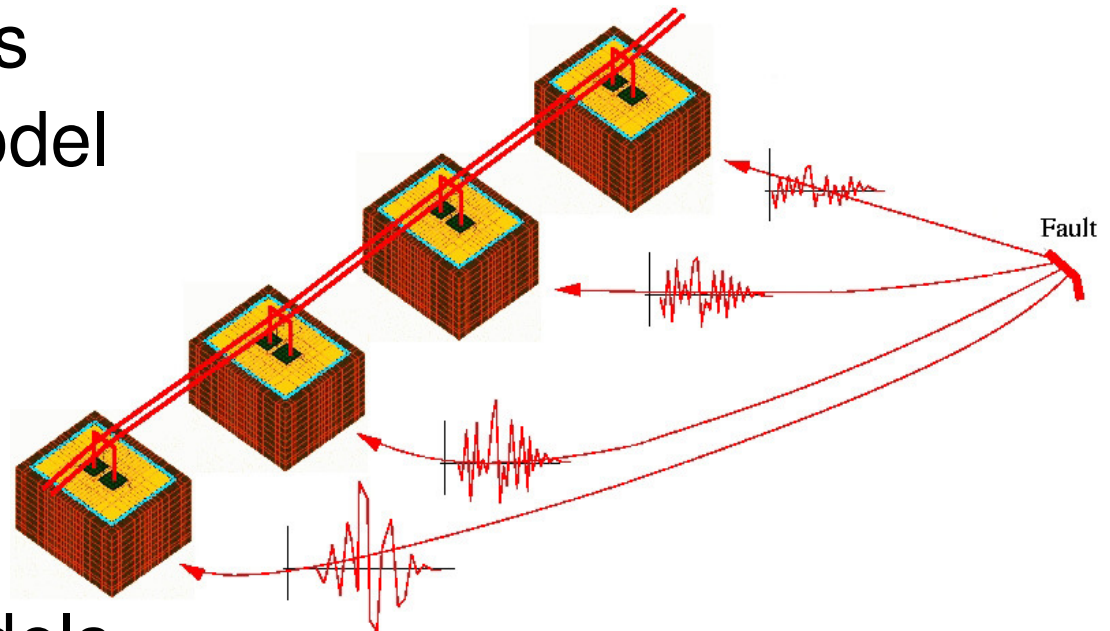
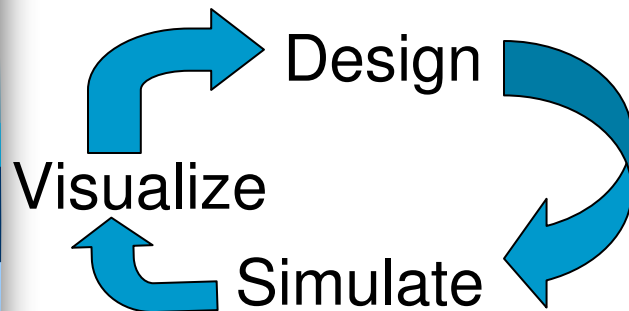


# OpenSees, VEES, and XML: Visualization and Model Archiving

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# What Does Geomechanics Need?

- **Run-time** visualization
- **New** techniques
- **Iterate** on a model



- **Archive** of models

8/29/2006 XML

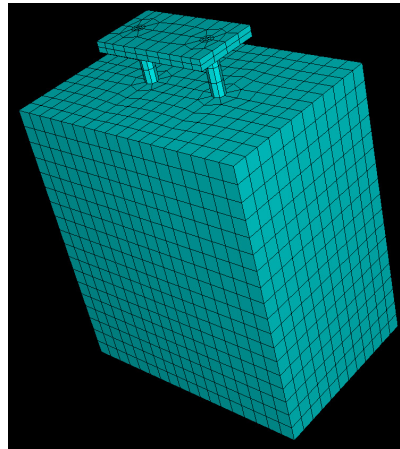
XML is like money- it works best if you pass it around

