2.2.19 Laboratory : Laboratory of Structural Function

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

A. Research Activities (2009.4-2010.3)

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-fibre 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 in-plane 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) c) Structural utilization of compressed wood made of softwood.

Compressing relatively low density softwood timber into 50 to 30 % of the original volume can easily produce high-strength joint supplemental material. This maybe useful to utilize low

quality fast grown 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 in accordance with 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 develope glulam portal frames using mixed species glulam in all members to with better strength. Thebeam-column joints and leg joints can be also designed to utilize the stronger properties of outer laminae. In addition, the research projects that develope 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 durable and low environmental burden 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 12cmx 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℃ with moisture control system, so as to keep natural high anti-fungi and anti-termite properties induced from heart-wood extractives.

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.

A-2.Publications and presentations

a) Publications

Books

- Kohei Komatsu(Co-author) : Design Manual for Engineered Timber Joints, Architectural Institute of Japan, 323p, November, 2009. (in Japanese)

Original Papers

- Masahiro Noguchi, Takuro Mori, Kenji Miyazawa : A strength calculation method of the timber with a circular hole, Journal of Structural and Construction Engineering, 74(640), 1121-1129, 2009.(in Japanese)
- Jung Kiho, Akihisa Kitamori, Kohei Komatsu : Development of a joint system using a compressed wooden fastener I: evaluation of pull-out and rotation performance for a column-sill joint, Journal of Wood Science, 55(4), 273-282, 2009.
- Akihisa Kitamori, Takuro Mori, Yasuo Kataoka, Kohei Komatsu : Effect of additional length on partial compression perpendicular to the grain of wood: difference among the supporting conditions, Journal of structural and construction engineering, Transactions of AIJ, 74(642) , 1477-1485, 2009 (in Japanese)
- Satoru Murakami, Tomihiko Tamaoka, HIdenobu Kadowaki, Kohei Komatsu : Improvement of single-braced shear wall system having same performance for push and pull load, AIJ Journal of Technology and Design, 15(30), 421-426, 2009 (in Japanese)
- Munekazu Minami, Akihisa Kitamori, Jung Kiho, Kohei Komatsu : Shear performances of the floor system using Japanese cedar planks: improvement of in-plane stiffness by H-shape fastener, Journal of structural and construction engineering, Transactions of AIJ, 74(649) , 1785-1794, 2009 (in Japanese)
- Takeshi Shiratori, A.J.M. Leijten and Kohei Komatsu: The structural behaviour of a pre-stressed column beam connection as an alternative to the traditional timber joint system, Engineering Structures, 31, 2526-2533, 2009.
- Hiroshi Watanabe, Takuro Mori, Kohei Komatsu, Daisuke Sakuma : Cyclic loading tests on bolt joints consists of Japanese cedar glulam and steel side plates, Symposium of Technology for Wooden Bridge, Vol.8, 29-36, 2009.(in Japanese)
- Kinsaku Nakata, Kohei Komatsu : Development of timber portal frames composed of compressed LVL plates and pins (3) Strength properties of timber portal frames composed of compressed LVL beam-to-column joints and steel column-to-base joints,

Journal of the Japan Wood Research Society, Vol. 55, No.4, 207-216 , 2009. (in Japanese)

- Akihisa Kitamori, Jung Kiho, Takuro Mori, Kohei Komatsu : Mechanical Properties of Compressed Wood in Accordance with the Compression Ratio, Mokuzai Gakkaishi,Vol. 56(2), 67-78, 2010 (in Japanese)
- Kei Tanaka, Tsuyoshi Sato, Yutaro Nakashiro, Risa Tenkumo, Takuro Mori and Masafumi Inoue：Proposal of calculating method for ultimate strength of glued-in rod joint using material strength of wood, Journal of Structural Engineering, Vol.56B, 303-308, 2010.(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、Vol.56、No.2、pp.118-126, 2010
- Makoto Kageyama, Masatoshi Murakami, Kohei Komatsu : Study on evaluation method of structural performance of connection in moment resistance timber frame under combined stress of bending moment and shearing force, Journal of structural and construction engineering, Transactions of AIJ, 75(647)、165-173、2010 (in Japanese)

