

National Institute of Standards and Technology (NIST)  
National Construction Safety Team Advisory Committee (NCSTAC)

NIST NCSTAC 2024 Annual Report to Congress

December 14, 2024

The Honorable Frank Lucas  
Chairman  
Committee on Science, Space, and Technology  
United States House of Representatives  
Washington, DC 20515

Dear Mr. Chairman:

We are pleased to submit the 2024 Annual Report of the National Construction Safety Team Advisory Committee (NCSTAC/the Committee) of the National Institute of Standards and Technology (NIST). The Committee serves as NIST's advisor on implementation of the National Construction Safety Team (NCST) Act (P.L. 107-231; the 'Act'), and the opinions and recommendations expressed in this letter reflect our views as an independent body composed of technical experts in engineering, public health, and the social sciences. The Act was passed in response to 9/11 and empowers NIST to conduct rigorous investigations of significant disasters impacting the built environment. Following the collapse of the World Trade Center towers, NIST conducted a groundbreaking study of building performance and issued transformative, evidence-based recommendations for improvements in building codes and standards.

The Act directs the Committee to report to Congress annually on its findings and recommendations in two areas:

1. Evaluation of NCST activities, and
2. Assessment of the implementation of recommendations of NCST and the Advisory Committee.

This year the committee met on March 6-7, 2024, and again on September 12, 2024. During these meetings, NIST staff briefed the Committee on activities performed under the Act and closely related activities performed by NIST under other authorities. The Committee also asked NIST staff and research team members questions and provided feedback on their many ongoing activities. These meetings, as well as our review of presentation slides and other available documents, informed this annual report.

Throughout this report, we use a **bold** typeface and indented text to highlight our recommendations.

**NIST'S RESPONSE TO THE RECOMMENDATIONS IN THE COMMITTEE'S 2023 REPORT TO CONGRESS**

*GENERAL COMMENTS*

In our 2023 Report to Congress, we provided seven recommendations to NIST and its NCSTs: one related to NIST's evaluation of new events for potential study (specifically the wildfires in Hawaii), one regarding support to address the personal challenges for psychological support of NCST members experienced while on field assignments, and five related to the ongoing NCST investigation of the partial collapse of Champlain Towers South (CTS) in Surfside, FL.

We are pleased to report that NIST accepted all our recommendations and developed responsive implementation plans. Examples of NIST's initiatives are as follows:

- NIST has engaged with state and federal agencies that are investigating the fires in Hawaii.
- Investigative team members are actively monitored to limit overcommitment, and the Employee Assistance Program is available to address stress or other work-related issues.
- The CTS NCST continuously endeavors to maintain focus and efficiency, and to engage in public outreach as appropriate.

### *CAMP FIRE RESEARCH*

The Committee and NCST discussed the challenges of informing communities of fire risks, efforts to create hazard maps, and how the risks are impacted constantly by varying weather patterns. They also presented the impact fires have on communities when a critical resource, such as a single hospital in rural areas, is affected or evacuated. We also discussed pre-fire reconnaissance efforts and rapid screening protocols used for other hazards like earthquakes, and how a similar framework could be used for wildfires. The Committee recommends continuing discussion and coordination with other relevant federal agencies about the potential role that NCST may play in future fire incidents. Emphasize the relevance of NCST in incidents that impact critical infrastructure like hospitals and evacuation routing.

### **UPDATES TO THE DISASTER AND FAILURE STUDIES PROGRAM**

The Committee and NCST staff discussed various topics including the following:

- The updates to the approach for evaluating and scoring future events, including wildfires.
- The demands placed on field teams.
- Report recommendations and the appropriate place to document processes that should be implemented for future investigations.
- The different reviews required for NCST reports and how to maintain the technical integrity of the reports, and
- The review timeline, including the committee's opportunity to review when reports are released for public comments.

