World Academy of Science, Engineering and Technology
International Journal of Mathematical and Computational Sciences
Vol:14, No:12, 2020

Calculation of the Thermal Stresses in an Elastoplastic Plate Heated by Local Heat Source

Authors : M. Khaing, A. V. Tkacheva

Abstract : The work is devoted to solving the problem of temperature stresses, caused by the heating point of the round plate. The plate is made of elastoplastic material, so the Prandtl-Reis model is used. A piecewise-linear condition of the Ishlinsky-Ivlev flow is taken as the loading surface, in which the yield stress depends on the temperature. Piecewise-linear conditions (Treska or Ishlinsky-Ivlev), in contrast to the Mises condition, make it possible to obtain solutions of the equilibrium equation in an analytical form. In the problem under consideration, using the conditions of Tresca, it is impossible to obtain a solution. This is due to the fact that the equation of equilibrium ceases to be satisfied when the two Tresca conditions are fulfilled at once. Using the conditions of plastic flow Ishlinsky-Ivlev allows one to solve the problem. At the same time, there are also no solutions on the edge of the Ishlinsky-Ivlev hexagon in the plane-stressed state. Therefore, the authors of the article propose to jump from the edge to the edge of the mine edge, which gives an opportunity to obtain an analytical solution. At the same time, there is also no solution on the edge of the Ishlinsky-Ivlev hexagon in a plane stressed state; therefore, in this paper, the authors of the article propose to jump from the side to the side of the mine edge, which gives an opportunity to receive an analytical solution. The paper compares solutions of the problem of plate thermal deformation. One of the solutions was obtained under the condition that the elastic moduli (Young's modulus, Poisson's ratio) which depend on temperature. The yield point is assumed to be parabolically temperature dependent. The main results of the comparisons are that the region of irreversible deformation is larger in the calculations obtained for solving the problem with constant elastic moduli. There is no repeated plastic flow in the solution of the problem with elastic moduli depending on temperature. The absolute value of the irreversible deformations is higher for the solution of the problem in which the elastic moduli are constant; there are also insignificant differences in the distribution of the residual stresses.

Keywords : temperature stresses, elasticity, plasticity, Ishlinsky-Ivlev condition, plate, annular heating, elastic moduli
Conference Title : ICSRD 2020 : International Conference on Scientific Research and Development
Conference Location : Chicago, United States
Conference Dates : December 12-13, 2020