

**National Institute of Standards and Technology
National Construction Safety Team Act
Annual Report**

Fiscal Year (FY) 2012

Summary

This annual report to Congress for FY 2012 is required by the National Construction Safety Team (NCST) Act. In FY 2011 National Institute of Standards and Technology (NIST) Director Patrick Gallagher established a Team under the NCST Act to study the tornado that struck Joplin, MO, on May 22, 2011. The primary objectives of the Team's investigation of the Joplin tornado are to:

- Determine the tornado hazard characteristics and associated wind fields in the context of historical data;
- Determine the pattern, location, and cause of fatalities and injuries, and associated performance of emergency communications systems and public response;
- Determine the response of residential, commercial, and critical buildings, including the performance of designated safe areas;
- Determine the performance of lifelines as it relates to the continuity of operations of residential, commercial, and critical buildings; and,
- Identify, as specifically as possible, areas in current building, fire, and emergency communications codes, standards, and practices that warrant revision.

This study is ongoing, and NIST expects to release its final report with recommendations in FY 2013. See <http://www.nist.gov/el/disasterstudies/weather/joplin-072511.cfm> for a summary of the study.

NIST did not undertake any new NCST investigations in FY 2012. In early FY 2013, NIST assigned one staff member to participate in the Federal Emergency Management Agency (FEMA)'s Mitigation Assessment Team (MAT) study to examine the storm surge and flood effects from Hurricane Sandy on critical facilities in the affected area (New York and New Jersey).

Introduction

In October 2002, the President signed into law the National Construction Safety Team (NCST) Act (P.L. 107-231), which authorized the Director of the NIST to establish Teams for deployment after events causing the failure of a building or buildings that result 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 (U.S.). A team shall:

- (A) establish the likely technical cause or causes of the building failure;
- (B) evaluate the technical aspects of evacuation and emergency response procedures;

- (C) recommend as necessary, specific improvements to building standards, codes, and practices based on the findings made pursuant to subparagraphs (A) and (B); and,
- (D) 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 to the Committee on Science, Space, and Technology of the House of Representatives and to the Committee on Commerce, Science, and Transportation of the Senate by February 15 of each year a report that includes:

- (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; and,
- (3) a description of the actions taken to improve building safety and structural integrity by the 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 2012 and related NIST activities.

1. Investigations Conducted by NIST During FY 2012

a. Investigations Conducted by Teams During FY 2012

On May 22, 2011, a massive tornado impacted Joplin, MO. The tornado was rated EF5, the most powerful on the Enhanced Fujita scale. According to the National Weather Service (NWS) and the FEMA, the multiple-vortex storm impacted an area approximately three-quarters of a mile wide by 14 miles long, destroyed some 8,000 buildings in its path, killed 161 people, and injured over 1,000. This makes it the single deadliest tornado in the U.S. in the 61 years that official records have been kept.

NIST sent four employees to Joplin during May 25-28, 2011, to conduct a preliminary reconnaissance of building performance and emergency communications during the tornado. Based on the recommendations of the preliminary reconnaissance and analysis of the additional criteria set forth in the regulations implementing the NCST Act, NIST Director Patrick Gallagher established a Team under the NCST Act to proceed with a more comprehensive study of the impacts of the disaster. The primary objectives of the Team's investigation of the Joplin tornado are to:

- Determine the tornado hazard characteristics and associated wind fields in the context of historical data.
- Determine the pattern, location, and cause of fatalities and injuries, and associated performance of emergency communications systems and public response.
- Determine the response of residential, commercial, and critical buildings, including the performance of designated safe areas.

- Determine the performance of lifelines as it relates to the continuity of operations of residential, commercial, and critical buildings.
- Identify, as specifically as possible, areas in current building, fire, and emergency communications codes, standards, and practices that warrant revision.

The expected outcomes of this study will include findings and recommendations that provide the technical basis for:

- Assessing tornado hazard probabilities at the local, regional, and national levels;
- Potentially improving emergency communications systems and public response to those communications; and,
- Potentially improving tornado-resilient design and construction of buildings and structures, including residential buildings, designated safe areas within buildings, and lifeline facilities as related to maintaining building operations.

The anticipated impacts of the NIST investigation include improved resilience of buildings, infrastructure, and communities to tornadoes. These improvements are specifically focused on life safety objectives and enhanced performance of buildings during tornadoes to better protect building occupants and property. In addition, the investigation may lead to enhanced emergency communications systems and lifeline performance in future disasters. Finally, the results of this investigation will inform future research for the development and dissemination of guidance and tools for assessing and reducing vulnerabilities related to tornadoes, and producing the technical basis for cost-effective changes in national codes, standards, and practices.