mesh

parse

XML

ODEn



Set Material Properties, Boundary Conditions

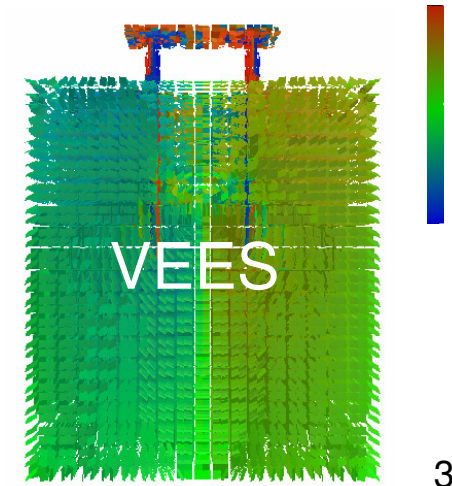
XML

XML

Simulate

XML

Visualize



# We're Not Starting from Zero:

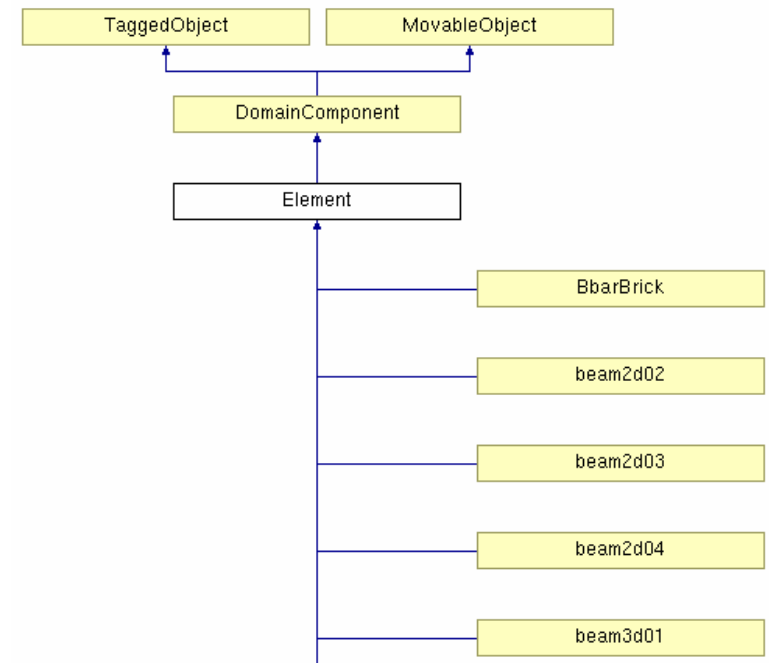
