

Mitigation of Collapse Risk in Older Concrete Buildings

Grand Challenge Research

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SEISMIC PERFORMANCE OF EXTERIOR & CORNER NON-DUCTILE BEAM COLUMN JOINTS IN GRAVITY LOAD DESIGNED REINFORCED CONCRETE BUILDINGS

Wael Hassan

Advised By

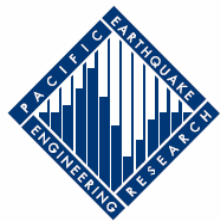
Prof. Jack Moehle



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PART 1

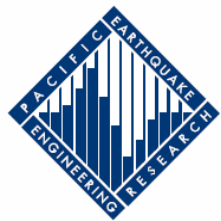
LITERATURE STUDY



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Part 1: Background & Review of Available Literature

- 1- Background, past Earthquake Joint Failures**
- 2- Tests on Non-Ductile Exterior Joints**
- 3- Tests on Non-Ductile Corner Simulated Joints**
- 4- Tests on Non-Ductile Corner Joints**
- 5- Modeling Non-Ductile Exterior Joints**
- 6- General Experimental Conclusions**



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Past Earthquakes Joint Failures



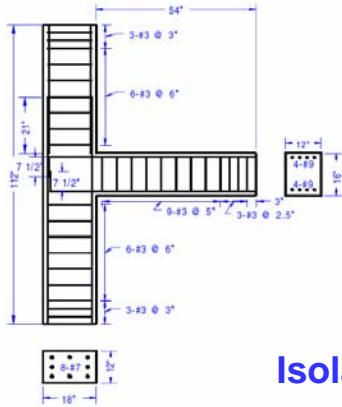
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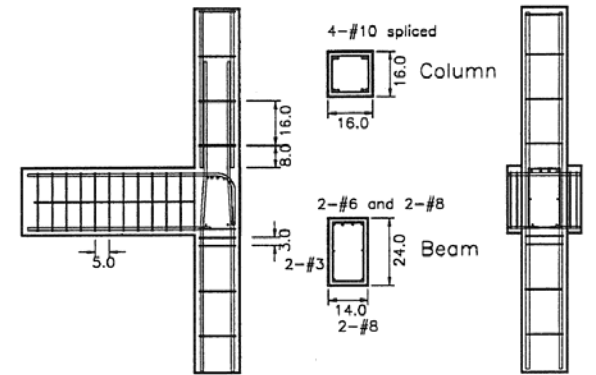




