NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY
U.S. DEPARTMENT OF COMMERCE

Disaster and Failure Studies

Since 1969, NIST has studied more than **40** earthquakes, hurricanes, tornadoes, building and construction failures, and fires — all with the aim of identifying improvements that could be made to building and fire codes, standards and practices. Each study or investigation leads to actionable findings and recommendations that make communities safer.

Congress gave NIST the authority to conduct these types of studies and investigations through the National Construction Safety Team (NCST) Act, National Earthquake Hazards Reduction Program (NEHRP), National Windstorm Impact Reduction Program (NWIRP), and NIST Organic Act.

The Work

Since the passage of the NCST Act in 2002, NIST has conducted **five** investigations with the goal of determining the technical cause of building failures and making recommendations to improve safety: World Trade Center collapse; The Station nightclub fire in Rhode Island; Joplin, Missouri, tornado; and Hurricane Maria in Puerto Rico and Champlain Towers South condominium partial collapse in Florida (both in progress).

Non-NCST studies include the Camp Fire in California, Hurricanes Florence and Matthew, the Charleston Sofa Super Store Fire, and the Dupont Plaza Hotel Fire, among others.

NIST's potential impact is limited by its capacity to undertake investigations and studies. Since 2017, NIST has:

- Evaluated **128** events.
- Conducted **16** preliminary reconnaissance missions.
- Launched **2** NCST investigations, **2** NWIRP research studies and **3** other research activities.

Why NIST?

Unique expertise: NIST staff members have measurement science and standards expertise in a range of technical areas that are needed to understand why engineered structures or systems fail. These include materials science, engineering, emergency response and communications, fire science, chemistry, physics, social science and more.

Collaboration: NIST collaborates with universities, companies, industry organizations, federal agencies and local authorities around the country, as necessary, to broaden the available expertise for a given study or investigation. For example, more than **200** professionals and subject matter experts participated in the World Trade Center collapse investigation. And to date, NIST has awarded more than a dozen contracts and worked with more than **15** federal and local agencies for the Champlain Towers South investigation.

Wildfires are no longer just a California problem or a forest problem. Within the past eight years, Tennessee, California, Oregon, Colorado, New Mexico, and Hawaii have all experienced their most destructive wildland-urban interface (WUI) fires on record, destroying infrastructure and thousands of homes and businesses, and causing devastating loss of life.

The Impact

Studies and investigations conducted by NIST have led to significant improvements to building and fire codes, standards, and practices to enhance the health and safety of the American public. One of the first major impacts of this work was the passage of the Hotel-Motel Sprinkler Act in 1990, as a direct result of NIST's study of the Dupont Plaza Hotel Fire in Puerto Rico. Other outcomes include:

Disaster or Failure	NIST's Findings	Impact
World Trade Center Hijacked airliners were flown into two buildings in the World Trade Center on Sept. 11, 2001. The resulting fires led to the collapse of the two main towers as well as a neighboring skyscraper.	NIST analyzed the collapse with unprecedented detail to determine how it unfolded and recommended many ways to improve building and fire codes and standards for skyscrapers.	Forty changes were adopted into the International Building Code and the International Fire Code based on NIST's recommendations. These changes included improving the fire resistance of the building frame, increasing the size of exit stairways, and reinforcing sprinkler systems. In addition, NIST's recommendations resulted in the development of a new American Society of Civil Engineers standard focused on designing structures that resist "disproportionate collapse."
Station Nightclub Fire A rapid fire started in a crowded nightclub when a pyrotechnics display ignited insulation on the walls and ceiling. The fire became deadly in less than a minute. Unable to evacuate, 100 people died.	The nightclub was not equipped with an automatic fire sprinkler system. Full-scale experiments from NIST showed that a sprinkler system could have suppressed the fire long enough for people to escape. NIST also found issues with inadequate emergency exits.	NIST worked with the National Fire Protection Association to change building and fire codes to require sprinklers in more types of buildings — including nightclubs — and update festival seating and crowd management requirements, as well as record-keeping of the inspection of emergency exits.
Joplin Tornado In 2011, a severe tornado struck Joplin, Missouri, destroying a quarter of the town and killing 161 people.	At the time, there were no building codes to protect against the threat of tornadoes. In tornado-prone regions of the U.S., many important buildings such as schools and fire departments were not built to withstand even weak tornadoes.	NIST conducted the fundamental research to map tornado windspeeds across the U.S. Using that research, NIST helped develop the first building codes to protect against threats from tornadoes.
California Camp Fire The Camp Fire was the deadliest wildfire in California history. Exit roads became gridlocked, making evacuation impossible for many residents. The fire burned for 18 days, caused 85 deaths, destroyed thousands of structures, and displaced over 50,000 people.	Emergency responders ushered people into open spaces where they could safely wait for help. NIST's study found that these impromptu refuge areas saved many lives when there was no other way to escape the fire. It also revealed that existing building and fire codes did not always prevent fires.	NIST refined the idea of "temporary refuge areas" and provided guidance on how they could be included in wildfire evacuation plans. This guidance has been implemented in 30 communities across California and is gaining traction across the United States. NIST's study also led to changes to the California Fire Code and the creation of the Hazard Mitigation Methodology (HMM), a community-wide approach toward safeguarding residences and helping prevent fires from spreading.

Learn More

Visit www.nist.gov/disaster-failure-studies

Contact NIST Congressional Affairs at NISTCLA@nist.gov to arrange for a briefing or tour.