Modelling of Pulsing Postflashover Compartment Fires

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The Fire Dynamics Simulator version 6 (FDS6) has been extensively validated against a wide range of fire experiments. Typical validation studies from compartment fire experiments focus on common measurements such as temperatures, velocities, layer heights, heat release rates, mass loss rate etc. These comparisons are obviously useful but the real capabilities of FDS6 are demonstrated in its ability to model less common compartment fire phenomena.

One such poorly understood compartment phenomenon is pulsating fires. Under certain circumstances, pulsing behaviour have been observed in both pre- and post-flashover compartments and have been identified with poorly ventilated compartments. In this paper, a series of small scale post-flashover compartment fires that exhibited sustained harmonic pulsing are simulated in FDS6. The experiments were conducted in a small scale compartment (1 m by 1.5 m by 1 m high) with a horizontal vent in one wall and a circular vertical vent in the ceiling. A 0.3m diameter heptane pool fire was placed against the wall opposite the horizontal opening. The compartment was well insulated and quickly entered into the post-flashover phase with compartment temperatures ranging from 800-1200°C. After approximately 5 minutes the fire would enter into a steady pulsing phase with a frequency of 45-60 pulses/minute depending on the size of the vents. Eleven experiments were conducted in which five exhibited the steady pulsing behaviour.

The five experiments that exhibited pulsing were modelled in FDS6 with a prescribed heat release rate taken form the experiments. In four of the five experiments, FDS6 showed the same pulsing behaviour with similar frequencies recorded from Smokeview animations. Figure 1 compares the Smokeview image of the FDS6 simulation with a video image taken from one of the experiments. Compartment temperatures and vent velocities were also compared with experimental results and were found to be within the experimental uncertainty.

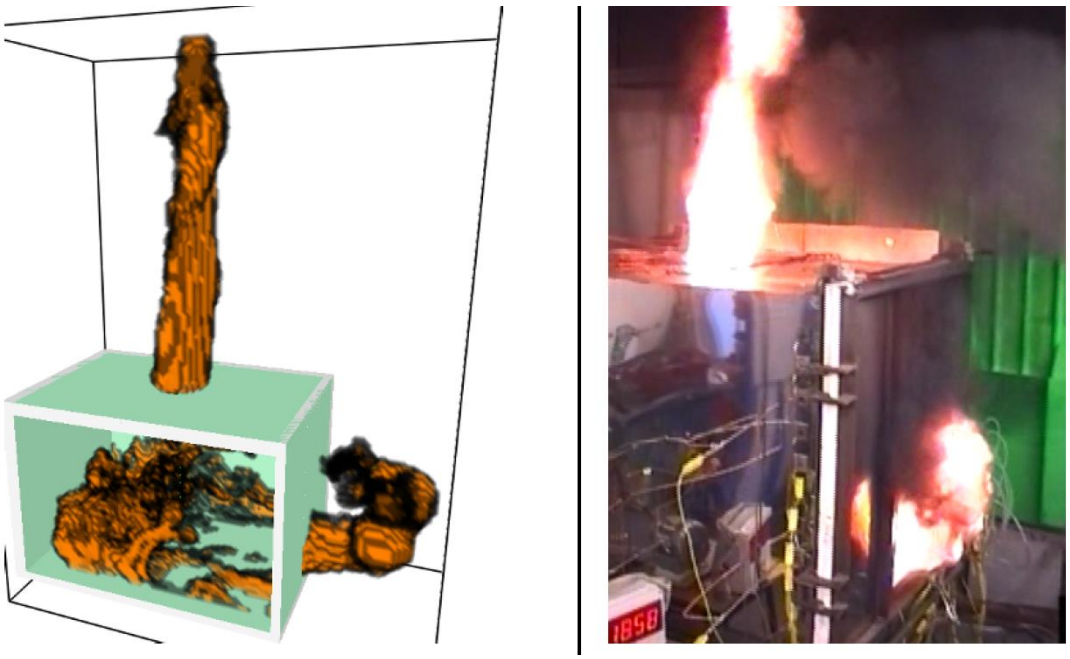

Figure 1 - Smokeview image of pulsing fire compared to experimental video image.