Chair Structural Functions of Timber Structures

2.2.19 Laboratory : Laboratory of Structural Function

Member:	Professor	Kohei Komatsu, Dr.Agric.Sci
	Assistant Professor	Takuro Mori, Dr. Engr.
	KU Visiting Professor	Akihisa Kitamori, Dr. Agric. Sci.
	Doctor's program	3
	Master's Program	2
	Post-Doctoral fellow	1

A. Research Activities (2010.4-2011.3)

A-1. Main Subjects

a) Estimation of various wooden shear walls and floor system.

We have developed various shear wall and floor systems which compose of sawn lumbers, engineered wood materials such as glulam, plywood, oriented strand boards, and non-fiber natural resources like mud, many of these works were undertaken with industry. We also study the evaluation method of timber semi-rigid frame systems by cooperating with independent estimation organization. Their inplane shear performances are investigated including the estimation of strength ratio (multiplier).

b) Mechanical analysis on Japanese traditional interlocking joint systems.

We are investigating complicated behavior of (1) Japanese traditional timber joints which are composed by interlocking wooden members; (2) their ductile deformation due to resistance mechanism of both embedment and friction; and (3) their brittle failure by shearing or splitting. In addition, the problem in reduction of initial stiffness of joints induced by shrinkage is also of interest. We aim to evaluate their mechanism so as to satisfy the requirement of the construction standard and to make improvement by taking advantage of wooden characteristics, for further utilization of traditional technique in modern buildings.

c) Structural utilization of compressed wood made of Sugi

Compressing relatively low density Sugi into 50 to 30 % of the original volume can easily produce high-strength joint supplemental material. This may be useful to utilize low quality fast growing timber species. We are developing innovative timber joint method with less stress relaxation function by making use of both characteristics of high strength properties and volume recovering by vapor absorption. Actually, we are investigating applicability of compressed wood as wedge or dowel as well as structural members.

d) Evaluation of pull-out capacity of Lagscrewbolt and its application to glulam frame structures.

We developed screw-in type connector called 'Lagscrewbolt (LSB)' as an innovative fastener using minimum steel and high aesthetic concealed joint, and explored its working mechanism in strength. At the same time, we are developing structural design method as well as recognizing safety of LSB jointing by full-scale experiments in order to apply LSB to the actual glulam portal frame structures. Thus we expect LSB will be more and more popular in general wooden constructions.

e) Development of High Ductility and High Strength Wooden Portal Frames Using Mixed Species Glulam.

Mixed species glulam constitutes the relatively inferior inner laminae made of domestic Sugi and superior outer laminae made of imported Douglas fir to improve the mechanical properties. We developed glulam portal frames using mixed species glulam in all members to with better strength. The beam-column joints and leg joints can be also designed to utilize the stronger properties of outer laminae. In addition, the research projects that developed and improve the moment resisting joint system by using various materials such as hardwood are ongoing.

f) Development of Wooden Post & Beam Dwelling House by Utilizing Natural Building Materials.

In order to propose a long life and low environmental load wooden post & beam dwelling house using domestic Sugi timber aiming to encourage the domestic forestry, we are developing heavy timber housing system which shall be composed of 15cm square timber with pith for continuous column, 12cm square timber with pith for short post and 12cm x 24cm rectangular timber for beams, roof girder, and horizontal girders. All timber members are pre-dried in the forest to reduce energy consumption, then kiln-dried under low temperature of about 40°C with moisture control system, so as to keep natural high anti-fungi and anti-termite properties induced from heart-wood extractives. In addition to this, we did health monitoring of the house by applying shaking force test and also shaking table test for mud-shear walls were conducted. A new nondestructive test using ultra sonic pulls transmition technique seemed to be useable for predicting residual strength of mud-shear wall.

g) Evaluation of the bio-deterioration factor on the structural performance of the timber buildings