NEESforge

VEES

OpenSees

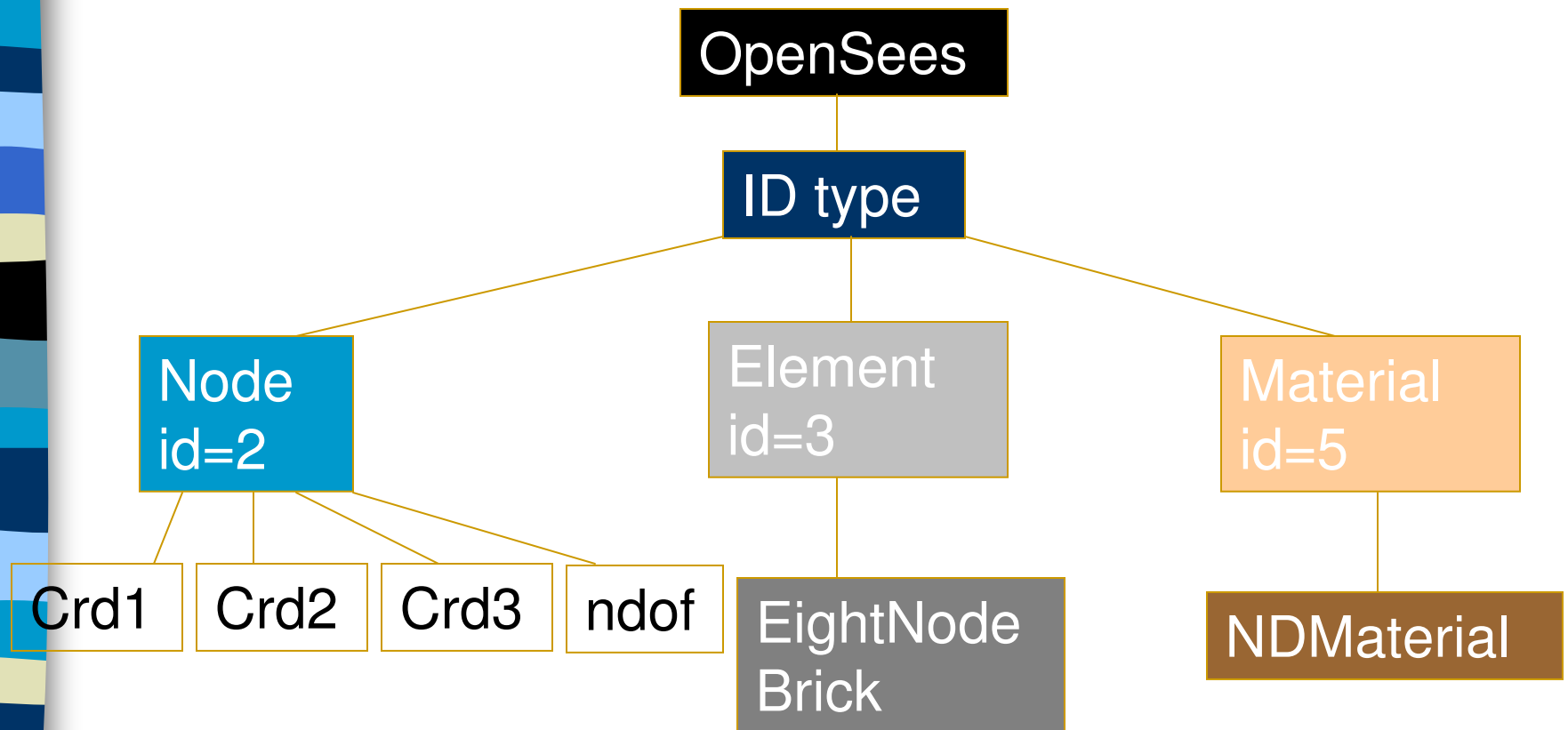
Open System for Earthquake Engineering Simulation  
Pacific Earthquake Engineering Research Center