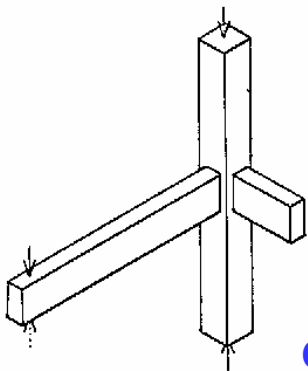
Previous Joint Tests



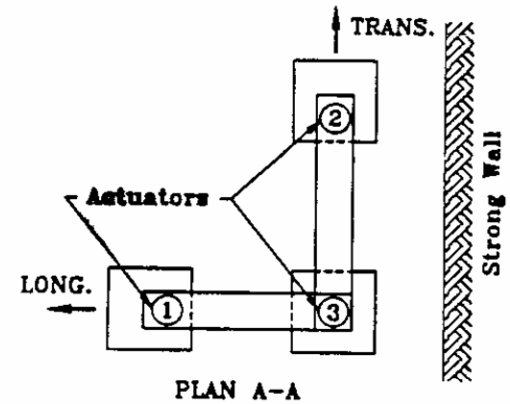
Isolated Exterior



Exterior with 2 Stubs



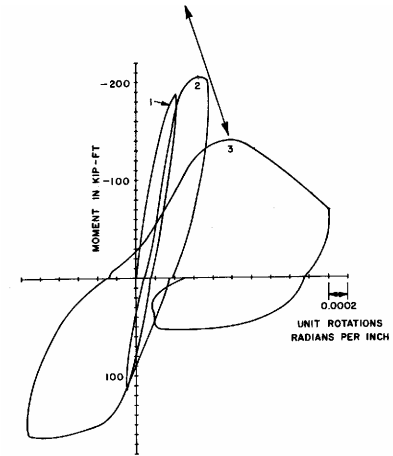
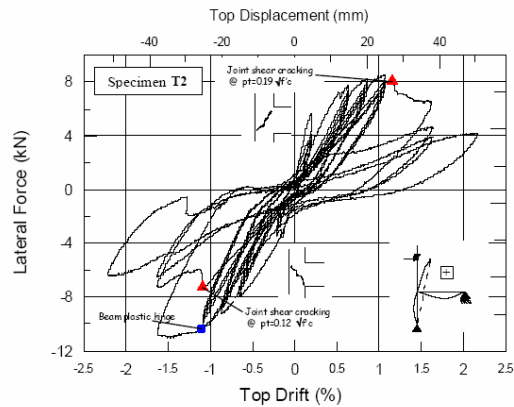
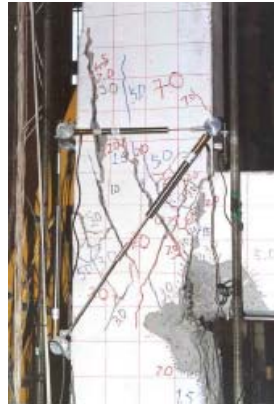
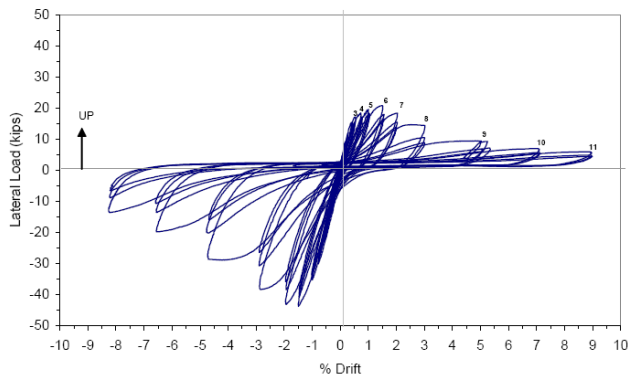
Corner Simulated



Corner

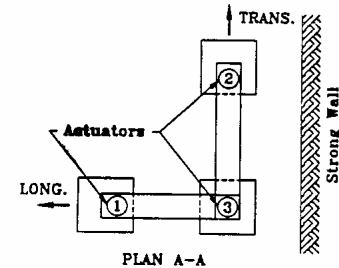
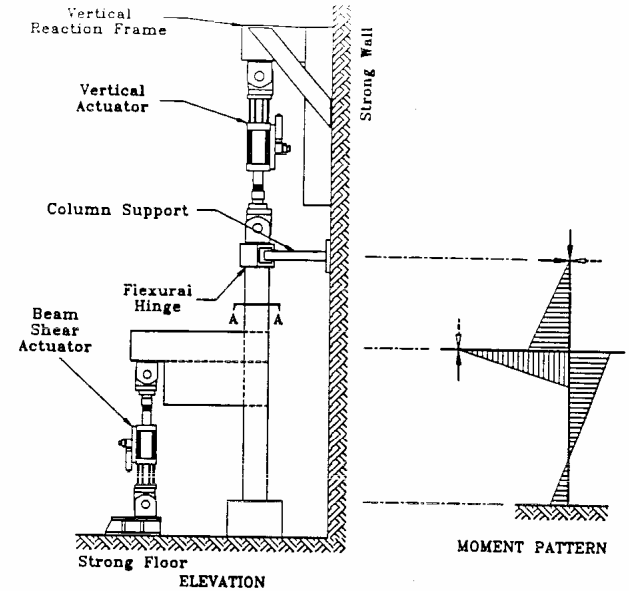
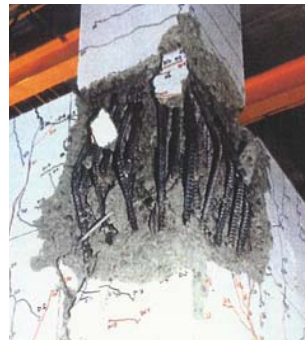
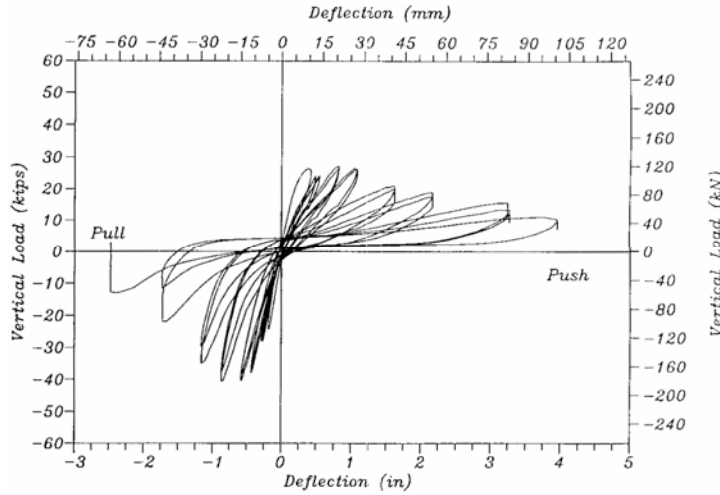


