Natural Hazards Engineering Research Infrastructure

QUARTERLY NEWSLETTER
NEWS FROM THE NHERI COMMUNITY
SUMMER 2020

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ASCE LIFELINES CONFERENCE
University of California, Los Angeles, CA

August 15-18, 2021
GEO-EXTREME 2021
Savannah, GA, USA

FOLLOW US AND JOIN THE NATURAL HAZARDS ENGINEERING COMMUNITY!

DESIGNSAFE-CI
NHERI: NATURAL HAZARDS ENGINEERING RESEARCH INFRASTRUCTURE

Data Papers and Data Reuse Magnify Research Impact

DesignSafe serves as valuable hub for natural hazards research

One way of measuring the impact of DesignSafe is by identifying research papers that cite the use of DesignSafe or the data available at DesignSafe.

Table 1 lists identified citations during 2018, 2019, and up until May 31, 2020 as determined from papers identified via Google Alerts.

The first column represents papers that make any reference to DesignSafe through citation of the DesignSafe marker paper (Rathje et al. 2017) or through the acknowledgements.

The next column represents papers in which a researcher cites their own data in DesignSafe as a part of the original research project, and the third column represents papers that re-use data available in DesignSafe after the original project is over.

Note that a paper may contribute to multiple columns in Table 1. For instance, a data re-use paper may also reference the marker paper, or a paper may cite more than one dataset. There is a meaningful number of total citations that reference the use of DesignSafe and the data published in DesignSafe.

While Google Alerts may not capture all of the citations and mentions of DesignSafe datasets that are available in the literature, the positive trend highlights the value of publishing data, the importance of citing data in the references using DOIs, and the types of research being conducted using data published in DesignSafe.

Table 1. Scholarly Citations of DesignSafe
(up to May 31, 2020)

Year	DesignSafe Citation	Primary Data Use	Subsequent Data Reuse	Totals
2020	18	42	3	63
2019	20	29	26	75
2018	26	31	12	69

DATA REUSE VIGNETTES

From continuing work on established lines of research to validating numerical models and testing new hypotheses, data reuse can take many forms.

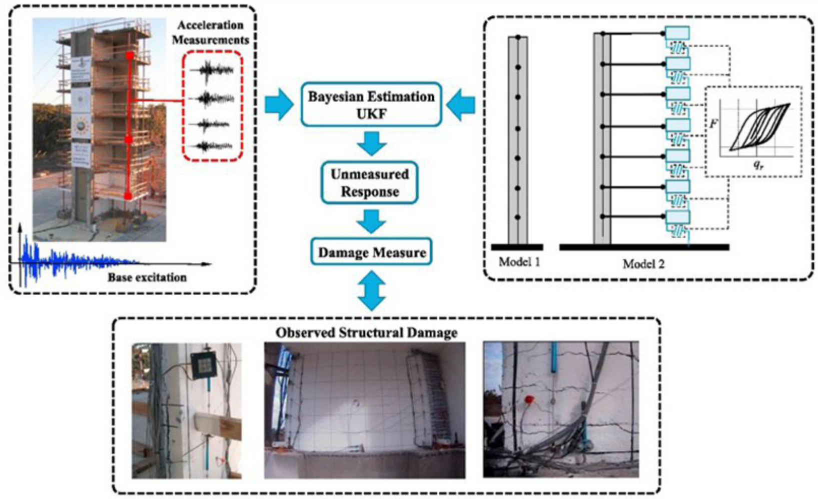
To learn more about the motivations for data reuse, we interviewed a handful of DesignSafe data consumers. The following cases exemplify how the variety of data published in DesignSafe supports diverse data reuse scenarios to advance the field of Natural Hazards Engineering.

MODEL VALIDATION

Dr. Kalil Erazo and his colleagues from Rice University and Tufts University have repeatedly used data from the experimental project "Shake Table Response of Full Scale Reinforced Concrete Building Slice" (Panagiotou et al. 2013, doi.org/10.4231/D35T3G04T) to validate a Bayesian-modeling approach that couples experimental measurements with a numerical model of the system.

This approach has the potential to improve predictions of the seismic response of large structures and the evaluation of quantitative measures of structural damage (Erazo et al. 2019, Erazo and Nagarajaiah 2019).

The unique experimental data comes from a full-scale, seven-story building subjected to earthquake motions of varying intensity. While it took time to gather the subset of acceleration data from this very complex dataset, the team found all the data and the metadata that they needed to complete their research in the published dataset available in the DesignSafe Data Depot.



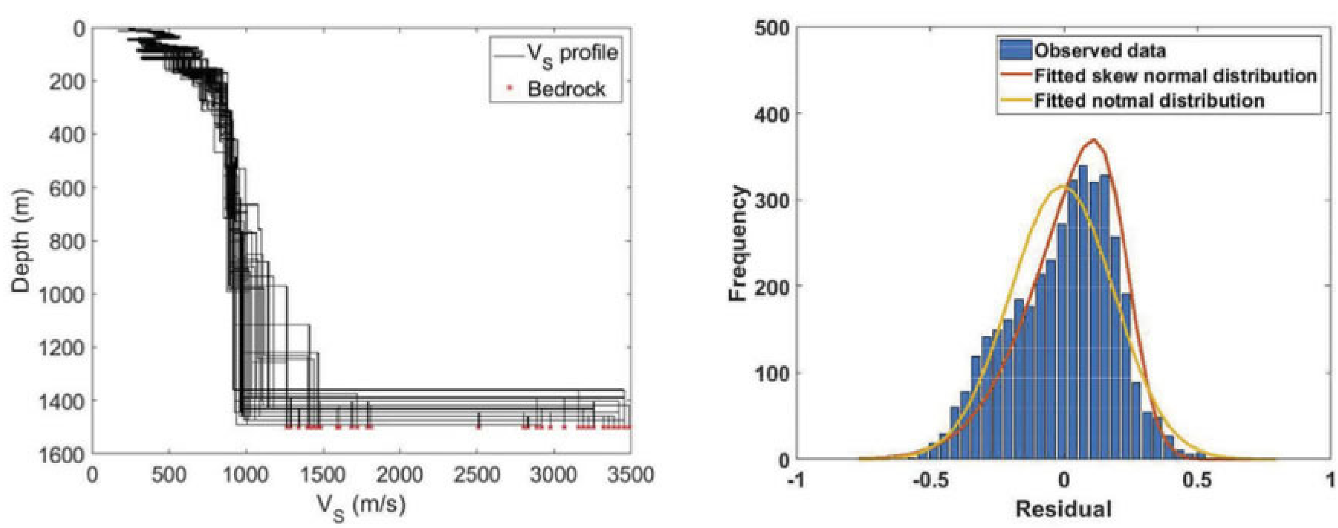
Research by Erazo et al. (2019) that used experimental data from Panagiotou et al. (2013)

