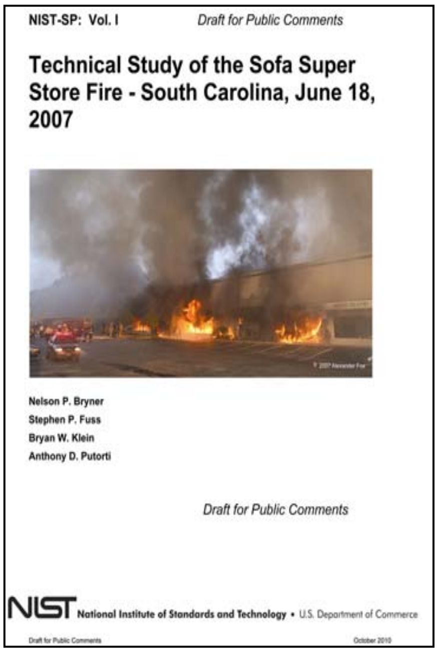
Public Comments Received by NIST on Draft Reports:

Technical Study of the Sofa Super Store Fire - South Carolina, June 18, 2007
Volumes I and II
DRAFTS FOR PUBLIC COMMENTS

October 2010


NIST-SP: Vol. I *Draft for Public Comments*

Technical Study of the Sofa Super Store Fire - South Carolina, June 18, 2007

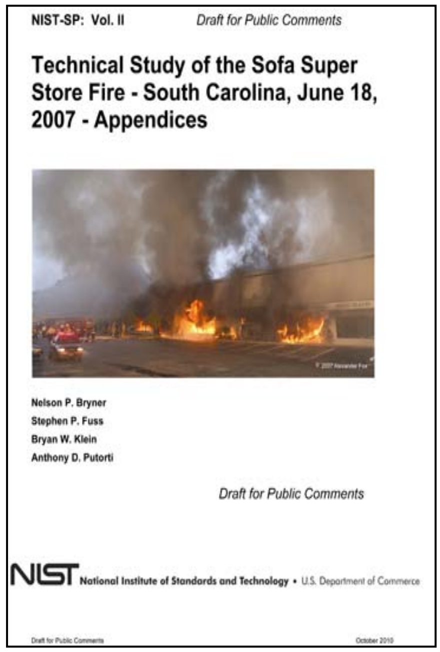
Nelson P. Bryner
Stephen P. Fuss
Bryan W. Klein
Anthony D. Putorti

Draft for Public Comments

NIST National Institute of Standards and Technology • U.S. Department of Commerce

Draft for Public Comments October 2010

http://www.nist.gov/manuscript-publication-search.cfm?pub_id=907220


NIST-SP: Vol. II *Draft for Public Comments*

Technical Study of the Sofa Super Store Fire - South Carolina, June 18, 2007 - Appendices

Nelson P. Bryner
Stephen P. Fuss
Bryan W. Klein
Anthony D. Putorti

Draft for Public Comments

NIST National Institute of Standards and Technology • U.S. Department of Commerce

Draft for Public Comments October 2010

http://www.nist.gov/manuscript-publication-search.cfm?pub_id=907221

Sofa Super Store Study

Brian Couzens [brian@tundramedia.com]

Sent: Thursday, December 02, 2010 10:58 AM

To: investig

Cc: bcouzens@tundramedia.com

Attachments: SSS Work in progress.pdf (2 MB)

To Whom it may concern,

I am writing to provide comment on the recent release of the report on the Charleston SC. Sofa Super Store Fire of 2007. While I have not completed a full review of the report, it seems to be exceptionally well prepared and very through. My purpose for writing is as follows. First I wish to make your organization aware of an 3D visualization project that my company has been working on for over two years. The project is being developed as a philanthropic (not for profit) training effort for the benefit of the fire service community. While I doubt that our work would be beneficial to your efforts at this time, I do feel compelled to offer any of our resources should they serve any useful purpose or benefit to your work. Please find a pdf sample of the ongoing project attached.

While seemingly unimportant, there are a few inconsistencies that I have noted between the various reports. The first of these is the location of the doorway in the room just East of the Holding area and immediately North of the Repair Shop. The Routley report shows this doorway on the West wall of the room, where your drawings indicate that it is aligned on the North wall. Additionally while a storage shed is noted in several photographs and the Routley report, it seems to be missing from your study. While these issues may be insignificant, they do present a disparity that must be rectified by researchers when studying the various reports.

More significantly however, in section 3.3.4 there is no mention of whether the AC was able to close the double doors prior to deployment of the hose line in that area. This would seem significant to fire spread as an open path would be established to the West showroom, and additional oxygen would be available to the fire. There is a contradiciton between the Routley report (pg 55 Routley 2) which indicates the Acting Captain from E-11 was able to close the doors, and a statement that showed up on the ATF report (8. Fire Suppression) that indicates that the doors could not be closed. While statements may not allow a final disposition on this contradiction, It would be helpful if this issue could be laid to rest.

Please note that while we would be happy to provide our work products to NIST should they be helpful in any way, we will also be looking for additional publicly available information to aid us with ensuring the accuracy of our animations. Specifically we are interested in the smoke/fire plume studies and any information that provides further detail regarding furniture placements and building layout.

I hope to contact NIST in the near future and I look forward to speaking with your agency. Should our resources be of any use to NIST, please do not hesitate to call.

Sincerely,

Brian Couzens, President
Tundra Media
(720) 495-0512

A Side E Bound View.jpg

A Side E11.jpg

A Side Jib.jpg

AD Side.jpg

B Side.jpg

C Side 01.jpg

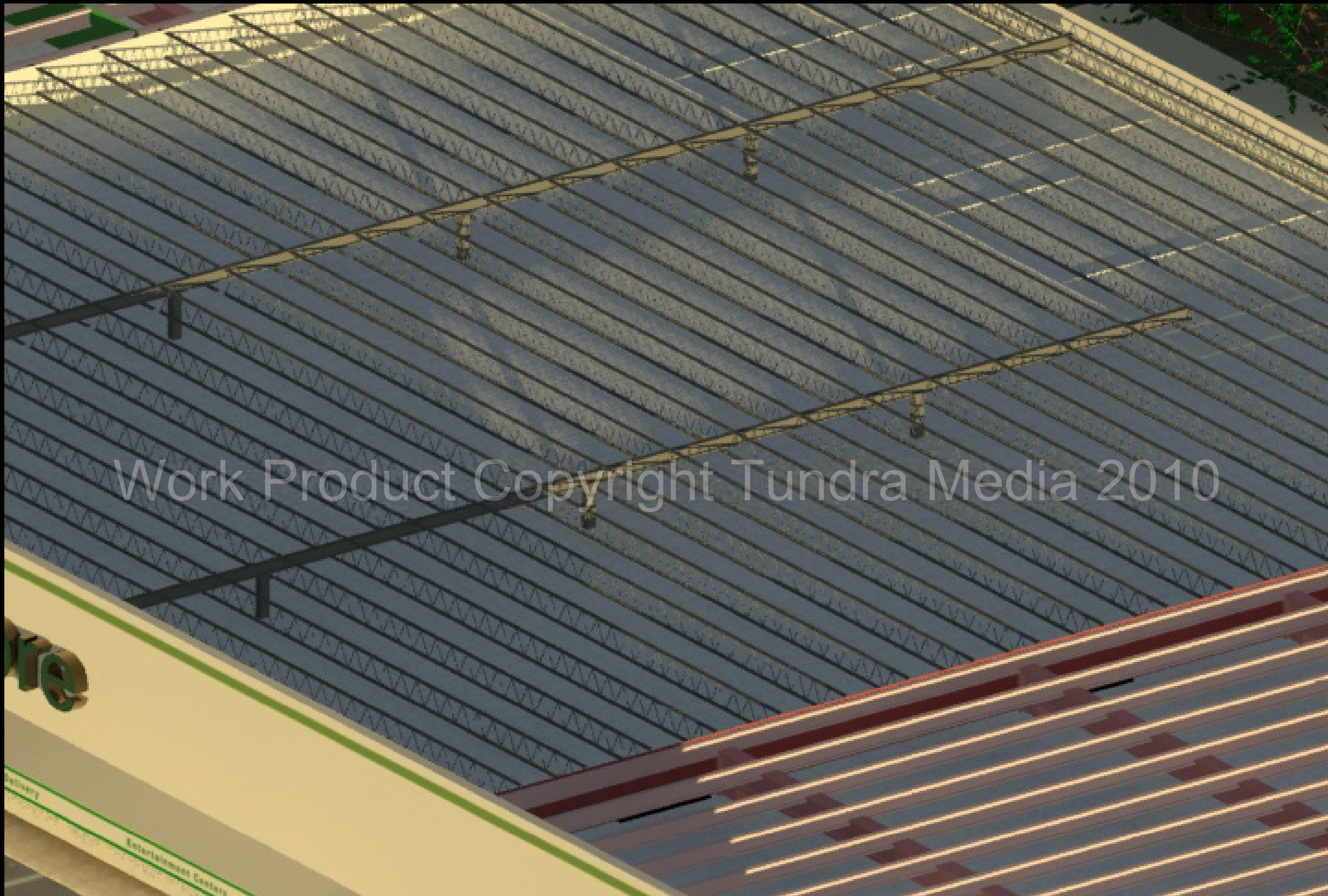
Ceiling 01.jpg

D Side.jpg

MSR01.jpg

MSR02.jpg

Overview.jpg



Roof 02.jpg

Savannah Hwy EB.jpg

WSR01.jpg

Charleston

Weedon, Butch [bweedon@montana.edu]

Sent: Thursday, October 28, 2010 2:30 PM

To: investig

Why is there no mention of about in-service inspections missing all the code issues? Did they have no inspection process?

FW: Suggestion for Charleston Fire Recommendations

Newman, Michael E.

Sent: Thursday, October 28, 2010 2:45 PM

To: Bryner, Nelson P.

Cc: investig

Here's your first comment on the report!

****
Michael E. Newman
Senior Communications Officer
National Institute of Standards and Technology

100 Bureau Drive, Stop 1070
Gaithersburg, MD 20899-1070

Phone: (301) 975-3025
Fax: (301) 926-1630
E-mail: michael.newman@nist.gov

NIST info at http://www.nist.gov
NIST news and NIST Tech Beat newsletter
at http://www.nist.gov/news

****

From: Charlie Brush [Charlie.Brush@myfloridacfo.com]
Sent: Thursday, October 28, 2010 2:38 PM
To: Newman, Michael E.
Subject: Suggestion for Charleston Fire Recommendations

6. Ventilation of Burning Structures: NIST recommends that state and local authorities:
a) develop guidelines as to how and when ventilation should be implemented during a fire; and
b) provide training to fire fighters on different types of ventilation—vertical, horizontal and positive-pressure—and integrate into daily operations on the fire ground.

Add c) Provide education to firefighters on the science of fire behavior in non-vented structures and how the introduction of air impacts the burning characteristics.
Add d) Provide education regarding the dangers of altering the ventilation pattern within a structure while firefighters are working inside.

Charlie Brush EFO MS
Safety Programs Manager
Bureau Fire Standards and Training
352-369-2836
Fax - 352-732-1433

Give careful consideration to wearing respiratory protection during overhaul, the dangers of ultra-fine particulate and combustion gases out-weigh any advantage of not using SCBA during overhaul.

Wear the Gear, Wear it Right!

JOSEPH P. RILEY, JR.
MAYOR

THOMAS W. CARR, JR.
CHIEF

City of Charleston

South Carolina

Fire Department

December 1, 2010

VIA ELECTRONIC DELIVERY, FACSIMILE AND U.S. MAIL
NIST Technical Study: Sofa Super Store
100 Bureau Drive, Stop 8660
Gaithersburg, MD 20899-8660

RE: The City of Charleston's comments regarding the October 28, 2010, Draft NIST Report.

Dear Sir/Madame:

On behalf of the City of Charleston, I would like to thank NIST for its comprehensive examination of the tragic fire which we suffered at the Sofa Super Store on June 18, 2007. It is our understanding that NIST's three and a half year effort was aimed at studying fire spread which lead to firefighter fatalities. It is further our understanding that the goal of NIST is to recommend code, standard and firefighter practice changes rather than determining fault.

The City of Charleston was most impressed with the computer simulation as well as the verbal presentation given to enlighten us regarding the likely path of the fire. The City is wholeheartedly in agreement with NIST's recommendation regarding fire sprinklers, and in fact, we have been steadily promoting fire sprinkler legislation in all levels of government. Unfortunately, at the municipal level, the City is not in a position to effectuate mandated fire sprinkler legislation as such is superceded by state law. However, we are making every effort to advocate the importance of fire sprinklers to our legislators and in fact we are providing your computer simulated models of the fire spread to every member of our state's legislature and state fire chiefs.

The City also wholeheartedly agrees with many other NIST recommendations such as future research to be conducted at a federal level. However, again, the City of Charleston is unfortunately not in a position to effectuate the recommendations in that regard.

As you may have heard, subsequent to the Sofa Super Store tragedy, City of Charleston has undergone numerous changes in our fire department. As your report is now the fourth in a series of federal and state investigations, and since it is our understanding that your publication is

46 ½ WENTWORTH STREET, CHARLESTON, SOUTH CAROLINA 29401 • PHONE (843) 720-1981 • FAX (843) 720-3991

prohibited from use in any legal proceedings, the City does not feel it necessary to comment upon each and every area wherein there may be some disagreement with the report.[1] However, there are a few areas where the City respectfully requests amendment, edification or clarification.

First and foremost, a review of the written report itself without the NIST commentary as provided by Mr. Bryner in his presentation leads one to believe that our heroic firefighters died as a result of the windows in the front of the store being broken, which occurred late into the incident. However, upon explanation by Mr. Bryner during his presentation, it was clear that by the time the windows were broken, our nine heroes had already succumbed in the fire as the building had become "untenable."

Accordingly, we believe that the NIST draft report needs to be corrected in that in multiple places throughout, it appears that the agency is suggesting that the breaking of the windows was responsible for the deaths of the firefighters even though we understand that it was not NIST's intent or mission. While your report raises the issue of tenability, that discussion does not begin until page 4-23. Accordingly, the City respectfully requests that this important issue be moved to the forefront of your report and that the report specifically set forth the fact that the nine firefighters who perished had most likely succumbed prior to the store front being ventilated.

The City also would respectfully request that NIST review its section regarding the record keeping system of the City. NIST correctly points out that the Sofa Super Store building was originally in the county when constructed.[2] Also correct is that there were permitted additions and a variance granted when the building was later annexed into the City. The City's records are available. What your report suggests, however, is that there are missing records for the five illegal additions which joined the Sofa Super Store warehouse to the main location. For instance, on page 1-32 of the report, NIST states "[b]uilding permits were not located for the loading dock area or the repair areas which were added subsequent to the completion of the warehouse." The reason those records were not located is because they are not in existence. The additions were clearly not permitted and never would have been permitted. Therefore, rather than this being an error of the City regarding record keeping, the City would respectfully request that it be made clear there were no permits issued. The store's owner knew or should have known that he would never have been able to receive permits for those additions which would have (and did) effectively eviscerate the intent of fire codes.

---

1 To cite a few examples: The City of Charleston did not remove a fire hydrant; the City was unaware that the Sofa Super Store warehouse was going to be used for high piled storage; the City does use qualified fire inspectors and has added inspectors; there is no mention that the Sofa Super Store's exits were padlocked; there are numerous mentions of the lack of fire alarms, smoke detectors and stand pipes without regard to any codes requiring those items or how those items impacted this fire; N.F.P.A. 1500, while a worthwhile goal for any fire department, is not the legal standard in South Carolina; the timeline is not wholly accurate and omits the commander's first order to evacuate the building; the NIST report mentions various and sundry matters such as incident command, water supply, vertical ventilation (which apparently would not have assisted in this case), mutual aid and other topics which appear to go against NIST's stated goal of not casting blame, and beyond the scope of the NIST study.

2 The County of Charleston's building department should have maintained the records, not the City.

Also, I note that there is a mention that the civil litigation and/or the criminal case perhaps delayed NIST's determination. The City is unaware of any delay on our end which may have hindered NIST's study. If the City is in a position to assist your effort at moving along a final report, kindly let us know and we will certainly assist.

Finally, it would appear from your report that NIST truly does not exactly know how the fire spread from the illegal loading dock additions into the store front. A variety of scenarios has been thoroughly examined by NIST, and they present interesting possibilities. Much more clear, however, was the impact that fire sprinklers would have had if the sprinklers had been in place. For that reason, as stated earlier, we will be working with other local governments and fire chiefs throughout our state to push for sprinkler legislation in our upcoming legislative session. We look forward to any assistance that NIST is willing to provide us in this effort.

Once again, the City of Charleston is appreciative of NIST's effort and study.

Very truly yours,

Thomas W. Carr
Chief, City of Charleston Fire Department

TWC/sh
cc: Joseph P. Riley, Jr.
Mayor, City of Charleston

City of Charleston
Legal Department
50 Broad Street
Charleston, SC 29401
PO Box 304 29402
Phone: (843) 724-3730
Fax: (843) 724-3706

FAX COVERSHEET

FROM: Susan J. Herdina
Assistant Corporation Counsel

TO: NIST / Fire Safety FAX: 301-975-4052

DATE: Dec 1, 2010

RE: Sofa Super Store Draft Report Comments

NUMBER OF PAGES INCLUDING COVERSHEET: 4

MESSAGE:

Comments of ICC on Sofa Super Store Study

David Karmol [dkarmol@iccsafe.org]

Sent: Thursday, December 02, 2010 12:07 PM

To: investig

Cc: Bruce E. Johnson [bejohnson@iccsafe.org]; Sara Yerkes [SYerkes@iccsafe.org]; McNabb, Nancy

Attachments: ICC Comments NIST Report -~1.doc (69 KB)

Please accept the attached comments of ICC on the Draft NIST report on the Sofa Super Store Fire.

David L. Karmol
Vice President, Federal and External Affairs
International Code Council
dkarmol@iccsafe.org
202-370-1800, ext 6243

International Code Council
500 New Jersey Avenue, NW
Sixth Floor
Washington, DC 20001
tel: 888.icc.safe (422.7233)
fax: 202.783.2348
www.iccsafe.org

NIST TECHNICAL STUDY OF SOFA SUPER STORE FIRE, October 2010

COMMENTS OF:
THE INTERNATIONAL CODE COUNCIL (ICC)
500 New Jersey Ave, NW
Washington, DC 20001

Contact:
David Karmol, dkarmol@iccsafe.org
Bruce Johnson, bejohnson@iccsafe.org

The International Code Council (ICC) offers the following comments on the NIST Draft Report on the Technical Study of the Sofa Super Store Fire—South Carolina, June 18, 2007.

The International Code Council (ICC) is a membership association dedicated to building safety, fire prevention, and energy efficiency. The International Codes, or I-Codes, published by ICC, provide minimum safeguards for people at home, at school and in the workplace. Building codes benefit public safety and support the industry's need for one set of codes without regional limitations. The International Code Council also publishes the International Energy Conservation Code (IECC), which is referenced in the Energy Independence and Security Act (EISA) of 2007, and is a national requirement in section 410 of the American Recovery and Reinvestment Act of 2009. Fifty states and the District of Columbia have adopted the I-Codes at the state or jurisdictional level. Federal agencies including the Architect of the Capitol, General Services Administration, National Park Service, Department of State, U.S. Forest Service and the Veterans Administration also enforce the I-Codes for the facilities that they own or manage. The Department of Defense references the International Building Code for constructing military facilities, including those that house U.S. troops, domestically and abroad. Puerto Rico and the U.S. Virgin Islands enforce one or more of the I-Codes.

The International Code Council (ICC) was established in 1994 as a non-profit organization dedicated to developing a single set of comprehensive and coordinated national model construction codes. The founders of the ICC are Building Officials and Code Administrators International, Inc. (BOCA), International Conference of Building Officials (ICBO), and Southern Building Code Congress International, Inc. (SBCCI). Since the early part of the last century, these non-profit organizations developed three separate sets of model codes used throughout the United States. Although regional code development has been effective and responsive to our country's needs, the time came for a single set of codes. The nation's three model code

INTERNATIONAL CODE COUNCIL®

International Code Council
500 New Jersey Avenue, NW
Sixth Floor
Washington, DC 20001
tel: 888.icc.safe (422.7233)
fax: 202.783.2348
www.iccsafe.org

groups responded by creating the International Code Council and by developing codes without regional limitations; the International Codes.

We begin by congratulating NIST for the thorough investigation and analysis of this tragic fire. The review of all significant contributing factors to the ignition and spread of this fire that lead to the line of duty death of nine firefighters serves as a "lessons learned" document for all current and future firefighters and building and fire inspectors. Understanding of the circumstances that lead to this tragedy, and implementation of the NIST recommendations that are presented as a result of this investigation, will undoubtedly serve to prevent similar occurrences in the future.

The information contained in Chapter 5 of Volume I provides an accurate and concise history on the development and acceptance of model building and fire codes in the United States. We find the information about the ICC as a model code organization and the accompanying historical information about the three legacy model code organizations that merged to become the ICC to be accurate.

In addition, Chapter 5 provides the reader of this report an excellent synopsis of the importance of building and fire codes as part of a fire protection system to ensure acceptable minimum levels of safety in the built environment; covering both existing buildings and newly constructed buildings. This chapter accurately and concisely describes the passive and active fire safety provisions of the International Building Code (IBC) and International Fire Code (IFC); providing the reader a framework of how these two model codes work in conjunction to ensure minimum levels of safety for both building occupants and firefighters. We appreciate that NIST specifically recommends that the requirements for automatic sprinkler systems be installed and maintained, as required in the IBC.

The "Model Codes and Standards" section under Findings (Section 6.2.6 in Chapter 6) clearly articulates the importance of strict adherence with the model building and fire code legally adopted by a jurisdiction in providing safety for building occupants and firefighters. ICC commends NIST for the material contained in this section, as it clearly highlights the importance of a comprehensive model code adoption and administration program to ensure safety in the built environment. The Findings and Recommendations Chapters in this report serve to emphasize that a failure in fire prevention through model code adoption and effective enforcement programs can have significant and tragic results, such as the Sofa Super Store fire. Given the current impact of the recession on municipal budgets, these sections have ever greater importance today for municipal building departments and fire prevention bureaus facing major staff reductions or even elimination. We believe these recommendations on the importance of ensuring continued and effective model code administration is essential as an overall component of community risk reduction and public safety.

INTERNATIONAL CODE COUNCIL®

International Code Council
500 New Jersey Avenue, NW
Sixth Floor
Washington, DC 20001
tel: 888.icc.safe (422.7233)
fax: 202.783.2348
www.iccsafe.org

The report Recommendations with respect to Improving Model Standards, Codes and Practices (Section 6.3) and the emphasis that effective code administration is a responsibility of building owners, design professionals and municipal building and fire inspectors is right on point. The first two recommendations clearly explain the importance of adopting and enforcing a correlated model building and fire code and the role all stakeholders play in that process.

In recommendation 3, the report recommends "*fire inspectors and building plan examiners are professionally qualified to a national standard such as NFPA 1031"* ICC suggests that this recommendation should be expanded to include that such "professional qualification" be demonstrated through a nationally accepted certification examination, such as the Building Plans Examiner; Fire Plans Examiner (based on NFPA 1031); Fire Inspector I 7 II and Certified Fire Marshal that are currently offered and widely utilized by many jurisdictions that strive to demonstrate their professional competency.

