

**National Construction Safety Team Advisory Committee**  
National Institute of Standards and Technology

NIST Report to Congress 2021

December 15, 2021

The Honorable Eddie Bernice Johnson, Chairwoman  
House Committee on Science, Space & Technology  
2321 Rayburn House Office Building  
Washington, D.C. 20515

Dear Madam Chairwoman,

I am pleased to submit the 2021 Annual Report of the National Construction Safety Team (NCST) Advisory Committee of the National Institute of Standards and Technology (NIST). The Committee serves as NIST's advisor on implementation of the NCST Act (P.L. 107-231; the 'Act'), and the opinions and recommendations expressed in this letter reflect our views as an independent, private sector body. This year the committee met via internet connection on June 10-11, and on Nov. 8. The meeting was used by NIST staff to brief the Committee on activities performed under the Act and closely related activities performed by NIST under other authorities.

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

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

The Act was stimulated by the World Trade Center attack in 2001. NIST distinguished itself with its thorough study of the performance of the affected structures and the thoughtful recommendations for improvements in building standards and codes that came as a result. NIST has a long history of investigating disasters of various types, going back at least as far as the 1971 earthquake in the San Fernando Valley. The Act facilitates NIST's ability to conduct such investigations and enhances cooperation with other federal agencies.

NIST is to be complimented on their thorough and thoughtful responses to our recommendations. In particular, the recommendations related to emergency communications during hurricane Maria and design for tornado hazards have been or are currently being addressed. We are pleased that NIST has restarted the Disaster Working Group. This mechanism should be helpful in streamlining the process for future responses to investigations.

*Automated Scoring of Events*

The addition of automated scoring of events shows promise to be able to score events in anticipation of the occurrence as well as at different points of time as the event unfolds. It does come with some questions about the methodology. The Disasters and Failure Studies (DFS) program scored 14 domestic and international events in FY2021, including seven windstorms, three earthquakes, two structural failures and two wildland-urban interface fires.

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One question on the methodology is the use of mortality as the human indicator of severity. Mortality is an extreme end-point of health and may not be the best indicator of severity of a disaster. It may be a useful exercise to consider a broad list of categories for measuring impact on the population and their health beyond mortality. For example, an event that results in a large number of severe injuries that lead to disability may be more severe than one with fewer deaths. Further, social vulnerability as defined by Centers for Disease Control and Prevention (CDC) may not be the best indicator of predicting mortality (or injury). That is not to say that looking at social determinants of injuries (and deaths) is not valuable. More exploration of the best way to model this will be helpful.

*Hurricane Maria NCST Investigation*

NIST has done an excellent job of reorienting its data collection processes due to the pandemic. For projects that involve the determination of business, social and health parameters, they have moved from in-person and telephone collection methods to telephone and web procedures. A similar change has been implemented for the evaluation of emergency communications. In all cases, they have obtained required approvals for data collection and have developed pilot surveys to test the instruments and refine them.

For their morbidity and mortality characterization, they have had to work with their contractor to move to verbal autopsies and social environmental surveys, augmented by medical records and hospital functions reviews. This has necessitated the development of a structured interview survey and the retrieval of additional hospital data. Most of the analysis and survey instruments have been tested, but the final pilot studies and updated instruments are to be developed.

While this has caused some delays in the investigation, they have made excellent progress and are on a reasonable schedule to complete these studies. They have successfully obtained generic clearance for many of the surveys by working within the Paperwork Reduction Act review by the Office of Management and Budget and in coordination with the NIST Institutional Review Board. They are well aware of the drawbacks associated with remote collection, including the delay and will be monitoring their data for these effects.

For studies of the physical conditions of buildings and infrastructure, as well as the hazard characterization, they have been able to proceed without significant disruption due to the pandemic, relying on physical observations and interviews. The interview instruments, however, are still undergoing review.

The extensive impacts of Hurricane Maria on social institutions throughout Puerto Rico, including schools and hospitals, warrants the considerable attention directed by the NIST investigation. Learning about the longitudinal effects on infrastructure and social recovery will aid in the identification of underlying characteristics and conditions associated with recovery of critical social functions.

We recognize the challenges associated with contracting and acquisitions that the NIST team has faced in the past, especially as it relates to launching investigations in a timely manner and

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capturing perishable data from populations affected by significant events. The recent efforts to develop and obtain approval for instruments that can be used in future studies will allow NIST researchers to be nimble and responsive for data collection activities. This will enable research activities to more quickly ramp up, potentially eliminating some of the hurdles faced by previous study teams. We are pleased to see the inclusion of social scientists and encourage their involvement and placement early in the design of research and data collection.