Reports

- Kohei Komatsu, Akihisa Kitamori, Kiho Jung and Takuro Mori, Estimation of the Mechanical Properties of Mud Shear Walls Subjecting to Lateral Shear Force, Proceedings of the 11th International Conference on Non-conventional Materials and Technologies (NOCMAT 2009), 6-9 September 2009, Bath, UK
- Takuro Mori, Akihisa Kitamori, Kiho Jung, Munekazu Minami, and Kohei Komatsu, Enhancing the Bending Stiffness of a Compound Timber Beam Using a Pin-Keyed Joint, Proceedings of the 11th International Conference on Non-conventional Materials and Technologies (NOCMAT 2009), 6-9 September 2009, Bath, UK
- Ivón Hassel, Akihisa Kitamori, Kiho Jung, Kohei Komatsu : Shear Performance of Prefabricated Japanese Mud Wall Units – Superficial Fissure Growth Evaluation Using DSP, Proceedings of the 11th International Conference on Non-conventional Materials and Technologies (NOCMAT 2009), 6-9 September 2009, Bath, UK
- Akihisa Kitamori, Kiho Jung, Kohei Komatsu : Utilization of Compressed Wood as Mechanical Fasteners of Friction Joints in Timber Buildings, Proceedings of the 11th International Conference on Non-conventional Materials and Technologies (NOCMAT 2009), 6-9 September 2009, Bath, UK
- Kiho Jung, Satoru Murakami, Akihisa Kitamori, Kohei Komatsu：Improvement of Glued In Rod (Gir) Joint System Using Compressed Wooden Dowel, Proceedings of the 11th International Conference on Non-conventional Materials and Technologies

(NOCMAT 2009), 6-9 September 2009, Bath, UK

- Kohei Komatsu: Analyses on Though-Bolts Type Wooden Beam-Column Joints Subjected to Rotational Moment, Proceedings of the 1st International Symposium of Indonesian Wood Research Society, Contribution of Scientific Profession Society on the Development of Wood Science and Technology in Indonesia, Bogor, Indonesia, 2nd November, 2009.
- Yasuo Iijima, Satomi Sonoda, Hideki Aoi, Tomoaki Soma, Shiro Aratake, Takuro Mori, Yoshinori Ohashi, Current state of accumulation of timber strength data in Japan, Wood Industry, 64(10), 455-460, 2009 (in Japanese)
- Takuro Mori : Introduction of the 110th RISH symposium, Wood Industry 64(6), 281-284, 2009 (in Japanese)
- Takuro Mori : Termite Resistance and Residual Strength Perpendicular to the Grain at Heart Wood Dried by Different Drying Method, Wood Architecture, 24, 40-43, 2009 (in Japanese)
- Kohei Komatsu, Hiroyuki Nakatani, Shoichi Nakashima, Hitoshi Oguchi, Azuma Fujishiro, Hiromichi Itho : Analyses on Though-Bolts Type Wooden Beam-Column Joints Subjected to Rotational Moment, Proceedings of the 13th Technical Meeting of Japan Timber Engineering Society, 33-36, 2009 (in Japanese)
- Shoichi Nakashima, Munekazu Minami, Akihisa Kitamori, Kohei Komatsu: The Construction of Portable Structure Made by Logs and Steel Pipes, Proceedings of the 13th Technical Meeting of Japan Timber Engineering Society, 45-48, 2009 (in Japanese)
- Takuro Mori, Yoshiyuki Yanase, Kohei Komatsu: A Experimental Study on Strength Properties of White Wood Attacked by Termite, Proceedings of the 13th Technical Meeting of Japan Timber Engineering Society, 53-56, Tokyo, 2009. (in Japanese)
- Akihisa Kitamori, Satoru Murakami, Hiroyuki Nakatani, Shoichi Nakashima, Shin Toba, Munekazu Minami, Kohei Komatsu : Development of a Shear Wall by Utilizing Domestic Softwood Timber, Proceedings of the 13th Technical Meeting of Japan Timber Engineering Society, 59-62, 2009 (in Japanese)
- Munekazu Minami, Akihisa Kitamori, Kohei Komatsu : Improvement of the Floor Performance using Rubbed Joint Board and H-Shaped Fastener, Proceedings of the 13th Technical Meeting of Japan Timber Engineering Society, 59-62, 2009 (in Japanese)

b) Conference and seminar papers presented

- The 2009 Annual Meeting of Arch. Inst. of Japan (26-28, August, 2009): 7 papers

- The 53rd Annual Meeting of Japan Congress on Materials Research (19-21, October, 2009): 1 paper
- The 2009 Annual Meeting of the Japanese Environmental Entomology and Zoology Society (14-15, November, 2009): 3 papers
- The 2009 Annual Technical Meeting of the Japan Timber Engineering Society (3-4, December, 2009): 5 papers
- The 2009 Annual Meeting of the Japan Wood Research Society (15-17, March, 20010): 10 papers
- The 2009 Annual Meeting of Arch. Inst. of Japan on Kyushu branch (6-7, March, 20010): 2 papers

A-3.Off-campus activities

Membership in academic societies

- Komatsu, Kohei, Dr.Agri.Sci : Architectural Institute of Japan (Committee Member of Timber Structure, Chief of Sub-Committee for Design of Timber Joints), Japan Wood Research Society (Award Winner Selection Committee Member), Japan Timber Engineering Society (Board member)
- Mori, Takuro, Dr.Eng. : Architectural Institute of Japan, Society of Materials Science Japan (Committee Member in Wood Based Materials), Japan Wood Research Society (Editorial Member), Wood Technological Association of Japan, Japan Timber Engineering Society
- Kitamori, Akihisa, Dr.Agr.Sci. : Architectural Institute of Japan, Japan Wood Research Society, Japan Timber Engineering Society

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) : Development New Innovative Wooden Post & Beam Structures Taken Material's Characteristics As Much As Possible and Analysis of Its Strength Expression Mechanism
- 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.

