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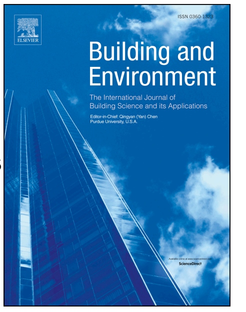

Mechanism and capability of ventilation openings for alleviating micro-pressure waves emitted from high-speed railway tunnels

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Mechanism and capability of ventilation openings for alleviating micro-pressure waves emitted from high-speed railway tunnels

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ABSTRACT

Micro-pressure waves are a major environmental problem related to modern high-speed railway systems. The strength of this harmful noise is proportional to the amplitude of the compression wave gradient generated by a high-speed train entering a tunnel. Employing an accurate numerical method, the mechanism and effects of ventilation openings on these compression waves are parametrically investigated. The numerical results indicate that after installing an opening, the compression wave is principally developed as multiple series of wave families, and thus, the pressure gradient curve is formed by numerous peaks and troughs. The gradient peaks U_{P0} and U_{V0} are generated successively by the train nose entering the tunnel and passing over the opening, respectively, and dominate the maximum pressure gradient. The vent ratio of the opening can be optimized by balancing these two peaks. However, the vent location and train Mach number can significantly affect the optimizing and the aerodynamic behaviour of the optimized opening, which is attributed to wave superposition. Three original engineering equations are proposed for understanding the effects of the vent ratio, vent location and train Mach number on the gradient peaks, respectively, and the denoising capability of the opening is evaluated.

Key words: Building environment, high-speed railway, tunnel hoods, train aerodynamics, micro-pressure wave, fluid-structure interaction