National Institute of Standards and Technology
National Construction Safety Team Act
Annual Report
Fiscal Year (FY) 2025

Summary

This annual report to Congress for Fiscal Year (FY) 2025 is required by the National Construction Safety Team (NCST) Act (Public Law 107-231).

In FY 2025, the National Institute of Standards and Technology (NIST) continued to evaluate Hurricane Maria's (HM) impacts on Puerto Rico as part of the NCST investigation launched by the NIST Director on February 21, 2018. The goals of this investigation are to characterize: (1) the wind environment and technical conditions associated with deaths and injuries; (2) the performance of representative critical buildings, and designated safe areas in those buildings, including their dependence on local lifelines; and (3) the performance of emergency communications systems and the public's response to such communications. More information about the Hurricane Maria NCST investigation can be found here: https://www.nist.gov/disaster-failure-studies/hurricane-maria-program

In FY 2025, NIST also continued the NCST investigation launched by the NIST Director on June 30, 2021, to investigate the partial collapse of the Champlain Towers South (CTS) Condominium that occurred in Surfside, FL, on June 24, 2021. The goals of this investigation are (1) to establish the likely cause or causes of the partial collapse, (2) recommend any changes to standards, codes, and practices, and (3) recommend any research or other appropriate actions needed to improve the structural safety of buildings. More information about the Champlain Towers South NCST investigation can be found here: https://www.nist.gov/disaster-failure-studies/champlain-towers-south-collapse

The Joplin Tornado NCST Investigation[1] resulted in recommendations to develop consensus standards and building code provisions related to tornado resistant design, and NIST has made additional progress on implementing those recommendations.

Highlights of FY 2025 activities include:

- The NIST HM Team completed data collection for the three National Windstorm Impact Reduction Program (NWIRP) projects being conducted as part of the HM Program. They also integrated the previously-developed wind-field model dataset with wind tunnel datasets; conducted Computational Fluid Dynamics (CFD) simulations on the effects of topography and forest canopies on winds; continued collecting wind measurements for an additional year on four towers in Yabucoa, Puerto Rico, to support final datasets of topographic effects on winds; and conducted focus groups and interviews with businesses to examine how Hurricane Fiona in 2022 affected recovery efforts from Hurricane Maria.

[1] Report available at: http://www.nist.gov/customcf/get_pdf.cfm?pub_id=915628.

- The NIST HM Team completed draft project reports and began the internal NIST review process for these; they recorded and released a public progress update[2] in July 2025, which included preliminary findings and anticipated areas for recommendations.

- The NIST CTS Team completed the majority of their technical work, including: the evaluation and damage assessment of hard drives recovered from the collapse site; materials testing of subsurface (below-ground) materials; completion of full-scale building replica tests; updated the building collapse timeline based on data and analysis of evidence; and made significant progress on their assessment of failure scenarios.

- The NIST CTS Team transferred custody of the physical evidence back to the Miami-Dade Police Department (MDPD), now the Miami-Dade Sheriff's Office, in November 2024.

- The NIST CTS Team recorded and released an in-depth public progress update[3] in June 2025, which described the investigation's history and progress, preliminary findings, and potential impacts on future codes and standards. NIST also provided news updates to the public in a bimonthly cadence.

- NIST conducted one preliminary reconnaissance mission in February in response to the Los Angeles County wildfires. An NCST Investigation will not be undertaken due to resource constraints.

- NIST began work to develop and validate a novel drone-mounted sensor for making measurements of horizontal and vertical wind speeds inside a tornado, including design, fabrication, and wind tunnel testing of the first prototype. This activity supports implementation of Recommendation #1 from the Joplin Tornado NCST Investigation.

- NIST continues to co-lead the American Society of Civil Engineering (ASCE) Structural Engineering Institute (SEI) Standards Committee that is collaborating with the American Meteorological Society (AMS) to develop the new ASCE/SEI/AMS Wind Speed Estimation in Tornadoes Standard. In FY 2025, the committee voted on draft chapters for wind speed estimation methods utilizing in-situ measurements, forensic engineering, and remote-sensing data; and draft Damage Indicators for the Enhanced Fujita (EF-) Scale. These activities address Recommendation #4 from the Joplin Tornado NCST Investigation.