## **HURRICANE MARIA NCST INVESTIGATION**

### *Overview of the Hurricane Maria Investigation*

The Hurricane Maria investigation has two major components, the NCST investigation and the National Windstorm Impact Reduction Program (NWIRP) investigation. These two investigations generated seven technical projects: (1) Hazard Characterization, (2) Performance of Critical Buildings, (3) Public Response to Emergency Communications, (4) Morbidity and Mortality, (5) Impacts to and Recovery of Infrastructure Systems, (6) Recovery of Business and Supply Chains, and (7) Recovery of Social Functions. These technical projects have been developed with the support of several federal, state, local, and territorial agencies. At this point, the collection of all data for the NCST portion of the investigation, and the collection of most of the data for the NWIRP portion, has been completed.

According to the Hurricane Maria NCST investigators, the draft of the final report is currently being prepared, with the final report to be ready for release in 2025.

We applaud the monumental efforts of this team. Considering the importance of the results generated by these studies, we encourage the research team to continue meeting their deadlines to ensure that these important data and findings are broadly shared with the public.

### *NCST Reports*

The NCST presented its report to the committee under three themes: Hazard Exposure, Hospital Functionality & Infrastructure Dependencies, and Protective Action & Preparedness.

**Hazard Exposure.** The Committee was impressed with the NCST's collection of measurement data and surveys, and their numerical and experimental results. These included all multi-hazard components of Hurricane Maria: Wind, heavy rainfall, flooding and landslides. Uncertainty quantification of the wind-field model and the regression of measured rain gauge data were presented and talked about. The Committee and the Hurricane Maria NCST discussed landslide susceptibility and flood hazard maps, wind measurements and modeling, and the public's assessment of the hazard's effects. Discrepancies between observations and modeling results regarding flood hazard maps were elaborated upon and resolved. The significance of vegetation maintenance in wind afflicted areas was highlighted. Difficulties encountered by the survey respondents' perception of water entry caused by flood water vs. rainwater and their ability to distinguish between the two were also discussed, as was the difference between public perception of flooding, flood risk maps, and the actual flooding experienced during Hurricane Maria.

**Hospital Functionality and Infrastructure Dependencies.** The Committee and NCST discussed the transportation study, the inaccessibility index, and the relationship between whether hospitals

were operational, transportation interruption and population access to health care. They presented challenges hospitals experienced with locating critical systems to avoid exposure to flooding and water intrusion, particularly through the roof. Water intrusion results in critical interruption in the ability to provide care. This may be an area for further exploration for code change. The Hurricane Maria NCST presented its efforts to acquire detailed data about the impacts of the hurricane on hospital functionality, and how that functionality was disrupted by infrastructure failures. The presentations explained how the Hurricane Maria NCST is drawing information from related investigations by the NWIRP, with NCST leading studies of critical buildings, emergency communications, morbidity and mortality, and NWIRP leading studies of the recoveries of infrastructure, social functions, and businesses.

The Hurricane Maria NCST described available data concerning the extent of riverine flooding and breaches of building envelopes. The team explained how flooding and envelope damage allowed water intrusion that severely disrupted hospital operations by disabling equipment, damaging supplies, shutting down electrical and water systems, and rendering portions of hospitals unusable.

The Hurricane Maria NCST explained how road closures prevented patients and staff from reaching hospitals, further preventing the general population from receiving timely and fully effective care for many weeks after the hurricane. They further elaborated on how power network and on-site power failures impacted hospital services. Care for patients was severely hampered during the hurricane and for many weeks thereafter.

**Protective Action and Preparedness.** The Committee and NIST staff discussed the data related to the school and shelter plans and the variability of effectiveness of these plans based on their level of detail and how often they were practiced prior to the disaster. They further discussed the protective actions residents took and the ability of the team to evaluate the efficacy of these approaches, especially for socially vulnerable populations. They also presented analyses of mortality records and the integration of various health- and social-datasets.

