



Simulation and Information Technologies

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PEER Summative Meeting – June 13, 2007

Simulation Practice and Research Prior to PEER

◆ Simulation in practice:

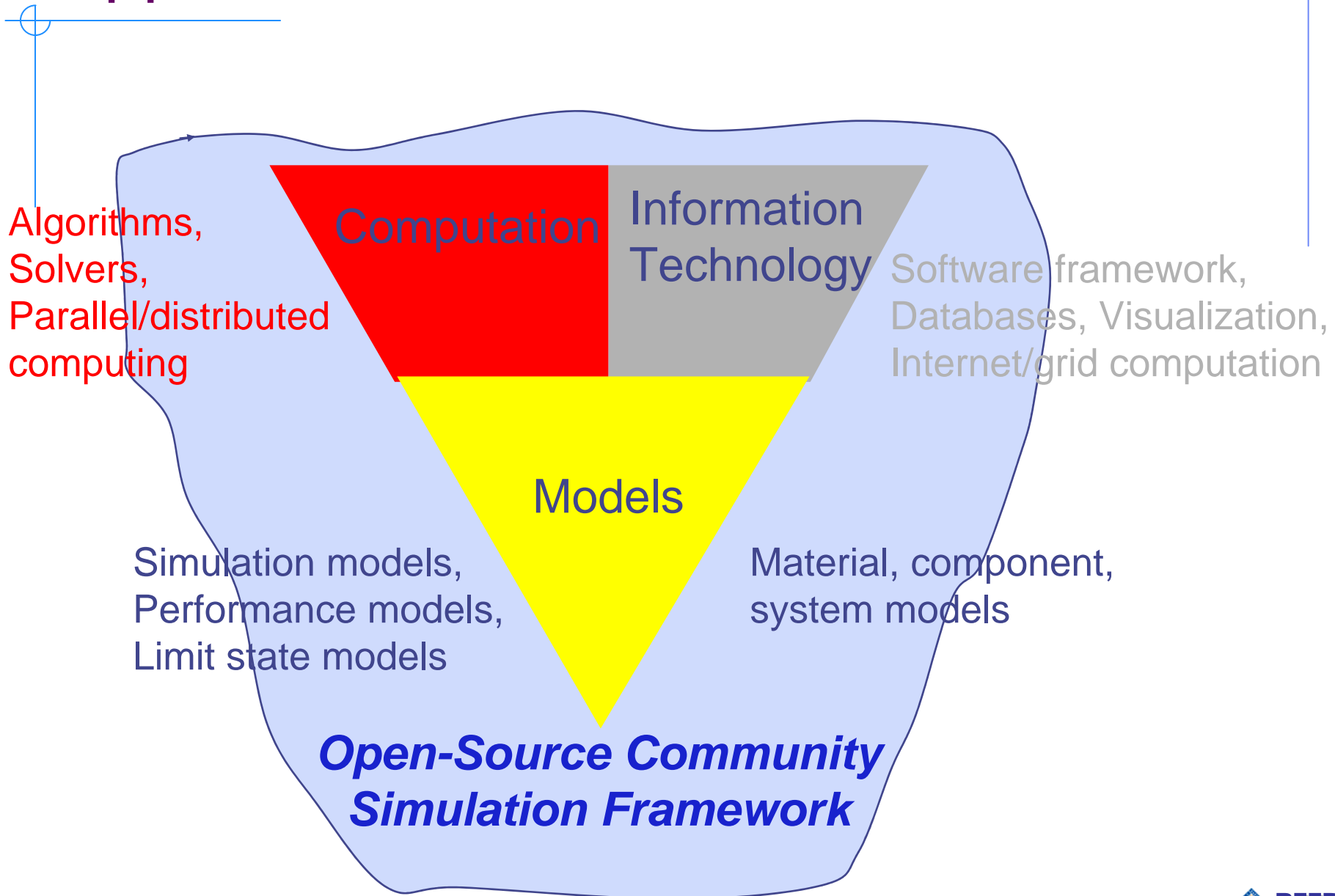
- Little use of pushover analysis, almost no use of nonlinear dynamic analysis
- Models based on simple hinge representation
- Very little consideration of soil-structure interaction

◆ Simulation in research:

