CFS-NHERI

(Cold-Formed Steel – Natural Hazards Engineering Research Infrastructure)

Opportunities for Payload Projects

T.C. Hutchinson (UCSD), B.W. Schafer (JHU) &
K.D. Peterman (UMass) – Diaphragm Companion Project

December 11 2017

NHERI@UC San Diego User Workshop

American Iron and Steel Institute

CFS-NHERI

Who NSF, UCSD, JHU, UMASS, CFSRC, AISI, SFIA (more)

What New $996,358 NSF-funded research project to advance understanding of the seismic/lateral response of mid-rise CFS-framed buildings in order to advance resilient and sustainable building systems

Where UCSD including NHERI shake table facility and JHU

When 2017-2021, (building, system-level) shake table tests in 2019

Why CFS framing shows great potential as a modern building system; however, the response is different from skeletal framing systems and new understanding and tools are needed, particularly to quantify and utilize the large contributions from non-designated seismic systems

How Experiments from the fastener scale up through full-scale mid-rise building shake table tests supported by modeling across the same scales and extending to larger suite of CFS-framed archetype buildings

CHS-NHERI builds upon the PIs efforts in CFS-NEES, CFS-HUD, and BNCS-NEES

CFS-NHERI will

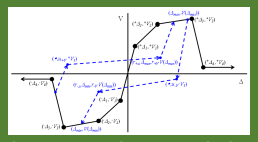
Engage Industry, develop and support codes and standards for seismic CFSF

- Technical Adv. Board
- Testing standards
- Modeling standards
- Seismic design proposals

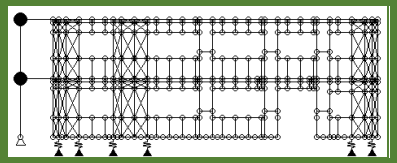
Provide new Archetype Designs

- Archetypes create our system definition
- Opportunity to be forward leaning
- Help define the bounds of what is possible and what needs developing

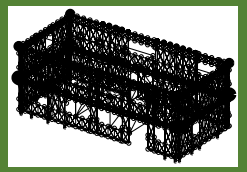
Enable modeling for better building design

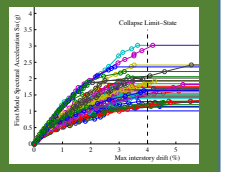


hysteretic models



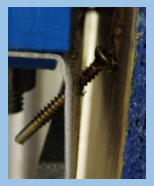
validated wall line models





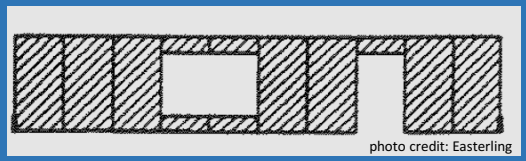
building models IDA

Improved tools, engine for new design methods, better R, R_s



Fastener

cantilever response



shear walls and wall line resposne

Wall line & (diaphragm) tests

Full mid-rise shaking

System identification..

Benchmark whole building, shake table tests

Specific CFS-NHERI Tasks

- Kickoff meeting and Technical Advisory *(October 2017)*
- Task 1: Quantify Lateral (Cyclic) Performance of CFS Wall Systems w/Shear Walls

2018

  a) Small-scale Fastener-Sheathing Testing & Isolated Wall Testing ***Spring 2018 JHU***
  b) Subsystem Wall-line Tests ***June-July 2018 NHERI@UCSD***

- Task 2: CFS-Framed Total Building System Seismic Performance Assessment via Full-Scale Shake Table Testing ***Fall 2019 NHERI@UCSD***

2019

  - Payload opportunity: Post-Earthquake Fire Performance Investigation

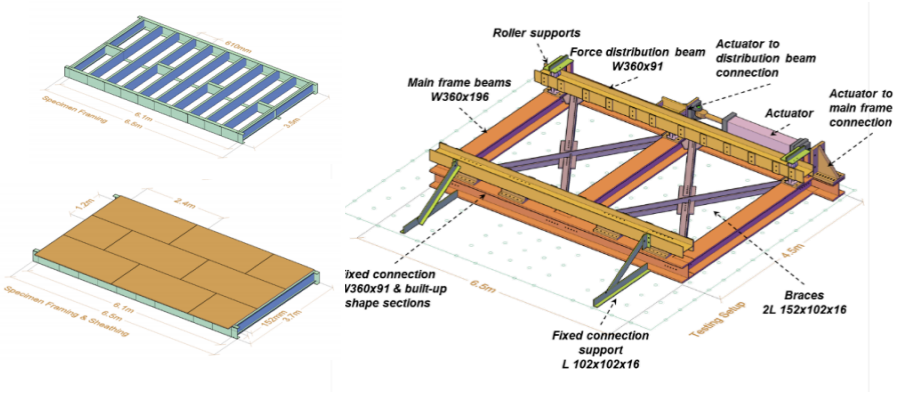
- Task 3: Numerical Modeling
  a) Extending fastener-based proxy models
  b) Advancing stiffness, strength, and cyclic response of CFS members in OpenSees
  c) Supporting testing and developing building-scale models
  d) Incremental Dynamic Analysis and P695 Evaluation
- Task 4 Technology Transfer

