SECTION C

301/C

Solution of one dimensional geometric nonlinear problems using finite different approach

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Finite Difference Method (FDM) is one of the powerful tools available to solve structural mechanics problems even in this computer age. Development of the computers has facilitated the efficient use of Finite Difference Technique and sometimes preferred over the Finite Element Method, which is widely used in most structural engineering computer software. However advances in this type of research are limited as its true potential has not been fully realized specially in solving nonlinear problems. In this study FDM is utilized to solve a nonlinear differential equation numerically, and thereby reducing the time and memory requirements when compared to other numerical methods.

All the structural analysis tools are essentially concerned with solving the basic differential equations of equilibrium and compatibility, although in some methods this fact might be obscured. However, the analytical solutions have not still been explored well for the differential equations of the structures, where the geometry, loading, and boundary conditions become complex. In such situations use of a numerical method is the general approach to solve the problem. In this method the solution will be obtained for chosen points on the structure, those are referred as nodes or pivotal points, by using the differential equation which could be applicable to the whole member.

The scope of this investigation is limited to the study of geometrically nonlinear large deformation problems of one dimensional members. This paper describes an application of finite difference method to solve such a single member subjected to axial tension with large deformations with a curved profile. Resulting governing equation for the member is a nonlinear non-homogeneous integral differential equation, in which an analytical solution is not feasible, though analytical solutions are available for small deformation problems. The Gauss-Seidel technique has been employed to solve a set of simultaneous equations and a new iterative approach has been developed to calculate the fixed end moment of the member under the axial tensile forces.

A computer program has been developed and results were compared with the results obtained by using Finite Element Method and with other analytical methods. Results were used to prove the consistency of the applicability of Finite Difference Approach to solve geometrical nonlinear problems for 1D structural members.

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