NIST presented the FY 2025 activities to the NCST Advisory Committee (NCSTAC or Committee) via web conference on September 9 and 16, 2025. A summary of these meetings may be found on the NIST NCST website[4] and in the FY 2025 Annual Report of the NCSTAC to Congress.[5]

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[2] https://www.nist.gov/news-events/news/2025/07/nist-shares-preliminary-findings-hurricane-maria-investigation

[3] https://www.nist.gov/news-events/news/2025/06/nist-releases-extensive-video-update-champlain-towers-south-investigation

[4] NCSTAC meeting agendas, presentations, and summaries are available at: https://www.nist.gov/topics/disaster-failure-studies/national-construction-safety-team-ncst/advisory-committee-meetings.

[5] FY 2024 NCSTAC Report to Congress available at: https://www.nist.gov/topics/disaster-failure-studies/national-construction-safety-team-ncst/advisory-committee.

1. Introduction

In October 2002, the NCST Act was signed into law by President George W. Bush and authorized the Director of NIST to establish and deploy Teams to investigate events leading to failure of a building, or buildings, that resulted in substantial loss of life or that posed significant potential for substantial loss of life.

The purpose of these investigations is to improve the safety and structural integrity of buildings in the United States. A Team shall:

1. Establish the likely technical cause or causes of building failure.
2. Evaluate the technical aspects of evacuation and emergency response procedures.
3. Recommend, as necessary, specific improvements to building standards, codes, and practices based on the findings made pursuant to (1) and (2).
4. Recommend any research and other appropriate actions needed to improve the structural safety of buildings, and improve the evacuation and emergency response procedures, based on the findings and recommendations of the investigation.

Under Section 10 of the NCST Act, NIST is to provide an annual report to the House Committee on Science, Space, and Technology, and to the Senate Committee on Commerce, Science, and Transportation each year. This report is to include:

1. A summary of the investigations conducted by Teams during the prior fiscal year.
2. A summary of recommendations made by the Teams in reports issued under Section 8 of the NCST Act during the prior fiscal year and a description of the extent to which those recommendations have been implemented.
3. A description of the actions taken to improve building safety and structural integrity by NIST during the prior fiscal year in response to reports issued under Section 8 of the NCST Act.

This report summarizes NIST's activities under the NCST Act for FY 2025 as required by Section 10 of the Act.

2. Investigations Conducted Under the NCST Act during FY 2025

a. Hurricane Maria

On September 20, 2017, Hurricane Maria made landfall in Puerto Rico as a strong Category 4 storm, causing fatalities, injuries, and damage to buildings and infrastructure. The NIST Director established a Team (HM Team) under the NCST Act, based on an analysis of the event against the criteria in the NCST Act and its implementing regulations (15 C.F.R. Part 270), to conduct a technical investigation of the building performance and emergency response and evacuation during Hurricane Maria. The goals of the NCST Hurricane Maria Investigation are to characterize: (1) the wind environment and technical conditions associated with deaths and injuries; (2) the performance of representative critical buildings, and designated safe areas in those buildings, including their dependence on lifelines; and (3) the performance of emergency communications systems and the public's response to such communications.

The HM Team members continue to work on four projects that address the investigation goals, as described below:

(1) Hazard Characterization:

The objective of this project is to characterize the wind environment associated with Hurricane Maria's impact on Puerto Rico, including topographic effects, and to document other hazards associated with the hurricane, including storm surge, rainfall, flooding, and landslides in order to understand subsequent building failures. The investigative methods for this project include wind field modeling, wind tunnel testing, field measurements, and numerical simulation.

(2) Performance of Critical Buildings:

The objective of this project is to characterize the performance of critical buildings in Hurricane Maria by evaluating damage and loss of function for representative hospitals, schools, and storm shelters with respect to the hazards they experienced and by evaluating the selection criteria and design requirements for storm shelters.