2.Other Research Grants

- TOSTEM Foundation for Construction Materials Industry Promotion, Research Grant, : Kohei Komatsu (Chief) : Development of Built-up Structural Members for Super Long Life Wooden Residential Houses using Sugi 15cm Sawn Squares.
- Research for Promoting Technological Seeds-B : Kohei Komatsu (Chief) : Development of High Performance Wooden Fastener for Improving Re-use & Re-cycling Rate of Wooden Building Component.
- TOSTEM Foundation for Construction Materials Industry Promotion, Research Grant : Takuro Mori(Sub) : Symposium for long term wooden house.
- TOSTEM Foundation for Construction Materials Industry Promotion, Research Grant, : Takuro Mori(Sub) : Development of shear wall system of possibility to put on and take off.
- Research Grant of Japan Society for the Promotion of Science for New Young Scientist : Akihisa Kitamori (Chief) : Development and application of innovative timber construction material by utilizing wood compression technique.
- TOSTEM Foundation for Construction Materials Industry Promotion, Research Grant : Jung Kiho (Chief), Akihisa Kitamori (Sub) : Prediction of Strength Properties of Mud Shear Wall using Nondestructive Methods.

A-4.International cooperation and overseas activities

Membership in academic societies

- Kohei Komatsu, Dr.Agr.Sci.: NZ.Timber Design Society

International meetings(country,roles)

- Kohei Komatsu, Dr.Agr.Sci. : NOCMAT2009, 6-9th September 2009, Bath, United Kingdom, (Presenter & Session Chairman), The First International Symposium of Indonesian Wood Research Society, 2-3rd , November, 2009, Bogor, Indonesia (Presenter & Session Chairman)
- Takuro Mori, Dr.Eng. : NOCMAT2009, 6-9th September 2009, Bath, United Kingdom, (Presenter)
- Akihisa Kitamori, DR.Agr.Sci. : NOCMAT2009, 6-9th September 2009, Bath, United Kingdom, (Presenter)

International joint research, overseas research surveys

- 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)
- Establishment of Numerical Analysis Model of Joint Composed of Compressed Wood Plates and Pins, Kohei Komatsu, Takuro Mori, Akihisa Kitamori and Kiho Jung (RISH, Kyoto University), Zhongwei Guan (Liverpool University, UK)

B.Educational Activities(2009.4-2010.3)

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 II (Komatsu, Mori), Lecture for Kyoto Sustainable Initiative Course (Komatsu), Seminar in Structural Functions (Komatsu, Mori, Kitamori), Laboratory Course of Structural Functions (K omatsu, 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: Tokushima Sugi coordinator growing course. The third lecture, TS-WOOD, Lecture: Strength of Wood
- Akihisa Kitamori: Tokushima Sugi coordinator growing course. The third lecture, TS-WOOD, Lecture: Traditional timber joint and mechanical characteristics
- Akihisa Kitamori: The 270th research meeting, JSMS, Lecture: Potential of compression timber for engineered fastener
- Kohei Komatsu: Tokushima Sugi coordinator growing course. Symposium, TS-WOO, Key-Note Speaker: Strength of Wood

B-3.Overseas teaching

International students

- International students : Research Students 2 (UK 1, Indonesia 1)

Lectures and seminars

- Kohei Komatsu

Innovative Connection Systems in Japan(Keynote Speaker) : Forintek Canada Cooporation(Canada)

State-of-the-Art on Glulam Portal Frames Composed of Lagscrewbolts(Lecture) : National Taiwan University and National Cheng-Kung University(Taiwan)

State-of-the-Art on Timber Construction in Japan(Special Lecture) : Faculty of Architecture in Islamic University(Indonesia)

- Akihisa Kitamori

The evaluation and application of traditional joint techniques in timber building(Special Lecture) : National Taiwan University and National Cheng-Kung University(Taiwan)

The evaluation and application of traditional joint techniques in timber building(Special Lecture) : Faculty of Architecture in Islamic University(Indonesia)

C.Other Remarks

- Kohei Komatsu : Technical Committee Member of General Building Research Cooperation of Japan, Estimator for FFPRI Project, Committee Member of Japan Housing and Wood Technology Center for ISO-TC-165
- Takuro Mori : WG member of Kansai-branch on Architectural Institute of Japan, Secretary of Wood and Wood-Based Materials Committee on the Society of Materials Science Japan, Committee Member of Japan Housing and Wood Technology Center for Utilization of domestic timber, Committee Member of Evaluation of Durability for Wooden House.
- Akihisa Kitamori : Committee member of Japan Housing and Wood Technology Center for evaluating structural components such as joints.