NHERI GSC

Graduate Student Council

Proceedings of the Inaugural NHERI GSC Mini-Conference

Friday, May 26, 2023

Please note all events are in Central Standard Time (CST).

Time	Event
10:00am-10:30am	Welcome Remarks & Keynote Address *Jennifer L. Irish, Virginia Tech University*
10:30am-11:30am	Paper Session 1: *Multidisciplinary Perspectives on Natural Hazards Risk and Resilience*
11:30am-12:30pm	Paper Session 2: *Novel Methods in Geotechnical, Structural, and Seismic Research*
12:30pm-1:30pm	Break
1:30pm-2:30pm	Poster Presentations
2:30pm-3:30pm	NHERI GSC Research Challenge Presentations
3:30pm-4:30pm	Paper Session 3: *Innovative Design for Structural Performance against Seismic Hazards*
4:30pm-5:00pm	Closing Remarks

The Natural Hazards Engineering Research Infrastructure, NHERI, is a shared-use network funded by multiple grants from the National Science Foundation. The NHERI GSC is support through the Network Coordination Office, award #2129782.

Opening Remarks

Welcome to the inaugural NHERI GSC Mini-Conference! Thank you for being here with us today. We are so pleased that so many of you were able to join us in the first of what we hope will be many of these events.

I would like to express my sincere appreciation to those who generously helped us make this a successful event.. The organizers, Rakesh Salunke, Jasmine Bekkaye, and Olaniyi Afolayan; our NHERI Liaison, Robin Nelson; our executive committee; and all of the presenters, moderators, and reviewers who contributed to this event.

This mini-conference was born out of a desire to share work with fellow graduate students in the natural hazards field. With the climate change crisis, intensifying and increasing disasters, combined with the growing awareness that social and historical disadvantage shapes inequalities in how people experience and are able to adapt to and recover from environmental hazards in a changing climate, there is an incredible demand for innovative and interdisciplinary work that graduate students are on the cutting edge of producing. We wanted the space to share work, find potential collaborators, and celebrate the successes of our peers. This is that space, and we are so excited to see what this has the potential to become.

Throughout the day, we'll hear from graduate students in civil and environmental engineering, sociology, demography, public health, and other fields in natural hazards discussing multidisciplinary perspectives on resilience, recovery, and risk. We'll also be joined by our participants in the first NHERI GSC Interdisciplinary Research Challenge.

Thank you again for joining us, and we look forward to sharing everyone's work and ideas today!

Taylor Heath
NHERI GSC Research Chair and Mini-Conference Co-Organizer

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Paper Session Presentations

Paper Session 1. Multidisciplinary Perspectives on Natural Hazards Risk and Resilience
Presider: Jasmine Bekkaye, Louisiana State University

Presenters:

1. Amer Abukhalaf, University of Florida, "Toward a comprehensive behavioral model of hurricane preparedness: The Protective Behavior Model"
2. Taylor Renee Heath, University of Pennsylvania, "The Racial Geography of Repetitive Flooding"

Paper Session 2. Novel Methods in Geotechnical, Structural, and Seismic Research
Presider: Taylor Heath, University of Pennsylvania

Presenters:

1. Chengxin Feng, Leibniz University Hannover, "Spatial uncertainty analysis in geotechnical engineering with sparse data"
2. Benjamin B. Labar, Szechenyi Istvan University, "Investigating the Structural Response of Reinforced Concrete Building in Relation to Soil Properties"
3. MohammadAli Izadifar, Louisiana State University, "Performance Evaluation of Design Methods for Geosynthetic-Reinforced Pile-Supported Embankments"

Paper Session 3. Innovative Design for Structural Performance against Seismic Hazards
Presider: Rakesh Salunke, Jackson State University

Presenters:

1. Rajendra Gautam, Tribhuvan University, "Performance of Medium-Rise elastomeric base-isolated Reinforced Concrete Building in high seismic region with its re-centering mechanism."
2. Nurullah Bektas, Széchenyi István University, "Risk Reduction in Urban Areas: Seismic Vulnerability Assessment of Existing Buildings in Győr, Hungary"

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Paper Session Abstracts

Abstracts are listed alphabetically by the presenter's last name.

