

diaphragms at the 5th and 7th floors, and the seat connections between the beams and columns at the building perimeter may have become overloaded after the collapse of the transfer trusses and caused the interior collapse to propagate to the whole floor and to the exterior frame. The structural system between floors 5 and 7 appears to be critical to the structural performance of the entire building.

An alternative scenario was considered in which the collapse started at horizontal or inclined members. The horizontal members include truss tension ties and the transfer girder of the T-1 truss at the east side of the 5th floor. Inclined members spanned between the 5th and 7th floors and were located in a two-story open mechanical room. The horizontal haunched back span of the eastern cantilever transfer girders, located roughly along the kink, rested on a horizontal girder at the 7th floor supported by the T-1 transfer truss. Even if the cantilever transfer girder had initiated the collapse sequence, the back span failure would most likely have not caused the observed submergence of the east mechanical penthouse.

The collapse of WTC 7 was different from that of WTC 1 and WTC 2, which showered debris in a wide radius as their frames essentially “peeled” outward. The collapse of WTC 7 had a small debris field as the façade was pulled downward, suggesting an internal failure and implosion.

To confirm proposed failure mechanisms, structural analysis and fire modeling of fuels and anticipated temperatures and durations will need to be performed. Further study of the interaction of the fire and steel, particularly on the lower levels (i.e., 1st–12th floors) should be undertaken to determine specific fuel loads, location, potential for impact from falling debris, etc. Further research is needed into location of storage and file room combustible materials and fuel lines, and the probability of pumps feeding fuel to severed lines.

5.7 Observations and Findings

This office building was built over an electrical substation and a power plant, comparable in size to that operated by a small commercial utility. It also stored a significant amount of diesel oil and had a structural system with numerous horizontal transfers for gravity and lateral loads.

The loss of the east penthouse on the videotape suggests that the collapse event was initiated by the loss of structural integrity in one of the transfer systems. Loss of structural integrity was likely a result of weakening caused by fires on the 5th to 7th floors. The specifics of the fires in WTC 7 and how they caused the building to collapse remain unknown at this time. Although the total diesel fuel on the premises contained massive potential energy, the best hypothesis has only a low probability of occurrence. Further research, investigation, and analyses are needed to resolve this issue.

The collapse of WTC 7 was different from that of WTC 1 and WTC 2. The towers showered debris in a wide radius as their external frames essentially “peeled” outward and fell from the top to the bottom. In contrast, the collapse of WTC 7 had a relatively small debris field because the façade came straight down, suggesting an internal collapse. Review of video footage indicates that the collapse began at the lower floors on the east side. Studies of WTC 7 indicate that the collapse began in the lower stories, either through failure of major load transfer members located above an electrical substation structure or in columns in the stories above the transfer structure. Loss of strength due to the transfer trusses could explain why the building imploded, with collapse initiating at an interior location. The collapse may have then spread to the west, causing interior members to continue collapsing. The building at this point may have had extensive interior structural failures that then led to the collapse of the overall building, including the cantilever transfer girders along the north elevation, the strong diaphragms at the 5th and 7th floors, and the seat connections between the interior beams and columns at the building perimeter.