FIELD CHARACTERIZATION DATA

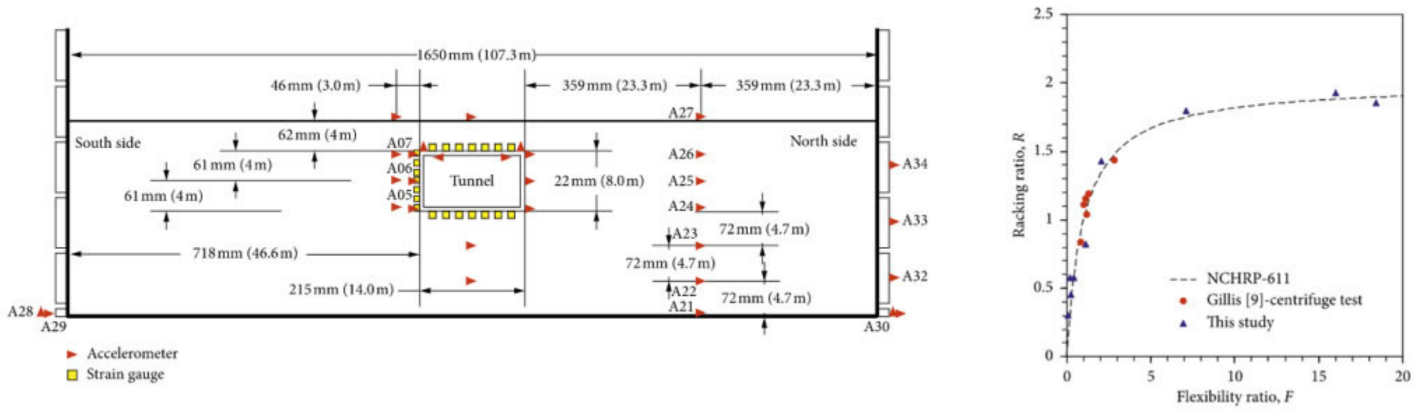
Field characterization datasets such as the subsurface geotechnical dataset from the DesignSafe project "Dynamic Characterization of Wellington, New Zealand" project (Cox and Vantassel 2018, doi.org/10.17603/DS24M6J) can be exploited for a variety of purposes.

Although the data collected by Cox and Vantassel (2018) was collected to understand earthquake shaking in Wellington, New Zealand from the 2016 Kaikoura earthquake, Dr. Rodriguez-Marek and his colleagues at Virginia Tech used the data to represent the statistical uncertainty of the shear wave velocity (Vs) at a site for use in ground response analysis.

In Bahrampouri et al. (2019), they calculated the statistical distribution of site amplification functions (AF) given the statistical distribution in Vs, and demonstrated that the resulting AF distribution is skewed.



Research by Bahrampouri et al. (2019) that utilized the processed data published by Cox and Vantassel (2018)



Research by Sadiq et al. (2019) that used the experimental data published by Gillis et al. (2014) to validate a numerical approach for analyzing tunnels.

This finding has the potential to improve probabilistic seismic hazards analyses (PSHA) that include site response. Rodriguez-Marek and his colleagues were able to easily use the published data because it included not only the raw geophysical data, but also the processed results representing the range of Vs profiles.

VALIDATION OF NUMERICAL APPROACH

Availability of open, curated datasets are fundamental to those researchers who do not have the resources to conduct large-scale experiments.

Such is the case for Dr. Duhee Park and his students at Hanyang University in South Korea. Their research group studies various effects of earthquakes on tunnels, and they were looking for experimental data regarding the seismic response of a tunnel system.

In their published research (Sadiq et al. 2019) they used Gillis et al. (2014, doi.org/10.4231/D3JQ0SW10) published data from a geotechnical centrifuge test that investigated the seismic response of a shallow cut and cover tunnel in sand to validate a widely used Equivalent linear (EQL) analysis approach for seismic analysis of tunnels. They found the experience of retrieving the recorded responses and corresponding ground motions easy and fast due to the clear organization of the dataset.

SUMMARY

We learned from these researchers that it is useful for relevant data and metadata to be available online in one reliable location.

Although these researchers often learned about the datasets from journal papers or conferences, it was important that they could easily access the datasets electronically without contacting the original authors. Their testimony highlights the lasting value of the datasets that continue to be used decades after they are published.

DesignSafe is eager to continue helping and encouraging data publishing and reuse activities. Citing the data in the reference section of papers using the data DOI/citation language provided by DesignSafe is a fundamental piece of promoting data impact and reuse.

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Sadiq, S., Nguyen, Q., Jung, H., and Park, D. (2019). "Effect of Flexibility Ratio on Seismic Response of Cut-and-Cover Box Tunnel." Advances in Civil Engineering, vol. 2019, July 2019, pp. 1–16. DOI.org (Crossref), doi.org/10.1155/2019/4905329.

Collaborative Research Boosts Resilience in Cascadia Subduction Zone

Bio-mediated soils improve liquefaction resistance in the north Portland area

As detailed in Oregon's 2013 Resilience Plan, the likelihood of an M9 Cascadia earthquake occurring during our lifetimes, and the consequences of such an earthquake, are significant.

Similar to other North American coastal regions with loose alluvial soils, the Portland, Oregon, area is prone to liquefaction during a strong earthquake. Liquefaction occurs when intense ground-shaking increases water pressure in saturated cohesionless and low plasticity soils, causing the soil to lose strength and stiffness suddenly — and turn temporarily to a viscous fluid. In places such as Christchurch, New Zealand, and Palu, Indonesia, liquefaction has caused catastrophic infrastructure losses in recent earthquakes.

