NIST NEHRP Activities List – FY24-25
Supports *NEHRP Strategic Plan for FY22-29*

The following provides a list of agency activities since October 1, 2023, to May 31, 2024 for consideration in developing ACEHR's FY24-FY25 assessment report. Activities listed are those within the reporting period that were either 1) initiated or awarded, 2) ongoing that have achieved a significant outcome or impact, or 3) terminated. Activities are provided under the goal/objective from the NEHRP Strategic Plan for FY22-29 they support.

Goal 1: *Advance the understanding of earthquake processes and their consequences.*

- Objective 1: Advance the understanding of earthquake phenomena and the propagation of seismic energy.
- Objective 2: Advance the characterization of the nation's seismicity, including sources, and seismic hazards.
- Objective 3: Advance seismic monitoring including improving, extending, and maintaining the Advanced National Seismic System.
- Objective 4: Advance the understanding of the consequences of earthquakes and associated hazards to society and the built environment.

  - **NIST researcher Katherine J. Johnson participated in a preliminary reconnaissance mission to Lahaina, Maui, Hawaii, in August 2023 to better characterize barriers to effective emergency communication and evacuation in response to the devastating fire that occurred there. The knowledge gained regarding the transmission and receipt of messages, as well as interactions among first responders and emergency management personnel, is informative for all fast-paced hazards, such as earthquakes. [supports Focus Areas 6 and 8]**
  - **NIST researcher Juan F. Fung collaborating with EERI members of Learning From Earthquakes (LFE) Business Resilience subcommittee as well as researchers and business organizations in Turkey on multi-faceted study of business recovery after the 2023 Kahramanmaraş Earthquake Sequence. [supports Focus Area 6]**

    Publications:

    - **"Advancing Methodologies for Hurricane Disaster Research Using Social Media Data" Routledge Handbook of Risk, Crisis, and Disaster Communication (Johnson) [supports Focus Area 6]**

- Objective 5: Advance the understanding of social, behavioral, and economic factors pertinent to implementation of earthquake preparedness, mitigation, and recovery strategies.

  Significant research efforts across the Earthquake Engineering Group have been dedicated to understanding, assessing, and tracking socio-behavioral and economic aspects relevant to the development and implementation of the functional recovery performance objective framework for buildings and lifelines. [supports Focus Area 5]

  Notably, NIST personnel are:

  - **participating in committees at the Earthquake Engineering Research Institute and the NEHRP Building Seismic Safety Council Provisions Update Committee Subcommittees [supports Focus Area 2]**
  - **executing contracts to support research and convening workshops to engage and gather data from subject matter experts [supports Focus Area 6]**
  - **initiating an effort to develop an infographic to explain functional recovery concept [supports Focus Area 6]**
  - **and other collaborative inter-disciplinary efforts to evaluate the chief objectives and prioritization for functional recovery performance such as engaging with colleagues at other organizations, and participating in collaborative inter-agency development of informational resources (such as a FEMA fact sheet) that assist in communicating about enhanced functional recovery performance. [supports Focus Areas 2 and 6]**

Goal 2: *Enhance existing and develop new information, tools, and practices for protecting the nation from earthquake consequences.*

- Objective 6: Enhance current earthquake scenarios, risk assessment methodologies, and loss estimation tools to improve seismic risk information.
  - **Developed a new data-driven processes to quantify prescriptive design requirements for new buildings to meet functional recovery performance objectives [supports Focus Area 2].**
  - **Completed a study on benchmarking performance-based design standards for existing buildings against measured building response and observed damage from past earthquakes [supports Focus Area 3]**
  - **Developed modeling parameters and acceptance criteria for reinforced concrete shear walls retrofitted with fiber reinforced polymers [supports Focus Area 6]**

- Completed a study on quantification of Uncertainty in Performance-Based Seismic Evaluations of Reinforced Concrete components [supports Focus Area 3]
- Completed a study on vulnerability assessment of rail transit network following earthquakes. [supports Focus Area 5]
- Initiated a new project developing a research database of nonstructural building components and seismic fragilities to support functional the functional recovery assessment of buildings. [supports Focus Area 2]
- Installed, instrumented, and tested a fire sprinkler system in a full-scale, 6-story test building on the outdoor shake table at UCSD. [supports Focus Area 6]
- Initiated a new project in FY24: "Accommodating Environmental Considerations into Forward-Looking Building Standards" that will enable better integration of earthquake related risk mitigation and assessment activities with increasing future hazards from environmental considerations. This project has areas of focus related to developing key information that can be useful for enhancing codes, standards, and practices to better accommodate concerns for change of the geotechnical environment, assessment of environmental impacts from buildings, and the costs and tradeoffs necessary for improving the performance of transportation systems.

