

Chapter 8

INITIATING EVENT HYPOTHESES

8.1 INTRODUCTION

This chapter addresses the initiating event and collapse propagation hypotheses that formed the basis of the technical approach to determine why and how the 47 story WTC 7 building collapsed on September 11, 2001. Specifically, NIST considered (1) building contents fires on tenant floors, (2) fuel oil fires from leaks in the emergency generator fuel systems, (3) hypothetical blast events, and (4) fires in the Con Edison substation.

The leading collapse hypothesis will be presented first, followed by supporting evidence and calculations that led to the hypothesis. Prediction of the growth and spread of fires from fire simulation models, analysis of heating of the structural elements due to these fires, and structural analysis of the initiating event hypothesis and global response are presented in subsequent chapters.

8.2 LEADING COLLAPSE HYPOTHESIS FOR WTC 7

Based on observations and analyses of photographic and videographic records, critical study of the steel framing, and simplified and detailed analyses to investigate possible failure modes that could lead to an initiating event, the following leading collapse hypothesis was identified.

Initial Local Failure for Collapse Initiation

An initial local failure occurred at the lower floors (below Floor 14) of the building due to fire-induced floor failures, leading to buckling of a critical column (the initiating event) which supported a large-span floor bay with an area of about 200 m² (2,000 ft²).

The leading hypothesis for the failure sequence that characterized the initial local failure was based on fire-induced failure events in the tenant floors. Floor beams, girders, slabs, and connections heated more quickly and to higher temperatures than the columns. Elevated temperatures in the floor elements led to thermal expansion, with or without thermal weakening and sagging, which resulted in failure of floor connections and/or buckling of floor beams. Sufficient floor component failures (connections and/or beams) resulted in at least one unsupported column over multiple floors at the lower floors. This column buckled and led to the initiation of global collapse.

Vertical Progression of Failure

Vertical progression of the initial local failure occurred up to the east penthouse, and as the large floor bays became unable to redistribute the loads, this initial local failure brought down the interior structure below the east penthouse.