Dr. Diane Moug (CoPI from PSU) logging the retrieved soil samples with graduate students from Portland State University and Arizona State University. From left to right: Diane Moug (PSU CoPI), Melissa Preciado (PSU graduate student), Elizabeth Stallings Young (ASU graduate student), Kayla Sorenson (PSU graduate student).

OVERVIEW

Geotechnical engineers from Portland State University are focused on improving vulnerable soils around Portland, which is located uncomfortably near the off-shore Cascadia Subduction Zone. Principal investigator Arash Khosravifar and co-PI Diane Moug, both assistant professors in the PSU Department of Civil and Environmental Engineering, are evaluating a new ground improvement technique for mitigating liquefaction.

The improvement technique employed was developed by Arizona State University (ASU) researchers at the Center for Bio-mediated and Bio-inspired Geotechnics (CBBG), a National Science Foundation Engineering Research Center. Called "microbially induced desaturation," or MID, it is a cost-effective, low-impact ground improvement method that could be used relatively easily under existing structures. The method works by encouraging the growth of gas-producing bacteria in soil, thereby desaturating the soil and reducing the potential for triggering of liquefaction.

To test the MID ground improvement technique, the project deployed the mobile shaker equipment available from the NHERI equipment facility at the University of Texas at Austin (NHERI@UTexas).

PROJECT IMPACT

Field data collected in this multidisciplinary, multi-institutional project suggests that the MID method can substantially desaturate the silty soils that are prone to liquefaction in the Portland area. If the induced desaturation can be shown to be well distributed and persistent, the technique promises to keep Portland area soils stable, even during intense ground shaking, with low environmental impact and expense.

This is particularly important in Portland where important infrastructures are located on potentially liquefiable soils. The Portland International Airport and the Critical Energy Infrastructure (CEI) hub, where 90% of the state's fuel supplies are handled, are located on liquefaction-prone grounds.

"Other mitigation efforts are more expensive, and a lot of times you can't apply them to existing structures," says Khosravifar. "This could be a game-changer in mitigating liquefaction risk not just in Portland, but all over the world."

IMPACT Field data from the project suggests that the MID method can substantially desaturate silty soils prone to liquefaction in thePortland area.

If the desaturation proves to be well-distributed and persistent, the technique promises to keep Portland area soils stable, even during intense ground shaking, with low environmental impact and expense.

If validated, the MID technique may well prevent worst-case scenarios dreamed up for an M9 earthquake in the region: For instance, soils liquefying under the Critical Energy Infrastructure (CEI) hub could collapse and rupture fuel tanks, leading to fires and an environmental disaster in the nearby Willamette River — not to mention the loss of vital fuel supplies.

Usually, improving soils under existing structures is simply too expensive to consider. But instead of vibrating or pounding the liquefiable soil into a stiffer, and more resistant state (the conventional means for mitigating liquefaction), the CBBG-developed technology subtly uses the existing microorganisms in the soil. CBBG researchers designed the treatment procedure and provided technical support during treatment and monitoring for this project.

RESEARCH METHODOLOGY

One of the two sites selected for study was a 62-acre habitat restoration area owned by Portland General Electric in Portland known as Harborton, which is located near Oregon's CEI hub. The similarity of soil-types provided an opportunity to determine if the MID soil remediation treatment could address one of Oregon's most serious resiliency concerns. The second site was situated near the Portland airport.

At both sites, engineers fertilized a patch of ground by injecting nutrients down a pipe 6 to 20 feet below the surface. As the nutrients seep into the soil, they stimulate the growth of "nitrate-reducing" bacteria — native communities of microbes that, as they metabolize, produce two environmentally benign gases, nitrogen and carbon dioxide. Like yeast in bread dough, this process creates gas pockets in the soil. The compressibility of the gas inhibits water pressure build up in the soil — a precondition for liquefaction.

"Desaturation is significantly cheaper than conventional ground improvement techniques because a small volume of gas is sufficient for liquefaction resistance and there is a growing body of evidence showing that desaturation is persistent with our method," says Edward Kavazanjian, director of the CBBG.

To assess the state of the treated soil before and after the MID ground improvement, sensors were placed in the ground to measure the biochemical conversion and degree of saturation. The two mobile shakers from NHERI@UTexas, T-Rex and Rattler, made geophysical measurements and simulated a series of earthquakes. The UTexas team also held a workshop to illustrate the use of mobile shakers for monitoring stiffness-based ground improvements.

At one of the two sites, the team installed cross-hole sensors which measure the speed at which compressional waves, or P-waves, travel through the ground. The P-wave velocity is directly related to the soil saturation, and regular measurements of the P-wave velocity have enabled long-term monitoring of the process performance. Before and after the ground was treated with the MID process, the team measured and analyzed the collected P-wave data, which showed a significant reduction in P-wave velocity, indicating that the microbial process effectively desaturated the soils.

Dr. Ken Stokoe, director of NHERI@UTexas and UT CoPI, explaining in situ field shaking with TREX during a field demonstration on September 10, 2019 at the field trial site by the Portland airport.

Researchers from Portland State University and NHERI@UTexas at the field trial site by Portland airport. From left to right: Arash Khosravifar (PSU CoPI), Andrew Valentine (technician NHERI@UTexas), Ken Stokoe (UT CoPI and NHERI@UTexas director), Robert Ken (technician NHERI@UTexas), Kayla Sorenson (PSU graduate student), Diane Moug (PSU CoPI), and Benchen Zhang (UT graduate student).

Project team at the project/NHERI workshop on September 10, 2019 in Portland, OR. From left to right: Farnyuh Menq (operation manager, NHERI@ UTexas), Benchen Zhang (graduate student, UT), Melissa Preciado (graduate student, PSU), Diane Moug (CoPI, PSU), Kayla Sorenson (graduate student, PSU), Leon van Paassen (CBBG), Yumei Wang (Oregon Department of Geology and Mineral Industries), Edward Kavazanjian (director of CBBG), Soheil Kamalzare (Condon Johnson and Associates), Dominic Parmantier (Condon Johnson and Associates), Ken Stokoe (director of NHERI@ UTexas), and Arash Khosravifar (CoPI, PSU).

