FORCE METHOD DEVELOPMENT IN STRUCTURAL MECHANICS FOR THE NONLINEAR TASKS. FEM HYBRID MODELS

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For the forces method development in the nonlinear field the generalized More's formula [1] with tangent stiffness matrix has been invented. This matrix was obtained as the integral parameter of the stress-strained condition of the whole cross-section rod points. Formulation of the finite elements method is considered as a movement method and a forces method. The advantages and disadvantages of the two forms of the FEM in elastic-plastic analysis noted. It is proposed to form the procedure of calculating bending rod systems via the force method based on the bending moments formation by using state equations [2, 3].

There is shown the key differences and advantages at calculation of rod systems by the discrete-analytical method. The results of calculation of rod systems obtained by the discrete-analytical method with the finite element method are compared.

The generalized force method consists of the following stages: determination of stiffness matrix or the rod element flexibility matrix via the generalized More's formula; elaboration the balance equations or the deformation consistency equations; determination of internal stresses in the bars by the reactions at the nodes; determination of the stresses in cross section via generalized rod's curvature $\{\sigma\}=[A][S]\{\psi\}$; determination of the tangent stiffness rod's cross-section matrix for the elastoplastic deformation conditions $[T]=\int[L][A][SdF$ [1], where ψ – the kinematic parameters' matrix-column in the cross section; σ – matrix-column of stress at the cross section's point; L – the cross section's point coordinates matrix.

Components $[S]$ depend on the coordinates of the considered rod's cross section point. Matrix components $[A]$ depend on the stress in cross section's point at each temporary step. When the elastoplastic deformation is occurred the matrix $[A]$ corresponds to the differential analog of Hooke's law with pseudo flexible ratios, depending on the stressed condition at the point. While calculation algorithm sat each temporary step are created the above mentioned formulas should be written via incremental correlation. The proposed method allows to obtain adequate results without significant processor and time consuming.

REFERENCES

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