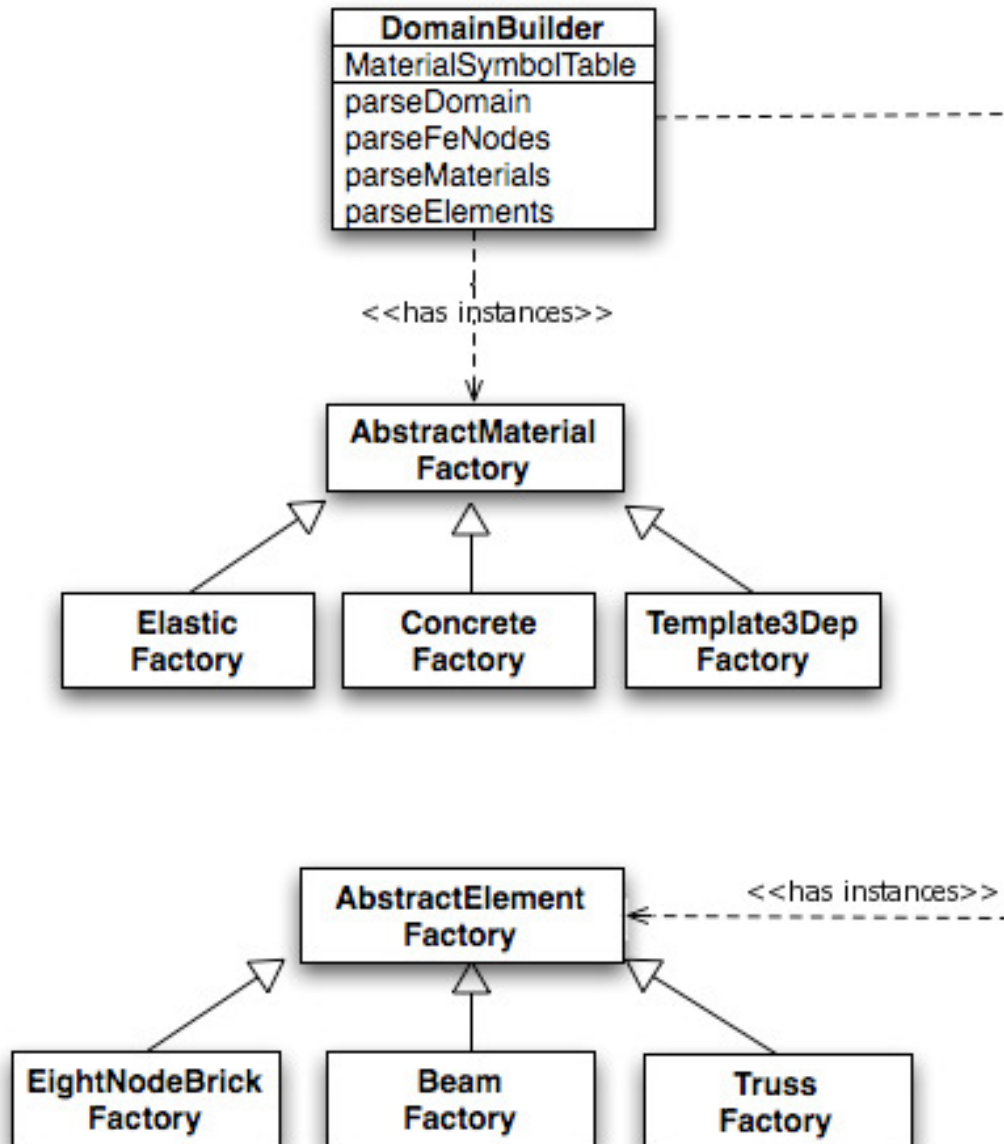
- Object-Oriented C++/Tcl FEM simulator
  - Data types organized in **natural hierarchy**
  - Runs on Linux and Windows
- All the data we might want to visualize:
  - Stress, strain, displacement, acceleration, elements, materials



8/29/2006

# XML Schema follows OpenSees Hierarchy





XML parsing code creates a running OpenSees simulation

How about the 687 other OpenSees classes???



# Code that writes code!!

- Java code (`XMLFactoryBuilder.java`)  
parses a C++ constructor and creates:
  - XML schema entry
  - C++ factory class
  - OpenSees `printXMLModel` function

That's all good, but  
what about the visualization?