The nondestructive testing techniques (NDT) that evaluate the strength properties of the wooden members and joints on existing buildings with the bio-deterioration (termite and fungi) damages are of our interest. The aim is to study the relationship between bio-deterioration factor and nondestructive factor, and to develop the in-situ evaluation method of the bio-deterioration damage in the existing houses.

h) Evaluation of Mechanical Properties of Shiga prefectural Sugi and Hinoki and development of built-up beams

As a contract research from Shiga prefecture, we evaluated bending and shear strength of Shiga-grown Sugi and Hinoki sawn timbers. The size effects were remarkable in both bending and shear. While as a part of another contract research project, we have been developing portal frame using builtup beam and column to apply it to residential house. In 2010, we conducted both dynamic and static evaluation of mechanical properties of portal frames by changing numbers of dowels for connecting built-up members as experimental parameters. We found out that High degree vibration mode was affected by the dowel numbers.

A-2.Publications and presentations

a) Publications

Books

- Kohei Komatsu (Co-author) : Fundamental Theory of Timber Engineering, Chapter 4 "Theory of Joint", Architectual Institute of Japan, December, 2009. (in Japanese)

- Takuro Mori (Co-author) : Fundamental Theory of Timber Engineering, Chapetr 3 " Mechanics of Axial Member", Architectual Institute of Japan, December, 2010. (in Japanese)

- Takuro Mori (Co-author) : Q&A of Wood and Wooden House by current data, Wood Structure Prom Inc., March, 2011. (in Japanese)

- Ahikisa Kitamori (Co-author): Fundamental Theory of Timber Engineering, Architectural Institute of Japan

, 340p, Jan., 2011 (in Japanese)

- Ahikisa Kitamori (Co-author): Kenchiku Gijutsu, Kenchiku Gijutsu Co.ltd, 218p, Dec., 2010 (in Japanese)

Original Papers(including book-reviews)

- Kohei Komatsu : Analyses on Though-Bolts Type Wooden Beam-Column Joints Subjected to Rotational Moment, WOOD RESEARCH Journal-Journal of Indonesian Wood Research Society, Volume 1, Number 1, 13-22, April 2010

- Takuro Mori, Akihiro Kosoku, Yoshiyuki Yanase, Kohei Komatsu :Relationships between Strength Properties and Density or Ultrasonic Velocity of Timber Attacked by Termite, Journal of the Society of Materials Science Japan, Vol.59, No.4, pp.297-302, Apr.2010

- Kei Tanaka, Risa Tenkumo, Yuji Noguchi, Takuro Mori, Masafumi Inoue :Proposal of Calculating Method for Ultimate Pull-out Strength of Glued-in rod Connector Embedded in Perpendicular to the Grain in Glulam, Journal of Structural Engineering, Vol.57B, 373-378, 2011.(in Japanese)

- Kiho Jung, Akihisa Kitamori and Kohei Komatsu, Development of Joint System using Compressed Wooden Fastener 2, Evaluation of rotation performance for column and beam joint, J.of wood science, 56(2), 118-126, 2010

- Jung Kiho, Kitamori Akihisa, Ivon Hassel, Komatsu Kohei, Evaluation for Shear Performance of Prefabricated Mud Wall, AIJ J. Technol. Des., Vol.16, No.34, 929-934, 2010 (in Japanese)

- Kiho Jung, Satoru Murakami, Akihisa Kitamori, Wen Shao Chang and Kohei Komatsu, Improvement of Glued-in-Rod (GIR) joint system using compressed wood (CW) dowel, Holzforschung, Vol. 64, No. 6, 799-804, 2010

- Maryoko HADI, Satoru MURAKAMI, Akihisa KITAMORI, Wen-Shao CHANG, Kohei KOMATSU, Performance of Shear Wall Composed of LVL and Cement Fiber Board Sheathing, Journal of Asian Architecture and Building Engineering, vol.9, No.2, 463-469, 2010

