A numerical fire case study: Effect of smoke barrier on semi-transverse ventilation strategies for long tunnel sections

The results of a numerical study are presented: An underground vehicle facility was constructed to analyze the partial transverse ventilation system in the case of fire.

A special section of tunnel which was separated into two ventilation shafts was considered. This section was located between two axial jet fans. In the simulations, these two jet fans were not modeled directly but the effect of discharge velocity was implemented as a boundary condition. The main objective of the study was to investigate effects of fire barriers on different transverse extraction strategies.

All the simulations were performed by using commercial code STAR-CCM+ v6.06. At first, the selection of single-point extraction (SPE) opening strategy versus multi-point extraction (MPE) opening strategy was analyzed. In the single-point extraction (SPE) opening strategy, the smoke spread was found to be contained between the fire site and the point of smoke extraction. This result was obtained when the tunnel air velocity reached the critical velocity for preventing back-layering of smoke. For multi-point extraction (MPE) strategies with more than one opening, the smoke spread to all the extraction openings.

After these observations, fire barriers were activated. Smoke propagation was tried to lead between the extraction point and the fire core. Additionally, ventilation timing and ventilation shaft capacity changes were tested. Distributions of smoke spread, visibility, velocity and temperature were analyzed.

The most important outcome was that fire barrier additions to the ventilation systems play an important role for evacuation as well as to extinguish a fire.

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