8/29/2006



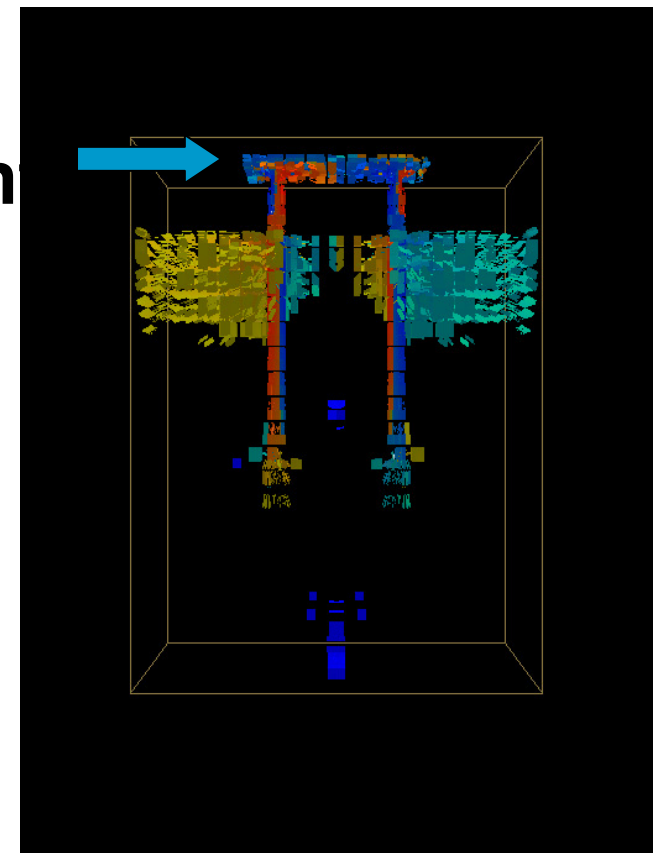
# Software Reuse aids visualization

NEESforge

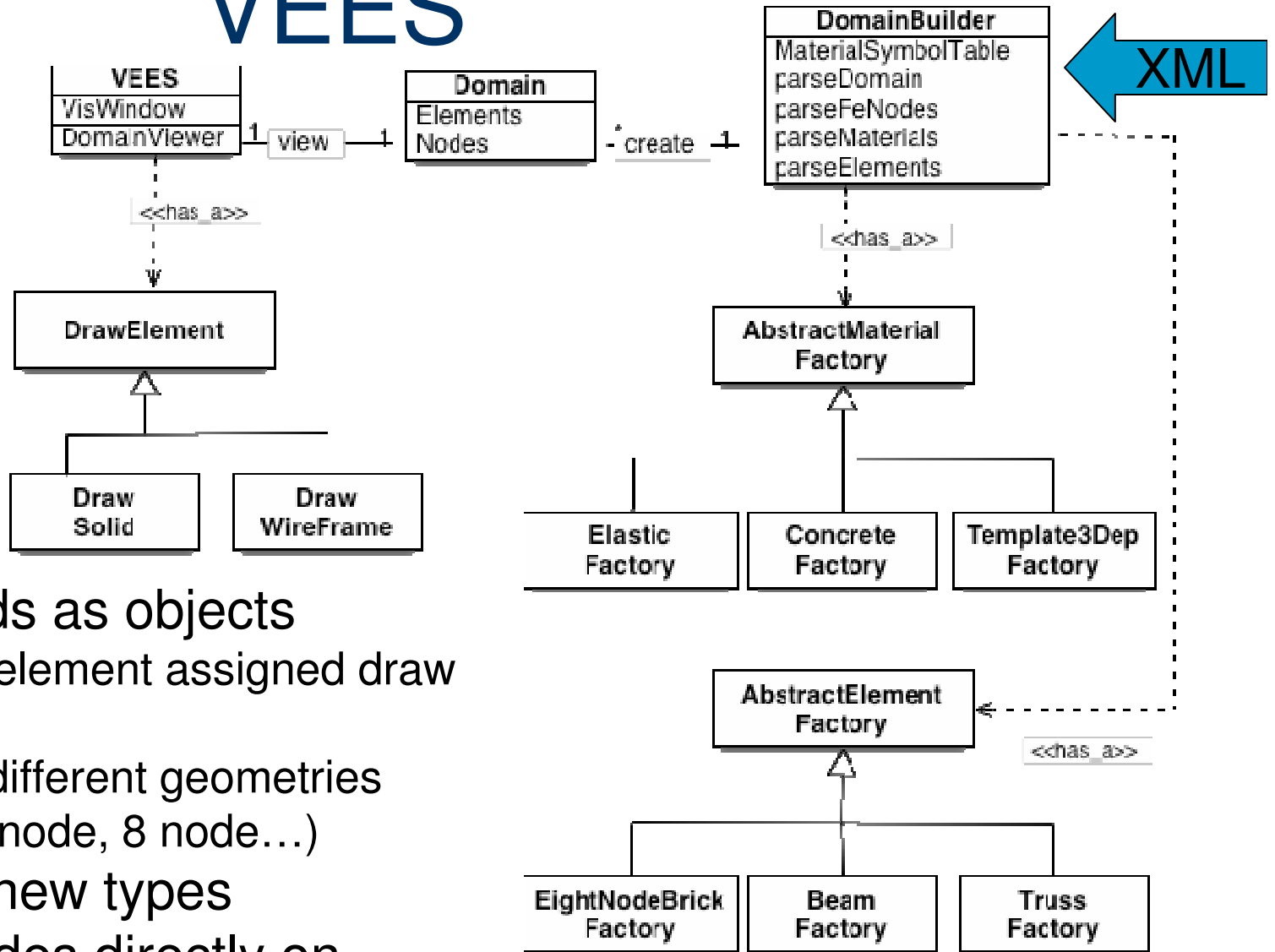
VEES

- OpenSees **full** of helpful data structures:
  - Graph, elements, nodes, Iterator!
- Scalar, vector, tensor data **right at hand**
- Mix & Match: individual elements visualized using different techniques
  - Stress colored by volumetric or distortional change
  - Probabilistic damage measure glyphs
  - Thresholding to find interesting data, assess accuracy of simulation
  - Displaced mesh

