

2012/13 Undergraduate Research Grant Scheme

Project title: Sustainable moment connections in timber structures

University: Queen's University Belfast

Supervisor: Daniel McPolin

Student: tba

Aims of research:

The objective of the research programme is to investigate and develop a sustainable means of creating moment resistant connections within timber frames, with a specific emphasis on the portal frame. The use of internal dowel connections will be investigated using steel bar and also novel pultruded basalt fibre reinforced polymer (BFRP) rods due to its excellent strength, weight and sustainable properties.

The overall object will be broken down into several aims:

Development of theory for predicting capacity

Determination of the mode of failure and performance of the dowel connections

Impact of pitch change on joint performance

Description of method:

The research objective will be achieved by initially conducting numerical analysis of the structural components to guide subsequent structural testing.

The starting point will be considering the connection as a simple moment connection with the capacity controlled by the lever arm and the pull-out capacity of the dowels. Models for pull-out capacity have already been developed and published by QUB. The lever arm will be determined purely by the test geometry.

In both the numerical analysis and testing a number of variables will be considered to assist understanding of the structural behaviour and optimise performance. These key parameters influencing structural load capacity include the bonded in length, bar diameter, glue line thickness, edge distance and timber connection angle.

The timber connections will be manufactured using sawn timber to replicate portal frame connections found in practice. Due to the variable nature of timber, tests will be completed on a one quarter scale to ensure meaningful statistical conclusions can be obtained. The mode of failure will be determined experimentally to give confidence that the design process is both accurate and reliable.

The experimental results will also be used to refine the analysis allowing the creation of a usable and reliable model for design purposes. Of particular importance will be the capacity change due to pitch alteration which will be determined experimentally. This is of key interest due to the variation in key timber properties parallel and perpendicular to the grain.

Benefits to structural engineering:

Such connections enable the timber frame to act rigidly, thus reducing the moment in the beam and allowing an increase in clear span.

It is envisaged that a sustainable, practical and efficient alternative to traditional steel hybrid connections will be achieved.

These engineered steel connections are expensive, intrusive and vulnerable to fire. The research programme will continue and expand upon previous work conducted at Queen's developing timber dowel connections. Research into timber dowel connections is generally limited, with particularly

limited published material available on the use of modern fibre reinforced polymers due to their novel nature.

Proposed finish date: May 13