

Transient Heat Transfer Analysis of High Speed Train Disc Brake Systems

Satoshi Fujii, Makoto Saito, Ph.D.

CAE & Materials Department, Nabtesco Corporation, Japan

As the maximum speed of bullet trains continues to increase, overheating and thermal deformation/stress on brake systems are going to be critical for emergency stops. Precise prediction of the maximum temperature is needed for the design of brake systems, especially for both discs and linings, where how to handle the high speed spinning of discs is the point of the heat/structure coupled analyses.

Abaqus provides couple of potential methods but each one had critical shortcomings. The authors investigated the feasibility of a new method; Abaqus/Explicit using 'rigid bodies with temperature degrees of freedom' for fully coupled thermal analysis. Temperature of both discs and linings was successfully analyzed over the whole time span of an emergency braking event with practical computation time.

Full-scale experiments were carried out to verify the analysis results related to the temperature of both discs and linings, and the results showed good agreement.

Keywords: Heat Transfer, Dynamic Explicit, Train, Disc Brake

1. Introduction

Overheating and thermal deformation of disc brake systems during emergency braking are becoming critical as the maximum speed of bullet trains increases. To design the brake systems, precise prediction of the maximum temperature is needed, especially for discs and linings.