“Build...Sustain...Survive”

The current approach to address a natural peril is to “build...destroy...rebuild.” We believe this is not an acceptable loss mitigation model to follow. Increasing a structures resiliency by redirecting/transferring energy through various building connections, using novel products such as elastomeric adhesives, or mitigating uplifting forces subjected to roofing structures is a better approach to surviving perils caused by seismic or wind forces.
Our Mission

The **Mission** of the Bronco Construction Research Center is to:

- Advance construction body of knowledge through innovative research
- Distill research results into best practices that can be implemented by industry
- Educate the next generation of construction researchers by engaging doctoral, masters, and undergraduate students in BCRC research
- Transfer technology to industry through product development and through knowledge dissemination (publications, workshops, and seminars)
Research Initiatives

A few of our Research Themes:
• Advanced Construction Methods
• Smart and Innovative Construction Materials
• Resilient Structural Systems
• Sustainable and Green Design of Structures
• Energy Consumption and Renewable Energy
• Smart Buildings and Structures
• Safety Processes and Equipment
• Asset Management (operation and maintenance)
• Life-Cycle Analysis
• Advanced Wood Engineering Research.
Organizational Dashboard

- **DIRECTOR**
  - Mr. Brian Montgomery

- **GOVERNMENTAL PARTNERS**
- **EXTERNAL FUNDING/PARTNERS**
- **INDUSTRY PARTNERS**
- **WMU PARTNERS**
- **RESEARCH STAFF**
- **CONSULTANTS**
- **DEFINE RESEARCH THEMES**
- **ADVISORY BOARD**

**BRONCO CONSTRUCTION RESEARCH CENTER**
Senior Staff

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Equipment

*Dynamic Wind Uplift Table 12’ x 24’*:

- The only dynamic wind uplift table in the United States
- Provides vacuum pressures exceeding 200psf
- Five levels of protocol (A-E) can simulate Category V hurricane fatigue loading
- Tests comprise 19 hours of fatigue loading
Dynamic Wind Uplift
Equipment

**Monotonic Wind Uplift Table 8’ x 8’**:  
- Provides vacuum pressures exceeding 200psf  
- First step in testing various novel wind engineering experiments  
- Monotonic pressure levels may be held according to client specifications
Equipment

Load Frame:
• 100kip vertical actuator (can accommodate full-scale prestressed/precast bridge beams)
• 22kip horizontal actuator (may be used in shear wall studies, earthquake simulations, landing gear impact/fatigue studies)
• Fully adjustable framing to accommodate various vertical and horizontal fixturing
Equipment

**Instron Tensile Testing:**
- 22kip
- 15gpm hydraulic flow rate
- Material strength testing including tension, bending, durability and compression (monotonic or dynamic)
- 3500 servo-controller with advanced software
Facility

Our facility offers all the comforts of an advanced research laboratory and them some. The Bronco Construction Research Center is equipped so faculty/staff may have a virtual presence while experiments/tests are being conducted. Some of our amenities are:

• Room to accommodate visiting faculty and staff office requirements
• Kitchen/break area
• Conference room (VTC capable)
• Secure and non-secure WiFi
Associations

**American Association of Wind Engineers**

AAWE Corporate Members

**ASTM International**

Welcome Western Michigan University

ASTM Content

Books & Journals

Other Publishers

- My Standards (2)
- My Documents (0)
- My Draft Standards (0)
- My Documents (0)
- Standards (0)
- Standards (0)
- Publications in Draft with Me (0)
Publications and Papers

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**Uplift Capacity of Light-Frame Rafter to Top Plates Connections Applied with Elastomeric Construction Adhesives**

Bilal Alhawasneh, S.M.ASCE; and Xiyuan Shao, P.E., M.ASCE

Abstract: The effects of the application of elastomeric construction adhesives on the uplift uplift resistance of light-frame wood connections were investigated and are presented in this paper. Previous research has revealed that proper roof-shear connections play a crucial role in ensuring the durability of the light-frame building. However, testing has not been conducted on the uplift resistance of these connections when elastomeric adhesives are applied. The uplift uplift resistance was determined and compared to the effectiveness of the two adhesives (i.e., polymer-based and polyurethane) when applied to 1 connections. Experimental studies show that the addition of adhesives allowed both to meet higher uplift load capacities (200%, 400%) and significantly increase the uplift capacity to exceed the energy dissipation by nearly half-load, to reduce uplift uplift capacity. This allowed increased performance of the connections.

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**Test Setup Development for Lateral Loading Experiment of Light-Frame Wood Shearwall**

Based on ASTM Standards

Brian Montgomery, Director
Ph.D., Bilal Alhawasneh, Research Associate
Ondrej Pukarovic, Mechanical Engineer

Bronco Construction Research Center (BCRC)
Western Michigan University (WMU)

2020

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**Fatigue performance of wood frame roof-to-wall connections with elastomeric adhesives under uplift cyclic loading**

Bilal Alhawasneh, Xiyuan Shao

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**Engineering Structures**

Journal homepage: https://www.editorialmanager.com/engstruk/default.asp

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**Western Michigan University**

Website: uwsrc.wvu.edu/construction-research

Phone: 269-276-2045

Address: 2413 E Kilgore Rd. Kalamazoo, MI 49008

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Publications and Papers

**Western Michigan University**
Bronco Construction Research Center

**Title:** Fire Safety in Smart Building – 4D Fire and Smoke Simulation

**PI:** William W. Lou, PhD
Professor of Aerospace Engineering
Mechanical and Aerospace Engineering Department
Western Michigan University

**Report Number (use your project number here):** 17-1

**Date:** 30 September 2018

**Title:** Means and Methods for Improving Structural Integrity of Roof Systems

**PI:** Upal Arranayake, Ph.D., P.E.
Kanchan Banmaya, M.Sc.

**Report Number:** 17-8

**Date:** October 31, 2018

**An Innovative Application of Construction Adhesives to Enhance Resilience of Wood Residential Buildings to Natural Hazards — Part I:**

Uplift Capacity of Light-Frame Rafter to Top Plate Connections with Construction Adhesive Application

**PI:** Xiaoyu Shao, Ph.D., PE

**Report Number:** 17-3 (1)

**Date:** 09/20/2018
Publications and Papers

Title: A Holistic Framework to Support Compliance Checking in the Construction Domain

PI(s): Wawzi Shon

Report Number: 17-4

Date: 1/10/2019

Title: Fire Safety in Smart Building

PI(s): William W. Liu, PhD
Professor of Aerospace Engineering
Mechanical and Aerospace Engineering Department
Western Michigan University

Report Number: 18-5

Date: 30 September 2011

Title: Development of a Simulation and Experimental Environment for Evaluating Structural Performance under Wind Loads

PI(s): Upal Atta Ray, Ph.D., P.E.
William Lion, Ph.D.

Report Number: 18-2

Date: December 31, 2019
Publications and Papers

A Simulation-based Investigation of Adhesive Construction to Enhance Hazard Resilience of Wood Frame Residential Building

PI: Xiaoyun Shao, Ph.D., PE
Graduate Research Assistant: Sharthak Bhandary

Report Number: 18-3
Date: 12/05/2019

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Title: Means and Methods for Improving Structural Integrity of Roof Systems

PI(s): Upul Attanayake, Ph.D., P.E.
Kanchani Basnayake, M.Sc.

Report Number: 17-8
Date: October 31, 2018
Questions?