Earthquake-safe Buildings

# Article 1. Bandung and Earthquakes

Indonesia’s many volcanoes that spread along its length from Sumatra to beyond Lombok remind us that we are living on the Pacific Rim of Fire. As well as being vulnerable to volcanic eruptions, we are also living on the edge of a tectonic plate. It forces the Australian Plate to bend as it constantly slides underneath Indonesia as fast as our finger nails grow! (Figure 1). The movement is not smooth. At times the sliding becomes stuck. Stresses build up. The stress and energy are released by sudden and violent rupture of rock, causing an earthquake. Figure 2 shows the sizes and locations of recent Indonesian earthquakes.

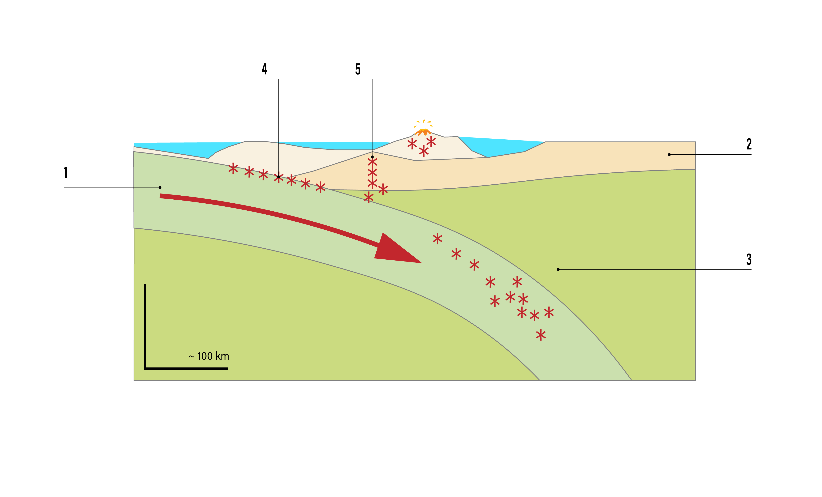


Figure 1. A cross-section through Sumatra and a volcano showing the Australian plate (1) sliding under Sumatra and the Continental crust (2) into the mantle (3). Earthquakes (4) are generated by this movement and also along the Sumatran fault (5).

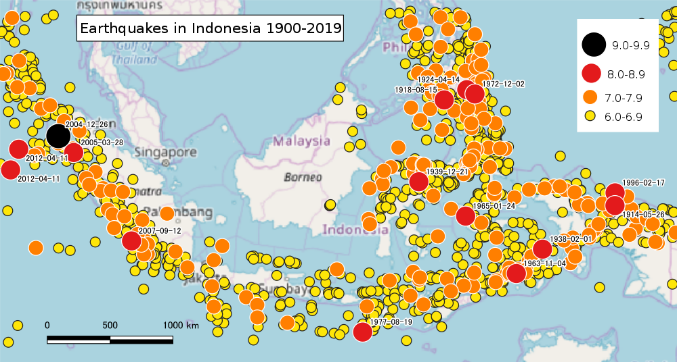


Figure 2. Recent large earthquakes in Indonesia (Wikipedia). The earthquakes are grouped according to their magnitudes or their released energy.

While the most earthquake-active regions in Indonesia are near the edges of moving tectonic plates, other regions, such as Greater Bandung, experience earthquakes from local active faults. Here, the Lembang Fault runs East-West between northern Bandung and Lembang (Figure 3). Scientific research1 shows that during a person’s lifetime there’s a 20% chance of an earthquake on this fault strong enough to damage and collapse buildings.

During an earthquake the ground moves to-and-fro quickly and randomly in all directions. Ground movements during a large earthquake may cause you to become so unsteady you can’t stand. The ground itself can be affected by this shaking, causing earthquake-induced landslides, and liquefaction where wet soil turns to mud. But usually, the buildings we live and work in every day, will suffer the most.



Figure 3. Aerial view showing the location of Bandung and the Lembang fault (Direktorat Geologi Bandung).

Buildings vibrate, shaking side-to-side during an earthquake. The higher parts or floors of buildings move sideways further than those below as buildings bend and distort during the shaking (Figure 4). This puts enormous stress on the structure supporting buildings, like columns, beams and walls. It’s like you standing tall with both feet on the ground, and a friend pushing you gently from behind. Your head and shoulders will move much more than your knees and shins. The muscles in your feet will be doing most of the work to keep you from falling over. This is similar to what a building experiences during an earthquake. Reinforced concrete columns and masonry walls are the most vulnerable. If they get damaged, buildings may collapse. We, our families, friends and others may be among the casualties.



Figure 4. House during earthquake shaking.

Fortunately, it’s straight forward and not overly expensive to design and construct buildings to resist earthquakes. Building damage during earthquakes is not inevitable. It can be prevented! Further articles in this series explain how in greater detail. For new buildings in Indonesia and in other countries to be both safe and avoid serious damage during earthquakes it’s a matter of improving current practice and applying well-known and proven principles and practices. This is how we can keep ourselves, our families, and our future relatives safe during earthquakes.

Even though Bandung is not in the most active seismic region, the chance of a damaging quake severely damaging your building is relatively high. Higher than, for example, you having a serious traffic accident. Earthquake-safe buildings are readily achievable, but they don’t happen without greater care than usual.

## About this article series:

This is a series of articles about earthquakes, their effects on buildings, and how to ensure that buildings are safe against earthquakes. They are intended for potential owners of new houses and larger buildings and others involved in the building industry. The articles are written by Andrew Charleson and colleagues from the World Housing Encyclopedia (http://www.world-housing.net/) which is sponsored by the Earthquake Engineering Research Institute (https://www.eeri.org/) and the International Association of Earthquake Engineering (http://www.iaee.or.jp/). If required, articles are translated and content may be modified by local experts to suit local conditions.

## References:

Daryono, M. R., Natawidjaja, D. H., Sapiie, B., and Cummins, P., 2019. Earthquake Geology of the Lembang Fault, West Java, Indonesia, *Tectonophysics*, Volume 751, 20 January, pp. 180-191.