The Committee and NIST staff discussed the timeline for the completion of the final report and opportunities to promote availability of investigation data for the research community. They also discussed the complexities associated with qualitative and social science data considering the need to de-identify and maintain confidentiality.

The Committee made the following recommendations for the Hurricane Maria NCST:

**Hurricane Maria Recommendation 1.** The Hurricane Maria NCST explained that riverine and coastal flooding differed from that predicted by FEMA flood maps. To the extent possible within the scope of this NCST's assignment, the team should comment on where and why the flood maps should be evaluated and potentially updated.

**Hurricane Maria Recommendation 2.** The Hurricane Maria NCST reported that it was studying where there was extensive damage to the tree canopy and how the wooded

areas have recovered since the hurricane. To the extent possible within the scope of this NCST's assignment, the team should attempt to estimate wind speeds that induced widespread damage. The team also should evaluate whether wind Exposure Factors commonly used for design need to be reviewed to recognize changes in site shielding that can occur during extreme windstorms.

**Hurricane Maria Recommendation 3.** The Hurricane Maria NCST might consider studying how the sequence of roadway clearing and electrical distribution repair might have impacted recovery of hospital services, and whether preplanning the sequence of restoration of these essential services might facilitate more rapid recovery in the future. Such studies could inform Puerto Rico, and other communities nationwide, about strategies to speed recovery after widespread wind- and rain-induced disruptions. It also could aid decisions about locations for new medical facilities as well as mitigate efforts for existing facilities.

**Hurricane Maria Recommendation 4.** The Hurricane Maria NCST described the various preparations implemented by residents and facility managers. The team also described the types of damage that impacted functionality of buildings. Future planning will be enhanced if the Hurricane Maria NCST can comment on the efficacy of the various observed preparations for the prevention of damage and the mitigation of outcomes.

**Hurricane Maria Recommendation 5.** The Committee considers all aspects of the Hurricane Maria products (surveys, data, models and results) of great interest to wind engineering researchers, social scientists, and emergency planners. These materials should be archived, advertised, and made publicly accessible to researchers and the broader community.

**Hurricane Maria Recommendation 6.** Considering the significant impact of water intrusion and extended power failure on hospital functionality, recommendations about the level of tolerance of roof failure leading to water intrusion should be made for hospitals. Likewise, solutions to long-term power outages – likely combined with limited availability of fuel for generators – need to be found for hospitals and other critical facilities.

## **CHAMPLAIN TOWERS SOUTH PARTIAL COLLAPSE NCST INVESTIGATION**

### *Overview of the Champlain Towers South Investigation*

NCST provided a summary of activities that have occurred over the past year. NCST highlighted the integrated nature of the technical projects; the contracting process, timeline, and efficiencies; the invasive testing program and workflow; updates on the structural testing program; coordination with local officials; efforts to search for additional video footage enhancing and analyzing of the collapse; outreach activities; and progress on evaluating failure hypotheses. They concluded their

presentation by describing the technical updates that would follow using multidisciplinary thematic panels.

**Champlain Towers South Recommendation 1.** The CTS NCST explained that its report on the collapse will be extensive and detailed. To address the various audiences that will take interest in these findings, the CTS NCST will prepare a report that has several layers. It will include an overarching report that targets the general audience and strongly reflects the coordination of the interdisciplinary contributors to the study. The Committee believes this is essential to the communication of the CTS NCST findings.

NCSTAC admires how NIST and NCST have established a plan to communicate findings to impacted family members prior to releasing information publicly. We commend the NCST's diligence and efficiency in the wide and extended-duration range of research activities, but we also applaud their dedication to ethical communication as a vital component for establishing and keeping public trust in the process.

With the above in mind, we also acknowledge that intense interest, particularly from family members and other members of the public directly impacted by the collapse—in the ultimate findings of this thorough investigation is generating frustration over its duration. With the expectation that the final report might not be released until 2026, this frustration is likely to grow. As such, using all communication strategies possible to keep survivors and other interested parties informed of the progress remains paramount.