CFS-NHERI: Diaphragms (Extension)

Nov-Dec 2018 NHERI@UCSD

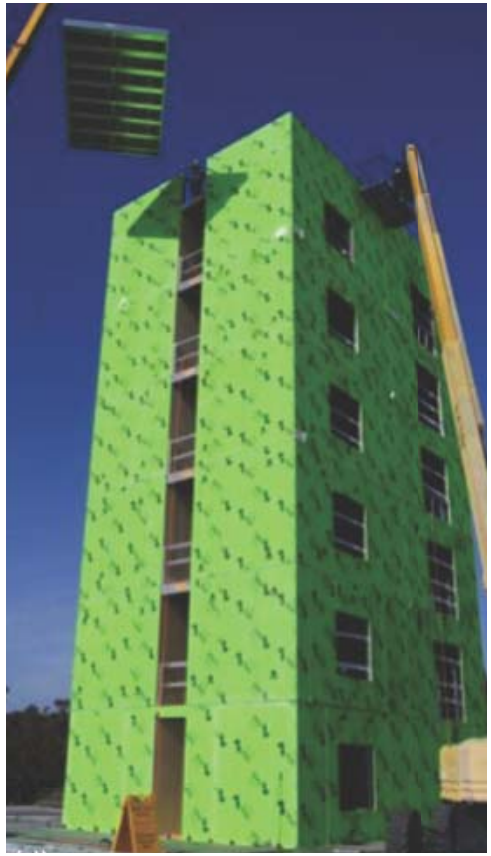
- Current data is limited and focused on OSB sheathed CFS joist diaphragms only
- New diaphragm design methods in ASCE7 do not provide for CFS floor systems
- Diaphragm-vLFRS interaction has been observed as influential, but not characterized for CFS framing
- New diaphragm solutions are now available

- Test diaphragms from CFS-NHERI building separately, establish all the pieces
- Explore diaphragm specific issues (openings, mass, etc.)

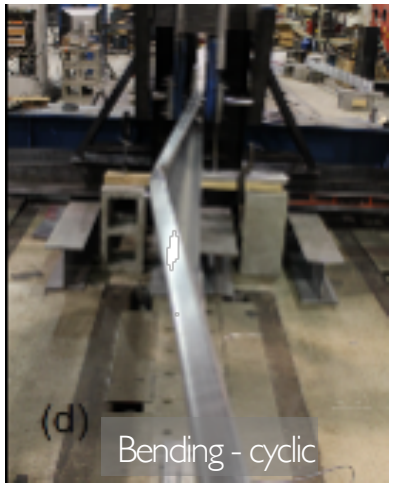


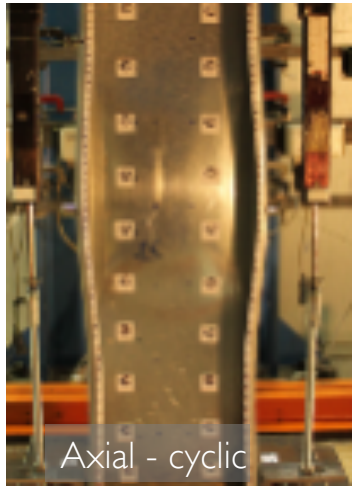
CFS-NHERI Opportunities for Payload Projects

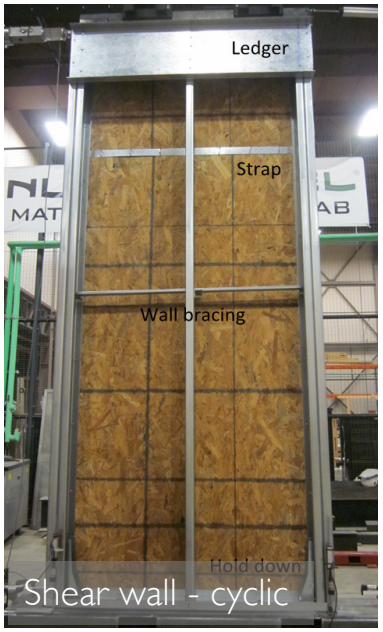
- The most prominent opportunities would exist in 2019 with the planned full-scale mid-rise building tests
  - New sensors distributed within test building
  - Specific nonstructural components/systems seismic and/or fire performance
  - New system identification analysis strategies
  - Video image analysis of damage (exterior damage to finishes should be pronounced at early intensity level)
  - ….