Generally, ICC encourages NIST and others to continue with the research efforts recommended in the report, and should NIST identify specific changes that research indicates would improve the IFC or the IBC, and prevent such fires, NIST should propose such changes to the specific sections of the code, consistent with ICC procedures for the code change proposals.

The ICC appreciates the opportunity to present these comments and again commends the outstanding work of NIST and the staff and technical consultants that compiled the data and prepared this report.

Charleston fire report

D Holmes [nyfd136@yahoo.com]

Sent: Monday, November 01, 2010 11:52 PM

To: investig

After reading the summary I became curious if evacuators had been used instead of breaking glass would the heat and smoke above the ceiling not ignited? Smoke ejectors are not really thought of as a first line item but I keep wondering if they would really make a difference.

Thanks for checking.

Charleston Question

Mundy, Greg [gmundy@irmofire.org]

Sent: Thursday, November 11, 2010 2:13 PM

To: investig

Cc: Sonefeld, Mike [17thCav@irmofire.org]

Sirs;
I have looked at and found the report from the Charleston,SC Furniture store event very interesting and informative. I do have a question/comment on the ventilation of the building from your perspective. First, the building had a metal lightweight roof construction with metal decking. Second, it had a very large sq. ft of space to be vented with a high fire load. Third, the time frame from beginning of the fire to the point of breaking windows was lengthy. The point of my question is how does the fire service vent this type of fire vertically, within a window of safety in minutes and still release the products of combustion at a rate of adequacy to ventilate the building in a rapid fire development scenario? This is very difficult due to the size of the opening needed, building materials and how the roof materials are anchored to the roof structure and the collapse potential due to the lightweight building components. Lightweight buildings with metal deck roofs are a real challenge for today's fire service due to the items listed previously. I look forward to your response and in assisting me with any additional information.
Thank you,

"Even if you're on **the right track**, you'll get run over if you just sit there."

Asst. Chief of Operations Greg Mundy

6017 St. Andrews Road
Columbia, S.C. 29212

gmundy@irmofire.org

P O Box 147
Ranson, WV 25438
December 3,2010
Robbie4771@aol.com
304 724 4159

Mr. Nelson P. Bryner
Fire Research Division
Engineering Laboratory
NIST
Gaithersburg, MD 20899

Dear Mr. Bryner:

Thank you for favoring me with a copy of Volumes 1 and 2 of the "*Technical Study of the Sofa Super Store Fire-South Carolina, June 18, 2007.* " I have special interest in this fire, not only because of the large number of firefighter fatalities but having had contact with their fire department starting in 1952 when on active duty in the Coast Guard, followed by making a number of fire inspections in the city while employed by the then Factory Insurance Association, followed by contact with both the fire and building departments while employed by NFPA, including preparing a published report on their activities during and after Hurricane Hugo.

A Thanksgiving train trip to and from Norman, Oklahoma gave me an opportunity to study/read the report in detail and prepare a few comments as a result.* You and your team deserve a great deal of credit for an excellent job in the interest of fire fighter safety.

* Just returned night of first so missed deadline

Sincerely,

J C Robertson

J. C. Robertson

COMMENTS ON DRAFT REPORT "*Technical Study of the Sofa Super Store Fire-South Carolina, June 18, 2007.*" Prepared by J. C. Robertson, P O Box 147, Ranson, WV 25438

1. page xxv item 6 : this is an extremely important issue and was also contributory to the recent firefighter fatalities in Homewood, IL. I plan on mentioning this at next meeting of VFD where I belong. An outstanding reference is the chapter on ventilation pages 53-60 Chapter VII, *Fire Fighting Tactics*" by Lloyd Layman, published by NFPA in 1953. It was my opportunity to discuss this "slippery" phase of fire suppression with Chief Layman on several occasions.

2. page xxv item 7 suggest removing the word "upholstered" from the heading and lead sentence since this implies that the problem is with the upholstering when often the foam cushion is the real area of concern.

3. page xxv item 8(c) add "and activation devices" after "roll up doors"

4. page 3-2 last paragraph , 2nd sentence Add words " Compliance with" before "NFPA"

5. page 3-19 first full paragraph, 3rd from last sentence re: mutual aid: suggest giving an example of one or two of such failures.

6. page 3-19 last two paragraphs change to St James Island total of 3 times

7. page 5-4 3rd full paragraph from top, last sentence that starts "The use" is inimical to earlier and later statements regarding this usage i.e. last paragraph on page 5-7.

8. Observations regarding code coverage as portrayed on page5-10 are especially cogent. The final summary paragraph should be reiterated in the Recommendation Section prior to page 1 as it is probably the most important recommendation included in the report. As an alternate, a recommendation based on the UK solution to the instant problem as started in 1989, banning foam furniture from manufacture and sale would eventually solve the problem. This would address residential fire severity as well as the New Zealanders have found with their exhaustive tests.

9. On page 6-1 the "activities" section should have been expanded to include effectiveness of code enforcement, a factor that has been largely ignored for far too long with major fatality fire losses being accurately attributed to poor quality of inspections due to incompetence, poor training and a host of other excuses.

10. Recommendation 5 on page 6-13 should make it clear that this refers to Pre-fire planning as included as a factor in the Fire Suppression Rating Schedule of the Insurance Services Office, Inc.

11. Recommendation 6 on page 6-13 might well have the last sentence expanded to include after the word "broken", the words "probably resulting in the deaths of nine firefighters". In the same recommendation include the another sentence. Another sentence could state "coordination of ventilation and fire suppression activities is essential" then a note that "indirection application of water fog is often a suitable alternative to ventilation.

12. Recommendation 7 on page 6-14 might be expanded to include consideration of research in The United Kingdom and New Zealand in these areas.

13. page 6-16 Recommendation 11 and 6.4.2 is confusing to me as to the meaning of metrics. Dictionary definition relates to means of measurements but does not give use of the word the meaning as synonym of same. Is the use of the metric system being advocated? Having represented NFPA in Canada awhile back I saw very little fire service use of the metric system. Maybe it has changed by now. My consulting work is primarily with communities desiring to get a "heads up" on where they stand with the Fire Suppression Rating Schedule of ISO. I believe it does a good job of evaluating same and the loss experiences show that the Classes track very closely with loss experience. In addition to the criteria listed on page 6-15 it includes communications for reporting fires, an essential component.

14.page 6-16 suggest removing word "upholstered"

15. Volume II, page M-1 First three words in explanation should be Charleston Building Dept., believe that is correct name as the fire department is NOT the agency having responsibility for fire inspections in the city. That responsibility shifted from the Fire Department to the Building Department during the time I have been visiting the city, probably occurring in the 1980's when the quality of fire inspections was found to be lacking in a multiple fatality apartment house fire. I was surprised that post incident reports on the instant fire do not appear to have suggested return of the responsibility to the fire department. Such a move back to the fire department has occurred in the neighboring city of Savannah. Notice the heading on above form uses the term "fire official" not fire chief or fire department. This refers to the SBC term of fire official.

I appreciate having had the opportunity to review and comment on this excellent report. Now the job is to get its impact out to the code making community including the public officials having such commercial locations in their jurisdictions. The NIST personnel who prepared this report should be commended for their exacting efforts.

Respectfully submitted,

J. C. Robertson

NIST Technical Study: Sofa Super Store

Kowalski, John [kowalsj@culver.org]

Sent: Thursday, October 28, 2010 5:29 PM

To: investig

Good afternoon,

As an e-subscriber to your on-line updates and postings, and as the health and safety resource for our school who provides fire safety training and PFE instruction to our students and staff, I was interested in reading thru the report on your study of the Charleston Furniture Store fire that was just sent out this afternoon. While I certainly have no training or technical experience to question the reaction and judgment of the responding departments, or the recommendations from your study, I did note a couple points of concern and interest that prompted me to write.

On the first read-through, it occurred to me that I did not fully understand what was meant by 'unburned fuel in the smoke layer below (above?) the drop ceiling', then it occurred to me that this was probably representative of the combustible gases that were created by the slow-burning and super-heating of furniture items and other materials, due to the lack of oxygen required for combustion.

As I read through the study, I felt myself questioning why the responders were duty-bound to break out (all?) the front windows for ventilation. Presuming these were the large, full-view panes typical of most furniture and department stores, common sense tells me that this would introduce a sudden rush of oxygen, the 3rd leg required to provide ignition and sustainability. Could the roof have been vented instead, thus providing a possible release for the smoke and gas without enhancing ignition? Could just select windows have been vented with similar results? I understand the need to vent heat, smoke, and gases to protect any trapped occupants, let alone well-equipped firefighters and responders, and hopefully your recommendations in item 6 will lead to a better understanding of the science to this process. Something along the lines of ceiling and roof-level external pop-off valves or heat-activated vent chambers comes to mind, but I'm no engineer.

Your recommendation item 7 really captured my attention, (***Research on Upholstered Furniture Flame Spread:*** *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 specific areas requiring research are:*
a) prediction of ignition of natural and synthetic coverings for current 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) as I had just recently reached out to various agencies and loss prevention consultants on this very issue in response to a query about purchasing dorm furnishings- A group of parents wanted to upgrade the furniture in the lounge of their sons' barracks, and had thoughtfully asked whether we had any policy stipulations regarding flammability that they should consider prior to their purchase. Upon learning that we had no written guidelines, I set out to determine if there was some NFPA or other (geared toward educational institutions) standard that we should adapt regarding furnishings in dorms. All I could find of relevance were the CA-117 & CA-133 technical standards for flammability testing, but no real guidance or applicable written standards.

Hopefully your recommendations here will result not only in stringent standards that help prevent or retard flammability altogether, but I would hope that the findings would lead to some logical progression and implementation in the form of guidance and then regulation of the furniture industry, as well as to furnishings policy guidelines for schools, colleges, universities, hospitals, and the hotel and motel industry, etc.

Our fire-fighting men and women are arguably the best-trained and well-equipped in the world, and they voluntarily perform search and rescue and property-preservation response in structure fires every day, fully aware of the potentially devastating consequences. It is truly saddening to know that we lost one, let alone nine dedicated and selfless souls, to an event as insignificant as a furniture store fire. Can we imagine the loss and suffering due to a dorm fire, or perhaps a Spring-break destination hotel fire, that originated from a cigarette smoldering on a bed or sofa, that otherwise could have been engineered to preventability?

Thanks for your time and your dedication to the task. I'm looking forward to reading of your future progress!

John

John M Kowalski
Risk Manager
Culver Educational Foundation
1300 Academy Rd- Dept 154
Culver, IN, 46511-1291
Ph (574) 842-8223
Fax (574) 842-8273
Cell (574) 276-9337

'Do what you can, for who you can,
with what you have, and where you are!'

Atkinson, Jonathan [Jonathan.Atkinson@city.pittsburgh.pa.us]

Sent: Thursday, November 11, 2010 6:15 PM

To: investig

To Whom It May Concern:

I have read the entire draft report that the NIST released in reference to the Charleston-9 and fire inside the Sofa Super Store. The amount of hard work that was put into this document is evident. The investigators and analysts that compiled and examined all of the data from both the scene of the fire and from the laboratory tests have clearly taken the time to be as thorough as humanly possible. As a Deputy Fire Chief in suburban Pittsburgh Pennsylvania, I read your reports regularly. I find that the data and information provided in your reports are invaluable to all firefighters, from Chief Officers down to new recruits. Your discussion on fire movement and behavior on the fire scene in Charleston and in the laboratory is important information. I always learn from your reports and try to apply what I have learned in the real world of firefighting. I encourage the members of my fire company to read your reports and discuss your findings with them. Your personnel are obviously the utmost professionals and experts in their fields. I believe that the NIST is a valuable resource for us in the fire service and I know how lucky we are to have your personnel completing the studies that you do. It is clear that we in the fire service can learn a lot from the tragedies that have happened to our brothers and sisters. Your personnel take the time to tell their stories in an objective manner, examining every aspect of the incident itself and the response to the incident. Please keep up the good work. I applaud the effort of the men and women at the NIST.

Jon Atkinson NREMT-P / Public Safety Diver
Pittsburgh EMS
Medic-1 / River Rescue
412-716-1888 (cell)

Comments on Study of Charleston Furniture Store Fire

Morgan Hurley [mhurley@sfpe.org]

Sent: Thursday, December 02, 2010 2:28 PM

To: investig

Cc: Bryner, Nelson P.

Hello:

I offer the following comment on the subject report:

On page 4-1, the report states, in part: "Computer simulations, also known as numerical modeling, have been demonstrated to be useful, when properly applied, as a tool to help fill in details of the fire dynamics and to demonstrate the value of alternative building designs and fire safety measures [1]. Simulation results are an approximation of the
actual event, and are most valuable when considered as qualitative rather than quantitative."

It is not appropriate for NIST to opine that model results are most appropriate when considered qualitatively as opposed to quantitatively, especially when the context of the statement has implications for design. The value of the modeling in the subject report is qualitative, but to extrapolate to all applications of models is inappropriate. When properly verified and validated, models can be used to obtain quantitative results. I recommend deleting "and are most valuable when considered as qualitative rather than quantitative."

Respectfully,

Morgan J. Hurley, P.E.
Technical Director
Society of Fire Protection Engineers
7315 Wisconsin Ave., #620E
Bethesda, MD 20814 USA
+1.301.718.2910 x102
Mobile +1.301.661.5987
Fax +1.301.718.2242
www.sfpe.org

Sofa Superstore Draft Report

fpeschulte@aol.com [fpeschulte@aol.com]

Sent: Thursday, November 18, 2010 11:03 AM

To: investig

Ladies and Gentlemen-

Just a comment regarding the NIST Draft Report on the Sofa Superstore. The report utilizes the term "dropped ceiling". This term is slang for the term "suspended ceiling". It is recommended that the term "dropped ceiling" be replaced with the term "suspended ceiling" wherever the term "dropped ceiling" is used in the report.

One other comment which is sort of preliminary in nature, but as I looked through the photographs in the Appendix D, I noted that much of the metal roof deck did not have a roof covering. That seems rather odd. There are a few photographs, D-16 and D-27, that appear to show some type of insulation on the metal deck, perhaps foam plastic insulation. Foam plastic on a metal roof deck is known to generate combustible gases which can seep through the seams of a metal deck roof. Since I haven't gotten into the report yet, I'll just leave my comment at that for the moment. Once I get into the report, I may have further comments regarding the roof insulation.

Richard Schulte
Schulte & Associates
Building Code Consultants
Evanston, Illinois
fpeschulte@aol.com

Sofa Superstore Draft Report

fpeschulte@aol.com [fpeschulte@aol.com]

Sent: Thursday, November 18, 2010 1:48 PM

To: investig

Ladies and Gentlemen-

In the report and in various other documents, I see a reference to the the term "high bay warehouse", but in the photographs I only see a standard "low bay warehouse". Typically, a "high bay warehouse" has a ceiling height of at least 40 feet; most would not consider a warehouse to be a "high bay warehouse" until the height of the warehouse is at least 50 feet. I would recommend that all references to "high bay" when referring to the warehouse be removed from the report and other documents.

Richard Schulte
Schulte & Associates
Building Code Consultants
Evanston, Illinois

Sofa Superstore Report (Page 6-8)

fpeschulte@aol.com [fpeschulte@aol.com]

Sent: Thursday, November 18, 2010 2:12 PM

To: investig

Ladies and Gentlemen-

In the first line on this page, the sentence refers to the SBC and IBC codes. The "C" in SBC and IBC stands for "Codes", hence this sentence refers to the "Standard Building Code and the International Building Code codes".

Richard Schulte

Sofa Superstore Report (Page 1-3)

fpeschulte@aol.com [fpeschulte@aol.com]

Sent: Thursday, November 18, 2010 6:03 PM

To: investig

Page 1-3 in the report describes the access road to the warehouse as an "alley". **An alley is a public way.** Based upon the photograph on page 1-4 in the report, it does not appear that the access road is a public way, but rather a part of the property on which the building is located. It is recommended that the term "alley" not be used to refer to the road way which provides to the warehouse portion of the building.

Richard Schulte
Schulte & Associates
Building Code Consultants
Evanston, Illinois
fpeschulte@aol.com

Sofa Superstore Draft Report (Foam Plastic Roof Insulation)

fpeschulte@aol.com [fpeschulte@aol.com]

Sent: Friday, November 19, 2010 11:03 AM

To: investig

From: fpeschulte@aol.com
To: fresafety@nist.gov
Sent: Fri, Nov 19, 2010 9:01 am
Subject: Sofa Superstore Draft Report (Foam Plastic Roof Insulation)

Ladies and Gentlemen-

Page 1-34 in the draft report on the Sofa Superstore makes reference to foam plastic roof insulation. With the main portion of the building constructed in 1960, the hazard of foam plastic roof insulation was not realized at that point in time. See the model code provisions for the use of foam plastic insulation. A layer of gypsum wallboard is required between the metal deck and the foam plastic unless the roof deck/roof covering pass specific UL or FM tests. In a fire, the foam plastic material decomposes and forms a combustible vapor which is forced into the building where it ignites.

I haven't been through the entire report yet, but so far there has been no discussion as to the contribution of the foam plastic material to the fire.

Richard Schulte
Schulte & Associates

Sofa Superstore Draft Report Comment

fpeschulte@aol.com [fpeschulte@aol.com]

Sent: Friday, November 19, 2010 11:55 AM

To: investig

Ladies and Gentlemen-

Page 2-1 indicates that the fire started at 6:56 p.m. **Eastern Standard Time**. Most states utilize Daylight Time in June. Did the fire ignition occur at 6:56 standard time or daylight saving time?

Richard Schulte
Schulte & Associates
Building Code Consultants

Sofa Superstore Draft Report Comment

fpeschulte@aol.com [fpeschulte@aol.com]

Sent: Friday, November 19, 2010 2:02 PM

To: investig

Ladies and Gentlemen-

In the last paragraph on page 2-11, the text uses the term "air gap". The term "concealed space" or "stud space" would be more appropriate than the term "air gap".

Richard Schulte
Schulte & Associates
Building Code Consultants
fpeschulte@aol.com

Sofa Superstore Draft Report Page 2-12

fpeschulte@aol.com [fpeschulte@aol.com]

Sent: Friday, November 19, 2010 2:19 PM

To: investig

Page 2-12:

"***There did not appear to be significant fuel in this interstitial space, but the hot gases could have ignited items that dropped through the ceiling into the main showroom and ignited furniture.***"

Pyrolysis of the foam plastic on the roof of the main showroom would have caused combustible gases to be generated and leak into the concealed space and filled the concealed space with combustible gases. This hazard of metal deck roof construction was recognized in the late 1960's or early 1970's and this type of construction has not been permitted since the early/mid 1970's. A layer of gypsum wallboard is required between foam plastic roof insulation and a metal deck to limit the heating of the foam plastic and to prevent pyrolysis gases from leaking below the metal deck and then igniting causing a flash fire.

Richard Schulte
Schulte & Associates
Building Code Consultants
fpeschulte@aol.com

Draft Report-Sofa Superstore Comment

fpeschulte@aol.com [fpeschulte@aol.com]

Sent: Friday, November 19, 2010 5:57 PM

To: investig

-----Original Message-----
From: fpeschulte@aol.com
To: firesafety@nist.com
Sent: Fri, Nov 19, 2010 1:09 pm
Subject: Draft Report-Sofa Superstore Comment

Ladies and Gentlemen-

The term "interstitial space" is used on **page 2-12.** The space above a suspended ceiling is not referred to as an "interstitial space". This space is referred to as a "concealed space". An interstitial space is a space above a ceiling which is provided with a walking surface and is typically high enough to allow walking in an upright position. Interstitial spaces are typically found in hospitals. The use of an interstitial space in other than hospitals is extremely rare.

Richard Schulte
Schulte & Associates
Building Code Consultants
fpeschulte@aol.com

Sofa Superstore Draft Report (Page 3-13)

fpeschulte@aol.com [fpeschulte@aol.com]

Sent: Friday, November 19, 2010 6:01 PM

To: investig

"If the wall was constructed using two layers of fire resistant Type X, 15.6 mm (0.625 in) thick gypsum board on both sides of a metal studs, the wall would have been rated as a one-hour fire wall [16]." (Page 3-13)

Ladies and Gentlemen-

Two layers of 5/8 inch thick gypsum wallboard on either side of a metal stud should develop a 2 hour fire resistance rating.

Richard Schulte
Schulte & Associates
Building Code Consultants
Evanston, Illinois

Sofa Superstore Draft Report;

fpeschulte@aol.com [fpeschulte@aol.com]

Sent: Saturday, November 20, 2010 9:58 AM

To: investig

Page 4-2, Sofa Superstore Report

The section on sprinklers refers to sprinklers as "automatic water sprinklers". Never heard sprinklers referred to as "water sprinklers". The term "fire sprinklers" might be more appropriate, although in a report on a building fire, it would be assumed that the authors are not referring to "lawn sprinklers" when the term "sprinklers" is used. It is suggested that the term "sprinklers" or "fire sprinklers" be used rather that the term "water sprinklers".

Richard Schulte
Schulte & Associates
Building Code Consultants
Evanston, Illinois
fpeschulte@aol.com

Sofa Superstore Draft Report (Page 4-29)

fpeschulte@aol.com [fpeschulte@aol.com]

Sent: Saturday, November 20, 2010 5:04 PM

To: investig

Sofa Superstore Draft Report

Page 4-29

"*The sprinkler system layout was designed in accordance with NFPA 13, Standard for the Installation of Sprinkler Systems [17]. The system was designed as a light hazard wet pipe system, assuming that the enclosed loading dock area was heated. A light hazard sprinkler system was utilized in order to provide a conservative estimate for the area/water density for the simulations. The locations of the sprinklers within the enclosed loading dock are shown in Figure 4-35.*"

The paragraph above states the the sprinkler system layout would be per NFPA 13, then states that the sprinkler system protecting the loading dock would be considered to be a light hazard. The loading dock would be classified as an ordinary group 2 hazard at minimum. With flammable liquids stored on the loading dock, the loading dock could be considered to be an extra hazard occupancy per NFPA 13.

In other words, the statement above contradicts itself. Either the sprinkler protection is per ordinary hazard occupancy requirements per NFPA 13 or it doesn't comply with NFPA 13.

Richard Schulte
Schulte & Associates
Building Code Consultants
fpeschulte@aol.com

Sofa Superstore Draft Report

fpeschulte@aol.com [fpeschulte@aol.com]

Sent: Saturday, November 20, 2010 5:19 PM

To: investig

Sofa Superstore Draft Report

Page 4-33

"Twenty sprinklers were placed inside the loading dock in a 3 x 4 mesh, as shown by the black circles in Figure 4-35. The sprinkler specifications that were used in the simulation are detailed in Appendix K, Table K-6. **In this configuration, the coverage for each sprinkler was 6 L/min/m2 (0.15 gpm/ft2).** Two sprinklers, labeled 3 and 6 in Figure 4-35, activated in the simulation. Sprinkler 3 was the first to activate, at 50 s, while sprinkler 6 activated at 75 s."

Comment: The coverage of sprinkler refers to the area protected by the sprinkler. 0.15 gpm/SF is referred to as the density. That's **basic** sprinkler system design terminology. Obviously, someone who is unfamiliar with sprinkler system design wrote this section of the report!

