ABSTRACT

A comprehensive analysis of design, mechanical performance, thermal performance and structural characteristics of a disc brake for front wheels of a light duty passenger comfort vehicle was carried out for its potential development in the existing braking technology. A design model for the prediction of optimum dimensions of cast iron brake disc has been formulated and developed based on the geometric and genetic programming techniques. The above design model is based on the Dixit, Beohar and Bal (1998) and Indian standards, (IS : 7300-1974) and Das and Pratihar (2002) design modeling concepts. The design model takes into consideration on an overall basis, the details of maximum torque to be transmitted based on the objective function under different operating conditions. The inner and outer radius of the brake disc is calculated based on the classical approaches of geometric and genetic programming. The mechanical performance parameters were calculated based on the performance parametric relations. The heat transfer calculations for the brake disc are based on Limpert (1974), Limpeprt and David Sheridan, James A. Kutchery and Farzad Samiee (1988) heat transfer and thermal loading models for brake disc. A thermal network model for the braking components assembly was developed and formulated to evaluate the heat transfer from the brake disc. These models are coupled along with the
above design and performance models to predict the effect of increased instantaneous brake disc temperature on thermal stresses, performance, deformations and overall performance of the brake disc. In this work, the overall effect of brake disc design conditions, application of alternate materials such as SiC Al MMC & Al Al MMC on mechanical and thermal performances have also been formulated developed and analyzed. As an additional investigation, the theoretically designed brake disc was analyzed for its structural characteristics using PRO-E and ANSYS finite element software packages.

To validate the predicted results, experimental investigations were carried out under identical conditions on a light duty passenger comfort vehicle under on-road test conditions. The vehicle was tested with all the three brake discs individually, made of cast iron, SiC Al MMC and Al Al MMC.

The predictions by the computer model, the experimental results and the capability of the model in predicting design dimensions, design and thermal performances on an overall basis are demonstrated, and the correlations are highly satisfactory.