

Digital Image Correlation using the natural beauty of wood

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Abstract.

The current work examines using the natural features of wood to form a 'speckle pattern' for Digital Image Correlation (DIC) techniques, rather than using a spray applied paint. The work further investigates the impact of applying a spray painted speckle pattern and the impact on both the timber under investigation and the corresponding results.

Introduction

Timber is one of the oldest building materials used by mankind and in terms of carbon sequestration is arguably one of the best building materials available today. One only has to survey the historic building stock in the UK to see that, with good design, timber framed structures can last for many hundreds of years. However, when degradation has set in, the majority of the existing historic UK timber framed buildings have received repairs that are either resin assisted, screwed, or bolted. This is frequently required at beam ends, where the timber has traditionally been interfacing with a moisture absorbent and retaining material, such as brick, which focuses and exacerbates degradation processes.

On the other hand, with the advent of engineered timber, such as Laminated Veneered Lumber (LVL), Cross Laminated Timber (CLT) and other glued laminated (Glulam) timbers, timber is experiencing a resurgence in usage. These large 'slabs' of engineered timber, used for both walls and floors, are predominately connected with metal brackets and screwed or nailed fixings [2]. The height of the multi storey high rise timber framed building is getting ever taller and the associated design codes are being tested, especially as new techniques and fixings come in to the commercial market place: currently, Brock Commons (a student accommodation block at The University of British Columbia) is the tallest timber building, reaching 17 storeys in height.

Understanding the interactions and behaviour of both solid timber and engineered timber products

To understand and characterise the behaviour of complex materials such as wood and further predict its behaviour under a variety of loading conditions, allows us to improve the building codes, see BS EN 1995-1 [3] which we construct modern buildings to, as well as improving the future safety of all those using the buildings.

Digital Image Correlation (DIC) has been used successfully in the past to determine stress strain values for wood, particularly with respect to orthotropic properties, Jeong and Park [4].

The current work has two objectives. It can be difficult to apply a suitable speckle pattern to wood, and so the question of whether the natural features of the timber (Fig. 1), may be suitable for DIC at this scale is considered. Secondly if it is not possible to use the natural wood surface, then does spray paint speckle pattern influence any outputs from the DIC.

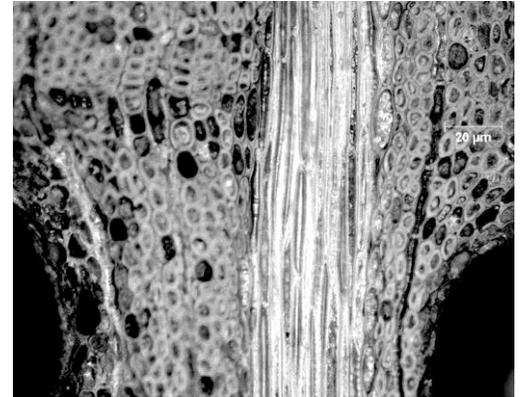


Figure 1 – Showing potential for natural speckle of wood (pine) at x50 magnification using unique timber surface features

Very seldomly do individual wood fibres run parallel to an axis, for the full length of a prepared sample, rather individual fibres twist around. Thus when any piece of wood is prepared to a sample shape, then part severing of fibres along the long axis can occur. This often leads to an issue of depth of field. Where this fibre severing occurs, then issues with movement of the timber due to loading in experiments, in the camera z plane, might lead to further distortions of paint, coating the exposed inner faces of the fibre ‘tubes’. This is due to flexure of the fibre in an unpredictable manner, essentially changing the spray pattern shape due to ‘mesh’ change of shape (change of surface topography) of the fibre. However when considering whether the natural surface of wood may be used for DIC then such factors become a more compelling reason to use the natural surface.

Concluding Remarks

Using the natural surface of the wood holds advantages over using spray paint applied speckle pattern. There is no adhesion issue¹. There are no z plane distortion issues of topological severed fibres. Sealing the surface with spray paint can also impact on ‘fixing’ the moisture content of the wood, again impacting on surface topography. Using the natural wood surface is therefore to be encouraged.

References

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