T-Rex and Rattler were used to induce earthquake-like ground motions in the treated soil strata, during which water pressures and soil deformations were measured. Unfortunately, the induced shaking was not quite strong enough the generate significant pore pressure in the liquefiable soil strata.

“My co-PI, Diane Moug, and I enjoyed working with the UT team and CBBG researchers. Our workshop-field demo on September 10-11, 2019, using the T-Rex shaker was a great hit,” says Khosravifar.

Dr. Edward Kavazanjian, director of the Center for Bio-mediated and Bio-inspired Geotechnics (CBBG) at Arizona State University, presenting at the project/NHERI workshop on September 10, 2019 in Portland, OR.

Dr. Leon van Paassen from the Center for Bio-mediated and Bio-inspired Geotechnics (CBBG) at Arizona State University installing a solar-powered wireless data logger for embedded sensors that measure hydraulic conductivity and water content of the soil in situ.

“The workshop attracted a lot of local engineers and media, which was great for raising awareness about the liquefaction-prone soils in our region and our efforts to address the problem.”

THE FUTURE

The NHERI@UTexas team trained PSU graduate students on how to collect and analyze measurements from cross-hole seismic wave instruments installed in the treatment zone. The project team at PSU is now monitoring the persistence of the desaturation and is making plans to return to the site with T-Rex and implement measures to enhance the level of shaking to demonstrate the effectiveness of desaturation in mitigating liquefaction.

CROSS-DISCIPLINARY PARTNERSHIPS

The PSU research project, the CBBG, and the NHERI@UTexas mobile shaker equipment are all funded by the National Science Foundation. The collaboration demonstrates a growing convergence of research funded by NSF.

The study also included collaborators from the Oregon Department of Geology and Mineral Industries, Portland General Electric, Portland Bureau of Transportation and Portland Water Bureau, and industry partners including Geosyntec Consultants, Condon and Johnson Associates and ConeTec.

Centrifuge Model Testing Advances Viability of Rocking Foundations

Work spearheaded by NHERI at UC Davis leads to adoption of code provisions

In the past, many building owners and design engineers operated under the notion that a good foundation is one that does not move. But stiff and strong foundations can be expensive.

Research in the last couple of decades has shown that rocking foundations can absorb some of the ductility demand during earthquake loading and can be an economical and effective part of a seismic force resisting system for buildings and bridges.

A rocking foundation is designed to allow significant rotation of a footing during seismic loading; a gap is allowed to develop under the left edge of the footing when it rotates to the right and vice versa — the gap cyclically opens and closes, and the footing rocks back and forth.

IMPACT Model tests on the 1-m and 9-m radius centrifuges at the UC Davis experimental facility demonstrated that rocking foundations could be designed to reduce ductility demands on buildings and bridges during earthquakes.

These experimental data were central to the eventual adoption of code provisions accounting for the benefits and consequences of rocking foundations in practice.

OVERVIEW

Foundation rocking has two appealing characteristics: a self-centering tendency associated with the gap closure and an energy dissipation capability. However, the fundamental mechanisms and their behaviors for a range of soil and loading conditions was not well understood. In addition, the interactions between inelastic demands in the structural systems and nonlinear rocking demands on the foundations and their potential for accumulated settlement under rocking loads were complicating factors.