Presenter & Author: *Abukhalaf, Amer, University of Florida*
Title: *Toward a comprehensive behavioral model of hurricane preparedness: The Protective Behavior Model*

Purpose: Although literature regarding hurricanes and human behavior has been growing, there is generally a paucity of research that considers comprehensive behavioral models in a severe weather hazards context, and the question of "why do some people choose to take hurricane preparedness actions, while others do not?" remains answered only in part. This paper introduces a new comprehensive behavioral model, The Protective Behavior Model (PBM), which explains why people choose to engage in hurricane preparedness behaviors.
Design/methodology/approach: After the PBM was initially constructed based on the review of critical literature, we conducted a Subject Matter Expert's Validation, where five experts scholars with similar research interests agreed to review the model and make recommendations to improve it. The review process was done through multiple rounds of comments and alteration of the model until the five experts were satisfied with the final model.
Findings: With regard to explaining and predicting human behaviors, it is common in disaster studies to use one of the generic models developed for other purposes in another field. Not having a specific model built for a particular set of protective behaviors is problematic as it overlooks many critical factors that influence people's intention to prepare. Consequently, the recommendations built on such incomplete models should also be questioned.
Originality: We introduced a new behavioral model using constructs from 23 different theories in human behavior in one comprehensive model to explain hurricane protective behaviors, and that has never been done before.

Presenter & Author: *Bektaş, Nurullah. Széchenyi István University, Department of Structural Engineering and Geotechnics, 9026, Győr, Hungary*

Additional authors:

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Orsolya Kegyes-Brassai, Széchenyi István University, Department of Structural Engineering and Geotechnics, 9026, Győr, Hungary

Title: *Risk Reduction in Urban Areas: Seismic Vulnerability Assessment of Existing Buildings in Győr, Hungary*

Urban areas are increasingly susceptible to multiple hazards, including earthquakes, floods, and hurricanes, which can have devastating impacts on communities and infrastructure. For the purpose of reducing the risk posed by these hazards, it is essential to conduct multi-hazard risk assessments that consider the vulnerability of the built environment. In particular, seismic vulnerability assessment of existing buildings is an integral part of the risk assessment process, which could play a crucial role in identifying buildings at high risk of damage or collapse during an earthquake. This study focuses on the city of Győr in Hungary, which is located in an area with moderate to high seismic hazard.

The study employs a two-stage approach to evaluate the seismic performance of existing buildings in the city. The first stage is performing a Rapid Visual Screening (RVS) method, which is a quick and simple assessment tool used to conduct an initial seismic performance investigation of existing buildings. The results of the RVS are then used to select a subset of buildings, which requires further examination with a detailed vulnerability assessment (DVA) method. In the stage of the DVA of buildings, a Pushover Analysis is performed to determine vulnerability of buildings against seismic forces. The Pushover Analysis method considers the behavior of the entire building, including its structure and non-structural components, and provides a comprehensive assessment of its seismic performance. As a further enhancement to the results, the study also utilized Geographic Information Systems (GIS) to map the results of the vulnerability assessments and to analyze the spatial distribution of risk within the city. These findings can support informed decision-making and risk reduction efforts, such as prioritizing retrofitting measures for high-risk buildings and/or developing evacuation plans based on the location of vulnerable buildings.

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The findings of this study would demonstrate the critical role of seismic vulnerability assessment of buildings in urban multi-hazard risk assessment and resilience and the necessity for comprehensive and integrated approaches to assess the vulnerability of existing buildings and support risk reduction efforts in urban areas. By combining RVS, DVA, and GIS, this study provides a consolidated rapid and accurate assessment of the existing buildings' seismic vulnerability in Győr city. These methods can be applied to other cities to support informed decision-making and risk-reduction efforts and can be adapted to consider a range of hazards.

Presenter & Author: Feng, Chengxin, *Leibniz University Hannover, Germany*
Additional authors: *Michael Beer, Leibniz University Hannover, Germany*
Matteo Broggi, Leibniz University Hannover, Germany
Matthias Faes, TU Dortmund University, Germany
Marcos Valdebenito, TU Dortmund University, Germany

Title: *Spatial uncertainty analysis in geotechnical engineering with sparse data*

The spatial uncertainty of soil parameters significantly affects the safety in geotechnical engineering, and it is necessary to study it and quantify its effect. The random field method is an excellent means to characterize spatial uncertainty in geotechnical applications, which has developed rapidly in the past decade. However, it requires a large amount of data to obtain statistical information, such as type of distribution, mean, variance, autocorrelation function, autocorrelation length, etc. Usually, it is extremely challenging to obtain large amounts of data in problems of geotechnical engineering. Therefore, the interval field method is investigated in this paper to address spatial uncertainty in geotechnical engineering with sparse data. The interval field method is an expansion of interval analysis, which involves spatially dependent intervals. That is, a property at a particular spatial location lies within an interval that depends on the intervals identified at the so-called control points. Interval field analysis is becoming a complementary tool to traditional random field methods as it can take spatial uncertainties into account when data is scarce and has been rapidly developed in recent years. The identification and quantification of interval field parameters and the procedures for generating interval fields have been studied in depth. This paper proposes a method to evaluate the performance of geotechnical engineering in the presence of interval fields. The method first requires obtaining the parameters of the interval

