Emergency Ventilation System Modeling

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Architects and engineers are continually pushing the limits of design through the use of novel building shapes and mixed mode ventilation systems. Analysis techniques must be sufficiently sophisticated to follow suit, especially with respect to the life safety aspects of the design.

The mixed mode emergency ventilation system described in this work and proposed for a semi-enclosed bus terminal is a typical example. The terminal connects to a pedestrian mall and has a unique scalloped façade. STAR-CCM+ was used to aid in the design of the emergency ventilation system consisting of sprinklers as well as openings along the façade for natural smoke exhaust.

The project contained a number of modeling challenges including the size and complexity of the geometry, the boundary conditions (specifically related to determining a worst case wind condition and fire location) and the physics of modeling the sprinkler system.

Advanced meshing capabilities allowed the geometry to be properly represented with refinement in complex areas as well as in the fire zone. An iterative approach was used to determine the worst case wind direction and fire locations. Finally, Lagrangian multiphase particle tracking was used to account for the effects of the sprinkler system on the smoke migration in the terminal. Transient results demonstrated the evolution of smoke dispersion over time such that the performance of the emergency ventilation system could be evaluated.

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