

'Invisibility cloak' could protect against earthquakes

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The 'invisibility cloak' could be applied to buildings by installing rings into foundations

(PhysOrg.com) -- Research at the University of Liverpool has shown it is possible to develop an 'invisibility cloak' to protect buildings from earthquakes.

The seismic waves produced by earthquakes include body waves which travel through the earth and surface waves which travel across it. The new technology controls the path of surface waves which are the most damaging and responsible for much of the destruction which follows earthquakes.

The technology involves the use of concentric rings of plastic which could be fitted to the Earth's surface to divert surface waves. By controlling the stiffness and elasticity of the rings, waves travelling through the 'cloak' pass smoothly into the material and are compressed

into small fluctuations in pressure and density. The path of the surface waves can be made into an arc that directs the waves outside the protective cloak. The technique could be applied to buildings by installing the rings into foundations.

Sebastien Guenneau, from the University's Department of Mathematics, who developed the technology with Stefan Enoch and Mohamed Farhat from the Fresnel Institute (CNRS) in Marseilles, France, explained: "We are able to 'tune' the cloak to the differing frequencies of incoming waves which means we can divert waves of a variety of frequencies. For each small frequency range, there is a pair of rings which does most of the work and these move about a lot - bending up and down - when they are hit by a wave at their frequency.

"The waves are then directed outside the cloak where they return to their previous size. The cloak does not reflect waves - they continue to travel behind it with the same intensity. At this stage, therefore, we can only transfer the risk from one area to another, rather than eliminate it completely."

He added: "This work has enormous potential in offering protection for densely populated areas of the world at risk from earthquakes. The challenge now is to turn our theories into real applications that can save lives - small scale experiments are underway."

Seismic waves also include coupled pressure and shear body waves which are less destructive than surface waves. Sebastien Guenneau and Sasha Movchan at the University of Liverpool, together with Michele Brun at Cagliari University, have designed an 'elastic' cloak to protect against these particular seismic waves and the team is currently seeking a suitable material to accommodate the elastic parameters of the cloak.

The new research to protect against earthquakes is published in *Applied*

Physics Letters and *Physical Review Letters*.

Source: University of Liverpool ([news](#) : [web](#))

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