

National Construction Safety Team Advisory Committee (NCSTAC)
Hybrid Meeting Summary
National Institute of Standards and Technology (NIST)
Gaithersburg, Maryland
June 14-15, 2023

Advisory Committee Members:

Ross Corotis, Chair	University of Colorado, Boulder
Jose Izquierdo-Encarnación, Vice Chair	PORTICUS
Donald Dusenberry	Consulting Engineer
William Holmes	Rutherford + Chekene
Gary Klein	Wiss, Janney, Elstner Associates
Lori Peek	University of Colorado, Boulder
Kimberly Shoaf	Utah School of Medicine
Jeannette Sutton	University at Albany, State University of New York
Aspasia Zerva	Drexel University

NIST Leadership:

Joannie Chin	Director, Engineering Laboratory
Albert Wavering	Deputy Director, Engineering Laboratory
Therese McAllister	Acting Chief, Materials & Structural Systems Division (MSSD)
Steven McCabe	Associate Chief, MSSD
Jennifer Huergo	Director of Public Affairs and Family Liaison, Champlain Towers South NCST Investigation

NIST Staff and Associates (listed in alphabetical order):

Glenn Bell	Champlain Towers South NCST Associate Lead Investigator
Tanya Brown-Giammanco	Director, Disaster and Failure Studies
Maria Dillard	Hurricane Maria NCST Associate Lead Investigator
Tina Faecke	Designated Federal Officer
Emel Ganapati	Champlain Towers South NCST Project Leader
David Goodwin	Champlain Towers South NCST Project Leader
James Harris	Champlain Towers South NCST Project Leader
Kenneth Harrison	Hurricane Maria NCST Project Leader
Youssef Hashash	Champlain Towers South NCST Project Leader
Jennifer Helgeson	Hurricane Maria NCST Project Leader
Georgette Hlepas	Champlain Towers South NCST Project Leader
Kenneth Hover	Champlain Towers South NCST Project Leader
Katherine Johnson	Hurricane Maria NCST Project Leader
Scott Jones	Champlain Towers South NCST Project Leader
Marc Levitan	Hurricane Maria NCST Project Leader
Joseph Main	Hurricane Maria NCST Lead Investigator
Judith Mitrani-Reiser	Champlain Towers South NCST Lead Investigator and Hurricane Maria NCST Project Leader
Jack Moehle	Champlain Towers South NCST Project Leader

Sissy Nikolaou	Champlain Towers South NCST Project Leader
Fahim Sadek	Champlain Towers South NCST Project Leader
Kamel Saidi	Champlain Towers South NCST Project Leader
Christopher Segura	Champlain Towers South NCST Project Leader
Jonathan Weigand	Champlain Towers South NCST Project Leader
DongHun Yeo	Hurricane Maria NCST Project Leader

Public Speakers:

Martin Langesfeld
Pablo Langesfeld

I. Welcome and Opening Remarks

Ms. Tina Faecke, serving as the Designated Federal Officer (DFO), called the meeting to order and noted that nine Committee members attended in person, and one member was absent. She informed everyone the meeting would be recorded. Ms. Faecke then introduced the NIST Engineering Laboratory Director, Dr. Joannie Chin, who welcomed the Committee and thanked them for their engagement and participation. She noted the importance of the Committee, and highlighted key objectives for the agenda. She noted how recommendations from previous NCST investigations have led to lasting changes in building codes, standards, and practices.

II. Review of Meeting Goals

Committee Chair, Dr. Ross Corotis, described the meeting goals.

- Review NIST’s response to the NCSTAC’s 2022 Report to Congress,
- Review Disaster and Failure Studies program scoring of events and readiness of teams,
- Describe new disaster research initiatives,
- Review progress on the implementation of NCST investigation recommendations for the World Trade Center and the Joplin tornado,
- Review the status of the NCST investigation of Hurricane Maria’s effects on Puerto Rico,
- Review the status of the NCST investigation of the partial collapse of Champlain Towers South in Surfside, Florida, and
- Develop the Committee’s annual report to Congress

The Disaster and Failure Studies Director, Dr. Tanya Brown-Giammanco, then reviewed the agenda, which was modified to have Ms. Rebecca Hermanowicz provide the Federal Advisory Committee Act ethics briefing after the Disaster and Failure Studies program updates.

