

Chapter 6

RECONSTRUCTION OF THE COLLAPSES

6.1 APPROACH

The following presents an overview of the methods used to reach the accounts in Part I. The details may be found in the companion reports to this document, which are indexed in Appendix C.

A substantial effort was directed at establishing the baseline performance of the WTC towers, i.e., estimating the expected performance of the towers under normal design loads and conditions. This enabled meeting the third objective of the Investigation, as listed in the Preface to this report. The baseline performance analysis also helped to estimate the ability of the towers to withstand the unexpected events of September 11, 2001. Establishing the baseline performance of the towers began with the compilation and analysis of the procedures and practices used in the design, construction, operation, and maintenance of the structural, fire protection, and egress systems of the WTC towers. The additional components of the performance analysis were:

- The standard fire resistance of the WTC truss-framed floor system,
- The quality and properties of the structural steels used in the towers, and
- The response of the WTC towers to design gravity and wind loads.

The second substantial effort was the simulation of the behavior of each tower on September 11, 2001, providing the basis for meeting the first and second objectives of the Investigation. This entailed four modeling steps:

1. The aircraft impact into the tower, the resulting distribution of jet fuel, and the damage to the structure, partitions, insulation materials, and building contents.
2. The spread of the multi-floor fires.
3. The heating of the structural elements by the fires.
4. The response of the damaged and heated building structure, and the progression of structural component failures leading to the initiation of the collapse of the towers.

For such complex structures and complex thermal and structural processes, each of these steps stretched the state of the technology and tested the limits of software tools and computer hardware. For example, the investigators advanced the state-of-the-art in the measurement of construction material properties and in structural finite element modeling. New modeling capability was developed for the mapping of fire-generated environmental temperatures onto the building structural components.

For the final analyses, four cases were used, each involving all four of the modeling steps. Case A and Case B were for WTC 1, with Case B generally involving more severe impact and fire conditions than