

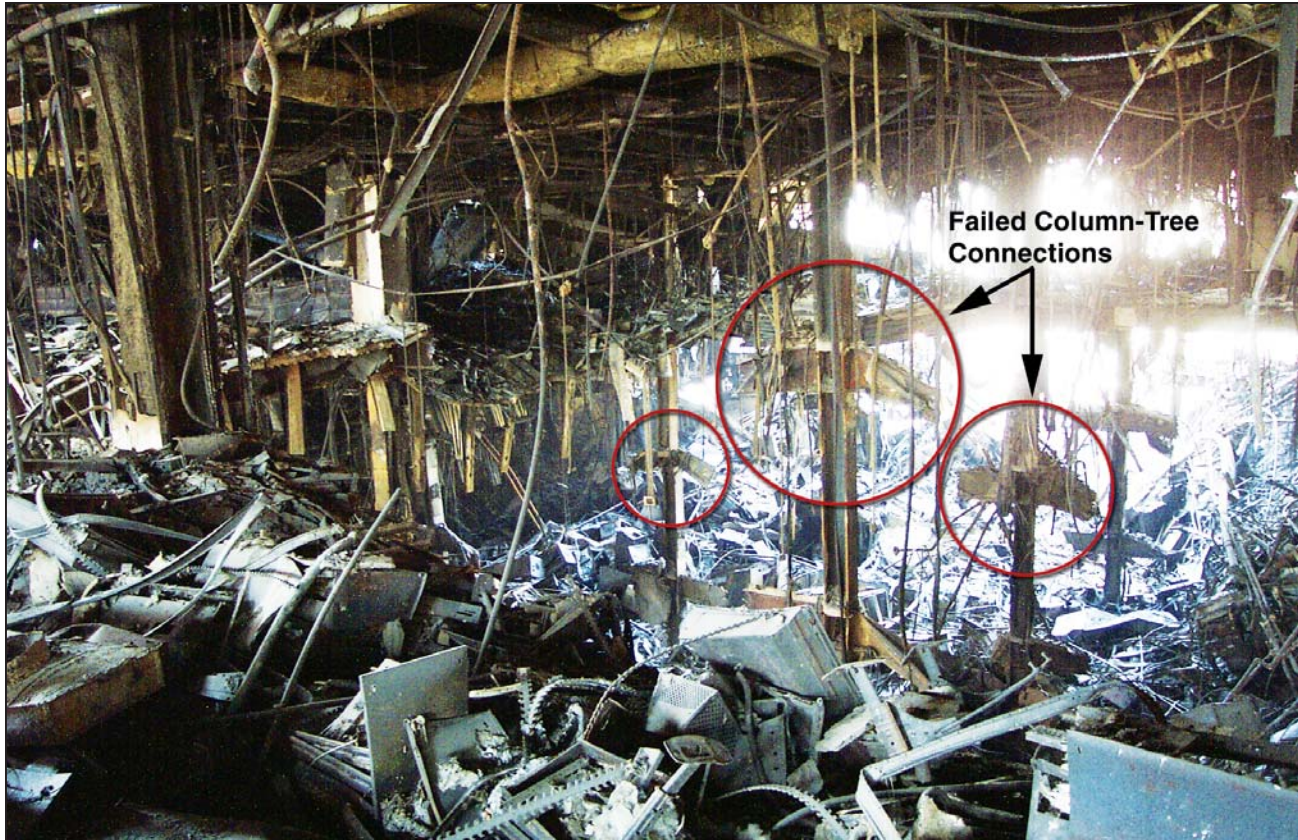


Figure 4-18 Internal collapsed area in WTC 5.

Tensile catenary action of floor framing members and their connections has been neither a design requirement nor a design consideration for most buildings. Further study of such mechanisms for member failures in fires should be conducted to determine whether current design parameters are adequate for performance under fire loads.

4.4 Observations and Findings

All three buildings suffered extensive fire and impact damage and significant partial collapse. The condition of the stairways in WTC 5 indicates that, for the duration of this fire, the fire doors and the fire protective covering on the walls performed well. There was, however, damage to the fire side of the painted fire doors, and the damage-free condition on the inside or stairwell side of those same doors indicates the doors performed as specified for the fire condition that WTC 5 experienced. These stairway enclosures were unusual for buildings that have experienced fire because they were not impacted by water from firefighting operations. In addition, the stairway doors were not opened during the fire and remained latched and closed throughout the burnout of the floors. Therefore, general conclusions regarding the effectiveness of this type of stairway construction may not be warranted.

The steel generally behaved as expected given the fire conditions in WTC 5. Many beams developed catenary action as illustrated in Figure 4-14. Some columns buckled, as shown in Figure 4-17. The one exception is the limited internal structural collapse in WTC 5. The fire-induced failure that led to this collapse was unexpected. As in the rest of the building, the steel beams were expected to deflect significantly, yet carry the load. This was not the case where the beam connections failed. The failure most likely occurred during the heating of the structure because the columns remained straight and freestanding after the collapse.