The Institution of Structural Engineers

International HQ
11 Upper Belgrave Street
London SW1X 8BH
United Kingdom
tel: +44 (0)20 7235 4535
fax: +44 (0)20 7235 4294
mail@istructe.org
www.istructe.org

Institution of Structural Engineers Research Award 2013

Project title: GFRP-Glass composite structures

Principal researchers: Dr Mauro Overend
Engineering Department, University of Cambridge
Tel: 01223 332659 Email: mo318@cam.ac.uk

Other researcher(s): Mr Shelton Nhamoinesu

Industrial partner: Dow Corning Limited

Aims of research:
Conventional glazed structures consist of metallic rectilinear frames with glass infill panels, typically double glazed. The two principal weaknesses of these systems are (i) structurally inefficiency, as they fail to exploit the potential composite contribution of the glass panels and (ii) thermal bridging at joints, leading to higher heating/cooling energy demands in the building.

The recent research on glass bonding at the University of Cambridge and the availability of new high-performance adhesives provide an opportunity to develop Glass Fibre Reinforced Polymer (GFRP)-Glass composite units. These units will consist of GFRP pultrusions structurally bonded to the edges of rectangular glass panels thereby generating composite action between the two materials and resulting in slim composite units that are structurally and thermally efficient.

The aim of this project is to investigate the composite structural behaviour between glass and FRP. The work will involve: (i) The selection of suitable candidate GFRP-glass adhesives; (ii) numerical and analytical modelling of typical GFRP-Glass adhesive joints; and (iii) experimental shear and bending tests on small scale GFRP-Glass specimens.

Benefits to structural engineering:
The development of GFRP-glass composite structures is novel and would lead to a new generation of slim glazed structures (e.g. curtain walls) that outperform existing ones. The improved structural efficiency would result in a reduction of materials used and lower embodied energy. The reduction in structural depth resulting from composite action would also increase the available internal space (e.g. net floor area in a building). The low thermal conductivity of GFRP would reduce unwanted thermal losses / gains thereby reducing the CO2 emissions and operational energy in buildings. Finally, the slim flush appearance would represent a significant refinement in the aesthetics of curtain wall systems.

The scientific outcomes of this research will primarily be of interest to three research communities: (i) glass; (ii) composite materials and (iii) adhesives / adhesion. The numerical modelling of the time-dependant response of adhesive joints will also be of interest to the wider polymer science community and the performance of the GFRP-glass units will be of interest to the wider structural engineering and building physics communities.

The project will involve close collaboration with the industrial partner (Dow Corning). Dow Corning will benefit from the testing capabilities and knowledge on glass and glass bonding at the Glass & Facade Technology Research Group at the University of Cambridge. Moreover, this project provides a novel application for some of Dow Corning's latest high performance products. In exchange, the project will benefit from Dow Corning's knowledge in polymer chemistry, the supply of materials and quick route-to-market

Research of this type is essential if multi-storey buildings in expanding cities are to meet the increasingly stringent legislation and standards regarding their operational energy efficiency and embodied energy. The results from this project will form the basis of a larger bid for funding via EPSRC responsive mode.

Proposed finish date: October 2013