

Test 3: 17 ft floor, $\frac{3}{4}$ in. insulation, restrained

Test 4: 17 ft floor, $\frac{1}{2}$ in. insulation, restrained

The results of the four tests are summarized as follows:

- All four test assemblies were able to withstand standard fire conditions for between $\frac{3}{4}$ hour and 2 hours without exceeding the limits prescribed by ASTM E 119.
- All four test specimens sustained the maximum design load for approximately 2 hours without collapsing.
- The restrained full-scale floor system obtained a fire resistance rating of $1\frac{1}{2}$ hours, while the unrestrained floor system achieved a 2 hour rating. Past experience with the ASTM E 119 test method led investigators to expect the unrestrained floor assembly to receive a lower rating than the restrained assembly.
- For assemblies with a $\frac{3}{4}$ in. SFRM thickness, the 17 ft assembly's fire rating was 2 hours; the 35 ft assembly's rating was $1\frac{1}{2}$ hours. This result raised the question of whether or not a fire rating of a 17 ft floor assembly is scalable to the longer spans in the WTC towers.
- The specimen in Test 4, with a fire rating of $\frac{3}{4}$ hour, would not have met the 2 hour requirement of the NYC Building Code.

The Investigation Team was cautious about using these results directly in the formulation of collapse hypotheses. In addition to the scaling issues raised by the test results, the fires in the towers on September 11, and the resulting exposure of the floor systems, were substantially different from the conditions in the test furnaces. Nonetheless, the results established that this type of assembly was capable of sustaining a large gravity load, without collapsing, for a substantial period of time relative to the duration of the fires in any given location on September 11.

6.14 COLLAPSE ANALYSIS OF THE TOWERS

6.14.1 Approach to Determining the Probable Collapse Sequences

At the core of NIST's reconstruction of the events of September 11, 2001, were the archive of photographic and video evidence, the observations of people who were on the scene, the assembled documents describing the towers and the aircraft, and Investigation-generated experimental data on the properties of construction and furnishing materials and the behavior of the fires. Information from all of these sources fed the computer simulations of the towers, the aircraft impacts, the ensuing fires and their heating of the structural elements, and the structural changes that led to the collapse of the towers. To the extent that the input information was complete and accurate, the output of the simulations would have provided definitive responses to the first three objectives of the Investigation. However, the available information, as extensive as it was, was neither complete nor of assured precision. As a result, the Investigation Team took steps to ensure that the conclusions of the effort were credible explanations for how the buildings collapsed and the extent to which the casualties occurred.