III. NIST Response to the NCSTAC’s 2022 Report to Congress

Dr. Brown-Giammanco provided a brief overview of the NCST Act and the Committee’s responsibilities under the NCSTAC Charter of 2020. She then provided a summary of each of the seven recommendations the Committee provided in their annual report, along with a NIST response to each. The presentation can be found here:

[NIST Response to the NCSTAC’s 2022 Report to Congress](#)

Discussion: The Committee and NIST staff discussed tornado-resistant design or safe rooms for

existing construction, the addition of social scientists to the Champlain Towers South NCST, communications with families of the Champlain Towers South victims in advance of Committee meetings, and scoring of events and data collection.

IV. Disaster and Failure Studies (DFS) Program Updates

Dr. Brown-Giammanco presented an overview of the DFS Program and the progress made since the October meeting. She highlighted the Committee's composition, and noted that two members would complete their second terms in July, while another three would complete their second terms in September. She then introduced Dr. Lori Peek as the newest member, and mentioned efforts are underway to recruit additional members. She then summarized a \$40M disaster supplemental provided to NIST by Congress in the omnibus budget in December 2022 to conduct disaster studies. She also highlighted recent disaster events that had been scored, and provided an overview of a preliminary reconnaissance mission conducted for the February 2023 Turkey-Syria Earthquakes. The presentation can be found here:

[Disaster and Failure Studies Program Updates](#)

Discussion: The Committee and NIST staff discussed the challenges with converting learnings from studies and investigations into changes to building codes and standards, performance expectations and education of engineers, and safety monitoring and training for deployed team members, as well as the need for a top-down approach to safety culture and a focus on emotional health of deployed team members. The Committee's role regarding the Hurricane Ian study and potential follow-on areas of study for the 2023 Turkey earthquake was reviewed.

V. Annual Ethics Briefing

Ms. Rebecca Hermanowicz from the Department of Commerce Ethics Law and Programs Office gave the annual briefing on ethics rules for Special Government Employees, and thanked the Committee for completing their annual online financial disclosure forms.

VI. Hurricane Ian Study Overview

The National Windstorm Impact Reduction Program (NWIRP) Acting Director, Mr. James LaDue, provided an overview of the impacts of Hurricane Ian. He described the wind speed measurements and wind field, which were below the design wind speed, as well as wind damage noted during the preliminary reconnaissance mission in October 2022. He also described the surge and associated damage, as well as damage from rainwater intrusion. He concluded his presentation by describing the newly-launched NWIRP study goals. The presentation can be found here:

[Hurricane Ian Study](#)

Discussion: The Committee and staff discussed the need to include social scientists in risk communications research and challenges that result from potential loss of perishable data. They also discussed the differences in high water data collected by various agencies, and possible challenges with getting people to evacuate from high water and obtaining perspectives of emergency responders.

VII. Summary of Progress on Previous Investigations

Dr. Fahim Sadek provided an update about the progress made on implementing the

recommendations from the World Trade Center NCST investigation. He described the recent completion of a recommendation to develop a disproportionate collapse standard, which was published as American Society of Civil Engineers (ASCE) 76-23 in May 2023. He described the overall impacts that have been made as a result of the 30 World Trade Center NCST investigation recommendations, which include dozens of changes to codes and standards in the International Building Code (IBC), International Fire Code (IFC), the National Fire Protection Association (NFPA) Life Safety Code and Uniform Fire Code, and the ASCE standards. With the new disproportionate collapse standard, all of the recommendations resulting from the World Trade Center NCST investigation have been completely implemented.

