

# Recommendations from the NIST Study of the Charleston Sofa Super Store Fire

From the March 2011 report, *Technical Study of the Sofa Super Store Fire - South Carolina, June 18, 2007* (NIST-SP 1118, Volume I)

## RECOMMENDATIONS FOR IMPROVING MODEL STANDARDS, CODES, AND PRACTICES

### **Recommendation 1**

*NIST recommends that, at a minimum, all state and local jurisdictions adopt a building and fire code based upon one of the model codes, covering new and existing high fuel-load mercantile occupancies, and update local codes as the model codes are revised.*

If current model codes had been adopted and applied retroactively to high fuel-load mercantile occupancies, the model codes would have required the Sofa Super Store's main showroom and warehouse be sprinklered.

### **Recommendation 2**

*NIST recommends that all state and local jurisdictions implement aggressive and effective fire inspection and enforcement programs that address:*

- a) all aspects of the building and fire codes;*
- b) adequate documentation of building permits and alterations;*
- c) means of fire protection systems inspection and detailed record keeping;*
- d) frequency and rigor of fire inspections, including follow-up and auditing procedures; and*
- e) guidelines for remedial requirements when inspections identify deviations from code provisions.*

Effective inspections and enforcement of the 2006 model building and fire codes available at the time of the Sofa Store fire would have required the door and walls of the showrooms and warehouse to be upgraded or would have required fire sprinklers to be installed throughout the structure. Either of those measures would go a long way to toward preventing similar tragedies in the future.

### **Recommendation 3**

*NIST recommends that all state and local jurisdictions ensure that fire inspectors and building plan examiners are professionally qualified to a national standard such as NFPA 1031. Professional qualification may be demonstrated through a nationally accepted certification examination, such as the Fire Plan Examiner; Fire Inspector I and II, and Certified Fire Marshal .*

If fire inspectors had identified the wood framing, solvent storage, and lack of fire-rated barriers and if corrective actions had been implemented, the fire would not have moved into the loading dock and the fire spread from the loading dock to the rest of the structure would have been slowed significantly.

#### **Recommendation 4**

*NIST recommends that model codes require sprinkler systems and that state and local authorities adopt and aggressively enforce this provision:*

- a) for all new commercial retail furniture stores regardless of size; and*
- b) for existing retail furniture stores with any single display area of greater than 190 m<sup>2</sup> (2000 ft<sup>2</sup>).*

An installed fire sprinkler system that complied with a national standard such as NFPA 13 [3] would have activated and would have controlled the fire growth. If the showrooms had been divided into smaller areas with fire barriers, the compartmentation would have slowed the spread of the fire as well.

#### **Recommendation 5**

*NIST recommends that state and local jurisdictions develop comprehensive fire risk management plans to:*

- a) identify low, medium, and high-hazard occupancies;*
- b) allocate resources according to identified risks; and*
- c) develop operating procedures that respond to specific risks.*

A fire risk management plan, properly implemented, would have identified the hazards associated with the size, type, and configuration of the fuel load and the large open spaces that existed at the Sofa Super Store.

#### **Recommendation 6**

*NIST recommends that state and local authorities:*

- a) develop guidelines as to how and when ventilation should be implemented during a fire;*
- b) provide education to fire fighters on the science of fire behavior in vented and nonvented structures and how the addition of air can impact the burning characteristics of the fuel; and*
- c) provide training to fire fighters on different types of ventilation (vertical, horizontal, or positive-pressure) and integrate into daily operations on the fire ground.*

Standard operating guidelines on when, how, and why ventilation should be used — would have prevented the rapid fire movement that occurred after the front windows were broken.

## RESEARCH RECOMMENDATIONS AND OTHER APPROPRIATE ACTIONS

#### **Recommendation 7**

In terms of furniture flammability, fire science needs to focus additional research on the development of two types of knowledge: 1) how to make furniture that is less flammable, and 2) how to accurately simulate the burning of existing furniture for forensic use. This research will help develop an understanding of the ignition and spread of fire over common furniture items and the resulting release

of heat and harmful combustion products. At present, it is necessary to rely on scientific experiments and real-scale fire testing of products in room geometries that are similar to what existed in the actual event to develop empirical data as input to computer fire models.

*NIST recommends that research be conducted to better understand ignition and fire spread on upholstered furniture in order to provide the tools needed by design professionals to improve the fire performance of furniture. The following areas require research:*

- a) prediction of ignition of natural and synthetic coverings, and foam padding, for furniture, wall, ceiling and floor lining materials, and room furnishings;*
- b) prediction of fire spread over actual furniture with and without fire barriers, fire retardants, and fire resistive materials; and*
- c) quantification of smoke and toxic gas production in realistic room fires.*

### **Recommendation 8**

Improving fire barriers requires that additional research be focused on: 1) how to design products that will contain a fire while at the same time meeting other functional requirements, and 2) replicating the performance of existing partitions in forensic models. Fire-resistance testing of walls, floors, ceilings, and door assemblies typically ends when the temperature on the non-fire side exceeds a standard value. There is insufficient understanding of the mechanisms by which partitions and door assemblies pass flames into adjacent spaces, especially for the composite assemblies typical of real construction. Having an accurate modeling capability for how flames pass into adjacent spaces will improve the ability to accurately establish fire time lines and to evaluate the relative importance of multiple fire paths.

*NIST recommends that research be conducted to provide the tools needed by design professionals to improve the performance of compartmentation. The following specific areas require research:*

- a) prediction of fire spread through walls constructed of wood, metal, and gypsum wallboard;*
- b) prediction of fire spread through doors constructed of glass, wood, and metal;*
- c) prediction of fire spread through penetrations; and*
- d) prediction of performance of roll-down fire doors in actual fires and after extended service.*

### **Recommendation 9**

New knowledge, data, and predictive methods generated in the above research will lead to new technologies and improved building and fire codes and standards. The selection among alternative fire safety technologies or building design options, and the threshold values established in the model codes, can have significant economic ramifications. New tools are needed that can be tailored to specific situations and rigorously account for costs and other impacts in a manner transparent to competing interests.

*NIST recommends that research be conducted to:*

- a) refine computer-aided decision tools for determining the costs and benefits of alternative code changes and fire safety technologies; and*
- b) develop computer models to assist communities in allocating resources (money and staff) to ensure that their response to an emergency with a large number of potential casualties will be effective.*

## **Recommendation 10**

First responders commonly use ventilation to improve the firefighting environment, increase the survivability of trapped occupants, and reduce property damage. In some cases though, ventilation may improve conditions within a structure, but may also lead to increased fire growth and spread, flashover, or back draft (deflagration). The effects of natural ventilation on the fire environment during fire fighter operations are not well understood.

*NIST recommends that additional research be conducted to:*

- a) improve understanding and characterization of how ventilation affects the growth and spread of fire within structures; and*
- b) provide the fire service with better guidance on when and how to use ventilation to improve the fire environment during fire service operations.*

## **Recommendation 11**

Providing fire protection for a community involves a range of factors including building stock, population demographics, climate, resource allocation, water supply, response time, and adoption of model codes. Assessment of the value of each of these factors is key to informed decision-making regarding technologies and procedures to provide an acceptable level of protection.

*NIST recommends that research be conducted to:*

- a) develop performance and effectiveness metrics for community fire protection;*
- b) survey effectiveness of existing fire services; and*
- c) use metrics to optimize development of new fire protection technologies.*

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