

2014 MSc Research Grant Scheme

Project title: Dynamic response of tall timber buildings

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Aims of research: Tall timber buildings are emerging as a solution for satisfying the pressing housing demands in densely populated areas with minimum environmental impacts. However, due to the low mass and flexibility typical of tall timber construction, concerns have been raised regarding their dynamic behaviour against lateral loads such as wind events. The aim of the present project is to undertake a systematic numerical study of the dynamic behaviour of tall timber buildings with alternative stabilizing systems subjected to transient wind action. Particular emphasis will be given to the relationship between loading parameters, structural response and structural configuration including the effects of pre-stressing.

Description of method: Recent studies have identified the structural vibration during turbulent wind events as an important design consideration and a potential limiting factor for the implementation of tall timber structures. Therefore a number of solutions for stabilizing the lateral structural system in multi-storey timber buildings have been proposed including solid panel construction, framed structures and various other lattice-type configurations. However, the issue of wind-induced vibrations in tall timber buildings is complicated by the lack of understanding of the dynamic response of these new types of structures when subjected to transient wind events and the absence of a systematic comparison between alternative building configurations. This study will employ state of the art modelling and load representation techniques in order to identify general trends in the dynamic behaviour of tall timber buildings under wind loads.

First, a selection of characteristic tall timber building configurations will be undertaken based on a comprehensive literature review. Solid CLT shear wall systems as well as framed structures will be included. Structural models of a selected number of buildings, including an adequate representation of material and structural damping will be developed considering a trade-off between simplicity and accuracy. These models will be subject to representative wind actions and their structural response parameters such as peak and mean acceleration values will be monitored. The influence of different loading characteristics and building configuration on the peak acceleration demands will be identified and regions of potential problems highlighted. Other parametric studies will be carried out on varying the height of the frame, and the inclusion of pre-stress action at selected locations.

Benefits to structural engineering: Although the sustainable aspects of constructing in timber are obvious, the dynamic characteristics of tall timber buildings represent a potential issue that may hinder their wider application in practice. By identifying general behavioural trends and analysing the feasibility of employing pre-stressed timber elements to reduce wind-induced vibrations, this study will contribute to establish the feasibility and competitiveness of tall timber building construction.

Proposed finish date: 06/2014