NUMERICAL STUDY ON THE INFLUENCE OF HIGH-SPEED RAILWAY (KCIC) VELOCITY ON A RETAINING WALL AT A DISTANCE OF S/H 1.0417

Audha Fitrah Aulina S.T., M.T. Chief Conselor

Ferdian Fahrezi Maulana
Automotive Mechanical Engineering Study Program
Engineering Department

ABSTRACT

The development of high-speed rail transportation requires more in-depth aerodynamic studies, particularly regarding the interaction between airflow and the surrounding environment along the track. This study aims to analyze the effect of the speed of the Indonesia–China High-Speed Railway (KCIC) on pressure distribution, airflow patterns, and aerodynamic drag under the condition of a wall located on one side of the track with a distance ratio (S/H) of 1.0417. The method used is a numerical study based on Computational Fluid Dynamics (CFD) using ANSYS Fluent software. Simulations were conducted using a two-dimensional (2D) geometric model under steady flow assumptions. The turbulence model applied is the Shear Stress Transport (SST) k-ω model, which is capable of accurately predicting near-wall flow behavior and flow separation phenomena. The flow velocity variations analyzed are 70 m/s, 83 m/s, and 97 m/s, representing the operational conditions of high-speed trains. The simulation results indicate that increasing flow velocity significantly affects the drag coefficient and pressure coefficient values. The drag coefficient tends to increase with increasing velocity due to the higher aerodynamic drag acting on the train surface. Meanwhile, the pressure coefficient (Cp) also increases, especially at the front (nose) of the train, which is characterized by the formation of a high-pressure region. At high speeds, Cp values can reach approximately 1.25, indicating the presence of flow compressibility effects. In addition, the observed flow phenomena show the

occurrence of a blockage effect due to the presence of the wall, which causes flow constriction and an increase in fluid velocity in the gap between the train and the wall (nozzle effect). This condition generates a larger pressure gradient and leads to flow separation, wake regions, and vortex formation at the rear of the train. Under certain conditions, increasing velocity also has the potential to produce local shock waves around the train nose. Based on the results of this study, it can be concluded that flow velocity and the presence of a wall along the track significantly influence the aerodynamic characteristics of high-speed trains, including drag force, pressure distribution, and flow patterns. These findings are expected to serve as a reference for designing infrastructure around high-speed railways, particularly in determining safe distances between buildings and tracks to minimize aerodynamic effects.

Keywords**:** *High-Speed Train, Aerodynamics, Cfd, Drag Coefficient, Pressure Distribution, SST k-ω.*