

- The *potential for inward bowing of exterior walls* (i.e., magnitude and extent of bowing over the width of the face and the number of floors involved) due to thermally induced floor sagging of long-span floors and associated inward pull forces.
- The *capacity of the structure to redistribute loads* (e.g., via the spandrels, hat truss, and floors) if the thermal conditions were sufficiently intense to cause inward bowing of the exterior walls.

In addition, NIST considered the following known facts:

- WTC 1 did not collapse during the major fire in 1975, which engulfed a large area (about one-fourth of the floor area or 9,000 ft²) on the southeast quadrant of the 11th floor. At the time, office spaces in the towers were not sprinklered. The fire caused minimal damage to the floor system with the ½ in. specified insulation thickness applied on the trusses (four trusses were slightly distorted), and at no time was the load-carrying capacity compromised for the floor system or the structure as a whole.
- Four standard fire resistance tests of floor assemblies like those in the WTC towers conducted as part of this Investigation showed that (a) it took about 90 min of sustained heating in the furnace for temperatures to exceed 600 °C on steel truss members with either ½ in. or ¾ in. insulation thickness, and (b) in no case was the load-carrying capacity compromised by heating of the floor system for 2 hours at furnace temperatures, with applied loads exceeding those on September 11 by a factor of two.

From these findings, factors, and observed performance, NIST concluded:

- In the absence of structural and insulation damage, a conventional fire substantially similar to or less intense than the fires encountered on September 11, 2001, likely would not have led to the collapse of a WTC tower.
- The condition of the insulation prior to aircraft impact, which was found to be mostly intact, and the insulation thickness on the WTC floor system contributed to, but did not play a governing role, in initiating collapse of the towers.
- The towers likely would not have collapsed under the combined effects of aircraft impact and the subsequent multi-floor fires encountered on September 11 if the thermal insulation had not been widely dislodged or had been only minimally dislodged by aircraft impact.

These findings apply to fires that are substantially similar to or less intense than those encountered on September 11, 2001. They do not apply to a standard fire or an assumed fire exposure which has (a) uniform high temperatures over an entire floor or most of a floor (note that the WTC floors were extremely large) and concurrently over multiple floors, (b) high temperatures that are sustained indefinitely or for long periods of time (greater than about 20 min at any location), and (c) combusted fire loads that are significantly greater than those considered in the analyses. They also do not apply if the capacity of the undamaged structure to redistribute loads via the spandrels, hat truss, and floors is not accounted for adequately in a full 3-dimensional simulation model of the structure.