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field, such as the interval's center value, the interval's radius, and the dependence length. Then the interval field is generated based on the parameters of the interval field. In this paper, the modified exponential function is introduced to characterize the spatial uncertainty of the interval field, and the Karhunen-Loève-like decomposition is used to generate the interval field. The safety analysis of geotechnical engineering can be calculated by methods such as the finite element method or limit equilibrium method, depending on the type of geotechnical engineering. In the case of this paper, the deterministic slope stability problem is analyzed by the Morgenstern-Price method to estimate the safety factor of the slope. Subsequently, the upper and lower bounds of the interval of safety factor are efficiently evaluated by Bayesian global optimization (BGO). Finally, the effectiveness of the proposed method is verified with a numerical example of a real slope. The results show that the proposed method can provide reasonable accuracy and efficiency and may be applicable to a wide range of geotechnical systems.

Presenter & Author: *Gautam, Rajendra, Tribhuvan University*
Title: *Performance of Medium-Rise elastomeric base-isolated Reinforced Concrete Building in high seismic region with its re-centering mechanism.*

Many nations are found at risk of high natural hazards such as earthquakes, floods, and landslides may suffer due to the physical damage and destruction to existing buildings, broad financial misfortunes, loss of life, and increments in mental wellbeing issues. This harm; mainly due to severe earthquakes, to basic administrations, such as clinics, banks, commercial complexes, colleges, and schools where the greatest number of individuals connected, can dive the primary resiliency obligation against the likelihood of seismic event or exceedances. The worldwide trend within the development of medium (semi-commercial) buildings: development expanded to 41% of construction nowadays.
It is important for the study to evaluate the seismic performance of a mid-rise RC building typically constructed with neoprene elastomer-based isolation at mid-height of the base- column below the base slab on a foundation with a re-centering and energy dissipating damper mechanism. The main objectives of this study are to evaluate the seismic performance of base-isolated medium-rise Reinforced Concrete Buildings and to identify the occupancy rate of semi-commercial general-purpose Isolated RC buildings for immediate use in post-disaster condition. The specific objective of this study is the identification of damper location and its type to re-center and improve stability of an isolated building. To find out the seismic performance of the isolation system in soft soil,

Kathmandu Valley, a numerical finite element modeling study of the main isolation system, an elastomeric rubber pad as an isolation system, was carried out. Linear and non-linear static and dynamic analysis was performed on the numerical model, which was also compared with the theoretical design and acceptance parameters. The dynamic response and deformation parameters were modified compared to the Bare frame model due to the isolated system and energy dissipative damping mechanism.

In addition, the time period of the isolated building is observed to change or shift 3 times larger compared to the time period of the fixed base building. This reduction is mainly due to the use of a rubber bearing in the middle of the base column. When performing a dynamic time history analysis, a base-isolated building with Fluid Viscous Damper (FVD) mechanism dissipates more than 20% of the corresponding average attenuation when the Maximum considered excitation (MCE) level is excited. Base-Shear was reduced by 53% due to a 3.5-fold reduction in the elastic seismic coefficient Cd (T). Despite the isolation system increasing the lateral flexibility of the structures, the dynamic response parameters of the superstructure are within the permissible limits (NBC 105:2020, ATC 40, FEMA 356 and ASCE 41-17), it is also observed that the higher inter-story drift ratio in the basement floor can cause great concern for structural instability due to the flexibility of the system, which was controlled by Fluid viscous dampers mounted at the base-slab level, restoring the system from the deflected shape. Also, problems arising from the isolation system such as uplift, rollout rocking behavior, recovery and re-centering and drift control at the basement level were solved by designing the isolators in the optimal position with the viscous fluid dampers.

Therefore, the isolation of semi-commercial buildings transferred less seismic input to the superstructure, which reduced the dynamic structural response and deformation parameter to achieve operational and immediate service levels of structural performance. The use of this technique can serve as a benchmark for further research, and to build resilient critical infrastructure under post-earthquake conditions.