(3) Public Response to Emergency Communications:

The objective of this project is to investigate the role of emergency communications in public response for those under imminent threat from Hurricane Maria. This project also examines the use of communications during response and recovery (during and immediately after the hurricane).

(4) Characterization of Morbidity and Mortality:
The objective of this project is to complete a quantitative morbidity and mortality assessment of Puerto Rico, to better understand how damaged buildings and supporting infrastructure played a role in the injuries and deaths associated with Hurricane Maria. The study results will provide guidance to improve codes and standards as well as to inform future approaches to accurately attribute and predict life loss due to windstorm building failure(s).

In FY 2025, the team shifted its focus to finalizing analyses, refining findings across projects, developing recommendations, and report writing. The HM Team's efforts in FY 2025 included:

- Completion of analysis, including CFD simulations of the effects of topography and forest canopy on winds and evaluation of building wind loads through integration of the HM wind-field model with wind tunnel data.

- Release of a public update video in July that provided an overview of the investigation, a timeline highlighting selected accomplishments since its launch in 2018, and a summary of data collection and analysis that has been completed, along with preliminary findings and anticipated areas for recommendations. [6]

[6] https://www.nist.gov/news-events/news/2025/07/nist-shares-preliminary-findings-hurricane-maria-investigation

- A presentation to the NCST Advisory Committee in September that summarized progress to date, presented plans for completion of the final reports, and highlighted preliminary findings and anticipated areas for recommendations. Recommendations from the HM Investigation are anticipated to result in improvements in the following areas:

    - Standards to account for faster winds caused by mountains and hills for design of buildings and other structures.
    - Standards for storm shelters and refuge areas.
    - Measures that will help hospitals and other critical facilities maintain services during and after hurricanes, such as standby generators for elevators and air-conditioning.
    - More robust tools for measuring wind, rainfall, and flooding.
    - Standards for attribution of disaster-related deaths.

- Completion of draft project reports and commencement of the review process.

- Commencement of work on the summary report for the HM NCST Investigation with support from a contractor.

In FY 2023, NIST's Engineering Laboratory received $40M in additional funding from Congress under the Disaster Relief Supplemental Appropriations Act, 2023, as part of the Consolidated Appropriations Act, 2023 (Public Law 117-328) "…to support the development of resilience standards with regard to weather and climate disasters, in addition to the underlying research to support those standards, and for necessary expenses to carry out investigations of building failures pursuant to the National Construction Safety Team Act of 2002". A portion of these funds have been and will continue to support the extension of existing work on Hurricane Maria to consider impacts of Hurricane Fiona, including assessment of the hazard, specifically wind and rainfall; evaluation of Hurricane Fiona's impacts on selected hospitals and shelters being evaluated in the Hurricane Maria NCST Investigation; assessment of impacts on infrastructure systems and their interdependencies (e.g., power, water, transportation); and evaluation of physical and non-physical impacts of Hurricane Fiona on schools, hospitals, and businesses as well as effects on recovery from Hurricane Maria. Observations from Hurricane Fiona are expected to provide context to inform recommendations that come from the HM NCST investigation. A portion of these funds will also be used going forward to support the completion of the HM NCST investigation.

The HM Team continues to provide regular updates on the NIST website.[7] Efforts are underway to complete the final reports, and streamline and sequence their reviews to ensure they can be published as soon as feasible.

b. Champlain Towers South Condominium Collapse

On June 24, 2021, around 1:30 a.m., approximately half of the Champlain Towers South Condominium collapsed suddenly in Surfside, FL, causing 98 fatalities. Based on the recommendations of a preliminary reconnaissance team and evaluation of the criteria listed in the NCST Act and its implementing regulations (15 C.F.R. Part 270), on June 30, 2021, the NIST

[7] NIST Hurricane Maria website: https://www.nist.gov/topics/disaster-failure-studies/hurricane-maria

Acting Director established the CTS Team under the NCST Act to conduct a technical investigation of the partial collapse. The goal of this investigation is to uncover factors that contributed to the initiation and sequence of collapse of the building and make recommendations to improve public safety and prevent recurrence of failures like the partial collapse of CTS.

