HOW ARE SKYSCRAPERS DESIGNED TO WITHSTAND EARTHQUAKES?

Every year, around 20,000 earthquakes occur worldwide. In 2023, 1780 of these had a magnitude of 5 or greater.

What happens to a building in an earthquake?

Earthquakes generate shock waves that spread across the ground, causing horizontal movements. While buildings are designed to handle vertical forces like gravity, they often struggle with side-to-side forces caused by seismic activity. This horizontal shaking creates vibrations in walls, columns, and beams, making lower stories bear greater forces than higher ones. If structures are not properly reinforced, they can fail to support their weight.

Four Methods for Earthquake-Resistant Buildings

Because earthquakes produce energy that pushes on buildings from one direction, the strategy is to have the building push in the other direction. Therefore architects and engineers use strategies like flexible foundations, damping systems, vibration deflection, and structural reinforcements to counteract or redirect seismic forces to keep buildings standing.

1. Flexible foundation

The strategy of base isolation entails erecting a structure on top of flexible steel, rubber, and lead pads. So, as the base moves, the isolators vibrate, but the structure stays stable.

2. Damping system

Shock absorbers reduce seismic waves' impact in two ways:

-Dampers are placed between columns and beams on each level of a building to regulate vibrations. Each damper is made up of piston heads in a cylinder filled with silicone oil. When an earthquake strikes, the building transmits the vibrational energy to the pistons, which press on the oil. The energy is subsequently converted into heat, which reduces the force of the vibrations.

-Pendulum Power Systems use a suspended ball at the building's top that sways in the opposite direction of the building's movement to stabilize it.

3. Vibration Deflection

The "seismic invisibility cloak", made of 100 concentric plastic and concrete rings, is buried at least 3 feet beneath the building's foundation. Due to their mobility, seismic waves can flow through the rings to the outer rings. Thus, they are efficiently guided away from the structure and spread across the environment.

4. Structural Reinforcements

Reinforcements like shear walls, cross braces, and diaphragms redistribute seismic forces. The materials used—such as steel, timber, or shape memory alloys—play a crucial role in a building's stability.

Did You Know?

Taller buildings are often safer than shorter ones during earthquakes because their flexibility helps them withstand seismic shaking.

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