User Experience

NHERI Lehigh Researcher Workshop

December 9, 2021

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Associate Professor, University of Oklahoma
PROPOSAL WRITING
& PLANNING
Nov. 2015
Met Dr. Ricles at NSF-sponsored workshop in Japan

Dec. 5-6, 2016
Attended NHERI Lehigh Research Workshop

Jan. 2018
Submitted internal proposal; selected!

Submitted internal proposal; not selected

Internal (OU) competition for NSF EPSCoR Track-4 program announced; contacted Dr. Ricles

March 2018
Submitted proposal to NSF w/ input from Drs. Ricles and Kusko; proposal not funded

March 2019
Re-competed internally, selected, and submitted revised proposal with feedback

Dec. 2019
Project Funded!

Award Period
10/2022 – 9/2021

Overview

- Investigate the multi-directional nonlinear dynamics of floor isolation systems (FISs) used to reduce seismic force demand and protect vital building contents.
- Rigorously evaluate a design methodology for multi-functional FISs incorporating building-FIS interactions.

Scope

- Perform large-scale FIS characterization tests to experimentally validate physics-based mathematical models.
- Perform large-scale real-time hybrid simulations to quantify the performance of FISs which incorporate multi-scale building-FIS interactions.
- Use of the Real-time Cyber-Physical Structural Systems Laboratory (CPSSL)
Table 1: Overview of project timeline. Host site visits are indicated by gray shading.

<table>
<thead>
<tr>
<th></th>
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<tbody>
<tr>
<td>10 11 12</td>
<td>1 2 3 4 5</td>
<td>6 7 8 9 10 11 12</td>
</tr>
<tr>
<td>Task 1</td>
<td>Task 2</td>
<td>Task 3</td>
</tr>
<tr>
<td>Documentation/Dissemination</td>
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</tbody>
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Table 2: Project timeline. Host site visits are indicated by gray shading.

<table>
<thead>
<tr>
<th>Activity</th>
<th>Month (2020)</th>
</tr>
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<tbody>
<tr>
<td>RTHS Primer</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>RTHS Hands-on Training</td>
<td>1(a) 1(b)</td>
</tr>
<tr>
<td>FIS Testbed Design/Fabrication</td>
<td>2(a) 2(b)</td>
</tr>
<tr>
<td>Assembly and Characterization Testing</td>
<td>3(a)</td>
</tr>
<tr>
<td>RTHS FIS Experimental Trials</td>
<td>2(c) 3(a)</td>
</tr>
<tr>
<td>Data Processing / Manuscript Preparation</td>
<td>3(b)</td>
</tr>
<tr>
<td>Debriefing and Proposal Planning</td>
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</table>

Covid-19 lockdown!

https://beta.nsf.gov/funding/opportunities/epscor-research-infrastructure-improvement-track-4-epscor-research-fellows
RII Track-4: Quantifying Seismic Resilience of Multi-Functional Floor Isolation Systems through Cyber-Physical Testing [OIA-1929151]
PHASE 1 (SUMMER 2020)
Experimental Substructure

Numerical Substructure (5x Deformation Scale)

Real-Time Hybrid Simulation of Flexible Equipment
Isolated via a Rolling Pendulum (RP)-based Isolation System
Nominal QuakeCoat Treatment w/ 240-lb proof mass
78.7-in.-Tall Flexible Equipment (5 Hz, 2% damped)
0.75x VERTEQII per GR-63-CORE
Supported by NSF Award No. OIA-1929151
Experimental Substructure

Numerical Substructure (5x Deformation Scale)

Real-Time Hybrid Simulation of a 3-Story Steel MRF Building with a Rolling Pendulum (RP)-based 50-kip Floor Isolation System (FIS) on the First Floor

2-Layer QuakeCoat Treatment w/ 143-lb proof mass
Impact Model w/ 5-in. gap (13.75 lb/in.)
1x El Centro, Imperial Valley Irrigation District substation, 1940
Supported by NSF Award No. OIA-1929151
PHASE 2 (SUMMER 2021)
Multi-Directional RTHS Testing

(3) Actuators

Shake Table

3000-lb Payload

Isolation System

(3) Restraint Points
Multi-Directional RTHS Testing
Multi-Directional RTHS Testing
Acknowledgements

• This material is based upon work supported by the National Science Foundation under Award Nos. CMMI-1663376, OIA-1929151, and CMMI-1943917. This support is greatly appreciated.

• Thanks to WorkSafe Technologies for providing the isolation systems used for this research.

• Thanks to NHERI Lehigh EF for the use of their laboratories and technical expertise.
Thank You! Questions?

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