The Institution of Structural Engineers

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Institution of Structural Engineers Research Award 2014

Project title: Force re-distribution in CLT panels under lateral loads for high-rise timber construction

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Industrial partner: Ramboll UK

Aims of research:
Increasing urbanisation and the need for low-carbon building solutions has driven the recent growth in tall timber structures. The UK has led this trend with notable cross-laminated timber (CLT) buildings like the Stadthaus and Bridport-House. However, the main factor hindering the design of taller CLT structures is the need to accommodate large lateral forces arising from extreme actions such as strong winds. Although some research has been directed towards the characterization of their global response, the actual mechanisms of stress transfer and load-redistribution within CLT panels at different deformation levels remains unknown. Especially for the loads and structural configurations typical of high-rise construction.

This study will develop fundamental understanding on the lateral response of CLT panels resulting in new, appropriate, analysis methods that could enable structural engineers to design taller timber buildings. This will be achieved by employing state-of-the-art numerical and experimental methods with special attention given to the force re-distribution and evolution of stress concentration within the panel and panel-connection assemblages at different damage stages.

Benefits to structural engineering:
Technical quality:
Research of this type is essential if the potential of high-rise timber buildings to address the global trends of increasing urbanisation and reduced embodied carbon emissions is to be realised. The numerical modelling and experimental methods, which will be employed, are all state-of-the-art. The project will be supervised by leading CLT design practitioners and academic researchers of established industrial and academic reputation.

Developing an existing working relationship:
This project will be the first collaboration between the Structural Engineering Section at Imperial College and Ramboll UK. It will open avenues of further collaboration and innovative research with an industrial focus, promoting the use of CLT as a sustainable and resilient construction system in the UK and abroad. The outcomes of this project will contribute to the formulation of further research bids via the EPSRC responsive mode.

Impact to Industry:
This project aims to solve a knowledge gap among structural designers and its outcome is expected to have a direct impact in engineering practice. The results will help to optimise designs and advance towards the tall-timber building paradigm giving the UK construction industry a marked competitive advantage.

Impact to Members:
The technical challenges and potential outcomes of this project are in line with the aims and objectives of the Institution of Structural Engineers

Value for Money:
This project will capitalize on the experimental and numerical research experience of the Principal Investigator as well as on the significant practical expertise of the Industrial Partner who will both be contributing towards the costs associated with their own time and expenses.

Benefit to Society:
The understanding gained from the outcome of this project will facilitate an improved performance of timber structures, which have well established social, environmental, economic and aesthetic advantages.

Proposed finish date: November 2015