

Based on these analyses and review of the numerous interview transcripts², NIST concluded that it was highly unlikely that any fires on the 5th or 6th floors contributed to the collapse of WTC 7.

NIST concluded that the only fires that could have led to structural weakening of WTC 7 were those on the 7th through 9th and 11th through 13th floors.

3.4.3 Fire Dynamics Simulator (FDS)

The major fires on Floors 7 through 9 and 11 through 13 in WTC 7 were simulated using the Fire Dynamics Simulator (FDS), version 4, in a manner similar to the simulations conducted for WTC 1 and WTC 2 (NIST NCSTAR 1-5F). There were far fewer photographs and videos of WTC 7 than of the towers; and, thus, the details of the WTC 7 fires were not as precise as for the fires in the towers. However, the imagery was sufficient to guide the WTC 7 fire simulations. Unlike the computations for WTC 1 and WTC 2, the fire simulations for WTC 7 were conducted for each floor individually, as there were no obvious pathways for the flames and heat to pass from one floor to another, aside from the debris-damaged area in the southwest corner of the building (NIST NCSTAR 1-9, Chapter 9). The fires on Floors 7, 8, and 12 were simulated using input from the visual imagery and established fire physics. The fire on Floor 9 was similar to that on Floor 8, and the simulation was derived from it. For the same reason, the fires on Floors 11 and 13 were derived from the fire on Floor 12. 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. A typical single floor fire simulation took up to two days on a Linux cluster with 8 processors.

Figure 3–5 shows hourly snapshots of the computed temperatures near the ceiling of the 8th floor. The general clockwise movement of the fires is in agreement with the visual images. Figure 3–6 is a similar visualization of the temperatures resulting from the computed fires on the 12th floor. The general counterclockwise movement of the fires is evident.

3.4.4 Fire Structure Interface (FSI)

The Fire Structure Interface (FSI) was used to impose the gas temperatures from the FDS simulations on the structural components of WTC 7 to predict the evolving thermal state of the building (NIST NCSTAR 1-9, Chapter 10). The thermal analysis approach was similar to that used to simulate the fire induced thermal loads on WTC 1 and WTC 2 described in NCSTAR 1-5G. The FDS temperature data for use in the structural analysis were sampled at 30 min intervals. For each time step, a set of thermal data files was generated that specified the thermal state of the lower 16 stories of the building. Three different thermal response computations were used. Case A used the temperature data as obtained from the FDS simulation. Case B increased the Case A gas temperatures by 10 percent and Case C decreased the Case A gas temperatures by 10 percent. Given the limited visual evidence, the Investigation Team estimated, using engineering judgment, that a 10 percent change in temperatures was within the range of reasonable and realistic values for the fires in WTC 7 on September 11, 2001. The computational time for each Case was approximately one to two days on a single processor desktop computer.

² For instance, sometime after 1:00 p.m., OEM and FDNY staff climbed the east stairway of WTC 7 and did not see much damage on the 4th, 5th, or 6th floors from their viewing location. They made no mention of fire, heat or smoke.