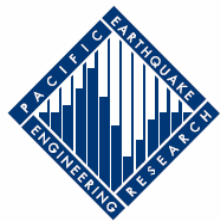
Sample Exterior Joints Test Failure





Corner Joint Test (UCSD)





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PART 2

Joint Shear Strength Degradation Trends



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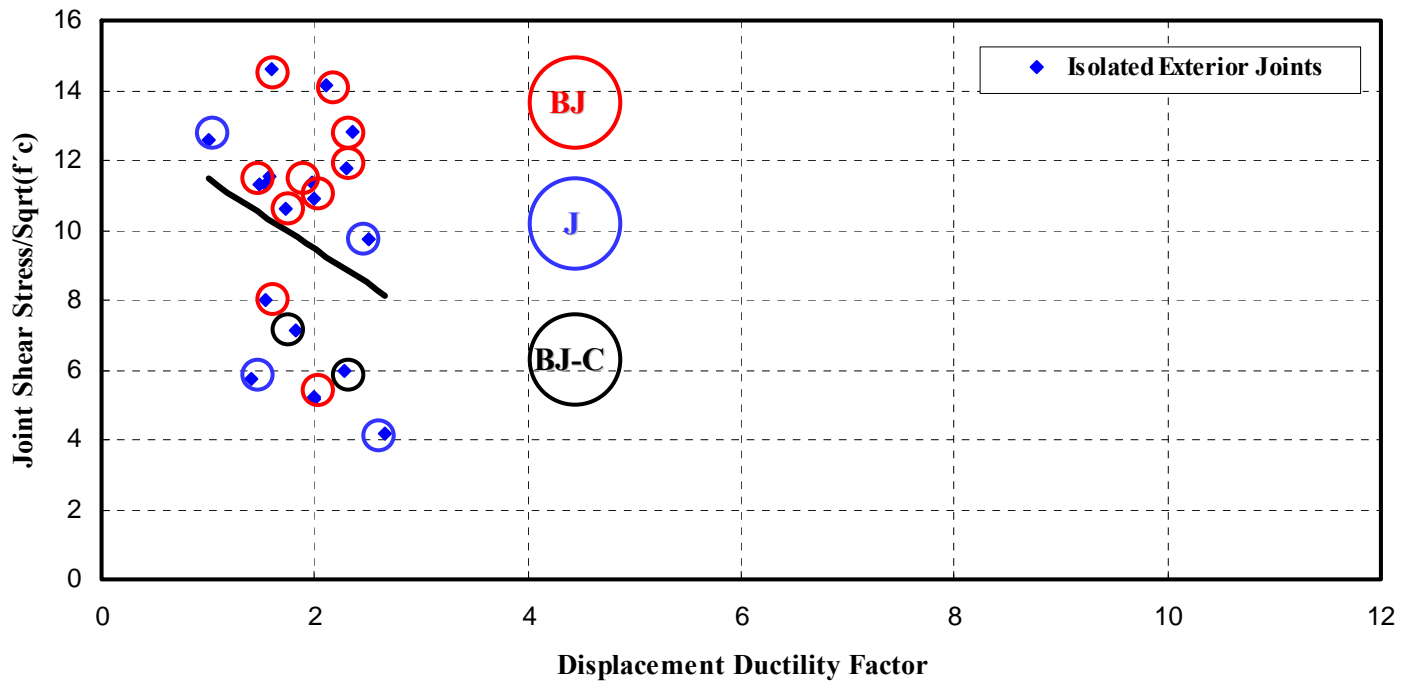
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NON-DUCTILE ISOLATED EXTERIOR JOINTS