- Embedding of computational procedures in codes makes it difficult to use new models and Information Technology
- “Closed-source” was the norm creating islands of software
- Poor integration between structural and geotechnical simulation
- Very little incorporation of probabilistic methods in simulation

◆ Combination of two impeded progress and both were inadequate for PBEE

Approach for Simulation in PEER



OpenSees

Open System for Earthquake Engineering Simulation Pacific Earthquake Engineering Research Center

- ◆ OpenSees has been under development by PEER since before 1997
- ◆ Large group of developers and users
- ◆ Open-source and license for non-commercial use
- ◆ The only widely used community-based simulation software in CEE
- ◆ NEES has adopted OpenSees for the NEESit simulation component

<http://opensees.berkeley.edu>

The screenshot shows the OpenSees website homepage. At the top, there is a navigation bar with links for HOME, USER, DEVELOPER, PROJECTS, SUPPORT, and SITE MAP. Below this, there are sub-links for About, News, Calendar, and Registration. The main content area is divided into three columns. The left column contains a 'HOME' link, a 'MESSAGE BOARD' section, and links for 'USER DOC', 'DOWNLOAD', 'SOURCE CODE', and 'BUG REPORT'. There is also a search box and a note about quicklinks. The middle column features a 'Welcome' message, a paragraph about the goal of OpenSees development, a paragraph about continual development and the importance of registering, and a paragraph about sponsorship by the Pacific Earthquake Engineering Research Center through the National Science Foundation. The right column has a 'Register' section with information about new releases and a 'News' section with a list of recent updates, including 'New Examples Manual released', 'Version 1.7.3 Released', 'Workshop Presentation Material Node Available', 'Version 1.7.2 Released', 'Copyright Revised', 'Version 1.7.1 Released', and 'Server Running Again'. At the bottom right, there is a 'Calendar' section with entries for 'OpenSees Symposium' and 'OpenSees Developer'.

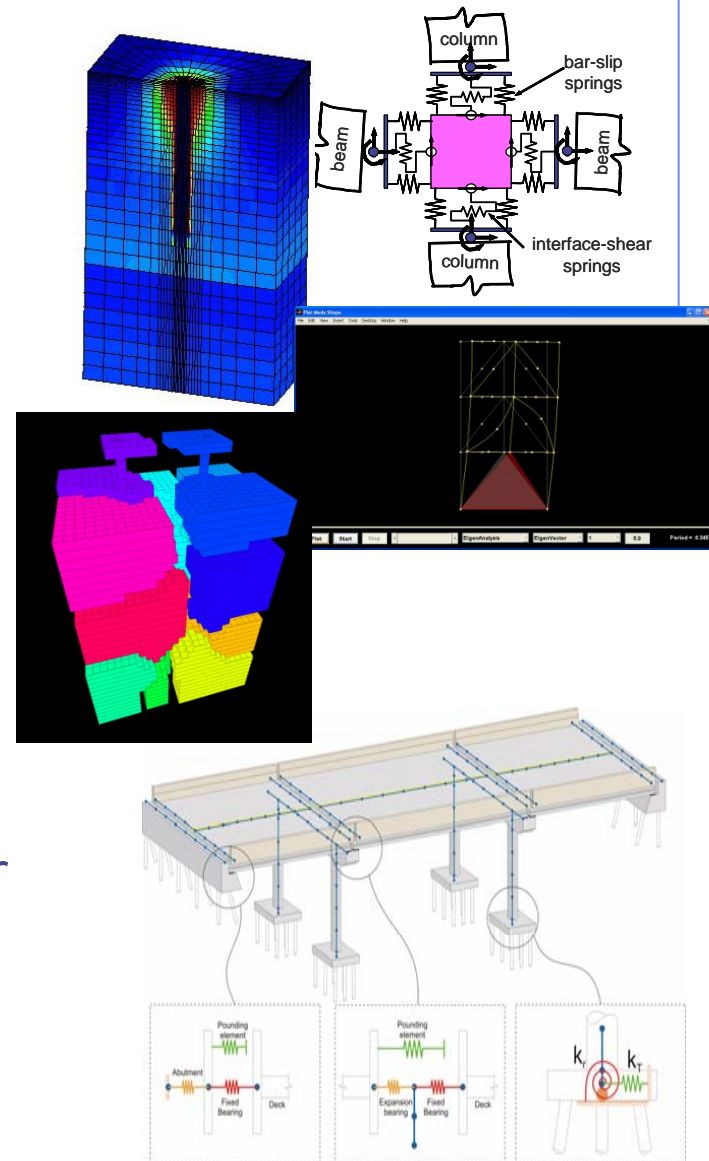
OpenSees Approach to Simulation

◆ Basic approach:

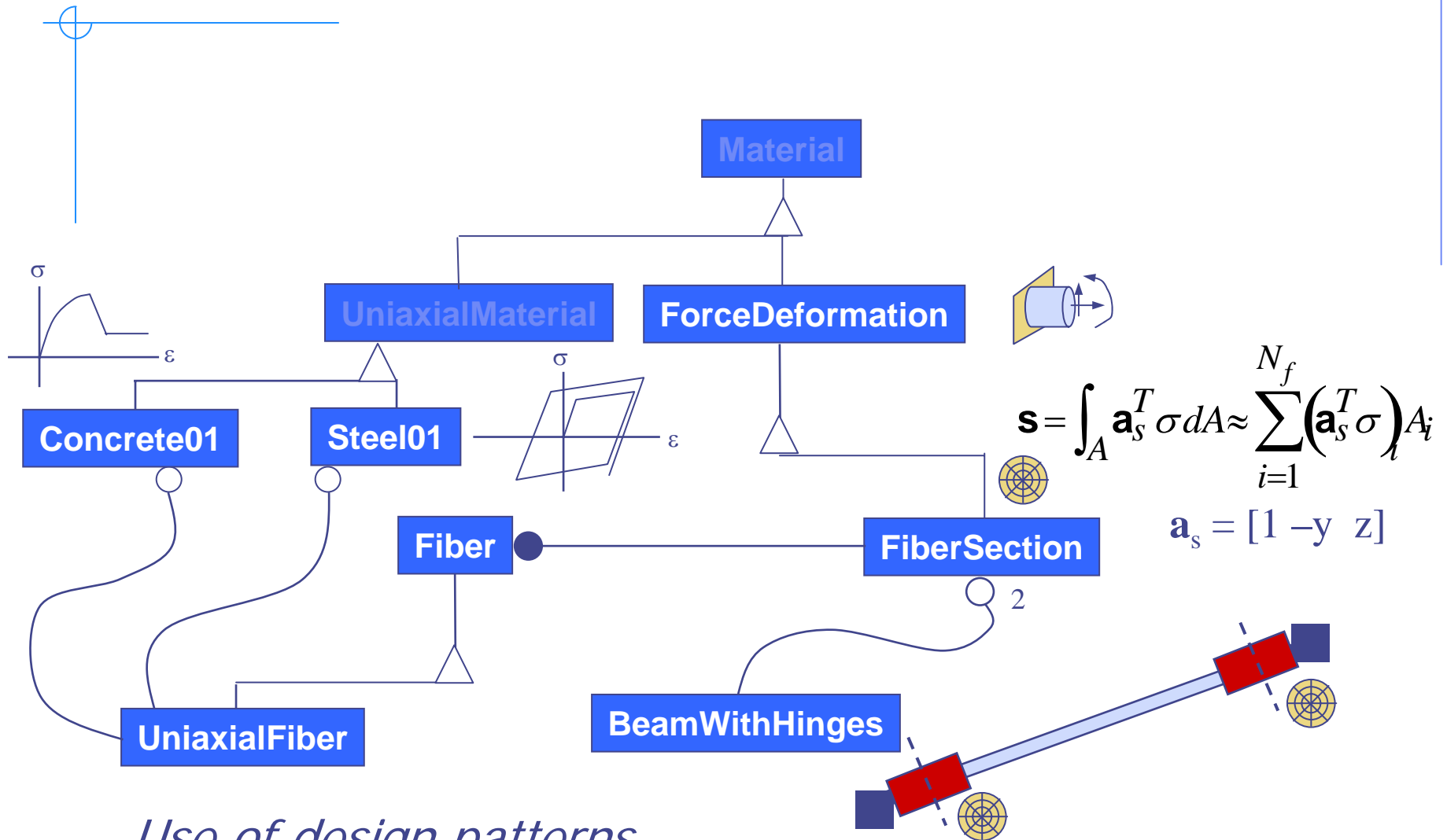
- Modular software design for implementing and integrating modeling, numerical methods, and IT for scalable, robust simulation
- Open-source software for building a community of users and developers
- Focus on capabilities needed for PBEE

◆ Most users: a “code” for nonlinear analysis

◆ Generally: a software framework for developing simulation applications



Form Follows Mechanics



Use of design patterns.