Dr. Marc Levitan provided an update about the progress made on implementing the recommendations from the Joplin Tornado NCST investigation. He described efforts to impact codes and standards for existing construction, especially as it relates to retrofitting to install tornado shelters. He described progress in standardizing the Enhanced Fujita (EF) Scale through data collection from the Quad-State Tornado of December 2021, which included: further testing of the science-based, probabilistic Smart[^]DI tool that has been previously reported on; and analysis utilizing the treefall wind speed estimation method that was pioneered in the Joplin Tornado NCST investigation. He also described recent successes in tornado-resistant designs being adopted in model codes and local regulations, including inclusion in the 2023 Florida Building Code, approval to be included in the 2024 National Fire Protection Association 5000 Building Construction and Safety Code, and the continuing process for adoption into the 2024 International Building Code. He discussed a design guide for ASCE 7-22 tornado loads and interim guidance for tornado-resistant design and retrofit of residences, both of which were published in collaboration with FEMA. He also summarized impacts and engagements, as well as remaining tasks associated with implementing the recommendations from the Joplin Tornado NCST investigation.

The presentations can be found here:

[Summary of Progress on Prior NCST Investigations](#)

Discussion: The Committee and staff discussed individual community efforts to adopt tornado-resistant design requirements, challenges with getting tornado shelter requirements to be adopted, and the perception that schools and other critical facilities are not frequently affected by tornadoes. They discussed the need for communications and consideration of social and political science disciplines that may influence decision making with regard to tornado protection. They also discussed the development of the new disproportionate collapse standard and why it was developed as a stand-alone standard and not incorporated into ASCE 7, and the need for standardization of wind tunnel testing recommended by the World Trade Center NCST investigation.

VIII. Hurricane Maria NCST and NWIRP Updates

- Summary of Hurricane Maria NCST Investigation Progress

Prior to the presentations, the DFO asked if any members of the Committee had a conflict of interest and if so, to recuse themselves. No Committee members recused themselves. Dr. Joseph Main then provided a summary of the Hurricane Maria Program, including both the NCST

investigation and NWIRP study projects. He described the program goals, and reviewed the supporting contracts and collaborations that are contributing to the program. He described the panel discussion format that the team would use in the meeting to describe cross-cutting themes in the Program, provided an overview of key datasets collected thus far, as well as key stakeholder engagement and new team member additions. The presentation can be found here:

[Summary of Hurricane Maria NCST Investigation Progress](#)

Discussion: The Committee and staff discussed the discrepancy between the number of deaths initially attributed to Hurricane Maria in Puerto Rico, the number reported days later, and the official death toll accepted by the Governor. They also discussed the new additions to the Hurricane Maria team and points of contact for power infrastructure interviews and surveys. They discussed the plan for data dissemination following the conclusion of the investigation.

- **Cross-Project Panel Theme 1: Hospitals**

Dr. Main provided an introduction to the first Hurricane Maria panel session, focusing on hospitals. He described the motivation and integration of data streams and analyses. Dr. DongHun Yeo then described recent progress on understanding the hazard exposure and specifically wind tunnel testing and modeling efforts for the Hospital Bella Vista. Dr. Main then described damage observations at hospitals, and data curation and processing for wind tunnel testing of two hospitals. Dr. Judith Mitrani-Reiser concluded the presentation by describing data obtained from the verbal autopsy and socio-environmental survey developed for the investigation. She also described preliminary observations from hospital function surveys that support mortality assessment. The presentation can be found here:

[Hurricane Maria Cross-Project Panel Theme 1: Hospitals](#)

Discussion: The Committee and staff discussed the challenges hospitals faced with regard to staffing in the immediate aftermath of the hurricane, the granularity of infrastructure damage data, efforts to pre-register those with medical needs that rely on power, baseline and hurricane-related mortality statistics, the demographic and geospatial data collected in the mortality project, and what recommendations could result from the investigation.

- **Cross-Project Panel Theme 2: Sheltering**

Dr. Maria Dillard introduced the second Hurricane Maria panel session on sheltering, describing the motivation and integration of data streams and analyses. Dr. Katherine Johnson then described pre-storm and during storm messages about sheltering, as well as the primary data sources. She described information related to sheltering obtained from surveys, as well as evacuation behavior determined from survey respondents. Dr. Levitan then described common themes observed during Phase 1 evaluations of shelters. He showed an example damage matrix for a shelter building and highlighted the benefit of using the matrix across the investigation. Dr. Dillard provided an overview of the performance of schools, which often served as shelters during Hurricane Maria. She highlighted locations where schools participated in the Wave 1 survey for the Recovery of Social Functions Project. She also showed an example damage matrix for a school. The presentation can be found here:

[Hurricane Maria Cross-Project Panel Theme 2: Sheltering](#)

Discussion: The Committee and staff discussed data sources for shelter occupancies given

the communications challenges following the hurricane, and challenges associated with determining exactly what facilities served as shelters, especially given Hurricane Irma's previous landfall on September 7, 2017. They also discussed demographics of shelter occupancy. They discussed the communications associated with "strong shelters" and the meaning in Puerto Rico that those are concrete buildings, which all formal shelters were, how this ties to the need for understanding local Spanish translation nuances, and how there are also parallels with language used for communicating the need for sturdy shelters during tornadoes. They also discussed shelter mortalities, especially given duration of occupation, and cross-project data collection efforts, as well as the lack of structural considerations in selecting shelter or best-available refuge shelters. Potential recommendations associated with emergency communications and the need to understand the baseline building characteristics were also discussed.

- **Cross-Project Panel Theme 3: Infrastructure Dependencies**

Dr. Dillard introduced the final Hurricane Maria panel session on infrastructure dependencies, and described the motivation and integration of data streams and analyses. Dr. Kenneth Harrison then described the role of infrastructure and damage to wireless communications, power, and transportation. He described how the infrastructure supported shelters, hospitals, schools, and businesses, which are each key themes within the Hurricane Maria Program. Dr. Dillard then described questions in the verbal autopsy and socio-environmental questionnaire that address the impact of infrastructure disruption on mortality, and showed a relationship between average days without power and the total deaths that occurred within 14 days of landfall. Dr. Jennifer Helgeson closed the presentation by describing the role of infrastructure in the recovery of businesses, education, and healthcare facilities. She showed the percentage of businesses that participated in the study, as well as a matrix for critical infrastructure disruption and preparedness as they relate to businesses. She also highlighted the duration without power for four areas of Puerto Rico, which exceeded 100 days in many regions. The presentation can be found here:

[Hurricane Maria Cross-Project Panel Theme 3: Infrastructure Dependencies](#)

Discussion: The Committee and staff discussed the confidence in preliminary results, survey response rates and distribution for businesses, and contact methods for business interviews. They also discussed Hurricane Maria's impacts on the water system and the need to clarify the specific functions that were lost. They discussed the data collected, the timeline for additional data collection, and the ability to demonstrate the uncertainty in the data in the final reports.

- **Conclusion and Update on Hurricane Fiona**

Dr. Dillard concluded the Hurricane Maria Program presentations by providing an overview of datasets collected to date, and those that are in progress, for both the NCST and NWIRP projects. She provided an update on the program's timeline and described efforts to understand the impacts of Hurricane Fiona, which made landfall on September 18, 2022, on the ongoing recovery from Hurricane Maria. The team has begun to include Hurricane Fiona-related interview questions and surveys, specifically for the Critical Buildings and Recovery of Social Functions projects, and has extended some staffing and is pursuing two new contracts. The presentation can be found here:

[Conclusion and Update on Hurricane Fiona](#)

Discussion: The Committee and NIST staff discussed an upcoming contract to facilitate development of the Hurricane Maria reports. They also discussed integration of questions related to

Hurricane Fiona into ongoing Hurricane Maria survey and interview efforts. They discussed the potential for buildings and infrastructure to have been weaker during Fiona due to previous damage from Maria, but also the possibility of them being stronger due to mitigation between the two events which could inform the development of recommendations. They discussed the ongoing challenges with the power infrastructure in Puerto Rico.

IX. NCSTAC Preparation of Annual Report to Congress

The Committee discussed the approach to prepare their annual report to Congress, as well as initial writing assignments.

Ms. Faecke adjourned the Day 1 portion of the meeting at approximately 5:00 pm ET.

NCSTAC HYBRID MEETING SUMMARY – Day Two
June 15, 2023

Ms. Faecke, serving as the DFO, called the Day 2 meeting to order and noted that nine members of the Committee were in attendance in person, and one member was absent. She reminded everyone the meeting would be recorded.