Investigations like CTS have plans, tasks, and needs for resources which evolve as the investigation unfolds. With the extraordinary support of NIST's Acquisition Management Division and other NIST operating units, as well as support of NIST management and leadership, the CTS Team has used all possible means to procure materials and services at speeds that align with the investigation's timeline, while continuing to meet the requirements of the Federal Acquisition Regulation. NIST has awarded more than 35 contracts, IDIQ task orders, and IAA work orders in support of the investigation.

The CTS Team members continue to work on six coordinated technical projects and one management project that address the investigation goals, as described below:

(1) Building and Code History:

The objective of this project is to assess the entire history of the building from original design through the partial collapse, including relevant codes and standards, design drawings and other documents, construction records, inspections, maintenance, renovations, and loads and environmental conditions.

(2) Evidence Collection and Preservation:

The objective of this project is to use innovative tagging and data collection methods to catalog and organize evidence and ensure the integrity of its origin through proper storage, handling, and sampling. This project also focuses on determining the original locations of evidentiary building debris from the CTS building prior to collapse using identification clues, design drawings and data collected during collapse pile deconstruction. This project leads the effort to extract and document testable subsamples, such as concrete cores and rebar, from evidentiary building debris that are representative from different areas of the building. This project also includes collecting key pieces of evidence by conducting interviews with CTS residents, first responders, family members or others with knowledge of the building condition and collapse events.

(3) Remote-Sensing and Data Visualization:

The objective of this project is to analyze data collected from the Champlain Towers South site after the collapse, as well as any available data on the building prior to the collapse. The analyzed 2D and 3D surface, and subsurface data will be compiled, organized, georeferenced, visualized and communicated as part of a geographic information system (GIS) model that will be designed to support the other investigation projects.

(4) Materials Science:

The objective of this project is to evaluate the strength, appropriateness, uniformity, and deterioration of materials used in specific building features and at different floors in the

building. This project compares the measured material properties to the characteristics specified in the building design and the measured data will be used in the partial collapse analyses and simulations.

(5) Geotechnical Engineering:

The objective of this project is to evaluate the foundation's design, as-built construction, and current condition. It will also assess geotechnical and soil factors that may have affected the foundation.

(6) Structural Engineering:

The objective of this project is to use evidence collected from the collapse site, the results of the other projects, and structural engineering and reinforced concrete design knowledge to conduct laboratory load tests and generate computer models to simulate the failure initiation and progression.

(7) Project Management:

The six technical projects described above are managed by the investigation's co-leads, who provide technical and project oversight to meet the objectives of each project and identify the underlying cause(s) of collapse of CTS.

In FY 2025, the team pivoted the investigation's workflow across all six technical projects toward finalizing the analysis of failure scenarios. All projects contributed to collecting evidence, conducting tests, and completing computational analyses to rigorously assess failure scenarios in a structured approach to arrive at the most probable failure scenario(s). The CTS Team's efforts in FY 2025 included:

- updating the building collapse timeline, based on observations by eyewitnesses, audiovisual evidence, and records collected by the Team;
- finalizing a historical review of development near the collapse site;
- completing historical timelines from various types of records collected by the Team;
- updating uncertainty quantification of physical measurements taken of physical building evidence and informed by digital evidence;
- continued planned interviews and prepared to finalize interviews early in FY 2026;
- new and continued analysis of structural movements in video footage captured before and during the collapse;
- analyses of accumulated data to assess the pre-collapse state of the structure and integration of these in the 3D visualization tool and the building information model (BIM), which has been key in analysis of failure scenarios;

- performing statistical analysis of the results of mechanical testing of concrete and steel reinforcement, including uncertainty quantification;

- performing petrographic analyses of concrete to assess potential deterioration mechanisms;

- measuring and analyzing corrosion of steel reinforcement;

- completion of testing and analysis of shrinkage of concrete;

- completion of tests on below-grade materials, and conducting additional soil-structure interaction analyses;

- completion of the full-scale structural laboratory testing program;

- performing extensive finite element analysis of failure initiation and progression scenarios; and

- incorporation of the work product of all projects–including analysis of evidentiary information, tests, and computational analyses–to assess potential contributors to the Team's analysis of failure initiation scenarios.

