

These real fires contrast with building code requirements for fire resistant design, which are based on a presumed duration of a standard fire as a function of fire load and building occupancy, height, and area. The severity of actual fires is determined by additional factors, which are not typically considered in building codes except as an alternate material method or equivalency when accepted by the enforcing official (the authority having jurisdiction). Although there have been a number of severe fires in protected steel buildings, including the three described in Appendix A, Section A.3.1.3, the team is unaware of any protected steel structures that have collapsed in a fire prior to September 11. However, none of the other fire events had impact damage to structural and fire protection systems. Recent fire research provides a basis for designing more reliable fire protection for structural members by analytical methods that are becoming more acceptable to the building code community. Such methods were not available when the WTC buildings were designed in the 1960s.

1.6 Report Organization

All seven WTC buildings, the Bankers Trust building, and other buildings that sustained major impact and/or fire damage from the attacks on the WTC towers are discussed in detail in this report. Information is presented about building performance documented during this study, as well as findings and recommendations for each building, as appropriate.

In order to simultaneously conduct multiple investigations into each building, a Chapter Leader was assigned as a lead coordinator and author for each chapter or appendix. This approach allowed a high level of productivity and resulted in a different writing style for each chapter. Additionally, the scope and level of detail varies considerably between chapters. The two major factors that define chapter content are the type and level of damage a building suffered and the availability of building information during this study, including damage documentation, structural and architectural plans, fire protection systems, building contents, and modifications made during occupancy.

This report opens with an executive summary, followed by the Introduction (Chapter 1), which documents the purpose and scope of this report; the events and actions that occurred on September 11, 2001, at the WTC site; and background information on the building design and codes.

The WTC buildings are presented in Chapters 2 through 5, and are grouped by types of construction and damage. Chapter 2 presents observations, data, and the results of preliminary analyses conducted on each tower (WTC 1 and WTC 2). Chapter 3 briefly discusses the hotel (WTC 3) performance for two severe debris impact events from the collapsing towers. Chapter 4 includes WTC 4, 5, and 6, because all three buildings are of similar construction and experienced fire damage from debris. Chapter 5 presents observations, data, and preliminary analyses of WTC 7, which also suffered a complete collapse. Chapter 6 describes how the Bankers Trust building arrested a local collapse on the north side that was initiated by debris impact from the collapse of WTC 2. Buildings adjacent to the WTC site that sustained major damage are presented in Chapter 7 (Peripheral Buildings). Chapter 8 presents observations, findings, and recommendations for each building, as well as overall recommendations based on the collective assessment of individual building performance and related issues.

The following appendixes are included to allow development of pertinent issues and topics without interrupting the flow of the report:

- A – Overview of Fire Protection in Buildings
- B – Structural Steel and Steel Connections
- C – Limited Metallurgical Examination
- D – WTC Steel Data Collection