Richard Schulte
Schulte & Associates
Building Code Consultants
Evanston, Illinois
fpeschulte@aol.com

Sofa Superstore Draft Report (Page 4-35)

fpeschulte@aol.com [fpeschulte@aol.com]

Sent: Saturday, November 20, 2010 5:25 PM

To: investig

Sofa Superstore Draft Report-Page 4-35

Figure 4-37 makes reference to "sprinkler head". The term "sprinkler head" is slang for the term "sprinkler". It is assumed that title makes reference to the plural, rather than the singular, since the temperatures at more than one sprinkler are shown.

Richard Schulte
Schulte & Associates
Building Code Consultants
Evanston, Illinois
fpeschulte@aol.com

Sofa Superstore Draft Report Comment (Figure 4-37)

fpeschulte@aol.com [fpeschulte@aol.com]

Sent: Saturday, November 20, 2010 5:36 PM

To: investig

Sofa Superstore Draft Report-Figure 4-37

There appears to be an error in the data displayed in Figure 4-37. The graph indicates that the maximum temperature at both Sprinkler 3 and Sprinkler 6 is 74oC (165.2oF). The air temperature at a sprinkler with a 165oF temperature rating when the sprinkler activates is never 165oF. The air temperature should be perhaps 400oF, maybe higher, unless an extremely slow developing fire has been assumed. **Temperatures of 800oF at the sprinkler are not unheard of if standard response sprinklers are utilized.**

Typically, intermediate temperature (212oF) or high temperature (286oF) sprinklers are used to protect areas such as a loading dock. Using intermediate or high temperature sprinklers, rather than ordinary temperature sprinklers, is good fire protection. Most sprinkler contractors would provide intermediate or high temperature sprinklers, rather than ordinary temperature sprinklers, for the loading dock.

Richard Schulte
Schulte & Associates
Building Code Consultants
Evanston, Illinois
fpeschulte@aol.com

Sofa Superstore Draft Report Comment

fpeschulte@aol.com [fpeschulte@aol.com]

Sent: Sunday, November 21, 2010 10:49 AM

To: investig

-----Original Message-----
From: fpeschulte@aol.com
To: firesafety@nist.com
Sent: Sat, Nov 20, 2010 4:13 pm
Subject: Sofa Superstore Draft Report Comment

Sofa Superstore Page 4-32

Previous text indicates that a sprinkler protection for the loading dock will be designed per the requirements for a light hazard occupancy. The sprinkler spacing shown in the illustration on Page 4-32 is 3.5 m by 3.27 m. When this is converted into English units, the sprinkler spacing is 123.2 SF/sprinkler. NFPA 13 limits the maximum spacing per sprinkler to 130 SF in ordinary hazard and 225 SF in light hazard. It would appear that the spacing for ordinary hazard occupancies has been utilized. Hence, the statement that the sprinkler design is per the requirements for light hazard occupancies in incorrect.

Richard Schulte
Schulte & Associates
Building Code Consultants
fpeschulte@aol.com

Sofa Superstore Draft Report (Chapter 5)

fpeschulte@aol.com [fpeschulte@aol.com]

Sent: Sunday, November 21, 2010 10:59 AM

To: investig

Ladies and Gentlemen-

It does not appear that Chapter 5 of the Draft Report for the Sofa Superstore investigation includes a discussion of the code requirements pertaining to the use of foam plastic with a metal deck roof. Both the Standard Building Code and the International Building Code contain special provisions where foam plastic is utilized in roof deck construction.

Specifically, a layer of gypsum wallboard is required between the metal deck and foam plastic insulation installed on top of the metal deck in order to prevent combustible gases generated due to pyrolysis of the foam plastic from being generated and seeping through the seams in the metal deck into the building in a fire. Both the SBC and the IBC contain an exception for compliance with specific FM or UL standards regarding the construction of metal deck roof systems. This hazard was not addressed in building codes until the early/mid 1970's. Given that, a metal constructed in 1960 would not have complied with the FM or UL standards for the construction of metal deck roofs.

So far, the report has not addressed the contribution of the foam plastic materials to the fire.

Richard Schulte
Schulte & Associates
Building Code Consultants
Evanston, Illinois
fpeschulte@aol.com

Sofa Super Store Draft Report Comment (Page 2-2)

fpeschulte@aol.com [fpeschulte@aol.com]

Sent: Monday, November 22, 2010 7:07 PM

To: investig

Sofa Super Store Draft Report, Page 2-2
The fire extinguisher is referred to as "***a portable dry powder fire extinguisher***". The fire extinguisher is correctly referred to as a portable "**multi-purpose dry chemical**" fire extinguisher. The term "dry powder" is a slang term.

Richard Schulte
Schulte & Associates
Building Code Consultants
Evanston, Illinois
fpeschulte@aol.com

Construction Concerns: Combustible Metal Deck Roofs

fpeschulte@aol.com [fpeschulte@aol.com]

Sent: Wednesday, November 24, 2010 6:38 PM

To: investig

Information on metal deck roof construction.

Construction Concerns: Combustible Metal Deck Roofs

Under fire conditions, metal deck roofs can present some problems for firefighting operations. Gregory Havel discusses their properties and some developments regarding insulating them.

To access this article, go to:
http://www.fireengineering.com/fireengineering/en-us/index/articles/generic-article-tools-template.articles.fire-engineering.construction-concerns.2010.07.combustible-metal-deck-roofs.html

Construction Concerns; Combustible Metal Deck Roofs
Article and photos by Gregory Havel
July 14, 2010

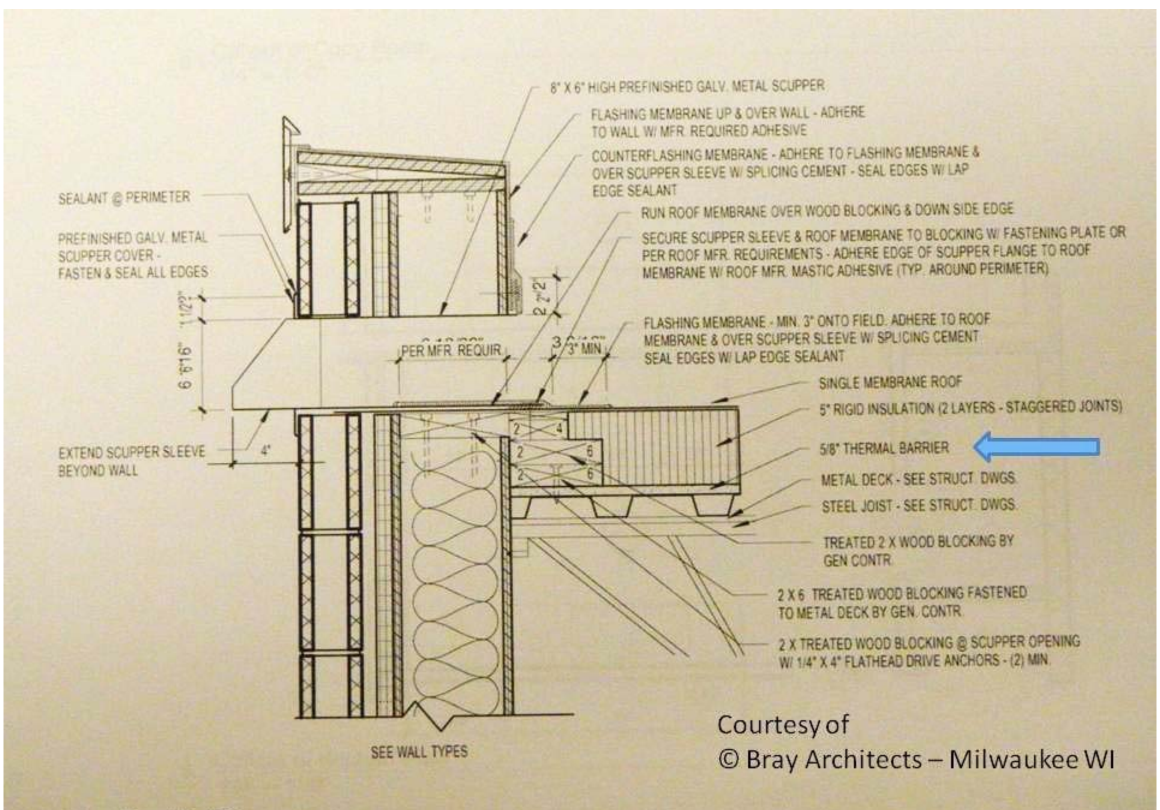
For decades, builders have been using metal roof decking supported by bar joists, covered with combustible insulation board and a roof membrane that is often topped with gravel. The earliest of these roofs had melted asphalt mopped onto the steel roof deck to hold down the insulation board with additional melted asphalt mopped between and on top of the layers of roofing felt. This was known as a "built-up" roof and was inexpensive when compared with other types of roofs.

A potential problem with this type of roof was recognized more than 50 years ago: If a fire heated the underside of the roof deck, it could melt, vaporize, and ignite the asphalt on top of the deck, starting another fire in addition to the original one inside the building (see *Brannigan's Building Construction for the Fire Service* 4th Edition, 213-214). This roof fire could spread far ahead of the original fire and ignite other fires when burning asphalt found its way through the steel deck. You can identify this type of roof by the asphalt "icicles" that often form along walls (photo 1) and at seams in the steel deck as a result of too much or too hot asphalt being used to assemble the roof. These "icicles" also form during and after a roof deck fire.

Since the 1980s, building codes have required more insulation on roofs, and reliable elastomeric (rubber or plastic) roof membranes have been developed. Photo 2 shows a typical modern metal deck roof. Multiple layers of plastic foam insulation board are laid on the steel roof deck, with offset joints. This foam board is supposed to be flame-retardant-treated extruded polystyrene or polyisocyanurate foam board. These materials will burn if heated or exposed to flame but will self-extinguish when the heat or flame is removed. The foam insulation is sometimes faced with roofing felt.

On top of the layers of insulation, a single layer of ethylene propylene diene monomer (EPDM, a type of synthetic rubber) roof membrane (or a similar rubber or plastic product), is laid down; joints are glued or solvent-welded. This membrane is sealed around pipes, vents, ducts, and other roof penetrations; and is ballasted with round gravel. With a fire below, this type of roof behaves like the older-style built-up roof and can develop a fire above the steel roof deck, which then will drip burning and molten plastic and rubber down into occupied space that is not yet affected by the original fire. This behavior could be made worse if the roofer substituted less expensive plain foam insulation board for the flame-retardant-treated foam board that is usually specified.

Roofs of these types are sometimes inaccurately advertised as “fire-rated.” They do not have a “fire rating” from testing under National Fire Protection Association (NFPA) 251, *Standard Method of Tests of Fire Endurance of Building Construction and Materials* (ASTM E119) like a wall or a floor-ceiling assembly. Rather, they have been tested under NFPA 256, *Standard Method of Fire Tests of Roof Coverings* (UL 790; ASTM E-108) for exposure to fires originating outside the building. They are rated Class A (severe), B (moderate), or C (light), based on the severity of fire exposure they can withstand. Tests for the rating include ignition from flaming brands, intermittent flame exposure, rain, weathering, and flame spread.



5 Typ. Thru-Wall Scupper
1 1/2" = 1'-0"

Photo 3 (*previous page*) shows a blueprint detail of the most recent development in metal deck roofs. A noncombustible thermal barrier (arrow) is laid down on top of the steel roof deck to separate it from the plastic foam insulation board. This thermal barrier provides enough separation between the steel deck and the foam insulation so that if there is a fire below the roof deck, it would be unlikely to start a second fire above the roof deck. The noncombustible thermal barrier is usually a moisture-resistant, fiberglass-faced, Type X gypsum board or a type of perlite board, ¼- to ¾-inch thick that meets standards like ASTM E-136 for noncombustibility and NFPA 255, *Standard Method of Test of Surface Burning Characteristics of Building Materials* 2006 edition (ASTM E-84 or UL 723) for low flame spread and smoke development. Search the Internet for “thermal barrier roof underlayment” and similar terms for more information from roofers’ associations and manufacturers.

Installing a thermal barrier between the steel deck and the plastic foam insulation on a modern roof is usually about five percent of the cost of the completed roof. However, building owners usually have tight budgets and often give up this fire-resistance feature so that their money can be spent where it will show. After all, the thermal barrier is of no value to the owner or to the business unless there is a fire, and most building owners don’t believe that this can happen to their building.

Gregory Havel *is a member of the Town of Burlington (WI) Fire Department; a retired deputy chief and training officer; and a 30-year veteran of the fire service. He is a Wisconsin-certified fire instructor II and fire officer II, an adjunct instructor in fire service programs at Gateway Technical College, and safety director for Scherrer Construction Co., Inc. Havel has a bachelor's degree from St. Norbert College; has more than 30 years of experience in facilities management and building construction; and has presented classes at FDIC.*

- **CLICK HERE** for more 'Construction Concerns' articles!

Sofa Super Store Draft Report Comment

fpeschulte@aol.com [fpeschulte@aol.com]

Sent: Friday, November 26, 2010 2:26 PM

To: investig

Page F-21, Appendix F, Volume II

The caption makes reference to a roof joist. There are no roof joists shown in this photograph. The horizontal member shown is a beam.

richard schulte

Sofa Super Store Draft Report Comment

fpeschulte@aol.com [fpeschulte@aol.com]

Sent: Friday, November 26, 2010 2:28 PM

To: investig

Page G-2, Volume II

The arrow in the diagram is shown in the wrong place.

richard schulte

Sofa Super Store Draft Report Comment

fpeschulte@aol.com [fpeschulte@aol.com]

Sent: Friday, November 26, 2010 2:36 PM

To: investig

Page I-2, Volume II

The arrow in the diagram is shown incorrectly.

richard schulte

Sofa Super Store Draft Report Comment

fpeschulte@aol.com [fpeschulte@aol.com]

Sent: Friday, November 26, 2010 2:53 PM

To: investig

Page K-45, Volume II

"Pendant" "pendent sprinkler" spelling

richard schulte

Sofa Super Store Draft Report Comment

fpeschulte@aol.com [fpeschulte@aol.com]

Sent: Friday, November 26, 2010 3:08 PM

To: investig

Page K-45, Volume II

The sprinkler "k" factor and operating pressure do not match the sprinkler density which was indicated in the report.

With an operating pressure of 25 psi and a "k" factor of 5.5, the sprinkler flow would be 27.5 gpm. The report indicates that the sprinkler density utilized is 0.15 gpm/SF. 27.5 gpm divided by 130 SF/sprinkler is 0.20 gpm/SF. The actual sprinkler spacing is less than 130 SF. Hence, the actual density would be > 0.20 gpm/SF. Certainly, the density indicated in the report is incorrect.

richard schulte

Sofa Super Store Draft Report Comment

fpeschulte@aol.com [fpeschulte@aol.com]

Sent: Friday, November 26, 2010 6:26 PM

To: investig

Page P-2

"The loading dock construction also included significant amounts of wood in the framing and decking. Wood studs were incorporated in the west walls and along the warehouse wall. Post- fire inspection also **demonstrated** [indicated that] several partition walls inside the loading dock that [were] also used [constructed with] wood studs. Wood **columns** [studs] were also used to support the wood roof joists. The estimated number of studs, columns, rafters, and joists was combined with density and heat of combustion to estimate energy content of framing. These values for the framing are tabulated in Table P-2. The estimated energy content of the framing was . . ."

Comment: The use of wood columns is rare, particularly in small structures. If wood columns were used, it would be likely that there would also be wood beams. There is no mention of wood beams.

richard schulte

FM 4450 (Insulated Steel Roof Decks)

fpeschulte@aol.com [fpeschulte@aol.com]

Sent: Monday, November 29, 2010 11:00 AM

To: investig

Attachments: 4450.pdf (1003 KB)

Ladies and Gentlemen-

The following are a few excerpts from FM 4450 (which addresses insulated steel roof decks):

"This standard states FM Approvals requirements for the Approval of Class 1 steel roof decks. A Class 1 insulated steel roof deck is one which meets the criteria of this standard for fire, wind uplift . . ." (Section 1.1, Page 1)

"Insulated steel deck roof components, incorporated in a complete insulated steel deck roof assembly (ies), which exhibit low fire spread below the deck. . .during the Approval examination will qualify as a Class 1 assembly." (Section 1.2, Page 1)

"Flame spread over a noncombustible surface, such as a metal faced combustible core assembly, is dependent upon the fuel contribution of combustible components and not the surface burning characteristics of the metal. This fact has been substantiated in actual rapidly spreading building fires on the underside of insulated steel roof decks in which combustible above the roof deck have supplied the necessary fuel contributions to induce rapid flame spread." (Section 1.1, Appendix B, Page 12)

The FM tests of insulated steel roof decks dates back to 1955.

I have attached a pdf of FM 4450.

Richard Schulte
Schulte & Associates
Building Code Consultants
Evanston, Illinois
fpeschulte@aol.com

FM Approvals®

Member of the FM Global Group

Approval Standard for Class 1 Insulated Steel Deck Roofs

Class Number 4450

February 1989

1 INTRODUCTION

1.1 Purpose

This standard states FM Approvals requirements for the Approval of Class 1 insulated steel roof decks. A Class 1 insulated steel roof deck is one which meets the criteria of this standard for fire, wind uplift, live load resistances, corrosion of metal parts, and fatigue of plastic parts. The standard applies to all components as assembled in the system below the roof cover. The roof cover is tested in accordance with FM Approval Standard 4470.

1.2 Scope

Insulated steel deck roof components, incorporated in a complete insulated steel deck roof assembly(ies), which exhibit low fire spread below the deck, adequate simulated wind uplift resistance, minimum heat damage potential and adequate strength during the Approval examination will qualify as a Class 1 assembly.

This standard applies to the assembling of an insulated steel deck. Weatherability is not a part of the Approval evaluation. Roof cover performance is evaluated in accordance with FM Approval Standard for Class 1 Roof Covers (4470). Steel deck performance is qualified by FM Approval Standard for Steel Deck (4451).

The performance of an insulated steel deck roof depends in part on all components in the roof system makeup, and on how they interact. It is therefore necessary to evaluate the roof assembly as a whole when measuring the fire spread potential on the underside of the roof and/or its windstorm resistance classification.

This standard is intended to evaluate only those hazards investigated, and is not intended to determine suitability for the end use of a product.

1.3 Basis for FM Approval

FM Approval is based upon satisfactory evaluation of the product and the manufacturer in the following major areas:

a) Examination and tests on production samples to evaluate
   - the suitability of the product;
   - the performance of the product as required by FM Approvals; and, as far as practical,
   - the durability and reliability of the product.

b) An examination of the manufacturing facilities and audit of quality control procedures is made to evaluate the manufacturer's ability to produce a product identical to that which was examined and tested, and the marking procedures used to identify the product. These examinations may be repeated as part of the FM Approvals' product follow-up program.

APPENDIX B

FIRE HAZARD TEST PROCEDURE

I INTRODUCTION

1.1 Flame spread over a noncombustible surface, such as a metal faced combustible core assembly, is dependent on the fuel contribution of combustible components and not on the surface burning characteristics of the metal. This fact has been substantiated in actual rapidly spreading building fires on the underside of insulated steel roof decks in which combustibles above the steel deck have supplied the necessary fuel contributions to induce rapid flame spread.

1.2 Measurement of the fuel contribution rate for any material or building assembly can be accurately determined by the FM Approvals Construction Materials Calorimeter as described in the following fire test procedure. The furnace, test procedures, results and fire hazard ratings were developed by FM Approvals, and have been in use since 1955.

1.3 Operating Principle of Test Furnace

The FM Approvals Construction Materials Calorimeter operates on a principle of direct fuel substitution in which evaluating fuel at a metered rate is introduced to replace the fuel contributed by the burning sample. The test procedure is accomplished in two steps: A. Fire Exposure, and B. Fuel Evaluation.

A. During the fire exposure period of 30 minutes, the test panel, which is a representative sample of the construction to be tested, is positioned as a horizontal cover on the liquid fuel-fired test furnace. As burning proceeds, a flue time-temperature curve is obtained, resulting from the combined burning of the test specimen and the fire exposure.

B. During the Fuel Evaluation with a noncombustible panel taking the place of the test sample, the 30 minute test is repeated under identical test conditions, adding auxiliary fuel at a metered rate to create the same time-temperature curve obtained in Step A. The recorded auxiliary fuel data represent the actual fuel originally contributed by the test sample.

Since all other conditions are maintained constant, the fuel contribution added through the evaluating burners equals the fuel contribution produced by the sample.

II Fire Test Furnace

2.1 The test furnace consists of a fire box of sufficient size to expose fully a 4 ft × 4 ft (1.2 m × 1.2 m) horizontal test specimen, provisions for fuel and air supply, main fire exposure burners, evaluating burners, and time-temperature recording equipment.

2.2 The fire test furnace, Figure 1, has approximate inside dimensions as follows: Width — 5 ft (1.5 m); Length — 17 ft 6 in. (5.3 m); Depth — 3 ft 9 in. (1.1 m) measured from the floor of the test furnace to the ledge of the inner walls on which the test sample is supported.

2.3 The floor of the furnace consists of a 3 in. (76 mm) layer of sand. A baffle is located on the floor 12 in. (305 mm) from the exposure end of the furnace. The baffle consists of wire reinforced Kaloblock, 16 in. (406 mm) high, 48 in. (1.2 m) wide, and 2½ in. (64 mm) thick.