- B. Anshari, Z.W. Guan, A. Kitamori, K. Jung, I. Hassel, K. Komatsu, Mechanical and moisturedependent swelling properties of compressed Japanese cedar, Construction and Building Materials, 25, 1718-1725, 2011 - Yasuo KATAOKA, Akihisa KITAMORI, Hiroyuki OCHI, Kohei KOMATSU, Takehiro WAKITA, Traditional wooden buildings of Chinese minority, Dong people, part2 "NUKI" construction system and allotment of timber, Transactions of AIJ. Journal of structural and construction engineering, 76(664), 1101-1108, 2011 (in Japanese)

Reports, others

- Masafumi Inoue, Risa Tenkumo, Tsuyoshi Sato, Yutaro Nakashiro, Kei Tanaka, and Takuro Mori, Study on Strength Mechanism of Joint System Composed of Metal Connector and Adhesive in Timber Structures, Proceedings of the WCTE 2010, CD-ROM, Trentino, Italia, 2010.

- Atsushi Tabuchi, Takuro Mori, Kohei Komatsu, and Satoru Murakami, An Effect of Lapped Length of Kanawa-Tsugi Connection on a Bending Performance as a Japanese Traditional Connection, Proceedings of the WCTE 2010, CD-ROM, Trentino, Italia, 2010.

- Tsuyoshi Yoshimura, Shuji Itakura, Wakako Ohmura, Yoshiyuki Yanase, Takuro Mori, Spreading of infestation of the invasive dry-wood termite Incisitermes minor in Japan – Japanese perspectives, Proceedings of the IUSSI 2010, CD-ROM, Copenhagen, Denmark, 2010.

- Takuro Mori, Munekazu Minami, Kiho Jung, Akihisa Kitamori, and Kohei Komatsu, Development of Reinforce Method for Bending Stiffness of Compound Beam Using Pin-Keyed Joint. Effect of Pin-Key's Diameter, Proceedings of the WCTE 2010, CD-ROM, Trentino, Italia, 2010.

- Kohei Komatsu, Akihisa Kitamori, Kiho Jung, and Takuro Mori, Prediction of Non-Linear Load-Deformation Curves of Various Types of Mud Shear Walls Subjected to Lateral Shear Force, Proceedings of the WCTE 2010, CD-ROM, Trentino, Italia, 2010.

- Takuro Mori, Yoshiyuki Yanase, Hiroshi Kurisaki, Shear strength properties of nail embedded wood attached by brown rot fungi, Proceedings of the Twelfth East Asia-Pacific Conference on Structural Engineering and Construction (EASEC-12), DVD-ROM, Hong Kong, China, 2011.

- Akihisa Kitamori, Kiho Jung, Ivon Hassel, Wenshao Chang and Kohei Komatsu, Mechanical analysis of lateral loading behavior on Japanese traditional frame structure depending on the vertical load, Proceedings of the 11th World Conference on Timber Engineering, 2010, June 20-24, , Trentino, Italy

- B. Anshari, A. Kitam, K. Komatsu and Z.W. Guan, Mechanical and moisture-dependent swelling properties of compressed Japanese cedar, Proceedings of the 11th World Conference on Timber Engineering, 2010, June 20-24, , Trentino, Italy

- Yulianto P Prihatmaji1, Akihisa Kitamori, Kohei Komatsu, The impact of tongue and gulls connection system for earthquake resistance for Javanese wooden house, Proceedings of the 11th World Conference on Timber Engineering, 2010, June 20-24, , Trentino, Italy

- Satoru Murakami, Kiho Jung, Akihisa Kitamori, Kohei Komatsu, Study for bearing performance reinforced by screws, Proceedings of the 11th World Conference on Timber Engineering, 2010, June 20-24, , Trentino, Italy

- B. Anshari, Z.W. Guan, K. Komatsu, A. Kitamori and K. Jung, Explore novel ways to strengthen glulam beams by using compressed Japanese cedar, Proceedings of the 11th World Conference on Timber Engineering, 2010, June 20-24, , Trentino, Italy

