

floor connections to the columns had not yet failed in this region, as there were no fires observed on the west side of Floors 10 through 14 at any time during the day, so the floors were intact and able to pull the exterior columns inward.

- The south and west exterior columns buckled first, followed by the north and east face columns.
- All exterior columns buckled between approximately Floors 7 and 14.
- Once column support was lost in the lower floors, the remaining exterior structure above began to fall vertically as a single unit.
- WTC 7 was prone to classic progressive collapse in the absence of fire-induced damage and debris impact damage when a section of Column 79 between Floors 11 and 13 was removed. The collapse sequence demonstrated a vertical and horizontal progression of failure upon the removal of the Column 79 section, followed by downward movement at the roofline due to buckling of exterior columns, which led to the collapse of the entire building.
- The observed descent time of the upper 18 stories of the north face of WTC 7 (the floors clearly visible in the video evidence) was 40 percent greater than the computed free fall time. A more detailed analysis of the descent of the north face found three stages: (1) a slow descent with acceleration less than that of gravity that corresponded to the buckling of the exterior columns at the lower floors, (2) a freefall descent over approximately eight stories at gravitational acceleration for approximately 2.25 s, and (3) a decreasing acceleration as the north face encountered resistance from the structure below.

## 12.7 REFERENCES

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