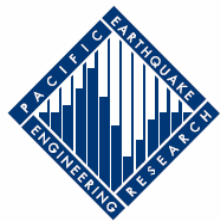
Joint Shear Stress-Displacement Ductility Relationship (Isolated Exterior Joints)



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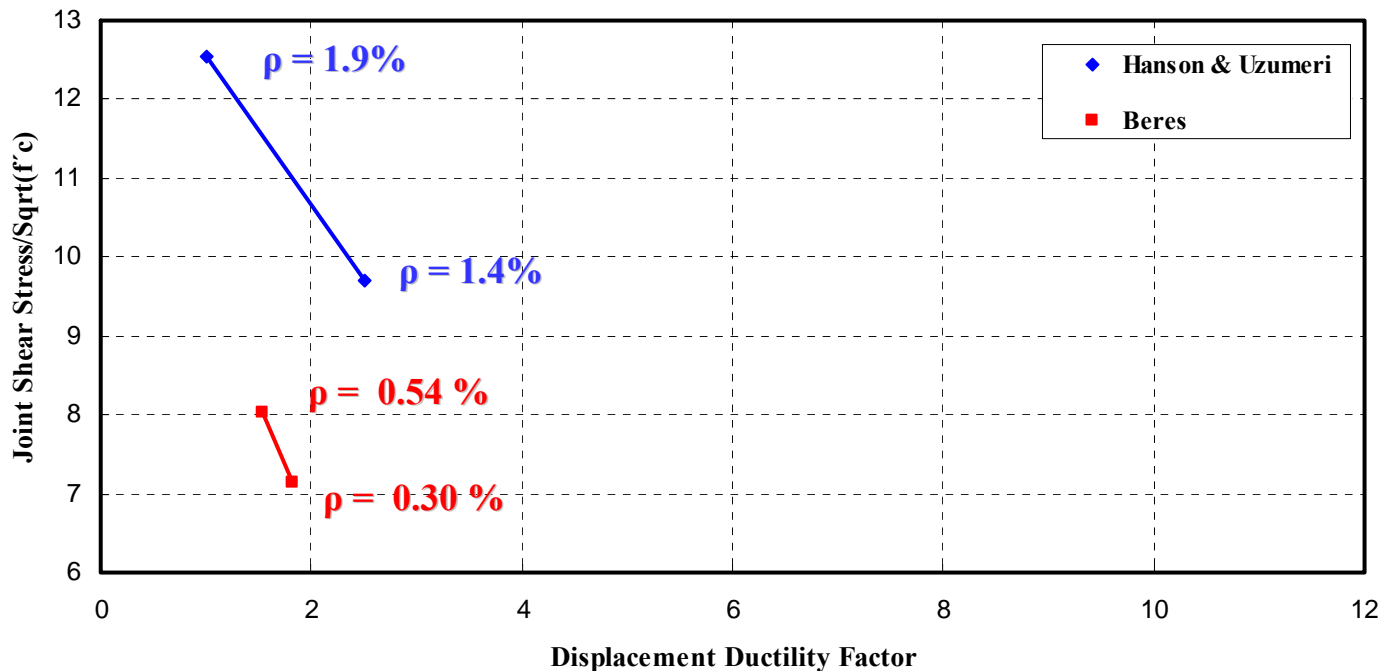
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NON-DUCTILE ISOLATED EXTERIOR JOINTS

