

contract for applying SFRM to the structural steel, indicate a type 1-B (3 h protected) classification.

14.5.2 Building Design and Structural Safety

- NIST found no evidence to suggest that WTC 7 was not designed in a manner generally consistent¹ with applicable building codes and standards in effect at the time of construction.
- WTC 7 was adequately designed for vertical loads due to gravity and lateral loads due to wind.
 - The vertical (gravity) load resisting system comprised the core and exterior columns, which received gravity loads from the floor framing. Of particular note were the three core columns on the east side of the building (Columns 79, 80, and 81), which supported large span floor areas with approximately 15 m (50 ft) spans on at least one side.
 - Above Floor 7, the lateral load resisting system comprised the exterior moment frame with a perimeter belt truss at Floors 22 through 24. There were also a perimeter belt truss between Floors 5 and 7, diaphragms at Floors 5 and 7 that transferred lateral wind loads to the core columns, and bracing in the core below Floor 7 that transferred lateral loads to the foundation. However, this system was not able to provide a secondary load path for gravity loads.
 - Above Floor 7, there was no bracing, or other load redistribution mechanism, to transfer gravity loads between interior columns. The floor framing, which was the only load path between columns, could not redistribute loads between columns because the shear connections from the interior floor beams to columns were only designed for transferring vertical shear loads.
 - Transfer girders, trusses, and cantilever overlays were used to transfer column loads above Floor 7 to a different column layout below Floor 5.
- The structural design did not explicitly evaluate fire effects, which was typical for engineering practice at that time and continues to remain so today. Many of the shear connections in WTC 7 were not capable of resisting lateral loads resulting from thermal expansion effects in the steel floor framing when the floor beams were heated.

14.5.3 SFRM Requirements and Application

- It is likely that the Monokote MK-5 SFRM, applied to the steel framing and metal decks, was undamaged by the impact of the debris from the collapse of WTC 1, except in the area where direct structural damage to WTC 7 occurred.
- NIST simulations showed that, for the heaviest columns in WTC 7, when properly insulated, it would have taken an exposure of about 7 h at post-flashover upper layer gas temperatures to raise the steel temperature to 600 °C (1100 °F), the point at which the steel strength would have been reduced by half. A similar calculation indicated it would have taken about 4 h to