The Champlain Towers South NCST investigation is highly visible to the public and media. Families and others impacted by the partial collapse need to know how and why the failure occurred. Owners, residents, managers, building officials, and regulators are eager to understand whether the factors that caused the Champlain Towers South partial collapse have implications for other structures. In FY 2025, these communications included:

- a summary, videos, and photos of the public meeting with the NCST Advisory Committee (September 2024);

- a summary of the collection, safeguarding, testing/analysis, and the final return of the physical evidence back to the Miami-Dade Police Department, now the Miami-Dade Sheriff's Office (November 2024);

- a summary, video, and photos associated with the publication of NIST's annual NCST report to Congress, including details of the full-scale structural testing program (February 2025);

- a summary, videos, and photos of NIST's progress update to structural engineers from across the country at the annual ASCE Structures Congress (April 2025);

- a detailed video summarizing NIST's progress on the investigation (June 2025);

- announcement of public meeting (August 2025); and

- a summary, videos, and photos of the update provided to the NCST Advisory Committee (September 2025).

The CTS NCST investigation is one of the most complex and challenging investigations of its type ever undertaken, with dozens of failure scenarios considered and an enormous amount of evidence analyzed. The implications of the findings of the investigation will be far reaching, and thus, must be of the highest quality. In FY 2025, the NIST CTS Team added purposeful communications and interactions with key professional stakeholders who will be partners in translating the findings and recommendations into real-world impacts by:

- reaching out directly to professional organizations via email, to ensure that their members are aware of public updates, meetings, investigation preliminary findings, and potential themes of future recommendations;

- participating in technical committee meetings of codes (e.g., International Code Council, American Concrete Institute) and standards (ASCE, ASTM); and

- presenting investigative updates at relevant national conferences (e.g., ASCE's Forensic Engineering Conference, ASCE's Structural Engineering Institute's Congress, and the National Council of Structural Engineering Association's Summit).

In FY 2025, the CTS NCST Investigation spent approximately $5.76M of the funds provided by Congress under the Disaster Relief Supplemental Appropriations Act, 2023, as part of the Consolidated Appropriations Act, 2023 (Public Law 117-328), to support labor, contracts, travel, and micro-purchases. In addition, the Team has cooperated, collaborated, and coordinated with more than 15 Federal and local agencies.

Updates on the NCST Champlain Towers South Condominium Investigation are regularly posted on the NIST website.[8] The investigation timeline has been reviewed and adjusted to ensure the investigation can be completed as soon as feasible.

3. Summary of Recommendations Made in Reports Issued Under Section 8 of the NCST Act during FY 2025.

During FY 2025, NIST did not issue a report under Section 8 of the NCST Act.

4. Actions Taken to Improve Building Safety and Structural Integrity During FY 2025 in Response to Reports Issued Under Section 8 of the NCST Act.

During FY 2025, NIST did not issue a report under Section 8 of the NCST Act.

The following actions were taken in FY 2025 to implement recommendations in the NCST Joplin Tornado Investigation final report[9] to improve building safety and structural integrity:

- Obtaining measurements inside tornadoes is difficult given their small spatial scale and extreme conditions. NIST initiated work to design and calibrate a novel drone-mounted sensor for measurement of horizontal and vertical wind speeds inside a tornado. An initial

[8] https://www.nist.gov/disaster-failure-studies/champlain-towers-south-collapse

[9] https://www.nist.gov/publications/final-report-national-institute-standards-and-technology-nist-technical-investigation

prototype was constructed and tested in NIST's wind tunnel facility. This activity supports implementation of Recommendation #1.

