

spandrels) be fire protected to the higher fire resistance rating required for the columns. The definition of the primary structural frame should be expanded to include bracing members that are essential to the vertical stability of the primary structural frame under gravity loading (e.g. girders, diagonal bracing, composite floor systems that provide lateral bracing to the girders) whether or not the bracing members carry gravity loads. Some of these bracing members may not have direct connections to the columns, but provide stability to those members directly connected to the columns. This recommendation modifies the definition of the primary structural frame adopted in the 2007 supplement to the International Building Code (IBC). The IBC considers members of floor or roof construction that are not connected to the columns to not be part of the primary structural frame. This recommendation ensures consistency in the fire protection provided to all of the structural elements that contribute to overall structural stability. State and local jurisdictions should adopt and enforce this requirement.

Relevance to WTC 7: Thermally-induced breakdown of the floor system in WTC 7 was a determining step in causing collapse initiation and progression. Therefore, the floor system should be considered as an integral part of the primary structural frame.

5.2.3 Group 3. New Methods for Fire Resistant Design of Structures

The procedures and practices used in the fire resistant design of structures should be enhanced by requiring an objective that uncontrolled fires result in burnout without partial or global (total) collapse. Performance-based methods are an alternative to prescriptive design methods. This effort should include the development and evaluation of new fire-resistive coating materials and technologies and evaluation of the fire performance of conventional and high-performance structural materials.

Recommendation F (NCSTAR Recommendation 8). NIST recommends that the fire resistance of structures be enhanced by requiring a performance objective that uncontrolled building fires result in burnout without partial or global (total) collapse. Such a provision should recognize that sprinklers could be compromised, non-operational, or nonexistent. Current methods for determining the fire resistance rating of structural assemblies do not explicitly specify a performance objective. The rating resulting from current test methods indicates that the assembly (component or subsystem) continued to support its superimposed load (simulating a maximum load condition) during the test exposure without collapse. *Model Building Codes:* This recommendation should be included in the national model codes as an objective and adopted as an integral part of fire resistance design for structures. The issue of non-operational sprinklers could be addressed using the existing concept of Design Scenario 8 of NFPA 5000, where such compromise is assumed and the result is required to be acceptable to the Authority Having Jurisdiction.

Relevance to WTC 7: Large, uncontrolled fires led to failure of a critical column and consequently the complete collapse of WTC 7. In the region of the collapse initiation (i.e., on the east side of Floor 13), the fire had not consumed the combustible building contents, yet collapse occurred.

Recommendation G (NIST NCSTAR 1 Recommendation 9). NIST recommends the development of: (1) performance-based standards and code provisions, as an alternative to current prescriptive design methods, to enable the design and retrofit of structures to resist real