Seismic Behaviour of Bi-Symmetric Buildings

Authors : Yogendra Singh, Mayur Pisode

Abstract : Many times it is observed that in multi-storeyed buildings the dynamic properties in the two directions are similar due to which there may be a coupling between the two orthogonal modes of the building. This is particularly observed in bi-symmetric buildings (buildings with structural properties and periods approximately equal in the two directions). There is a swapping of vibrational energy between the modes in the two orthogonal directions. To avoid this coupling the draft revision of IS:1893 proposes a minimum separation of more than 15% between the frequencies of the fundamental modes in the two directions. This study explores the seismic behaviour of bi-symmetrical buildings under uniaxial and bi-axial ground motions. For this purpose, three different types of 8 storey buildings symmetric in plan are modelled. The first building has square columns, resulting in identical periods in the two directions. The second building, with rectangular columns, has a difference of 20% in periods in orthogonal directions, and the third building has half of the rectangular columns aligned in one direction and other half aligned in the other direction. The numerical analysis of the seismic response of these three buildings is performed by using a set of 22 ground motions from PEER NGA database and scaled as per FEMA P695 guidelines to represent the same level of intensity corresponding to the Design Basis Earthquake. The results are analyzed in terms of the displacement-time response of the buildings at roof level and corresponding maximum inter-storey drift ratios.

Keywords : bi-symmetric buildings, design code, dynamic coupling, multi-storey buildings, seismic response

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