- NIST and National Oceanic and Atmospheric Administration staff are co-leading the ASCE/SEI/AMS Standards Committee that is developing the new Wind Speed Estimation in Tornadoes Standard, a consensus standard that will improve the accuracy of wind speed estimates in tornadoes. During FY 2025, the treefall method and remote-sensing method chapters had their second Main Committee ballot. Four additional Damage Indicators in the Enhanced Fujita (EF) Scale chapter had their first ballot at the Main Committee. Work on additional chapters for other wind speed estimation methods continued. This standards development activity addresses implementation of Recommendation #4 and supports Recommendations #1 and #2.

- NIST led the development of tornado hazard maps that were published in the 2022 version of the ASCE 7 Standard for Minimum Design Loads on Buildings and Other Structures, which requires design considerations for tornado hazards for certain building types. In FY 2025, NIST began work to develop updated tornado hazard maps for use in the 2028 version of the ASCE 7 Standard. This effort is supported by a cooperative agreement issued to Applied Research Associates, Inc. The new maps will incorporate an additional eight years of tornado data and improvements to the tornado climatology analysis and mapping methodology. This activity enhances implementation of Recommendations #3, #5, and #6.

5. Preliminary Reconnaissance Missions

NIST uses a scoring tool to assess the need for preliminary reconnaissance of disasters and failures. The scoring tool utilizes the following key decision criteria: event consequences (substantial loss of life or disabling injury, significant potential for loss of life, hazard intensity, and consequences to resilience); major challenges in evacuation and/or emergency response; international factors (relevance to the United States); feasibility (resources and safety of team); and study impacts (new knowledge gains, and potential impact to existing standards, codes and practices). Fourteen domestic and international events were scored in FY 2025, including five windstorms, seven earthquakes, one wildfire, and one structural failure. These events occurred in Alabama, Arkansas, California, Florida, Georgia, Idaho, Illinois, Indiana, Kansas, Kentucky, Louisiana, Michigan, Mississippi, Missouri, New Jersey, North Carolina, Ohio, Oklahoma, Pennsylvania, South Carolina, Tennessee, Texas, and in Afghanistan, Burma, China, Russia, Turkiye, Vanuatu. A preliminary reconnaissance mission was conducted for the Los Angeles County, CA, wildfires. Preliminary reconnaissance missions were not conducted for any of the other events, due to one or more of the following reasons: no clear study objectives that would impact standards, codes, and practices; unsafe conditions for NIST investigators; no primary authority or in-house expertise of hazard type; construction practice and codes for international events are not similar to those used in the U.S.; no new lessons would be gained; minimal impact to building occupants; or limited financial and personnel resources.

6. Conclusion

The NCST Act authorizes NIST to establish and deploy Teams to investigate building failures that result in a substantial loss of life or pose significant potential for loss of life. In FY 2025, NIST assessed 14 events (earthquakes, hurricanes, tornadoes, wildfires, and structural failures) using a scoring tool that considers: event consequences (substantial loss of life or disabling injury, potential for loss of life, hazard intensity and physical damage) and evacuation and/or emergency response; international factors (relevance to the U.S.); and study impacts (safety of team, new knowledge gains, and potential impact to existing standards, codes and guidelines). After analyzing the data from these 14 events, NIST conducted one preliminary reconnaissance mission, for wildfires in California.

NIST is approaching the conclusion of the investigations of the building performance and emergency response and evacuation during Hurricane Maria in Puerto Rico, and the partial collapse of Champlain Towers South in Surfside, FL, and continues to pursue actions related to improving building safety and structural integrity that were recommended by the 2014 Joplin Tornado NCST investigation report. As part of the HM NCST investigation, in FY 2025 NIST completed analyses, refined findings, developed recommendations, completed draft project reports, and began the internal NIST review process for these reports. As part of the CTS investigation, in FY 2025 NIST completed the majority of the technical work, including historical timelines of the building and site, two phases of interviews, statistical analysis of physical measurements and testing results, concrete shrinkage tests, testing of subsurface materials, and the full-scale structural testing program. NIST presented these FY 2025 activities to the NCST Advisory Committee during a web conference meeting on September 9 and 16, 2025. Based on current planning timelines, both active NCST investigations are projected for completion in calendar year 2026.