

- f. Fire protection ratings and safety factors for structural transfer systems should be evaluated for their adequacy relative to the role of transfer systems in building stability.

8.2 Chapter Observations, Findings, and Recommendations

The following sections present observations, findings, and recommendations specifically made in each chapter of this report, including the discussion of building codes and fire standards in Chapter 1 and the limited metallurgical examination of steel from the WTC towers and WTC 7 in Appendix C.

8.2.1 Chapter 1: Building Codes and Fire Standards

Observations and Findings

- a. The decision to include aircraft impact as a design parameter for a building would clearly result in a major change in the design, livability, usability, and cost of buildings. In addition, reliably designing a building to survive the impact of the largest aircraft available now or in the future may not be possible. These types of loads and analyses are not suitable for inclusion in minimum loads required for design of all buildings. Just as the possibility of a Boeing 707 impact was a consideration in the original design of WTC 1 and WTC 2, there may be situations where it is desirable to evaluate building survival for impact of an airplane of a specific size traveling at a specific speed. Although there is limited public information available on this topic, interested building owners and design professionals would require further guidance for application to buildings.
- b. The ASTM E119 Standard Fire Test was developed as a comparative test, not a predictive one. In effect, the Standard Fire Test is used to evaluate the relative performance (fire endurance) of different construction assemblies under controlled laboratory conditions, not to predict performance in real, uncontrolled fires.

8.2.2 Chapter 2: WTC 1 and WTC 2

8.2.2.1 Observations and Findings

- a. The structural damage sustained by each of the two buildings as a result of the terrorist attacks was massive. The fact that the structures were able to sustain this level of damage and remain standing for an extended period of time is remarkable and is the reason that most building occupants were able to evacuate safely. Events of this type, resulting in such substantial damage, are generally not considered in building design, and the ability of these structures to successfully withstand such damage is noteworthy.
- b. Preliminary analyses of the damaged structures, together with the fact the structures remained standing for an extended period of time, suggest that, absent other severe loading events such as a windstorm or earthquake, the buildings could have remained standing in their damaged states until subjected to some significant additional load. However, the structures were subjected to a second, simultaneous severe loading event in the form of the fires caused by the aircraft impacts.
- c. The large quantity of jet fuel carried by each aircraft ignited upon impact into each building. A significant portion of this fuel was consumed immediately in the ensuing fireballs. The remaining fuel is believed either to have flowed down through the buildings or to have burned off within a few minutes of the aircraft impact. The heat produced by this burning jet fuel does not by itself appear to have been sufficient to initiate the structural collapses. However, as the burning jet fuel spread across several floors of the buildings, it ignited much of the buildings' contents, causing simultaneous fires across several floors of both buildings. The heat output from these fires is estimated to have been