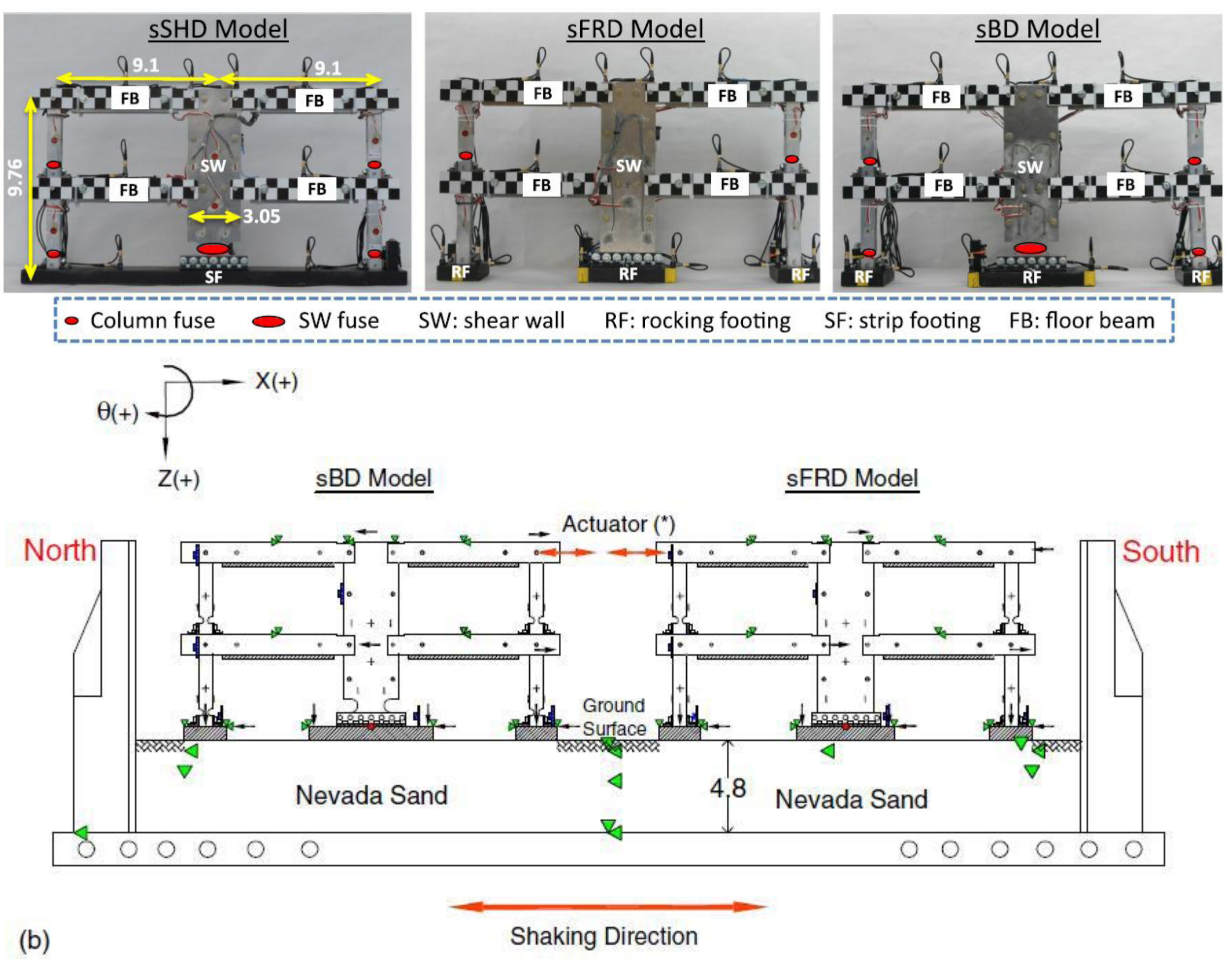

Figure 1. Frame wall-foundation models for testing on the 9-m centrifuge (Liu et al. 2015a)

Bruce Kutter, principal investigator and director (1996-2009) of the NEES geotechnical centrifuge at UC Davis, notes: “A concerted research effort in the international research community over the past 20 years, with centrifuge model testing under NEES and NHERI playing a major role, led to adoption of code provisions accounting for the benefits and consequences of rocking foundations (e.g., ASCE/SEI 2013).”

RESEARCH METHODOLOGY

Large-scale centrifuge models were an essential component of the research studies developing fundamental understanding and validation of analysis methods. One example is the work by Liu et al. (2015a, 2015b). Six different two-story-two-bay, frame-wall-foundation building models resting on dense sand were constructed and tested on the 9-m centrifuge (Figure 1) at the UC Davis facility.

The models represented low-rise structures for which the primary seismic lateral resistance was provided by a shear wall supported on a shallow foundation.

In cases where the moment capacity of the shear wall foundation is greater than the moment capacity of the shear wall itself, a hinge mechanism develops in the shear wall, which is consequently forced to absorb the majority of ductility demand (a hinging-dominated system).

In cases where the moment capacity of the foundation is less than that of the shear wall, the foundation acts as a fuse, and relatively large ductility demands are absorbed by the foundation rocking on soil (a rocking-dominated system).

The six models included two hinging-dominated systems, two rocking-dominated systems, and two balanced systems where the moment capacity of wall and its foundation are similar.

The models were subjected to slow cyclic (pseudo-static) loading in one series of tests, with moment rotation responses for the different components shown in Figure 2, and to dynamic earthquake shaking in another series of tests, with the moment rotation responses shown in Figure 3.

The shallow foundations for the shear walls and frame columns had reasonably well-defined moment rotation responses, consistent with those from a supporting series of tests of single-footing systems on the 1-m radius centrifuge (Hakhamaneshi and Kutter 2016).

The instrumentation consisted of vertical and horizontal accelerometers to define all inertial forces in the structural system and strain gages to define axial, shear, and moments in the key structural components.

The 1-m centrifuge was well-suited for rapid and economical testing of single footings, such that a wide range of footing shapes, sizes, soil types, and loading conditions could be parametrically examined economically.

The 9-m centrifuge, however, was required for constructing the holistic models shown in Figure 1, wherein small connection-scale details (e.g., beam-column plastic hinges), large building-scale frame action, and realistic nonlinear soil-structure interaction play important roles in the system behavior.

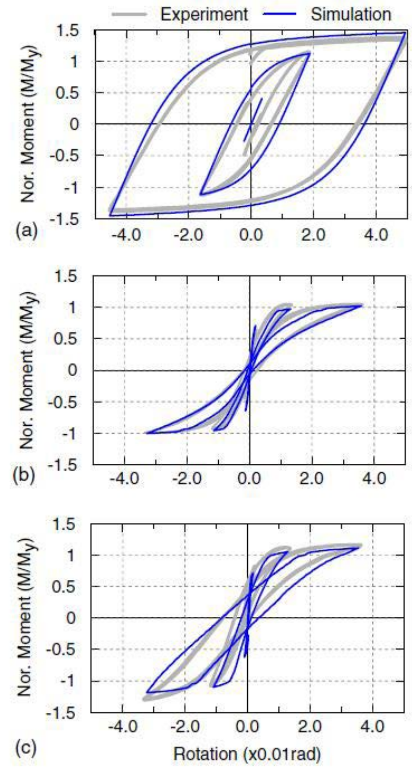

Figure 2. Hysteretic response of inelastic elements in the sFRD model: (a) column fuse at level 2, (b) shear wall rocking footing, and (c) column rocking footing (Liu et al. 2015a)

