

Chapter 4

PRINCIPAL FINDINGS

4.1 INTRODUCTION

This chapter presents the findings of the NIST Technical Investigation, organized according to the first three of the four Investigation objectives for Building 7 of the New York World Trade Center (WTC). The fourth objective ("Identify areas in current building and fire codes, standards, and practices that warrant revision") is the subject of Section 4.5. The findings were derived from the extensive documentation summarized in the preceding chapters and described in detail in the accompanying reports (NIST NCSTAR 1-9 and 1-9A). While NIST was not able to compile complete documentation of the history of WTC 7, due to the loss of records over time and due to the collapses, the investigators were able to acquire information adequate to arrive at and firmly support the findings and recommendations compiled in this chapter and the next. The chapter begins with summary statements and continues with the listing of the full set of principal findings.

4.2 SUMMARY

Objective 1: Determine why and how WTC 7 collapsed.

- WTC 7 withstood debris impact damage that resulted in seven exterior columns being severed and subsequently withstood fires involving typical office combustibles on several floors for almost seven hours.
- The collapse of WTC 7 represents the first known instance of the total collapse of a tall building primarily due to fires. The collapse could not have been prevented without controlling the fires before most of the combustible building contents were consumed.
- WTC 7 collapsed due to uncontrolled fires with characteristics similar to previous fires in tall buildings. The fires in WTC 7 were similar to those that have occurred previously in several tall buildings (One New York Plaza, 1970, First Interstate Bank, 1988, and One Meridian Plaza, 1991) where the automatic sprinklers did not function or were not present. However, because of differences between their structural designs and that of WTC 7, these three buildings did not collapse. Fires for the range of combustible contents in WTC 7 – 20 kg/m^2 (4.0 lb/ft^2) on Floors 7 to 9 and 32 kg/m^2 (6.4 lb/ft^2) on Floors 11 to 13 – persisted in any given location for approximately 20 min to 30 min. Had a water supply for the automatic sprinkler system been available and had the sprinkler system operated as designed, it is likely that fires in WTC 7 would have been controlled and the collapse prevented.
- The probable collapse sequence that caused the global collapse of WTC 7 was initiated by the buckling of Column 79, which was unsupported over nine stories, after local fire-induced damage led to a cascade of floor failures. The buckling of Column 79 led to a vertical progression of floor failures up to the east penthouse and to the buckling of Columns 80 and