X. Champlain Towers South NCST Updates

- Champlain Towers South NCST Investigation Introduction and Summary

Dr. Mitrani-Reiser opened the presentation by providing an acknowledgement of the lives lost in the Champlain Towers South partial collapse. She then provided background information on the NCST Act. She described what NIST can and cannot do under the NCST Act authorities. She provided an overview of highlighted activities since the October 2022 meeting. She also described the organization of the investigation team to support evaluation of failure hypotheses. She described recent efforts to develop a layout and move many of the evidence specimens to a new primary evidence facility to allow for safe invasive testing. She highlighted efforts to find the DVR of the building's security system, and non-destructive and destructive testing that had recently been completed. The presentation can be found here:

[Champlain Towers South NCST Investigation Introduction and Summary](#)

Discussion: The Committee discussed the concurrent investigation by Miami-Dade Police and the expanded acquisition authorities expiring September 30, 2023 that are limited to the Champlain Towers South investigation. They discussed obstacles faced by the investigation, particularly those associated with acquisition regulations and the potential pursuit of legislative changes in the NCST Act. They also discussed the collection of perishable data and evidence.

- Cross-Project Panel Theme 1: Evidence Collection, Measurements, and Visualization

Dr. Mitrani-Reiser introduced the panel, and Dr. Sissy Nikolaou then described some of the history of the Champlain Towers South site, including geologic and development information. Dr. Christopher Segura then described observations and measurements made on the physical evidence specimens and efforts to understand as-built and pre-collapse conditions. Dr. Jonathan Weigand highlighted pool deck conditions, including maintenance activities over the life of the building, as well as measurements and survey data. Dr. Emel Ganapati described social science data collection efforts through interviews, highlighted innovative techniques being used, and noted that some information on the progressive collapse not previously available had been collected using these methods. The presentation concluded with Dr. Georgette Hlepas describing the team's development of data management systems and visualization tools to help evaluate failure hypotheses. The presentation can be found here:

[Champlain Towers South Cross-Project Panel Theme 1: Evidence Collection, Measurements, and Visualization](#)

Discussion: The Committee and staff discussed efforts to match time-stamped videos, photographs, and other electronic data with interview data. The Committee suggested that once the investigation is complete, the team write methodological-based papers on the cognitive interview

techniques and the combined social science and engineering approach to the investigation. They also discussed the spacing of reinforcement in the evidentiary debris and how to convey this information graphically, as well as survey measurements, additional desired datasets and how plans are adjusted based on data that were able to be obtained versus those that were not. Implications of the 40-year recertification inspection, and additional layers added to the pool deck were also reviewed.

- **Cross-Project Panel Theme 2: Materials, Geotechnical, and Structural Analysis and Testing**

Mr. Glenn Bell introduced the second panel, and described work on conducting structural code checks. He showed a diagram of locations where the design strength of slab-column connections on the pool deck did not meet the original code and highlighted locations with moderate and severe understrength. Dr. Kenneth Hover then described efforts to develop a concrete mix design for use in laboratory testing. He described aggregate proportions and sizes, as well as water-to-cement ratios and implications for service life and durability. Next, Dr. Scott Jones described recent invasive coring work, mechanical tests that are underway, as well as preliminary observations from petrographic analysis of the concrete. Dr. Youssef Hashash then presented information on geotechnical analyses and testing to evaluate subsurface soils and the soil-structure interactions in the foundation. He described efforts to model the interactions using three-dimensional finite element models. The presentation concluded with Dr. Fahim Sadek describing progress in the collapse analysis modeling and analysis of potential failure initiation scenarios. The presentation can be found here:

[Champlain Towers South Cross-Project Panel Theme 2: Materials, Geotechnical, and Structural Analysis and Testing](#)

Discussion: The Committee and staff discussed load conditions for the pool deck, code checks, design checks and overlays, collapse conditions, concrete characteristics, and consideration of creep and time dependent effects. The Committee suggested that degradation of tensile strength over time be considered. The punching shear capacity of the slab as well as creep and shrinkage effects were described. The boundary conditions, depth, water level, and the number of layers incorporated for the three-dimensional model of the soil-structure interaction was discussed.

