

Haiti Earthquake: A simple concept to help save lives in the future

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A devastating earthquake measuring 7.3 on the Richter scale struck Haiti on 12 January 2010, killing more than 200,000 and severely affecting at least one million peopleⁱ. The affects that the earthquake had on Haiti's buildings was what killed so many people not the earthquake itself. Poor construction and overcrowded cities caused the vast majority of deaths. Through using this practical example and appropriate modelling the main reason why buildings collapse will be analysed and how a simple affordable concept can save lives will be explained.

The capital; Port-au-Prince has a rapidly growing population. When such a city has a growing population new homes are needed quickly so one can expect the building stock to be poor and the use of marginal land to be greater (e.g. people will build on unstable slopes, which are prone to landslides in the event of an earthquake). *Figure 1ⁱⁱ* shows one of many buildings that have collapsed as a result of the combination of vigorous shaking caused by the earthquake and poor construction. *Figure 2ⁱⁱⁱ* shows a building which has been constructed appropriately (i.e. main structure still standing). *Figure 3^{iv}* shows buildings constructed on areas much more susceptible to the affects of earthquakes.



Figure 1



Figure 2



Figure 3

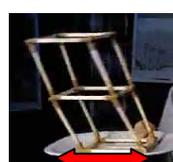
The above images illustrate just how devastating this earthquake was and subsequently much of the country will have to be rebuilt from scratch. There are simple and affordable ways to make Haiti's buildings safe in the future. We all live in stacked cubes and the problem with this is they are held up by their corners. The modelling of these 'stacked cubes' help to provide a simple description of why such buildings are so vulnerable in the event of an earthquake:



1

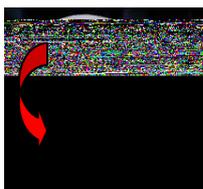


2

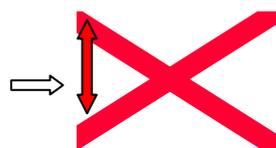


3

The model building has strong columns and beams but very weak corners (1). When the earthquake shaking occurs (side-to-side motion) the structure shakes very hard - large lateral movement (1 & 2).



4

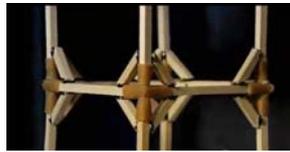
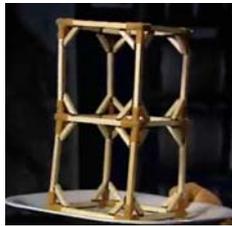


5

An earthquake can also produce torsion and the building is very weak in response to torsion (4). Earthquakes occasionally produce up and down motion and under compression, the building is also weak (5).

In the event of a major earthquake, these illustrations demonstrate that buildings constructed in such a way will ultimately collapse, killing everyone inside.

Haiti is the poorest nation in the western hemisphere, and much of the country will have to be rebuilt from scratch. But there are simple and affordable ways to make Haiti's buildings safe in the future. The vulnerability of all buildings made of cubes is described and illustrated above.



On producing the exact same building model as above but snapping in corner joints buildings can be made what engineers call 'life safe' (in the event of a natural disaster the main structure of the building will not collapse, hence enabling people inside to get out unharmed). By simply connecting the corners of each floor to the vertical columns with steel reinforcement a building can be made 'life safe' (6).

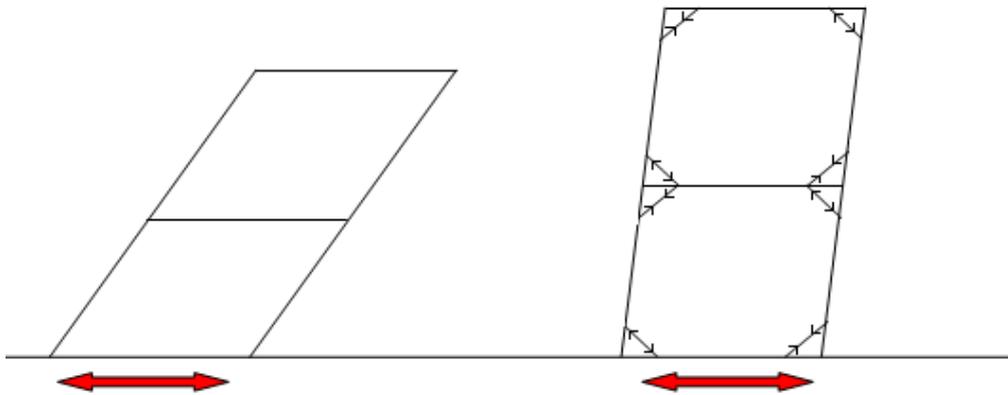
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6



Now when the side-to-side motion is applied the model hardly moves laterally. Similarly when the building is subjected to torsional forces or up and down forces the structures movement is minimal. This building would only require 15% more material with a 15% higher cost which is very affordable and essential if lives are to be saved in the future.

To explain why forming these triangular corners makes the model building much stronger and less likely to collapse during an earthquake, the main affect will be analysed: shaking or side to side motion:



The first diagram shows the lateral movement of the building without the triangular corner joints. There are no forces counter-acting those caused by the side-to-side motion. The second diagram shows the forces in the snapped in joints. Their horizontal components act with the beams and columns reacting against this lateral movement, which therefore helps to minimise sway. The same principle can be applied to the other affects caused by earthquakes.
