# Fire Modeling of Different Ventilation Scenarios in a Compartment Fire

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A study on the fire dynamics within a large compartment with openings using the computational fluid dynamics based software, FDS v5, was carried out. The objective was to assess and help advance the predictive capabilities of FDS. The challenges for this particular scenario, in addition to those associated with general fire dynamics modeling within a compartment, where tied to the ceiling. The entire ceiling incorporated wood floor and support beams along with some geometric complexity.

The particular setup that was modeled was taken from one of several experiments conducted on basement fires with engineered wood I-beam ceilings as part of the overall research program at UL. Figure 1 shows the details of the basement that were captured in the model. In this scenario, a heat source placed within the basement was ignited and the flames eventually reached the ceiling causing further ignition of the wood, continuing the spread of flame and heat.

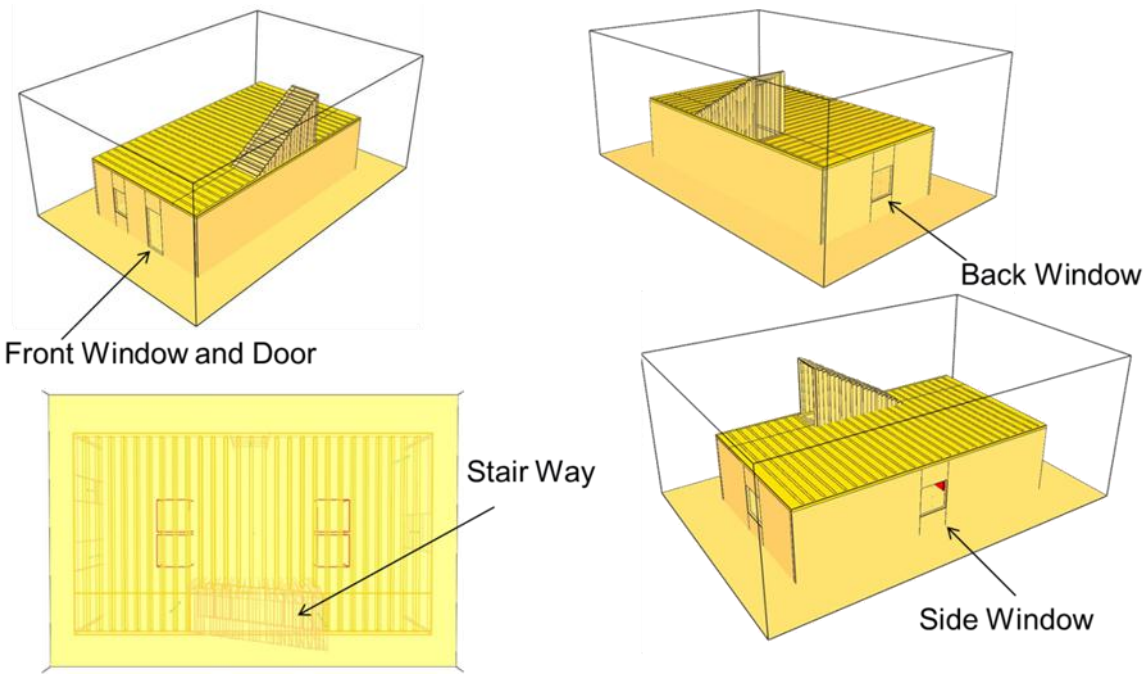


Figure 1

The basement model generated results both at discrete points and within planes related to temperature (both thermocouple and gas) and gas velocity along with flame and smoke visualization. Figure 2 shows a comparison of the flame and smoke visualization from the test and the model.

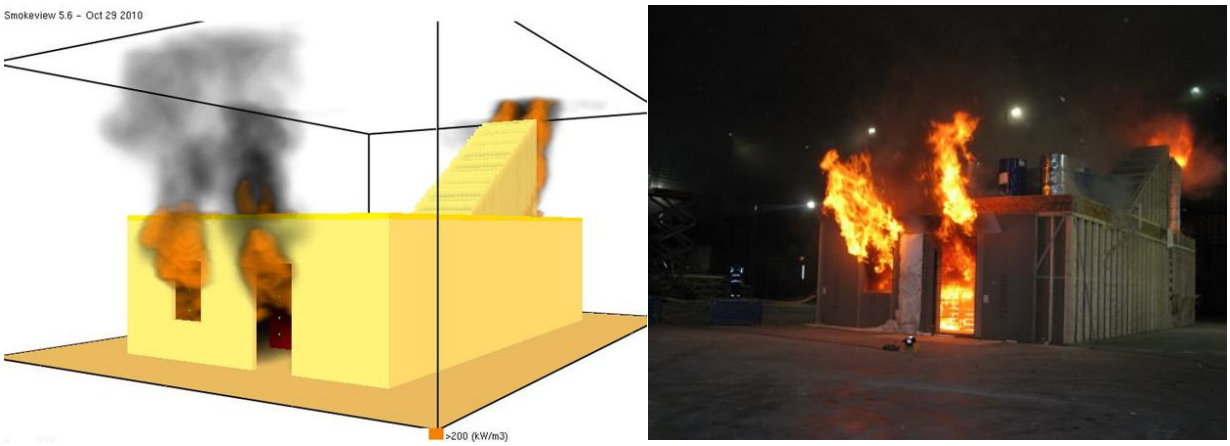


Figure 2

In general the model provided good agreement with bulk temperatures within the interior with differences noted at openings. Improvements in the predictability of the model can be tied to better heat release rate representation of the heat source and the burning wood.

