THE EVALUATION OF SHEAR PROPERTIES OF TIMBER BEAMS USING TORSION TEST METHOD

by

AAMIR MUHAMMAD KHOKHAR

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The Centre for Timber Engineering
School of Engineering and the Built Environment
Edinburgh Napier University
Edinburgh, Scotland, United Kingdom
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ABSTRACT

The use of shear properties including the shear modulus and shear strength of timber joists in current timber design is becoming increasingly important, especially to provide an adequate torsional stability and to avoid vibrational serviceability problems. No proper test method has been established to evaluate the shear properties and the standard testing agencies have recommended the determination of shear properties from modulus of elasticity of timber joists. A torsion test approach can be used to obtain the shear properties as it creates a purer state of shear in the timber joists. However, little research has been conducted to address the proper use of torsion and this requires an urgent detailed investigation on torsion.

This research was primarily conducted to provide a better understanding the use of torsion test approach to evaluate the shear modulus and shear strength of timber joists. Full-scale laboratory torsion tests were conducted on structural size Sitka spruce (*Picea sitchensis*) and Norway spruce (*Picea abies*) joists and on small clear wood and shear properties were obtained. It was found that torsion test produced considerably higher shear modulus and shear strength of timber joists than design values provided from the testing agencies. This signifies that torsion test may be a better approach to evaluate the shear modulus and shear strength of timber joists.

This project also investigated the variation in shear modulus along the length of joists and influence of knots on shear modulus. A substantial variation, as much as 30%, was found in shear modulus along the length of individual joists. However, it was observed that knots did not cause any variation of shear modulus.

This study also details the fracture mechanism of timber under torsional loading and recommends four general failure modes that can be used as a guideline for future investigations on torsion. In general, it was noticed that the torsion test yields predominantly shear failure in joists and that the fractures were commonly initiated within clear wood and propagated parallel to the long side of joists where shear stresses were presumed to be maximum under applied torque.

This research also investigated the relationship between shear modulus and modulus of elasticity. No correlation between shear modulus and modulus of elasticity was found when the relationship was developed from small clear wood to full structural size. This raises serious concerns to whether determination of shear modulus based on modulus of elasticity is an appropriate approach.

Overall, the work conducted here will provide an in-depth and broader understanding of use of torsion. The recent revision of the testing standard EN408 includes the torsion testing approach to obtain the shear modulus of timber. This work endorses the inclusion of torsion testing and proposes that the torsion test also be adopted as a method for evaluating the shear strength of timber.