NIST Sofa Super Store Draft Report Commentary

fpeschulte@aol.com [fpeschulte@aol.com]

Sent: Tuesday, November 30, 2010 10:25 AM

To: investig

Cc: rsolomon@NFPA.org; tgolinveaux@nfpa.org; Shyam-Sunder, Sivaraj; mhurley@sfpe.org

---

Ladies and Gentlemen-

Commentary on the **NIST Sofa Super Store Draft Repor**t can be found on the Building Code Resource Library website. Additional commentary on the recommendations included in the report will be added to the website in a few days.

http://buildingcoderesourcelibrary.com/commentary/

rich schulte
Schulte & Associates
Building Code Consultants
Evanston, Illinois
fpeschulte@aol.com

SCHULTE & ASSOCIATES

Building Code Consultants
880D Forest Avenue
Evanston, IL 60202
fpeschulte@aol.com
847/866-7479

A CRITIQUE OF THE NIST SOFA SUPER STORE DRAFT INVESTIGATION REPORT-PART 1

By Richard Schulte

The Fire Research Division of the Engineering Laboratory at the National Institute of Standards and Technology (NIST) released a draft report on its investigation into the fire at the Sofa Super Store in Charleston, South Carolina on October 28, 2010. The report titled "*Technical Study of The Sofa Superstore Fire-South Carolina, June 18, 2007*" was authored by Nelson P. Bryner, Stephen P. Fuss, Bryan W. Klein and Anthony D. Putorti and is dated October 2010. The following are excerpts from this report:

> "*A fire occurred on the evening of June 18, 2007, in the Sofa Super Store at 1807 Savannah Highway, Charleston, South Carolina. The fire swept from the rear to the front of the main showroom extremely quickly, and then into the west and east showrooms. Nine fire fighters from the Charleston Fire Department were killed in the fire.*" (Executive Summary, Page *xv*)

> "*During the early stages, the fire was unable to access enough oxygen (ventilation limited), which slowed its growth. Due to the lack of sufficient air to allow complete combustion, the fire produced large volumes of partially pyrolyzed fuel in the form of smoke and combustible gases. The large volumes of unburned fuel flowed into the interstitial space below the roof and above the drop ceiling of the main retail showroom. As the interstitial space filled with unburned fuel, the hot smoke also seeped through the drop ceiling into the main showroom and formed a hot smoke layer below the drop ceiling. . . When the front windows were broken out or vented, additional oxygen flowed in the front windows, along the floor, and to the rear of the showroom and became available to the fire. The additional oxygen allowed the heat release rate of the fire to increase extremely rapidly and ignite the layer of unburned fuel below the drop ceiling. The fire swept from the rear to the front of the main showroom extremely quickly, then into the west and east showrooms. Intense heat from sustained burning of furniture in the main showroom weakened the roof joists and supports and resulted in the collapse of a portion of the roof over the main showroom approximately 13 minutes after flames emerged from the front windows (40 minutes after the fire department arrived on scene). Furniture and merchandise in the showrooms and warehouse continued to burn for an additional 140 minutes before the fire was extinguished.*" (Executive Summary, Page *xv*)

"*The National Institute of Standards and Technology (NIST) conducted a study to determine the likely technical causes of the rapid fire growth that led to the high number of fire fighter casualties in that fire. . .The purpose of NIST building and fire safety studies is to use knowledge gained from the studies to help improve safety through recommended changes to codes, standards, and practices. NIST does not have the statutory authority to make findings of fault nor negligence by individuals or organizations.*" (Executive Summary, Page *xv*)

> "*. . .The purpose of NIST building and fire safety studies is to use knowledge gained from the studies to help improve safety through recommended changes to codes, standards, and practices.*"

"*The local criminal investigation of the fire took priority over the NIST technical study. NIST access to witnesses and local authorities was limited due to the criminal investigations and civil litigation.*" (Executive Summary, Page *xvi*)

"*Since there were no continuous real-time observations or photos in all locations, NIST conducted computer modeling to fill in the gaps and determine the probable sequence of events based on fire physics, coupled to the fire response time line.*" (Executive Summary, Page *xvi*)

"*The fire began in trash outside the loading dock and spread into the enclosed loading dock. From the loading dock, the fire spread through the merchandise holding area to the rear of the main showroom, then to the front of the main showroom, and then into the west and east showrooms. At the same time, the fire spread into the holding area and through a metal wall into the warehouse*." (Executive Summary, Page *xvi*)

> "*The fire began in trash outside the loading dock and spread into the enclosed loading dock. . .*"

"*The extremely rapid spread of fire through the main and west showrooms trapped six fire fighters in the main showroom and three fire fighters in the west showroom. Although the intense heat from the fire weakened the light weight steel trusses and led to the partial collapse of the roof, the coroner's report indicated that the fire fighters died from thermal burns and/or smoke inhalation, not from compression type injuries that would have been associated with the collapse*." (Executive Summary, Pages *xvi* and *xvii*)

"***Smoke and flames flowed from the holding area into the space above the main showroom drop ceiling. At a later stage, fire spread either over or through the holding area partition wall and into the rear of the main showroom.***" (Executive Summary, Page *xviii*)

"***Three fire doors between the main and west showrooms activated, but did not close during the fire. Three fire doors between the main and east showrooms activated; two doors closed completely and the third door partially closed.***" (Executive Summary, Page *xviii*)

"*Front windows were broken or vented by the fire department to improve visibility.*" (Executive Summary, Page *xviii*)

"***Fire spread extremely rapidly from the rear to the front of the showroom as additional air flowed through the broken windows, feeding the fire in the rear of the showroom.***" (Executive Summary, Page *xviii*)

"*Three fire doors between the main and west showrooms activated, but did not close during the fire. Three fire doors between the main and east showrooms activated; two doors closed completely and the third door partially closed.*"

"***Intense heat from sustained burning of the furniture weakened roof supports and resulted in collapse of the roof and walls into the warehouse.***" (Executive Summary, Page *xix*)

"***Only three of the seven roll-up fire doors activated and closed fully during the fire.***" (Executive Summary, Page *xix*)

"*There were more than five portable fire extinguishers located in the structure. A store employee discharged two portable extinguishers at the loading dock fire.*" (Executive Summary, Page *xx*)

"*Only three of the seven roll-up fire doors activated and closed fully during the fire.*"

"***The furniture fuel mass loading was estimated to range up to 16 kg/m^2 (3.4 lbs/ft^2) for the showrooms and 52 kg/m^2 (10.6 lbs/ft^2) for the warehouse. The high rack storage in the warehouse contributed to the higher fuel mass loading than in the showrooms.***" (Executive Summary, Page *xx*)

"***The furniture created a unique fire hazard in terms of the type and configuration of the fuel load. Furniture is often displayed in large open areas. As demonstrated in the main and west showrooms and warehouse, displaying large amounts of furniture in large open spaces can contribute to extremely rapid fire spread.***" (Executive Summary, Page *xxi*)

"***The fire department arrived on scene in fewer than 4 minutes after the 911 dispatch received the report of an exterior trash fire behind the Sofa Super Store.***" (Executive Summary, Page *xxi*)

"*Up to 5 minutes after arrival, there were no reports of significant smoke or fire observed inside any of the showrooms*." (Executive Summary, Page *xxi*)

"*The fire department arrived on scene in fewer than 4 minutes after the 911 dispatch received the report of an exterior trash fire behind the Sofa Super Store.*"

". . .***it took the fire department about 10 minutes to establish a water supply from a fire hydrant to the exterior loading dock area and about 16 minutes from a fire hydrant to the front of the store.***" (Executive Summary, Page *xxi*)

"*The fire department vented the front windows about 24 minutes after arrival.*" (Executive Summary, Page *xxii*)

"*Flames emerged from the front windows within 3 minutes of the windows being vented.*" (Executive Summary, Page *xxii*)

"*The last fire fighters to exit successfully from the front of the store did so within 4 minutes of windows being vented. The roof collapsed over the west side of the main showroom about 40 minutes after fire department arrived on scene.*" (Executive Summary, Page *xxii*)

"*The last fire fighters to exit successfully from the front of the store did so within 4 minutes of windows being vented.The roof collapsed over the west side of the main showroom about 40 minutes after fire department arrived on scene.*"

"*The initial response of the fire department included two engine companies, a ladder truck company, and a battalion chief. With an engineer, a fire fighter, and an officer on each apparatus, the fire department's initial response included 10 people. A comprehensive risk management plan developed according to NFPA 1500 for the Sofa Super Store would likely have identified it as a high hazard occupancy due to the lack of sprinklers and the presence of large open areas and a large fuel load. For high hazard occupancies, NFPA 1710 advocates a minimum crew size of 5 to 6 members for each apparatus, which for this incident would amount to 16 to 19 people for the initial response.*" (Executive Summary, Page *xxii*)

"*The supply of water to the fire fighters was limited to the water on the fire engines for 9 minutes at the loading dock and 15 minutes at the front of the store. . .*" (Executive Summary, *Page xxii*)

"***Venting the front windows of the main showroom did allow the smoke to escape, but it also provided more air to feed the fire and provided a path for the fire to spread.***" (Executive Summary, Page *xxiii*)

"*NIST recommends that research be conducted to better understand ignition and fire spread on upholstered furniture in order to provide the tools needed by the design profession to improve the fire performance of furniture.*" (Executive Summary, Page *xxv*)

"*. . .With an engineer, a fire fighter, and an officer on each apparatus, the fire department's initial response included 10 people. . .For high hazard occupancies, NFPA 1710 advocates a minimum crew size of 5 to 6 members for each apparatus, which for this incident would amount to 16 to 19 people for the initial response.*"

"*NIST recommends that research be conducted to provide the tools needed by the design profession to improve the performance of compartmentalization.*" (Executive Summary, Page *xxv*)

"*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 casualties is effective.*" (Executive Summary, Page *xxvi*)

"*The NIST team had access to the exterior of the Sofa Super Store the day after the fire. Exterior photographs documented the geometry, construction, and materials of the structure. A week after the fire, the NIST team was allowed access to the entire fire scene and collected additional photographs, both interior and exterior. . .*" (Page 1-2)

"*The Sofa Super Store was located at 1807 Savannah Highway, in the West Ashley Subdivision of Charleston, South Carolina. . .*" (Page 1-2)

"*Note that both Station 11 and Station 10 of the Charleston Fire Department (CFD) were located east on Savannah Highway, about 1.3 km (0.8 mile) and 2.1 km (1.3 miles) from the Sofa Super Store, respectively. . .*" (Page 1-3)

". . .*The main showroom was 38.4 m (126.0 ft) wide and 39.1 m (128.3 ft) deep and with an additional section of 13.5 m (44.4 ft) by 6.1 m (20.0 ft) deep in the southwest corner nearest to the loading dock area. The total area of the main showroom was calculated as about 1585* m^2 *(17,100* ft^2*).*" (Page 1-6)

"*. . .While there may have been exits on the rear wall when the structure was originally built, all the rear exits had been closed or filled using masonry blocks (see Figures I-4 and I-8). The east and west walls of the main showroom each featured three interior fire doors which allowed customers to move to either the east or west showrooms (Figure 1-4). . .*" (Page 1-6)

"*In addition to the six fire doors leading to the other showrooms, there was an additional fire door which was located in the rear southwest corner of the main showroom that connected to the warehouse. Also, in the rear southwest corner of the main showroom was a non-fire roll up door that provided access to the loading dock area.*" (Page 1-10)

". . .*The west showroom was 18.2 m (59.8 ft) wide and 35.8 m (117.5 ft) deep for a total calculated area of 652* m^2 *(7020* ft^2*). The west retail showroom was not part of the original structure. A single exit door was located at the northwest corner of the retail space (see Figure E-8), and a set of double doors at the rear of the showroom led to the loading dock (Figure C-7). . .*" (Page 1-12)

". . .*The east showroom was 18.2 m (59.6 ft) wide and 35.5 m (116.5 ft) deep for a total calculated area of 645* m^2 *(6940* ft^2*). The east retail showroom was not part of the original structure. There were two sets of double exit doors located on the east wall of the showroom (Figure F- 7). The wall shared with the main showroom featured three roll-up fire doors (Figures O-33, O-39, and O-48). Employees also used these fire doors between the west and main showrooms to reposition furniture and move furniture from the warehouse into the retail areas.*" (Page 1-15)

"*Aerial images (see Section 1.6) demonstrated that the loading dock, repair areas and warehouse were not part of the original structure, but were added in stages after 1989. . .*" (Page 1-18)

"*Based on dimensions collected at the post-fire scene, the loading dock area was approximately 12.6 m (41.3 ft) east to west and 15.4 m (50.6 ft) north to south for an area of 210 m^2 (2200 ft^2). Aerial images indicated that it was built in at least two sections although building permits could not be located for either addition. As evidenced by post-fire residue, both sections were built with wood framing, a wood deck/floor, and sheet metal siding and roof. The section that shared a wall with the warehouse was added first and featured a 2.7 m (9 ft) ceiling while the portion next to the rear of the west show room had a 3.7 m (12 ft) ceiling.*" (Page 1-18)

"*As determined by measurements and data collected on-site, the warehouse was approximately 36.9 m (120.9 ft) wide and 39.8 m (130.7 ft) front to rear for an area of 1470 m^2 (15800 ft^2). The warehouse was an open clear span structure with poured concrete floor and sheet metal walls and roof. The roof was approximately 8.8 m (29 ft) above the floor. . .*" (Page 1-20)

"*Between the north wall of the warehouse and the rear of the main showroom were two additional repair areas. . .*" (Page 1-21)

"*In the rear southwest corner of the main showroom was a small holding area approximately 15 m^2 (160 ft^2), 2.4 m (8 ft) wide x 6.1 m (20 ft) long. . .*" (Page 1-21)

"*As expected from a store of this type, the inventory of combustible material within the buildings was the retail merchandise. This included a wide range of furniture including sofas, chairs, tables, beds, dressers, lamps, and rugs. . .*" (Page 1-23)

"*Mattresses, upholstered chairs, sofas, recliners, and futons typically contain significant amounts of polyurethane foam* [19, 20]. *Dressers, tables, chairs, and end tables are made of wood or wood products* [21]. *Area rugs and carpeting also contain large amounts of synthetic materials. All of these items contributed to the fuel loading in the store. . .*" (Page 1-24)

"*As expected from a store of this type, the inventory of combustible material within the buildings was the retail merchandise. This included a wide range of furniture including sofas, chairs, tables, beds, dressers, lamps, and rugs. . .*"

"*. . .Retail merchandise which had already been purchased and was awaiting delivery was staged in the loading dock area. . .*" (Page 1-25)

"*There were no records or reports of fire alarms or smoke detectors installed in the showrooms or warehouse. . .*" (Page 1-29)

"*The area in which the Sofa Super Store was located had immediate access to a municipal hydrant system to support fire ground operations. Water hydrants were located along Savannah Highway to the west and east of the store, on Pebble Road behind the store, and at Blitchridge and Wappoo Roads to the north of the store. . .*" (Page 1-29)

"*Remote sensing images or aerial photographs have been routinely recorded by commercial imaging companies and have been used for monitoring land use or in planning new residential areas or commercial facilities. The early remote sensing images were usually black and white and of lower resolution. Aerial photographs taken more recently are typically in color and with better resolution.*" (Page 1-35)

"*These images provide some insight into the chronological order in which the Sofa Super Store was expanded, but since photographs were not available for each year, NIST could not identify the specific years when the loading dock and repair areas were constructed.*" (Page 1-35)

"*An image from 1994 (Figure 1-21) verifies that the west showroom was added first and was constructed before February, 1994. The east showroom, warehouse, loading dock, and repair areas do not appear in the image.*" (Page 1-35)

"*. . .For South Carolina, this fire was the deadliest fire since 11 people died in the Lancaster County Jail fire on Dec. 27, 1979* [1-2]."

"*Figure 1-22 is an aerial photograph taken in March 1998 which shows that the west and east showrooms as well as the warehouse had been added to the structure. Examination of the area between the rear of the west showroom and the warehouse reveals that the southern portion of the loading dock area had been constructed, but not the northern section. Neither the paint repair shop nor the wood repair shops had been constructed at this time.*" (Page 1-35)

"*The deaths of nine fire fighters on June 18, 2007, in the Charleston Sofa Super Store fire was the single greatest loss of life for the fire service in the United States since 343 fire fighters died in the collapse of the World Trade Center on Sept. 11, 2001. For South Carolina, this fire was the deadliest fire since 11 people died in the Lancaster County Jail fire on Dec. 27, 1979* [1-2]." (Page 2-1)

"*The time lines presented in this chapter identify the specific events that occurred during the Sofa Super Store fire that started just after 6:56 p.m., Eastern Standard Time (EST), June 18, 2007, as well as the order in which they transpired.*" (Page 2-1)

"*Since none of the photographers or videographers was present before the fire began, neither the video nor digital photographs captured the initial stages of the incident. All digital photographs and video were recorded outside the structure and did not provide images of fire growth inside the store.*" (Page 2-1)

"*Interviews with fire fighters provided information about the conditions inside and outside the structure. In combination with the fire department radio transmissions, it was possible to link the conditions to the time line. The arrival time of the fire department units was documented via the radio transmissions from arriving fire units to central dispatch. . .*" (Page 2-1)

"*. . .Investigative reports from Bureau of Alcohol, Tobacco, Firearms, and Explosives (ATF)* [13]*, National Institute for Occupational Safety and Health (NIOSH)* [14]*, and the Post Incident Assessment and Review Team* [15] *were carefully reviewed and provided critical insight into how the fire spread. Specifically, the time-linked reports by the fire fighters of smoke and fire conditions within the showrooms were invaluable in developing the time line.*" (Page 2-2)

"*On June 18, 2007, at 6:56 p.m., the time of the first sighting of the fire, the Sofa Super Store was open and employees were inside the showroom and warehouse areas within the structure. The fire was first observed by a passerby driving along Savannah Highway in front of the store and was reported to store employees. . .Upon initial verification of the fire, the store manager discharged a portable dry powder fire extinguisher, but was unable to extinguish the fire. Upon returning to the showroom area, the store manager asked other employees to call 911. The manager subsequently returned with a second extinguisher, found the loading dock more fully involved in fire, and discharged the extinguisher into the loading dock area from outside the loading dock. At 7:08 p.m., a report of a fire at the Sofa Super Store was received by the Charleston County 911 Emergency Center and the Charleston Fire Department was dispatched*. . ." (Page 2-2)

"*Upon arriving on the scene at 7:11 p.m., BC 4 reported a trash/debris fire at the rear of the showroom. Engine 10 was directed by the BC to position the apparatus near the loading dock and begin suppressing the trash fire (Figure 2-1).*" (Page 2-2)

"*Upon arriving on the scene at 7:11 p.m., BC 4 reported a trash/debris fire at the rear of the showroom. . .*"

"*Although the roll-up fire door in the breezeway between the holding area and warehouse had activated and closed direct access to the warehouse, the fire inside the enclosed loading dock spread to the front of the warehouse through a shared corrugated metal wall. The fire heated the metal wall sufficiently to cause items inside the warehouse to ignite.*" (Page 2-3)

"*At approximately the same time, 7:27 p.m., dispatch notified the Fire Chief of a cell phone call from a man claiming to be trapped inside the store. . .After 7:31 p.m., the AC, rescue team, and rescued employee returned to the front of the store.*" (Page 2-5)

"*. . .Beginning around 7:31 p.m., additional broken radio traffic more clearly indicated that several fire fighters were in distress. An unknown fire fighter called "Mayday," and dispatch advised the Fire Chief that the L-5 engineer had activated the emergency button on his radio. . .*"

"*During the rescue effort at about 7:27 p.m., several inaudible radio communications suggested that someone was trapped inside. It was not clear whether the calls reported that fire fighters were lost or trapped, or whether the calls were related to the trapped employee. Several minutes later, between 7:29 p.m. and 7:30 p.m., there were additional radio communications that were still difficult to understand, but seem to be one or more fire fighters asking for directions to exit or requesting assistance to escape. Other radio calls were interspersed with calls for help related to getting the trapped employee out. Beginning around 7:31 p.m., additional broken radio traffic more clearly indicated that several fire fighters were in distress. An unknown fire fighter called "Mayday," and dispatch advised the Fire Chief that the L-5 engineer had activated the emergency button on his radio. The Fire Chief radioed, "….we need to vacate the building.*" " (Page 2-6)

"*At about 7:35 p.m., the front windows of the main showroom were vented and broken out, heavy brown smoke poured from the broken windows. Less than a minute later, the smoke changed to thick black smoke.*" (Page 2-6)

"*At approximately 7:51 p.m., the roof over the west side of the main showroom collapsed into the main showroom.*" (Page 2-6)

"*The fire was brought under control after 10 p.m. Recovery operations continued until after 4:00 a.m. the next morning, June 19, 2007.*" (Page 2-6)

"*At about 7:35 p.m., the front windows of the main showroom were vented and broken out, heavy brown smoke poured from the broken windows. Less than a minute later, the smoke changed to thick black smoke.*"

"*The fire was ignited in a pile of trash and discarded furniture, which had accumulated on the asphalt outside the loading dock area. The fire spread into or through a wall that had an exterior surface of metal siding, wood studs and framing, and an interior surface of plywood and/or gypsum board*." (Page 2-11)

"*As the fire grew inside the loading dock, the energy from the fire heated up the metal siding of the warehouse and rear of the west showroom. At the rear of the west showroom, the interior surface was gypsum board mounted on metal studs (Appendix E, Figures E-23 and E-24).*" (Page 2-11)

"*At approximately 7:51 p.m., the roof over the west side of the main showroom collapsed into the main showroom.*"

"*From the holding area, the fire spread into the rear or southwest corner of the main showroom. The rollup fire door between the holding area and the warehouse closed and prevented the fire from spreading from the holding area to the warehouse. The fire growth is shown qualitatively in Figure 2-7 and estimated to have occurred around 7:31 p.m. It is not clear how the fire spread or moved into the rear of the main showroom*. . . *There did not appear to be significant fuel in this interstitial space, but the hot gases could have ignited items that dropped through the ceiling into the main showroom and ignited furniture*. . . *While the exact path is not understood, the fire did spread into the rear of the main showroom, which resulted in additional furniture being ignited.*" (Page 2-12)

"*Partially burned fuel in the form of smoke and combustible gases from the fire on the loading dock filled the interstitial space above the ceiling in the main showroom, and the smoke began to flow through ventilation openings down into the main showroom. At about the same time, the fire spread from the holding area into the rear of the main showroom. The smoke being generated by the fire in the rear of main showroom and the smoke flowing down through the ceiling was forming a layer of unburned fuel below the ceiling of the main showroom. At this stage, the fire did not have access to sufficient oxygen to burn completely*." (Page 2-12)

"*. . .In order to improve visibility, the fire fighters broke the front windows and allowed smoke to flow out of the showroom. However, breaking the windows also allowed additional air to flow into the main showroom. As this air flowed to the rear of the main showroom, the fire had additional oxygen and began to burn more intensely. The increased burning rate of the fire released additional energy, increased the temperature of the smoke layer, and ignited the layer of smoke and partially burned fuel below the ceiling in the main showroom.*" (Page 2-12)

"*In order to improve visibility, the fire fighters broke the front windows and allowed smoke to flow out of the showroom. However, breaking the windows also allowed additional air to flow into the main showroom. . .*"

"*. . .The three roll-up fire doors between the main showroom and west showroom (doors #2, #3, #4 in Figure 1-8) did not close, and this allowed the fire to move from the main showroom into the west showroom (Figure 2-10). On the east side of the main showroom, two rollup fire doors near the front of the store (doors #5 and #6 in Figure 1-8) did close, and the third fire door near the rear of the showroom (door #7 in Figure 1-8) closed only about one-third of the way down. The fire did not spread through the closed fire doors, but did spread through the partially closed fire door into the rear of the east showroom.*" (Page 2-12)

"*While this overview notes key tactical challenges facing the fire department and how they responded, the NIST study addressed the emergency response only as needed to reconstruct the behavior and time line of the fire. Additional analysis of the fire department response and recommendations were reported in the National Institute for Occupational Safety and Health Line of Duty Death Report 2007-18* [1], the City of Charleston *Post Incident Assessment and Review Team, Phase II Report* [2], and South Carolina Office of Occupational Safety and Health (SC-OSHA) *Report of S.C. OSHA Findings in June 18, 2007 Charleston Sofa Super Store Fire* [3]." (Page 3-1)

"*The Charleston Fire Department (CFD) provides fire suppression services to a community of approximately 108,000 people* [11]*. Emergency medical services are provided for the City of Charleston by two surrounding counties, Charleston and Berkeley.*" (Page 3-2)

"*The department's approximately 237 uniformed personnel operated from 14 stations with a combined response capability of 16 engine companies and three ladder companies* [12]*. For the CFD, a captain is in charge of each company, with an engineer/fire driver, and two fire fighters*. . .*On June 18, 2007, the department had 61 fire fighters, four BC, and an AC on-duty.*" (Page 3-2)

"*The department's approximately 237 uniformed personnel operated from 14 stations with a combined response capability of 16 engine companies and three ladder companies* [12]*. For the CFD, a captain is in charge of each company, with an engineer/fire driver, and two fire fighters*. . .*On June 18, 2007, the department had 61 fire fighters, four BC, and an AC on-duty.*"

