CEO: Convert ETABS to OpenSees - A Tool for Nonlinear Analysis of Reinforced Concrete Structures Subjected to Earthquakes

Carlos Garcia, *CSU Fullerton;* **Nathanael Rea**, *CSU Fullerton*
Advisor**: Kristijan Kolozvari**, Assistant *Professor*

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Background and Objective

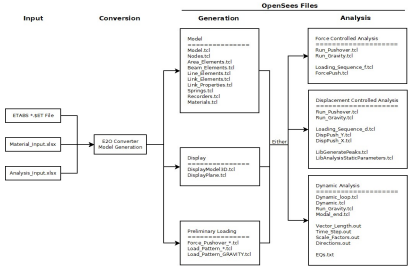
OpenSees (Open System for Earthquake Engineering Simulation)

- Simulate seismic response of structural and geotech systems.
- Performance-based earthquake engineering.

Motivation and Objective

- OpenSees difficult to learn, interface not user-friendly.
- Make OpenSees accessible to practicing engineers.
- Use interface that engineers are familiar with: ETABS

Process Flow



CEO: Convert ETABS to OpenSees

How does it work?

Python-based converter tool

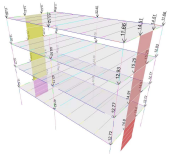
3 Easy Steps

1. ETABS 2. X 3. CEO

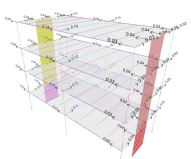
Step 1

ETABS Input - Build 3-D Model

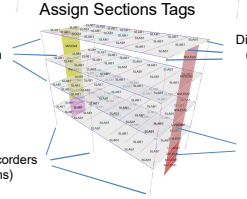
Gravity Loads



Mass Assignment



Assign Sections Tags



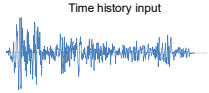
Step 2

Excel Input – 2 files

Analysis Input

Loading Sequence
Static or Dynamic
Numerical Algorithm

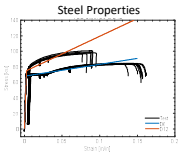
Time history input



Material Input

Concrete/Steel strength
Reinforcing Ratios
Fiber sections

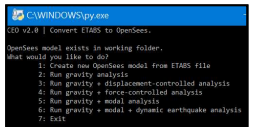
Steel Properties



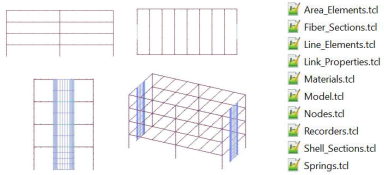
Step 3

CEO Converter Tool

On-screen Prompt

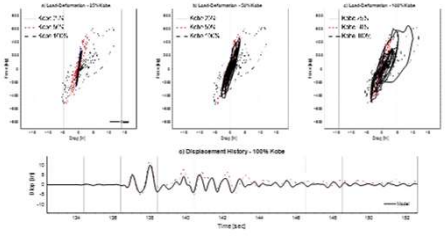


Model Generation



Results

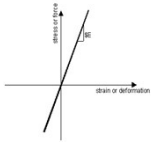
E-Defense (2010)
4 story RC building
Shake table test
Kobe ground motions



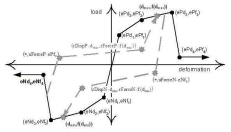
Material Modeling

Variety of Material Models

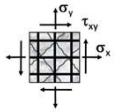
- **Linear**



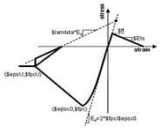
- **Pinching4**



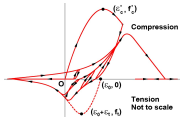
- **FSAM**



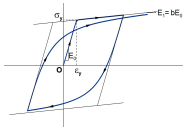
- **Concrete02**



- **ConcreteCM**



- **SteelMPF**

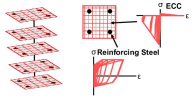


Element Modeling

Fiber Section

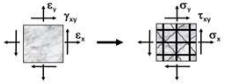
Beam-Column

- Elastic
- dispBeamColumn
- forceBeamColumn



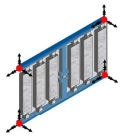
Floor Slab

- ElasticMembranePlateSection
- QuadWall element



RC Shear Wall

- MVLEM_3D
- SFI_MVLEM_3D
- QuadWall



Additional Features

Modeling

- Various recorders
- Rigid Diaphragm
- P-delta
- Node slaving

Analysis

- Gravity
- Displacement controlled
- Force controlled
- Modal
- Dynamic
- Parallel computing

Future Work

- Development of comprehensive user manual.
- Public release of an open source program.
- Collaborate with industry for model validation.
- NSF award: CMMI 1563428 & 1563577