Presenter: *Heath, Taylor Renee, University of Pennsylvania*
Title: *The Racial Geography of Repetitive Flooding*

New perspectives on climate and disaster research urge us to see flood disasters not as distinct, singular events but rather as multiple, repeat, compounding events affecting the same

disproportionately disadvantaged places and communities. In this paper, I examine the spatial and racial distribution of repetitive flood loss events in the United States since 1973. Using the National Flood Insurance Program (NFIP) Redacted Claims dataset and multiple years of American census data, I find that individuals living in predominantly non-white neighborhoods are significantly more likely to experience repeated flood events. Further, these differences in exposure to repetitive flood events get larger when considering the most risk-prone areas. Most importantly, these relationships are strongest in non-white, coastal areas, suggesting a mutually constitutive relationship between race and place. This work helps to illuminate the connection between race, space, and vulnerability over time with implications for future scholarly and policy directions.

Presenter & Author: *Izadifar, MohammadAli, Louisiana State University*
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Chen, Shengli, Louisiana State University
Title: *Performance Evaluation of Design Methods for Geosynthetic-Reinforced Pile-Supported Embankments*

Geosynthetic-reinforced pile-supported (GRPS) embankments are widely used in soft soil regions to support roadways. Various design methods for GRPS embankments have been developed; however, engineering experience and recent research have shown that the performance of these design methods varies case by case. This paper systematically evaluates the performance of several empirical GRPS embankment design methods, which include the BS8006 method, the Nordic method, the EBGEO method, the FHWA method, and the CUR226 method. A preliminary assessment of these methods using three field case studies confirms that the performance of these methods differs from each other and field measurements, which can be quite significant sometimes. To enable a more systematic evaluation of the design methods, a validated finite element model (FEM) was first used to conduct a comprehensive parametric study considering typical soft soil conditions and various geometrical parameters, the results of which served as a baseline for the evaluation of the design methods. The efficacy, stress concentration ratio, maximum differential settlement, and maximum reinforcement tension were used as indicators for the methods evaluation. The results show that overall; the CUR226 method outperforms other design methods. The percentage difference between the CUR226 method and FEM can be as small as 5%, and the maximum value is 130%. It was also found that the Nordic method does not apply to

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small embankment heights, and that the BS8006 method provides a large overestimation of reinforcement tension when pile spacing is large (> 4 ft.) for all embankment heights considered.
This paper is divided into three parts. First, a validated 2D finite element model and a brief review of design methods are presented. Secondly, a preliminary assessment of five design methods as well as the FEM model is carried out based on three case studies, which shed some light on the performance of these design methods. Finally, the validated FEM model is used to create various GRPS embankment models considering various geometries within a typical Louisiana soil, and the performance of the five design methods is investigated closely. Four design criteria are used in the assessment of the design methods, i.e., efficacy, stress concentration ratio, maximum tension in the reinforcement, and maximum differential settlement between the pile cap and soft soil surface. The definition of these parameters will be introduced in the upcoming sections.

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Title: *Investigating the Structural Response of Reinforced Concrete Building in Relation to Soil Properties*

Earthquake forces can quickly cause vibrations that damage structures, leading to cracks and possible collapse. Buildings designed in accordance with the design response spectrum and site-specific response spectra take soil properties based on ground motion amplification data into account. The purpose of this study is to investigate the structural response of reinforced concrete buildings, taking into account the effect of soil properties on ground motion data amplification, and considering the site-specific acceleration response spectrum design.
For structural analysis, the Axis-vm software, which is compatible with finite element analysis, is used for building design and analysis. It is possible to identify potential damages in an impending earthquake by using site-specific response spectra. The findings of this study highlight the

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significance of soil property-based amplification in ground motion data for reducing potential economic losses and making the building stock more sustainable.

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Poster Session Presentations

1. Amer Abukhalaf, University of Florida, “Evaluating the built environment impact on risk perception and intentions of hurricane preparedness in Florida”
2. Amina Meselhe, Oregon State University, “Cascadia and Islanding: Evaluating Accessibility to Community Assets after a CSZ Earthquake and Tsunami”
3. Harman Singh, Pennsylvania State University, “News Media Coverage of India’s National River Linking Program (2004-2022): A Case Study of the Ken-Betwa Link using Topic Modeling”
4. Natalie Coleman, Texas A&M University, “Analyzing the Heterogeneity of Recovery Trends and Variations for Disrupted Lifestyles in Natural Hazard Events”

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Poster Session Abstracts

Abstracts are listed alphabetically by the presenter's last name.

