DYNAMIC ANALYSIS OF MULTI-STOREYED FRAMES CONNECTED WITH RIGID FLOORS

by

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Mode shapes and frequencies of plane frames with shear walls can be predicted with reasonable accuracy. In buildings frames are interconnected through floors which may be assumed infinitely rigid in their own plane. Further, most of the structures are asymmetric and twist under lateral loads. A method for static analysis of such buildings has been reported by the authors elsewhere*. Stiffness matrix is derived for three degrees of freedom for each floor (two translations u and v, and one rotation θ) by considering the floor equilibrium under the action of lateral loads in two orthogonal directions and one moment about the centre of gravity of the floor loads.

Sets of three equations of motion for each floor (neglecting damping) result in a matrix equation of the form:

$$M \ddot{Q} + K Q = 0$$

where K is the stiffness matrix and Q the vector containing displacements ($u_1 \ldots\ldots u_n$, $v_1, v_2 \ldots\ldots v_n$) and rotation ($\theta_1, \theta_2 \ldots\ldots \theta_n$) -n being the number of storeyes. M is the diagonal mass matrix whose elements are ($m_1, m_2 \ldots\ldots m_n$, $m_1 \ldots\ldots m_n$, $J_1, J_2 \ldots\ldots J_n$) where m_r is the lumped mass and J_r total equivalent mass (units $[ML^2]$, corresponding to rotation θ) of rth floor.

The technique was employed to analyse an eight storey channel shaped building model. Frequencies and mode shapes were found for the self weight and also for all floors loaded with an additional eccentric mass. First two frequencies were also determined experimentally which were in close agreement with predicted values in both the cases, showing that the proposed approach may be used with confidence to determine the frequencies of framed buildings with rigid floors.

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* Sharma, S.P., Goyal, B.K. and Agrawal, S.K., "Lateral Loads on Multi-storeyed Buildings with Rigid Floors", Proceedings of the Regional Conference on Tall Buildings, Bangkok, January 23-25, 1974 pp. 291-300.

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