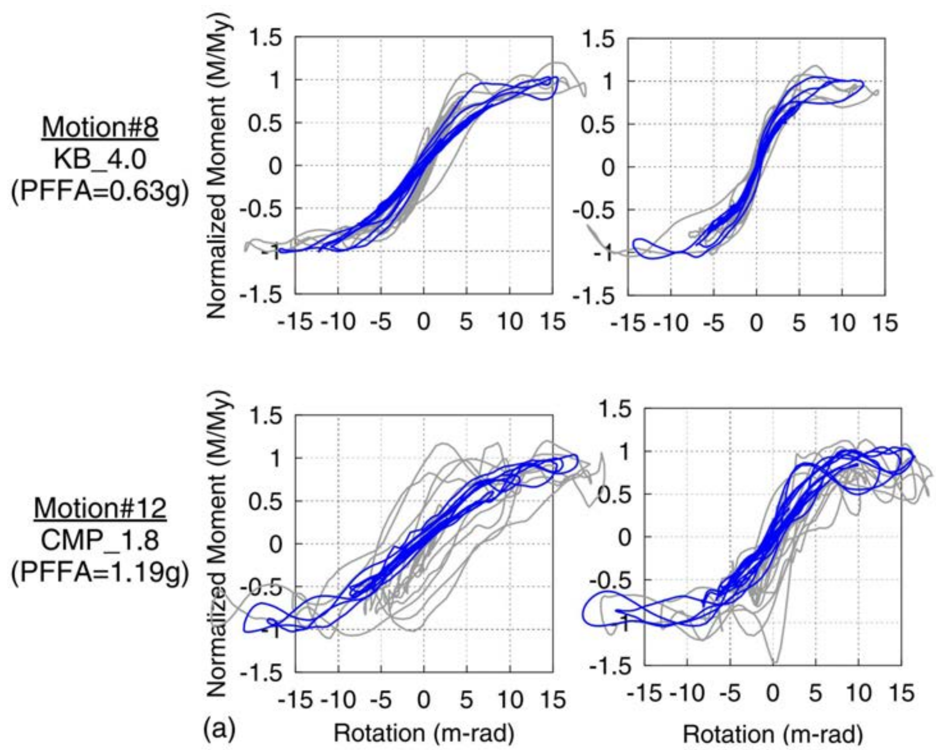

Figure 3. Hysteretic rocking response of shear wall footings during shaking with two for two input motions: measured response based on inverse analyses of sensor data (gray lines) and simulated responses from finite element analyses (blue lines) (Liu et al. 2015b)

PROJECT IMPACT

A common misconception about rocking foundations was that rocking foundations might increase the demand on the structure. The 9-m centrifuge building models showed that rocking foundations, if properly designed, could absorb much of the ductility demand and hence reduce the ductility demand on structural components. The slow cyclic tests on the model buildings demonstrated that the rocking-dominated systems had ductile and stable responses with very little strength degradation, and better re-centering than hinging-dominated systems.

The dynamic earthquake shaking tests at UC Davis by researchers from UC San Diego confirmed that the ductility demand on the shear wall component of the system decreases, and system performance improves, when demand is shifted from wall-hinging to the rocking foundation.

Furthermore, systems with rocking foundations sustained a smaller peak roof acceleration, residual drift, and reduced peak base shear despite the relatively larger peak transient drift demand. Consistent with slow cyclic test results, dissipated hysteretic energy was reasonably distributed amongst superstructure and substructure inelastic components if the capacity of the wall and its foundation are balanced (Figures 2 and 3).

These centrifuge models, with their holistic systems-level details, provided unique experimental data that was the basis for validating the ability of numerical simulation procedures to approximate nonlinearity in the structure and foundation. Numerical simulations showed comparable local and global response to measurements obtained during the experiments.

FOUNDATION ROCKING: OTHER OUTCOMES

Centrifuge model experiments like those described above, along with those performed by others (e.g., a set of companion tests on the NHERI outdoor shaking table at UC San Diego and 9-m radius at UC Davis; Figure 4) provided the basis for rapid development and implementation of design procedures for practice (Hakhamaneshi et al. 2016).

A Technology Transfer Team of practitioners with geotechnical and structural expertise related to buildings and bridges facilitated the project's impact on practice. From 2009 through 2015, this group of six people contributed significantly, including collaboration on revision of building code provisions that eventually allowed designers to use foundation rocking as an effective mechanism contributing to the seismic performance of buildings per ASCE/SEI 41 (2013, 2017).

