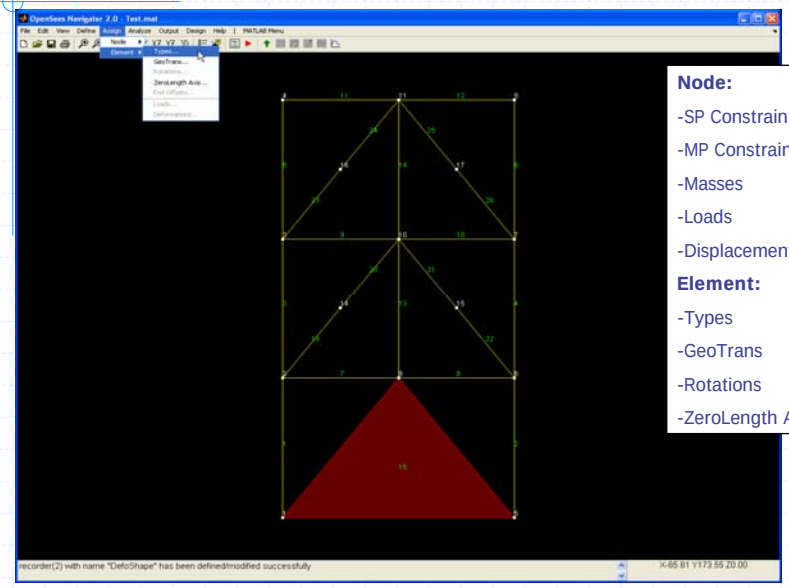
Integrator Type:

For example use AlphaOS Method for Hybrid Simulation

Solution Algorithm:

The AlphaOS Method requires a Linear solution algorithm

Assign menu



Node:

-SP Constraints

-MP Constraints

-Masses

-Loads

-Displacements

Element:

