An Approach to Modeling Flame Spread over Polyurethane Foam-covered Walls

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ABSTRACT

Computer simulation has been demonstrated to be credible, when properly applied, as a tool to help fill in critical details of a fire incident and to demonstrate the value of alternative building designs and fire safety measures. This poster presents the results of numerical simulations and analyses of fire spread over polyurethane foam-covered walls that relate to the conditions in The Station nightclub fire in West Warwick, Rhode Island, on Feb. 20, 2003. The numerical models used in this investigation were the NIST Fire Dynamics Simulator (FDS) [1] and Smokeview [2]. The essential fire properties of the materials needed as input to FDS were generated from small scale and real scale measurements described in the final report on the NIST investigation [3] and presented in a companion poster at this symposium. The key parameters were the combustion properties of the foam/plywood wall; i.e., ignition temperature, heat of vaporization, and maximum burning rate. The results from cone calorimeter tests of the polyurethane foam could not be used directly in the simulation because of the composite nature of the foam-plus-plywood fuel on the wall of the nightclub. A comparison between laboratory measurements in a full-scale mock-up of the region around the performance platform and the FDS simulations of the experiments indicated a lag in fire development in the simulation relative to the experiments, but once the simulated fire grew large enough the growth rate and smoke development were consistent with the experiments. The temperature, heat flux, and the oxygen volume fractions were used to assess the degree to which the numerical model was capable of reproducing the large-scale experiments, and, in turn, of predicting the conditions during the early minutes of fire spread in the actual nightclub.

KEYWORDS: modeling, forensics, flame spread, fire growth, compartment fires, heat transfer, CFD, heat release rate, fire investigation

REFERENCES

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