# TECHNICAL SCIENCES

## HEAT SPREAD. ONE-DIMENSIONAL FIELD THEORY PROBLEM AND THE FINITE ELEMENT METHOD

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**Introductions.** Heat propagation in a one-dimensional formulation belongs to the list of important physical problems described by partial differential equations.

**Aim.** The paper considers the approach of using the finite element method for solving one-dimensional problems of field theory, in particular the problem of heat propagation.

**Materials and methods.** The differential equation for the one-dimensional heat propagation problem of each is obtained from the general quasi-harmonic equation taking into account the boundary conditions, certain coefficients of which are considered independent of the field function and contain the direction cosines of the vector normal to the surface. This equation can be applied to isotropic and to anisotropic bodies, but the coordinate axes must be parallel to the principal axes of inertia in anisotropic regions. The other components correspond to the coefficients of thermal conductivity, the internal heat source, the heat flux at a part of the surface and the heat transfer coefficient, and the field function defines the body temperature.

The equation for the cases of one-dimensional and two-dimensional heat propagation can be obtained from the general equation taking into account the zero derivatives of the field function along the corresponding coordinates.

An important two-dimensional problem is the case of a vortex-free fluid flow. The equation reduces to a differential equation in partial derivatives taking into account the boundary conditions. If the field function is defined at the impermeable boundaries of the region, that is, at such boundaries there is no fluid flow normal to them, then the corresponding equation determines the flow lines in the vortex-free case. However, if the corresponding field function is defined on those parts of the boundary along which the fluid flows, then the corresponding equation describes equipotential lines that are orthogonal to the flow lines.

The differential equation for the case of a limited groundwater flow is also a partial differential equation, which is solved with the calculation of boundary conditions, and contains coefficients that determine the permeability of the soil, the source of water, the seepage of water through the aquifer along part of its boundary, and the field the function corresponds to the piezometric pressure.

In other important physical problems, which are described by the previously mentioned equation, electrostatic and magnetostatic fields, liquid lubricating films, etc. is considered.

From the variational point of view, the solution of the previously mentioned equation with the corresponding boundary conditions is reduced to the search for the minimum of the functional, the minimization of which is performed on a set of nodal values with before calculating the integrals.

**Results and discussion.** The differential equation for the one-dimensional heat propagation problem of each is obtained from the general quasi-harmonic equation that takes into account the boundary conditions and contains all the coefficients that reflect the physical essence of the problem. The specified equation can be extended to the case of limited groundwater flow, for electrostatic and magnetostatic fields, liquid lubricating films. The problem can be solved in a variational setting.

**Conclusions.** The paper examines the approach of using the finite element method for solving one-dimensional problems of field theory, in particular the problem of heat propagation.

## Literature

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