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СЕКЦІЯ 4.

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ANALYSIS OF STABILITY OF STRUCTURAL ELEMENTS UNDER THERMOMECHANICAL LOADS

The loss of stability of structural elements is dangerous because it leads, as a rule, to no less catastrophic consequences

than the exhaustion of the structure's safety margin in terms of static strength [1, 2]. At the same time, if the change in the last factor can be traced by the change in the kinematic characteristics of the structure, then the loss of stability occurs suddenly, without any previous signs that may indicate it [3, 4]. That is why it is important to be able to predict this phenomenon, based on theoretical and numerical calculations [5, 6]. This issue is especially relevant in such responsible branches of technology and industry as energy [7, 8], aircraft [9, 10] and rocket engineering [11, 12].

In this work, the phenomenon of loss of stability of the ring when it is heated is investigated. It is assumed that the ring is planar, that is, its axis is a circle and the cross section of the ring is constant. It turns out that if such a ring is heated strongly enough from the inside, it can lose its stability, leaving the plane of its previous location [13]. At the same time, the temperature field inside the ring can depend only on the radial coordinate and not at all on the axial and circular coordinates [14, 15]. At first glance, it seems that there is no reason for the ring to move out of the plane of its original location. Since ring elements are often found in engineering, for example as stiffeners or plates of flange connections, this phenomenon deserves a detailed study.

The paper considers a problem for a ring with a rectangular cross-section. As a load, the temperature field at the points of the ring was set, which varied linearly along the inner to outer radius. Research was carried out using the finite element method. Depending on the ratio of geometric parameters (inner and outer radii of the ring, thickness of the ring in the radial and axial directions), a critical temperature was found, which corresponds to the loss of stability of the flat shape of the ring. Elements are made of steel.

According to the research results, it was established that the critical temperature depends significantly on the ratio of ring

thicknesses and increases rapidly with its increase. It is established that the corresponding non-planar shape of the ring is stable. The torque required to turn the ring to a given angle is directly proportional to the moment of inertia of the cross section of the ring relative to the radial axis. This explains the sharp increase in the critical temperature with an increase in the axial thickness of the ring.

The developed method can be used in the study of composite structures under thermal force loading [16, 17], as well as their optimal design [18], taking into account the effects of temperature fields.

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