Seismic Performance Assessment of HSR Bridges through Structural Simulation and Testing

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INTRODUCTION

• Hybrid Sliding-Rocking Bridge Columns:
  • *Precast concrete* segments
  • Unbonded *post-tensioning* tendons
  • End *rocking* joints
  • Intermediate *sliding* joints

• Proof of Concept:
  • Past large-scale shake table and quasi-static tests

• Remaining Questions:
  • Computational modeling?
  • Optimal design?
  • Behavior under various load conditions?
COMPUTATIONAL MODELING

• HSR Element Formulation:
  • Representing HSR joints and their close vicinity
  • Capable of capturing the segments’ sliding-rocking interactions
  • Implemented in OpenSees and validated against test data

\[ \text{Gradient-inelastic beam with rocking at joint} \quad + \quad \text{Hysteretic friction model} \]

\[ \text{No-tension} \quad \text{Sliding joint} \]
EFFECTS OF DESIGN VARIABLES

• HSR Column Specific Design Variables:
  • Sliding joint distribution
  • Coefficient of friction
  • Sliding amplitude
  • Duct adaptor height
  • Post-tensioning

• Sample Results:
  ↓ Coefficient of friction = ↓ Strains
  ↑ Sliding amplitude = ↓ Strains
Effects of Ground-Motion Characteristics

- Effects of Ground-Motion Type:

- Effects of Vertical Excitation:
**EXPERIMENTAL STUDY**

- **Test Specimens:**
  - Four identical columns tested under static & dynamic loading

- **Test Setups:**

  ![Diagram showing test setups](image)
Would Like to Know More?

• Come to today’s poster session:
  • Time: 5:15 - 7:00 pm
  • Room: Pasadena (Exhibit Hall)
  • Poster location: No. 003