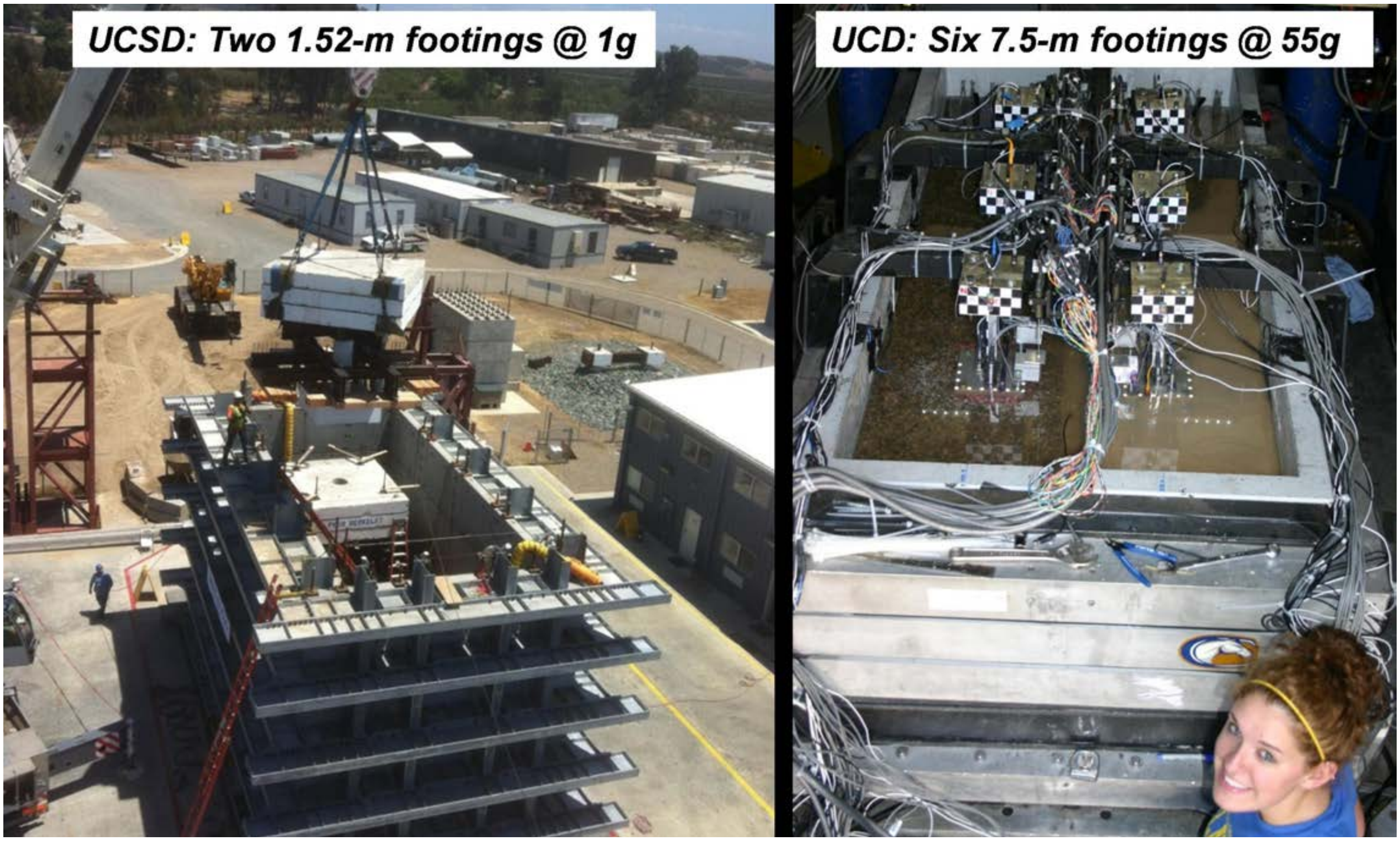

Figure 4. Rocking foundation tests: (a) on the NHERI 1g outdoor shaking table at UC San Diego (Antonellis et al. 2015), and (b) on the NHERI 9-m centrifuge at UC Davis (Allmond and Kutter 2014).

FOUNDATION ROCKING, continued

The Technology Transfer Team included:

- Mark Moore, ZFA Structural Engineers
- David Mar, Tipping Mar
- Lelio Mejia, URS Corporation
- Craig Comartin, CD Comartin, Inc.
- Dave Dwyer and Dean Browning, Charles Pankow Builders

The findings advanced the state of practice for design and for numerical modeling of soil-structure systems. The collaboration between students, faculty, and leading practitioners from industry provided a uniquely broad and influential experience for all the participants — especially the students. Participants included four faculty members, one post-doc, four graduate students, and two undergraduate assistants.

NEESR-CR: Design of Soil and Structure Compatible Yielding to Improve System Performance. Award Number: CMMI-0936503; Principal Investigator: Bruce Kutter, University of California, Davis; Co-principal Investigators: Tara Hutchinson (UC San Diego) and Mark Aschheim (Santa Clara University) and Sashi Kunnath (UC Davis). 10/01/2009 through 9/30/2013.

NEW TECHNICAL TRANSFER WHITE PAPER AVAILABLE ON LINE

NHERI's Tech Transfer Committee is committed to helping researchers, especial early career faculty, transform their research findings into practice.

The TTC's new white paper, "*Mechanisms for Implementation of NHERI Results*," focuses on tech transfer mechanisms for improving the performance of civil infrastructure during and after natural hazard events.

Download the white paper from the TTC web page.

Opportunity for researchers: Request a consultation with the Technology Transfer Committee at ttc-inquiry@design-safe-ci.org. Be sure to indicate the hazard involved.

EDUCATION CORNER

NHERI SUMMER INSTITUTE GOES VIRTUAL

Given NHERI site closures and travel bans due to the COVID-19 pandemic, the annual Summer Institute for Early Career Faculty has been rescheduled as a virtual event.

The free NHERI Workshop for Early Career Faculty takes place — online — June 29 and 30, 2020.

Karina Vielma, EdD NHERI Education and Community Outreach Research Fellow and Educational Specialist University of Texas, San Antonio

The Zoom-based program introduces early career faculty, graduate students and others to NHERI's experimental facilities and the faculty experts who manage them.

The day includes an overview of the NSF proposal process by Program Director Joy Pauschke and a panel of early career faculty researchers. Participants can also schedule one-on-one meetings with facility representatives on day two.

Find details and register at the DesignSafe Learning Center. The registration deadline is June 26.

NHERI'S REU PROGRAM ON ZOOM

Unfortunately, due to COVID-19 restrictions, NHERI's 2020 Research Experiences for Undergraduates program is rescheduled for next year.

Nevertheless, the Education and Community Outreach committee is planning a one-day summer session for prospective REU students.

The Zoom-based program will include introductions to NHERI research facilities and a meet and greet with REU alumni. Watch your email for details. Questions about NHERI's summer outreach programming? Contact Karina Vielma: karina.vielma@utsa.edu

2019 REU students with Prof. Kurtis Gurley at the University of Florida experimental facility.

2020 User Satisfaction Survey, Member Elections

As the community voice within the governance of NHERI, the User Forum is responsible for conducting the annual Community User Satisfaction survey for NHERI users and publish a subsequent Annual Community Report.

This year, users of the NHERI experimental facilities have received a survey link via email. The User Forum encourages users to complete the survey and forward the survey link to other NHERI users in their network, such as graduate students and co-PIs. Fill out the survey online here.

Past user satisfaction survey reports can be found on the User Forum page on DesignSafe. Measuring user satisfaction and providing this feedback to the NHERI Council is critical to supporting the long-term sustainability of NHERI and its mission as a multidisciplinary and multi-hazard network.

ELECTIONS

Member elections are also ongoing as member terms expire for three User Forum Committee Members. Our governing body represents your voice within NHERI, so thank you for casting your ballot to elect new members. We will announce our new leadership shortly.

The User Forum is grateful for outgoing leaders Elaina Sutley (past Chair and Secretary), Nina Stark (past Vice Chair), and Adda Athanasopoulos-Zekkos (Member) for their three years of service.

ABOUT THE USER FORUM

The User Forum is a NHERI-wide group focused on providing the NHERI Council with independent advice on community user satisfaction, priorities, and needs relating to the use and capabilities of NHERI.

Members on the User Forum represent the scientific and engineering communities who use NHERI's resources and services for research and/or educational purposes, but who are not directly affiliated with NHERI awardee institutions.

User Forum membership spans academia and industry, the full breadth of civil engineering disciplines, the social sciences, and widespread hazard expertise including earthquakes, windstorms, and water events.

Elaina J. Sutley, Ph.D. (Chair)

University of Kansas

Specializes in design and retrofit of wood buildings subjected to natural hazards, including seismic, wind, and water events, as well as building portfolio analysis, housing recovery modeling, loss estimation, social vulnerability, and interdisciplinary science.

people.ku.edu/~e244j869

Nina Stark, Ph.D. (Vice Chair)

Virginia Tech

Specializes in coastal geotechnical engineering and sediment dynamics, including field instrumentation, sediment remobilization processes, beach erosion, beach trafficability, pore pressure evolution under ocean wave forcing, Arctic coastal erosion, remoe sensing, scour, and ocean renewable energy.

www.cee.vt.edu/profile/?pid=nina

Adda Athanasopoulos-Zekkos, Ph.D.

