Research of a thermo-stressed state of a core of variable section in the presence of a heat flux, thermal insulations and heat exchange

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Abstract

The horizontal core of restricted length and variable transverse section is considered. Radius of section changes on coordinate linearly, and a sectional area non-linearly. On the area of the left-hand end of a core the heat flux is brought, the lateral area of a core is heat-insulated, and through the area of the right end there is a heat exchange to an environment. On the basis of the law of conservation of energy the field of distribution of temperature and three components is defined: deformations, tension and movements. Also the size of thermal lengthening and the arising axial effort, in case of jamming of two ends of a core is defined.

Keywords: Core of variable section, axial effort, deformation, tension, lengthening.

1 Introduction

The horizontal core of restricted length of l (cm) and variable transverse section is considered. At the same time the section of a core is a circle. Radius on coordinate changes linearly, and a sectional area non-linearly. The sectional area of the left-hand end of F₀ [cm²] is more than the right end of F₁ [cm²]. The lateral area of the studied core is completely heat-insulated. On a sectional area of the left-hand end of a core the heat flux of constant intensity is brought q [watt/cm²]. Through a sectional area of the right end there is a heat exchange to a surrounding medium. At the same time coefficient of heat exchange of h [watt/cm²°C], and environment temperature of T₀ [K]. Physicomechanical properties of material of the studied core it is characterized by a thermal expansion coefficient α [1/K], and heat conductivity of Kₓ [watt/cm°C], and also E [Kg/cm²]. The calculated scheme of a task is provided in the figure 1.

Cores of variable section from refractory materials are widely used as the bearing elements of power stations, jets and processing industry. In these designs they work at influence of heterogeneous types of sources of heat. In a corollary of what in them arise the composite non-linear thermo - an intense strained state. Therefore development of the express methods, computing algorithms and programs allowing to investigate thermo - an intense strained state of rod stock of variable section is a current problem. As reliable work of power complexes of engines depends on thermo-strength characteristics of the bearing elements in the form of rod stock of variable section.

2 Overview

On the basis of fundamental laws of conservation of energy the numerical solution of the established problems of a thermomechanical condition of rod stock of restricted length and a constant transverse section at simultaneous influence of heterogeneous types of sources of heat is provided in works [1-3]. In these tasks sizes of lengthening of the studied core because of influence of sources of heat were defined. In case of jamming of both ends of a core the size of the arising axial compressive force and also distribution laws of temperature, components of deformation, tension and movement is calculated.

3 Decision

At the solution of an objective it was applied:

1. For definition of the field of temperature, deformation, tension and movement the method of minimization of the total thermal energy on nodal values of temperature is used. Later the size of lengthening of a core of variable section from heating and also the size of the arising squeezing axial effort in case of jamming of both ends of a core is calculated

2. For definition of the field of movement the method of
minimization of a potential energy of elastic deformations (taking into account existence of the field of temperature) on nodal values of movement is used.

3. Programs in the Phyton programming language are developed and realized on computers.

4 Conclusion

The analysis of the received results showed that application of fundamental laws of conservation of energy at the solution of the established tasks thermo - an intense strained state of rod stock of variable section in the presence of heterogeneous types of sources of heat leads to obtaining results of a high precision. These results naturally satisfy the corresponding laws of conservation of energy for the considered tasks. The Phyton programming language allows to perform necessary difficult analytical operations without errors.

References

