PEER
PACIFIC EARTHQUAKE ENGINEERING RESEARCH CENTER

Research Project Highlight

Dissipative Base Connections for Moment Frame Structures in Airports and other Transportation Systems

Project # 1141-NCTRAM

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Start-End Dates:
1/1/2018-12/31/2018

Abstract
Steel column to concrete footing connections are critical components of numerous structures within the transportation infrastructure. These primarily include moment frames in airports (a large majority of airports in California utilize these to achieve unobstructed bays), and in numerous pre-1990 bridges and freeway overpasses. The current practice for designing base connections is inhibited by knowledge gaps in several areas, with serious implications for the performance and economy of critical infrastructure. First, structural systems do not allow ductile/dissipative response in the base connections, requiring designers to design them as elastic and fixed. This results in extremely expensive base connections. Recent experimental research shows that the base connections may be highly ductile, whereas the columns have limited rotation capacity (due to local or lateral torsional buckling). Against this backdrop, the research develops a design paradigm that allows for dissipation/inelastic deformation in the base connections, while providing acceptable frame performance. This is achieved through a coordinated plan of testing and simulation; tests (supported independently of the PEER project) are required to develop resilient (i.e., reliably ductile and reparable) base connections, whereas simulations are required to examine interactions between these connections and the system, to establish acceptance/demand criteria for the components themselves while developing guidelines for structural design such that it achieves

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acceptable performance (e.g., collapse probabilities, deformations etc.), as determined within a PBEE framework.

Deliverables

A PEER report and several conference and journal papers describing the simulations, results, and implications for the companion program. When the experimental program is completed, a comprehensive report describing findings from the tests, simulations, and the integration of the two will be submitted.

Research Impact

Column base connections are an essential component of a huge number of transportation structures. Moreover, they are possibly the most important connections in these structures because they carry the largest forces, and also interact with the frame affecting its response. Current design/construction practices for base connections as well as the structures that utilize them have major conservatisms in material requirements (e.g., deeper embedment or large anchor rods) and inefficiencies (e.g., multiple concrete pours, coordination between steel and concrete trades) that may be eliminated by more research on embedded base connections. These outcomes (mitigation of conservatisms and inefficiencies) will be particularly impactful for two reasons:

- They will affect all structures that employ steel-concrete footing connections. These impacts are not limited to one connection detail or issue and have a broad impact affecting possibly thousands of transportation structures.
- Research on base connections is much less developed compared to other connections (beam-column connections). As a result, we are on the steep part of the learning curve, such that major (rather than incremental) advances in our understanding of these connections are expected.

These impacts will be pursued through early and sustained engagement with key code/standard committees, including at the American Institute of Steel Construction.

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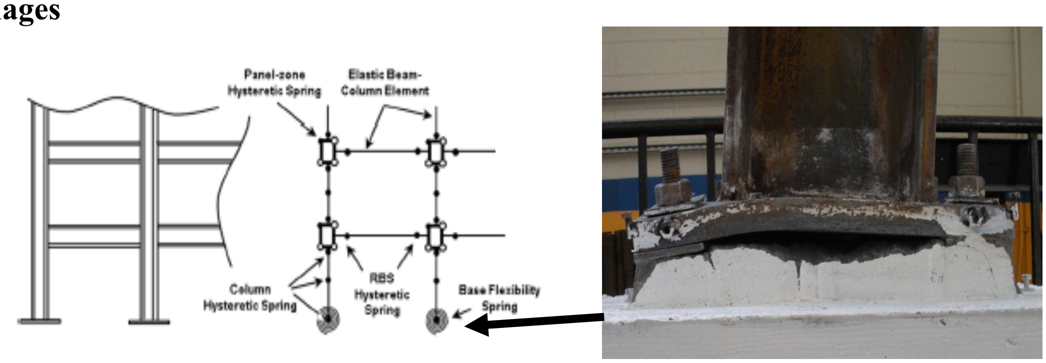
Project Images



(a) Computational model of frames with dissipative/yielding bases

(b) Test setup for experimental component of the study

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