Presenter: *Abukhalaf, Amer, University of Florida*
Title: *Evaluating the built environment impact on risk perception and intentions of hurricane preparedness in Florida*

In spite of the fact that literature regarding risk perception has been growing, there is generally a paucity of research on how risk perception is shaped in a disaster context, and there is even less research on how housing conditions influence risk perception in the context of severe weather hazards. The few disaster studies that looked into housing conditions mainly focused on one type of housing, such as mobile homes or manufactured housing, and considered a small range of housing characteristics, mostly represented by housing size, age, and location. To our knowledge, there have been no studies conducted to explore in-depth the relationship between housing conditions/characteristics and risk perception, and how that relationship influences personal hurricane preparedness intentions and behaviors. Correspondingly, this study is trying to fill this research gap by answering the following question: "How can the design of your dwelling influence your decision to take personal protective behaviors, such as preparing an emergency supply, evacuation plan, and communication plan?" Florida was chosen to be the location of this research, given its significant vulnerability to hurricanes. A quantitative approach is utilized involving an online questionnaire with a sample size of 1152 participants from Tallahassee, Gainesville, and Miami. Different statistical approaches will be used to uncover patterns and quantify behaviors and attitudes so that they can be generalized to Floridian communities. Our findings may considerably contribute to a better understanding of how the built environment influences human disaster-related behaviors. This will allow architects and structural designers to better understand how their designs encourage or discourage certain disaster-related behaviors, and they will be able to consider these new factors in their future designs. Moreover, even though our findings will be specific to the context of Floridian cities, they will still be relevant to other hurricane-prone areas in the US, such as Texas, Alabama, and South Carolina. Our findings may also apply to other populations in states that are prone to other severe weather hazards, such as tornadoes and thunderstorms. Our results will provide new insight into this critical area of study

more broadly, and it may awaken further questions about human protective behaviors during disasters and create new opportunities for future research.

Presenter: *Coleman, Natalie, Texas A&M University*
Additional authors: *Tejas Kakad, Texas A&M University*
Chenyue Liu, Texas A&M University
Ali Mostafavi, Texas A&M University
Title: Analyzing the Heterogeneity of Recovery Trends and Variations for Disrupted Lifestyles in Natural Hazard Events

Disaster recovery is a complicated process that requires multiple systems, stakeholders, and sectors of the community working together to return to a state of normalcy. However, the current research is limited on how to quantify critical recovery milestones at granular spatial scales. It ultimately fails to capture the trends and variations of recovery among households. This lack of information can disrupt the distribution of resources and fail to effectively measure recovery efforts.

As a way to quantify recovery, the research proposes a novel approach to leverage privacy-enhanced location intelligence data to characterize distinctive lifestyle patterns. Lifestyle patterns involve the essential and non-essential services that make up a person's daily routine. These can include essential trips to the grocery store or non-essential trips to entertainment facilities. It represents a holistic recovery milestone by capturing people's interactions with vital infrastructure, businesses, and social organizations in the community. Recovery is then able to be tracked by people's ability to return to their standard way of living with essential and non-essential services. Our preliminary research supports the use of lifestyle recovery trends at a census-block-group (CBG) level. It also found that a combination of demographic and flooding attributes are associated with the different recovery rates of lifestyle patterns, which can shed light into the underlying mechanisms contributing to recovery rates.

This specific research study expands on those findings by focusing on the household-level impact and analyzing the heterogeneity of recovery within CBGs. The study uses the case studies of 2017 Hurricane Harvey in Harris County, Texas and 2021 Hurricane Ida in coastal Louisiana. The storms caused intense disruptions to people's lifestyle through flooding and power outages, respectively.

We processed location-intelligence data to calculate the normal and disruptive periods of human mobility. We first calculated the recovery of essential and non-essential services at the household level. We then characterize CBGs as those with high or low mean value of recovery in combination with high or low variation to create a quadrant of impact. The temporal and spatial distribution are visualized to detect CBGs of high recovery and high variation. Additional factors such as hazard disruption of flooding and power outages, demographic features, and social connections are considered in the analysis to determine the statistical association with recovery and variation at the household level.

The analysis and findings will provide data-driven insights for public officials and emergency managers. The current approach to recovery is extremely reactive; however, by building a foundational knowledge on lifestyle, decision makers could be more proactive in detecting potential disproportionate rates of recovery and acknowledge areas of intense inequality.

Presenter: *Meselhe, Amina, Oregon State University*
Additional authors: *John Bolte, Oregon State University*
Dan Cox, Oregon State University
Peter Ruggiero, Oregon State University
Dylan Sanderson, Oregon State University
Jenna Tilt, Oregon State University
Title: *Cascadia and Islanding: Evaluating Accessibility to Community Assets after a CSZ Earthquake and Tsunami*

"Historical ruptures at the Cascadia Subduction Zone (CSZ) have resulted in the dramatic lowering of the coastline following ground shaking and a subsequent tsunami. The impending occurrence of another CSZ event within the next century combined with increased economic, social, and natural developments along the Oregon Coast reinforce the urgency to investigate the resilience of the infrastructure at both a local and regional scale. Specifically, this research presents an integrated social-science and engineering approach to quantify the resilience of Oregon's transportation network. Resilience, as defined herein, extends beyond transportation network damage and connectivity to consider increases in travel time to services within a community, such as food, education, and healthcare. Loss of access to such services could result in community members facing a sense of isolation or "islanding".

