

Chapter 9

FIRE SIMULATIONS

9.1 OVERVIEW

9.1.1 Approach

The major fires in WTC 7 were simulated using the Fire Dynamics Simulator, version 4 (McGrattan 2004), the same software that NIST used to simulate the fires in the World Trade Center towers (NIST NCSTAR 1-5F). These simulations were part of a sequence of estimates that included the debris damage from WTC 1, the subsequent fires, the heating of the structural elements, the structural response, and the eventual collapse. Temperature predictions from the fire model were passed to the structural model via the Fire Structure Interface, again using the same process as in the reconstruction of the collapse of the World Trade Center towers (NIST NCSTAR 1-5G).

As described in Chapter 5, sustained and/or late fires were observed on Floors 7 through 9 and 11 through 13 of WTC 7. There was a single observation of a late, small fire on Floor 14. In addition, there might have been concealed fires in the mechanical spaces on Floors 5 and 6. No fire was observed on the 10th floor. The fires on the upper floors (19, 22, 29, and 30) died out well before the collapse of WTC 7.

The fire simulations for WTC 7 were conducted for each floor individually. Section 5.6 showed that there were no externally visible observations of flames passing from one floor to another, aside from what might have remained hidden in the debris-damaged area in the southwest of the building. The only floor-to-floor connection within the tenant spaces was a flight of convenience stairs connecting the 11th and 12th floors. It was located near the southwest corner of the building, near the multi-floor debris damage zone, and essentially acted as an enlargement of the debris damage zone. The stairs were thus not included in the FDS simulations. The analysis described in Section 9.1.2 found that any late developing floor breaches would not have had a major effect on the structural heating.

It would have been difficult to observe fires on the 5th and 6th floors, due to the partitions just behind the various windows or louvers (Chapter 3). Thus, the Investigation Team simulated a variety of fire scenarios and examined the outcome of each to determine whether it would have produced a visible telltale or whether it would have been severe enough to weaken any structural elements on those floors.

The actual fires on Floors 7 through 9 and 11 through 13 were likely initiated when WTC 1 collapsed (Section 5.6). However, there was limited photographic evidence or on-site personal observation upon which to base simulation of the early development of these fires. While use was made of the appearance of flames and window breakage in photographs and videos in formulating the simulations, the Investigation Team realized that the absolute timing of the simulations might not align exactly with the timing of the fires on September 11, 2001.

Using a timeline reconstructed from the limited photographic evidence and eyewitness testimony, fire simulations were conducted for Floors 7 and 8. For the simulations, the fires on these two floors were assumed to have initiated at a time designated as noon. There was no evidence of visible fire growth on