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Top Structural Engineers to Do Autopsy On Twin Towers to Assess Why They Fell

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Ronald Hamburger turned on his television on the day of the attack just in time to watch the collapse of the second World Trade Center tower.

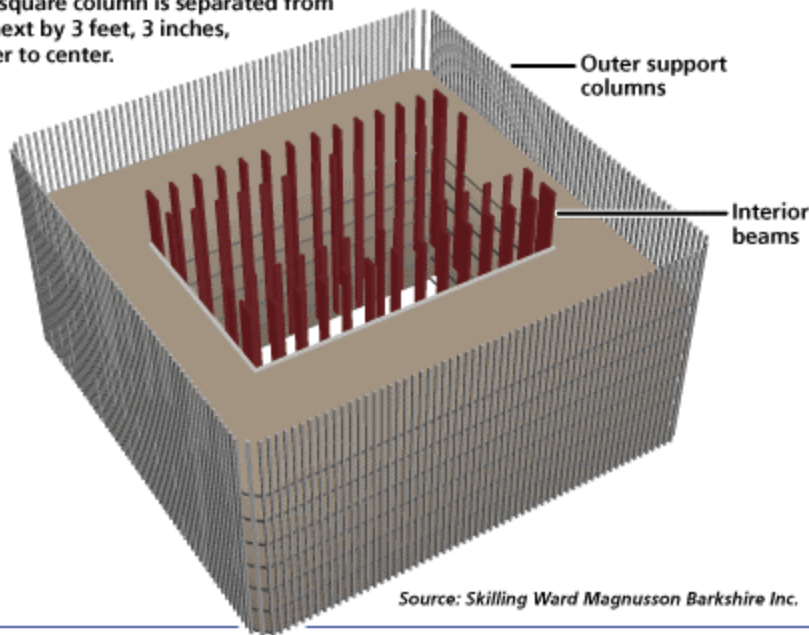
"It appeared to me that charges had been placed in the building," said Mr. Hamburger, chief structural engineer for ABS Consulting in Oakland, Calif. Upon learning that no bombs had been detonated, "I was very surprised," said Mr. Hamburger. The buildings "certainly did not do as well as I would have hoped."

Mr. Hamburger is one of four top forensic engineers commissioned to perform a postmortem on the World Trade Center's collapse. Their investigation, conducted pro bono on behalf of the American Society of Civil Engineers, will begin when the rescue and recovery effort ends, and last as long as 18 months. They will examine precisely how and why the towers fell, and what -- if anything -- might be done to mitigate the damage of similar disasters. Should buildings be hardened to protect against future attacks? Or would the effort be futile and overly expensive, as some engineers contend?

The efforts of these four experts will be similar to an ASCE-sponsored study of the Oklahoma City federal building that Timothy McVeigh blew up in 1995. That investigation concluded that enhancements could have prevented as many as 85% of the 168 casualties, while adding only 1% to 2% to the original cost. Noting how easily floors and ceilings in that building collapsed, the ASCE team recommended the reinforcement of steel beams, among other improvements. W. Gene Corley, senior vice president of Construction Technology Laboratories Inc., in Skokie, Ill., who led that investigation, is leading the Twin Towers effort.

DETAILS OF THE DESTRUCTION

Structural engineers will be studying concrete and steel remnants to determine precisely why the towers collapsed. The plane that hit the south tower severed an estimated 45 of 61 steel supporting columns on one face of the building. The diagonal approach of that plane may have spread more fuel over more floors than a horizontal approach would, and thus spread the fire more extensively. Each 14-inch-square column is separated from the next by 3 feet, 3 inches, center to center.



By now it is accepted wisdom that the Twin Towers collapse was inevitable -- the result of extraordinary trauma followed by extraordinary fire. But this was far from the initial reaction of the nation's top structural engineers. The collapse of the two buildings stunned them. After all, other buildings had withstood trauma -- earthquakes, for instance -- akin to the assault by two 767 commercial jets. And despite the intense heat of the jet-fuel-fed flames that raged through the Twin Towers, fire-protection experts said other skyscrapers had been subjected to flames as hot without collapsing.

"I was absolutely flabbergasted when it happened -- that it happened at all, and that it happened in less than three or four hours," said another panel member, Charles H. Thornton, an engineer and chairman of Thornton-Tomasetti Group Inc., a New York structural engineering firm.

Within hours of the collapses, the engineering profession's view of the Twin Towers' performance swung from disappointment to something akin to pride at how long the buildings remained up. The South Tower remained erect for 56 minutes, the North Tower for 100 minutes, allowing thousands to escape down stairwells.

The case of the World Trade Center presents questions that are more obvious than answerable: Could it have better withstood the impact of the 767s, and the resulting inferno? Mr. Hamburger, a specialist in earthquake-zone construction, wonders whether the towers might have stood longer if fortified the way that West Coast regulations require (and that increase the total cost by 1% to 2%). That would mean stronger connections between the horizontal and vertical beams. Mr. Thornton said it might not have made a big difference.

Was the insulation around steel beams sufficiently thick, or would the impact of the plane have knocked any amount of insulation loose on immediately surrounding floors? Studies of the collapsed steel beams will determine the temperatures and stresses that overcame them, perhaps leading "to a change in design standards or construction codes," said James Milke, a fire-protection engineer at the University of Maryland who has been asked to help conduct the investigation. He said jet-fuel fires aren't necessarily hotter than other major office fires, although they reach high temperatures faster and last longer.

Likely to emerge from the report is the conclusion that a massive concrete core, or greater use of concrete, might have kept the towers standing longer. Concrete has more of a "damping" effect than steel -- that is, the tendency to stop lateral vibration of the building. That makes a building with a concrete core potentially more impervious to earthquake, wind -- and terrorist attacks.

One tantalizing question is whether the hijackers, who were sophisticated enough to commandeer commercial jets, also had sufficient knowledge of structural engineering to target the buildings at vulnerable points. In particular, the approach of the second jet -- its wings tilted at a sharp angle, its nose pointed toward a corner of the South Tower -- was primed for maximum damage. "He came in banked so that the fuel and the impact would hit over more than one story," said W. Gene Corley, a Chicago-area structural engineer who is leading the ASCE World Trade Center team. But Mr. Thornton suspects that would be giving the hijackers more credit for expertise than they deserved.

The performance last week of the World Trade Center towers receives a top grade from Jon Magnusson, chairman and chief executive of Seattle-based Skilling Ward Magnusson Barkshire Inc. His firm is one of two successor agencies to the firm that served as the original structural engineering consultants for the World Trade Center.

Although he couldn't confirm the widely reported assertion that the buildings were built to withstand the impact of a Boeing 707, Mr. Magnusson contends that they withstood the impact of an even larger plane. The critical damage, he contends, came from the subsequent fire.

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