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This work integrates the use of community identified assets from underrepresented coastal groups with the analysis of transportation network damage and recovery following a CSZ ground shaking and inundation scenario. Fusing of transportation network performance with direct community input results in a bottom-up framework for mitigation planning. A bottom-up approach is considered within the context of larger regional transportation network recovery. Also revealed, is the value of community oriented metrics in constructing narratives that inform disaster policies and engineering practices. This study evaluates the value of integrating the needs of communities within engineering approaches to understand, mitigate, and recover from large-scale hazard events."

Presenter: *Singh, Harman, Pennsylvania State University*
Title: *News Media Coverage of India's National River Linking Program (2004-2022): A Case Study of the Ken-Betwa Link using Topic Modeling*

In this study, we employ a Latent Dirichlet Allocation (LDA) topic modeling to analyze a corpus of Indian English language newspapers from 2004 to 2022, focusing on the Ken-Betwa River link. This project has been heavily contested in the public sphere by those concerned with its potential negative social and ecological outcomes. To examine the topics and themes around this link, we seek to answer the following questions: 1) Which topics related to river linking can be identified from news media coverage; 2) How prevalent are these topics between 2004 and 2022, and how have they changed over time; and 3) How are these topics related to each other? We identified and categorized the coverage into 23 distinct topics and three overarching themes. We conclude by discussing the implications of shifting media discourse and the role of news media in both generating and reflecting public perception.

Research Challenge Presentations and Abstracts

This spring, NHERI GSC had the sincere honor of organizing an Inaugural NHERI GSC Research Challenge. The goal of this challenge was to bring together graduate student scholars across disciplinary, hazard, and methodological backgrounds to develop new, innovative, and interdisciplinary research projects with peer scholars they might not otherwise have gotten the opportunity to work with. These five groups each worked on a project corresponding to a topic developed from the NHERI Science Plan and the NHERI CONVERGE Modules. The challenge groups used the NHERI GSC Mini-Conference as an opportunity to present preliminary findings on their research projects, gaining valuable feedback, perspectives, and insights to move these projects forward towards publication and/or professional presentation. Thank you so much for all of your hard work Research Challenge groups, and thank you to all attendees for helping to move these projects forward with your constructive and generative critiques!

Group 1. Use of new techniques (incl. simulation, machine learning, AI, and others) to model the behavior of civil infrastructure and risk to communities due to loading from natural hazards.

Title: "Assess Earthquake Damage & Loss Susceptibility of Buildings and Compare with Social Vulnerability Indicators – A Study on Earthquake Hazard in Turkey"

***Participants*:**
Julie Elliot, University of Delaware, *DIscipline*: *Sociology, Urban Planning / City Planning*
Rakesh Salunke, Jackson State University, *DIscipline*: *Civil & Geotechnical Engineering*
Niko Grisel Todorov, Chapman University, *DIscipline*: *Computer science, Data Science*

February 2023, the countries of Turkey and Syria were rocked by a massive 7.8 magnitude earthquake. Both countries experienced extreme damage and, as of late-February 2023, the death toll has exceeded 45,000 people (with this number expected to increase). This disaster reminds us, even in the modern age, catastrophic disasters are possible and pose challenges to mitigation, preparedness, response, and recovery. As our world continues to grow in complexity, more advanced tools are needed to model and understand vulnerability from natural hazards. Increased knowledge of earthquake potential and the composition of exposed communities may

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help scientists, policymakers, and practitioners better allocate funds, resources, and time to decrease future hazard impacts.

In this study, researchers will utilize advanced modeling tools, software, and Turkey census data to model earthquake impacts and cross-compare the results against social vulnerability indicators. Tools employed by the research team will include the NHERI SimCenter Building Recognition using AI at Large-Scale (BRAILS) (for developing a regional inventory), the USGS Shakemap, and the Regional Resilience Determination (R2D) tool.

