# Structural Alterations: A Risky Proposition

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In Mumbai there are hundreds of buildings, which are standing in precarious structural conditions. Although declared as "dilapidated" and unfit for occupation several years ago, these structures have stood for years without collapse. In contrast, we find that a few relatively young and apparently strong buildings have come crashing down without the slightest warning. What could be the reason for the sudden loss of stability for these unfortunate buildings?

The answer is "Structural Alterations".

Most of the recent buildings constructed in Mumbai are *RCC Framed Structures*. RCC stands for "Reinforced Cement Concrete", wherein reinforcement in the form of steel bars is embedded in concrete for required strength. For such buildings, while ageing and poor maintenance can progressively lead to loss of strength, such deterioration is gradual and grows with time, often with warnings in forms of, cracks, bulges and corrosion of bars in the structural members. However in case of structural alterations, the result could be a sudden collapse without any warning.

In order to appreciate the gravity of structural alterations, let us first understand how an RCC framed building supports its loads.



An RCC framed building consists of various structural elements connected to one another as a frame, which carries loads and transfers them safely to the earth. Walls in such structures are constructed after the frame is ready and are not normally meant to support any load.

## Structural Elements:

RCC frame mainly consists of the following elements:

- The ceilings of your rooms called '**Slabs**'.
- Horizontal members under slabs called '**Beams**'. You will find most beams at the top of walls.
- Vertical members supporting the beams called '**Columns**' (pillars). Most columns are located at the junctions of beams or at corners of walls. A specially designed long column is called a '**Shear Wall**'.
- The underground system transferring the load of the building to the earth called '**Foundation**'.

Other RCC elements such as chajjas, lofts, staircase, water tanks etc can be called as secondary elements, which are supported on the main elements.

## Loads & Load Transfer:

The gravity loads on a building are of two types: 'Dead Load' and 'Live Load'. Dead load consists of the weight of the building itself including the frame, walls, plaster, flooring, waterproofing etc. Live load constitutes the transient loads such as the weight of people, furniture, domestic equipment etc.

Load transfer means supporting the loads acting on the building and safely carrying them down to the earth below. In a framed building, the loads are transferred by 'Frame Action'. The loads on slabs are transferred on beams. Beams, in turn, transfer the loads on columns immediately below them. The upper columns transfer the loads to lower columns. A slab or beam carries the load for that floor only; e.g.

for a 7 storeyed building, the third slab and its beams would carry and support loads on the third slab only and the slabs above or below it would not transfer any loads on it. In contrast, a column carries the accumulated loads for all the floors above it, which means that columns in third floor must be able to carry and support all the slabs above them e.g. $4^{th}$ to $7^{th}$ slab and also the terrace slab together with the loads of water tank, lift room etc. It is for this reason that the columns on lower floors are bigger than those on the upper floors. The lowermost columns transfer the loads to the foundation, which, in turn, transfers them to the earth.

### Structural Alterations & Collapse:

Due to scarcity of space and an urge to renovate one's home, alterations within flats are very common. Sadly, many times, such alterations are carried out in a casual or reckless manner thereby compromising on the stability of the building. During such works if the RCC frame is tampered with, the stability of the building can be adversely affected. Further, if the original construction quality of the frame is bad, the grade of maintenance is poor or the building is overloaded, the situation can be significantly aggravated. Depending on their nature and extent, such structural alterations can lead to local or total collapse of the building. Tampering with a column or foundation is the worst and can almost certainly lead to collapse. Similarly, tampering with major beams can lead to a local collapse, which in turn may trigger total collapse in a cascading manner.

### The Common Risks:

While structural alterations in any form are undesirable, we can list the following as potentially the most dangerous:

- Breaking columns especially on lower floors
- Constructing additional floors on buildings which do not have that provision
- Excavating and lowering the plinth level
- Overloading: Constructing overhead water tanks, Using residential buildings for industrial or warehousing purposes
- Breaking floor beams
- Making cutouts in slabs



In view of the recent building collapses, we should understand the grave risks of structural alterations. The risks are so high that alterations or renovations should never be undertaken or allowed unless a competent structural engineer is consulted.