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news

NIST Releases Findings on Collapse of Twin Towers

By Mark Fitzgerald

At an April 5 press briefing in New York City, ASCE member Shyam S. Sunder, Ph.D., the principal investigator in the study carried out by the National Institute of Standards and Technology (NIST) of the collapse of the World Trade Center's twin towers, named intense fire as the primary cause. "While the buildings were able to withstand the initial impact of the aircraft, the resulting fires that spread through the towers weakened support columns and floors that had fireproofing dislodged by the impacts," Sunder said. "This eventually led to collapse as the perimeter columns were pulled inward by the sagging floors and buckled." NIST's findings corroborate those of the study, published in May 2002, carried out jointly by ASCE and the Federal Emergency Management Agency (FEMA).

According to the NIST analysis, the collapse sequence unfolded as follows: Both aircraft severed perimeter columns, damaged interior core columns, and knocked fireproofing from steel as they penetrated the buildings. The weight carried by the severed columns was distributed to other columns. Subsequently, fires began that were initiated by the jet fuel but were fed by the building contents and the air supply resulting from breached walls and fire-induced window breakage. These fires—in combination with the dislodged fireproofing—were responsible for a chain of events during which the building core weakened and began losing its ability to carry loads. The floors weakened and sagged from the fires, pulling the perimeter columns inward. The sagging of the floors and the high temperatures caused the perimeter columns to bow inward and buckle—a process that spread across the faces of the buildings. Collapse then ensued.

Carried out with a view to improving the ways that buildings, especially high-rises, are designed, constructed, maintained, and used, the NIST WTC analysis recommends the following structural enhancements: impact-resistant fireproofing; larger perimeter columns and floor framing; greater compartmentation; heat-resistant window assemblies; fire-resistant and structurally hardened elevators with continuous, redundant water supply for standpipes; and the use of steels with creep behavior and improved high-temperature properties.

“The findings released today by the National Institute of Standards and Technology bring us closer to a conclusive understanding of the structural response of the World Trade Center towers to the plane crashes and subsequent fires that eventually led to their collapse,” notes W. Gene Corley, Ph.D., P.E., who led the team that carried out the ASCE and FEMA study. “Results of the NIST team’s extensive study are in close agreement with the findings of the ASCE/FEMA team that conducted the initial assessment in the months immediately following September eleventh. The broad scope and more comprehensive detail of the NIST study will help engineers better understand the performance of tall structures when subjected to unanticipated extreme forces.”

“We applaud NIST for the thoroughness and openness of its process, which recognizes the urgent needs of the victims’ families, the professional community, and the public to understand what happened,” says Jeremy Isenberg, Ph.D., P.E., the president of ASCE’s Structural Engineering Institute (SEI). “Catastrophic events like the collapse of the twin towers are rare, and the knowledge that engineers gain from them is essential. Through detailed study, analysis, debate, and discussion, we both validate longtime practices and, on occasion, change long-held beliefs. NIST has done an important public service by conducting a comprehensive effort to study and analyze the collapse. On behalf of the profession, SEI is eager to begin the process of reviewing, discussing, and debating the contents of this extensive report in our ongoing efforts to advance the safety and performance of buildings and other structures.”

The investigation’s recommendations for improving building and fire codes and revising standards and practices will be released for public comment in June. To view NIST’s WTC collapse sequence analysis, as well as all previous WTC investigation findings, visit <http://wtc.nist.gov>.