Effect of Beam Longitudinal Reinforcement Ratio (Isolated Exterior Joints with Same Dimension Beams)



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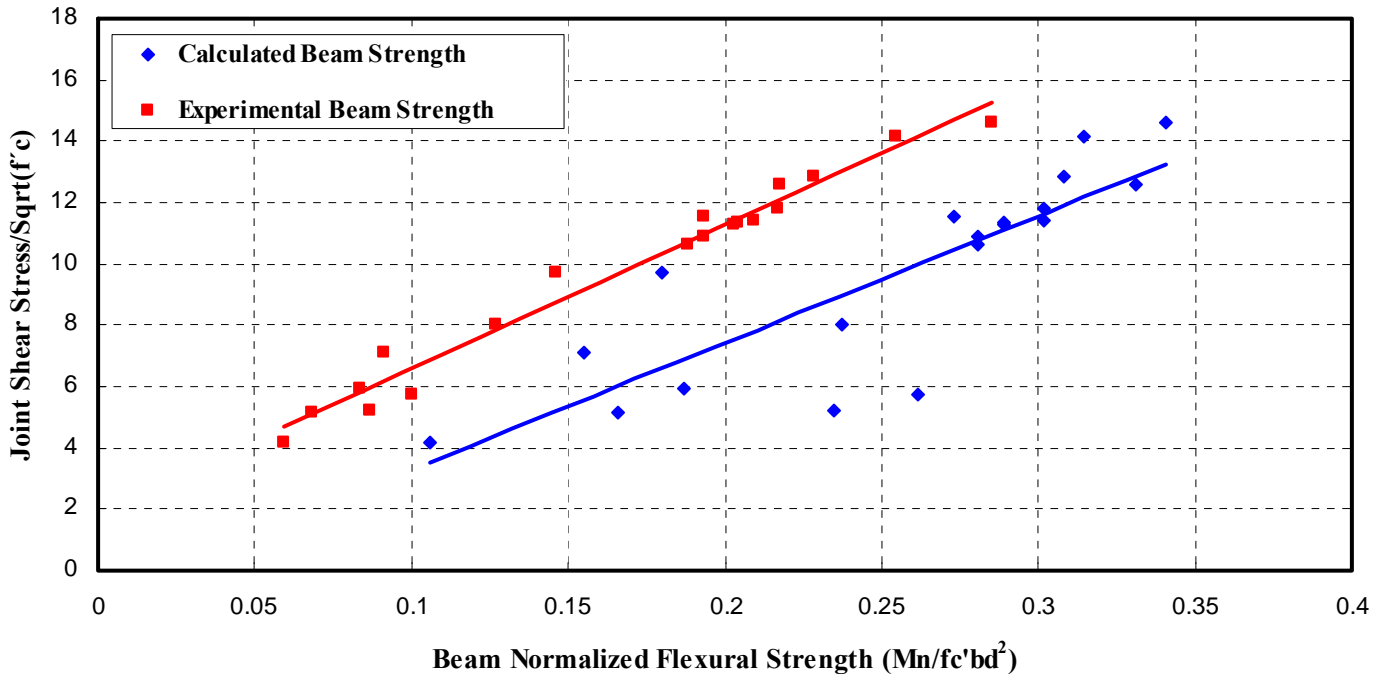
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NON-DUCTILE ISOLATED EXTERIOR JOINTS

Joint Shear Stress-Beam Flexural Capacity Relationship (Isolated Exterior Joints)