- Z.W. Guan, K. Komatsu, K. Jung and A. Kitamori, Structural characteristics of beam-column connections using compressed wood dowels and plates, Proceedings of the 11th World Conference on Timber Engineering, 2010, June 20-24, , Trentino, Italy

- Takuro Mori, Munekazu Minami, Kiho Jung, Akihisa Kitamori and Kohei Komatsu, Development of reinforce method for bending stiffness of compound beam using pin-keyed joint, Proceedings of the 11th World Conference on Timber Engineering, 2010, June 20-24, , Trentino, Italy

- Akihisa Kitamori, Kiho Jung, Kohei Komatsu, Development of Friction Joint System by Compressed Wooden Fasteners, The 2nd International Symposium of Indonesian Wood Research Society, 2010, Nov.12-13, , Bali, Indonesia

- Shoichi Nakashima, Akihisa Kitamori, Kohei Komatsu, Reinforcement of tensile bolted moment resisting joint by hardwood bearing plate, The 2nd International Symposium of Indonesian Wood Research Society, 2010, Nov.12-13, , Bali, Indonesia

- Satoru Murakami, Akihisa Kitamori, Jung Kiho,

Makoto Nakatani, Kohei Komatsu, Pull-out Performance of Screw in Terms of Diameter and Types of Thread, The 2nd International Symposium of Indonesian Wood Research Society, 2010, Nov.12-13, , Bali, Indonesia

- Yulianto P Prihatmaji, Akihisa Kitamori, Kohei Komatsu, Mechanical Analysis of Rotation Performance of Javanese Traditional Timber Joint System, The 2nd International Symposium of Indonesian Wood Research Society, 2010, Nov.12-13, , Bali, Indonesia

- Kohei Komatsu, Shoichi Nakashima, Akihisa Kitamori, Development of Semi-Rigid Moment-Resisting Joint for Timber Portal Frame Structures. -Innovation for giving ductility to beam-column joint-, The 2nd International Symposium of Indonesian Wood Research Society, 2010, Nov.12-13, , Bali, Indonesiaori, K. Jung - Wen-Shao Chang, Kohei Komatsu : Experiment On Traditional Timber Connections Subjected To Bi-Axial Bending, Proceedings of WCTE2010, Paper ID 829, (CD-ROM), June 20-24, Riva Del Garda, Trentino, Italy, 2010.

- Buan Anshari, Zhongwei Guan, Kohei Komatsu : Finite Element Modeling Of The Pre-Camber Of Glulam Beams Reinforced By Compressed Wood, Proceedings of WCTE2010, Paper ID 366, (CD-ROM), June 20-24, Riva Del Garda, Trentino, Italy, 2010.

- Zhongwei Guan, Kohei Komatsu, Kiho Jung and Akihisa Kitamori : Structural Characteristics Of Beam-Column Connections Using Compressed Wood Dowels And Plates, Proceedings of WCTE2010, Paper ID 324, (CD-ROM), June 20-24, Riva Del Garda, Trentino, Italy, 2010.

- Yasunobu Noda, Naoyuki Furuta, Kohei Komatsu : Development Of Compressed Cross-Lapped Corner Members For Rigid Frames, Proceedings of WCTE2010, Paper ID 471, (CD-ROM), June 20-24, Riva Del Garda, Trentino, Italy, 2010.

- Kohei Komatsu, Syouichi Nkashima, Hiroyuki Nkatani, Kenho Okura, Shigeaki Kawahara, Takeshi Shimizu : Extended Design Equation for Column-Beam Joint Composed of LSB, Proceedings of 14th Annual Meeting of Japan Timber Engineering Society, p.55-58, 2010.

