京都大学若手人材海外派遣事業　ジョン万プログラム
研究者派遣プログラム

# 英文報告書

提出日：平成２６年　１月　９日

| １．渡航者　（日本語） | | | |
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| 氏　　名 | 森　拓郎 | 採択年度 | 平成 25 年 |
| 部　　局 | 生存圏研究所 | 電　話 | |
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| 研究課題名 | CLT を用いた LSB 接合による大規模木質構造の開発とその耐力発現機構の解明 | | |
| 海外渡航期間 | 平成２５年　６月　３日～　平成２５年１１月２９日 | | |
| 渡航先<br>（英語表記） | 国名：Canada<br>大学等研究機関名：University of New Brunswick<br>研究室名等：　Wood Science and Technology Centre<br>受入研究者名：　Hei Ying Chui (Director, Professor) | | |

２．渡航の報告　（英文）

渡航先の研究環境、研究者との交流、研究発表の状況等、渡航中の滞在経験について英語 (500～1000 語) で記述して下さい。受入研究者と撮影した写真や研究発表で用いた図等について、可能な範囲で別添として提出して下さい。ページ数については増加してもかまいません。
この報告は、ジョン万プログラムの成果として、京都大学ホームページ（英文）などに掲載されることがあります。

I stayed in the Wood Science and Technology Centre (WSTC), which is a wood-related research centre of the University of New Brunswick (UNB), Fredericton, New Brunswick, Canada. WSTC is similar to RISH at Kyoto University. The WSTC was established in 1988 with start-up fund from the federal and provincial goverments. WSTC is located in Hugh Jhon Flemming Forestry Complex, in which there are four forestry-related research organations: Canadian Forest Service, Department of Natural Resources of the province of New Brunswick, Maritime College of Forestry Technology. The WSTC has grown from a small regional research centre to one which is now nationally and internationally recognized, particularly for its strength in wood engineering. It is one of best places doing research on wood construction and engineered wood products. The WSTC doesn't have the undergraduate students, but has master course and doctor course students, and post-doctoral fellews as well. In addition to research and education, WSTC provides it services to industry. There is an interesting program called WSTC-IRAP Innovation Assistance. WSTC provides an Innovation Assistance Service to incorporated small to medium size (500 employees or less) Canadian companies on matters relating to wood products. Funded through the National Research Council's Industrial Research Assistance Program's (NRC-IRAP) network member agreement, this no cost service gives access to WSTC staff or associates on a specific issue. WSTC is committed to helping wood products manufacturers remain competitive. Numerous Canadian firms have been assisted in meeting demanding global markets with innovative technologies and quality products. Some of WSTC's activities under the WSTC-IRAP program including as follows:

- On-site trouble-shooting of manufacturing processes
- Literature search

Technology search and review

Selection of equipment

Assisting with preparation of technical research methodologies and work plans for developing new innovative projects

Preliminary market research

Technical training of company staff and presenting seminar on specific technical issues of interest to the industry.

WSTC is the headquater of NEWBuildS (A Strategic Research Network for Engineered Wood-based Building Systems). The objective of this research network is to increase the use of wood-based products in mid-rise and non-residential construction, or integrated into hybridized construction. There are four research themes:

Theme 1: Cross laminated timber (CLT) – material characterization and structural performance

Theme 2: Hybrid building systems – structural performance

Theme 3: Building systems – fire performance, acoustic and vibration serviceability

Theme 4: Building systems – durability, sustainability and enhanced products

Under this network, there are 23 university professors and 19 researchers from FPInnovations (Canadian National Research Institute of Wood Products), the Institute for Research in Construction of the National Research Council, and Canadian Wood Council. There are more than 60 graduate students and post-doctoral fellows from 11 universities across Canada.

A key technical outcome of the Network research will be the development of new and improvement of existing technical tools for use by design engineers, researchers and product manufacturers to predict product and building system performances. These technical tools include sophisticated mathematical models based on first principles, applied engineering models, process models and experimental techniques.

In my observation, WSTC provides high quality research. I also attended the monthly seminars held in WSTC and graduate students' activities such as thesis defenses, proposal presentations, and qualifying examinations. In seminars, I presented my previous research projects on 1) the connectors or connections used in large scale wooden buildings, and 2) the damaged wooden construction of "The 2011 off the Pacific coast of Tohoku Earthquake". These topics were important to the building structures and codes, which was interesting to my fellow researchers in WSTC. In addition, I presented the research results of during my staying UNB, which was related to use of lagscrewed bolted connections in cross lamianted timber (CLT) .

During my staying, I attended the CLT Workshop for Industry in Vancouver and the Forum of Canadian Manuctured Housing Institute in Ottawa. I learnt some knowledge on CLT for mid- and high-rise wooden structures and informations of industrial trials. Also I had several communications with other university's professors and researchers, the desinars and industrial engineers or producers. I was fortunate to meet the engineers from two CLT manufacturers, the only two in Canada.

During my six-month stay in WSTC, I did several exprimental studies on the pull-out strength of lagscrewbolted (LSB) connection in CLT, which is the first reserach of this kind in the world. The goals of my research were to examine the effects of the insertion direction of LSBs to wood, the edge distance, and number of LSBs. As a result, it showed similar

tendencies to LSB connections in glued laminated timber (glulam) in terms of strength and stiffness. However, it was found that the both strength and stiffness values of LSB connections in CLT was slightly lower than those in glulam. This could be due to the cross lamination, which requires further theroectical analysis. As for the inserting grain direction, the strength of normal connectors being insered into glulam in the parallel-to-the-grain direction was quite higher than that in the perpendicular-to-the-grain direction. But in the case of LSB in CLT, the results were different from other connectors. About the edge distance, it was found that it was necessary to keep the twice wide in CLT in comparation to that in glulam. The joint of several LSBs could produce a strong connection, which requireed the wider space between LSBs in CLT than in glulam. My findings will be presented at the 2014 World Conference on Timber Engineering in Quebec City, Canada (An abstracted had been submitted.), and also be published in the journals regarding wooden materials or construction. My overall objective of using LSBs in CLT is to establish the design values for mid- and high-rise wooden buildings. However, more research on this topic is in need in both experiment and theory.

In a word, I reached my goal of 6-month stay in WSTC in terms of research, information exchange, and networking with other reserchers in Canada.