Thermal Simulation of Vehicle Brake Disc during Successive Braking

Rahim Jafari
Department of Automotive Engineering, Atilim University
Kizilcasar Street, Incek, Ankara, Turkey

Abstract

In automotive engineering, mechanical braking systems are generally used to decelerate vehicles. During the braking, the friction between brake disc and the brake pads converts the kinetic energy of the vehicle into the thermal energy. The generated heat is proportional to the contact pressure. The perturbations develop in the pressure distribution if the sliding speed is high enough, leading to the local higher temperature increase or hot spot. Because of the hot spots on the friction surfaces, local greater thermal expansions occur in which cause thermoelastic distortion. This phenomenon is known as frictionally excited thermoelastic instability (TEI). If the generated heat is not dissipated effectively, some problems including excessive components wear, material degradation, thermal cracking and in extreme cases failure of the brakes occur. In this study, the thermal behaviour of the brake disc was investigated, numerically. Three dimensional geometry of the vehicle braking system including the disc, pads, the tire and the wheel rim was simulated. The SST turbulent flow model used for simulation of airflow on the system. Considering conduction, convection and radiation, the temperature distributions on the braking disc and pads were estimated. Although the results of successive braking revealed that the temperature increased continuously, but the increase rate was lower than the estimated values by common airflow over flat plate correlations.

Keywords: disc and pads, numerical method, turbulent flow, thermal analysis