

An equivalent truss method for the analysis of timber diaphragms

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ABSTRACT: Recent years have seen more ambitious and elastic seismic for tall timber buildings. In response, an ambitious timber community has been proposing challenging plans and ideas for multi-story commercial and residential timber buildings. While engineers have been generally looking at generic load-carrying elements as well as walls, frames and cores to resist lateral loads, floor diaphragms have been largely neglected.

Complex floor geometries and long open floor diaphragms create stress concentrations, high frame demand and potentially large deformations. There is a lack of guidance and regulation regarding the analysis and design of timber diaphragms so structural engineers need a practical alternative to simplify equivalent shear beam analysis or costly finite element modelling.

This paper presents an equivalent truss method capable of solving complex geometries for both high timber framing and massive timber diaphragms. Floor panels are discretized by equivalent diaphragms, having the same stiffness as the panel including its beams. With this method the panel and shear forces (shear flow) and reactions (shear demand, chord forces and reaction forces) can be evaluated. Shear panel stiffness is increased by diaphragm deflection, torsional effects and boundary forces can also be assessed.

1 INTRODUCTION

There is a growing interest in engineered multi-story timber buildings around the world. A number of tall timber buildings have already been built in Europe and Northern America, with New Zealand and Australia following this global trend (IBBC 2014, IPTF 2014).

The local availability of glued laminated timber (glulam), Cross Laminated Timber (CLT), Laminated Veneer Lumber (LVL) as well as prefabricated Light Timber Frame (LTF) elements are encouraging the use of timber for new multi-residential, commercial and industrial buildings, supported by the need and the desire to be reduced emissions to the NPV Timber Structures Worksheet (NPV WS) as well as

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 CLT (Cross-Laminated Timber)
 LVL (Laminated Veneer Lumber)
 Glulam (Glue-Laminated Timber)

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