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Department of Commerce Releases NIST Response to the World Trade Center Disaster

As reported by David Biggs

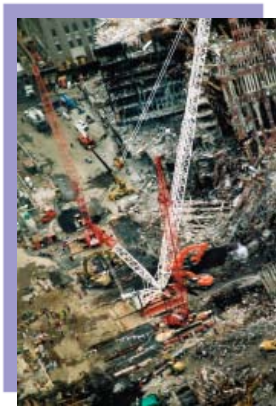
On June 23, 2005, NIST presented its draft final report on the disaster for public comment. This follows the April 2005 NIST release of 15 technical reports. They released 28 additional technical reports on June 23rd. All documents are open for public comment until August 4, 2005. One additional report on the collapse of World Trade Center 7 is still pending.

Comments can be presented to NIST by several means, including:

- a link on the WTC Investigation Web site, **http://wtc.nist.gov**;
- e-mail to **wtc@nist.gov**;
- fax to (301) 975-6122; or
- surface mail to WTC Technical Information Repository, Attn: Mr. Stephen Cauffman, NIST, 100 Bureau Dr., stop 8610, Gaithersburg, Md. 20899-8610

Building upon the efforts of the Building Performance Assessment Study by FEMA and ASCE that was released in May 2002, this report addresses the collapses and makes 30 recommendations including:

- improvements to building standards, codes and practices;
- changes to, or the establishment of, evacuation and emergency response procedures; and
- research and other appropriate actions needed to help prevent future building failures.



While a significant number of the recommendations involve fire safety, materials, egress and emergency response, several recommendations will affect the future practice of structural engineering. Structural engineers should review all recommendations contained in the draft report and make comments to NIST.

Selected Conclusions on the Collapses

1. Buildings are not designed to resist attack by jet fuel laden aircraft.
2. The towers would have remained standing after the initial impact if the structural steel fireproofing had not been dislodged.
3. The heat of the fires weakened the core columns and caused them to shorten, which resulted in a redistribution of loads to the exterior columns by way of the hat trusses. Sagging floor joists pulled the exterior columns inward, resulting in buckling and progressive collapse.
4. Conventional fires within the towers would not have produced collapse.
5. The corner core columns had no redundancy and carried almost 50% of the gravity loads.

Recommendations for Structural Changes

NIST believes that changes are needed for how we design tall buildings and other buildings with special significance. Their definition of a tall building is over 20 stories, based upon the difficulty in fighting fires in upper floors. The other buildings could be of any height but would be at risk due to types of structural, fire safety or egress systems used, location, use, historic/iconic status, nature of occupancy, etc.

Some NIST structural recommendations include:

1. Progressive collapse should be prevented in buildings through the development of consensus standards and code provisions, along with the tools and guidelines needed for their use in practice. The primary structural systems should provide alternate load paths in case certain components fail (e.g., transfer girders, columns supporting only gravity loads). This is especially important in buildings where structural columns and girders support large floor areas.
2. A standard methodology should be developed, supported by analytical design tools and practical design guidance, to reliably predict the potential for complex failures in structural systems subjected to multiple hazards
3. Nationally accepted performance standards should be developed for conducting wind tunnel testing of prototype structures that result in repeatable and reproducible results among testing laboratories; and estimating wind loads and their effects on tall buildings for use in design, based on wind tunnel testing data and directional wind speed data.
4. An appropriate criterion should be developed to enhance the performance of tall buildings by limiting how much they sway under lateral load design conditions (e.g., winds and earthquakes).
5. Performance-based standards should be developed to enable the design and retrofit of structures to resist real building fire conditions, including their ability to achieve the performance objective of burnout without structural or local floor collapse.
6. The performance and suitability of advanced structural steel, reinforced and pre-stressed concrete, and other high-performance material systems should be evaluated for use under conditions expected in building fires.
7. The design of stairwell and elevator shafts should be enhanced by considering accidental structural loads such as those induced by overpressures (e.g., gas explosions), impacts, or major hurricanes and earthquakes, in addition to fire separation requirements. In selected buildings, structural loads due to other risks such as those due to terrorism may need to be considered.▪

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The draft final report and the technical reports are available for download from NIST at http://www.nist.gov/public_affairs/releases/wtc_briefing_june2305.htm. The executive summary, recommendations, and full report can be selected individually.