# ADVANCES IN MATERIALS ENGINEERING

## Volume 1

Edited By:
Zahurin Halim
Iskandar Idris Yaacob
Md Abdul Maleque

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# Thermal Profile Analysis of Composite Brake Rotor

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**Keywords:** Brake rotor, finite element analysis, composite material, heat transfer, thermal profile, hot spot.

**Abstract.** The thermal profile analysis of the composite brake rotor for frictional heat generation is performed using the finite element analysis. To analyze the temperature distribution of the rotor surface the heat transfer phenomenon in the braking process is considered. A mathematical model has been developed to produce a systematic thermo-mechanical coupling to predict the surface temperature distribution. The ANSYS/Ls-dyna software was used for the analysis and the result was presented in 3D thermal profile for the brake rotor. The result shows that a remarkable heat distribution profile was achieved due to the high thermal conductivity of the composite material when compared to the conventional cast iron material. Based on the results, excessive heat generation on the rotor surface was prevented which could lead to regions of hot spots as a result of localized high temperature contact regions.

## Introduction

The application of finite element method for brake rotor analysis is utilised as a preferred procedure for studying brake performance. It has the ability to provide solutions to a variety of engineering problems involving complex and advanced material properties. Thermal distribution profile generated during braking significantly affects the brake rotor performance as a result of excessive frictional heat generation rate. Frictional heating and thermal deformation in sliding contact systems affect the contact pressure and temperature on the friction surfaces. If the sliding speed is excessively high, these coupled thermal and mechanical behaviors can be unstable leading to localized high temperature contact regions called "hot spots" on the sliding interface [1]. Regions of hot spots on the rotor surface can influence material damage and thermal crack which in turn can induce an undesirable frictional vibration in the brake rotor systems. Consequently, the frictional vibration imposes design constraints on high performance of the automotive brake rotor. The FE techniques can be used as a reliable tool to solve brake rotor problems which include heat generation, thermal distribution, contact pressure and thermal instability analyses approach.

Recent studies have shown that the use of finite element for composite material application is a potential technique for brake rotor development due to its thermo-physical properties [2]. In a study by Gao and Lin [3], they observed that considerable evidence has shown that the contact temperature distribution is an integral factor influencing the combined effect of load, speed, friction coefficient and the thermo-physical and durability properties of the materials. In another study Lee and Yeo [4] stated that the uneven distribution of temperature at the surfaces of the rotor could bring about thermal distortion which causes thermal judder and excited vibration. Chandrupatla and Belegundu [5] stated that temperature distribution analysis is mostly performed using FE method