"*At the time of the fire, the CFD's unit staffing (as noted above) was less than the minimum complement of engine and truck company personnel recommended in the National Fire Protection Association (NFPA) Standards 1500* [13] *and 1710* [14]. . . *Unit staffing levels directly affect the fire fighting crew's tactical performance capabilities, the speed at and duration of which they can be relied upon to accomplish various tasks, such as establishing water supply, advancing hose lines, or effecting rescues, as well as the overall scope and effectiveness of the tactical intervention strategy being applied in a given situation.*" (Page 3-2)

"*CFD procedures indicated that for fires involving structures less than five stories in height, the first alarm assignment was two engine companies, a ladder truck company, and a BC* [1, 8]. *For structures over five stories, the first alarm assignment was three engines, a ladder truck, a BC, and an AC. Procedures also stated that a confirmed report of smoke would trigger the assignment of an additional engine company.*" (Page 3-4)

"*At this early stage in the response, only five minutes after dispatch, the fire department had located the trash fire on the asphalt paved area and had discovered that the fire had spread to the interior of the loading dock. The AC surveyed the interior of the showrooms and did not observe any fire or smoke. Based on observations of the fire fighters in the showroom, the fire did not appear to have spread into the showrooms.*" (Page 3-8)

"*. . .As the team retreated from the loading dock area, the hose line burst or was burned through by the fire near the doorway. The fire fighting team moved through the water spray from the burst hose line and exited the structure through the door adjacent to the warehouse.*" (Page 3-9)

"*After observing the black smoke plume, units from St. Andrew's Fire Department, a mutual aid department, self dispatched to the fire scene. At 7:24 p.m., the mutual aid department arrived and after discussion with the Fire Chief, at least two engine companies and a ladder company from St. Andrew's Fire Department were assigned to the rear of the warehouse. Once the mutual aid units connected to a hydrant on Pebble Road, they deployed their ladder/platform and directed an aerial water stream onto the rear of the warehouse.*" (Page 3-10)

"*After observing the black smoke plume, units from St. Andrew's Fire Department, a mutual aid department, self dispatched to the fire scene. At 7:24 p.m., the mutual aid department arrived. . .*"

"*. . .Since fire crews were pulling the hoses to the rear of the west showroom, the fire department appeared to be focused on suppressing the fire on the loading dock. They did not appear to have evidence that the fire had spread through the open roll-up door into the holding area, into the void space above the drop ceiling, and eventually into the rear of the main showroom.*" (Page 3-11)

"*A second potential path for the fire might have been through the partition wall. However since the wall was constructed out of 12.7 mm (0.5 in) thick gypsum board on both sides, it would have taken the fire some time to penetrate both sides of the partition wall. If the wall was constructed using two layers of fire resistant Type X, 15.6 mm (0.625 in) thick gypsum board on both sides of a metal studs, the wall would have been rated as a one-hour fire wall* [16]. *If the fire team on the loading dock had directed a solid stream of water onto the partition wall then the impingement of the water stream on the gypsum wall would have likely shortened the time to failure of the wall. . .*" (Page 3-13)

"*. . .The CFD did not ventilate the roof, so no vertical pathway existed in the rear of the main showroom. There were no doors or windows on the rear (south) side of the main showroom. Although there were open fire doors between the main showroom and the east and west showrooms, the exterior doors on the west and east showrooms were closed. The fire growth in the rear of the main showroom was slow due to the lack of air.*" (Page 3-13)

"*. . .The fire growth in the rear of the main showroom was slow due to the lack of air.*"

"*As the fire continued to grow in the rear of the main showroom and the smoke filled the volume above the ceiling, smoke continued to accumulate in the main showroom. As the smoke layer above the heads of the fire fighters continued to thicken and eventually dropped closer to the floor the visibility decreased. The fire fighters within the smoke filled main showroom became disoriented as evidenced by radio transmissions, and at approximately 7: 27 p.m., fire fighters began to request help* [8, 9]." (Page 3-14)

"*. . .The fire fighters within the smoke filled main showroom became disoriented as evidenced by radio transmissions, and at approximately 7: 27 p.m., fire fighters began to request help* [8, 9]."

"*. . .At about 7:35 p.m. the fire fighters broke the front windows to allow more of the smoke to vent and improve the visibility in the main showroom. After the windows were vented, the smoke changed color and became much blacker. The change in smoke color was still consistent with partially oxidized combustion products from a fire that was ventilation-limited.*" (Page 3-14)

"*. . .At about 7:35 p.m. the fire fighters broke the front windows to allow more of the smoke to vent and improve the visibility in the main showroom. After the windows were vented, the smoke changed color and became much blacker. . .*"

"*. . .Eventually, the hot smoke mixed with sufficient air to create a layer below the drop ceiling. As the fire at the rear of the main showroom ignited this layer of unburned combustion products, the fire rapidly moved from the rear of the showroom (southwest corner) to the front of the store (Figure 3-9). The fire then spread into the east side of the main showroom before emerging from the front of the store (northeast corner). After spreading to the entire main showroom, video recorded during the fire* [4] *demonstrated that the fire spread through the open fire doors into the west showroom and eventually to the front windows of the west showroom.*" (Page 3-14)

"*. . .The Fire Chief directed two two-man teams to attempt to enter and search for the trapped fire fighters. Both teams entered the main showroom, but were forced to retreat by the intense heat. At approximately 7:38 p.m., the last of the search teams exited the front of the structure.*" (Page 3-17)

"*. . .At about 10:00 p.m. the fire was declared under control and recovery operations were initiated. At approximately 4:00 am the next morning, recovery operations were completed.*" (Page 3-17)

"***. . .The additional oxygen allowed the fire to spread rapidly from the rear to the front of the main showroom.***"

"*As the fire spread to the rear of the main showroom, the fire still behaved as though it was under ventilated. At approximately, 7:35 p.m., the front windows of the store were broken by fire fighters. Shortly after the windows were broken, the fire was provided with additional air either from the vent front windows or through the loading door rollup door. The additional oxygen allowed the fire to spread rapidly from the rear to the front of the main showroom.*" (Page 3-17)

"*. . .The fire department did not appear to set up or designate a specific location as a command post. The fire department did not adopt a traditional incident command structure or paradigm. . .*" (Page 3-18)

"*. . .CFD procedures allow off-duty fire fighters to respond to and participate in fire ground activities. Department procedures required each fire fighter to provide a chief officer with an identification card before participating in fire ground activities. Department procedures did not require that the off-duty fire fighter check in with the incident commander, just a chief officer*." (Page 3-18)

"*The lack of a single command post and the ability of off-duty fire fighters to check in with different chief officers did not allow easy or coordinated tracking of personnel on the fire ground. . .*" (Page 3-18)

"*Most emergency services providers, and fire departments in particular, develop and operate with the assistance of mutual aid agreements with neighboring departments to augment their capability to respond to incidents when their assets are committed or otherwise unable to satisfy the community's emergency response requirements. . .*" (Page 3-18)

"*. . .All agreements benefit the member agencies by providing emergency surge capabilities (staffing, equipment, etc.) from other agencies that would be prohibitively expensive to operate and maintain in each jurisdiction.*" (Page 3-19)

"*Most emergency services providers, and fire departments in particular, develop and operate with the assistance of mutual aid agreements with neighboring departments to augment their capability to respond to incidents when their assets are committed or otherwise unable to satisfy the community's emergency response requirements. . .*"

"*. . .Jurisdictional differences in equipment, tactics, and communications systems may also present interoperability challenges to the effective use of mutual aid assets, as was the situation at this incident. . .*" (Page 3-19)

"*On-scene mutual aid was provided to the CFD by the St. Andrew's Fire Department and St. Jame's Fire Department. Each of the mutual aid departments responded on their own, not at the request of CFD. . .*" (Page 3-19)

"*Computer simulations, also known as numerical modeling, have been demonstrated to be useful, when properly applied, as a tool to help fill in details of the fire dynamics and to demonstrate the value of alternative building designs and fire safety measures* [1]*. Simulation results are an approximation of the actual event, and are most valuable when considered as qualitative rather than quantitative. In other words, it is likely that the simulations do not return exactly the same results as might have been present in the real world situation, but can provide a reasonable approximation of conditions. These simulated scenarios can then be used to further examine relative differences when simulations that include changes to the modeled environment are compared with each other.*" (Page 4-1)

"*The focus of this simulation was the examination of conditions that may have been present in the Sofa Super Store during the first 40 minutes (2400 s) after the fire department discovered the fire in the loading dock area. For these model simulations, the fire department was on scene at time = 0, the fire was discovered at the rear of the west showroom at 2 minutes, E-12 began pumping water to E-10 (loading dock) at 10 minutes, broken radio calls began to indicate fire fighters in trouble at 16 minutes, front windows were vented at 24 minutes, fire was emerging from front windows at 26 minutes, last fire fighter successfully exited structure at 27 minutes, and the roof over the main showroom partially collapsed at 40 minutes. Each 40 minute simulation covered the time period from fire department's arrival at 7:11 p.m., to just after the partial collapse of the main showroom roof at 7:51 p.m.*" (Page 4-2)

"*Computer simulations, also known as numerical modeling, have been demonstrated to be useful, when properly applied, as a tool to help fill in details of the fire dynamics and to demonstrate the value of alternative building designs and fire safety measures* [1]*. . .*"

"*. . .The spread of the fire into the showrooms was not reported by the fire fighters for at least 10 minutes after they entered the showrooms.*" (Page 4-2)

"*Automatic water sprinklers are very effective in controlling the growth and spread of fires. Water sprinklers were not installed in the showrooms, loading dock, or warehouse of the Sofa Super Store. . .*" (Page 4-2)

"*. . .Simulation results are an approximation of the actual event, and are most valuable when considered as qualitative rather than quantitative. In other words, it is likely that the simulations do not return exactly the same results as might have been present in the real world situation, but can provide a reasonable approximation of conditions. . .*"

"*Ventilation can significantly impact how a fire grows and develops. The fire service often ventilates a structure by breaking windows or cutting holes in roofs in order to allow the smoke and hot gases to be exhausted from the structure. Less smoke and hot gases can improve visibility and make working conditions more tenable. Ventilation can also provide additional air to the fire and can result in a greater release of heat or energy.*" (Page 4-2)

"*The NIST Fire Dynamics Simulator (FDS) is a computational fluid dynamics model of fire-driven fluid flow. It solves a form of the Navier-Stokes equations appropriate for low-speed, thermally driven flow with an emphasis on smoke and heat transport from fires* [3]*. . .*" (Page 4-3)

"*Inputs required by FDS include the geometry of the structure, the computational cell size, the location of the fire source, the energy release rate of the fire source, the mass, geometry and thermal properties of walls, ceilings, floors, and furnishings, and the size, location, and timing of door and window openings to the outside of the structure. The selection of thermophysical properties and dimensions for the input parameters can have a significant impact on the outcome of the simulation, and because considerable uncertainty exists in the values of these parameters, a range of values is used.*" (Page 4-3)

"*. . .The selection of thermophysical properties and dimensions for the input parameters can have a significant impact on the outcome of the simulation, and because considerable uncertainty exists in the values of these parameters, a range of values is used.*"

"*. . .The results of the simulation including the spread of fire and smoke within the loading dock, holding area, and showrooms, are compared to the photographic and video record and the statements of witnesses to assess the agreement between the simulation and the actual fire. The input parameters are systematically adjusted and the simulation re-run. This process of refining the input parameters continues until the best possible agreement has been achieved.*" (Pages 4-3 and 4-4)

"*. . .The input parameters are systematically adjusted and the simulation re-run. This process of refining the input parameters continues until the best possible agreement has been achieved.*"

"*Selecting the appropriate cell size required balancing the need to resolve critical dimensions and physical phenomena against the need to budget enough time to perform the hundreds of computer runs necessary to assess the importance of different variables on the outcome. The FDS input parameters were adjusted by comparing the simulation results with the available photos, videos, witness statements and other documentation of the fire. This methodology has been used previously by NIST researchers in post-fire studies* [6-13]. *Over 250 computer simulations were required to match the observed phenomena and time line. The simulation that best matched with observations and time lines is presented as the baseline case. . .Approximately four days were required to generate each 2400 second simulation.*" (Page 4-4)

"*. . .The consumption of fuel in the main and west showrooms was so extensive that the furniture layout used in the model was based largely on post-fire residue and witness accounts. Post-fire residue included metal hardware, steel frames, hinges, and springs. Witnesses described the showrooms as being "crowded" with furniture. The general description of the main showroom placed aisles down the center of the room, from the front door to the rear office area.* . ." (Page 4-6)

"*. . .Over 250 computer simulations were required to match the observed phenomena and time line. The simulation that best matched with observations and time lines is presented as the baseline case. . .Approximately four days were required to generate each 2400 second simulation.*"

"*. . .This sequence of events was used to synchronize the model time line to the physical time line, where time 0 in the simulation is equal to 7:10:53 p.m.*" (Page 4-9)

"*. . .FDS utilizes material properties of the furnishings, walls, floors, and ceilings to compute fire growth and spread. For materials that burn, additional parameters such as reference temperature, heat of combustion, heat of reaction and maximum burning rate are specified. The properties for the materials, to the extent they were available, were taken from published fire data and references.*" (Page 4-9)

"*The assumption was made that all furnishings in the building were composites of foam and fabric, and that this material or composite constituted the entire fuel load*. . . .*Other fuels such as flooring, wood display shelves, ceiling tile, paper documents, or wood framing, were not included as fuel for these simulations.*" (Page 4-9)

"*Interior finishes were categorized into the following list of materials: gypsum board, concrete block, concrete slab, sheet metal, steel, glass, carpet, ceiling tile, and wood. . .*" (Page 4-9)

"*During the course of a fire, some items within the building may be consumed by the fire or otherwise change position. FDS does not have the capability to calculate burn-through or collapse but the user can remove items during the course of the calculations. Items that are removed can represent objects that fall or are destroyed by fire, or objects that are changed by people such as doors or windows that are opened.*" (Pages 4-9 and 4-10)

"*. . .Other fuels such as flooring, wood display shelves, ceiling tile, paper documents, or wood framing, were not included as fuel for these simulations.*"

"*. . .A series of photographs documented the removal of the front windows on the main showroom between 7:35:05 p.m. and 7:35:57 p.m. Photos were also used to estimate the times at which the windows on the west showroom failed. These windows failed between approximately 7:38 p.m. and 7:44 p.m. In the simulation, windows were removed at times corresponding to estimates based on photographs and not based on the interior conditions or material properties of the windows.*" (Page 4-10)

"*. . .Flames are also visible and appear to be coming from the roof of the main showroom. Because it was not possible to determine the exact location or size of the holes in the ceiling and roof, several holes were used in the simulations to represent the ventilation that took place. Table K-4 summarizes the ventilation conditions used in the simulations.*" (Page 4-10)

"*The baseline simulation represents an estimate of what actually occurred in the Sofa Super Store based upon the evidence and time line described in the previous chapters. The resulting HRRs in the different portions of the store, visibility as estimated from the predicted smoke flows, and the temperatures and oxygen volume fractions at different elevations are presented in the following sections.*" (Page 4-12)

"*. . .As the fire spread into the rear of the main showroom, the fire became underventilated and began to decrease in HRR. The total HRR continued to decrease until about 1450 s when the removal of the windows in the main showroom, beginning at 1457 s (7:35:10 p.m.), provided a fresh influx of oxygen leading to the subsequent rapid fire growth. The HRR of the fire grew to over 100 MW in the main showroom and 50 MW in the west showroom. The energy release rate of the holding area/rear main showroom increased slightly and then leveled out at about 40 MW. The loading dock HRR exhibited a transient peak at about 50 MW and then decreased to about 15 MW.*" (Page 4-13)

"*. . .As the fire spread into the rear of the main showroom, the fire became underventilated and began to decrease in HRR. The total HRR continued to decrease until about 1450 s when the removal of the windows in the main showroom, beginning at 1457 s (7:35:10 p.m.), provided a fresh influx of oxygen leading to the subsequent rapid fire growth. . .*"

"*. . .The holding area was adjacent to the loading dock and was accessible through an open roll-up door. This room did not have a drop ceiling and had shelves upon which futon cushions were stored. Smoke and heated combustion gases produced by the fire passed into the void space above the main showroom*." (Page 4-15)

"*Purser* [2] *has published data that identify when conditions become untenable for humans. Purser provides an algorithm for estimating the time to lose consciousness due to low oxygen. At 0.12 volume fraction, the time is estimated at about five minutes. In a closed fire-engulfed environment, toxic gases (such as carbon monoxide) are likely to be present before the oxygen gets this low. Since the simulation tracks the oxygen volume fraction, it will be used as one indicator for tenability. A second indicator will be when the temperature exceeds 120°C (250°F). For each of the simulations, the time for areas to become untenable4 due to elevated temperature or oxygen depletion will be tabulated. These incapacitation criteria are simplifications of complex studies and serve as a basis for appraising the relative effects of alternate fire scenarios.*" (Page 4-23)

"*The NIST study did not include analysis of the threat to protected fire fighters. If a fire fighter in turnout gear is utilizing a self-contained breathing apparatus (SCBA) and has an adequate supply of air, the fire fighter can temporarily survive higher temperatures and depleted external oxygen levels. This safety shell ends when the fire fighter runs out of tank air or remains within the hot fire environment too long.*" (Page 4-23)

"*. . .A second temperature surge, which began at approximately 1460 s (7:35:13 p.m.), was due to the fire entering the west showroom through the open roll-up door as it moved to the front of the main showroom. It should be noted that the focus of suppression efforts was in this area of the showroom, and that the simulation does not take this into account*." (Page 4-25)

"*. . .FDS has been shown to be able to predict the number of sprinklers activated and the approximate activation times, as well as trends, temperatures, heat fluxes and oxygen volume fractions in reasonable agreement with measured values* [5; Vols. 2&3]. *However, the suppression physics in FDS is simplified and cannot capture all of the details of the suppression process.*" (Page 4-29)

"*The NIST study did not include analysis of the threat to protected fire fighters. If a fire fighter in turnout gear is utilizing a self-contained breathing apparatus (SCBA) and has an adequate supply of air, the fire fighter can temporarily survive higher temperatures and depleted external oxygen levels. . .*"

"*The sprinkler system layout was designed in accordance with NFPA 13, Standard for the Installation of Sprinkler Systems* [17]. *The system was designed as a light hazard wet pipe system, assuming that the enclosed loading dock area was heated. A light hazard sprinkler system was utilized in order to provide a conservative estimate for the area/ water density for the simulations. The locations of the sprinklers within the enclosed loading dock are shown in Figure 4-35. . .*" (Page 4-29)

"*FDS has been shown to be able to predict the number of sprinklers activated and the approximate activation times, as well as trends, temperatures, heat fluxes and oxygen volume fractions in reasonable agreement with measured values* [5; Vols. 2&3]. . ."

"*The results indicate that as early as 270 s into the simulation, smoke may have begun to flow down through ventilation openings in the drop ceiling and into the rear of the main showroom. By 300 s, there is also a layer of smoke beginning to develop under the drop ceiling in the rear of the west showroom. It cannot be concluded from the simulation whether an observer located in the main showroom would have noticed smoke in the rear main showroom at 300 s, or would have been able to distinguish the source of that smoke. The smoke continued to flow down through ventilation openings and, after forming a substantial layer in the rear of the main showroom, began to spread throughout the main showroom. At about 400 s, the simulation indicates that the smoke layer extended down to near the floor on the west side of the main showroom. As the fire spread from the holding area into the rear of the main showroom at around 500 s, additional smoke was added to the smoke layer in the main showroom. As demonstrated by the rendering of smoke by the simulation, visibility became compromised in the showrooms within 8 minutes to 10 minutes. The simulation results are consistent with the E-11 captain reporting heavy smoke in the main showroom at 7:20 p.m., which would correspond to 555 s into the simulation.*" (Page 4-49)

"*. . .The higher simulation temperatures in the front of both showrooms, as compared to the rear of the showrooms, are consistent with additional oxygen being available in the front of the showrooms, relative to the less ventilated rear areas of the showroom.*" (Page 4-50)

"*In the simulation with automatic sprinklers, the two sprinklers nearest the fire (in the southwest corner of the loading dock) activated early in the fire, at 50 s and 75 s. The two sprinklers controlled the fire and prevented the fire from spreading into the showrooms or warehouse. As a result, the temperatures and oxygen volume fractions remained below untenability thresholds.*" (Page 4-56)

> "*In the simulation with automatic sprinklers, the two sprinklers nearest the fire (in the southwest corner of the loading dock) activated early in the fire, at 50 s and 75 s. The two sprinklers controlled the fire and prevented the fire from spreading into the showrooms or warehouse. . .*"

"*A contract was entered into with Koffel Associates, Inc. of Elkridge, Maryland, to identify the current model building and fire codes that were available for application to a structure such as the Sofa Super Store. They were also contracted to identify the model building and fire codes in place at the time the building was constructed and at the times when modifications were made to the structure. Koffel Associates provided comparisons of the requirements of the identified building and fire codes. The analysis and discussion of this chapter focus on areas that are expected to be related to the growth and spread of the fire that occurred on June 18, 2007. Any conclusions and findings that are presented are solely those of NIST.*" (Page 5-1)

"*The model codes may require sprinkler protection for buildings based on a combination of factors including occupancy, building area, construction type, building height, and occupant location relative to exit discharge. . .The fire barriers between the showrooms may have been installed to avoid sprinkler system installation requirements, although the fire barriers may not have met the code definition of a fire wall. Those barriers failed during the fire due to a roll-down fire door not operating properly.*" (Page 5-7)

"*. . .The fire barriers between the showrooms may have been installed to avoid sprinkler system installation requirements, although the fire barriers may not have met the code definition of a fire wall. Those barriers failed during the fire due to a roll-down fire door not operating properly.*"

"*. . .NFPA 80 (§5.2.1) requires that inspection and testing occur not less than annually, and that a written record of the inspection be signed and kept for possible future inspection by the authority having jurisdiction.*" (Page 5-8)

"*The type and amount of fuel, in conjunction with the large open display area, enabled the Sofa Super Store fire to spread rapidly within the building. Both automatic fire sprinklers and compartmentalization can effectively limit how fast a fire spreads within a structure. . .*" (Page 5-9)

"*. . .NFPA 80 (§5.2.1) requires that inspection and testing occur not less than annually, and that a written record of the inspection be signed and kept for possible future inspection by the authority having jurisdiction.*"

"*For display areas of furniture stores, the maximum floor areas allowed by the model codes do not appear to be effective in sufficiently limiting the magnitude and severity of furniture showroom fires.*" (Page 5-10)

"*Based on allowable area, merchandise sold, and configuration of furniture stores, the maximum amount of fuel that is permitted by the model code does not appear to be effective in limiting the rapid spread and magnitude of the resulting fire to a level consistent with other sections of the code. . .*" (Page 5-10)

"*For display areas of furniture stores, the maximum floor areas allowed by the model codes do not appear to be effective in sufficiently limiting the magnitude and severity of furniture showroom fires.*"

"*In summary, the hazard of a fire spreading rapidly across a large furniture display area can be reduced by compartmentalizing the display area(s), or by installing automatic fire sprinklers which have been demonstrated as an effective method of controlling building fires. The unsprinklered fire areas allowed by the model codes are too large to prevent rapid fire growth and sufficiently limit the magnitude and severity of fires in furniture display areas. Reducing the maximum allowable size of unsprinklered furniture showroom fire areas to 190 m^2 (2000 ft^2) would slow the rate of fire spread within buildings and reduce fire magnitude by compartmentalizing the otherwise open spaces.*" (Page 5-10)

"***Smoke and flames flowed from the holding area into the space above the main showroom drop ceiling. At a later stage, fire spread either over or through the holding area partition wall and into the rear of the main showroom.***" (Page 6-3)

"***Three fire doors between the main and west showrooms activated, but did not close during the fire. Three fire doors between the main and east showrooms activated; two doors closed completely and the third partially closed.***" (Page 6-3)

"***Smoke and flames from the fire on the loading dock and holding area flowed into the space above the main showroom drop ceiling.***" (Page 6-3)

"***During the early stages of the fire (10 minutes to 15 minutes after fire department arrival) the heat release rate of the fire in the rear of the main showroom was slowed by the lack of air; that is, the fire was under-ventilated.***" (Page 6-3)

"*Front windows were broken or vented by the fire department to improve visibility*." (Page 6-3)

"***Fire spread extremely rapidly from the rear to the front of the showroom as additional air flowed through the broken windows, feeding the fire in the rear of the showroom.***" (Page 6-3)

"*Front windows were broken or vented by the fire department to improve visibility*."

