

Institution of Structural Engineers Research Award 2013

Project title: Adaptive structures to save energy and material

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Industrial partner: Expedition

Aims of research:

The aim of this project is to build a large-scale prototype that demonstrates that active elements strategically located and controlled save large amounts of energy over the structure's whole life. Most structures are designed to withstand a worst case loading that will only occur rarely (earthquake, storm). In these cases, the structure is effectively overdesigned for most of its life. As part of an on-going Expedition-UCL research project, a novel design methodology has been developed allowing a given structure to withstand ordinary loads passively while enrolling the support of active elements when loads exceed a certain threshold. Extensive numerical testing on trusses of various topologies has shown that this methodology can save up to 80% in the structure whole life energy. The IStructE Research Award will enhance this collaboration by enabling the construction of a well-equipped, large-scale prototype to validate robustly the method experimentally and demonstrate convincingly its exciting potential to design practitioners.

Benefits to structural engineering:

Technical Quality: The theoretical part of this work has already been published in a number of academic journals. One of the papers won the Hangar Prize 2011. The project has been supervised by leading design practitioners and established academic researchers. Expedition is known for its daring approach to engineering and UCL academic excellence is well established.

Developing an existing working relationship: This EngD project was the first collaboration between UCL and Expedition. The project itself has already led to highly innovative and outstanding research outcomes. The grant would allow us to showcase jointly the research to other design practices and academic institutions and at the same time promote to the construction industry the potential of successful academic/industrial collaborations.

Impact to Industry: Adopted at scale, this new design methodology would be a game changer in design practice. Mastering this technology would give the UK construction industry a highly competitive advantage.

Impact to Members: this project is both extremely innovative and technically challenging in the field of structural engineering. As such it is a perfect fit for what the Institution of Structural Engineers stands for.

Value for Money: This award will capitalise on new but already existing theoretical knowledge. It is led by experienced researchers/engineers who know how to maximise impact and minimise risk. The extra fund will provide a step-change in the type of prototype that we can build: without funds, we can build a toy. With this research award, we can build a demonstration structure that engineers will want to use in their next project.

Benefit to Society: In a resource scarce world where energy prices are unlikely to go down soon, saving energy is something everyone would benefit from and should aspire to. This is exactly what our methodology allows structural designers to do.

Proposed finish date: August 2014