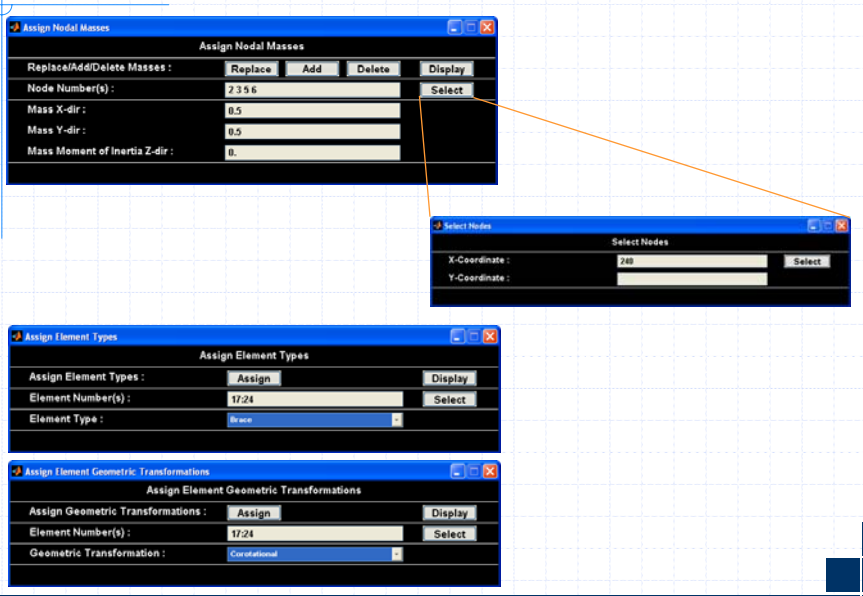
-Types

-GeoTrans

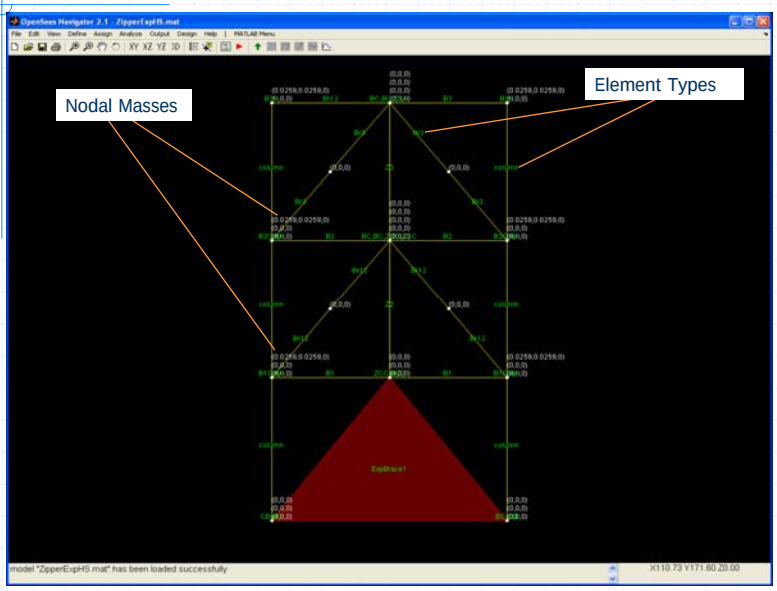
-Rotations

-ZeroLength Axis

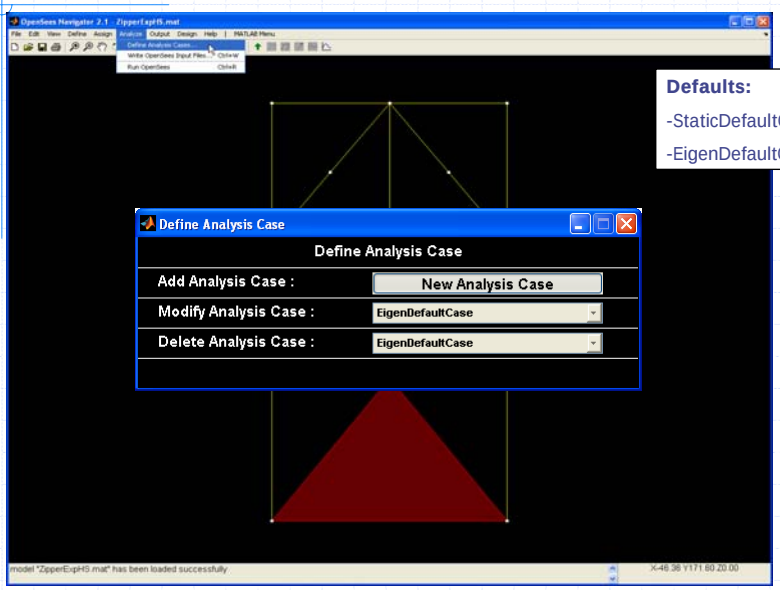
Assign menu



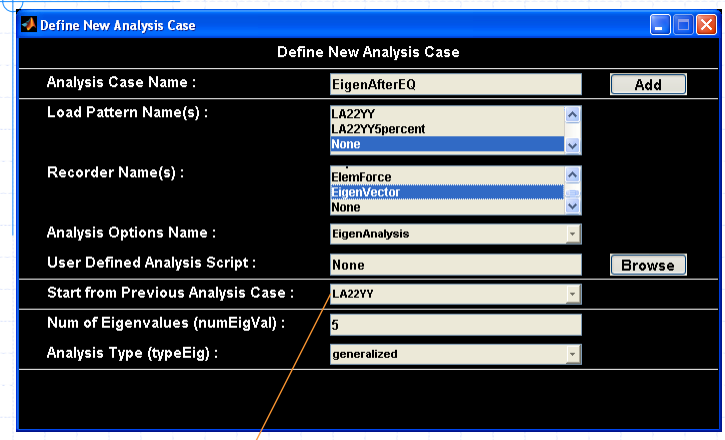
Display assigned properties



Define analysis case



Define analysis case: new analysis case

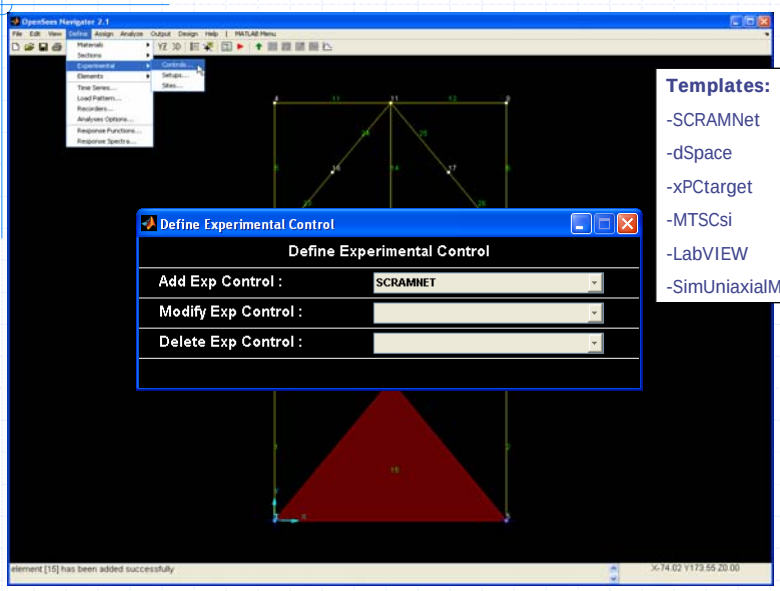


For Example:
Periods and Mode Shapes after Time-History Analysis

OpenFresco: hybrid simulation

- expControl
  - Interfaces to the different control and data acquisition.
- expSetup
  - Transforms between the experimental element degrees of freedom and the actuator degrees of freedom (linear vs. non-linear transformations).
- expSite
  - Stores data and provides communication methods for distributed testing.
- expElement
  - Represents the part of the structure that is physically tested and provides the interface between the FE-software and the experimental software framework

Define expControl:



Templates:

-SCRAMNet

-dSpace

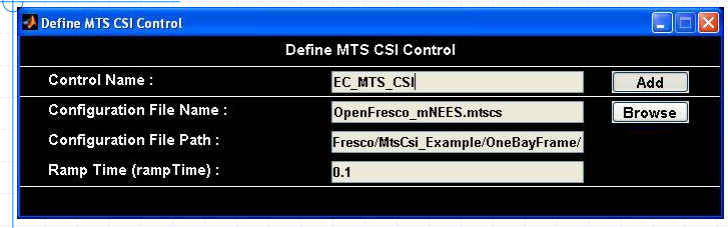
-xPCtarget

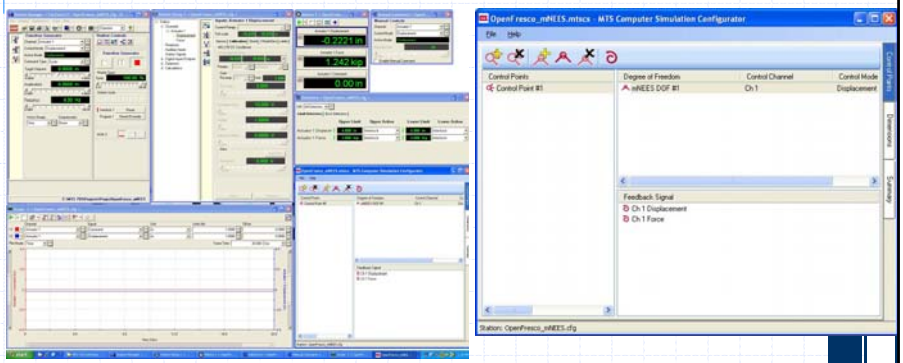
-MTSCsi

-LabVIEW

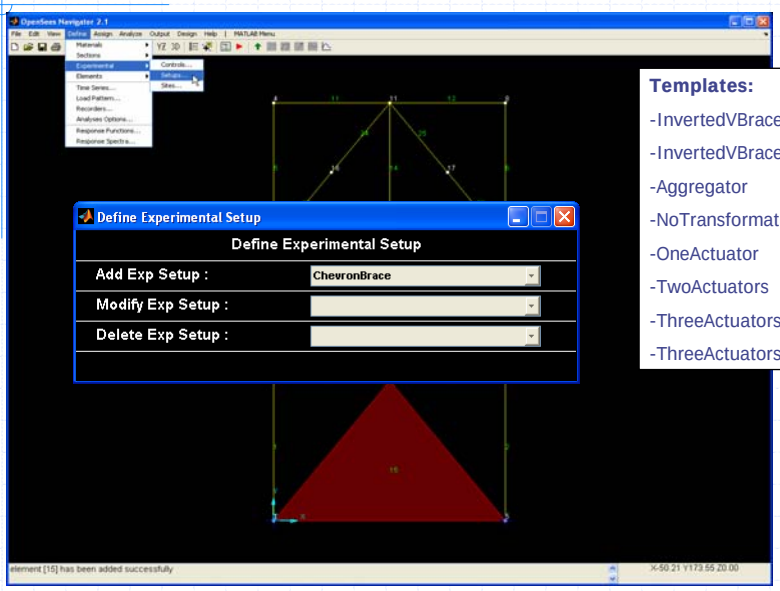
-SimUniaxialMaterials

Define expControl: MTSCsi





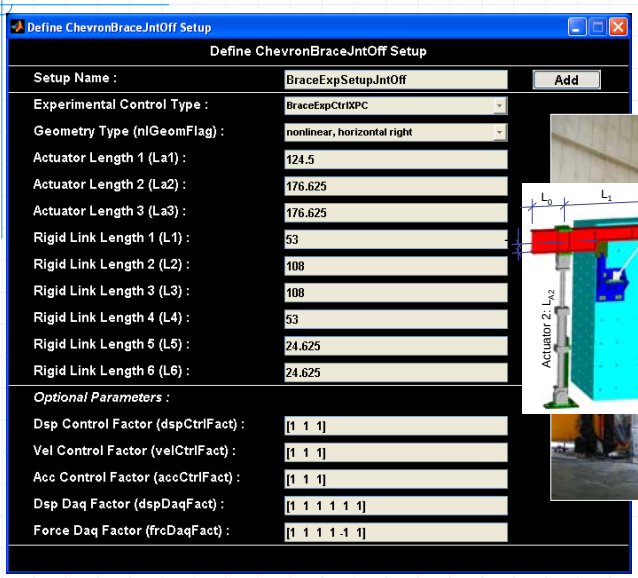
Define expSetup:

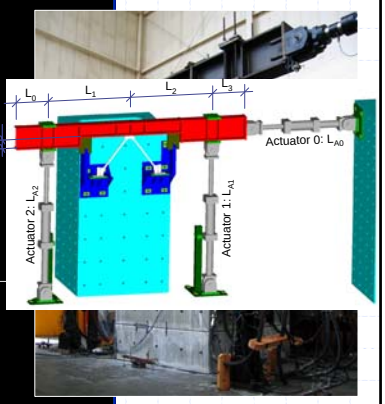


Templates:

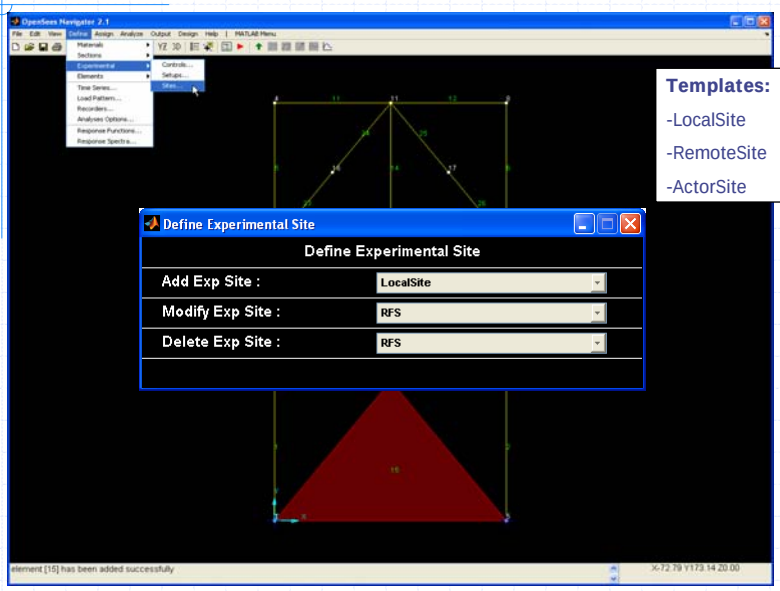
- -InvertedVBrace
- -InvertedVBraceJntOff
- -Aggregator
- -NoTransformation
- -OneActuator
- -TwoActuators
- -ThreeActuators
- -ThreeActuatorsJntOff

Define expSetup: InvertedVBrace





Define expSite:



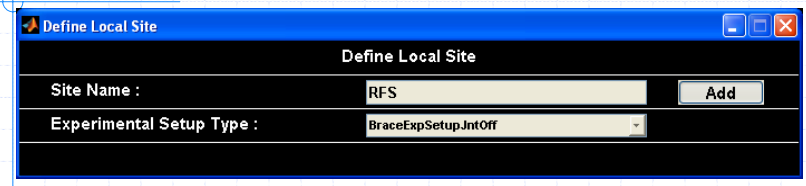
Templates:

-LocalSite

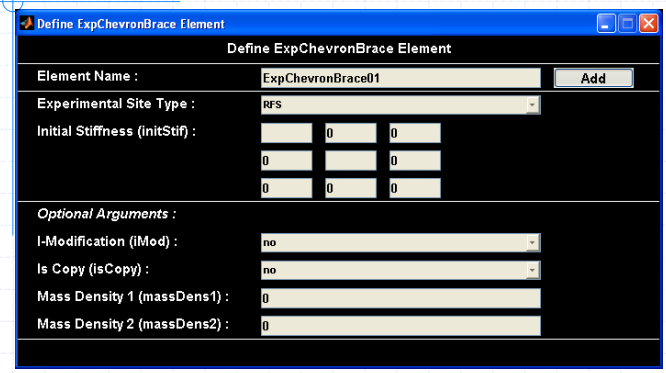
-RemoteSite

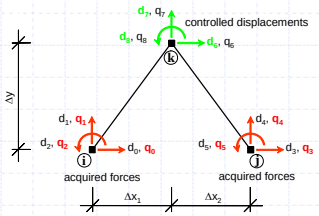
-ActorSite

Define expSite: LocalSite

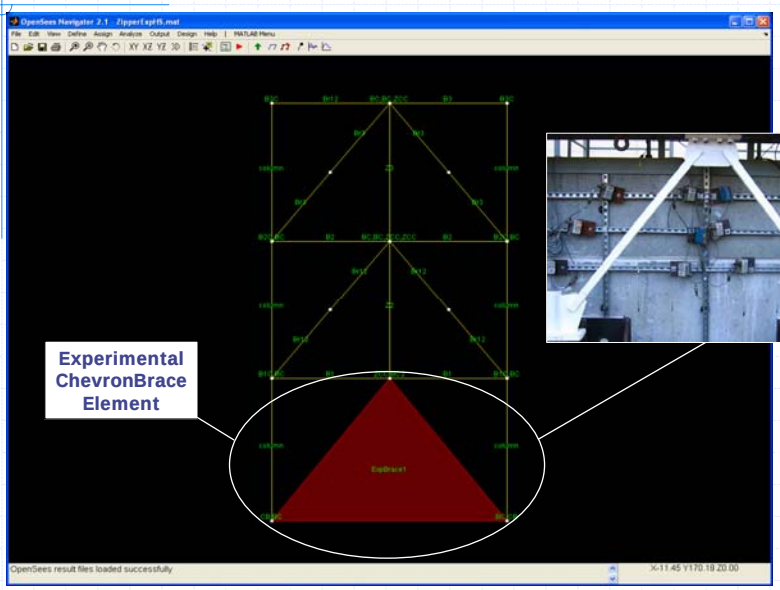


Define expElement: InvertedVBrace

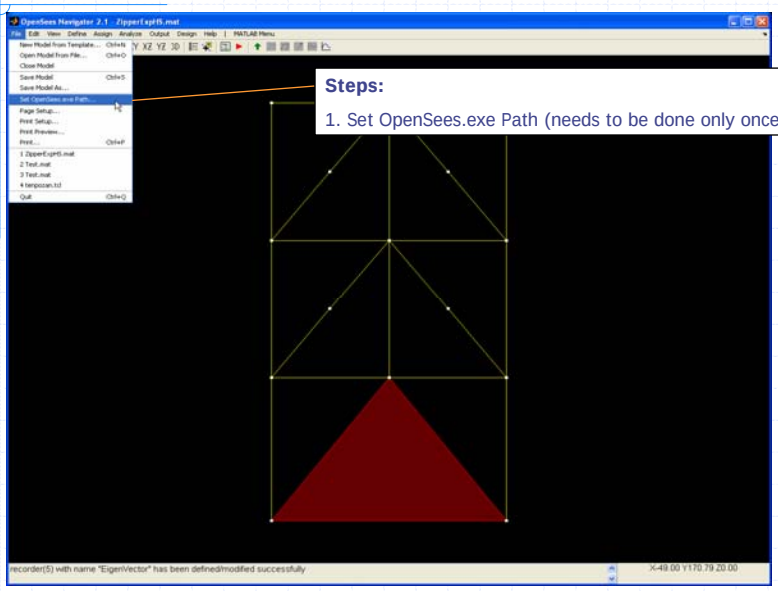




Define expElement: InvertedVBrace



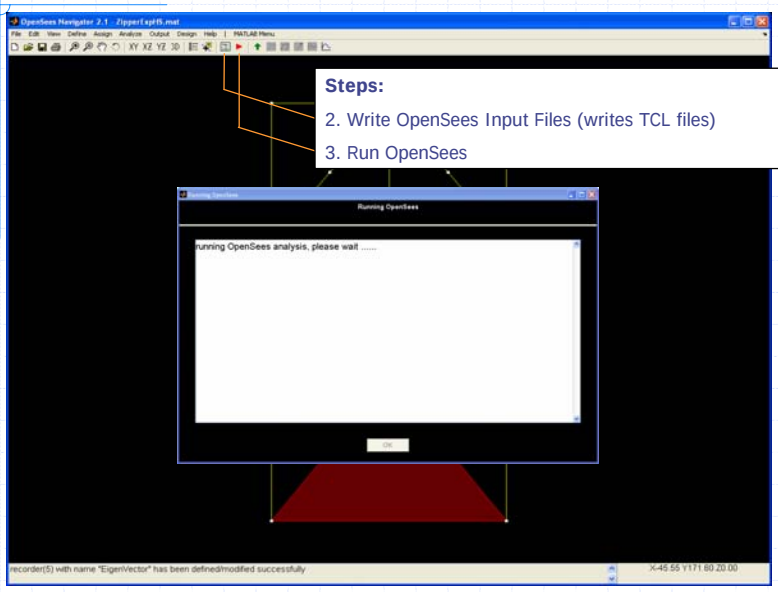
Run OpenSees: set OpenSees.exe path



Steps:

1. Set OpenSees.exe Path (needs to be done only once)

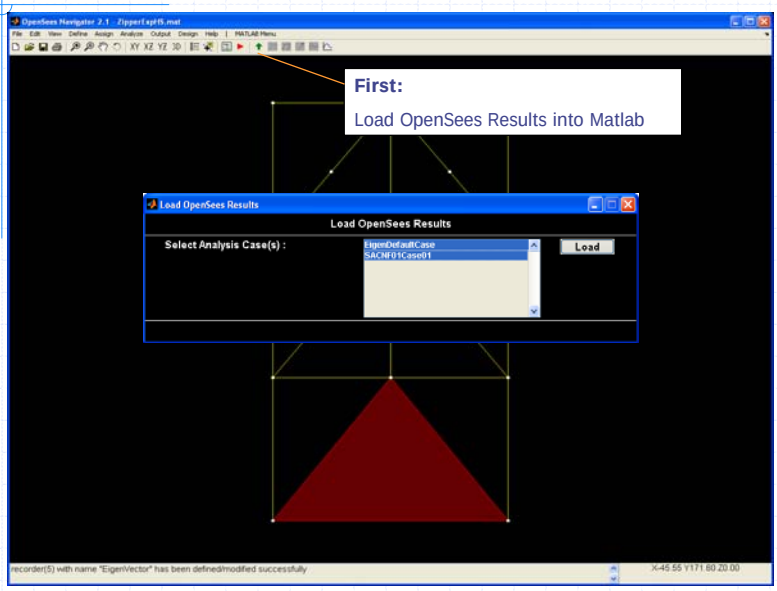
Run OpenSees: write TCL files



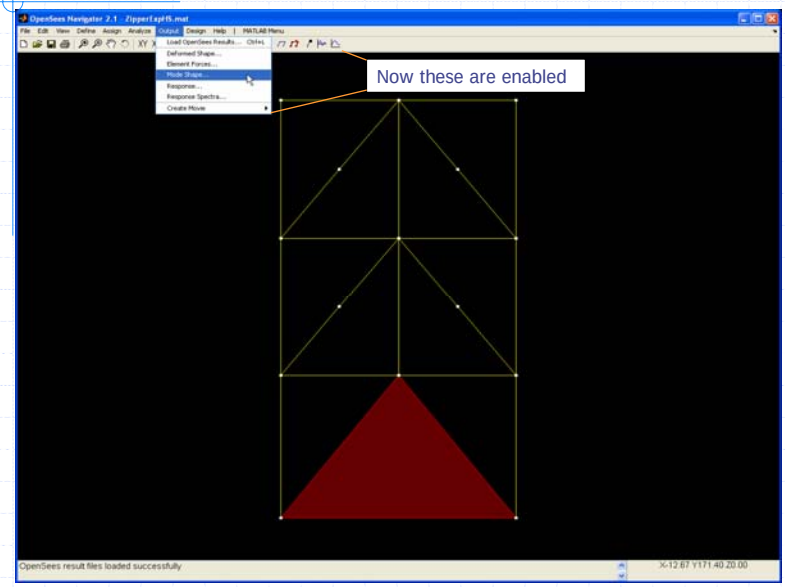
Steps:

2. Write OpenSees Input Files (writes TCL files)
3. Run OpenSees

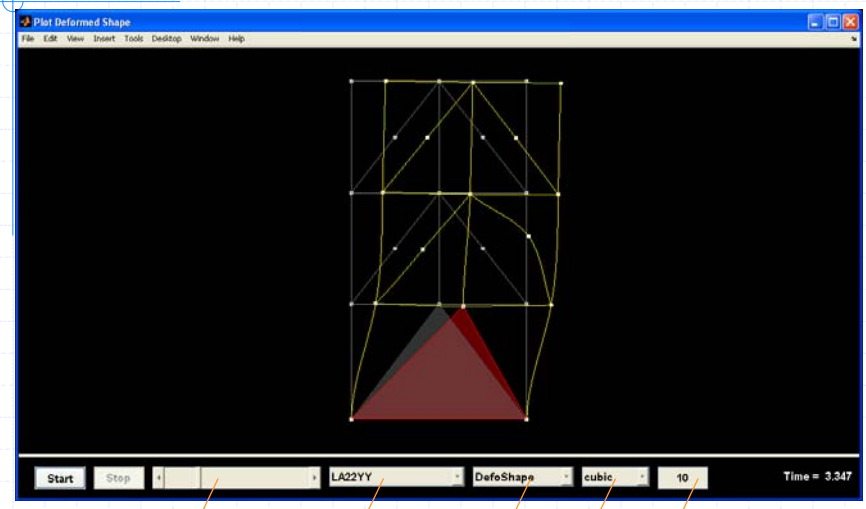
Post processing: load results



Post processing: output

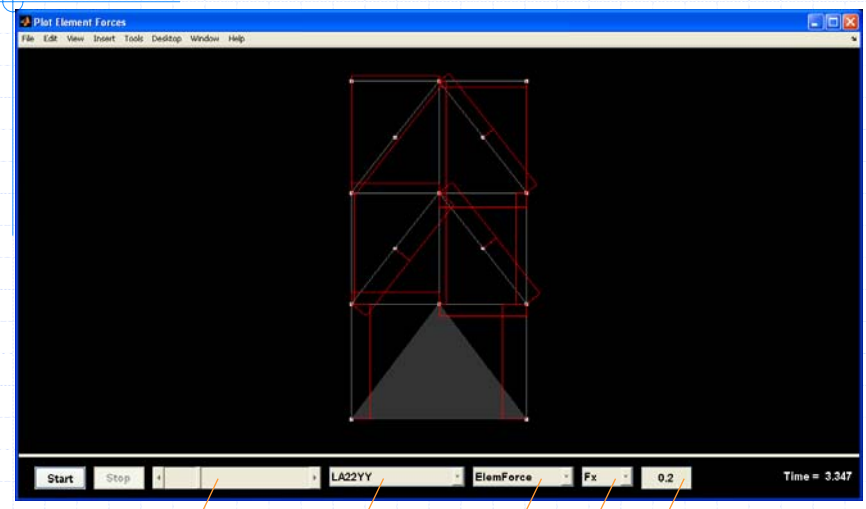


Post processing: plot deformed shape



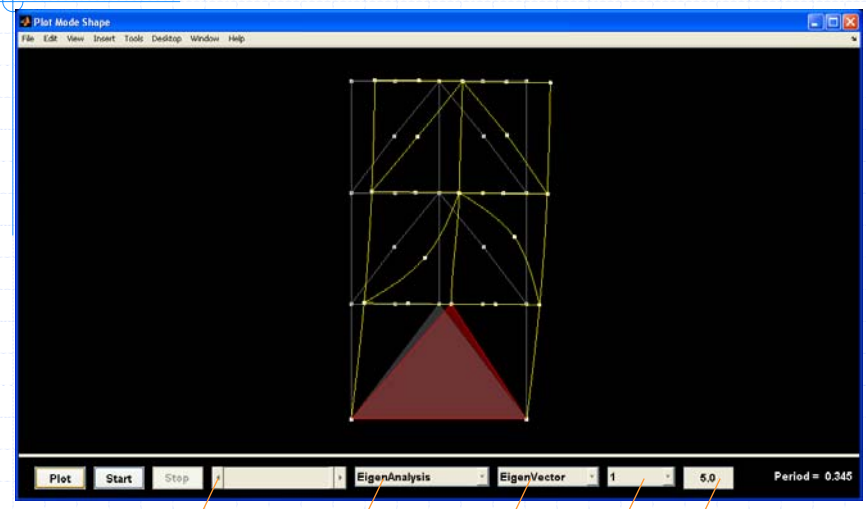
Time Step AnalysisCase Recorder Order Magnification

Post processing: plot element forces



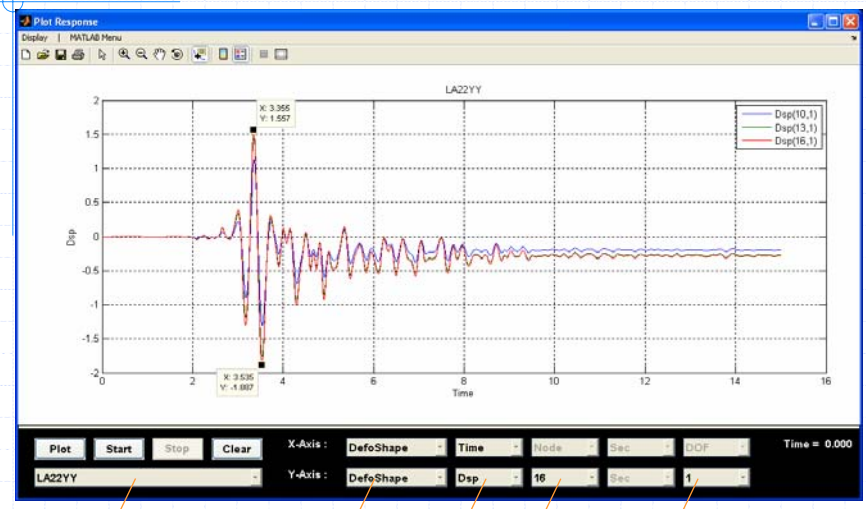
Time Step AnalysisCase Recorder Response Magnification

Post processing: plot mode shape



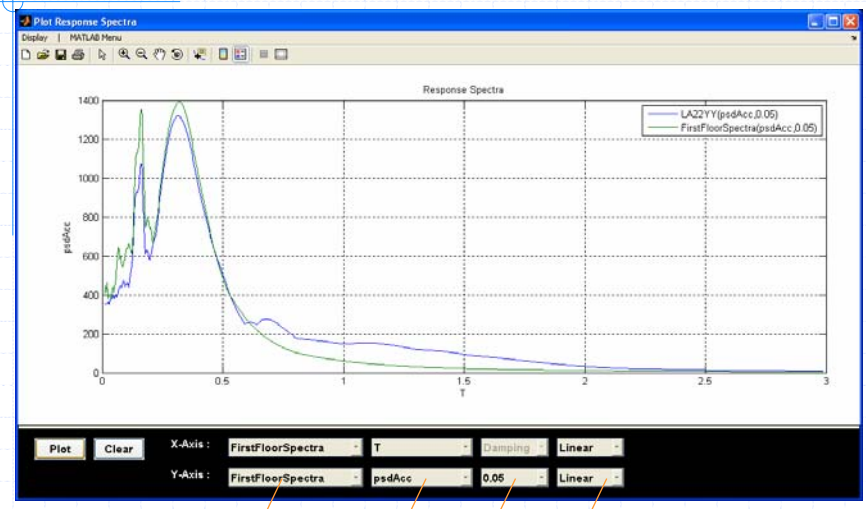
Animation Speed AnalysisCase Recorder Mode Magnification