We applaud the NIST outreach and communication team for their efforts at disseminating the progress report on the Hurricane Maria investigation. There is clear evidence that public interest in the initial and ongoing work remains high and will likely draw attention from scholars, practitioners and policy makers as investigation findings are produced. Such interest also demonstrates the importance of focused and intentional longitudinal research with clearly articulated objectives that can provide evidence for future risk communication and building construction practices. Studies on the effects of hurricane forces on topography for the performance of critical buildings have progressed. The use of field measurements and wind tunnel modeling has improved the accuracy of modeling by developing target inflow profiles at 1:100 scale based on Particle Image Velocimetry (PIV) measurements from 1:3100 scale topographic models.

We look forward to seeing how the use of verbal autopsies in the Hurricane Maria study impacts the thoroughness and richness of data gathered on disaster related deaths. As the team works through this process, developing standards for conducting these verbal autopsies will be useful in future events.

We are pleased to see the significant data collection efforts underway from the Hurricane Maria investigation. It is heartening to learn that interviews and survey research may be near completion within the year. We also commend the team for their decision to continue their work with social media data by completing translation activities and commencing with data coding and analysis. These data may also deliver insights into risk communication activities that may have occurred in real time during the Hurricane Maria response and recovery activities and can be a point of comparison to data collected at much later time points or a counterpoint to radio communications that remained active throughout the response period.

In the event of an extreme event like Hurricane Maria, radio broadcast proved that it became an essential tool for informing the public, due to the collapse of the modern cellular data towers. Radio was the only public communication for emergency actions for several weeks.

*Joplin Tornado NCST Investigation*

NIST should be commended for their progress on implementing the 16 recommendations in their comprehensive report on the 2011 Joplin tornado, published in 2014. There has been significant progress on essentially all of the recommendations, including primary completion on eight. One item with only modest progress is under coordination with FEMA. Perhaps the most impactful effort was the development of tornado hazard maps, which enable site specific tornado resistant design. These maps and accompanying design methodologies are expected to be included in the

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2022 ASCE 7 standard, which will become part of the 2024 International Building Code, controlling building design in most of the U.S. This accomplishment is a testament to NIST's follow-through on recommendations developed in their reports. However, the trajectory of this significant improvement could be cause for concern about the overall building code adoption process in the U.S., taking 14 years to be included in national building codes—and probably one to two more years for effective enforcement. In addition, the improved design process only applies to “important buildings” (Risk Category III and IV). The vast majority of buildings, including the housing stock, are Risk Category II and will not be affected by this code change. We wish to point out that NIST has no control over this process and that the delay does not diminish their accomplishment. The Advisory Committee encourages NIST to continue to explore alternative strategies for houses and other small wood-frame buildings, as well as the improvement of tornado shelter standards and public tornado sheltering strategies.

### *Champlain Towers South Partial Collapse NCST Investigation*

The plan to investigate the Champlain Towers South partial collapse, co-led by Mr. Glenn Bell and Dr. Judith Mitrani-Reiser, is comprehensive and includes materials science, remote sensing, evidence preservation, building code evaluation, geotechnical engineering and structural engineering. NIST has assembled an extremely strong team of experts, both within NIST and from the outside, who are experienced and very accomplished in their respective fields (see attachment: slide 11)

While not directly related to the cause of the collapse, the extensive amount of field data collected by NIST and others may provide the opportunity to understand patterns of mortality and morbidity throughout the building. This could be of interest in the case of future failures in terms of search and rescue guidelines as well as evacuation patterns, including both shelter-in-place and physical movement from the building.

In contrast to prior NCST investigations, the cause of the Champlain Towers South failure will not be known until completion of the investigations, since there was not an obvious extraordinary initiating event. This complexity is important for the public to understand as families and other community members wait for answers. Many of the projects underway by NIST will not be able to provide solid answers until they reach near completion. It will be helpful if NIST is able to provide a tentative timeline for the projects, including milestones, and have a well-developed communication plan to keeping the public informed. (attach slide 6)

In summary, the Committee finds the NCST program to be highly valuable to the safety of the members of our community. We commend the current administration at NIST for their diligence in evaluating events for worthwhile study and the commitment to finding the funding to carry out the studies when justified. We also want to restate our recommendation to Congress that the Act be revised. The Act focuses exclusively on safety from building failures. NIST has studied failures of construction that cannot be characterized purely as buildings, and should do so again in the future. The failures of the power grid and communication systems in Puerto Rico caused by Hurricane Maria are good examples. Studies of such events are crucial to building performance but also to improving tools to enhance community resilience, which is a current

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focus of research at NIST. A past example of an important NIST (then the National Bureau of Standards (NBS) investigation of a construction failure that was not a building was the 1978 collapse of a cooling tower for the Pleasants Power Station at Willow Island, West Virginia. While investigations of failures of nonbuilding structures have been and could be carried out under the authorities granted to NIST in the Organic Act, in the National Windstorm Impact Reduction Program and in the National Earthquake Hazard Reduction Program, we recommend that formal consideration be given to amending the NCST act to emphasize the important role NIST should play in such investigations. The specific changes that we recommend are contained in the appendix to this letter.

