CAUSES OF CRACKS IN HIGH-RISE BUILDINGS

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In this modern era, with the rise of population densities and land prices, the city is being developed with an increasing number of high-rise structures. It has also driven up demand for buildings that rise vertically in urban areas for both commercial and residential uses.

Building cracks are a global issue that affects people all over the world. When the stress in a building component exceeds its strength, cracks form. External forces like dead load, live load, wind load, seismic loads, or foundation settlement may cause stress in a building's structural elements. Internal factors such as temperature changes, moisture changes, and chemical reactions can also lead to stress. Cracks can be formed in structures for a variety of reasons. It can be classified as structural or non-structural. The most common structural cracks are due to poor design, foundation settlement, wind load, and overloading. Non-structural cracks can form as a result of any external cause, such as moisture variation, changes in temperature, or other factors.

This article includes research on cracks, what their causes are, and how they affect structures. It is crucial to understand cracks because they are common today. To understand the fundamental causes of crack formations, every factor that is considered during the design phase of a high-rise building is included in the list of its causes. The crack, though currently minor, has the potential to grow significantly in the future. It is essential to correspond with a structural engineer as they can recommend various preventive measures against the occurrence of cracks and solutions to the existing issue without impacting other areas of the structure.

Concrete is currently one of the composite materials that is typically used at every stage of construction, but it is susceptible to damage or defects throughout its service life for a variety of reasons. Table 1 shows the causes of cracks might be due to:

Table 1: The Causes of Crack

Causes	**Description**
Faulty design	Poor structural design and specifications are the most important factors in a building's failure. All environmental surveys, including soil investigations, should be incorporated into the design. For instance, a building designed for residence usage will have different structural specifications than one designed to operate machinery. Some buildings are also designed to withstand specific load conditions.
Overloading	Buildings are typically designed to withstand the typical loads encountered during their lifetime, but occasionally they are overloaded by dead load or live load [1].
Drilling hole in structural element	To drill through structural elements, approval shall be obtained from the structural engineer to ensure that such action is safe for the building structure. The most common scenario is the owner drills through the beam to get access to pipes or wires. Drilling into a support beam can endanger the structure's integrity. If the building has a higher level and users drilled through a support beam on the first level incorrectly, it is extremely difficult to replace. Such drilling action may cause the structural elements to lose some strength, resulting the nearby building structure have to support more weight and eventually develop cracks. The worst case can be a structural crack.
Foundation settlement	Due to shrinkable clay soils, foundations are susceptible to settlement from landslips, earthquakes, and moisture changes. Cracks form when a

	part of a structure is displaced from its original location without any change in material size [1].
Moisture	The alternate expands when wet and shrinks when dry may cause changes in the intermolecular spaces of the building materials. This cyclical movement change the interpore pressure of the material and cause a crack.
Poor workmanship	Walls, beams, and slabs will develop cracks due to improper material mixing, shoddy work, lack of curing, a change in the water-cement ratio, and inadequate compaction [1]. The poor mix of water-cement ratio will increase concrete creep and decrease the permeability of concrete, eventually leading to a decrease in durability.
Wind Loads	The cumulative increase in wind pressure up height increases the storey shear and storey moment as the number of storeys increases. The maximum wind pressure in the highest part of the structure is where the wind load will be transferred through the column to the foundation. Hence, the ground floor will experience the maximum shear force. Subsequently, cracks are most likely to appear on the lowest floor of a high-rise building when the wind load exceeds the design limit.

Effect of cracks

Crack increases the structure's vulnerability to external effects, expedite ageing, and can reduce the structure's mechanical resistance. Furthermore, cracks impair a structure's capacity to withstand stress and could cause it to collapse. If cracks appear, it is important to assess how they will affect the structure's strength and to create a monitoring schedule as the impact of cracks could be enormous to the building occupants. The building occupants have to contend with negative effects such as uncomfortable living conditions, security risks, and high repair costs [2]. It is undeniable that a user's comfort and productivity are correlated with the performance of the building they use to live in, learn in, conduct research in, or work around, thus maintaining a building has an ongoing impact on everyone's life [2].

It should be noted that surface examination cannot determine the cause of the problem by simply observing the visible signs in the building. After using proper diagnostic techniques, only an experienced structural consultant can recommend the repair methodology [3].

Conclusion

With the surging demand for high-rise buildings, an ever-growing number of cracking cases in high-rise buildings is being observed. Structure deterioration can be caused by a variety of factors. When defects are spotted in the building or structure, it is necessary to seek advice from a professional structural engineer. With properly planned inspections and test or even design verifications, a customized solution could then be generated to mitigate or rectify the defects before they worsen.

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