Post processing: plot response histories



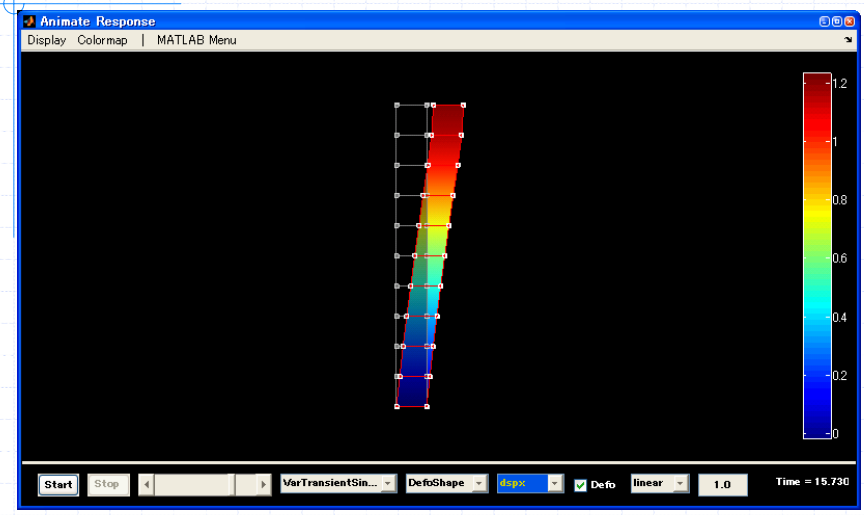
AnalysisCase Recorder Parameter Node/Element DOF

Post processing: plot response spectra

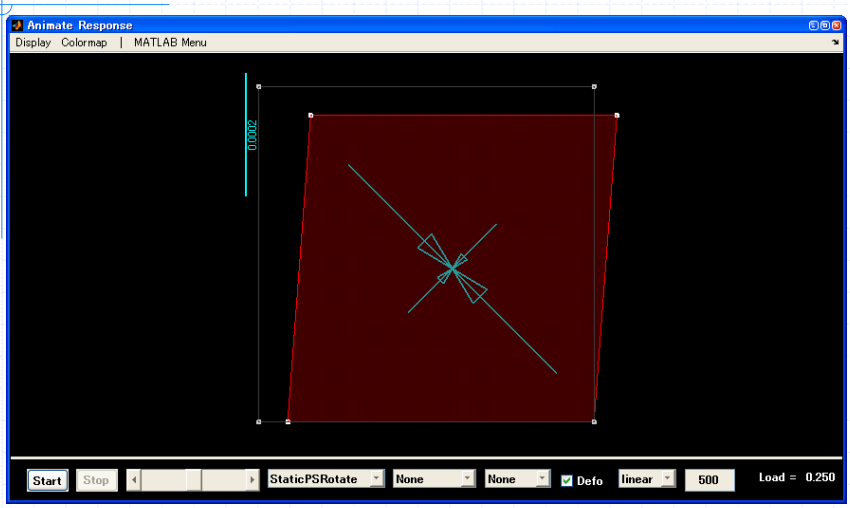


Spectra Name Response Damping Axis Scale

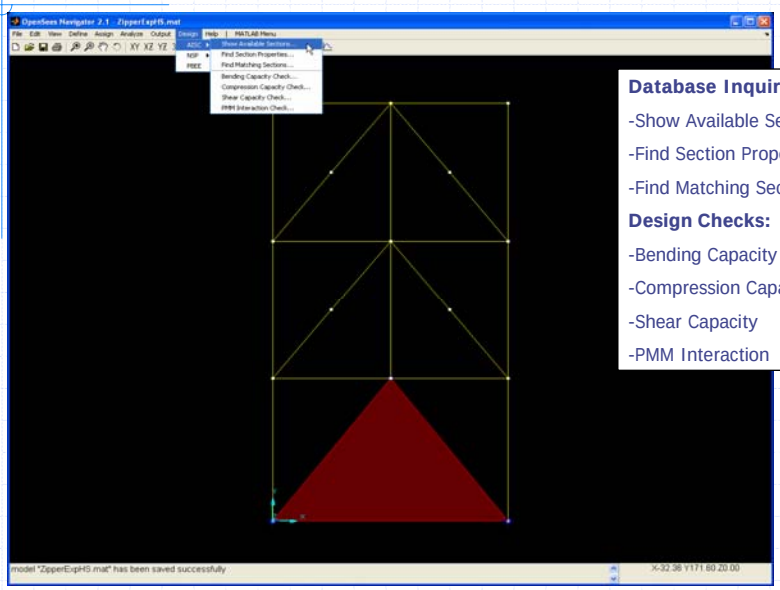
Post processing: animate response



Post processing: principal stress and strain



Design: AISC design toolbox



Database Inquiries:

-Show Available Sections

-Find Section Properties

-Find Matching Sections

Design Checks:

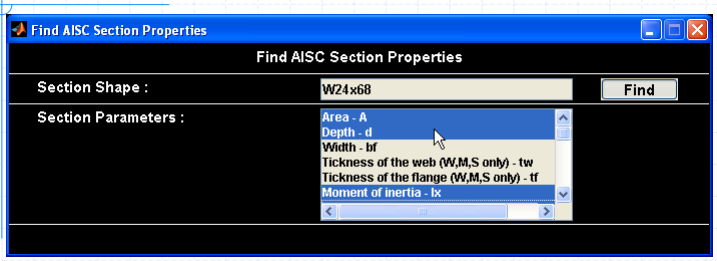
-Bending Capacity

-Compression Capacity

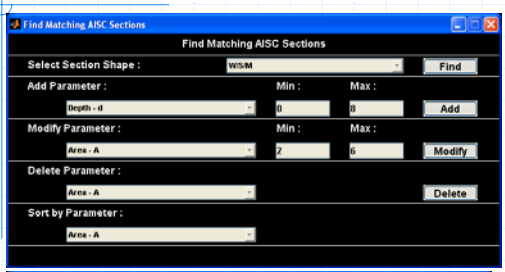
-Shear Capacity

-PMM Interaction

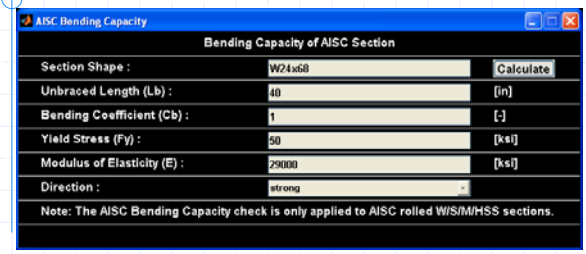
AISC design toolbox: find section properties