Patents

- Patent Application No.2010-246922: 3rd November 2010, Joint System using Lagscrewbolt, Inventor:Kohei Komatsu, Applicant: Kyoto University

A-3.Off-campus activities 1

Membership in academic societies

- Kohei, Komatsu : Architecture Institute of Japan (Steering committee member on timber structures, WG member on testing method of timber structures), Japan Wood Research Society (Award nomination committee), Jpan Timber Engineering Committee (Board member)

- Takuro, Mori, Dr. Eng. : Society of Materials Science Japan (Committee Member in Wood Based Materials), Japan Wood Research Society (Editorial Member), Architecture Institute of Japan (Committee member on resezrch promotion and education), Wood Technological Association of Japan, Jpan Timber Engineering Committee

- Akihisa, Kitamori : Architecture Institute of Japan, Japan Wood Research Sciety, Japan Timber Engineering Society

A-3.Off-campus activities 2

Research grants

1. Grants-in-aid for Scientific Research(KAKENHI)

- Research Grant of Japan Society for the Promotion of Science (B2) : Kohei Komatsu(Chief), Takuro Mori & Akihisa Kitamori (Sub) : Proposal of various wooden portal frames and analyses on their performances enhancement

- Research Grant of Japan Society for the Promotion of Science (S) : Yoshiyuki Suzuki(Chief), Kohei Komatsu, Takuro Mori and Akihisa Kitamori (Sub) : Research on Development of Seismic Design Method of Traditional Wooden Structures Based on their Structural Details.

- Research Grant of Japan Society for the Promotion of Science Grant-in-Aid for Young Scientists(A) : Takuro Mori(Chief) : Fundamental Study on Evaluation of Survival Strength of Wooden Structural Material and Joint attacked by Biodeterioration.

- Research Grant of Japan Society for the Promotion of Science (A) : Yasuhiro Hayashi(Chief), Takuro Mori(Sub) : Construction of the Low-cost Earthquake-Resistant Method of the Existing Wooden Construction House Aiming at Environmental Load Reduction - Research Grant of Japan Society for the Promotion of Science (Startup support) : Ahikisa Kitamori : Development of construction use of log timber reinforced by wood compression technique

2. Other Research Grants

- Grant of Japan 2x4 Home Building Association : Takuro Mori(Chief) : Development of Earthquake-Resistant Method using Stairs Core

- Grand of Housing Research Foundation: Yoshiyuki Yanase(Chief), Takuro Mori(Sub): Survey Study of Damage of Wooden House Attacked by American Dry Wood Termite

- Colaborative Research Budget from All Jpan LVL Association: Kohei Komatsu(Chief): Development of LVL portal frame

- Contract Resrach Budget from Torisumi Glulam Co.Ltd., : Kohei Komatsu(Chief) : Development of portal frame using mixed species glulam

- Contract Resrach Budget from Planner Co.Ltd., : Kohei Komatsu(Chief) : Test and evaluation on Cross Laminated Timber (CLT)

- Contract Resrach Budget from Shiga Prefecture : Kohei Komatsu(Chief), Takuro Mori & Akihisa Kitamori (Sub) : Investigation of Mechanical Properties of Shiga Prefectural Sugi and Hinoki Timbers

A-4.International cooperation and overseas activities 1

Membership in academic societies

- Kohei, Komatsu: Newzealand Timber Design Society (NZ, Member)

International meetings(country,roles)

- Kohei Komatsu: WCTE2010, 20-24th, June, 2010, Riva del Garda, Trentino, Italy, (Presenter), International Conference of Timber Bridge 2010, (12-16 September 2010), Norway, (Attendee), The second International Symposium of Indonesian Wood Research Society, (11-13 November, Indonesia; presenter, session chairman)

- Takuro, Mori, Dr. Eng. : WCTE2010, 20-24th, June, 2010, Riva del Garda, Trentino, Italy, (Presenter), EASEC-12, 26-28th, January, 2011, Hong Kong, China, (Presenter)