In FY 2012 and early FY 2013, NIST published two documents related to its Joplin, MO Technical Investigation:

1. Investigation Plan - National Institute of Standards and Technology (NIST) Technical Investigation of Building and Emergency Communications System Performance in the Joplin, Missouri, Tornado of May 22, 2011 (May 2012)¹, and
2. Progress Report National Institute of Standards and Technology (NIST); Technical Investigation of the May 22, 2011, Tornado in Joplin, Missouri (November 2012)²

The investigation plan outlines the objectives of the technical investigation and the specific tasks to be completed to achieve each objective.

The progress report summarizes the progress NIST has made and the cooperation it has received from a variety of organizations in conducting the investigation. It includes information on the following activities:

- Establishing the investigative Team under the NCST Act;

¹ Investigation Plan - National Institute of Standards and Technology (NIST) Technical Investigation of Building and Emergency Communications System Performance in the Joplin, Missouri, Tornado of May 22, 2011 - http://www.nist.gov/manuscript-publication-search.cfm?pub_id=911000

² Progress Report National Institute of Standards and Technology (NIST); Technical Investigation of the May 22, 2011, Tornado in Joplin, Missouri - http://www.nist.gov/manuscript-publication-search.cfm?pub_id=912461

- Identifying and collecting materials relevant to the investigation from state and local government agencies, businesses, and other sources;
- Determining the tornado hazard characteristics, including the meteorological conditions leading to and during the event, the tornadic wind field, and the tornado climatology;
- Investigating the behavior and fate of individuals—both those who survived and those who did not—by collecting and analyzing information on injuries and fatalities, human behavior, situational awareness, and emergency communications before and during the tornado;
- Analyzing the performance of single- and multi-family residential buildings, commercial structures, and critical buildings, including designated safe areas;
- Assessing the performance of lifelines as it relates to the continuity of operations of residential, commercial, and critical buildings; and,
- Briefing the NCST Advisory Committee

Highlights of the progress report include:

- A timeline of weather conditions and emergency communications preceding and during the tornado, including warnings and siren soundings;
- A methodology for creating a map from the observed data that estimates maximum surface wind speeds during the tornado event;
- Information about first-person data collection efforts targeting human behavior, situational awareness, and emergency communications before and during the tornado, including a description of the data collection and analysis methodology; and,
- An analysis of information relevant to the design, construction and performance of buildings during the tornado.

b. Studies Conducted by NIST Under Legal Authorities other than the NCST Act in FY 2012

NIST is including summaries of its studies conducted under legal authorities other than the NCST Act in this report because the objectives of these studies are similar to those conducted under the NCST Act and also fall within NIST’s Disaster and Failure Studies Program. The Disaster and Failure Studies Program provides for the establishment of teams to assess building and infrastructure performance and emergency response and evacuation procedures in the wake of disaster and failure events that have resulted in substantial loss of life or posed significant potential of substantial loss of life.

In late October 2012, Hurricane Sandy impacted the U.S. The hurricane caused tens of billions of dollars in damage and killed 131 people in eight states³. There were several unique aspects of this event. The flood levels experienced exceeded design-level in many locations, based on FEMA’s Flood Insurance Rate Maps and codes and standards adopted by local jurisdictions. The flood event impacted a dense urban area with complex interdependent infrastructure (much of which is located underground) and critical facilities. The loss of the infrastructure caused substantial disruption to the community and building functionality.

³ <http://www.reuters.com/article/2012/11/16/us-storm-sandy-deaths-idUSBRE8AF0ZX20121116>

NIST agreed to participate in the FEMA MAT study to examine the storm surge and flood effects from Hurricane Sandy on critical facilities in the most affected areas (New York and New Jersey).

The primary objectives of NIST's role in the study will be to:

1. Collect data/observations on the performance of critical facilities and infrastructure systems in the affected area to support the development of resilience metrics for buildings in a dense urban community.
2. Examine the effect of cascading infrastructure failures on the performance and recovery of critical facilities.

The collected data will include information on the performance and design criteria for American Society of Civil Engineers (ASCE) 7 Risk Category IV facilities, such as hospitals, data centers, facilities for power and communication, and emergency response facilities. These observations are important for evaluating the concurrent failure of multiple critical facilities within a community. Data on recovery plans and impact on economics and business continuity will be collected where available. The FEMA MAT report is expected to be completed in September 2013.

NIST did not complete any studies under its other legal authorities during FY 2012.

2. Summary of Recommendations Made by Teams in Reports Issued Under Section 8 of the NCST Act During FY 2012

During FY2012, NIST did not issue a report under Section 8 of the NCST Act.