"*The lack of automatic sprinklers to suppress the fire during an early stage of its growth and the lack of effective compartmentalization were direct contributors to the loss of nine fire fighters' lives and the loss of the retail showrooms and distribution warehouse. . .*" (Page 6-4)

"***Computer model simulations demonstrated that automatic fire sprinklers in the loading dock would have controlled the fire and prevented the fire from extending beyond the loading dock.***" (Page 6-4)

"***Computer model simulations demonstrated that tenable (survivable) conditions were maintained within the loading dock, showrooms, and warehouse had a sprinkler system been installed on the loading dock.***" (Page 6-4)

"***Only three of the seven roll-up fire doors activated and closed fully during the fire.***" (Page 6-5)

"*There were more than five portable fire extinguishers located in the structure. A store employee discharged two portable extinguishers at the loading dock fire.*" (Page 6-5)

"***The type and configuration of the fuels played a role in how fast the fire was able to spread.***" (Page 6-6)

"***The furniture fuel mass loading was estimated to range up to 16 kg/m^2 (3.4 lbs/ft^2) for the showrooms and 52 kg/m^2 (10.6 lbs/ft^2) for the warehouse. The high-rack storage in the warehouse contributed to the higher fuel mass loading than in the showrooms.***" (Page 6-6)

"*The furniture created a unique fire hazard in terms of the type and configuration of the fuel load. Furniture is often displayed in large open areas. As demonstrated in the main and west showrooms and warehouse, displaying large amounts of furniture in large open spaces can contribute to extremely rapid fire spread.*" (Page 6-8)

"***The fire department required about 10 minutes to establish a water supply from a fire hydrant to the exterior loading dock area.***" (Page 6-8)

"***The fire department vented the front windows about 24 minutes after arrival.***" (Page 6-9)

"***Heavy smoke flowed out of front windows within 2 minutes of the windows being vented.***" (Page 6-9)

"*The fire department vented the front windows about 24 minutes after arrival.*"

"***Flames emerged from the front windows within 3 minutes of the windows being vented.***" (Page 6-9)

"*The last fire fighters to exit successfully from the front of the store did so within 4 minutes of windows being vented.*" (Page 6-9)

"*The roof collapsed over the west side of the main showroom about 40 minutes after fire department arrived on scene.*" (Page 6-9)

"*The initial response of the fire department included two engine companies, a ladder truck company, and a battalion chief. With an engineer, a fire fighter, and an officer on each apparatus, the fire department's initial response was 10 people. . .For high hazard occupancies, NFPA 1710* [12] *advocates a minimum crew size of five to six members for each apparatus, which for this incident would amount to 16 to 19 people for the initial response.*" (Page 6-9)

"*The responders did not know when fire and smoke entered the showrooms. The fire department visually checked below the drop ceiling for fire spread. The NIST study was not able to document any fire fighter removing a ceiling tile to check for fire spread above the drop ceiling. . .*" (Page 6-9)

"*The supply of water to the fire fighters was limited to the water on the fire engines for 9 minutes at the loading dock and 15 minutes at the front of the store. When the connection was made to the municipal water supply, the two engines were pumping water to the store through long lines of small diameter 6.4 cm (2.5 in) hose. . .*" (Page 6-10)

"***Venting the front windows of the main showroom did allow the smoke to escape, but it also provided more air to feed the fire and provided a path for the fire to spread.***" (Page 6-10)

"***After the windows were broken, the fire spread extremely rapidly into the main showroom and into the west showroom.***" (Page 6-10)

"*Fire department inspections did not identify the large fuel load, the non-code compliant wood construction, the solvent storage on the loading dock, or the lack of a fire door between loading dock and holding area as significant fire hazards.*" (Page 6-11)

"*Adoption of a model code, in and of itself, is not sufficient to guarantee the safety of a building. . .Recognizing this, model codes need to be robust and contain sufficient redundancies to minimize the chances of loss of life caused by the failure of a building that is built or operating out of compliance with code provisions.*" (Page 6-11)

"*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.*" (Page 6-12)

"*After the windows were broken, the fire spread extremely rapidly into the main showroom and into the west showroom.*"

"*Adoption of a model code, in and of itself, is not sufficient to guarantee the safety of a building. . .Recognizing this, model codes need to be robust and contain sufficient redundancies to minimize the chances of loss of life caused by the failure of a building that is built or operating out of compliance with 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 sprinklers to be installed. . .*" (Page 6-12)

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 m² (2000 ft²).

(Page 6-12)

"*A risk management plan, properly implemented, would have identified the hazards associated with the size and type of fuel load and the large open spaces that existed at the Sofa Super Store.*" (Page 6-13)

"*The acceptance of the recommendations made in this report by the model code and standards organizations and the adoption of any modified provisions of the national model codes into local codes will depend upon the perceived benefits weighed against the costs of implementing any changes. There are a number of areas where the benefits may be obvious and the costs of implementation may be easily determined. . .*" (Page 6-13)

"*There are other areas in which the basis for making changes to local codes is not currently supported by reliable technical information. Continuing research is needed to gain new understanding and to collect the data necessary to ensure that changes are adopted, or rejected, based upon sound scientific findings*. . ." (Page 6-14)

"*. . .Continuing research is needed to gain new understanding and to collect the data necessary to ensure that changes are adopted, or rejected, based upon sound scientific findings*."

"*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. . .*" (Page 6-14)

"*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 use requirements, and 2) replicating the performance of existing partitions in forensic models. Fire-resistance testing of walls, floors, ceilings, and doors 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 doors 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 importance of multiple fire paths*." (Page 6-14)

"*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 use requirements, and 2) replicating the performance of existing partitions in forensic models. . .*"

"*New knowledge, data, and predictive methods generated in the above research will lead to new technologies and improved fire standards. The selection among alternative fire safety technologies or building design options, and the setting of threshold values 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 in a manner transparent to competing interests.*" (Page 6-15)

"*. . .New knowledge, data, and predictive methods generated in the above research will lead to new technologies and improved fire standards. . .*"

"*First responders commonly use ventilation is 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.*" (Page 6-15)

“***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 technologies.”

(Page 6-16)

“*Completing the research recommended will provide a reliable technical foundation for making changes to codes, standards and practices.* . .” (Page 6-16)

“*Completing the research recommended will provide a reliable technical foundation for making changes to codes, standards and practices.*”

Part 2 of this article will include an analysis of the Draft Report.

* * * * *

NIST Sofa Super Store Draft Report-Livonia-1953

fpeschulte@aol.com [fpeschulte@aol.com]

Sent: Tuesday, November 30, 2010 12:27 PM

To: investig

Posted February, 1999

The Great Hydra-Matic Fire

By Thomas E. Bonsall

The recent explosion and fire at Ford Motor Company's giant Rouge complex has brought back memories of the Hydra-Matic fire of 1953, the worst industrial fire in American history up to that time and still ranked as the worst in dollar loss in the history of the auto industry. On August 12th of that year, a fire at the Hydra-Matic plant in Livonia, Michigan, completely destroyed the facility, cost some $80 million in damages, caused the injury or deaths of a score of workers, and resulted in the loss of automobile production from five different manufacturers variously estimated at from 100,000 to 300,000 units.

The Livonia plant, which was operated by the Detroit Transmission Division of GM, was nearly new and represented the state-of-the-art in early post-World War II plant design. It was also the only source of Hydra-Matic transmissions for General Motors car and truck lines, as well as those of several other manufacturers. Pontiac, Oldsmobile and Cadillac were the principle GM divisions that were effected, but Lincoln, Hudson, Kaiser and Nash also used Hydra-Matic at the time.

The fire started when some outside construction workers using a oxyacetylene cutting torch ignited a conveyor dip pan that contained a highly flammable liquid used as a rust inhibitor for transmission parts. Attempts to put out the fire with hand-held extinguishers were nearly successful — until the extinguishers ran dry. Then, the fire spread with tremendous speed throughout the 1.5 million square foot plant. Within minutes, the fire had engulfed the entire building, including a small Ternstedt Division area (about 133,000 square feet). Ternstedt manufactured interior hardware (window cranks, etc.) and other small parts used by GM's automotive divisions.

Fire fighters from all over the Detroit area were called to the scene, but there was little anyone could do once the fire went out of control. By the time fire fighters arrived on the scene, the roof had already partially collapsed making the building too dangerous to enter (see the top photo). The fire finally burned itself out the following day (see the bottom photo) leaving a scene reminiscent of Dresden or Hiroshima.

Given the speed of the fire — it roared completely out of control in fifteen or twenty minutes — it is a miracle that virtually all of the 4,200 workers escaped with their lives. In fact, only fifteen sustained serious injuries. In addition, three members of the Ternstedt in-plant fire brigade were trapped and killed and a member of the Livonia Fire Department suffered a fatal heart attack. Several days later, two construction workers were electrocuted while clearing debris. So, the final total was six dead and fifteen seriously injured — astonishingly light considering the nature and scope of the catastrophe.

In the wake of the disaster, Cadillac and Olds quickly converted to the Buick Dynaflow transmission, while Pontiac switched to Chevrolet's Powerglide. Lincoln was able to switch over to Ford's in-house automatic, which was similar to Powerglide, but the other manufacturers had to do without.

One of the genuine crash programs in the history of the auto industry was undertaken by GM to rebuild Hydra-Matic. A new plant, the former Kaiser-Frazer factory at Willow Run (see photo below), was quickly leased and later purchased outright, while Kaiser production was transferred to Kaiser's recently acquired Willys-Overland plant in Toledo. New equipment and new supplies for the resumption of Hydra-Matic production all had to be put in place in record time. The first Hydra-Matic unit was produced in a make-shift plant in Detroit in October — a mere nine weeks to the day from the date of the fire — and GM gallantly sent the first units to Hudson, Kaiser and Nash. The former Kaiser plant was in full Hydra-Matic production by mid-December and remains a key GM automatic transmission facility to this day.

The Hydra-Matic fire served as a wake-up call for the entire American industrial community and fire standards were significantly improved as a result. As the National Fire Protection Association noted:

"The general awakening of industrial management to the potentially disastrous results of fire on production was the one beneficial effect of this disastrous fire. Viewing this destruction, many industrial managements are recognizing the inter-relationship of production records and fire safety, and are facing the well-known fact that fire can reduce production records to zero and, in some cases, keep them there. It is almost fortunate that this tremendous fire occurred in the property of a company that is financially well-equipped to withstand such a loss."

R&D

Click the "home" icon above to return to the Ride&Drive main index.

Click here to return to the Blast from the Past menu

Insulated Metal Deck Roof Construction-Livonia 1953

fpeschulte@aol.com [fpeschulte@aol.com]

Sent: Tuesday, November 30, 2010 12:35 PM

To: investig

Attachments: Insulated Metal Deck Roof ~1.pdf (42 KB)

Ladies and Gentlemen-

The following is information of the history of fire testing of insulated metal deck roof construction developed subsequent to the fire which destroyed a General Motors plant in Livonia, Michigan in 1953.

http://docserver.nrca.net/pdfs/technical/434.pdf

rich schulte
Schulte & Associates

SCHULTE & ASSOCIATES
Building Code Consultants
880D Forest Avenue
Evanston, IL 60202
fpeschulte@aol.com
847/866-7479

THE NIST SOFA SUPER STORE
DRAFT INVESTIGATION REPORT-PART 3
(ANALYSIS: INSULATED METAL DECK ROOF CONSTRUCTION)

By Richard Schulte

The Sofa Super Store in Charleston, South Carolina consisted of the main showroom constructed around 1960 and numerous additions. Page 1-34 in the NIST draft report of their investigation of the fire at the Sofa Super Store indicates that the original building was constructed with concrete masonry exterior walls and an insulated metal deck roof supported on steel bar joists. The insulation provided on the roof of the main showroom was a foam plastic material.

The insulation provided on the roof of the main showroom was a foam plastic material.

Page 1-34 in the NIST draft report is the only reference made to the construction of the roof deck of the main showroom. The report (and the appendices to the report) contains numerous photographs of the building construction, both prior to the fire and after the fire, however, the only photographs which shows the roof deck and insulation for the main showroom are on Pages D-16 and D-27 (Appendix D) of the report.

The International Building Code (IBC) contains special provisions for the use of foam plastic insulation in building construction in Chapter 26 of the Code, specifically Section 2603 in the 2006 edition of the Code.

The International Building Code (IBC) contains special provisions for the use of foam plastic insulation in building construction in Chapter 26 of the Code, specifically Section 2603 in the 2006 edition of the Code. The general provisions for the use of foam plastic materials contained in Section 2603 indicate that foam plastic materials are required to have a flame spread index of 75 or less and a smoke developed index of 450 or less when the material is tested in accordance with ASTM E84.

In addition to the requirement outlined above, section 2603.4 of the IBC requires that foam plastic materials be covered with materials which have a 15 minute finish rating when tested per ASTM E119. Given that metal roof decking will not develop a 15 minute finish rating, a material which develops a 15 minute finish rating, such as one-half inch thick gypsum wallboard, is required to be provided between the metal deck and the insulation where the roof is insulated with foam plastic materials.

The code provides a number of exceptions to the general requirement for separating foam plastic materials from interior building spaces with materials with a 15 minute finish rating. The exception contained in section 2603.4.1.5 specifically indicates that an insulated metal deck roof is exempt from the requirement for a thermal barrier between the deck and foam plastic insulation if the metal deck and roof covering are tested and pass either the 1989 edition of FM 4450 (with revisions through 1992), the Approval Standard for Class 1 Steel Deck Roofs, or the 2002 edition of UL 1256, Fire Test of Roof Deck Construction.

The following are excerpts from 1989 edition of FM 4450:

> "*This standard states FM Approvals requirements for the Approval of Class 1 insulated steel roof decks. A Class 1 insulated steel roof deck is one which meets the criteria of this standard for fire, wind uplift . . .*" (Section 1.1, Page 1)

> "*Insulated steel deck roof components, incorporated in a complete insulated steel deck roof assembly(ies), which exhibit low fire spread below the deck. . .during the Approval examination will qualify as a Class 1 assembly.*" (Section 1.2, Page 1)

". . .This fact has been substantiated in actual rapidly spreading building fires on the underside of insulated steel roof decks in which combustible above the steel deck have supplied the necessary fuel contributions to induce rapid flame spread."

> "*Flame spread over a noncombustible surface, such as a metal faced combustible core assembly, is dependent on the fuel contribution of combustible components and not the surface burning characteristics of the metal. This fact has been substantiated in actual rapidly spreading building fires on the underside of insulated steel roof decks in which combustibles above the steel deck have supplied the necessary fuel contributions to induce rapid flame spread.*" (Section 1.1, Appendix B, Page 12)

"*. . .The furnace, test procedures, results and fire hazard ratings were developed by FM Approvals, and have been in use since 1955.*" (Section 1.2, Appendix B, Page 12)

"*. . .The furnace, test procedures, results and fire hazard ratings were developed by FM Approvals, and have been in use since 1955.*"

Based upon the description of the roof deck construction of the main showroom and the two photographs included in the report, it does not appear that there was a thermal barrier between the metal decking and the foam plastic insulating material. Perhaps it is possible that the construction of the main showroom roof deck complied with either FM 4450 or UL 1256, but that seems highly unlikely given that early 1970's vintage editions of the BOCA Basic Building Code did not make reference to either one of these two standards for steel roof deck construction.

Did the insulated metal deck roof provided for the main showroom at the Sofa Super Store contribute to the fire? Assuming that the roof deck construction did not comply with FM 4450 or UL 1256, there seems that there would be little doubt that the roof deck insulation would have contributed to the fire. Were the combustible gases generated by the foam plastic insulation on the metal deck the primary contributor to the increase in the rate of burning after the front windows of the main showroom were broken out? At this point in time, it's simply not possible to say, but it would seem that there is a relatively high probability that that was the case.

For certain, it can be stated that the NIST draft report totally ignored this possibility.

For certain, it can be stated that the NIST draft report totally ignored this possibility.

* * * * *

Ooops-Wrong Attachment

fpeschulte@aol.com [fpeschulte@aol.com]

Sent: Tuesday, November 30, 2010 12:44 PM

To: investig

Attachments: Insulated Metal Deck Roof ~1.pdf (317 KB)

Ooooooops-wrong attachment.]

rich schulte

PERFORMANCE CRITERIA AND TESTING FOR WIND AND FIRE RESISTANCE

R. L. Fricklas
Roofing Industry Educational Institute

Performance tests for fire and wind-uplift resistance of built-up roof assemblies evolve through experience and reaction to serious loss. Tests for three types of fire resistance—external, internal and time-rated fire endurance—have followed this pattern, with the catastrophic 1953 General Motors plant fire in Livonia, Michigan, sparking the most drastic changes in testing procedures and roof construction.

A similar process characterizes the development of tests and standards for wind-uplift resistance. The rising incidence of blowoffs during the 1960s paralleled the advent of lighter gage, flexible steel decks. New design criteria based on uplift tests and wind-tunnel tests, plus bad field experience with adhered (as opposed to mechanically fastened systems), have toughened wind-uplift standards for conventional bituminous roof systems.

The advantages of two-layered insulation—mechanically fastened bottom layer, hot-mopped top layer—have been documented through research and field experience. Meanwhile, the advent of loose ballasted roof systems, for which no generally recognized wind-uplift test procedures have been developed, poses the latest challenge in wind-uplift resistance.

TESTING FOR FIRE RESISTANCE

Fire testing can be classified into three basic categories:

- External fire exposure from flying brands or burning debris blown over from neighboring buildings on fire
- Internal fire exposure from interior inventory or equipment fires as measured by flame spread along the roof assembly soffit
- Fire endurance testing (time-temperature rating) per ASTM E119 furnace test

External fire-resistance tests have been designed to simulate wind-blown flaming debris as well as to measure the movement of flames up a roof covering's surface. UL test conditions, known as Class A, B, and C, simulate field conditions very well. They are widely accepted under ASTM E108. The test conditions can be duplicated remarkably well from laboratory to laboratory, and the tests are suitable for evaluating fire resistance of many different types of roof covering system.

Internal (below-deck) fire testing evolved as a reaction to the catastrophic 1953 fire in a General Motors Transmission plant in Livonia, Mich. The Livonia fire exposed the previously unrecognized fire hazard presented by a bituminous roof system applied directly to metal deck. Intense heat from an interior equipment fire reached the underside of the metal deck. Bituminous vapor-retarder materials in direct contact with the hot metal deck melted or vaporized and entered the building, where they accelerated rapid spread of the fire.

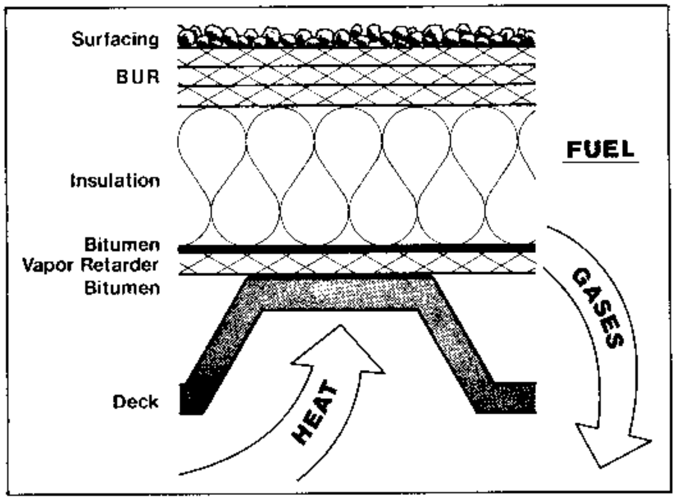


ILLUSTRATION 1
Fire Hazard of Insulated Steel Deck Construction

To establish criteria for fire-safe steel-deck built-up roof assemblies, Factory Mutual (FM) and Underwriters Laboratories (UL) built several large-scale building models to duplicate conditions that caused the intense burning and rapid flame spread in the GM fire. Incremental reductions were made from that level of combustibles until they were reduced to a safe level. The next step was to develop small-scale laboratory tests that duplicated the acceptable conditions determined by the large-scale tests.

As its approach to the problem, FM devised a test procedure featuring heat-release measurements in full-scale fire tests. These heat-release measurements (quantity and maximum rate during 30-minute fire exposure) are correlated with similar data from large-scale test-building fires to determine acceptable quantites of combustibles in the roof assembly. Since the mid-1950s, this FM Building Materials Calorimeter test procedure has been nationally recognized as the most representative acceptance criterion for the roofing and insurance industries, under the designation "Class I." It is applicable to roof assemblies with steel, wood, or structural cement fiber decks.