8/29/2006



# VEES



## Draw methods as objects

Each finite element assigned draw object

Just a few different geometries  
(2 node, 4 node, 8 node...)

Easy to add new types

VEES also rides directly on

OpenSees Tcl interpreter

# Info Viz approach

1. Overview (entire domain)
2. Zoom and Filter
3. Details on Demand

# Filter by color/value and invert

The screenshot displays the VEES software interface. The main window shows a 3D model of a structure, likely a bridge or a similar engineering component, rendered in a color gradient. The model is shown in two views: a perspective view on the left and a top-down view on the right. The left view shows the model with a color gradient from dark blue to green. The right view shows the model with a color gradient from dark green to light green. A red star-shaped icon is visible in the bottom right corner of both views.

The interface includes a terminal window at the top left displaying the following output:

```
alisa@bedlam:~/bin
File Edit View Terminal Tabs Help
CTestNormDispIncr::test() - iteration: 1 current Norm: 0.000264231 (max
: 2.54e-06 residual Norm: 3.36845e-07
CTestNormDispIncr::test() -
: 2.54e-06 residual Norm: 4.99994e-07
CTestNormDispIncr::test() -
: 2.54e-06 residual Norm: 5.12035e-07
CTestNormDispIncr::test() -
: 2.54e-06 residual Norm: 4.55382e-07
CTestNormDispIncr::test() -
: 2.54e-06 residual Norm: 3.98882e-07
CTestNormDispIncr::test() -
: 2.54e-06 residual Norm: 3.5591e-07
```

The 'Rendering Controls' dialog box is open, showing the following settings:

- Draw Function: Undisplaced Solid
- Color Function: Element Number
- Max Color: 0.261236
- Min Color: 0.0
- Invert Color Range
- Hide Element Type: -
- EightNodeBrick
- ElasticBeam3d

# Filter by element type - list automatically generated

The image shows a terminal window and a 3D visualization window. The terminal window displays the output of a simulation, including the following text:

```
alisa@bedlam:~/bin
File Edit View Terminal Tabs Help
: 1e-05 residual Norm: 8.19916e+06)
  CTestNormDispIncr::test() iteration: 4 current Norm: 9.99904e-06 (max
: 1e-05 residual Norm: 8.19909e+06)
Analysis step 36 finished!
: 1e-
: 1e-
: 1e-
: 1e-
5 res
: 1e-
Analysis step 37 finished!
  CTestNormDispIncr::test()
: 1e-05 residual Norm: 8.19957e+06)
  CTestNormDispIncr::test()
: 1e-05 residual Norm: 8.1995e+06)
  CTestNormDispIncr::test()
```

The 3D visualization window shows a wireframe model of a structure, likely a bridge or a similar engineering component, with a red region indicating a specific element type. A "Rendering Controls" dialog box is open, showing the following settings:

- Draw Function: Displaced Mesh
- Color Function: Element Number
- Max Color: 1.0
- Min Color: 0.0
- Invert Color Range
- Hide Element Type: --
- EightNodeBrick
- ElasticBeam3d

The 3D viewer shows a wireframe model of a structure, likely a bridge or a similar engineering component, with a red region indicating a specific element type. The right window shows a 2D projection of the structure, highlighting the red region.

# Where we are today



## XML

- Basic framework in place
- Lots of non-research manpower needed to complete XML but automation should help a lot

## VEES

- Basic framework in place
- GUI coming along
- details-on-demand will be part of thesis research



# Thanks!



Working pre-alpha release can be found at  
NEESforge: VEES project

Help us help you! The wish list is long and  
we need to prioritize.

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