Shouldering the storm: engineering resilience to extreme weather

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The destruction wrought by Typhoon Haiyan is difficult for most of us in the West to conceive. It seems to have been one of the strongest tropical cyclones ever recorded, with 1,833 confirmed dead in the Philippines and fears that this number could rise still further when contact is established with more remote rural regions.

While much damage was caused by the sheer strength of the wind, heavy rain fall led to floods, which cause landslides due to unstable wet ground. Debris from failed buildings also caused much damage to other buildings. This is very much in line with what has been reported from other such disasters – that damage and destruction has multiple causes that are inter-related in complex ways.

It does appear that 'engineered' structures that have been through some design process withstood the storm rather better than those that didn't. Again this is an observation that can be generally made in such circumstances – where the nature of a building requires proper engineering design to have been carried out, with proper consideration of the loads and the risks, then damage can be minimised.

For example in the **St Jude's day events (http://www.telegraph.co.uk/topics/weather/10409362/Was-St-Judes-storm-really-that-bad.html)** in the south of England, there was relatively little structural damage to buildings, roads and railways, with disruption being caused mainly by fallen trees. Similarly, in the 2011 Japan earthquake, which was one of the strongest to have been measured in recent decades, there was relatively little structural damage to high-rise or low-rise buildings or transport links as a direct result of the earthquake, although the appalling secondary effects of the associated tsunami were of course only too apparent.

These points illustrate that engineers know very well how to design and build structures that are resistant to even extreme environmental loads so that they can remain intact and safe. However, the issue in the Philippines was not the engineered structures, but rather the mass of non-engineered structures that were utterly destroyed, exposing their inhabitants to extreme conditions. One suspects that much of the housing stock was of a relatively low standard, built cheaply without a rigorous inspection regime. Indeed, the building of stronger structures with such inspection is a Western luxury that few countries in the developing world can afford.

The question than arises as to whether such storms are becoming more common or more severe due to climate change? In Europe there is little evidence that this is the case, either from the study of past meteorological data, or from the output of climate models. Indeed the predicted wind speeds from current climate models cannot be regarded as robust, unlike the predictions for temperature and rainfall. However there does seem to be a developing scientific consensus that, due to the warming of the Pacific Ocean, the frequency of severe storms such as Typhoon Haiyan may be increasing.

What then should be the way forward? In the short term this might involve the building of well engineered emergency shelters in vulnerable communities that could be used as shelters for evacuees when very strong events are forecast (and indeed it should be noted that Haiyan was predicted in a timely and accurate manner). While this will not result in less damage, it would at least minimise loss of life. In the medium term more resilient community infrastructure such as energy and transport systems could be constructed, such as would withstand the worst of the storms and enable some level of normality to be restored as quickly as possible. The ultimate solution would, however, seem to be to take action to reduce anthropogenic climate change, through reduction of greenhouse gas emissions, and thus to reduce storm frequency. Unfortunately this seems to be a road that both the developed and the emerging economies are not yet inclined to travel.

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