

document much of the sequence of these changing requirements and arrive at an estimation of the passive protection in place on September 11, 2001.

Floor Systems

At the time the WTC was designed, the ASTM E 119 test method had been used for nearly 50 years to determine the fire resistance of structural members and assemblies. However, The Port Authority confirmed to the Investigation Team that there was no record of fire endurance testing of the innovative assemblies representing the thermally protected floor system used in the towers. The floor assembly was not tested despite the fact that the Architect of Record and the Structural Engineer of Record stated that the fire rating of this novel floor system could not be determined without testing.

Prior to construction, the Architect of Record had used information from (unidentified) manufacturers to recommend a 1 in. thickness of SFRM around the top and bottom chords of the trusses and a 2 in. thickness for the web members of the trusses. This was to achieve the fire endurance requirements for Class 1A construction (Section 5.3.3).

In 1969, The Port Authority directed that a ½ in. thick coating of BLAZE-SHIELD Type D (BLAZE-SHIELD D), a mixture of cement and asbestos fibers, be used to insulate the floor trusses. This was to achieve a Class 1A rating, even though the preponderance of evidence suggests that the towers were chosen to be Class 1B, the minimum required by the NYC Building Code. NIST found no evidence of a technical basis for selection of the ½ in. thickness. This coating had been installed as high as the 38th floor of WTC 1 when its use was discontinued due to recognition of adverse health effects from inhalation of asbestos fibers. The spraying then proceeded with BLAZE-SHIELD DC/F, a similar product in which the asbestos was replaced by a glassy mineral fiber and whose insulating value was reported by Underwriters Laboratories, Inc., to be slightly better than that of BLAZE-SHIELD D. On the lower floors, the BLAZE-SHIELD D was encapsulated with a sprayed material that provided a hard coat to mitigate the dispersion of asbestos fibers into the air.

In 1994, The Port Authority measured the SFRM thickness on trusses on floors 23 and 24 of WTC 1. In all, average thicknesses were reported for 32 locations, and the overall average thickness was found to be 0.74 in. NIST performed a further evaluation of the SFRM thickness using photographs taken in the 1990s of floor trusses on (non-upgraded) floors 22, 23, and 27 of WTC 1 (Figure 5–5). By measuring dimensions on the photographs, NIST estimated the insulation thicknesses on the diagonal web members of trusses. (The thickness of chord member insulation could not be measured.) The average thickness and standard deviation of web members was 0.6 in. ± 0.3 in. on the main trusses, 0.4 in. ± 0.25 in. on the bridging trusses, and 0.4 in. ± 0.2 in. on the diagonal struts. These numbers indicated that there were areas where the coating thickness was less than the specified 0.5 in.