Publications:
- **[NIST SP XX]** *A framework to Map Simulated Functional Recovery Performance Outcomes to Prescriptive Seismic Design Provisions for Buildings [will be published in June 2024]* **[supports Focus Area 2]**
- **[EQ Spectra] Nonlinear Modeling of Rectangular Reinforced Concrete Columns Jacketed using FRP Materials ()** *[under review]* **[supports Focus Area 3]**
- **[18WCEE] Nonlinear Modeling Parameters for the Seismic Analysis of FRP Jacketed Concrete Columns (Brena, Ghannoum, Kim, Sattar, Dukes) [supports Focus Area 3]**
- **[EQ Spectra] Nonlinear Modeling Parameters for Reinforced Concrete Shear Walls Retrofitted with Fiber Reinforced Polymers (Dukes, Sattar)** *[to be published 2024]* **[supports Focus Area 3]**
- **[ICASP Conference] Vulnerability Assessment of Infrastructure Networks Following Earthquakes: The Fundamental Step to Assess Network Resilience and Functional Recovery (Saadat, Cook, DeBock, Sattar, Nikolaou) [supports Focus Area 2]**
- **[Journal of Structural Engineering] Functional Recovery of Modern**

        Reinforced Concrete Buildings. (Cook et al) [supports Focus Area 2]

- [18WCEE] Leveraging Decision Trees to Map Functional Recovery Seismic Design Provisions for Reinforced Concrete Moment Frames (Cook) [supports Focus Area 2]
- [EQ Spectra] ASCE/SEI 41 Assessment of Reinforced Concrete Buildings: Benchmarking ASCE/SEI 41 Nonlinear Dynamic Procedures with Empirical Damage Observations (Cook et al.) [supports Focus Area 3]
- [EQ Spectra] ASCE/SEI 41 Assessment of Reinforced Concrete Buildings: Comparison of the Nonlinear Dynamic Procedure with Other Evaluation Methods (Sen, Cook et al.) [supports Focus Area 6]
- [Structural Safety] Modeling and material uncertainty quantification of RC structural components uncertainty (Hariri, Segura, Sattar) [supports Focus Area 6]
- [Structures] Uncertainty and bias in generic ground motion sets used for PBEE (Hariri and Sattar) [supports Focus Area 6]
- [Soil Dynamics and Earthquake Engineering] Probabilistic sensitivity matrices under stressor uncertainty (Hariri, Segura, Sattar) [supports Focus Area 6]
- [NIST TN] Sensitivity Analysis of Reinforced Concrete Structures (Hariri, Sattar) [supports Focus Area 6]
- [18WCEE] Component-level fragility functions with multiple sources of uncertainty (Hariri, Sattar, Segura) [supports Focus Area 6]

- Objective 7: Further develop and implement a West Coast earthquake early warning system and its associated communication, education, and outreach.
- Objective 8: Enhance and develop cost-effective tools and practices, including up-to-date building codes and national consensus standards, that improve the seismic performance of new and existing buildings and lifeline infrastructure.
  - Four NIST researchers (Drs. Siamak Sattar, Dustin Cook, Katherine Johnson, and Therese McAllister) serve on various subcommittees of the BSSC PUC Task Committee on functional recovery. [supports Focus Area 2].
  - NIST has expended significant effort in assisting the professional community in devising a framework for decision making in the application of functional recovery performance to lifelines infrastructure. In FY24, NIST has concluded a multi-year effort completed by a committee of experts to develop an initial framework that can be utilized

by lifelines systems owners/operators and designers to enhance both the performance of physical assets and the organizational actions needed to support post-earthquake response activities. These efforts build upon the NIST-FEMA Functional Recovery Report and are directly related to water, wastewater, and electric power utility systems. The framework is also intended to be useful for the development of guidance for other lifelines systems, and eventually for improvement and incorporation of multi-hazards concerns. [supports Focus Area 2 and 5]