UC Berkeley

Specializes in soils mechanics and geotechnical earthquake engineering, including soil liquefaction, seismic slope stability, seismic response of levees and retaining structures, ground motion propogation characteristics due to pile-driving activities, and the impact of ground motion selection for dynamic analyses.

addazekkos.geoengineer.org/

GRANTS AWARDED AND STARTED BETWEEN Q4 2019 AND Q1 2020

Oct 1 through March 31, 2019

NHERI RAPID, UNIVERSITY OF WASHINGTON

RAPID/Collaborative Research: Multi-Hazard Damage to Puerto Rico's Civil Infrastructure - Investigation of the Interactions of 2017 Hurricane Maria and 2020 Earthquake Sequence
Award Number: 2022427; Principal Investigator: Jamie Padgett; Organization: William Marsh Rice University; NSF Organization: CMMI Start Date: 03/01/2020; Award Amount: $29,288.

RAPID/Collaborative Research: Multi-Hazard Damage to Puerto Rico's Civil Infrastructure - Investigation of the Interactions of 2017 Hurricane Maria and 2020 Earthquake Sequence
Award Number: 2022390; Principal Investigator: Arash Esmaili Zaghi; Co-Principal Investigator: Alexandra Hain; Organization: University of Connecticut; NSF Organization: CMMI Start Date:03/01/2020; Award Amount: $43,069.

RAPID: Evaluation of Pre and Post Blast Liquefaction Soil and Site Parameters
Award Number: 2002382; Principal Investigator: Jonathan Hubler; Organization: Villanova University; NSF Organization: CMMI Start Date: 12/01/2019; Award Amount: $49,447.

RAPID/Collaborative Research: Japan-U.S. Collaboration on the Seismic Performance of Reinforced Concrete Structures
Award Number: 2000478; Principal Investigator: Paolo Calvi; Co-Principal Investigator: Laura Lowes; Organization: University of Washington; NSF Organization: CMMI Start Date: 11/01/2019; Award Amount: $135,043.

WALL OF WIND, FLORIDA INTERNATIONAL UNIVERSITY

CAREER: Flow Physics of Transient Rooftop Vortices at High Reynolds Numbers and Bio-Inspired Flow Control Strategies to Mitigate Wind Hazards
Award Number: 1944776; Principal Investigator: Wei Zhang; Organization: Cleveland State University; NSF Organization: CMMI Start Date:03/01/2020; Award Amount:$580,249.

STEER-CONVERGE, UNIVERSITY OF COLORADO BOULDER

CAREER: Theory-Guided Statistical Framework for Advancing Learning from Post-Windstorm Engineering Assessments
Award Number: 1944149; Principal Investigator: David Roueche; Organization: Auburn University; NSF Organization: CMMI Start Date: 09/01/2020; Award Amount:$ 573,297.

CONVERGE, UNIVERSITY OF COLORADO BOULDER

RISE 2019 Conference: Transforming University Engagement in Pre- and Post Disaster Environments: Lessons from Puerto Rico; Albany, New York; November 18-20, 2019
Award Number: 2002409; Principal Investigator: Christopher Thorncroft; Co-Principal Investigator: Sheila Bernard; Organization: SUNY at Albany; NSF Organization: CMMI Start Date:11/15/2019; Award Amount:$42,760.

O.H. HINSDALE WAVE RESEARCH LABORATORY, OREGON STATE UNIVERSITY

Understanding and Quantifying Structural Loading from Tsunami-Induced Debris Fields
Award Number: 1933184; Principal Investigator: Michael Motley; Co-Principal Investigator: Pedro Arduino, Gregory Miller, Marc Eberhard; Organization: University of Washington; NSF Organization: CMMI Start Date: 10/01/2019; Award Amount:$690,800.

DESIGNSAFE CYBERINFRASTRUCTURE, UNIVERSITY OF TEXAS AUSTIN

CAREER: Leveraging Existing Knowledge and Artificial Intelligence to Understand the Performance of Civil Infrastructure Under Extreme Hazard Loads
Award Number: 1944301; Principal Investigator: Stephanie Paal; Organization: Texas A&M Engineering Experiment Station; NSF Organization: CMMI Start Date: 08/01/2020; Award Amount:$520,000.

CAREER: Remote Sensing for Enhanced Understanding of Tornado Actions and Broadened STEM Education in Rural West Texas
Award Number: 2006613; Principal Investigator: James Womble; Organization: Insurance Institute for Business & Home Safety; NSF Organization: CMMI Start Date: 11/15/2019; Award Amount: $428,412.

CAREER: Protecting Buildings and Structures from Vibration Damage using Variable Inertance Mechanisms
Award Number: 1944513; Principal Investigator: Nicholas Wierschem; Organization: University of Tennessee Knoxville; NSF Organization: CMMI Start Date: 06/01/2020; Award Amount: $513,406.

CAREER: Mitigation of Seismic Risk to Critical Building Contents via Optimum Nonlinear 3D Isolation
Award Number: 1943917; Principal Investigator: Philip Harvey Jr.; Organization: University of Oklahoma Norman Campus; NSF Organization: CMMI Start Date: 08/01/2020; Award Amount: $500,000.

2019 Ridgecrest, California, Earthquake Sequence Sessions at the 2020 National Earthquake Conference; San Diego, California; March 2-6, 2020
Award Number: 2002617; Principal Investigator: Heidi Tremayne; Organization: Earthquake Engineering Research Institute; NSF Organization: CMMI Start Date: 01/15/2020; Award Amount: $49,634.

Dual System Strongback Designs for Seismic Damage-Resistant Structures
Award Number: 1940197; Principal Investigator: Mark Denavit; Co-Principal Investigator: Nicholas Wierschem; Organization: University of Tennessee Knoxville; NSF Organization: CMMI Start Date: 01/01/2020; Award Amount: $349,908.

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