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COUPLED THERMOMECHANICAL COMPUTATION METHOD FOR VIRTUAL DESIGN PROCESSES OF BRAKE DISCS

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The brake disc as a safety-related component has to fulfil competing targets in the design process: reliability, comfort and lightweight design. During the development phase of a brake disc regarding thermomechanical aspects, both the deformations during operation as well as the fatigue strength have to be considered. Hence the focus of the research is to improve the forecast quality and to create a deeper understanding of the physical effects.

The results of the brake test bench show a high sensitivity of the fatigue strength of a brake disc to the parameters of the entire brake system. In addition to the design concept of the caliper (floating or fixed caliper) the inherent rigidity of the calliper has a major impact. This leads to a non-uniform contact pressure on the brake disc, and in consequence, to an inhomogeneous distribution of the applied heat energy to the brake disc.

Consequently the following challenges must be met:

- Determine of the heat energy distribution into the brake disc depending on the brake caliper.
- Simulation of the brake system, taking account to the effects of the coupled thermomechanical behaviour of the interacting components.

There are two principal methods to approach a thermomechanical problem: the fully coupled method, which carries out the thermal and mechanical calculations simultaneously and the serially coupled method, which performs both operations one after the other. Only the first one takes the influence of the changing mechanical pressure conditions into account, which are caused by the heated brake disc. However, the great disadvantage of the fully coupled method is the very long computation time.

The so far used simulation methods are limited to investigations of the brake disc as a single component with a serially coupled method. The described restrictions shall be eliminated through an advancement of the FE methods. The idea is switching from the investigations at the single brake disc to a particular solution of thermomechanical simulation of the brake system. This method consists of divided calculations using ABAQUS that are carried out sequentially in a plurality of time steps with updated energy input.

Several examinations have been made to verify the new method concerning the most important assumptions and parameters in the simulation model. The aim of the paper will be: presenting the results, their evaluation and the conclusions which lead to the advanced FE solution.