o NIST has continued efforts on a multi-year project to evaluate the benefits of implementing cost-effective, low-damage earthquake-resistant structural systems that are designed for controlled rocking and that can enable rapid functional recovery following strong earthquake shaking. In FY 24, NIST developed a set of conventional and low-damage reinforced concrete structural wall buildings and developed computational models to assess the performance of the archetypes. NIST has collaborated with external structural engineers who have experience designing building for controlled rocking to develop the archetype buildings. NIST has also collaborated with an external seismologist who has expertise in ground motion selection and scaling to develop a consistent set of input ground motion records to evaluate the performance of the rocking and conventional archetypes. [supports Focus Area 2]

o NIST researcher collaborated with external researchers to develop a new computational model for nonlinear analyses of reinforced concrete structural wall buildings. The model is summarized in a journal article accepted for publication in the ACI Structural Journal. [supports Focus Area 6]

o Attended the NIBS Lifelines Infrastructure Hub Meeting and workshop on May 21, 2023 in D.C. to coordinate HUB activities with NEHRP activities.

Publications:

- [Disaster Prevention and Resilience Journal] Multidisciplinary research to advance the development of functional recovery for community resilience (Fung, Zhang, Johnson, Cook, Sattar) [supports Focus Area 2]

- [NIST SP 1295] NIST Transportation Systems and Functional Recovery Workshop Report (Beyzaei, Johnson, Nikolaou, Sattar, Dukes, Saadat) [supports Focus Area 2]

- [NIST SP 1310 and 1311] Initial Framework to Design Lifeline Infrastructure for Post-Earthquake Functional Recovery

(Johnson) [supports Focus Area 2] [supports Focus Area 5]

- ▪ *"Future of Seismic Codes: Functional Recovery and Geotechnical Engineering"* Geostrata February 2024 (Beyzaei, Johnson, Nikolaou) [supports Focus Area 2]

- ▪ [Natural Hazards Review Journal] Benefit–Cost Analysis for Earthquake-Resilient Building Design and Retrofit: State of the Art and Future Research Needs (Zhang, Fung, Cook, Johnson, Sattar) [supports Focus Area 2]

- ▪ [ACI Structural Journal] Autoregularized Model of the Compressive Behavior of Structural Wall Boundary Elements (Segura) [supports Focus Area 3]

- Objective 9: Advance knowledge to facilitate characterization of earthquake resilience and develop tools to measure successful implementation of resilience practices and policies.
  - o **Developed a tool ("RESISTANT") that allows users to plan investments in enhancing earthquake performance and recovery time [supports Focus Area 2]**

Goal 3: *Promote the dissemination of knowledge and implementation of tools, practices, and policies that enhance strategies to withstand, respond to, and recover from earthquakes.*

- Objective 10: Enhance the accuracy, timeliness, usefulness, and accessibility of earthquake information products for a diverse range of users to better prepare for and respond to earthquakes.

  - o **Hosted a collab with FHWA, DOT offices for data needs in RESISTANT and for using the tool to prepare and respond in transportation networks post EQ. [supports Focus Area 2 and 5]**

- Objective 11: Implement and regularly update a National Seismic Hazard Model based on the latest research, source models, seismicity, and field studies, essential for implementing state-of-the-art mitigation, design, and construction strategies.
- Objective 12: Actively engage in the continual development and use of up-to-date seismic design guidelines, standards and building codes, and advocate for their adoption and enforcement at the state and local level.

  - o **Hosted and led the Spring 2024 meeting of the Interagency Committee on Seismic Safety in Construction (ICSSC) which focused on seismic evaluation and screening tools for federally-owned existing buildings and privately-owned leased building space. [supports Focus Area 8]**
  - o **Released the next EO 13717 Compliance Data Call to the ICSSC for Feb. 2,**