- **Cross-Project Panel Theme 3: Failure Hypotheses Development and Evaluation**

Dr. Mitrani-Reiser introduced the final Champlain Towers South panel. Dr. David Goodwin then described the recently-developed failure hypothesis database and the associated workflow for evaluating each hypothesis. Dr. Kamel Saidi then described different remote sensing and data visualization techniques and datasets that support the analyses of failure hypotheses. Dr. Jack Moehle described how failure initiation and progression hypotheses are evaluated and provided a few examples of specific hypotheses. Next, Dr. Mitrani-Reiser described the various points in the lifetime of the building leading up to the collapse, the kinds of data available at each phase and how they are evaluated in the context of failure hypotheses. The presentation concluded with Dr. James Harris describing potential topics and areas for recommendations to be developed as a result of the investigation. He highlighted specific building standards that may be appropriate to seek to change. The presentation can be found here:

[Champlain Towers South Cross-Project Panel Theme 3: Failure Hypotheses Development and](#)

Evaluation

Discussion: The Committee and staff discussed the analysis of the collapse progression timeline, as well as the ability of local jurisdictions to evaluate building designs and potential need for peer review. Quality control and assurance, and requirements for retention of design drawings, as they relate to investigation recommendations were also discussed. Implications of climate change, scientific communication of the investigation, and possible extraordinary loading mechanisms were discussed.

- **Concluding Remarks and Next Steps**

Mr. Bell concluded the Champlain Towers South sessions by revisiting key takeaways from each of the panel presentations. He reinforced preliminary results regarding the pool deck evaluation, and provided additional information about misplaced reinforcement and above-design loading caused by heavy planters with palm trees being placed on the pool deck throughout its lifetime. He described additional fill and pavers that were added after the initial construction, corrosion of slab and column reinforcement, and how these factors combined to result in critically low margins against failure. He also described next steps for each of the six technical projects, as well as an updated investigation timeline. He concluded the presentation with an acknowledgement of the lives lost, complexity of the investigation, and the need to get the technical work right. The presentation can be found here:

[Concluding Remarks and Next Steps](#)

Discussion: The Committee and staff discussed the possibility of finding an initiating mechanism versus the possibility that long-term degradation of the structure lead to the collapse. They also discussed details surrounding punching shear and reinforcement, as well as the relationship between the timeline and budget.

XI. Public Input

Ms. Faecke opened the public comment period. Mr. Martin Langesfeld, family member of Nicole Langesfeld who was killed in the Champlain Towers South collapse, spoke and described his concerns about the pool deck not being constructed to code, with the slow pace of the investigation, and that the collapse site will have a new building constructed prior to NIST completing its investigation. Mr. Pablo Langesfeld, also a family member of Nicole Langesfeld, spoke of frustrations about not knowing the reason for the collapse and the need for families to gain closure.

XII. Closing Remarks

Dr. Joannie Chin, gave the closing remarks. She thanked the NIST staff who organized the meeting, as well as the Committee members for their participation and advice. She presented an appreciation letter and certificate of recognition to Mr. Gary Klein and Dr. Jeannette Sutton for their service on the Committee, and noted this was their last meeting. She also announced that Dr. Kimberly Shoaf agreed to be the Vice Chair beginning in October, when Mr. Pepe Izquierdo-Encarnacion would assume the Chair role following the end of Dr. Ross Corotis's term. Dr. Chin also highlighted the progress made for each of the ongoing investigations as well as in the implementation of recommendations from previous investigations. She acknowledged the

dedication and hard work of the investigation teams, and acknowledged the difficulty for those waiting for answers from the investigations. She concluded by encouraging members of the public to continue to submit data and information to the NIST disaster data portal.

XIII. NCSTAC Preparation of Annual Report to Congress

The Committee used the remainder of the meeting time to revisit the draft writing assignments and discussed a timeline for submission of draft materials. They discussed the need to reach consensus during the September 7, 2023 meeting.

Following the Committee's discussion, Ms. Faecke adjourned the meeting at approximately 3:30 pm ET.