International joint research, overseas research surveys

- Survey of durability of Joglo Style wooden Structure among Traditional Timber Buildings in Indonesia, Takuro Mori, Kohei Komatsu (RISH, Kyoto University), Sulaeman Yusaf (LIPI, Indonesia), Yuliant Prihatmaji (Islamic University, Indonesia)

- Development of semi rigid frame structure connected by Lagscrewbolt using cross laminated timber, Takuro Mori, Kohei Komatsu (RISH, Kyoto University), Chui Ying Hei, Meng Gong (University of New Brunswick, Canada)

- Comparative Studies on Traditional Timber Structures in Japan and Taiwan, Kohei Komatsu, Akihisa Kitamori (RISH, Kyoto University), Min-Fu Hsu (National chengkung University, Taiwan), Wen-Shao Chang (Birth University, UK)

- Analysis on Structural Performance of Jogor Constructons among Traditional Timber Buildings in Indonesia, Kohei Komatsu, Akihisa Kitamori (RISH, Kyoto University), Yuliant Prihatmaji (Islamic University, Indonesia)

- Analysis on Seismic Performance of Timber Dweling Houses Made of Engineered Wood in Indonesia, Kohei Komatsu (RISH, Kyoto University), Maryoko Hadi (Building Research Institute, Indonesia)

B.Educational Activities(2010.4-2011.3)

B-1.On-campus teaching

a) Courses given

- Undergraduate level :	Science for Sustainable Humanosphere - Development of Technology and Materials for Cyclical Utilization of Bio-based Resources (Komatsu), Drafting and Design for Architecture (Mori)
- Graduate level :	Wooden Structural Function I (Komatsu, Kitamori), Lecture for Kyoto Sustainable Initiative Course (Komatsu), Seminar in Structural Functions (Komatsu, Mori, Kitamori), Laboratory Course of Structural Functions (Komatsu, Mori, Kitamori), Transdisciplinary Arts and Sciences Educational Program "Wood and Culture"(Komatsu, Mori, Kitamori)

B-2.Off-campus teaching etc.

Part-time lecturer

- Kohei Komatsu: Chyubu University, Faculty of Eng., Architecture and Society B

Open lectures, etc.

- Kohei Komatsu: High quality capenter's seminar, Houseing management training center, Lecturer

- Kohei Komatsu: Wood utilization workshop for contributing environment, Wood Technological Association of Japan, Lecturer

- Takuro Mori: Open Lecture of Forest and Biomaterials Science, "Large Construction Built from Wood", Lecturer

- Akihisa Kitamori: The 270th research meeting, JSMS, Lecture: Potential of compression timber for engineered fastener

B-3.Overseas teaching 1

International students

- International students : Doctral 1 (Indonesia)

B-3.Overseas teaching 2

Lectures and seminars

- Takuro Mori

The current research on timber structure(Special Lecture) : Faculty of Architecture in Islamic University(Indonesia)

C.Other Remarks

- Kohei Komatsu: Technical Committee Member of General Building Research Cooperation of Japan(Vise-Chairman), Committee Member of Japan Housing and Wood Technology Center for ISO-TC-165, Committee for Design and Evaluation of Traditonal Timber Buildings (Board Member, Chair of Material Section, WG Member of Material Quality, SWG Member of Joint), Evaluation Committee for Grant of Science Research of JSPS

- Takuro Mori : Committee Member of Ivestigation, Ecamination to Affect Applications of Resource Allocation Policy to Roughly Estimation Budget Demand of 2011 about Technology and Science, Committee Member of Evaluation of Durability for Wooden House on Ministry of Land, Infrastructure, Transport and Tourism, Committee for Design and Evaluation of Traditonal Timber Buildings (WG Member of Durability), Committee Member Of American Dry Wood Termite on Forestry Agency, Committee Member of Application for Result of Research and Education on Architectural Institute of Japan

- Akihisa Kitamori: Committee for Design and Evaluation of Traditonal Timber Buildings (WG Member of Material Quality, SWG Member of Joint)