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NUMERICAL EVALUATION OF EMERGENCY VENTILATION SYSTEMS IN CURVED AND SLOPED SUBWAY TUNNELS IN CASE OF FIRE

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Abstract

Based on corresponding engineering drawings, the goal of this study is to numerically assess the effectiveness of ventilation systems for the following emergency in subway networks: train on fire, stopped in the middle of a sloped tunnel, in the lowest point that corresponds as well to the point of maximum curvature of this tunnel. The following Computational Fluid Dynamics (CFD) approach is employed for predictions concerning the airflow and pollutants (monoxide carbon - CO and carbon dioxide - CO_2) dispersion due to fire: conservation of mass, momentum, energy (including radiative heat transfer), and species mass fraction (CO and CO_2), plus transport of turbulent quantities. Furthermore, time-varying source terms of heat, CO, and CO_2 are set to integrate the fire temporal evolution in the CFD model. Therefore, this method allows obtaining air velocity, air temperature, and pollutants concentrations throughout the computational domain. The results show that the designed ventilation strategy in case of emergency (based mainly on classic longitudinal ventilation) maintains a tenable environment and assures the safe evacuation of passengers despite the curved and sloping tunnel, considering that: the air velocity in the tunnel is well below the limit values recommended for tenability criteria along the path of egress; the air temperature is far from producing thermal burns to the respiratory tract; CO and CO_2 levels are well below the dangerous limit values to life and health.

Keywords: CFD modelling, emergency, subway train fire, ventilation

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