

increasingly influenced the deterministic physics-based collapse process, and the details of the progression of the horizontal failure and final global collapse were increasingly less precise.

Thus, while the two predictions of the time of descent of the west penthouse also straddled the observed time, the mechanisms of building decay were quite different. In the analysis without debris impact damage, the exterior columns buckled near mid-height of the building, approximately between Floors 17 and 29. In the analysis with debris impact damage, the exterior columns buckled between Floors 7 to 14, due to the influence of the exterior damage near the southwest corner. In both analyses, the eastern exterior wall deflected inward at the roof level as the structure became unsupported after the vertical collapse event. The western wall also deflected inward in the analysis without debris impact damage, as it was pulled inward as the last line of core columns failed.

There was another observable feature that occurred after the global collapse was underway and, thus, could not be captured accurately in the simulation. After the exterior facade began to fall downward at 6.9 s, the north face developed a line or “kink” near the end of the core at Column 76. As shown in Figure 5-205, the northeast corner began to displace to the north at about 8.8 s, and the kink was visible at 9.3 s. The kink and rotation of the northeast façade occurred 2 s to 3 s after the exterior façade had begun to move downward, as a result of the global collapse.

Given the complexity of the modeled behavior, the global collapse analyses matched the observed behavior reasonably well. The global collapse analyses confirmed the leading collapse hypothesis, which was based on the available evidence.

12.5.3 Timing of Collapse Initiation and Progression

The timing of global collapse of WTC 7, as indicated by downward motion of the north wall, was investigated using a video of the collapse taken from the vantage point of West Street near Harrison Street (Camera No. 3, Figure 5-183). The pertinent building dimensions were determined using architectural drawings (Roth 1985). An initial analysis compared the observed time for the roofline to fall approximately 18 stories to the free fall time under the force of gravity. A more detailed analysis examined the vertical displacement, velocity, and acceleration through different stages of the collapse process.

The initial analysis required two quantities: (1) the distance that some feature of the building descended and (2) the time it took to fall that distance. The chosen feature was the top of the parapet wall on the roofline aligned with the east edge of the louvers on the north face. The distance was the difference between the elevation of the roofline prior to the collapse and the last elevation where the roofline could be observed before it was obstructed by a building in the foreground.

The elevation of the top of the parapet wall was +925 ft 4 in. The lowest point on the north face of WTC 7 that was visible on the Camera 3 video, prior to any downward movement, was the tops of the windows on Floor 29, which had an approximate elevation of +683 ft 6 in. Thus, the distance that the roofline moved downward before it disappeared from view was about 242 ft.

It was difficult to detect the exact instant that the north wall began to collapse because of the resolution of the video image and because, as columns buckled, vertical movement was initially very small. The instant of initial movement was estimated by analyzing changes in the color of a pixel in the video