Framework Design/Source for Developers

Source Code Viewing/Updating

Class Specification Application Program Interface

OpenSees PEER NEES NEESit

HOME USER DEVELOPER PROJECTS SUPPORT SITE MAP

Dev Doc API Source Download Builds Bug Reports Message Board

Click on a directory to enter that directory. Click on a file to display its revision history and to get a chance to display diffs between revisions.

Current directory: [\[local\]](#) / [OpenSees](#) / [SRC](#) / [element](#) / [20nbrick](#)

File	Rev.	Age	API	Last log entry
Parent Directory				
Makefile	1.2	2 years		z.yang - adding 20 node brick element that is not tensor based
TclTwentyNodeBrickCommand.cpp	1.5	4 years		small changes, mostly on top... Boris Jeremic (@ucdavis.edu)
TclTwenty_Node_BrickCommand.cpp	1.2	10 months		fmk - changes for vc 2005 compiler; problems with understading some end-of-line ...
TwentyNodeBrick.cpp	1.21	3 months	api	removing unused Information argument from setResponse
TwentyNodeBrick.h	1.14	3 months	api	removing unused Information argument from setResponse
Twenty_Node_Brick.cpp	1.5	3 months		removing unused Information argument from setResponse
Twenty_Node_Brick.h	1.4	3 months		removing unused Information argument from setResponse

Show only files with tag: Module path or alias:

FreeBSD-CVSweb <freebsd-cvsweb@FreeBSD.org>
 openses-support @ berkeley.edu ©2006, UC Regents Supported by the National Science Foundation

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HOME USER DEVELOPER PROJECTS SUPPORT SITE MAP

Dev Doc API Source Download Builds Bug Reports Message Board

Main Page Namespaces Classes Files Directories

Alphabetical List Class List Class Hierarchy Class Members

TwentyNodeBrick Class Reference

```
#include <TwentyNodeBrick.h>
```

Inheritance diagram for TwentyNodeBrick:

```

graph TD
    TaggedObject --> DomainComponent
    MovableObject --> DomainComponent
    DomainComponent --> Element
    Element --> TwentyNodeBrick
  
```

[List of all members.](#)

Public Member Functions

TwentyNodeBrick (int element_number, int node_num_1, int node_num_2, int node_num_3, int node_num_4, int node_num_5, int node_num_6, int node_num_7, int node_num_8, int node_num_9, int node_num_10, int node_num_11, int node_num_12, int node_num_13, int node_num_14, int node_num_15, int node_num_16, int node_num_17, int node_num_18, int node_num_19, int node_num_20, **NDMaterial** *Globalmodel, double b1, double b2, double b3, double r, double p)

TwentyNodeBrick ()

~TwentyNodeBrick ()

const char * **getClassType** (void) const

OpenSees User Support Services

OpenSees Executable Distribution

Current version is: 1.7.3

Your last download was on Tue Oct 10 16:39:38 2006, and the version was 1.7.3.

OpenSees executables for Windows 98/2000/NT/XP are available for download. The current OpenSees has been tested and is generally stable. However, users may encounter problems for the first time. For that reason we strongly encourage you to participate in [message boards](#) hosted by OpenSees. And **please** report any **bugs** you find! That, of course, is the reason we make these binaries available.

OpenSees uses [Tcl/Tk](#), a general purpose scripting language that we have extended with [OpenSees](#). It is necessary to download a DLL for the Tcl/Tk interpreter.

The first step is to download the two files below. The first file is a zip file containing the OpenSees source code. The second file is a self-installing executable for Tcl/Tk.