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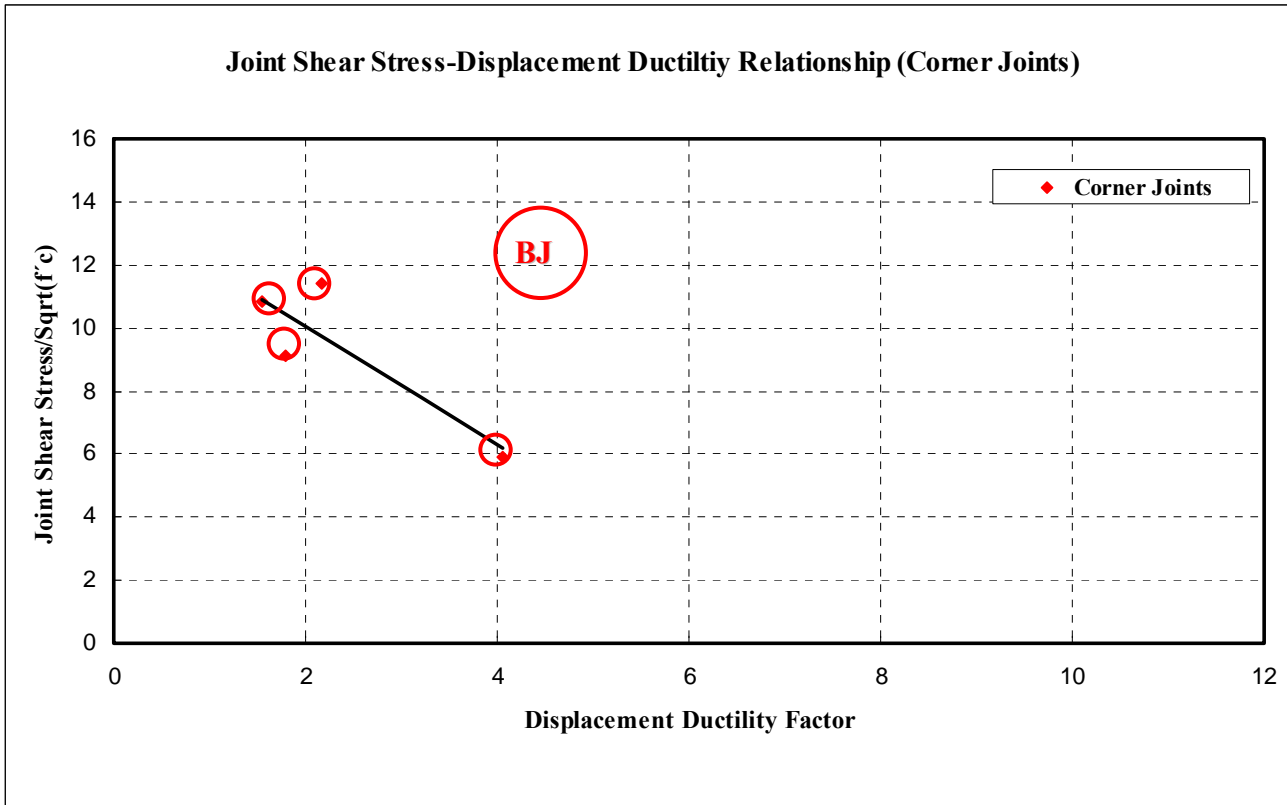
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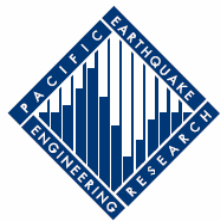
CORNER NON-DUCTILE JOINTS



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PART 3

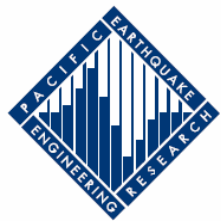
TENTATIVE FULL SCALE CORNER BEAM COLUMN JOINT TEST



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Drawbacks & Unanswered Questions in Previous Tests