3. Actions Taken to Improve Building Safety and Structural Integrity During FY 2012

a. Actions Taken to Improve Building Safety and Structural Integrity During FY 2012 in Response to Reports Issued Under Section 8 of the NCST Act

In FY 2012, there have been no additional actions taken in response to reports issued under section 8 of the NCST Act. NIST anticipates that there will be actions taken in FY 2013 as a result of the current Joplin tornado investigation.

b. Actions Taken to Improve Building Safety and Structural Integrity During FY 2012 in Response to Studies Conducted Under Other NIST Authorities

NIST's Disaster and Failure Studies Program coordinates their efforts with the NIST Engineering Laboratory's Codes and Standards Program to promote, enable, and track the adoption of NCST and other NIST studies' recommendations through improved standards, codes, and practices as well as any research and other appropriate actions based on study findings to improve building safety and structural design. NIST takes appropriate action after disaster and failure studies both under the NCST Act, and as a result of studies conducted under other NIST authorities.

Two code changes, responsive to NIST's recommendation in its report on the NIST study of the collapse of the Dallas Cowboys Practice Facility, were adopted by the International Code Council (ICC) for the 2015 International Building Code. These changes require that (1) tensile membrane structures be designed according to ASCE Standard For Tensile Membrane Structures (ASCE 55-10) and (2) in membrane covered frame structures, the membrane shall not provide required lateral stability to the frames. These code changes are responsive to NIST's recommendation and address two aspects of design of fabric-covered frame structures: (1) use of the fabric to provide lateral bracing to the frames and (2) ability of the structural system to maintain overall structural integrity.

NIST issued its final report on the Sofa Super Store fire that occurred in Charleston, SC, in March 2011. The final report included recommendations that have resulted in the following code changes and proposed changes. In addition to changes revising the threshold for fire protection of upholstered furniture occupancies or use in the 2015 International Building Code that have already been successful, the ICC Code Technology Committee is proposing changes to the 2015 International Fire Code and 2015 International Existing Buildings Code to require periodic inspections, recordkeeping, inspector qualifications and automatic sprinkler systems for occupancies involving upholstered furniture or mattresses that exceed 2,500 square feet (manufacture or storage) or 5,000 square feet (display and sales). An additional proposal to address conversions or changes in use or occupancy with a fire protection threshold requirement may also be proposed.

4. Other NIST Activities Related to the NCST Act

In FY 2012, NIST received 55 requests under the Freedom of Information Act (FOIA) for information that NIST collected and created during the NIST World Trade Center (WTC) Investigation. NIST has closed 27 of those requests and also closed an additional 4 requests that had been received prior to FY 2012. The remainder of the requests received in FY 2012 remain open, and are awaiting disclosure determinations from record owners regarding permission to release, or awaiting review and/or clearance of interim or final responses by the Office of the Chief Counsel for NIST. In total, from FY 2006 through FY 2012, NIST has received 248 FOIA requests for information related to the NIST WTC Investigation. Six of these FOIA requests have resulted in litigation. Of those six cases, three were settled and the other three cases remain open.

Documents responsive to the FOIA requests include tens of thousands of photographs and videos collected by NIST during the WTC Investigation and thousands of documents provided to NIST related to the construction and maintenance of the WTC buildings, as well as images representing the results of engineering models created by NIST during the WTC Investigation. In responding to the WTC Investigation-related FOIA requests, where appropriate NIST has withheld certain types of information pursuant to 5 U.S.C. § 552 (b) in conjunction with the statutory FOIA exemptions found in paragraphs 7(c) and 7(d) of the NCST Act. Section 7(c) prohibits NIST from disclosing voluntarily provided safety-related information if that information is not directly related to the building failure being investigated and the NIST Director finds that the disclosure of the information would inhibit the voluntary provision of that type of information. Section 7(d) prohibits NIST from publicly releasing any information it

receives in the course of an investigation under the NCST Act if the NIST Director finds that the disclosure of that information might jeopardize public safety.

5. Disaster and Failure Events Data Repository

NIST is creating a Disaster and Failure Events Data Repository which will host a national archival database of significant hazard events. The repository, which is accessible on NIST's website, will also help ensure that this valuable information is organized and maintained to enable study, analysis, and comparison with subsequent severe disaster events. The repository will contain information gathered during NCST investigations as well as other NIST-led studies.

The data repository will be established in three phases:

Phase 1 (launched August 2011) includes data from NIST's six-year investigation of the collapses of three buildings at New York City's World Trade Center (WTC 1, 2 and 7) as a result of the terrorist attacks on Sept. 11, 2001. See <http://wtcdata.nist.gov/>

Phase 2, which is currently underway, consists of pilot datasets from the 2010 Chile earthquake and the Joplin, MO, tornado NCST investigation. This repository consists of over 100 fields of data on 273 buildings affected by both the 1985 and 2010 earthquakes. NIST plans an initial release of the Chile and Joplin datasets on the NIST website in 2013.

Phase 3 includes the implementation plan for the repository. This plan includes the following elements:

1. Finalizing the user requirements and creation of a system design document;
2. Selecting the operating platform based on user requirements;
3. Developing standard data collection systems for different kinds of events;
4. Populating the repository with selected high-impact data from historical and future events; and,
5. Developing a plan to maintain, update, operate and improve accessibility of the repository.