Mitigating the Seismic Risk

How densely-populated countries are trying to become less vulnerable to earthquakes

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The 2015 Nepal earthquake was last weekend's devastating natural disaster. One reason is the geologic setting: When a magnitude 7.9 quake with a shallow source of only 12 kilometers below the ground strikes, very strong seismic shaking is to be expected and significant ground motion will spread over a very large area. Indeed, last Saturday's seismic waves were clearly felt both in New Delhi as well as in Okhara. Each capital is located more than 800 km away from the epicenter.

But such seismic circumstances alone do not necessarily lead to a catastrophe of the magnitude now seen in Nepal. Were a similar sized earthquake to occur in the Tibetan tundra or in the huge vastness of arctic Canada, only a few seismologists would take notice. The reason both of these regions are sparsely populated and neither contains much infrastructure. Similar to other powerful natural events like cyclones or tsunamis, earthquakes follow the rule that the risk — and hence the expected damage — associated with the event is the product of two independent factors: hazard and vulnerability.

What do these two terms mean? The seismic hazard is the ability of the Earth to generate strong earthquakes. This value is especially high along the Himalayan front, in the last 60 years alone, four quakes with magnitudes of more than 8 have struck the area. The largest one occurred in 1934 in Assam. It was measured as 8.6. In contrast to hazard, the term vulnerability is more complex and describes how prone human society, its support structure and its lifelines are to the effects of a natural event. While the vulnerability in uninhabited areas without infrastructure is very low, it can be extremely high in densely populated cities.

Unfortunately, the valley of Kathmandu is one of the most vulnerable places on Earth. While we cannot twiddle with nature and alter the seismic hazard, human society can do a lot to significantly reduce its vulnerability to an earthquake. Over the last few decades many densely populated countries undertook serious efforts to make themselves much less vulnerable to earthquakes.

As an example, look at California. While the US West Coast has not had a quake as strong as last Saturday’s for the last 180 years, it was struck by several deadly and damaging quakes. After each of these quakes, starting with a destructive tremor in the Los Angeles area in 1933, earthquake engineers comb through the rubble, trying to understand why buildings collapsed and why infrastructure elements like bridges or dams were damaged. These investigations led to recommendations on how to strengthen the statewide building code. Once implemented, those new regulations were then strictly enforced. Such tough standards and their rigorous enforcement are the most effective means to reduce the earthquake vulnerability. This has to include the political will to prosecute builders who cheat.

Another important mechanism to bring seismic vulnerability down is retrofit. After the 1989 Loma Prieta quake, which caused major damage around the San Francisco Bay, the concrete columns of highway bridges were braced with steel mangers and the huge tunnels, which bring drinking water into the region, were made to be flexible, wherever they cross active earthquake faults. Hospitals and schools were made more robust so that they would withstand stronger shaking without experiencing structural damage.

While working on buildings and infrastructure can bring the vulnerability down significantly, humans have to do their part as well. This applies to emergency managers who coordinate the response to an earthquake. They need to have workable plans on putting out fires, search and rescue, setting up emergency shelters and restoring lifelines like power, drinking water, sewer systems and telecommunications. Emergency personnel in California and Japan go through exercises at least once a year to train for and improve their response to a disaster.

The final element is new technology. Earthquake early warning systems, implemented in Japan, Taiwan, some parts of Mexico and Turkey are not able to predict the occurrence of a quake. They can, however, issue a warning, once a strong quake has started. Immediate messages sent over the mobile networks, radio and the internet can alert people. Even if they have only ten seconds, it is enough to seek shelter under a strong part of a building or run into the open before the damaging waves arrive. It is certainly about time that the countries along the Himalayan front start planning for such an earthquake early warning system. It has to be done jointly and cooperatively, because for seismic waves national boundaries are not more than arbitrary lines drawn on the globe.