Looking at some of the details of the model prediction, Figure 3 shows a snapshot of the gas temperature contours in plane cutting through the middle of the stairway. As the flames and hot air spread along the ceiling, they naturally followed the narrow channel created by the parallel engineered wood joists supporting the floor. Unlike the other door on the ground floor, the door for the stairway on the first floor was mostly seeing hot air leaving. Clearly, for an occupant to exit through the stairway would be hazardous.

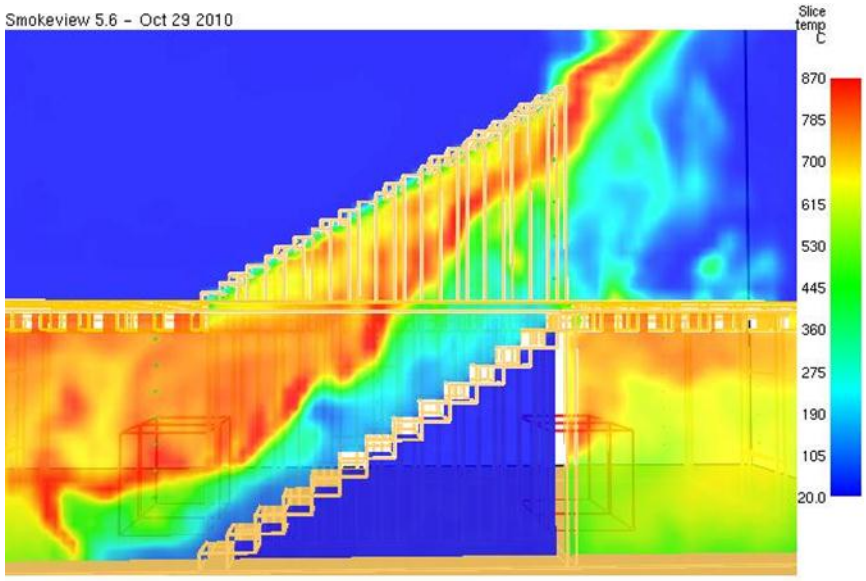


Figure 3

In the model heat and flames spread either by travelling along the narrow channel created by two adjacent joists (Figure 4) or over a joist in a lateral direction. The flow between the channels also is not adequately captured with only a few cells in a LES-based turbulent simulation.

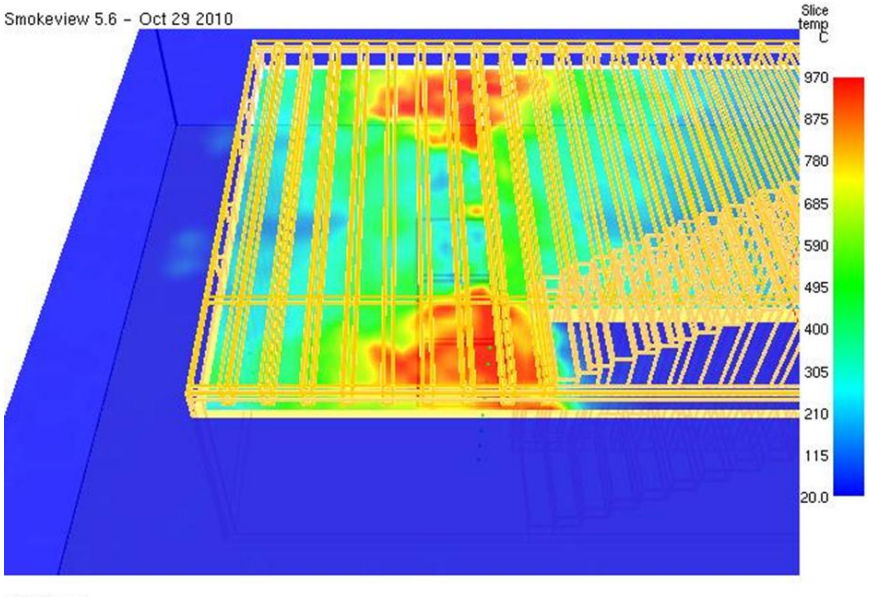


Figure 4

With this initial model showing good agreement with test data, then a series of different ventilation scenarios will be run to assess the change in fire dynamics with different firefighting strategies.