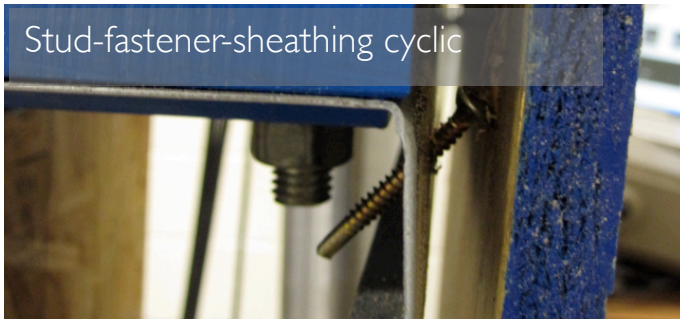


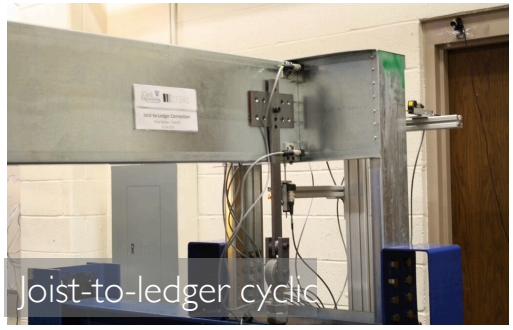
CFS-NEES Testing





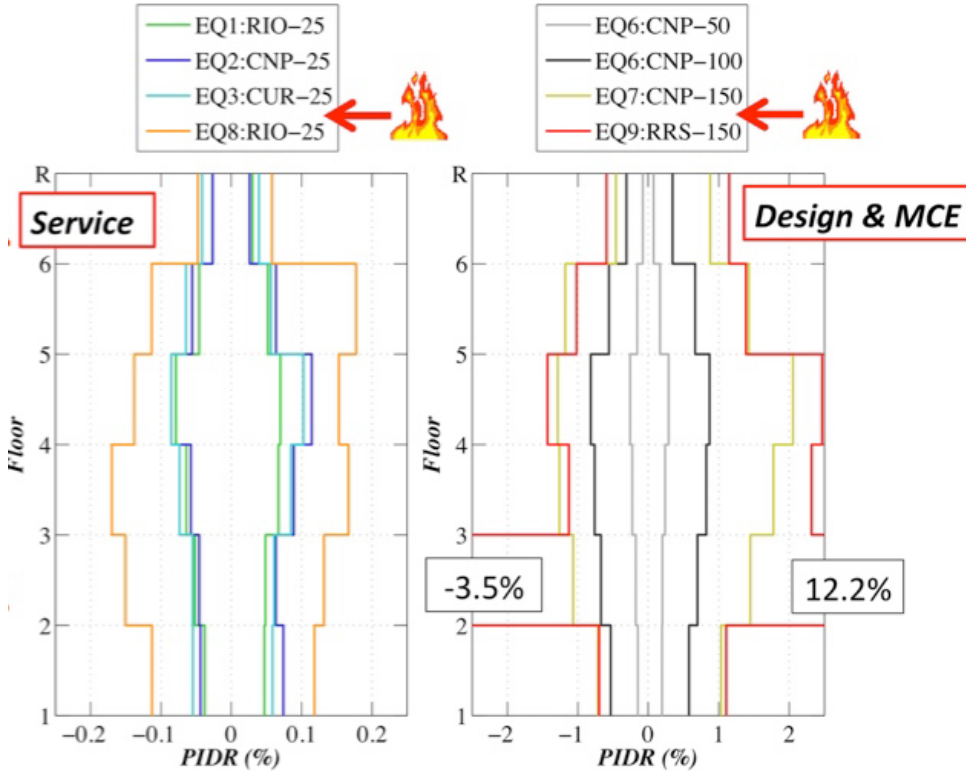






CFS-NEES testing benchmarked system response, and enabled multi-scale models, kicked off new understanding

CFS-HUD Testing



CFS-HUD benchmarked mid-rise performance, demonstrated efficacy of unique CFS steel sheet shear wall system, demonstrated drift potential under extreme demands, made new ground in fire