Open System for Earthquake Engineering Simulation

Open System for Earthquake Engineering Simulation

Contents

3D Structural Modeling & Analysis Examples

Example 7: 3D Frame, 3-story, 3-bayX, 3-bayZ, Reinforced-Concrete Section & Steel W-Section

Example 8: generic 3D Frame, 4-story, 4-bayX, 4-bayZ, Reinforced-Concrete Section & Steel W-Section

Section Modeling And Analysis

OpenSees Community Forums

The time now is Fri May 18, 2007 9:47 am

The OpenSees Community Forum Index

Forum	Topics	Posts	Last Post
OpenSees.exe Users Forum for OpenSees users to post questions, comments, etc. on the use of the OpenSees Interpreter, OpenSees.exe Moderator: sliva	1052	3700	Fri May 18, 2007 7:46 am sliva →D
Documentation For posts concerning the documentation, errors, omissions, general comments, etc. Moderator: sliva	79	227	Thu May 17, 2007 7:47 am sliva →D
Framework For developers writing C++, Fortran, Java, code who have questions or comments to make. Moderator: sliva	155	511	Fri May 18, 2007 9:04 am lml →D
Useful Scripts. If you have a script you think might be useful to others post it here. Hopefully we will be able to get the most useful of these incorporated in the manuals. Moderator: sliva	17	35	Tue Apr 24, 2007 9:21 am lukash →D
Future Directions A forum dedicated to the future direction of OpenSees, i.e. what would you like, what do you need. Moderator: sliva	26	100	Tue May 01, 2007 10:28 am ahmetalbarker →D

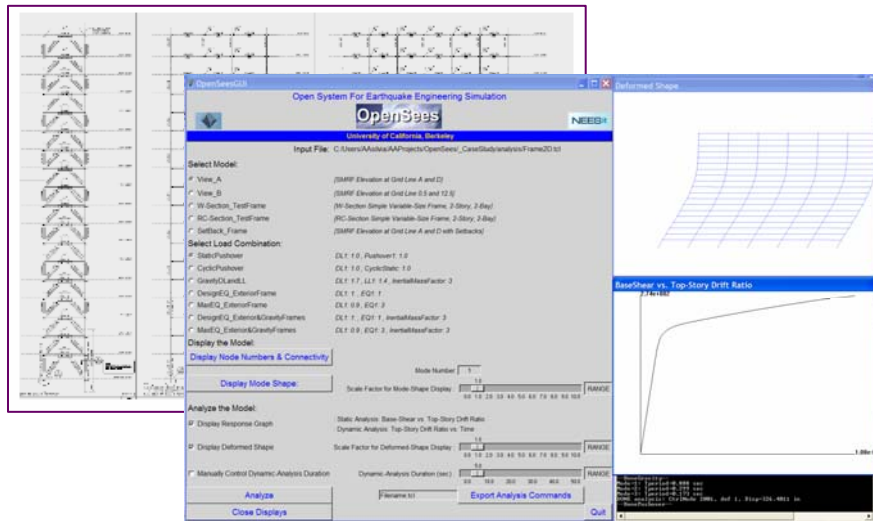
Who is Online
Our users have posted a total of **4573** articles
We have **6169** registered users



