

4.7 STRUCTURAL THERMAL INSULATION

4.7.1 Material Selection, Application, and Condition

As presented in Chapter 2, Monokote MK-5 was the sprayed fire resistive material (SFRM) used to insulate the structural elements in WTC 7. Chapter 2 also presents the available documentation of the thermal properties and installed condition of the insulation.

4.7.2 Simulations of Thermal Protection

To understand the susceptibility of various structural components to fires of varying duration, NIST performed a number of computations in which a single beam, column, or floor assembly was subjected to elevated temperature. Typically, these simulations involved a furnace-like exposure, i.e., immersing the structural element in a steady state temperature bath. This was conservative, since in an actual fire, the gas temperature field to which the element was exposed would rise less quickly and would wane as the combustibles were consumed. The temperatures at various locations in the structural element were monitored as time progressed.

The computations were performed for five entities:

- Columns. For the following sizes, the WTC 7 specifications had a 3 h fire resistance rating. This was achieved with 7/8 in. of Monokote MK-5.
 - One of the heaviest columns, typified by Column 79, which had a W14x730 steel section and additional steel plates welded across the open face of the flanges. Interior columns 58, 61, and 73 to 81 also had this massive section (Column schedule, Cantor 1985).
 - A lighter column, with a W14x500 steel section. This is typical of a number of columns in the building core and the exterior (Column schedule, Cantor 1985).
- Composite Floor Assemblies. Typical of tenant floor sections, these assemblies consisted of one of three sizes of steel beams supporting a corrugated steel deck (3 in. corrugations) and a 5.5 in. thick concrete slab, 2.5 in. of which was above the steel deck. The steel deck was insulated with 3/8 in. of Monokote MK-5 to achieve a 2 h fire resistance rating. The floor beams were modeled with 7/16 in. of Monokote MK-5 (Section 2.5). The floor beams were later found to have been protected with 1/2 in. of MK-5, for the specified 2 h fire rating of the floor assembly. The beam sizes analyzed were:
 - A light floor beam – W14x22 steel section.
 - A medium mass floor beam – W24x55 steel section.
 - A heavy floor beam – W36x135 steel section.

Figure 4–4 shows the temperature rise in the heavy column.