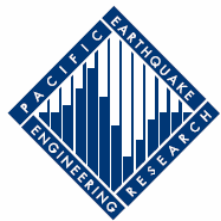
- 1- Definite Result about the Effect of High Axial load
- 3- Reliable Shear Strength Degradation Models for Non-ductile Joints
- 4- Reliable Corner Joint Test and Modeling
- 5- Non-ductile Joint Shear Strength, for varying Joint Aspect Ratio
- 6- Effect of Beam to Column Width Ratio, (Joint Masking Area)
- 7- Effect of Slab Presence for non-ductile joints
- 8- Realistic Representation of Biaxial Loading
- 9- Axial Load Residual Capacity



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Suggested Test Parameters

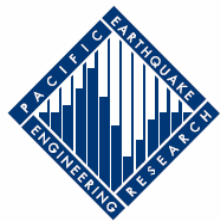
- 1- Axial Load Level, $0.15 f_c' A_g$ vs $0.30 f_c' A_g$
- 2- Failure Mechanism, Joint Shear failure vs Joint Shear Failure after Beam Yielding
- 3- Beam to Column Flexural Strength $\sum M_c / \sum M_b$,
Strong Column Weak Beam vs Strong Beam Weak Column Conditions.
- 4- Joint Shear Strength, through Joint Aspect Ratio, 1 vs 1.92
- 5- Beam to Column Width Ratio, (Joint Masking Area), 0.9 vs 0.55
- 6- Effect of Slab Presence



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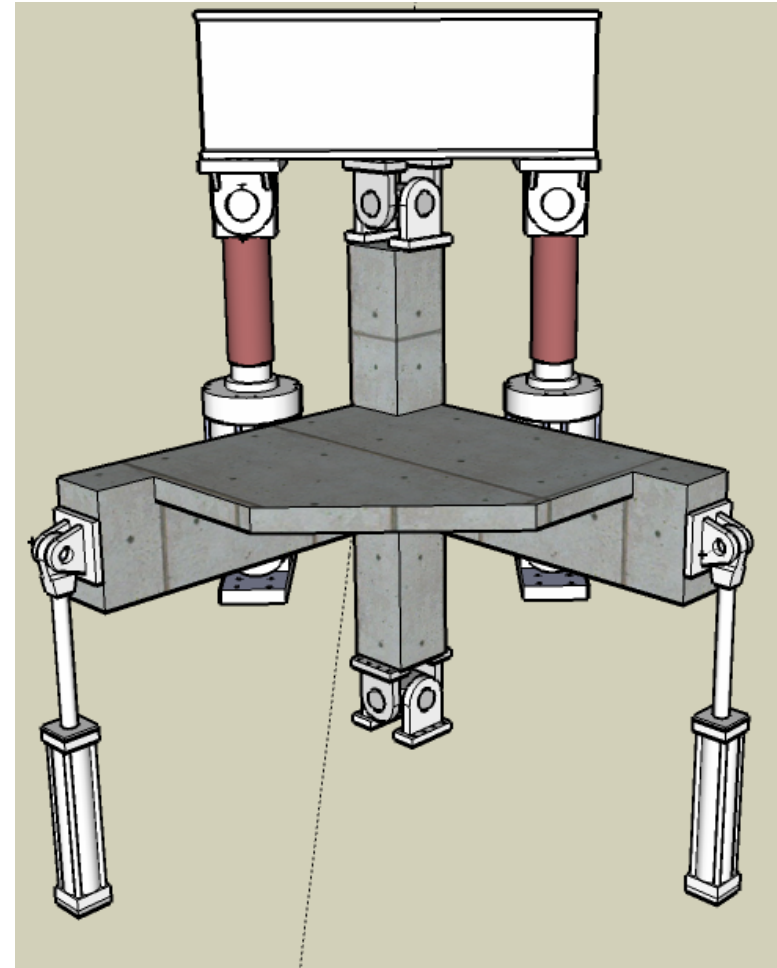


-Test Setup

- Two 120 Kips Beam Act.
- Two 1000 Kips Axial Actuators
- Slab Included
- Variable Axial Load
- Realistic Bidirectional Loading

-Specimen Design

Collaboration with Sangjoon



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