The research team will construct fragility curves (or employ Hazus earthquake data) for the chosen jurisdictions of interest in Turkey. The study will also, for comparison, examine structure performance and estimate failure probability in another region of Turkey susceptible to a similar disaster. Finally, the study will identify social vulnerability indicators and contribute to a social vulnerability index for Turkey, helping scholars and practitioners better articulate the unequal impacts of disasters. A multi-disciplinary study with perspectives from an intellectually diverse team, the study has the potential to contribute to several fields and has broader impacts on practitioner communities.

Group 2. Understanding key physical responses, vulnerabilities, and factors influencing post-event recovery of civil infrastructure and communities

Title: "Household Vulnerabilities and Stakeholder Responses Influencing Post-Event Decision Making and Recovery: An East Palestine Ohio Train Derailment Case Study"

Participants:

Taylor Renee Heath, University of Pennsylvania, *Discipline*: Sociology

Amina Meselhe, Oregon State University, *Discipline*: *Civil engineering*

Jiayun Shen, Clemson University, *Discipline*: *Civil engineering, Economics, Sociology, Urban Planning / City Planning*

Teye Yevuyibor, Louisiana State University, *Discipline*: *Sociology*

As large-scale disasters become increasingly frequent and impactful in communities across the world, the urgency for equitably developing community resilience becomes more pronounced. The confluence of the local and regional chronic events with these acute hazards can expose

communities' social, economic, and ecological vulnerabilities. Further, the key physical responses and factors that influence local, state, and federal decision-making require further investigation.

The recent train derailment in East Palestine, Ohio, presents a pressing environmental hazard and its proliferation into short and long-term recovery needs for both stakeholders and residents. Disaster case studies focus on either individual, household, or agency (local, state, or federal) responses. This study attempts to bridge those decisions in a dynamic context examining how individuals and government bodies are making decisions that are in tandem with, contradictory to, or in response to each others' immediate recovery decision-making. Specifically, this work characterizes (1) what immediate decisions are being made by residents and agencies following the disaster; (2) what are the driving mechanisms behind these decisions; and (3) how these decisions vary by social, spatial, and temporal differences. Further, will embed this study in a growing but still limited field of work on the intersection of social vulnerabilities and disaster response and recovery.

Using an array of transportation, demographic, environmental, mobile, and news data from DOT, EPA, SafeGraph, the Census, and public reports and statements, we will examine decisions on service disruptions in infrastructure including transportation and utilities, movement following orders to evacuate and return, and perceived safety and risk with a close eye to inequalities by social vulnerabilities such as race and class.

Group 3. Developing and testing mitigation strategies to achieve community resilience in contexts of multiple hazards, shifting vulnerabilities, and sustainable development

Title: "Enhancing Community Resilience Against Earthquakes: A Study of Existing Buildings in Western Region, Nepal"

***Participants*:**
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Discipline: *Civil engineering & Geotechnics*
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Communities languish in the face of natural hazards such as earthquakes, floods, and landslides due to the physical damage and destruction to existing buildings, extensive economic losses, loss of life, and increases in mental health issues. This damage to essential services, such as hospitals (health posts) and schools, can plunge the community's resilience. As one of the least developed nations, Nepal has one of the lowest living standards. The country is often susceptible to disasters due to its diversified climate, which includes a strong monsoon season and high terrain.

Therefore, earthquakes are the most typical hazard in Nepal because of their location on the plate boundary, which can have deadly consequences for its already marginal and fragile communities. However, other natural disasters, such as fires, winds, and droughts, often impact its communities, especially in the rural areas of the Karnali and Sudhirpachhim provinces. The Karnali province is among the poorest in Nepal, with an estimated 51.7% of the population living in multidimensional poverty and an estimated 28.9% of the population living in absolute poverty (the second-highest rate in the nation). The mountainous geography of Nepal and lower living standards present a challenge for transporting construction materials and obtaining skilled labor for erecting buildings. Therefore, the local people construct their buildings using locally available materials such as mud mortar, brick, stone, timber, and bamboo. The 2015 Gorkha Nepal earthquake caused nearly 9,000 deaths and 600,000 buildings to be severely damaged or destroyed in 16 districts, resulting in more than $10 billion in economic loss. In November 2022, the Doti Far-Western Nepal earthquake (6.6 magnitudes) resulted in six lives lost and unmasked the vulnerability of older, dilapidated houses made of stone and mud mortar to even moderate earthquakes. This is an alarm for potential damages during a severe earthquake, as the region has not seen an earthquake greater than 7.0 in magnitude since 1505. Therefore, to increase community resilience against earthquakes, existing buildings must be assessed before a severe earthquake. In this study, a rural community of Karnali province is considered for determining the performance of the existing buildings and enhancing the community's resilience. Since rapid visual screening (RVS) methods are computationally efficient and require less personnel, RVS methods are used to examine extensive building inventories to ascertain the degree of vulnerability, such as high, medium, and low.

