



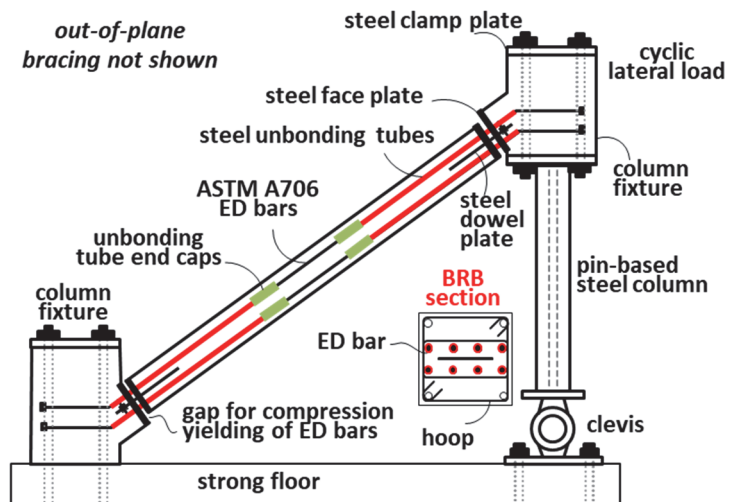
U.S. National
Science Foundation



Analysis, Design, and System-Level Performance of Repairable Precast Concrete Buckling-Restrained Braced (BRB) Frames under Seismic Loads

Project Overview

In this project, an academic–industry consortium — including the University of Notre Dame (UND), Clemson University (CU), the University of California San Diego (UCSD), and the precast concrete industry — is developing and experimentally validating a novel precast concrete buckling-restrained braced (BRB) frame seismic structural system. The project is funded by the National Science Foundation (NSF), the Precast/Prestressed Concrete Institute (PCI), Clark Pacific, Metromont Corporation, Coreslab Structures – Indianapolis Inc., and Nabih Youssef Associates, with additional industry support.



Unlike moment frames and structural walls, BRB frames rely on diagonal braces that yield in tension and compression without buckling, providing stable, near-symmetric hysteretic behavior. The proposed precast BRB frame retains the proven seismic performance of steel BRB systems, while enhancing resilience through a cost-effective precast concrete solution.

Scope and Vision

- Design, fabricate, and experimentally validate ductile reinforced concrete BRB components and connections for precast concrete frame structures.
- Characterize the behavior of the novel reinforced concrete BRB component.
- Develop and validate numerical analysis and seismic design methodologies for multi-story precast BRB frames using both high-fidelity and practical design-level simulation methods.
- Evaluate system-level dynamic earthquake response through shake-table testing of a multi-story precast BRB frame on the NHERI-UCSD Large High Performance Outdoor Shake Table.
- Advance resilient precast BRB frames for adoption as a primary seismic lateral force-resisting system in the United States by developing the design, analysis, and experimental evidence needed according to the methodology described by FEMA P695.

Project Team and Tasks

PCI & NSF
Funding and advisory

INDUSTRY STEERING COMMITTEE
Technical and financial support

ACADEMIC LEADERSHIP
Yahya Kurama, PI (UND)
Jose Restrepo, Co-PI (UCSD)
Laura Redmond, Co-PI (CU)

RESEARCHERS
Muhammad Haroon, PhD, Post-Doctoral Research Associate
Ahmad Abu-Abah, PhD student (UND)
Yanghong Wei, PhD student (UCSD)
Edwina Lewis, PhD student (CU)

