SC/Tetra

Cradle
MSC Software Company

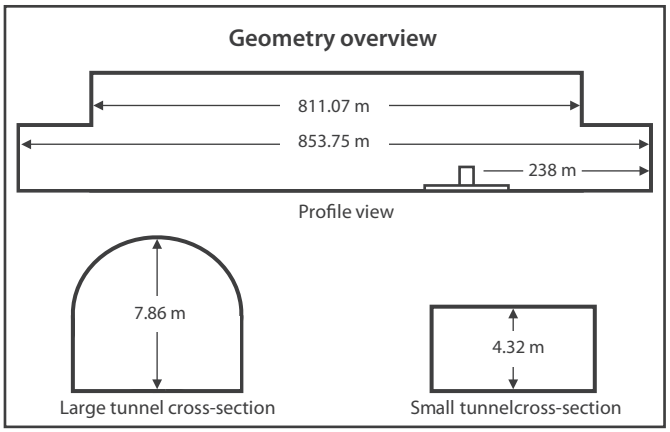
Temperature Ventilation Prediction of Vehicle Tunnel

Determining severity of back layering in underground car tunnel

Overview

Underground tunnels are equipped with mechanical ventilation systems to exhaust heat and smoke in the event of a fire. It is important that the ventilation system be able to prevent back layering during a fire. Back layering refers to the tendency of smoke and heat to be spread towards oncoming traffic, creating a harmful environment for people. Engineers use CFD to predict the severity of back layering during mechanical ventilation.

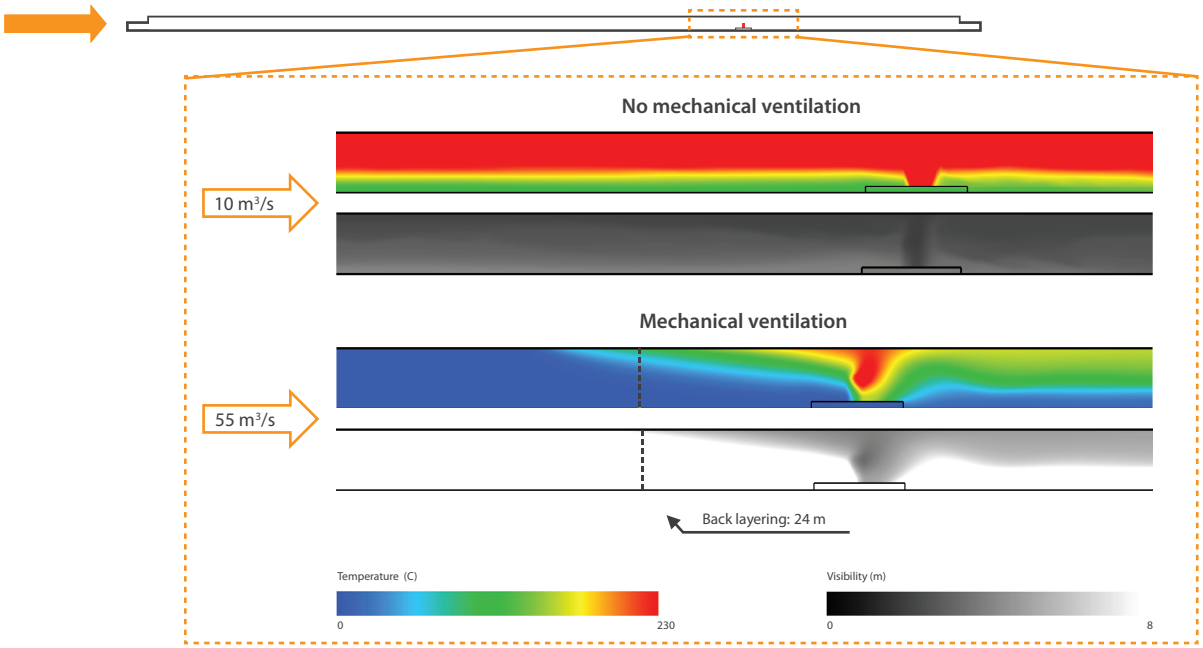
Both fire intensity and ventilation flow rate effect the severity of back layering. In this simulation, the temperature distribution and visibility of a tunnel with and without ventilation is compared to display the effect ventilation has on controlling temperature and visibility. Visibility was determined by relating the concentration of soot to visibility in meters.



Model and conditions

- Steady state analysis
- Soot generation: 0.02058 kg/s
- Fire heat generation: volumetric heat source of 12MW
- Ambient air temperature: 3.9˚C
- Airflow:
  - Mechanical ventilation: 55 m^3/s
  - Ambient airflow: 10 m3/s
- Number of elements: 1,989,680

Simulation results



Notes

Mechanical ventilation significantly reduces the spread of heat and smoke. When fully controlled, back layering is limited to 24 meters upstream from the fire. Without adequate ventilation, heat and smoke easily spread throughout the tunnel. This creates a dangerous atmosphere for occupants. CFD can be used to efficiently predict various scenarios by changing ventilation rates, fire/smoke intensities, and location of the fire source.