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GM PLANT FIRE-LIVONIA, MICHIGAN (1953): LESSONS LEARNED (AND LONG FORGOTTEN)

By Richard Schulte

On October 28, 2010, the National Institute of Standards and Technology (NIST) released a draft report on its investigation into the fire which occurred at the Sofa Super Store in Charleston, South Carolina on June 18, 2007. The NIST draft report is 214 pages in length and includes another 516 pages of appendices. The draft report is filled with photographs, diagrams and illustrations.

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Of all the photographs included in the draft report, only the photographs on pages D-16 and D-27 (Appendix D) show the construction of the roof deck provided for the main showroom in detail. The only other reference to the main showroom roof deck construction is on page 1-34 in the report. Page 1-34 indicates that the roof provided for the main showroom was an insulated metal deck roof which included foam plastic insulation.

According to NIST's report, the fire at the Sofa Super Store originally started in trash located in the vicinity of the loading dock provided for the building. The trash fire spread into the loading dock and then into a space referred to as the holding room. Heat and other combustible products from the fire in the loading dock and holding room apparently flowed into the concealed space above the main showroom and, when fire fighters broke out the front windows of the main showroom to vent smoke from the building interior, the fire appears to have "flashed" once a sufficient quantity of oxygen reached the rear of the showroom from the new source of fresh air.

The investigators at NIST theorize that the flashover was caused by unburned combustible gases generated by the under-ventilated fires in the holding room and loading dock collecting in the ceiling space of the main showroom. Perhaps this was the case, but, more than likely, the primary source of the unburned combustible gases was the insulated metal deck roof.

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Given the fact that the main showroom was constructed with an insulated metal deck roof, a look back at the reaction to the fire at the General Motors transmission plant in Livonia, Michigan back in 1953 should be of interest.

An undated article titled "*Performance Criteria and Testing for Wind and Fire Resistance*" written by R. L. Fricklas of the Roofing Industry Educational Institute provides a bit of a history of the testing of insulated metal deck roof construction. Excerpts from this article include the following:

"Performance tests for fire and wind-uplift resistance of built-up roof assemblies evolve through experience and reaction to serious loss. Tests of 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 dramatic changes in testing procedures and roof construction."

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"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. . .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."

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"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 . . ."

“ . . . 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 roof 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 gases . . . ”

Further information on the subject of fire hazard of insulated metal deck roof construction is found in the 1989 edition of FM 4450, the Approval Standard for Class 1 Steel Deck Roofs. 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)

“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)

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“ . . . 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)

It appears that NIST may have overlooked one of the significant contributing factors to the fire at the Sofa Super Store, the insulated metal deck roof construction over the main showroom.

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