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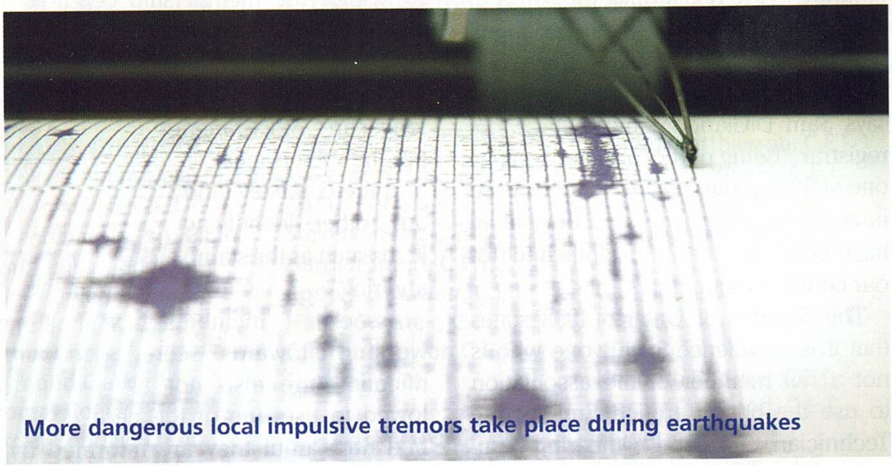
How earthquakes destroy structures built to withstand intense blasts

Every strong earthquake causes new and unexpected destruction of buildings, in spite of existing seismic defense measures. [1] Earthquakes often destroy structures that were built in accordance with current building codes, even while nearby buildings that weren't designed in accordance with building codes escaped unharmed. [2]



More dangerous local impulsive tremors take place during earthquakes

Some experts [1,3] believe that besides well-known low-frequency ground vibrations, [5,6,7] more dangerous local impulsive tremors take place during earthquakes. Building codes do not include impulse load.

For example, a seismic event on Jan. 17, 1995 with the intensity of nine degrees on the MSK-64 scale in Kobe, destroyed more than half of the most modern high-quality buildings in the city that were built to handle this seismic load. [8]

After the Spitak temblor in Armenia on Dec. 7, 1988, concrete crumbled in the hands of observers, [9] but chemical analysis showed that it had enough quantity of cement to withstand the shock of the earthquake. [10]

In 1862, near Baikal, Russia, an earthquake with the intensity of nine degrees on the MSK-64 scale produced jerky horizontal movements of the ground and vertical blows. This was considered to be the main cause of destruction that took place. [4]

Many round blasting cones, with the diameter of 50 m and depth of 20 – 30 m, appeared as a result of an earthquake that hit Hait, Tajikistan in 1948. [11] One of them formed in the zone where the earthquake had an intensity of six degrees on the MSK-64 scale. [12] The phenomena were accompanied by heavy ejections of crushed rock. [11] Any explosion gives rise to local impulse load.

During the Jirgatal, Tajikistan earthquake in 1984, blasting cones with a diameter of about 40 m and depth of up to five m sprang up. [12] Ground (loamy aggregate and fragments of rock) was ejected at a distance of up to 180 m. [12]

The Ashkhabad, Turkmenistan earthquake in 1948, with an intensity of nine degrees on the MSK-64 scale [4], started from a strong vertical blow and tossed high even heavy objects. [13]

Gigantic explosions preceded and accompanied both the Gobi-Altai earthquake on Jan. 4, 1957, and its numerous aftershocks. [11] They were heard at a distance of more than 100 km, sounding like peals of thunder. [11]

In another seismic event in New England, observers recorded that the earthquake's tremors were like a pulse. [14]

These examples of unexpected seismic destruction show that earthquakes cause not only low-frequency vibrations, but also local impulsive tremors that cause building failures.

It is necessary to protect buildings from low-frequency vibrations and local impulse tremors. The evidence shows that metal elements connected by welding may be destroyed by impact load. If designers and builders use another way to connect these elements, such as bolts or wood construction, the risk to the buildings from impulse tremors may be reduced.

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