BEHAVIOUR OF TALL STRUCTURES LIKE MULTISTOREY FRAMES, TRANSMISSION TOWER SUBJECTED TO DYNAMIC LATERAL FORCES

by

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SYNOPSIS

The purpose of this paper is to describe a simple method to analyse the space frame structures and emphasis the effect of lateral stiffness of complete structure, while subjected to lateral forces like earthquake, wind, etc. For dynamic frame analysis a method to get the stiffness and consistent mass matrix has been developed. The analytical investigations on different structures like one or more storeyed framed structures are carried out. Finally, the space frame analysis is carried out on a structure which is assumed to be made of combination of plane frames with several interlinked members i.e. cross members at different floor levels or panels.

STATIC AND DYNAMIC ANALYSIS OF TWO AND THREE DIMENSIONAL FRAMED STRUCTURES AND COMPUTER PROGRAM

The technique for formulation of stiffness matrix of overall structure is based on, first evaluating the stiffness of each element like column element, main beam element, cross beam and bracing elements, etc. and then combining these element stiffnesses to build up the overall stiffness matrix. The stiffness coefficients are represented by slope deflection equations in the matrix form for the different elements used in the framed type structures. Four nodal displacement i.e. two translational (one lateral and one vertical) and two rotational (one torsional and one bending) corresponding to structural orientation are considered at each joint of a framed structure. The analysis of static frame displacements are carried out by solving joint equilibrium equations and the forces in each of the elements of the structure may be computed from different element stiffness matrices. It is also noted that the overall stiffness matrix of the framed structure is utilized directly in a dynamic analysis as indicated by the equation $M\ddot{X} + C\dot{X} + KX = P$ where, M is the consistent mass matrix of the overall structure and other notations have the usual meaning. A FORTRAN program based on above procedure of analysis has been developed for the IBM 7044/1401 computer which can treat different type of structures with little modifications. A few problems like framed building and transmission tower have been analysed in two different approaches i.e. of plane and space frames.

The results show that cross members between two or more parallel frames also contribute appreciably towards stiffness and distribute the lateral forces formed due to earthquake, blast, wind etc. on the overall structure. Considering this effect in the analysis, a more economical design may be made for various type of framed structures. This will also give a stress distribution which is more closer to reality. Experimental investigations also justify the analytical presumption. Analytical investigations show that stiffness characteristics of hi-rise structures may not be the algebraic addition of stiffnesses of individual plane frames. However, for low-rise structures the above assumption may be correct.

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