OpenSees User and Developer Workshops

Presented by the OpenSees Community
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Context

- PEER Research Program in Performance-Based Earthquake Engineering.
- Development of enabling technology is expected of NSF research centers.
- Many researchers and students for PEER Thrust Area “Simulation and Information Technology” are contributing to technology development and application.
- New initiatives such as NEES and MBS are encouraging new simulation methods and technology.
Observations on Current Situation

• Tight binding of models in research and commercial codes is an impediment to new research and implementation of models for professional practice.

• Embedding of computational procedures in codes makes it difficult to experiment and take advantage of computing technology:
  – Parallel and distributed computers
  – Computational grids

• “Closed-source” is the norm, whereas other fields have adopted “open-source” software for communities users.
What is OpenSees?

• A software framework for simulation applications in earthquake engineering using finite element methods. OpenSees is not a code.

• A communication mechanism within PEER for exchanging and building upon research accomplishments.

• As open-source software, it has the potential for a community code for earthquake engineering.
Conceptual Approach for Simulation

Open-Source Community Simulation Framework

Computation

Information Technology

Software framework, Databases, Visualization, Internet/grid computation

Models

Simulation models, Performance models, Limit state models

Material, component, system models

Algorithms, Solvers, Parallel/distributed computing
Software Framework

- A *framework* is a set of cooperating software components for building applications in a specific domain.
- A framework dictates the architecture of the application. It must represent the design decisions common to the application domain.
- A frameworks is based on the assumption that an architecture will work for most applications within the domain.
- Loose-coupling of components within the framework is essential for extensibility and re-useability for applications.
- Examples: Visualization (GLUT), MS Office, compilers ...
- *A framework is not a “code”*
Simulation Software Alternatives

Traditional Code

User Interface
Input Language
Base Code
Compute Technology

Framework of Components

Model Builders
Model Domain
Elements
Materials
Other
Solution Procedures
Solvers
Compute Technology
Databases

Application Program Interface (API)
What Should be Your Expectations?

• OpenSees is a research tool
• It is under continual development by students, faculty and other researchers
• User interface development lags behind computational technology
• As with any nonlinear analysis, it requires careful consideration of model and interpretation of results
• It is not bullet-proof
• An investment of time and learning is required
Objective of Workshops

• **USERS**
  – Describe overall capabilities of OpenSees
  – Overview of applications, structural and geotechnical
  – Pointers to more information.

• **DEVELOPERS**
  – Basics of OOP and C++
  – Architecture of OpenSees
  – Practice implementing a material model and element
  – Analysis procedures
  – Discussion of needs and development roadmap
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