Main Tasks

Design and Testing of BRB Members

High-Fidelity Nonlinear Modeling

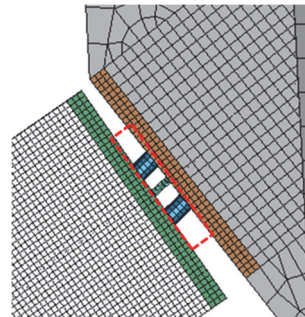
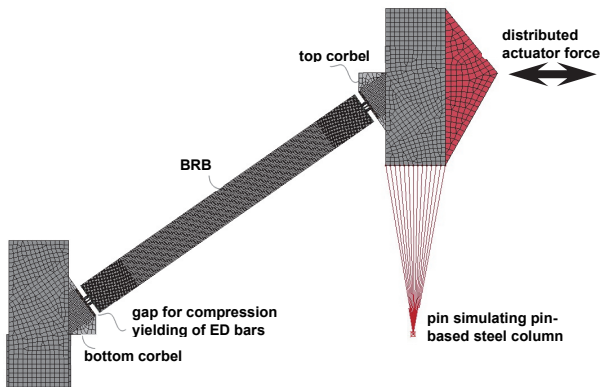
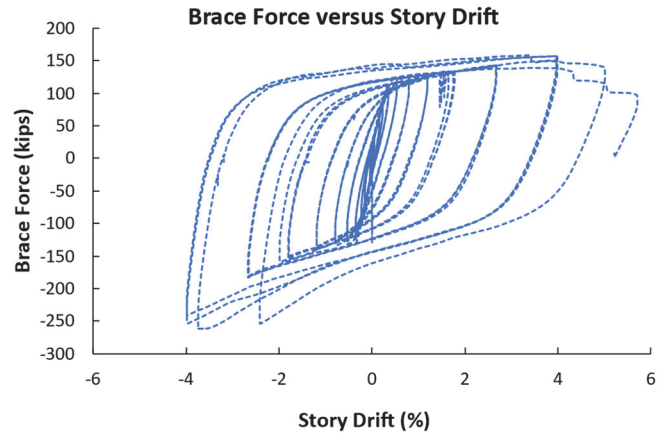
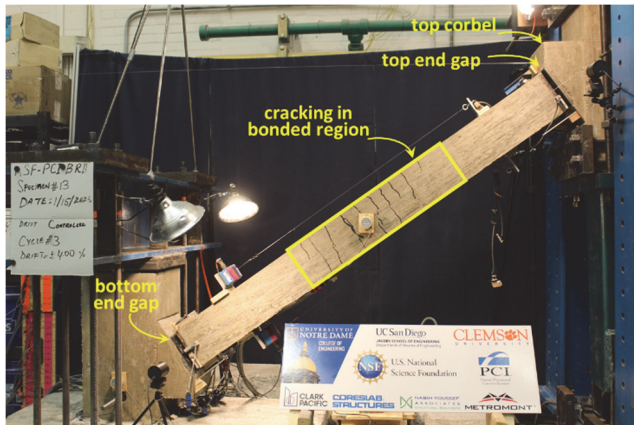
Modeling of Multi-Story BRB Frames

Design of Multi-Story BRB Frames

Shake-Table Testing of BRB Frames

Synthesis and Generalization

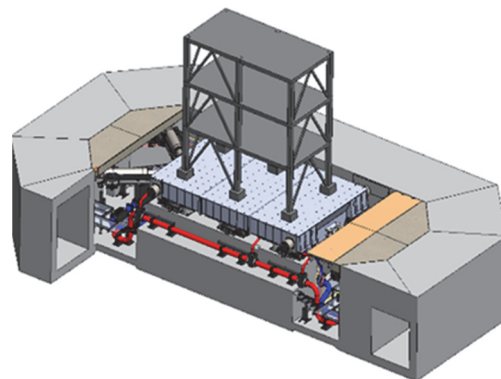
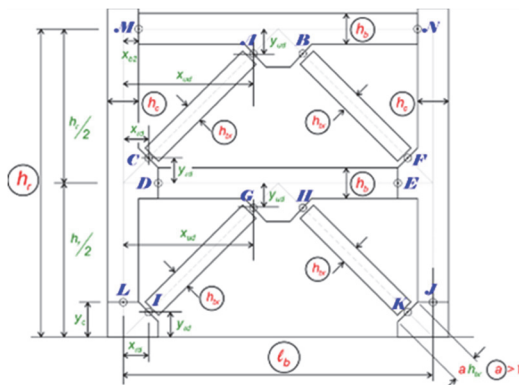
Ongoing Design, Testing, and Numerical Analysis



Numerical Simulation: ED bar buckling and dowel plate yielding at failure



Observed Behavior: ED bar buckling and dowel plate yielding at failure



Project Advisory Board and Industry Support

- Suzanne Aultman, Vice President of Engineering, Metromont Corporation
- Jared Brewé, Vice President, S. K. Ghosh Associates
- Matthew Cooper, Director of Engineering and Drafting, Shockey Precast Group (A Metromont Company)
- Dave Dieter, Precast Concrete Executive
- Fanfu Fan, Structural Engineer, Metromont Corporation
- Harry Gleich, Owner, Gleich Engineering & Associates, LLC
- Kevin Kirkley, Chief Engineer, Product & Process Development, Tindall Corporation
- Ismail Kuzucu, Structural and Earthquake Engineer, The Consulting Engineers Group, Inc.
- Alex Mihaylov, Principal, Vector Structures, LLC
- Jon Mohle, Director of Product Innovation, Clark Pacific
- Andrew Osborn, Senior Principal, Wiss, Janney, Elstner Associates, Inc.
- Michael Owings, Engineering Manager, Coreslab Structures (Indianapolis), Inc.
- Brandon Ross, Cottingham Professor, Clemson University
- Amy Trygestad, Vice President of Engineering, Precast/Prestressed Concrete Institute

Additional Industry Support Provided By:

- Clark Pacific
- Metromont Corporation
- Coreslab Structures (Indianapolis), Inc.
- Nabih Youssef Associates
- ALP Supply
- Headed Reinforcement Corporation (HRC)

NSF Project Information

- NSF award no. 2230187
- NSF project website: https://www.nsf.gov/awardsearch/show-award?AWD_ID=2230187
- Program director: Dr. Lesley Sneed
- Former program director: Dr. Joy Pauschke

Contact

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