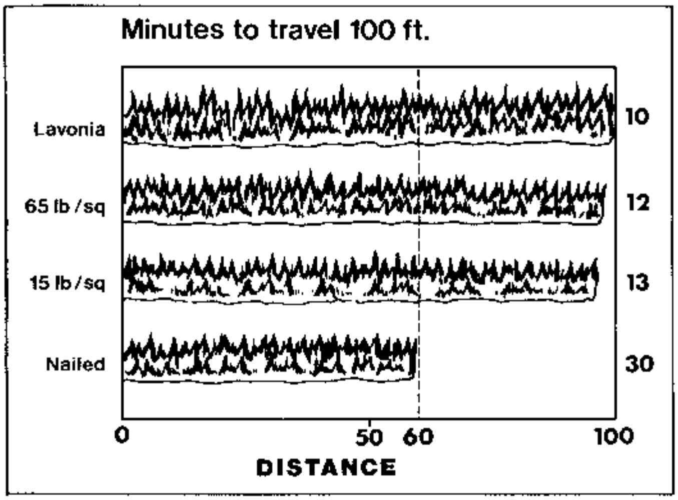


ILLUSTRATION 2
Fire Spread in Large Scale Test Building

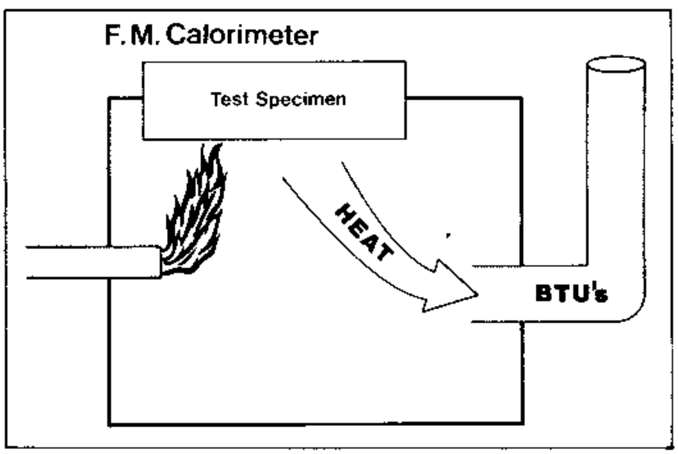


ILLUSTRATION 3
Factory Mutual Calorimeter

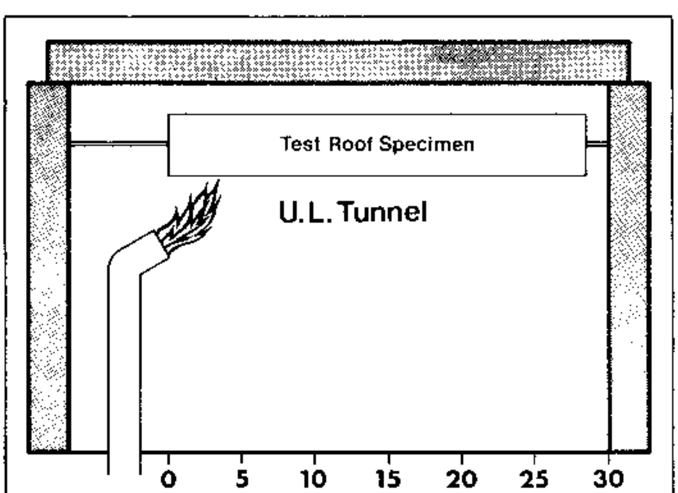


ILLUSTRATION 4
Underwriters Laboratories Tunnel

UL took a different approach, featuring its already developed test device, the Steiner tunnel, which measures flame spread and smoke density of building materials in a 10-minute test using red oak as the basis for comparison. To fire-test steel deck roof assemblies, UL modified the Steiner tunnel and installed in it a metal deck system, with all components from deck through surfacing aggregate. By comparing results with the large-scale tests, UL determined that a satisfactory assembly would not spread flame more than 10 ft. down the tunnel in 10 minutes, 14 ft. or less in 30 minutes. The 100-plus different insulated steel deck constructions that have passed this widely accepted test are listed in the current edition of the ***UL Building Materials Directory.***

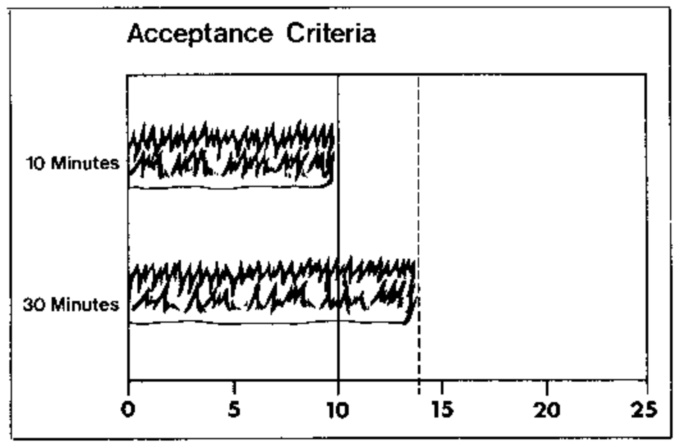


ILLUSTRATION 5
Acceptance Criteria of U.L. Procedure

Fire-endurance testing, using ASTM method E119, the third basic type of testing, exposes the bottom side of a roof-ceiling assembly to a specific temperature. Representing the fire load to which a building might be exposed, ASTM E119 is an index of its resistance to collapse. ASTM E119 does, however, pose a dilemma: as the system's thermal efficiency increases, the thermal load on the structural elements may increase, resulting in earlier failure. UL engineers have discovered that massive roof deck systems are not affected by increasing the R value from 22 or 3 to 20 or 30. There is more effect in the lighter constructions, such as

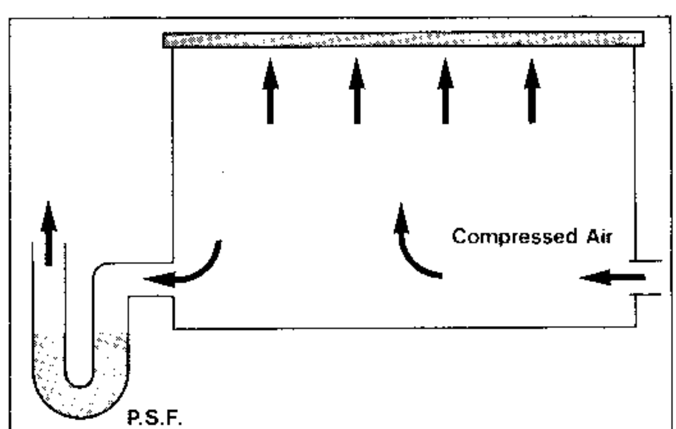


ILLUSTRATION 6
Fire Endurance (Time-Temperature) Testing

metal decks with hung ceilings. Nonetheless, several of these systems have been successfully tested and represented in UL's Fire Resistance Directory.

RECENT AND FURTHER DEVELOPMENTS IN FIRE RESISTANCE

In contrast with the successful fire tests described above, some small-scale fire tests, notably ASTM D1692, failed to exhibit the hazards of plastic foam insulation products when they were first used as construction materials. Some bad construction fires were unpredictable from the results of these small, unrealistic fire tests. Fortunately, when these same plastic foams were tested by the roof system tests previously discussed, these tests were found to be perfectly adequate, undoubtedly because the entire roof system was tested rather than single components. Polyurethane boards failed both the FM and UL criteria not merely because of their burning characteristics, but also because in melting they lost their ability to isolate the bituminous built-up roofing system from the fire. Acceptance of these materials was achieved by interposing perlite board, fibrous glass, or gypsum board between the polyurethane and the deck. Even if the plastic foam melted, the other product would remain in place as a barrier to fuel and combustible gasses. By having valid fire tests available to conduct development tests, the plastics industry was able to develop polyurethane foams with an isocyanurate "back-bone." In a fire, these will char in place, maintaining enough structure to hold back any bitumen. Several of these systems are now listed by FM and UL for direct application to metal roof decks.

Another recent related development has been the application of urethane foam sprayed directly to the topside of metal buildings. In this case, Underwriters Laboratories conducted a series of full-scale fire tests rather than laboratory tests, because of the complicated nature of the burning process. Some raised-seam roof decks, with appropriate combinations of foam and roof coating, are now classified.

WIND RESISTANCE

For about 10 years following the Livonia fire, field performance of these fire-rated steel roof deck assemblies was extremely good, with few problems reported. But then in the mid-1960s came thinner gage steel decks spanning longer distances with less securement at the ends, no fastening at sidelaps, stiffener grooves in the top flanges and narrower (3-in.) top flanges. These deck economies created their own set of problems: flange dishing and inadequate flat contact surface to receive adhesive and insulation. Under foot traffic, these thin-gage decks produced excessive dynamic deflections, causing failure of the adhesive bond. As a result of these compromises by the steel deck industry, steel deck roofs began to experience more frequent and larger-scale wind blowoffs.

The lack of attachment attributable to these economizing steel deck manufacturing practices remains a contributing factor in most wind losses. Just as the strength of a building depends on its foundation, the integrity of a roof system depends on the deck's rigidity.

Of the several small-scale laboratory tests available to evaluate steel roof deck systems for acceptable attachment, the FM method, developed in 1954, is probably the most widely recognized. It comprises a dynamic pressure test, with compressed air introduced between deck and roofing system in incremental steps until the roofing system fails. Roof assemblies that resist 60-psf uplift pressure for at least 60 seconds and meet the Class I fire condition are rated by FM as Class I-60 systems; those that resist 90-psf uplift for at least 60 seconds are rated I-90. This method has been satisfactory for testing the adhered roofing systems of the last 30 years. Critics point out that this FM test does not evaluate the effects of vibrations, oscillations and dynamic construction deflections that occur on a real building. There is, however, no available test programmed to duplicate these variables, especially construction traffic.

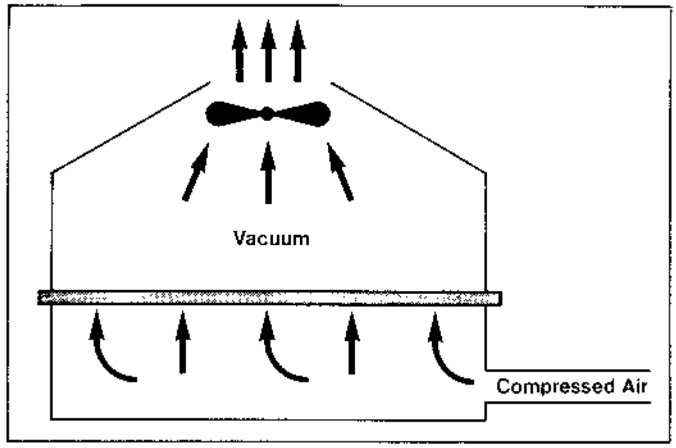


ILLUSTRATION 7
F.M. Uplift Pressure Test

UL uses a less well-known wind-pressure device. The lower chamber applies positive pressure like the FM method, but there is also an upper chamber cycled between atmospheric and negative pressure. This combination results in flexing of the roofing assembly thereby possibly correcting some deficiencies of the smaller scale FM test. UL classification levels are currently designated as Class 30, 60, and 90 with a Class 15 to be added when ANSI A58.1 is revised.

The roofing industry has been very slow to accept these standards, perhaps because of the severity of the UL tests, the cost, or both. The first conventional insulated metal deck

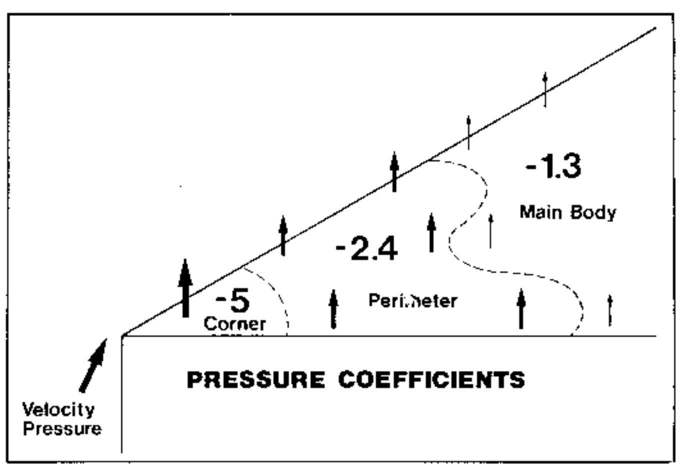


ILLUSTRATION 8
U.L. Uplift Pressure Test

system appeared in the UL directory in 1980.

In addition to progress in testing procedures, wind-uplift design pressures are periodically refined. When the American National Standards Institute published ANSI standard A58.1 in 1972, designers were able to mathematically estimate wind-uplift forces for a building under study. The ANSI standard recognizes such variables as terrain surrounding the building, building height average wind velocity from weather bureau studies, etc. By using published pressure coefficient data, wind-uplift pressures can be calculated for three different roof areas:

- corner areas where pressure coefficients are extremely high
- perimeter areas with moderate pressure coefficients, and
- interior portions where up-lift pressures are expected to be considerably less.

Height Above Ground	WIND ISOTACH M.P.H. (30 ft.)						
	70	80	90	100	110	120	130
0 - 30							
30 - 50	1						
50 - 100							
100 - 200			2				
200 - 300							
300 - 400							
400 - 500					3		
500 - 600							
600 - 700							
700 - 800							
800 - 900							
900 - 1,000							

ILLUSTRATION 9
Pressure Coefficients for Various Roof Areas

This basic ANSI approach is incorprated in FM's Loss Data Sheet 1-7, which defines three wind zones.

Wind zone 1, for roofing systems with calculated wind-uplift pressure = 30 psf or less. This is related to the FM static pressure test by assuming that those systems passing their Class I approval standard (60) (safety factor = 2) are suitable for application on roofs in Zone 1.

Zone 2, where wind-uplift pressures are between 30 psf and 45 psf. In zone 2, roofing assemblies must be approved by FM through its I-90 listings.

Zone 3, for roofing systems with calculated wind-uplift pressures exceeding 45 psf where metal roof decks may be inadequate and special design precautions required.

The ANSI method provides the numerical uplift pressures in pounds per square foot, leaving it up to the designer to develop sufficient information to select an appropriate roof system. FM lists systems that meet its zone requirements. In the perimeter and corner areas subject to higher pressure coefficients, FM requires use of approved mechanical fasteners to supplement the basic method of attachment. Mechanical fasteners are more reliable than any adhesive system.

The difficulties in accomplishing reliable field attachment of roofing systems with both cold adhesives and hot bitumens

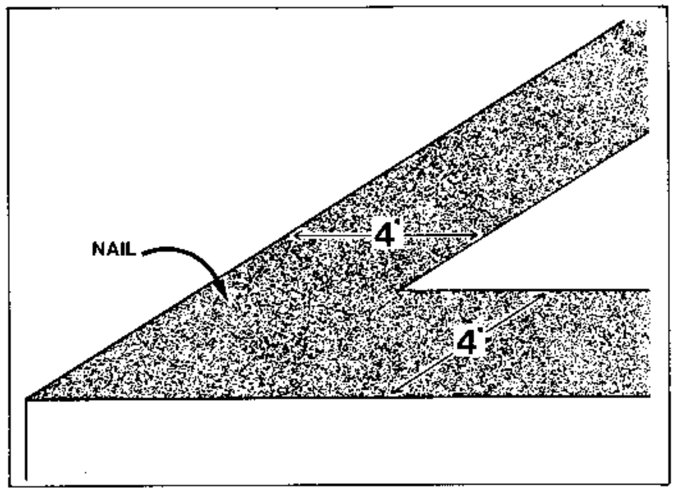


ILLUSTRATION 10
F.M. Zone Chart for Wind Resistance

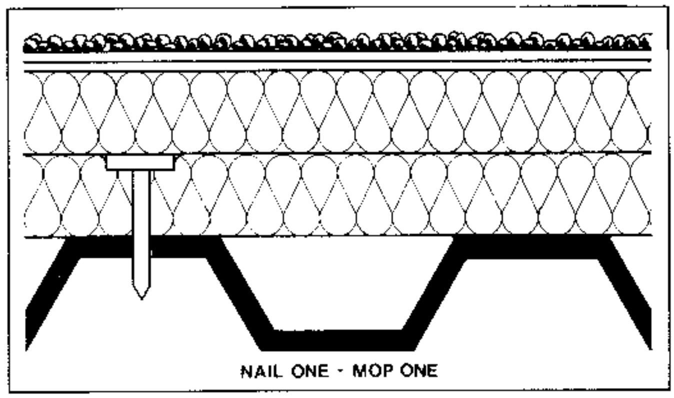


ILLUSTRATION 11
F.M. Perimeter Nailing Requirements

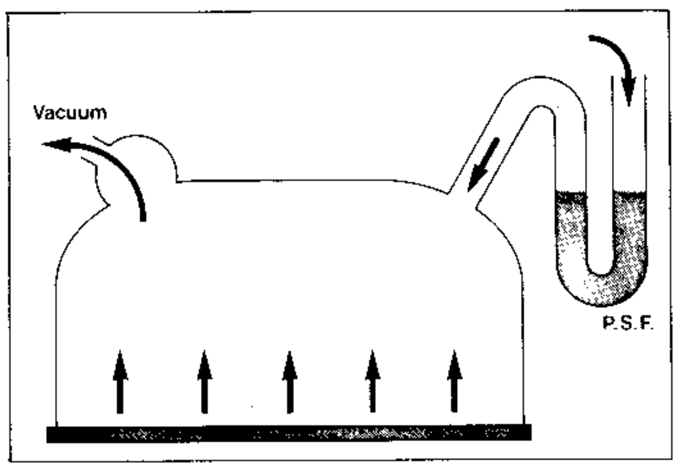


ILLUSTRATION 12
First Layer of Insulation Mechanically Fastened

have led to the "nail-one, mop-one" technique. Here, the bottom layer of roof insulation is mechanically fastened throughout the entire roof area, not merely at the perimeter. The top insulation layer is adhered to the bottom layer by a solid asphalt mopping. Joints between the two insulation layers are staggered. Two-layered insulation has several advantages:

1. Improved insulation anchorage (since adhesion is less dependent on substrate temperature) and consequently improved resistance to construction loads and wind-induced oscillations
2. Improved thermal efficiency (through elimination of "thermal bridges" at single-layered insulation joints)
3. Reduced stress concentrations at insulation joints (improved continuity of the insulation "plate" reduces low-temperature thermal contraction stress in the membrane by about 10%, according to Owens-Corning research).

Introduction of these two-layer systems also allows a combination of two different insulating materials, exploiting the special advantages of each. For one example, the bottom layer can serve as fire barrier for the top layer. For another, the top layer might act as a heat sink to prevent gas pressure from forming between a bottom layer of plastic foam and an impermeable roof membrane.

Judged by FM's loss experience, secure anchorage of perimeter flashing is vital to roof-system wind resistance. If metal flashing is lost in a severe wind storm, wind peeling action is likely to destroy even a securely fastened roofing system. FM Loss Data Sheet 1-49 includes recommendations for anchorage of perimeter wood members as well as fascia metal. The latest version of the 1-49 data sheet is now also designed to satisfy requirements of the various wind zones.

A revision to ANSI standard A58.1, currently underway, includes such things as hurricane factors, importance factors and other adjustments to the basic method of calculating the potential wind-uplift forces. After its publication, FM will update Loss Data Sheet 1-7 to reflect these changes. Basic concepts will however, remain unchanged.

One criticism made of laboratory tests for wind-uplift resistance is that while these tests adequately establish discrete levels of performance for various roofing materials and systems, they do not simulate installation abuses and localized overloads.

Through the pioneering work of the Midwest Roofing Contractors Association and more recently an ASTM committee on wind tests, a field uplift test has been designed to test actual roofing in the field. This test is intended to be non-destructive,—i.e. an acceptable roof membrane would require no repair after the test is run. The obvious advantage of a non-destructive method is its testing of the actual roof assembly, not a sample assembly applied by experienced technicians under ideal weather conditions on a clean, warm, metal deck in a laboratory.

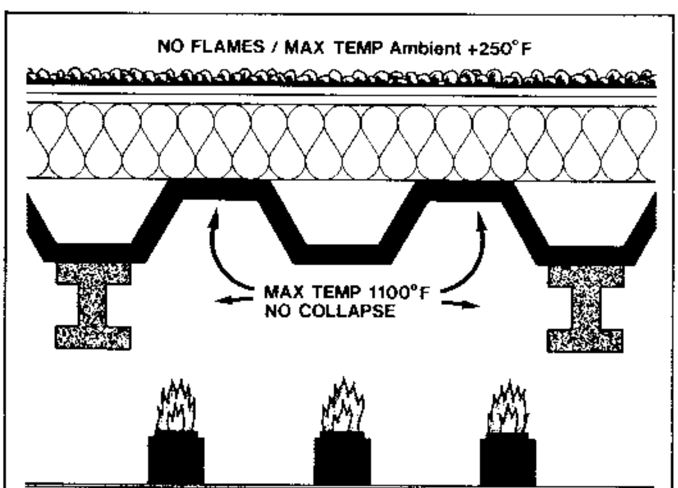


ILLUSTRATION 13
Uplift Test Device Designed for Field Testing

As the only compromise normally required for this field test, it is normally conducted before the flood coat and aggregate are applied. This timing is necessary to achieve an air-tight seal between the up-lift device and the roof membrane.

One drawback to running the negative pressure test prior to the graveling operation is that application of roofing aggregate normally involves heavy mechanized equipment. If the deck is not rigid enough to withstand the deflections and vibrations of this equipment traffic, the roofing system anchorage just judged acceptable could be ruined.

Work is continuing on the development of this test method. FM Data Sheet 1-52 on field uplift tests now includes this negative pressure test as a method of evaluating wind damaged roofing systems.

The entry of loose-laid roof systems into the roofing markets presents the latest problem in wind-uplift testing. Loose-laid roof systems, with their unanchored insulation and membrane, rely on ballast to keep them in place. It is impracticable to load a structure with ballast weighing 30 psf or more. More commonly, the dead weight of the ballast is around 10-15 psf. While this weight is probably insufficient to meet the design criteria of 30-40 psf normally required for attached systems, field experience suggests that an entirely different failure mechanism takes place in a ballasted roof. In the adhered system, any area that disbonds no longer contributes to the wind resistance of the roof system. These small unbonded areas can expand rapidly due to the low peeling resistance of the remaining attached section. An adhered roof system can thus experience a blowoff from local failure, much like the failure of the weakest link in a chain.

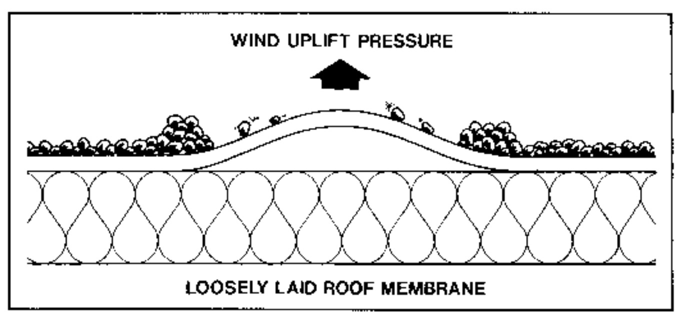


ILLUSTRATION 14
Wind Uplift Force on Loosely Laid, Ballasted Membrane

In ballasted systems, any area that does lift up transfers the ballast by rolling or dislodgement to nearby areas. Thus while a small section of the membrane might lose its ballast cover and be lifted up, the surrounding area would have the weight of the dislodged ballast as well as the original ballast and this should prevent further spreading of the damage.

Since we know that perimeters and corners are most vulnerable to wind-uplift, loosely laid systems are frequently protected by adding additional ballast at these locations. Sometimes concrete pavers weighing 20-25 psf are used instead of gravel in these areas. This provides a neat appearance to the roof structure and helps prevent roofing gravel from being blown off the roof, where it might break windows or hit pedestrians. These pavers are also used to delineate traffic walkways and to provide traffic platforms around rooftop HVAC units and other locations where workmen perform maintenance services.

Though we currently lack a valid wind-uplift test for loose-laid roof systems, the industry's successful development of performance tests for adhered systems points to a similar evolution of loose system testing of comparable reliability.

New Article: "GM Plant Fire: Livonia, Michigan (1953)"

fpeschulte@aol.com [fpeschulte@aol.com]

Sent: Wednesday, December 01, 2010 11:19 AM

To: investig

Cc: Shyam-Sunder, Sivaraj

Ladies and Gentlemen-

A new article titled "***GM Plant Fire: Livonia, Michigan (1953): Lessons Learned (and Long Forgotten***" has been posted on the Building Code Resource Library website.

richard schulte
Schulte & Associates
Building Code Consultants
Evanston, Illinois
fpeschulte@aol.com

Sofa Super Store report

deputy161@optonline.net [deputy161@optonline.net]

Sent: Wednesday, December 01, 2010 10:54 PM

To: investig; work [rsoltis@lawrencetwp.com]

Attachments: nist report.doc (25 KB)

To whom it may concern,
Attached are comments on the Sofa Super Store report and recommendations.

