The primary function of the braking system is to reduce the speed of a vehicle or operating machinery due to the effects of friction forces. The rapid nature of the process and a considerable amount of energy dissipated can lead to excessive temperature rise and subsequent wear of working surfaces, degradation of the friction material, brake fluid vaporization, thermal deformations of the disc, as well as cracks preventing proper and safe operation of the system.

In order to decrease costs and shorten the time of a bed-in, test and implement the prototype brake, as far back the design stage with a sufficient degree of reliability, the characteristics of different materials of the friction pair, the construction of friction elements and brake in its entirety should be estimated. The basis of analytical, analytical-numerical and numerical calculations of temperature are the solutions of the corresponding boundary-value problems of thermal problems of friction. It should be noted that analytic solutions of such problems can only be obtained for bodies of limited planar parallel surfaces – these are, for instance, systems of sliding semi-spaces or layers. Such modeling of heat generation due to friction allows to obtain exact solutions, but does not include a number of features of the actual process, including the size of friction elements. In non-stationary processes of friction, which include braking, changing in all of the parameters over time are interdependent. Change in the velocity, load, moment of braking force and temperature during braking are combined with each other and depend on friction, mechanical, thermal and physical properties of friction pair materials, construction of the brake and its conditions of use. Comprehensive evaluation of the operating characteristics of the brake allows to obtain the solution of equations of heat dynamics of friction and wear (HDFW). A typical arrangement of HDFW includes:

1) Law of change in contact pressure with time;
2) Equation of motion of the brake disc;
3) Experimental dependencies of the coefficients of friction and thermomechanical wear of the considered friction pair on the maximum temperature;
4) Experimental dependencies of hardness and thermophysical properties of materials of the friction pair on the temperature;
5) Thermal problem of friction for the pad-disc system to determine the mean temperature of the nominal contact area;
6) The problem of assessment of the flash temperature taking into account spatial distribution and migration of spots of the real contact and micro geometry;
7) The law of change of the coefficient of wear of the friction surfaces with time.

The aim of the project is to develop a methodology to determine spatial-temporal distributions of the temperature of the braking system at the interdependence of the braking speed and the temperature in the area of sliding contact based on a system of equations HDFW. The corresponding thermal problems of friction will be formulated at dependent on temperature coefficients of friction, mass wear, hardness, and taking into account the thermal sensitivity of the materials of the friction pair. For the calculation the programs based on the finite element method (FEM) will be used. The project in the first stage it is planned to develop a methodology to estimate the flash temperature in the contact area of the pad and the disc. To this a comparative analysis of values of flash temperature, obtained on the basis of different analytical solutions and the verification of the results with known experimental data will be carried out. Then, taking into account the established method of determining the flash temperature, numerical solutions will be obtained using FEM two- and three-dimensional thermal problems of friction contained in the equation set HDFW. In the final stage the author intends to propose a methodology for the selection of materials, overlays and disc brake system. It will include an estimation of the bulk temperature in extreme conditions in order to pre-determine the class of materials for the friction elements. Then, after determining the average temperature by using computational models developed, specific friction materials will be selected. In the last stage, maximum temperature will be set and the assessment of the coefficient of friction as well as the size of the mass wear rate of the working surfaces of materials selected pairs of friction will be determined.