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Asymptotic Solution of Anisotropic Cyclic Creep Problem

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Abstract

Thin-walled structural elements made from rolled metal usually demonstrate anisotropic creep behavior. Very often the model of transversally-isotropic material is suitable for its description. Due to the difficulties in direct numerical integration the case of cyclic loading demands the development of suitable method of the creep problem's solution when the material behavior isn't isotropic.

The general problem statement as well as the constitutive equations for two-dimensional creep problem are presented Transversally-isotropic creep material model developed by O.Morachkovsky is used The case of substantial stress values which are greater than yield limit is studied. Addition of cyclic loading, which is essentially varying the creep response, is analyzed

Deriving of resolving system of creep equations was performed by use of the method of asymptotic expansions jointly with the method of averaging in a period of stress cycle. This system allows simulation of only the problem of static loading with constitutive equations of special type, in which the values of cyclic parts of loading are included in so-called influence functions. These equations are derived from the general form by use of asymptotic expansions of creep strain functions with further averaging in a period of oscillations.

Developed method is realized as an applied C++ software. The Finite Element Method is used for solution of boundary-value problem jointly with Finite Difference Scheme for initial one.

The results of experimental investigations of creep in specimens and plates with holes made from rolled steel are discussed The anisotropic creep curves in three directions were obtained and constants for creep flow rule were determined Additional number of experiments was performed for the case of cyclic loading. The comparison between experimental and numerical data shows the satisfactory agreement. Due to this a number of numerical examples for cyclic creep simulation in thin plates were performed and their results are discussed

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