Multi-Level Seismic Performance Assessment of a Damage-protected Beam-column Joint with Internal Lead Dampers

Outline

• Motivation
• DAD concept
• Experimental specimen development
• Key construction hardware
• Computational modeling using IDA
• QED testing
• Results
• Conclusions
Development of the experimental specimen
Reinforcing Details
Beam-end region showing closure pour details and a LED device
LED Device

70mm DAMPER SHAFT

M10 CAP SCREW, TYP

30mm DAMPER SHAFT WITH 48mm EXTRUSION

ENDPLATE

25mm Oversized for threaded rod attachment
LED Device Performance

![Graph showing the performance of three LED devices. The x-axis represents shaft displacement (mm) and the y-axis represents compression force (kN). The graph compares Device 1, Device 2, and Device 3.]
Experimental Setup
Plan view of experimental setup
Results from quasi-static cyclic tests
QED: Structural modeling

- Tri-linear elastic spring
- Elasto-plastic spring
- Elastic beam/frame elements
- Graph showing experimental and computational results
IDA results
QED: results

90% DBE

50% MCE

90% MCE
Key Findings:

• The specimen performed well through the most arduous earthquake event with NO damage. Moreover, re-centering was maintained at all times.

• For successful DAD implementation small compact dampers should be installed within the connection region. Such devices should require no post-earthquake maintenance.

• The LED devices performed well in this regard.
Conclusion

• DAD precast systems are an attractive constructional alternative to monolithic conventional systems designed for ductility.

• DAD systems can eliminate damage to the structural elements over a broad range of extreme seismic performance. Thus post-earthquake serviceability (I.O.) can be maintained even for very rare (MCE++) events.
Future Work

• The next step is to investigate the potential for eliminating damage beyond the frame and wall systems. Particular emphasis should be directed to the articulations of precast floor systems within DAD precast concrete frames.