Sample paper for submission in national conference on advancements in mechanical engineering and energy environment

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Abstract

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Keywords*:* brake block, finite element, thermo-elastic instability, wear, vibration

1. Introduction

Lowering vibration level of tread brake railway cars is of importance for safety and satisfactory performance of rail traffic. Thermo elastic instability, crack analysis and finite element aspects to solve the problems related to wheel and brake block interaction have been studied by many researchers. The phenomenon of Thermo-Elastic Instability (TEI) was early investigated experimentally and analytically by Barber [1], and it was studied in detail by Burton [2]. Burton postulated that TEI can occur in lubricated as well as dry contact and is influenced by material properties, cooling, macroscopic constraints on the contacting bodies and wear.

In the present study, thermo-mechanical interaction of wheel and brake block interface is conducted to study the temperature rise which is responsible for initiation of wheel wear and roughness. Coupled transient thermal and quasi-static mechanical finite element analysis (FEA) with thermo-mechanical simulation capability based on load vector coupling has been conducted.

2. Modeling, simulation and analysis of brake-block wheel interaction

2.1 Modeling

The basic modeling and simulation process starts with making a model of cast iron block, steel block holder, and a portion of a steel wheel. Temperature dependent material data has been used for the simulation. The conditions of simulations were modeled using the software PRO/E. The model is shown in figure 1.

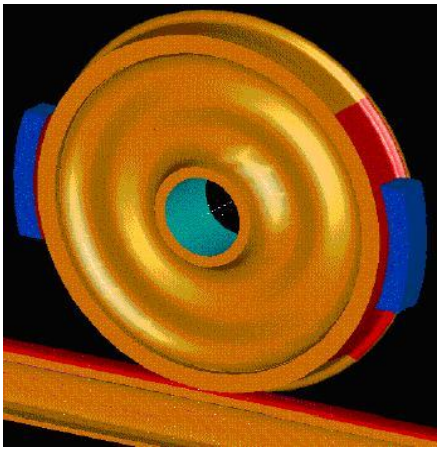

Fig. 1: Basic 3D model of wheel and brake block assembly

Simulations to analyze the transient thermo-mechanical interaction between the brake block and wheel were conducted for two different conditions.

3. Results and Discussion

The pressure distribution on wheel-block interface is initially parabolic. There is a rapid and large reduction of the contact zone. This reduction in the contact zone is due to thermo-elastic instability. Result is given in Table 1.

Table 1: Temperature obtained during experimental and simulated analysis at the speed 100km/h

Nodal Position	Experimental Result (in ^{o}C)	Simulated Result (in ^{o}C)
1	120	105
2	50	70
3	45	55

4. Conclusion

Results from the FE simulations show an initial pressure variation between block and wheel which grows exponentially during braking and the initial contact zone is transformed to a limited number of separated contact patches due to TEI. Results from modeling and simulation approach adopted in this communication are in good agreement with the experimental results. A maximum error of 12.5% was observed in the simulated result which may be introduced due to assumed heat partitioning factor or roughness of the surface.

Acknowledgment

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References

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