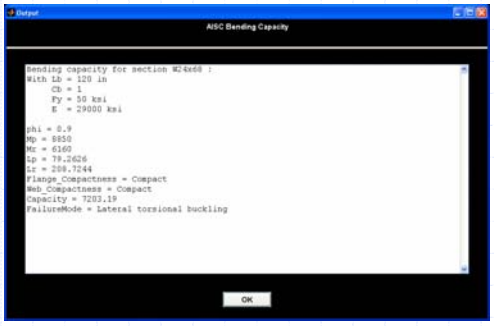


AISC design toolbox: find matching sections

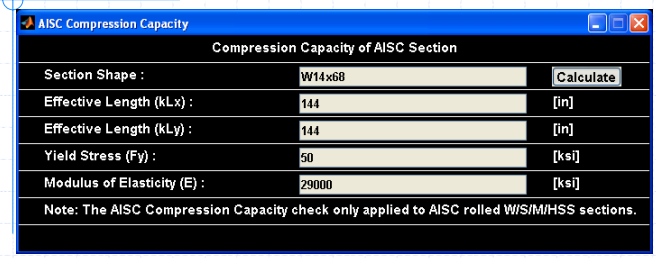


AISC design toolbox: bending capacity

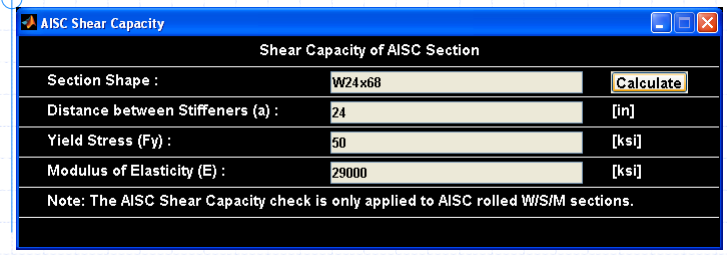


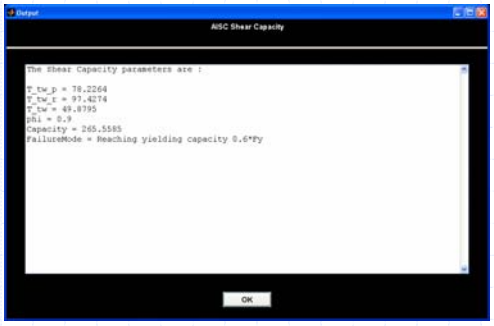


AISC design toolbox: compression capacity

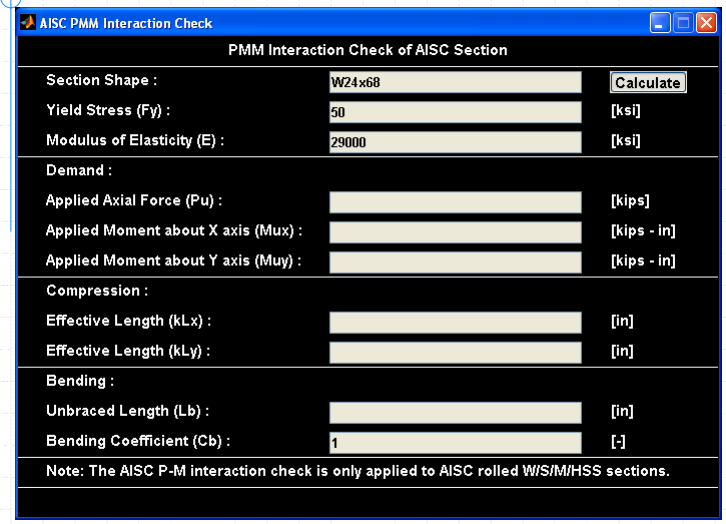


AISC design toolbox: shear capacity





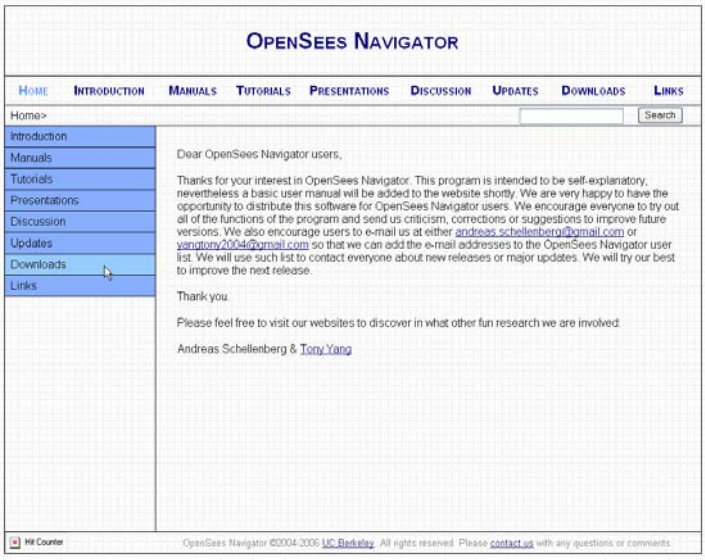
AISC design toolbox: PMM interaction



Summary

- OpenSees Navigator provides
  - Flexible and user friendly graphical user interface.
  - Great tool to visualize structural behavior.
  - Easy way to study material, section, element or system behavior.
- Hybrid simulation interface (OpenFresco).
- Many design toolboxes: NSP, PBEE, AISC design checks, AISC database, response spectra for linear and bilinear systems and signal filtering.
- Both MATLAB Pcode and self-executable versions are available.

Website: home



Website: download

Thank you!

OpenSees Navigator 2.4.2 is available at
http://peer.berkeley.edu/OpenSeesNavigator

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