

Construction expertise from Japan: earthquake proof buildings

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## Why is Japan a leader in earthquake proof buildings?

Japan's finesse at designing earthquake-proof buildings is born largely of necessity. The island nation sits on what is known as the Pacific Ring of Fire, a zone where the <u>Eurasian, Pacific and</u> <u>Philippine tectonic plates</u> are forced beneath one another. This enormous pressure periodically results in a huge release of energy – resulting in the archipelago's earthquakes.

Japan has suffered earthquakes throughout its history, with one of the worst being the Great Kanto Earthquake of 1923. The quake reached 7.9 on the Richter scale, destroyed Tokyo and Yokohama and killed over 140,000 people.

After WWII, the Japanese government introduced a series of increasingly strict measures to force builders to make earthquake proof structures (this was especially important as buildings were growing taller). Japan's earthquake proof building standards are <u>as follows</u>:

•**Taishin:** This is the minimum requirement for earthquake resistant buildings in Japan, and mandates that beams, pillars and walls be of a minimum thickness to cope with shaking.

•Seishin: The next level of earthquake-proof buildings in Japan, Seishin is recommended for <u>high rise buildings</u>. It uses **dampers** that absorb much the energy of an earthquake. Essentially, layers of thick rubber maps are placed on the ground below the foundations, thereby absorbing tremors.



**Menshin:** This is the most advanced form of earthquake proof buildings in Japan, and also the most expensive. The building structure itself is isolated from the ground by layers of lead, steel and rubber which move independently with the earth below. This means the building itself moves very little – even during the most severe quake



#### Behavior of Building Structure with Base Isolation System





### **Common earthquake-proof features in Japanese buildings**

- 1) The use of a steel frame in the building's core as opposed to the reinforced concrete core common in Western structures
- 2) The use of diagonal dampers, steel beams and columns rather than concrete columns
- 3) Pendulums in the core or on the roof of the building
- 4) Dampers installed between the levels of the building
- 5) Mesh structures to help to fortify the building
- 6) Made-to-break T-joints
- 7) Many new buildings are also connected to the country's early warning system, which alerts inhabitants of an oncoming quake
- 8) Use of fall-away doors which provide more ways to escape
- 9) Covered lights to protect people in case light bulbs explode

# **3 examples of Japan's earthquake-proof buildings**

**1.**Tokyo Skytree

As one of the tallest buildings in the world, the Tokyo Skytree tower is believed to be totally earthquakeproof. It uses seismic dampers on the structure's base which connect to a central pillar that can absorb an earthquake's shock.





### 2.Shinjuku Mitsui Building

Absorbing the power of earthquakes is not only something to think about on new builds. In the example of the Shinjuku Mitsui Building, also in Tokyo, several 300-tonne pendulums were retrofitted on the skyscraper's roof. The pendulums rock back and forth during a quake which helps counteract the building's side-to-side movement.



### **3.**Air Danshin's 'floating' homes

Japanese company Air Danshin has created a unique solution to the problem of earthquakes: levitation! The residential homes are fitted out with a quake detector. If it registers a tremor, a compressor pushes air into a space beneath the building, lifting it one to three centimetres from the building's foundation. This makes it impossible for the building to shake and therefore helps avoid damage.



## What can we learn from Japan's buildings?



RESILIENCE MEAN THAT JAPANESE BUILDERS KNOW WHAT TO DELIVER. THIS ALSO GIVES CUSTOMERS MORE SECURITY AND CONFIDENCE.

EARTHQUAKE PROOF BUILDINGS.

LONG RUN, THIS APPROACH SAVES OWNERS MONEY SINCE THEIR BUILDINGS ARE SAFE FROM DAMAGE WHEN EARTHQUAKES STRIKE.



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