Department of Civil Engineering
NIT Jamshedpur

Introduction to High Rise Buildings

- Subject Code: CE4206
- Subject: High Rise Structures
- M.Tech. 2nd Semester
  Structural Engineering

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Introduction to high rise buildings

- **World Trade Centre, NEW York 442m(1450ft.),104 floors**

- A high rise building is essentially a vertical cantilever that is subjected to axial loading by gravity and to transverse loading by wind or earthquake.
- Gravity live loading acts on the slab, which transfer it horizontally to the vertical walls and columns through which it passes to the foundation.
- The magnitude of axial loading in the vertical components is estimated from the slab tributary area.

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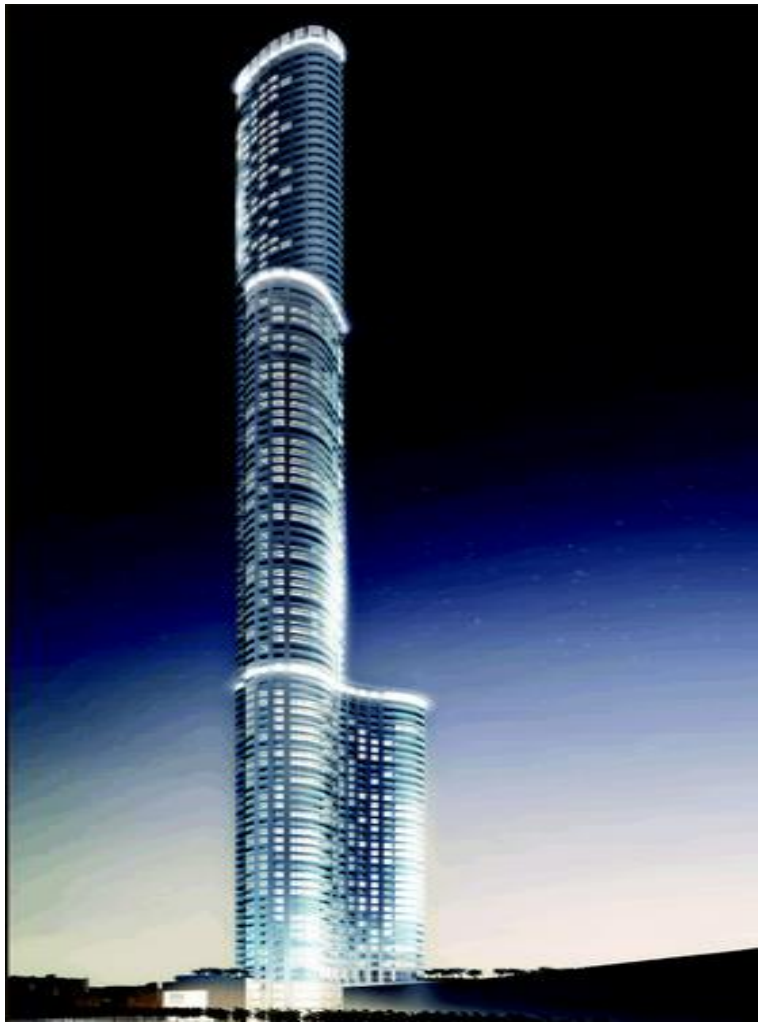

- **World One Tower, Mumbai, 442m(1450ft.),117 floors**

Horizontal loading exerts at each level of a building a shear, a moment, and some time a torque, which have max values at the base of the structure that increase rapidly with the building height. Response under horizontal loading is more complex than under gravity loading The resistance of the structure to the external moment is provided by the flexure of the vertical components.

The allocation of the external moment between the flexural and axial actions of the vertical components depends upon the vertical shearing stiffness of the web system connecting the vertical components , that is, the girders, slabs, vertical diaphragms, and bracing

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The described flexural and axial actions of the vertical components and the shear action of the connecting members are interrelated, and their relative contributions define the fundamental characteristics of the structure.

The horizontal shear at any level in a high rise structure is resisted by shear in the vertical members and by the horizontal components of the axial force in any diagonal bracing at that level.

Torsion of a building is resisted mainly by shear in the vertical components, by the horizontal components of axial force in any diagonal bracing members, and by the shear and warping torque resistance of elevator, stair and service shafts.

A structure's resistance to bending and torsion can be significantly influenced by the vertical shearing action between connected orthogonal bents or walls.

World One Tower, Mumbai, 442m(1450ft.),117 floors

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Orchid Crown 1, 2 & 3, Mumbai, 337 m(1106 ft.), 75 floors

The structural form of a high rise building is influenced by its function, while having to satisfy the requirements of strength and serviceability under all probable conditions of gravity and lateral loading. Other influential factors include the building's material of construction, its accommodation of services and, of course, its overall economy. The taller a building, the more important it is economically to select an appropriate structural form.

The basic structural forms of the first half of the twentieth century were the braced frame, which is unrestricted in height but limited to steel structures, and the rigid frame or the flat plate, which are economical to only about 25 stories in height and approximate particularly to concrete structures.

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Advances have occurred mainly in the use of shear walls, framed tubes, large scale braced systems, and space frames, and in better recognizing and accounting for the various types of vertical and horizontal interaction between the major vertical components.

The structural form used in the vertically prismatic modern high rise buildings of the 1950, 1960, and early 1970 have given way to some extent to hybrid, or mixed forms in the less regularly shaped post modem buildings of the latter 1970 and 1980.

Floors slabs are invariably of reinforced concrete. Reinforced concrete systems include one or two way spanning slabs on a system of beams or beams and girders.

Oberoi, Trident, Mumbai, 117 m(384 ft.), 35 floors

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New and versus old Trade Centre New york

Loading on high-rise buildings differs from loading on low rise buildings mainly in its accumulation over the height o cause very large gravity and lateral load forces within the structure. In buildings that are exceptionally slender or flexible, the building dynamics become important in influencing the effective loading.

Wind loading becomes significant for buildings over about 10 stories high, and progressively more so with increasing height. The building, which is not tall or slender, the wind loading may be estimated by static method. For exceptionally tall, slender, or flexible buildings, it is recommended that a wind tunnel test on a model is made to estimate the wind loading. If the building is exceptionally tall, or irregular in its structure, a model analysis procedure is recommended for estimating the earthquake loading.