SEISMIC PERFORMANCE OF EXTERIOR AND CORNER BEAM-COLUMN JOINTS IN EXISTING GRAVITY LOAD DESIGNED RC BUILDINGS

NEES Grand Challenge Project: Mitigation of Collapse Risk in Older Concrete Buildings

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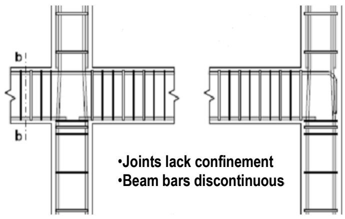
A. Introduction

The NEES-GC project on older-type concrete buildings aims to develop improved analytical tools to identify collapse-prone buildings. Beam-column joints are one of several vulnerable component types being studied.

A.1 Older-Type Detailing

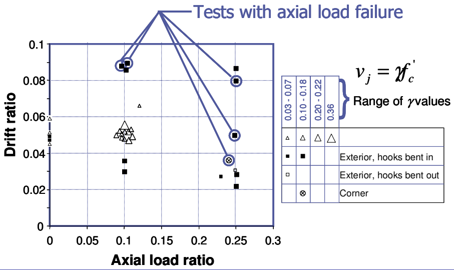


A.2 Earthquake Joint Failures

Unreinforced corner joints are especially vulnerable.

A.3 Previous Joint Tests

Most studies focused on requirements for new joint designs. Some data exist for older-type construction, but information about corner joints and high axial loadings is lacking.

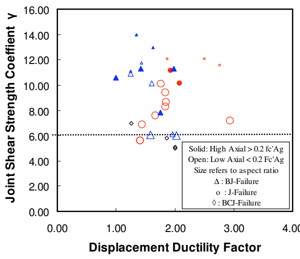


B. Joint Shear Strength: Current ASCE 41 Model Evaluation

B.1 ASCE 41-06 / FEMA356 Joint Shear Strength Model

$$V_j = \gamma \sqrt{f_c'}\, bh$$

joint geometry	γ
	4
	6
	8



Pros: - Familiar
- Simple to use

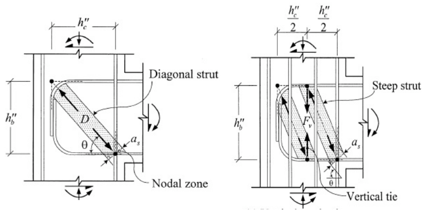
Cons: - No corner joint recommendation - No axial load consideration
- No aspect ratio effect - No bi-directional loading consideration
- No degradation model - Very conservative (lower bound)
- Inadequate for collapse assessment

C. Joint Shear Strength: Softened Strut & Tie Model

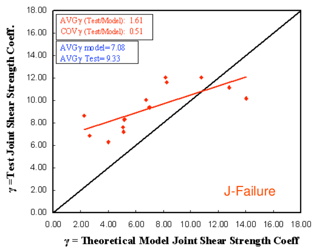
C.1 Softened Strut & Tie Models

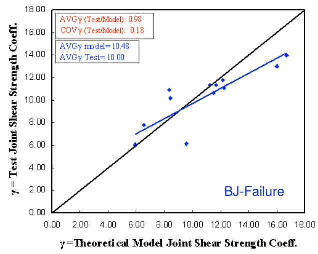
Pros: - Recognizes aspect ratio effect
- Recognizes axial load effect

Cons: - Unfamiliar
- Difficult to use
- Not suitable for all older-type joints failure modes



C.2 Model Assessment

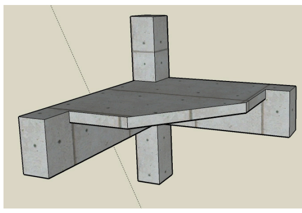




D. Test Program

- Four full-scale corner beam-column subassemblies (with floor slabs)
- Bidirectional lateral loading and varying overturning axial load

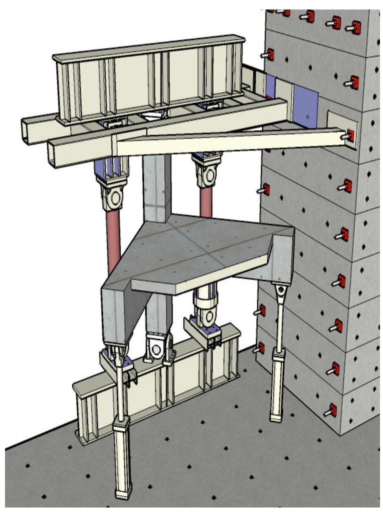
D.1 Test Specimens

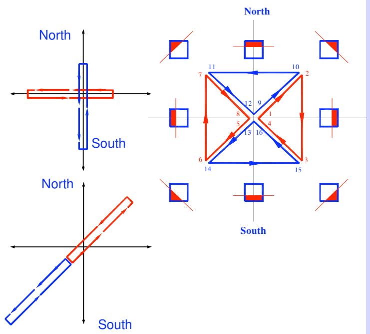


D.2 Test Parameters

1. Variable axial load including tension and high compression
2. Failure mechanism: joint shear failure before or after beam or column yielding
3. Joint aspect ratio (strut strength), 1 vs 1.92
4. Loading history (unidirectional, bidirectional)

D.3 Test Setup and Loading Protocol





D.4 Research Needs

•Definite answer about the effect of high axial load.
•Varying axial load, to account for overturning moment.
•Reliable shear strength degradation models.
•Joint aspect ratio vulnerability range.
•Realistic representation of bidirectional loading
•Axial load residual capacity-Axial load collapse potential

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