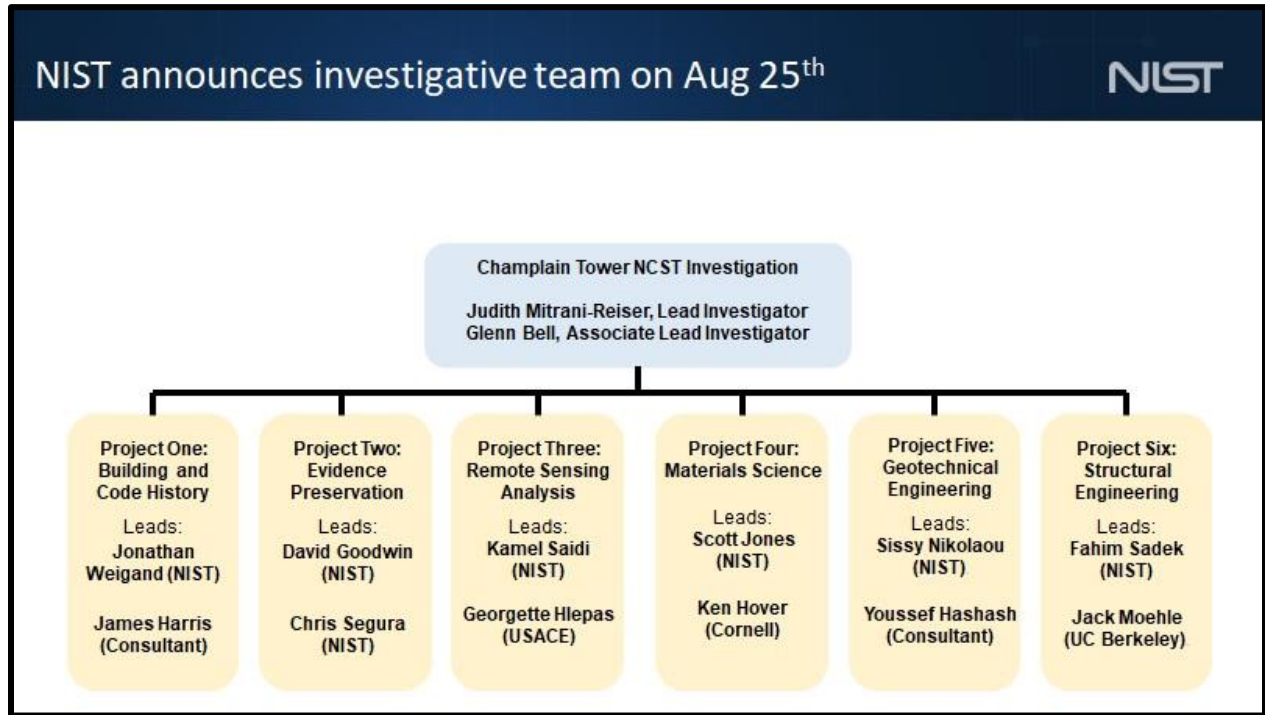
Sincerely yours,

Reginald DesRoches  
Chair, National Construction Safety Advisory Committee

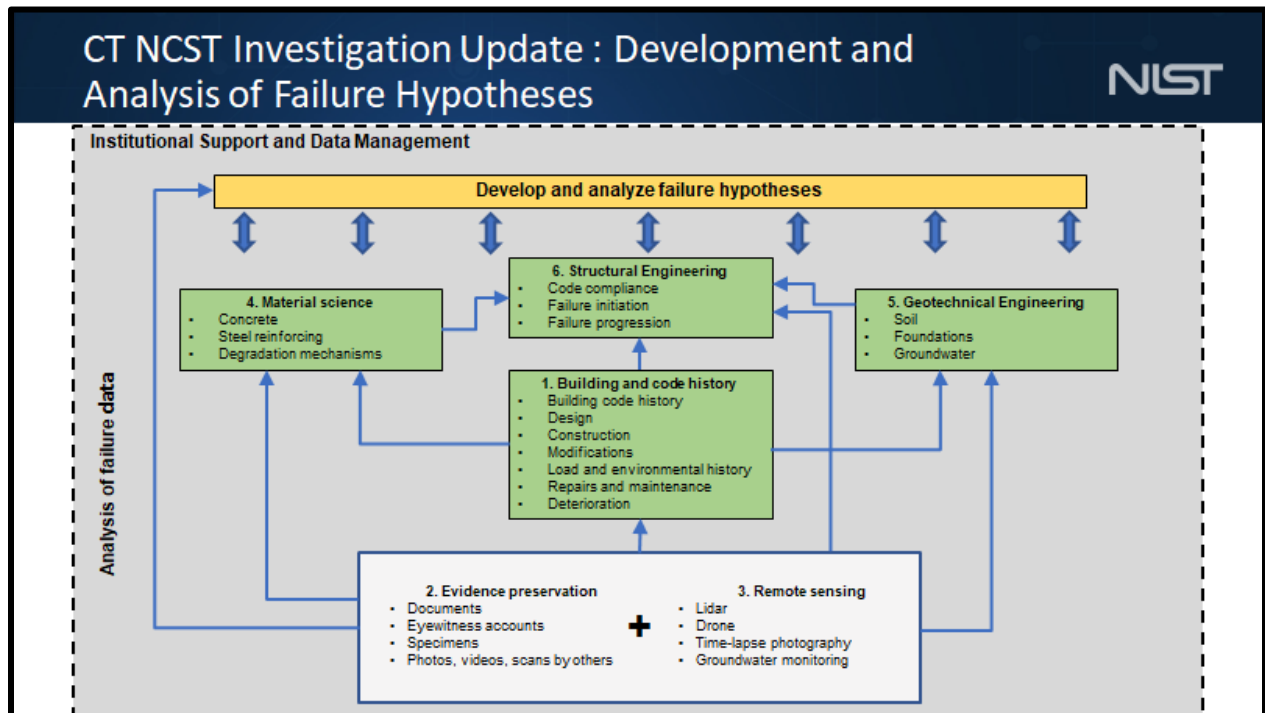
Attachment

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**Attachment: Slide 11**



**Attachment: Slide 6**



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**Appendix**

Proposed amendments to the NCST Act:

Sec. 2, paragraph (a):

“...after events causing the failure of a building or ~~buildings~~ structure that has resulted in substantial loss of life or that posed significant potential for substantial loss of life. Where the failure of the structure is the proper subject for investigation by another Federal agency, the Director shall defer to the authority of that agency. To the maximum extent practicable...”

And Sec. 2, paragraph (b)

“(1) PURPOSE.—The purpose of investigation by Teams is to improve the safety and structural integrity of ~~buildings~~ the built environment in the United States.

And replace the term “buildings” with “the built environment” in Sec. 2 paragraph (b)(2)(D)

And replace the term “building standards, codes, and practices” with “engineering standards, practices, and building codes” at the following locations:

