

# TORSIONAL VIBRATION OF SPACE STRUCTURES HAVING SEMI-RIGID DIAPHRAGMS

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## ABSTRACT

**Object.** The diaphragms of the civil and industrial structures are usually not rigid in horizontal direction. The ambient spatial modes of a 6-storied building show that the roof and floor slabs are all horizontally deflected. Earthquake damages of the single-storey mill buildings show also that the horizontal deformation of roof slab occurred accompanying with the torsion of the structures. Therefore, the assumption of diaphragms considered as rigid discs is no longer suitable for the seismic analysis of these structures.

**Methods.** For the 3-dimensional seismic analysis of the asymmetrical space structures, the "Series-Parallel lumped mass system" ( Fig. 1 or Fig. 2) is adopted as the mechanical model of the single storey mill buildings or multistorey structures.

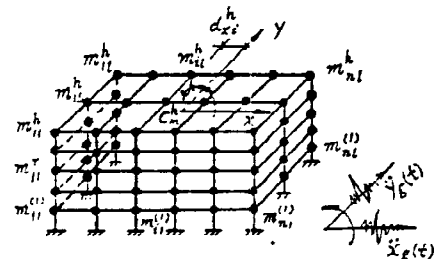
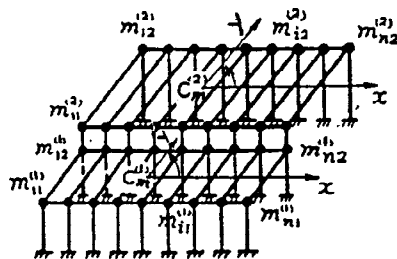


Fig. 1 Model of single story buildings. Fig. 2 Model of multistory buildings.

**Results.** For the single storey mill building with single wall at one end, the calculated former two normal modes of vibration and the seismic bending moments of the columns at the different bents are shown in Fig. 3 and Table 1 respectively. The first and third normal modes of vibration of a single storey building having two level roofs are shown in Fig. 4.

Table 1. Seismic bending moments at the bottom section of the columns of the various bents

Distance from the shear wall (m)	6	12	18	24	30	36	42	48	54	60
Bending moment (kN.m)	75	96	117	137	158	178	198	218	237	253

**Conclusions.** For the seismic analysis of the space structures having semi-rigid diaphragms the effect of the horizontal deformations of the diaphragms should be taken into account.

## KEYWORD

Torsional vibration; Space structure; Semi-rigid diaphragm; Earthquake damage; Series-parallel lumped mass system; Rigid disc.