A NEW APPROACH FOR ANALYSIS THE ELASTOPLASTIC FLOWS

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Summary The new method to analysis carrying capacity of viscous-elastoplastic bodies is proposed on the basis of predictor-corrector scheme of Wilkins - Kukudzhanov. It is considered the influence of relaxation time on strength of structural components.
The first stage. It is found the solution for boundary problem in elastic formulation. The region is determined in plastic range, using Mises's plasticity criterion.
The second stage. In elastic range, the solution for boundary problem conditions is found on the stipulation that the Mises plasticity condition is implemented at the border between elastic and plastic domains.
The third stage. In plastic domain the components of stress deviator are determined on basis of the Kukudzhanov's splitting method.
The fourth stage. In plastic domain the boundary problem is solved on the stipulation that the conjugate conditions are implemented at the border between plastic and elastic domains.
The predictor-corrector scheme is also used to analysis the dynamic problem:
The first stage. It is found the solution for boundary problem of Piccard in elastic formulation. The region is determined in plastic range, using Mises's plasticity criterion.
The second stage. In elastic range, the solution of Piccard's problem in condition that on the boundary which divides elastic and plastic domains, the Mises plasticity condition is implemented.
The third stage. In plastic domain the components of stress deviator are determined on basis of the Kukudzhanov's splitting method.
The fourth stage. In plastic domain the boundary problem is solved on the stipulation that the conjugate conditions are implemented at the border between plastic and elastic domains

ANALYSIS THE PROBLEM OF PLASTIC THEORY BY SPLITTING METHOD

In mechanics of continua the flow equations are divided into general dynamical equations, which describe the flows of all continua, and the equations which bind the strain tensor components with the tensor components of strain rate in the points of this continuum. These determinant rheological equations define the flow of this continuum. The mathematical definition of the plastic flow theory's determinant equations is different from the equations' definitions for other models of the continua mechanics, that it has finite relation along with differential relation. This finite relation is a plasticity condition which limits an invariant of the stress tensor. So due to this it is possible to have different mathematical definition of the determinant equations of the plastic flow models [1].
The most accepted formulation of solving the foregoing problem is to definite determining equations in the form of differential equation system. Then the determining equations come to the differential equation system with additional initial condition in the form of a prime plasticity condition [2]. This definition of the determining conditions has some disadvantages in assumed differentiation which connect on the one hand to the system order rise of determining equations, and on the other hand considerably complicate its integrations.
The second approach is to insert new variables which identically satisfy the plasticity condition [3, 4]. This approach hardly complicates the equation system and becomes ineffective in case of general three-dimensional problem.
The third approach is that plasticity condition is considered as some contingency for solution hypoelastic task and this task is solved by minimizing elastic function of function with additional contingencies on variable functions [1].
The fourth approach gives the possibility to solve the tasks in its original formulation when the equations of plastic flow theory are used without preliminary transformation, as they are basically formed for an elastoplastic model [1]. In [1] is offered new equations integral method for the elastoplastic continua which is based on the splitting method by physical processes of determinant equations for relaxation type continua.
In the work it is considered a new approach to analysis carrying capacity of elastoplastic body on the basis of the splitting method for elastoplastic equations [1, 5].
The 1st stage. It is found the solution for boundary problem in elastic formulation. The region is determined in plastic range, using Mises's plasticity criterion.
The 2nd stage. In elastic range, the solution for boundary problem conditions is found on the stipulation that the Mises plasticity condition is implemented at the border between elastic and plastic domains.
The 3rd stage. In plastic domain the components of stress deviator are determined on basis of the Kukudzhanov's splitting method.
The 4th stage. In plastic domain the boundary problem is solved on the stipulation that the conjugate conditions are implemented at the border between plastic and elastic domains.
There are considered some specific targets: the elastoplastic and elastic-viscoplastic conditions of a thick-walled tube when there is no strengthening according to the flow theory; the elastoplastic condition of a hollow sphere when there is no strengthening according to the flow theory; the elastoplastic and elastic-viscoplastic conditions of a spherical

enclosure in unrestricted body when there is no strengthening according to the flow theory; the Kirsch's generalized problem; analysis of elastic-viscoplastic flows of the ring with constant thickness; the elastoplastic condition of an infinite plate with a hole which is stretched axisymmetrically relative to the center of the hole; distribution of spherical waves in elastoplastic continuum.

CONCLUSIONS

It was proved that Kukudzhanov splitting method is effective in solving problems of elastoplastic body's carrying capacity on basis of considered model problems.
The offered approach helps to value the strength of the structural components and machines according to the modern plastic flow theory.
The new method to analysis carrying capacity of viscous-elastoplastic bodies is proposed on the basis of predictor-corrector scheme of Wilkins - Kukudzhanov. It is considered the influence of relaxation time on strength of structural components.

References

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