Fire safety is considered as one of the major objectives in design, construction and specially tunnel operation. The hot and toxic smoke propagation is a fundamental reason of human losses during a fire inside the tunnels. Therefore, an exact analytical investigation on the probable fire scenarios and its destructive effects for passengers, vehicles and structure are the main part of the tunnel safety measures. The complications of tunnel fires can be reduced, using a suitable hot smoke management regime through the standard safety plan.

In a unidirectional traffic tunnel, upstream of the fire is usually a place where people and vehicles are trapped and can leave the tunnel during a fire only via egress ways. Meanwhile, downstream the fire people and vehicles in most cases will have a chance to leave the tunnel. In order to have a full view of the problem and to find a proper solution, numerous effective parameters in smoke control and temperature distribution have to be considered in design phases. A sufficient longitudinal air speed is one of the most important parameters in the hot smoke management. Mentioned longitudinal airflow creates a safe place upstream the fire.
through preventing smoke back-layering from the location of the fire.

The critical velocity is known as a required volume flow to prevent smoke back-layering from the location of the fire. The mentioned critical velocity is influenced by the heat release rate (HRR) of the fire, tunnel slope and structural characteristics. The implementation of small size fire tests is an easy and cheap way to see the performance of safety installations, smoke back-layering, and airflow and temperature distributions. However, as in most cases a full-scale fire tests is not easily feasible, CFD simulations can be a great opportunity to investigate the tunnel ventilation in a fire incident.

In this numerical study, CFD simulation is employed, to demonstrate the effect of the required critical velocity during the fire with high heat release rates, in a tunnel with different longitudinal slopes. The results are compared with other experimental data and numerical studies.

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Full Scaled Numerical Simulation of the Critical Velocity in Sloping Tunnels during the High Load Fire Incidents


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