Advanced Precast Concrete
Dual-Shell Steel Columns

Gabriele Guerrini
Graduate Student Researcher

Jose' I. Restrepo
Professor, Principal Investigator

University of California, San Diego
Structural Engineering Department
Project Description

Goals

- Accelerated bridge construction (ABC - Caltrans)
- Improved bridge seismic performance

Main features

- Dual steel shells
- Postensioning / recentering
- Energy dissipation
- Fiber-reinforced dry pack

NCHRP 12-74
Hybrid connection concept

- Bent cap
- Precast column
- Prestressing tendon
- Mild steel reinforcement
Hybrid connection concept
Hybrid connection concept

Force

Displacement

Loading

Unloading
Dual-Shell Technology

Advantages

- Precast construction w/ permanent formwork
- Reduced column weight (hollow section)
- No reinforcing cage
- Reduced construction time
Self-Centering Behavior

Advantages

- Limited structural damage
- Small residual displacements
- Energy dissipation by specific devices
- Operability right after strong shakes

Monolithic system vs Self-centering system

Shear-wall test results

(Restrepo, Mander, Holden)
Energy Dissipation

Internal
bonded (column)
unbonded
bonded (foundation)
column base

External
lever fixed to column
bracekt fixed to foundation
weld
pin

cartoon portraying concept

Advantages
Easy to repair/replace

Aesthetically ok

Hard to repair/replace

Drawbacks
Aesthetic mitigation needed
Project Tasks

1. Prototype bridge
   - 2-span ordinary skew bridge
   - **Opportunity for Collaboration:** Bridge Testbed Group: Taciroglu, Stojaddinovic

2. Analytical modeling
   - TH analyses (Opensees) with 7 scaled records
   - Selection of bi-directional test protocol
   - FE analyses of external energy dissipators
   - **Opportunity for Collaboration:** J. Baker

3. Experimental tests
   - Design of two units: internal vs. external energy dissipators
   - Hysteretic characterization of external energy dissipators
   - Construction and test of the two units
   - **Opportunity for Collaboration:** Oestertag

4. Final report
Progress Forecast

- Expect to complete FEA and design of dissipators by November 2010
- Test two column specimens in February 2011
- Complete Opensees model in April 2011
- Complete nonlinear analyses in June 2011
- Final report due September 2011

- No additional costs are anticipated
Large Column Test Update

- Shake table testing of a full scale column designed per Caltrans SDC
- 1.2 m diameter by 7.2 m tall column
- 250 Ton of Inertial mass
- Densely instrumented (280 sensors)
- Objective to compare with tests done at E-Defense in Japan where significant flow of the concrete core was observed upon yielding of transverse hoops
- Provides an opportunity for the community to calibrate models and improve understanding on model uncertainty
- Blind prediction is being launched
- Testing to take place during second week of September
- Report due June 30 2011
Main funding from PEER transportation and lifelines (Caltrans) and FHWA through several DOTs, and NEEScomm

Industry partners: Skanska, CRSI
THANK YOU