#### *NCST reports*

The progress of the CTS work was divided into three areas: Timeline and Evidence Collection, Analysis & Testing Updates and Failure Hypotheses.

**TIMELINE AND EVIDENCE COLLECTION** - The Committee and NIST staff discussed time stamp coordination on the various videos collected and the sounds eyewitnesses have described in interviews. The triangulation of these various data points has implications for understanding the timing and the initiation of the collapse and demonstrates the importance of the inclusion of the social scientists in the team and the value of bidirectional information exchange between social scientists and engineers in contributing to evaluation of failure hypotheses. They also discussed several details seen in the videos of the failure, and comparisons between physical and video evidence to information obtained from eyewitness interviews. Tying all video sources for guiding failures hypothesis is impressive work. The committee congratulates the team for groundbreaking work incorporating these various viewpoints into such a technically challenging situation. We look forward to not only the results of this unique collaboration, but also the methodological advances that will be made for future events.

**ANALYSIS AND TESTING UPDATES** - The CTS NCST work has advanced tremendously since the last NCSTAC meeting of last year. Differences in building codes when the building was constructed 40 years ago and now, design drawings vs. actual construction, and building inspection practices throughout the US were presented and discussed. Extensive material testing included

concrete, steel and soil/rock with emphasis on fully capturing the interaction of concrete and steel, particularly the corrosion observed. Large scale testing of structural components informed numerical models so that a wide range of material properties on the structural response can be evaluated. The interaction of the structure with the surrounding soil/rock (Soil Structure Interaction – SSI) for static and sinusoidal wave loads was deliberated upon. Various numerical codes were utilized to capture all possible modes of failure. The work of the CTS team will have a significant impact on future design and construction practices.

**Champlain Towers South Recommendation 2.** During the analysis presentation the Committee recommends evaluating if all the steel reinforcement was from the same manufacturer.

**Champlain Towers South Recommendation 3.** The Committee applauds the extensive and thorough testing performed by the CTS team and strongly encourages them to incorporate the variability of material properties and limitations in construction in their future work, as planned.

**FAILURE HYPOTHESIS** - The committee and NIST staff discussed the details of specific failure and collapse progression hypotheses presented, as well as a few that are being considered that were not used as examples for the presentation. The team described how there are more than 100 individual possible failure points that are grouped into hypotheses for analysis and consideration. The group also discussed the resourcing dedicated to lower and higher probability failure hypotheses, and how that affects the team’s approach to gathering evidence. This discussion was appreciated by the committee as previous discussions had included questions about how the team was prioritizing the use of resources. Additionally, the implications of the investigation findings on a broader, national scale were discussed.

The NCST informed the Committee that its final report will be delayed for several months due to programmatic and technical issues. The Committee understands the reasons for the delay given the complexity of the issues and investigation, and judges that delaying the CTS report is reasonable and prudent under the circumstances.

## SUMMARY

NCSTAC met with NIST twice in 2024 to review progress on initiatives over the past year and to provide feedback to NIST. Based on our discussions with NIST, we make the following observations:

The NCST program is highly valuable to the safety and resilience of the built environment—and the people who occupy it in the United States mainland and its territories.

We commend NIST for diligently administering the NCST program and developing and maintaining an extraordinary technical workforce.

The NCST teams investigating Hurricane Maria and the Champlain Towers South collapse are making appropriate progress toward completion of their assignments, using comprehensive state-

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National Construction Safety Team Advisory Committee (NCSTAC)

of-the-art investigative tools and techniques. They are also pioneering new approaches to ethical, rapid, interdisciplinary research.

NIST and the NCST teams have been highly responsive to feedback from the NCSTAC.

Sincerely yours,

A handwritten signature in blue ink, appearing to read 'JME', with a long horizontal flourish extending to the right.

José M. Izquierdo-Encarnación  
Chair, National Construction Safety Advisory Committee