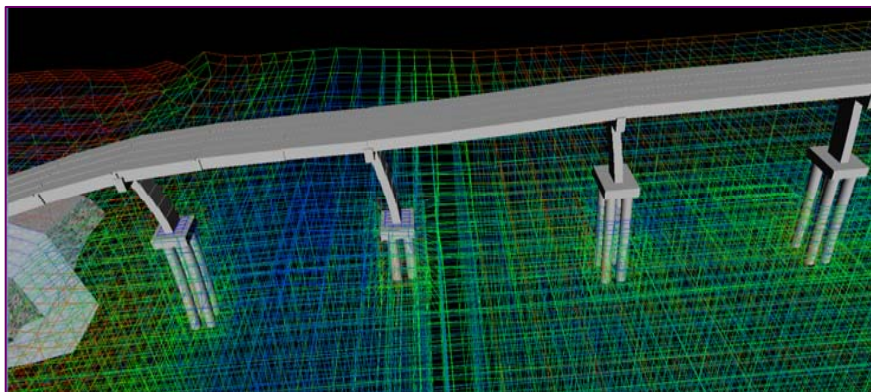
OpenSees Days



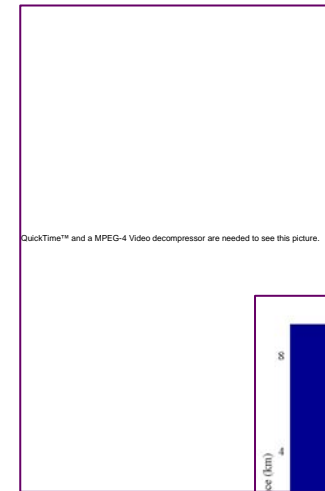
OpenSees Framework Applications



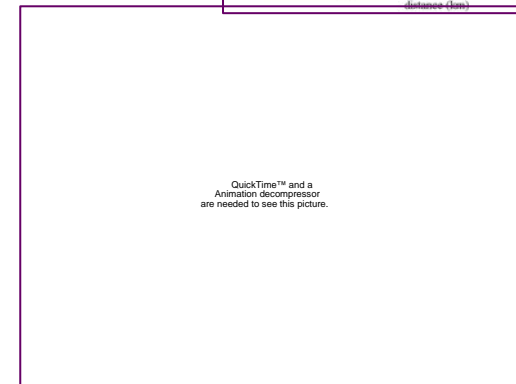
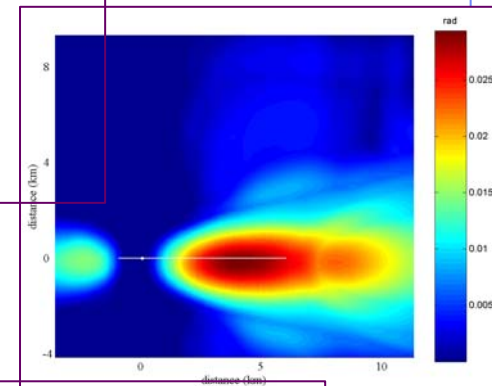
Tall Building Analysis



Advanced Visualization



QuickTime™ and a MPEG-4 Video decompressor are needed to see this picture.

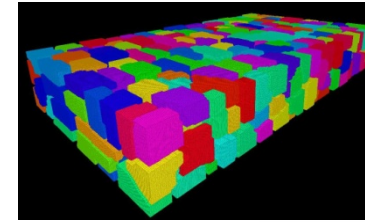


QuickTime™ and a Animation decompressor are needed to see this picture.

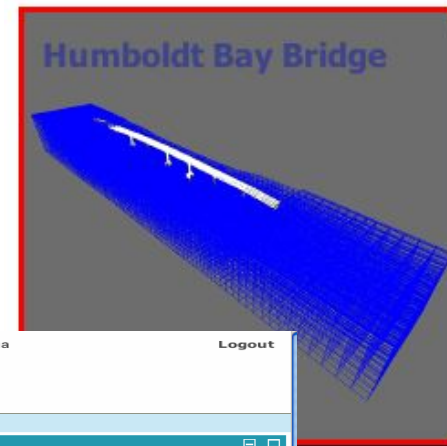
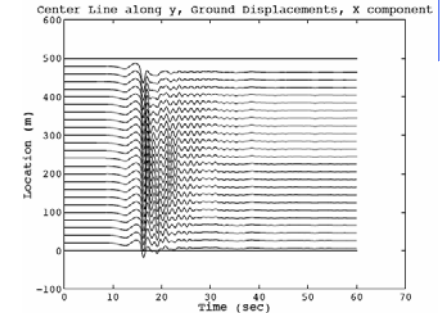
Seismic Performance of Urban Regions

NEESit: High-Performance Computing

- ◆ OpenSees implementations
 - Domain decomposition
 - High-fidelity site response by DRM
 - Large-scale parameter studies
- ◆ Teragrid allocation and usage
 - NEES wide 50,000 SU's (OpenSees, ABAQUS, Adina, LS-Dyna)
 - 22 projects have access to allocation
- ◆ NEESsphere interfaces for HPC jobs



QuickTime™ and a TIFF (LZW) decompressor are needed to see this picture.