The RVS method, developed by Bektaş and Kegyes-Brassai based on 2015 Gorkha, Nepal earthquake building inventory data, is employed in this study. Furthermore, reinforcement

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strategies, such as RC jacketing, wooden timber, steel plate support, and exhortations, are proposed to shift the vulnerability of existing buildings based on locally developed retrofitting guidelines and techniques. Finally, to be better prepared for impending earthquakes and subsequent hazards, steward recommendations are proposed to enhance the resilience of the community for the establishment of a response and recovery master plan.

Group 4. Innovative of collecting, sharing, presenting, and visualizing data and information on hazard risks, recovery, and mitigation strategies

Title: "Global Comparative and Temporal Study of Coastal Hazards in Coastal Communities."

***Participants*:**

Kayode Nelson Adeniji, East Carolina University, *Discipline:Geography, Urban Planning / City Planning*

William Hughes, University of Connecticut, *Discipline*: *Civil engineering, Structural engineering*

Wilfred Lunga, North West University, Potchefstroom campus, South Africa, *Discipline*: *Education, Environmental studies, Geography*

Climate change exacerbates extreme weather events, leading to sea-level rise, which can cause coastal hazards. Coastal hazards cause immense social and economic losses to shoreline communities, damaging infrastructure and homes and resulting in displaced populations and devastated communities globally. However, the comparative global impacts of these hazards are limited. To better understand and raise awareness of the impacts, this study is proposed to analyze and present global comparative impacts of coastal disasters to improve the community and individual awareness of these challenges. Using databases on historic disaster losses, exploratory statistical analyses will be conducted to examine the comparative and temporal impacts of coastal hazards in selected coastal communities globally. We will adopt a cluster random sampling technique to select our sample communities.

The outcome of this study will highlight and create awareness of global trends of coastal hazards' impacts on coastal communities. Also, it will guide community leaders to create more resilient communities. Hence, inform international organizations and national policymakers on how to prepare for the future impacts of climate change on coastal communities.

Closing Remarks

As we near the end of this captivating mini-conference, it is our privilege to extend heartfelt gratitude to each and every one of you in attendance today. This gathering of brilliant minds has been nothing short of remarkable. Together, we have explored the intricate and ever-evolving landscape of natural hazards, gained profound insights and forged meaningful interdisciplinary connections along the way. Thank you to each and every one of you for attending the mini-conference and making this a fruitful event.

Thank you to Dr. Jennifer Irish for taking the time to address the NHERI GSC members today and deliver an excellent keynote presentation at the inaugural NHERI GSC mini-conference.

To all the panel and poster presenters who have confidently taken the stage and delivered thought-provoking presentations, please know that your contributions are invaluable and hold great promise for the future of this field. From the intricacies of geological phenomena to the complexities of climate-related hazards, each presentation has contributed to our collective understanding of these critical issues.We thank you for your participation.

To the interdisciplinary research challenge participants, We thank you all for taking time outside of your routine schedule and working on interdisciplinary research challenge projects, and sticking together until the end. The future of natural hazards needs such interdisciplinary collaborations between diverse groups of engineers, social scientists, educators, and more. The preliminary findings presented here today by the four research challenge groups were fascinating, to say the least, and set a great example of successful interdisciplinary collaborations and make a solid case for similar future collaborations within the realm of Natural Hazards studies. We hope you can continue your collaborative work and publish your interdisciplinary work. We thank you for your participation.

The organizing committee sincerely thanks our NHERI Liaison, Robin Nelson, for her unwavering support and guidance.

Thank you to the NHERI GSC executive committee and the working groups for their contribution to the mini-conference.

A huge thank you to the NHERI GSC members who volunteered to help with abstract reviews. We also thank NHERI Simcenter & DesignSafe-TACC for delivering the workshop series and their continual support to the NHERI GSC. We also thank other NHERI Facilities and NHERI ECO for supporting NHERI GSC.

Finally, none of this would have been possible without my fellow organizing committee members, Taylor Heath, Jasmine Bekkaye, and Olaniyi Afolayan. Thank you all for the hard work in organizing the mini-conference, and I think we all agree that it was a rewarding experience.

We will keep you informed about future NHERI GSC interdisciplinary research challenges and mini-conference events.

With that, the inaugural NHERI GSC mini-conference 2023 comes to an end.

Rakesh Salunke
NHERI GSC Research Vice-Chair and Mini-Conference Co-Organizer

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