World Academy of Science, Engineering and Technology
International Journal of Aerospace and Mechanical Engineering
Vol:18, No:11, 2024

Study on the Influence of Different Lengths of Tunnel High Temperature Zones on Train Aerodynamic Resistance

Authors : Chong Hu, Tiantian Wang, Zhe Li, Ourui Huang, Yichen Pan

Abstract : When the train is running in a high geothermal tunnel, changes in the temperature field will cause disturbances in the propagation and superposition of pressure waves in the tunnel, which in turn have an effect on the aerodynamic resistance of the train. The aim of this paper is to investigate the effect of the changes in the lengths of the high-temperature zone of the tunnel on the aerodynamic resistance of the train, clarifying the evolution mechanism of aerodynamic resistance of trains in tunnels with high ground temperatures. Firstly, moving model tests of trains passing through wall-heated tunnels were conducted to verify the reliability of the numerical method in this paper. Subsequently, based on the three-dimensional unsteady compressible RANS method and the standard k-ε two-equation turbulence model, the change laws of the average aerodynamic resistance under different high-temperature zone lengths were analyzed, and the influence of frictional resistance and pressure difference resistance on total resistance at different times was discussed. The results show that as the length of the high-temperature zone LH increases, the average aerodynamic resistance of a train running in a tunnel gradually decreases; when LH = 330 m, the aerodynamic resistance can be reduced by 5.7%. At the moment of maximum resistance, the total resistance, differential pressure resistance, and friction resistance all decrease gradually with the increase of LH and then remain basically unchanged. At the moment of the minimum value of resistance, with the increase of LH, the total resistance first increases and then slowly decreases; the differential pressure resistance first increases and then remains unchanged, while the friction resistance first remains unchanged and then gradually decreases, and the ratio of the differential pressure resistance to the total resistance gradually increases with the increase of LH. The results of this paper can provide guidance for scholars who need to investigate the mechanism of aerodynamic resistance change of trains in high geothermal environments, as well as provide a new way of thinking for resistance reduction in non-high geothermal tunnels.

Keywords : high-speed trains, aerodynamic resistance, high-ground temperature, tunnel
Conference Title : ICWTA 2024 : International Conference on Wind Tunnel Aerodynamics
Conference Location : Singapore, Singapore
Conference Dates : November 18-19, 2024