2022 to Feb 1, 2024 reporting. [supports Focus Area 8]
- Hosted 2023 NIST-NSF Disaster Resilience Symposium [Hosted 50+ researchers to present ongoing research projects and findings from the Disaster Resilience Research Grant program, sponsored by a joint effort between NIST and NSF. Recordings from the keynote speakers and technical sessions are hosted on NIST's website: https://www.nist.gov/news-events/events/2022/09/2022-disaster-resilience-symposium
- Committee Leadership positions are held in the following committees/subcommittees [supports multiple Focus Areas]:
  - EERI's School Safety Earthquake Initiative (SESI)
  - EERI's SESI Classroom Education and Outreach committee
  - EERI's World Housing Encyclopedia (WHE)
  - EERI Learning From Earthquakes (LFE) Business Resilience subcommittee
  - PUC Functional Recovery Subcommittees
  - ACI 374-A: Functional Recovery
  - ACI 369-C: Frames
  - ACI 133: Disaster Reconnaissance
  - ASCE 41: Seismic Evaluation and Retrofit of Existing Buildings
  - ASCE 7: Minimum Design Loads and Associated Criteria for Buildings and Other Structures
  - AISC Task Committee 7: responsible for AISC 342: Seismic Evaluation and Retrofit of Existing Steel Buildings
  - Geotechnical Extreme Reconnaissance (GEER) Association
  - ASCE Geo-Institute's Innovations Committee (INNC)
  - New York City Seismic Code
- Continued active participation in the following committees:
  - PUC Functional Recovery Task Committee and Subcommittees
  - ACI 369: Seismic Repair and Rehabilitation
  - ACI 440: Fiber Reinforced Polymer Reinforcement
  - ACI 369-F: Retrofit
  - ACI 318-H: Seismic Provisions
  - AISC TC-9: Seismic Provisions (responsible for ASIC 341)
  - AISI Lateral Force Committee
  - Structural Engineers Association of California's (SEAOC) Resilience Committee
  - EERI's Learning from Earthquakes (LFE) Business Recovery Reconnaissance Subcommittee.
  - Lifeline Hub National Effort by NIBS
    - Executive and Advisory Committees, Inaugural Workshop presentation.

- Objective 13: Support and enhance earthquake education, emergency drills, and exercises to promote effective earthquake awareness as well as mitigation, response, and recovery planning.
- Objective 14: Promote the implementation of earthquake preparedness, safety, response, and recovery strategies.

  - **Institute for Catastrophic Loss Reduction (ICLR): NIST researchers invited to give webinar on comparing earthquake risk reduction policies across the world, with a focus on seismic retrofit. [supports Focus Area 6]**

Goal 4: *Learn from post-earthquake investigations to enhance the effectiveness of available information, tools, practices, and policies to improve earthquake resilience.*

- Objective 15: Maintain and advance Program-wide procedures and policies for post-earthquake investigations and data acquisition management.
- Objective 16: Advance earthquake preparedness, safety, response, and recovery strategies by translating post-earthquake investigation results into approaches for improved resilience.

  - **NIST researchers Amin Hariri and Matthew Speicher were deployed to Turkey after the Kahramanmaraş Earthquake Sequence to join ACI 133 reconnaissance team. [supports Focus Area 2]**
  - **NIST researchers Sissy Nikolaou was deployed to the epicentral region of the NY-NJ EQ alongside three GEER volunteers to primarily study deformation or failure of the ground. [supports Focus Area 8]**

    PUBLICATIONS:

    - **[Earthquake Spectra] Data-Driven Insights into Post-Earthquake Reconnaissance Findings: 2023 Türkiye Earthquake Sequence (Hariri and Sattar) [supports Focus Area 2]**

    - **[Earthquake Spectra] Reconnaissance-informed Post-Earthquake Functional Recovery: Observations and Challenges (Hariri and Speicher) [supports Focus Area 2]**

    - **[18WCEE] Functional recovery in the context of post-earthquake reconnaissance: challenges and opportunities (Speicher , Hariri and Sattar) [supports Focus Area 2]**

- Objective 17: Identify and take advantage of opportunities to collaborate on development of scientifically informed metrics and actions to evaluate community earthquake resilience after an earthquake.

- **RESISTANT / FHWA /DOTs – see item earlier [supports Focus Area 2]**

- Objective 18: Provide mechanisms to promote relevant feedback to the public regarding lessons learned from earthquakes.

The Program-identified focus areas are as follows:

1. Advance earthquake science for subduction zone regions.
2. Develop enhanced performance-based seismic design procedures and metrics for the functional recovery of new and existing buildings and lifeline infrastructure.
3. Advance performance-based seismic design and assessment methods to implement multi-system coordination.
4. Further expand earthquake early warning capabilities.
5. Develop consistent performance guidance for lifeline infrastructure.
6. Enhance guidance to ensure that information and tools effectively support the needs of those who implement mitigation, preparedness, and recovery measures.
7. Advance the science of earthquake sequence characterization.
8. Enhance risk reduction strategies for federal agencies.

If an activity supports an ACEHR recommendation, it should be noted as such. Recommendations are provided here: https://www.nehrp.gov/committees/reports.htm. Please see the 2023 Program responses to the ACEHR recommendations.