Welcome, Frank McKenna Logout

NEESit

NEESsearch myNEES Contribute NEESTools Docs/Help UserProfile

Home NEES Workbench

My Ontologies and Resources

- ASCII
- CUAHSI Data
- Excel
- GMT Raster
- GeoTIFF
- Images
- KeplerWorkflow
- Movies

Application Simulation Service

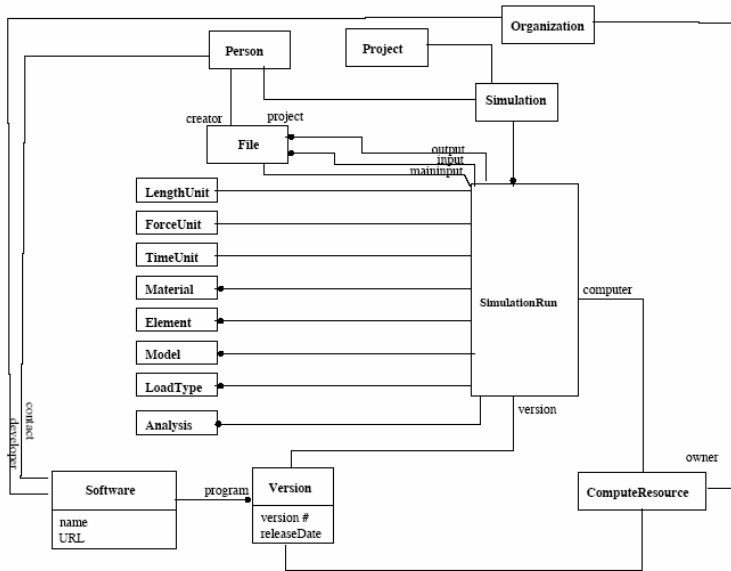
[Job Manager](#) [Download](#)

You have no archived input xml files for this simulation.

How many input files do you have?

[Next](#)

OpenSees Integration with NEESit



NEEScentral
Hello Frank!
Preferences
Logout

HOME MY PROJECTS ALL PROJECTS FACILITIES HELP Search Advanced Search

Home > My Projects > test2

Project: test2
Main Experiments Analysis Documentation Public Members

Analysis
Manage all project-level analysis or simulation files that are not specific to a particular experiment

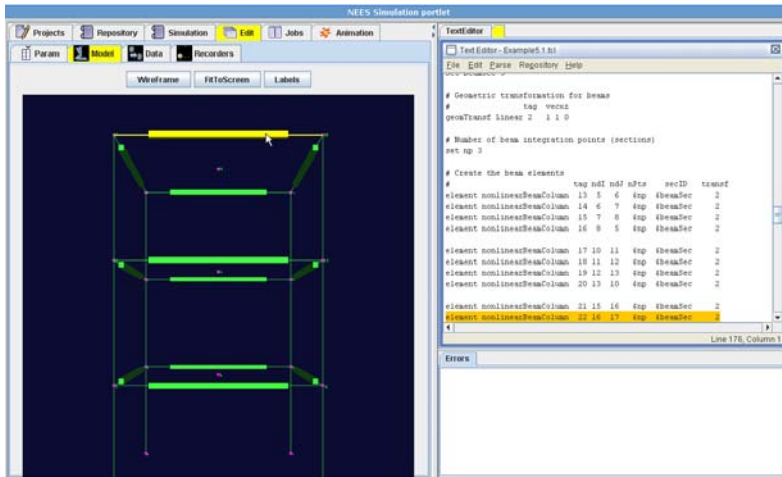
[Switch to Detailed View]

Analysis: Upload New Directory Refresh

Name	Timestamp	Size
test1		

ID: NEES-2006-0150 Active Dates: May 9, 2006 to TBD Visibility: Project Members [?]
Contact: Frank McKenna IT Contact: Frank McKenna [Edit]

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Support: it-support@nees.org / Toll Free: (866) 260-4100 / Fax: (858) 822-5464
Located at the [San Diego Supercomputer Center](#). Supported by the [National Science Foundation](#).



What Has Been Accomplished by PEER in Simulation/IT for Practice and Research?

◆ Simulation in practice:

- Much more robust and validated models for R/C
- Dynamic analysis for suite of ground motions used more widely, provide improved understanding of EDP distributions for PBEE
- Recognition of importance of SSFI on many structures

◆ Simulation in research:

- The first open-source software for earthquake engineering; developed an enabling technology for the community
- Introduced a new generation of students to modern IT
- Tackled more complex problems using teams of researchers to develop models, computational procedures, and model validations
- Improved coordination between structural and geotechnical simulation
- Created new opportunities for IT and cyberinfrastructure advances in earthquake engineering through NEES and other NSF initiatives

◆ Combination of two accelerated advances for simulation in PBEE, incorporated modern IT, and created a community of users.