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NIST COMMENTARY ON FIRE MODELING

By Richard Schulte

On October 28, 2010, the National Institute of Standards and Technology (NIST) released a draft report of its investigation into the fire at the Sofa Super Store which occurred on June 19, 2007 in Charleston, South Carolina. The NIST draft report is titled "*Technical Study of The Sofa Superstore Fire-South Carolina, June 18, 2007*" and is authored by Nelson P. Bryner, Stephen P. Fuss, Bryan W. Klein and Anthony D. Putorti and is dated October 2010.

Chapter 4 in the report contains a modeling analysis of the fire. Included in Chapter 4 are the following general statements regarding the fire modeling analysis:

> *". . .Simulation results are an approximation of the actual event, and are most valuable when considered as qualitative rather than quantitative. . ."*

"*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.*"

"*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.*"

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"*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. . .Approximately four days were required to generate each 2400 second simulation.*"

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

Analysis

The excerpts above provide a rather interesting commentary on the use of computer fire modeling, in particular, the Fire Dynamics Simulator. In essence, the comments above confirm commentary by other practitioners on the accuracy and reliability of the output from a computer model.

The following two excerpts should be of particular interest to those that use fire modeling in their practice:

> "*. . .Simulation results. . .are most valuable when considered as qualitative rather than quantitative. . .*"

> "*. . .Over 250 computer simulations were required to match the observed phenomena and time line. . .Approximately four days were required to generate each 2400 second simulation.*"

Given the above statements by NIST, comments on the limitations of fire modeling made by Dr. Alan Beard and by Dr. Vytenis Babrauskas would appear to be not only credible, but a "bulls-eye". Certainly, those in the profession who choose to utilize fire modeling in a forensic or engineering analysis must justify that the model is capable of producing reliable and accurate results in a specific application. It would appear that simply doing a single run of the model, without examining the results in detail is poor engineering practice.

Note: Other articles in the Commentary section of this website examine the use of fire modeling by"experts" in the fire modeling field. Based upon NIST's commentary above, the expertise of these "experts" would appear to be questionable.

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