Yours in the Fire Service,
Richard A.Soltis Jr
Safety Officer
White Horse Fire Co/Fire Dist. 6
Hamilton, N.J. 08610

December 1, 2010

NIST Technical Study: Sofa Super Store
NIST
100 Bureau Drive
Stop 8660
Gaithersburg, MD. 20899

As a member of the Fire Service for over 30 years, and a Chief Officer for over 5 years, and being involved in Code Enforcement for over 24 years, I wish to contribute my thoughts on this Study.

In reference to recommendation #2, the best codes are worthless without effective code enforcement. I think that was from the end of the Coconut Grove Fire book. The International Codes are currently being updated every three years, but if they are not adopted and enforced on the local level, there is no sense of updated them to protect against catastrophic fire events from happening again. Codes have been developed over the years due to catastrophic fire events in this country or around the world; the Iroquois Theater the Coconut Grove, the Station Night Club.

In reference to recommendation #3, properly trained Inspectors are needed to make code effective. Properly enforced codes during construction of a structure are important. But Maintenance codes are equally important once the structure is complete and occupied. Items such as fire alarm systems, fire suppression systems and means of egress need to be inspected on at least an annual basis to assure they are at full operational readiness. Therefore properly trained inspectors are needed for both construction and maintenance of a structure.

In reference to recommendation #6, correct ventilation of burning structures is an important part of fire ground operations. Proper ongoing training is vital to the fire service, especially on ventilation. Initial training of firefighting forces is important but advanced and ongoing training is even more important. As new methods or technology becomes available on safer methods to fight fires, this information needs to be passed on to suppression forces around the country. I feel one example of how the fire service did not pass down information or was left out of the loop is light weight truss construction, for years we went under the assumption that a wood frame construction was wood frame construction. But hidden behind the walls were structural members that were meant to fail. And until we realized this, we lost many firefighters until we started changing our tactics in light weight truss construction. Ongoing training is vital to proper ventilation. If ventilation of a structure that is on fire is not properly executed, firefighters may be injured, the fire may be feed oxygen and grow beyond control.

In reference to recommendation #10, more research is needed on the affects of ventilation on fire growth. Similar to the recent study of fire on light weight truss construction, an in-depth study on the affects of ventilation on fire growth and spread need to be conducted and the findings passed along to the fire service so they can adjust their fire ground tactics to make safer discussions.

I commend NIST for collecting this data and formulating these recommendations. Hopefully more members of the fire service will read this initial and final report to make the fire service safer.

Yours in the Fire Service,

Richard A. Soltis Jr
Fire Sub Code Official, Lawrence Twp., N.J.
Past Chief, White Horse Fire Co, Hamilton, N.J.

December 1, 2010

NIST Technical Study: Sofa Super Store
NIST
100 Bureau Drive
Stop 8660
Gaithersburg, MD. 20899

As a member of the Fire Service for over 30 years, and a Chief Officer for over 5 years, and being involved in Code Enforcement for over 24 years, I wish to contribute my thoughts on this Study.

In reference to recommendation #2, the best codes are worthless without effective code enforcement. I think that was from the end of the Coconut Grove Fire book. The International Codes are currently being updated every three years, but if they are not adopted and enforced on the local level, there is no sense of updated them to protect against catastrophic fire events from happening again. Codes have been developed over the years due to catastrophic fire events in this country or around the world: the Iroquois Theater the Coconut Grove, the Station Night Club.

In reference to recommendation #3, properly trained Inspectors are needed to make code effective. Properly enforced codes during construction of a structure are important. But Maintenance codes are equally important once the structure is complete and occupied. Items such as fire alarm systems, fire suppression systems and means of egress need to be inspected on at least an annual basis to assure they are at full operational readiness. Therefore properly trained inspectors are needed for both construction and maintenance of a structure.

In reference to recommendation #6, correct ventilation of burning structures is an important part of fire ground operations. Proper ongoing training is vital to the fire service, especially on ventilation. Initial training of firefighting forces is important but advanced and ongoing training is even more important. As new methods or technology becomes available on safer methods to fight fires, this information needs to be passed on to suppression forces around the country. I feel one example of how the fire service did not pass down information or was left out of the loop is light weight truss construction, for years we went under the assumption that a wood frame construction was wood frame construction. But hidden behind the walls were structural members that were meant to fail. And until we realized this, we lost many firefighters until we started changing our tactics in light weight truss construction. Ongoing training is vital to proper ventilation. If ventilation of a structure that is on fire is not properly executed, firefighters may be injured, the fire may be feed oxygen and grow beyond control.

In reference to recommendation #10, more research is needed on the affects of ventilation on fire growth. Similar to the recent study of fire on light weight truss construction, an in-depth study on the affects of ventilation on fire growth and spread need to be conducted and the findings passed along to the fire service so they can adjust their fire ground tactics to make safer discussions.

I commend NIST for collecting this data and formulating these recommendations. Hopefully more members of the fire service will read this initial and final report to make the fire service safer.

Yours in the Fire Service,

Richard A. Soltis Jr.
Fire Sub Code Official, Lawrence Twp., N.J.
Past Chief, White Horse Fire Co, Hamilton, N.J.

Fwd: Fwd: NIST Study on Charleston Furniture Store Fire Calls for National Safety Improvements

rgmeagher@strategicsafety.net [rgmeagher@strategicsafety.net]

Sent: Monday, November 01, 2010 10:17 AM

To: investig

From: Robert Meagher <rgmeagher@comcast.net>
To: Meagher Robert <rgmeagher@strategicsafety.net>
Subject: Fwd: NIST Study on Charleston Furniture Store Fire Calls for National Safety Improvements
Date: Mon, 1 Nov 2010 12:43:55 +0000 (UTC)

Thank yoiu for the information. I do have one question on item # 6.

Factors identified as contributing to the fire's progress include:

6. the four fire-activated roll-up doors (out of seven) that activated but did not close during the fire.

1.) Were these doors serviced annually, I guess we would never know if the fusible links were painted ???? Did the insurance company have recommendations on these doors to serviced????

Do you know what was the fire rating of the wall.

Thank you;

Robert G. Meagher, CFPS
Strategic Safety Incorporated
P.O. Box 98
205 North Bridge Street
Linden MI 48451

Main Office Phone: 810 / 735-9885
Robert's Office Phone: 734 / 358-0228
Fax: 810 / 735-0705

Website: www.strategicsafety.net

Email: rgmeagher@strategicsafety.net

Please reply to this message if you are experiencing technical difficulty. For all other nquiries, please Contact USFA.You are subscribed to the U.S. Fire Administration's USFA) General Announcements E-mail list. This message is provided by USFA for nformational purposes only. NIST Study on Charleston Furniture Store Fire Calls for ational Safety ImprovementsFor Immediate Release: October 28, 2010Contact: Michael E. Newman 301-975-3025Draft Study Released for Public Comment Includes 11 Recommendations for Changes to Codes and Procedure

The complete draft report is available online at the NIST website.CHARLESTON, S.C.

— Major factors contributing to a rapid spread of fire at the Sofa Super Store in Charleston, S.C., on June 18, 2007, included large open spaces with furniture providing high fuel loads, the inward rush of air following the breaking of windows and a lack of sprinklers, according to a draft report released for public comment today by the U.S. Commerce Department's National Institute of Standards and

Technology (NIST). The fire trapped and killed nine firefighters, the highest number of firefighter fatalities in a single event since 9/11.Based on its findings, the NIST technical study team made 11 recommendations for enhancing building, occupant and firefighter safety nationwide. In particular, the team urged state and local communities to adopt and strictly adhere to current national model building and fire safety codes.1 If today’s model codes had been in place and rigorously followed in Charleston in 2007, the study authors said, the > conditions that led to the rapid fire spread in the Sofa Super Store probably would have been prevented.“Furniture stores typically have large amounts of combustible material and represent a significant fire hazard,” said NIST study leader Nelson Bryner. “Model building codes should require both new and existing furniture stores to have automatic sprinklers, especially if those stores include large, open display areas.”Specifically, the NIST report calls for national model building and fire codes to require sprinklers for all new commercial retail furniture stores regardless of size, and for existing retail furniture stores with any single display area of greater than 190 square meters (2,000 square feet). Other recommendations include adopting model codes that cover high fuel load situations (such as a furniture store), ensuring proper fire inspections and building plan examinations, and encouraging research for a better understanding of fire situations such as venting of smoke from burning buildings and the spread of fire on furniture.Using a state-of-the-art computer model to simulate the fire, the study team found that the addition of automatic sprinklers inside the loading dock could have significantly slowed the fire (which began just outside the dock area), prevented it from spreading beyond the dock, and eventually, extinguished it completely. The model also showed that sprinklers on the loading dock likely would have maintained what firefighters call tenability conditions, the ability for individuals in a fire event to escape unassisted.Factors identified as contributing to the fire’s progress include: the high fuel loads—especially furniture—present throughout the building; the lack of sprinklers throughout the Sofa Super Store; the open floor plan of the facility; the hidden build-up of combustible smoke and gases in the area between the drop ceiling and the roof of the main showroom; the non-fire-activated roll-up door that was open between the loading dock and the holding area; the four fire-activated roll-up doors (out of seven) that activated but did not close during the fire; the metal walls in the warehouse and west showroom that allowed heat from the fire to ignite items next to the walls; and the breaking of windows at the front of the store that supplied air to the fire.NIST’s team of experts traveled to Charleston to gather data within 36 hours of the Sofa Super Store fire. Using these data and other information collected in the following months (such as building design documents, records, plans, video and photographic data, radio transmissions, interviews with emergency responders, and informal discussions with store

employees), the NIST study team developed its computer model to
> simulate and analyze the characteristics of the fire, including fire spread, smoke movement, tenability, and the operation of active and passive fire protection systems.Based on their model and the data collected, the NIST researchers determined the following sequence of events on June 18, 2007, at the Sofa Super Store:The fire began in trash outside the loading dock and spread into the enclosed loading dock. The fire spread from the exterior to the interior of the loading dock, which was used for staging furniture for delivery and repair. The fire spread quickly within the loading dock and moved into both the retail showroom and warehouse spaces.During the early stages of this fire, the fire was unable to access enough air, a state that slowed its growth. However, the lack of sufficient air for complete combustion did result in large volumes of smoke and combustible gases flowing into the space below the roof and above the drop ceiling of the main retail showroom.The fire spread to the rear of the main showroom through the holding area and ignited additional fuel in the rear of the main showroom, at which time it became more visible to firefighters in the main showroom.The growth of the fire at the back of the main showroom was still slowed by the lack of air. As the fire burned in the rear of the main showroom, the fire pumped more hot unburned fuel into the smoke layer below the drop ceiling. The lack of air prevented the unburned fuel in the smoke layer from igniting.When the front windows were broken (approximately 24 minutes after firefighters arrived at the store), additional air flowed in the front windows, along the floor and to the rear of the showroom, and became available to the fire. The additional air allowed the burning rate of the fire to increase rapidly and ignite the layer of unburned fuel below the drop ceiling.The fire swept from the rear to the front of the main showroom extremely quickly, then into the west and east showrooms, trapping six firefighters in the main showroom and three firefighters in the west showroom.Furniture and merchandise in the showrooms and warehouse continued to burn for an additional 140 minutes before the fire was extinguished.The complete draft report is available online at http://www.nist.gov/el.NIST welcomes comments on the draft report and its recommendations. To be considered for the final report, comments must be received by noon EST on Dec. 2, 2010. Comments may be submitted via e-mail to firesafety@nist.gov; fax to (301) 975-4052; or mail to the attention of NIST Technical Study: Sofa Super
> Store, NIST, 100 Bureau Dr., Stop 8660, Gaithersburg, MD 20899-8660.Once the final report is published, NIST will work with the appropriate committees of the International Code Council (ICC) on using the study’s recommendations to improve provisions in model building and fire codes. NIST also will work with the major organizations representing state and local governments—including building and fire officials—and firefighters to encourage them to seriously consider its
> recommendations.NIST has more than 40 years of experience conducting building and fire safety studies and researching the aftermath of disasters and failures. By understanding the technical causes for such incidents and making the information available to the public, NIST scientists and engineers strive to improve the safety of buildings, their occupants and emergency responders. NIST’s technical building failure and fire studies
> do not
> address fault.As a non-regulatory agency of the U.S. Department of Commerce, NIST promotes U.S. innovation and industrial competitiveness by advancing measurement science, standards and technology in ways that enhance economic security and improve our quality of life.1The International Code Council (ICC) I-Codes are used as models for building and fire regulations promulgated and enforced by U.S. state and local jurisdictions. Those jurisdictions have the option of incorporating some or all of the code’s provisions but generally adopt most provisions.The United States Fire Administration recommends everyone should have a comprehensive fire protection plan that includes smoke alarms, residential sprinklers, and practicing a home fire escape plan.Follow USFA updates onTwitterUpdate your subscriptions, modify your password or e-mail address, or stop subscriptions at any time on your Subscriber Preferences Page. You will need to use your e-mail address to log in. If you have questions or problems with the

U.S. Fire Administration · U.S. Department of Homeland Security · Emmitsburg, MD 21727 · (301) 447-1000

Comments on Draft Report-Technical Study of the Sofa Super Store Fire-South Carolina, June 18, 2007

Herdina, Susan [HERDINAS@charleston-sc.gov]

Sent: Wednesday, December 01, 2010 5:50 PM

To: investig

Cc: Carr, Thomas [CARRT@charleston-sc.gov]

Attachments: DOC001.PDF (83 KB)

Dear Sir or Madame,

On behalf of Chief Carr, Fire Chief for the City of Charleston, attached are the comments of the City of Charleston on the Sofa Super Store Fire draft NIST report.. Earlier today, we sent these comments by fax. We also are mailing an original to you. If you have any questions, please contact Chief Carr at 843.720.1981 or me at 843.724.3730.

Thank you,

Susan Herdina
Assistant Corporation Counsel
City of Charleston

JOSEPH P. RILEY, JR.
MAYOR

THOMAS W. CARR, JR.
CHIEF

City of Charleston

South Carolina

Fire Department

December 1, 2010

VIA ELECTRONIC DELIVERY, FACSIMILE AND U.S. MAIL
NIST Technical Study: Sofa Super Store
100 Bureau Drive, Stop 8660
Gaithersburg, MD 20899-8660

RE: The City of Charleston's comments regarding the October 28, 2010, Draft NIST Report.

Dear Sir/Madame:

On behalf of the City of Charleston, I would like to thank NIST for its comprehensive examination of the tragic fire which we suffered at the Sofa Super Store on June 18, 2007. It is our understanding that NIST's three and a half year effort was aimed at studying fire spread which lead to firefighter fatalities. It is further our understanding that the goal of NIST is to recommend code, standard and firefighter practice changes rather than determining fault.

The City of Charleston was most impressed with the computer simulation as well as the verbal presentation given to enlighten us regarding the likely path of the fire. The City is wholeheartedly in agreement with NIST's recommendation regarding fire sprinklers, and in fact, we have been steadily promoting fire sprinkler legislation in all levels of government. Unfortunately, at the municipal level, the City is not in a position to effectuate mandated fire sprinkler legislation as such is superceded by state law. However, we are making every effort to advocate the importance of fire sprinklers to our legislators and in fact we are providing your computer simulated models of the fire spread to every member of our state's legislature and state fire chiefs.

The City also wholeheartedly agrees with many other NIST recommendations such as future research to be conducted at a federal level. However, again, the City of Charleston is unfortunately not in a position to effectuate the recommendations in that regard.

As you may have heard, subsequent to the Sofa Super Store tragedy, City of Charleston has undergone numerous changes in our fire department. As your report is now the fourth in a series of federal and state investigations, and since it is our understanding that your publication is

46 ½ WENTWORTH STREET, CHARLESTON, SOUTH CAROLINA 29401 • PHONE (843) 720-1981 • FAX (843) 720-3991

prohibited from use in any legal proceedings, the City does not feel it necessary to comment upon each and every area wherein there may be some disagreement with the report.[1] However, there are a few areas where the City respectfully requests amendment, edification or clarification.

First and foremost, a review of the written report itself without the NIST commentary as provided by Mr. Bryner in his presentation leads one to believe that our heroic firefighters died as a result of the windows in the front of the store being broken, which occurred late into the incident. However, upon explanation by Mr. Bryner during his presentation, it was clear that by the time the windows were broken, our nine heroes had already succumbed in the fire as the building had become "untenable."

Accordingly, we believe that the NIST draft report needs to be corrected in that in multiple places throughout, it appears that the agency is suggesting that the breaking of the windows was responsible for the deaths of the firefighters even though we understand that it was not NIST's intent or mission. While your report raises the issue of tenability, that discussion does not begin until page 4-23. Accordingly, the City respectfully requests that this important issue be moved to the forefront of your report and that the report specifically set forth the fact that the nine firefighters who perished had most likely succumbed prior to the store front being ventilated.

The City also would respectfully request that NIST review its section regarding the record keeping system of the City. NIST correctly points out that the Sofa Super Store building was originally in the county when constructed.[2] Also correct is that there were permitted additions and a variance granted when the building was later annexed into the City. The City's records are available. What your report suggests, however, is that there are missing records for the five illegal additions which joined the Sofa Super Store warehouse to the main location. For instance, on page 1-32 of the report, NIST states "[b]uilding permits were not located for the loading dock area or the repair areas which were added subsequent to the completion of the warehouse." The reason those records were not located is because they are not in existence. The additions were clearly not permitted and never would have been permitted. Therefore, rather than this being an error of the City regarding record keeping, the City would respectfully request that it be made clear there were no permits issued. The store's owner knew or should have known that he would never have been able to receive permits for those additions which would have (and did) effectively eviscerate the intent of fire codes.

---

1 To cite a few examples: The City of Charleston did not remove a fire hydrant; the City was unaware that the Sofa Super Store warehouse was going to be used for high piled storage; the City does use qualified fire inspectors and has added inspectors; there is no mention that the Sofa Super Store's exits were padlocked; there are numerous mentions of the lack of fire alarms, smoke detectors and stand pipes without regard to any codes requiring those items or how those items impacted this fire; N.F.P.A. 1500, while a worthwhile goal for any fire department, is not the legal standard in South Carolina; the timeline is not wholly accurate and omits the commander's first order to evacuate the building; the NIST report mentions various and sundry matters such as incident command, water supply, vertical ventilation (which apparently would not have assisted in this case), mutual aid and other topics which appear to go against NIST's stated goal of not casting blame, and beyond the scope of the NIST study.

2 The County of Charleston's building department should have maintained the records, not the City.

Also, I note that there is a mention that the civil litigation and/or the criminal case perhaps delayed NIST's determination. The City is unaware of any delay on our end which may have hindered NIST's study. If the City is in a position to assist your effort at moving along a final report, kindly let us know and we will certainly assist.

Finally, it would appear from your report that NIST truly does not exactly know how the fire spread from the illegal loading dock additions into the store front. A variety of scenarios has been thoroughly examined by NIST, and they present interesting possibilities. Much more clear, however, was the impact that fire sprinklers would have had if the sprinklers had been in place. For that reason, as stated earlier, we will be working with other local governments and fire chiefs throughout our state to push for sprinkler legislation in our upcoming legislative session. We look forward to any assistance that NIST is willing to provide us in this effort.

Once again, the City of Charleston is appreciative of NIST's effort and study.

Very truly yours,

Thomas W. Carr
Chief, City of Charleston Fire Department

TWC/sh
cc: Joseph P. Riley, Jr.
Mayor, City of Charleston

NISTSSS Study Comments

capmora@aol.com [capmora@aol.com]

Sent: Friday, December 03, 2010 4:48 AM

To: investig

Here are a few questions for Mr. Bryner in regards to the Charleston Study.

I have just seen your news release briefing on the results of your study with great interest and am glad to hear of the recommendations you offer. Thank you for all the hard work you and your staff do to help us learn from tragedies such as Charleston. The report is excellent. I have some questions and comments in regards to the effects of ventilation holes made in the roof although you did state you were not going to get into the ventilation aspect of the fire.

1. Did you happen to factor in any wind speed and direction when that verticle ventilation model was developed or did you assume wind was not a factor?
2. If a model was developed for ventilation holes in the roof why was there not one done using an 11 mph wind from the South and also from the Southwest?
3. It is interesting to note that looking at the "Oxygen levels at six points during the Charleston Fire" graph (7:13-7:38pm), that it can be interpreted as an increase of fire caused by the introduction of air by the breaking of the windows on the Alpha Side but it can also easily be viewed as the effects of the wind driving or pushing the fire from the right rear area of the building toward the large vent point that was created following the breaking of the windows. This was not a simultaneous engulfing of all of the contents in the entire showrooms with fire such as a flashover but as noted by the District Chief who was one of the last to leave the building after the windows were broken - a wall of fire that was coming from the right rear of the building and venting first out of the west show room windows then the main show room window and then the east show room window- which is not what one of the steps in your sequence states.
4. The report mentions that early on in the course of the incident the fire was unable to access enough air and did not spread. This makes sense. One observation and reason I would like to offer is that it was due to the fact that the only air reaching that portion of the showroom was being provided by air that was entering the opened exterior door leading to the loading dock enclosure and the exhaust fan hole adjacent to the exterior door. However, that changed when a portion of the roof above the loading dock collapsed and fell unfortunately in a funnel shape to allow the Southwest winds to feed directly down into the the double doors and the opened overhead door leading to the back of the main show room (photo provided in Routely Report). This provided a greater volume of pressurized air to enter the showrooms but there was still no significant vent point, considering the size of the structure, for the wind, smoke and fire to find the path of least resistance. In the Routley report a fire company at the scene reported hearing an explosion and seeing a fire ball rise above the area of the loading dock. This could have been caused by the partial roof collapse over the enclosed loading dock. As you know roof and floor collapses when above a working fire often sound like explosions and will cause fireballs and will quickly spread fire and smoke throughout the interior of a structure. When the windows were then broken they represented a significant vent point and the path of least resistance for the fire to spread. Similar wind driven fires occurred in Salisbury, NC and in Phoenix, AZ. They also reported heavy black smoke right before heavy fire vented from the vent points created. This sequence could have also been possible in Charleston as suggested by the Routely Report (see page 87 last paragraph " All of the observations are consistent with smoke banking down into the main show room at approximately 19:22 hours. This suggests that the interstitial space above the ceiling had filled with smoke by that time and the smoke began to bank down into the showroom. **A rapid change in smoke conditions could have been caused by circumstances that allowed more air to reach the fire, such as a partial collapse of the loading dock roof."** Also see last paragraph of page 88 " It is also possible that a rapid acceleration of the fire, caused by the igmition of fire gases and flammable vapors in the loading dock or a change in the air flow to the fire, could have pushed the fire through the double doors and overwhelmed the rear part of the west showroom. The rapid fire growth would have forced the firefighters to abandon their postions".

I believe the wind hazard which is commonly overlooked by firefighters played a major role in this and many other fires as noted in your recent the PPV /high rise study that stated (paraphrased)wind speeds as low as 10 mph can cause life threatening conditions on the interior of a structure. The Sofa Super Store was huge and configured such that it took some time for everything to unfortunately fall into place and vent as it did.

One more factor could be considered for the list of 8 and that would be that a funnel shaped partial collapse of the loading dock roof allowed air from an 11 mph Southwest wind to drive the fire through the structure and out of the vent points created by the broken windows on the Alpha Side.

Thank you for your time and work,
William R. Mora, Captain, Ret.
San Antonio Fire Department