NCST Investigation of the Champlain Towers Collapse

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Response effort after building collapse

Experts from FEMA, NSF, USGS, USACE, FSU, Miami-Dade Fire Rescue, and VA Beach Fire Dept. support remote sensing activities

NIST establishes evidence tagging protocols with the Miami-Dade Police Department and US&R Task Forces

NIST conducts a subsurface investigation, with the USACE
Our Charge

National Construction Safety Team Act

Technical Cause(s) + Recommendations

SEC. 8. NATIONAL CONSTRUCTION SAFETY TEAM REPORT.

Not later than 90 days after completing an investigation, a Team shall issue a public report which includes—

(1) an analysis of the likely technical cause or causes of the building failure investigated;

(2) any technical recommendations for changes to or the establishment of evacuation and emergency response procedures;

(3) any recommended specific improvements to building standards, codes, and practices; and

(4) recommendations for research and other appropriate actions needed to help prevent future building failures.
A failure hypothesis is an investigative supposition about where and how the failure occurred with likely contributing causes.
Examining Failure Hypotheses

- Progressive Collapse Analysis
- Collapse Evidence Analysis
Examining Failure Hypotheses

- Progressive Collapse Analysis
  - Source: NIST, using ETABS software
  - Laboratory tests
  - Computer simulation

- Collapse Evidence Analysis
  - Building Loads
    - Source: NIST
  - Building Strength
    - Source: NIST, not CTS
Examining Failure Hypotheses

Source: except where noted, NIST

Collapse Evidence Analysis

Permission: Miami-Dade County
Examining Failure Hypotheses

Progressive Collapse Analysis

- Laboratory tests
- Computer simulation

Building Loads

Building Strength

Collapse Evidence Analysis

Source: except where noted, NIST

Source: NIST, using ETABS software

Source: NIST, not CTS

Source: NIST
Team Organization

Develop & Analyze Failure Hypotheses

- Structural Engineering
- Materials Science
- Building & Code History
- Evidence Collection & Preservation
- Remote Sensing & Data Visualization

Geotechnical Engineering
Project Overview

Geotechnical Engineering

Source: NIST

Source: GPR Technical Brief - Olson Eng., Inc. (used with permission)
Project Overview

Materials Science

Source: NIST, not CTS

Anode

O₂

Cl⁻

H₂O

O₂

Fe²⁺

Fe²⁺

Moist concrete conducts electricity

Cathode

Source: Hover

Source: NIST, not CTS
Project Overview

1. Structural Engineering

2. Test specimen detail

Source: NIST, using ETABS software

3. Test configuration

Source: NIST, using LS-DYNA software
Project Overview

Evidence Collection & Preservation

Source: NIST

1

2

3

4

Source: NIST

Source: NIST

Source: NIST

Source: NIST
Project Overview

Remote Sensing & Data Visualization

Permission: Miami-Dade County

Source: NIST

https://nisar.jpl.nasa.gov/mission/get-to-know-sar/interferometry/
There are enormous implications for the life safety of buildings across the United States and elsewhere in the world. The recommendations part of NIST’s report will be key to ensuring lessons learned result in improvements in practice to see that a disaster like the Champlain Towers South collapse never happens again.
$22 million to remain available until September 30, 2023

technical work complete by end FY2023

report complete by end FY2024
Next Step: Invasive Testing

over 600 pieces of physical evidence

Considerations
- Analysis of failure hypotheses
- Input for structural tests and computer modeling
- Input for material characterization and degradation mechanisms
- Evidence database > location in structure
- Non-destructive testing
- Sampling strategies for characterization (statistics/uncertainty)

Invasive testing plan
- Extract and test several hundred concrete samples
- Extract and test approximately 200 reinforcement samples

Source: NIST
DISCUSSION