Sec. 8 paragraph (3)

Sec. 9, paragraph (2)

Sec. 14

And replace the term “building failure” with “failure” at the following locations:

Sec. 2, paragraph (b)(2)(a)

Sec. 4, paragraph (c)(1)

Sec. 2, paragraph (c)(1)(G)

Sec. 4, paragraph (c)(2)

Sec. 2, paragraph (c)(1)(J)

Sec. 4, paragraph (d)(3)

Sec. 4, paragraph (a)

Sec. 4, paragraph (d)(4)

Sec. 4, paragraph (a)(1) [2 locations]

Sec. 7, paragraph (c)

Sec. 4, paragraph (a)(3)

Sec. 8, paragraph (1)

Sec. 4, paragraph (b)(a)

Sec. 8, paragraph (4)

Sec. 4, paragraph (b)(2)

And replace the term “building components” with “components” at the following locations:

Sec. 4, paragraph (a)(1)

Sec. 4, paragraph (a)(3)

Sec. 4, paragraph (b)(1)

And broaden Sec. 4, paragraph (d) on Interagency Priorities to include other agencies that have legislative mandates for the investigation of the failure of selected types of failures, such as the Army COE for dams and levees, the NRC nuclear power generation, the DOE for nuclear weapons facilities, and the DOT for vehicular bridges. *[Such mandates are assumed, not verified, by this advisory committee]*

Lastly, unrelated to the preceding, consider updating Sec. 2 paragraph (c)(1)(J) by adding a reference to the National Windstorm Impact Reduction Program.