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## Frank Lam

*Professor*

*Senior Chair Professor Wood Building Design and Construction*

**Research Interests:** [engineering](#), [wood products](#)

### Contact Info

[Teaching and Research](#)

[Publications](#)

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My main research interests are in the development of fundamental knowledge on the performance of solid sawn timber, wood-based composites, and engineered wood systems. The aim is to qualify performance and apply the developed basic knowledge to improve the utilization of structural wood products by addressing issues relevant to the forest products industries in the field of timber engineering and wood-based composites mechanics.

Specific interests include:

- Modeling the interacting influence of wood fiber geometry and orientations on the physical and strength properties of wood based composites through the applications of stochastic theory, engineering mechanics, finite element methods, and robot-based forming systems.
- Use of fiber reinforcement to enhance the performance of wood products.
- Modeling and testing of timber components and structures subject to seismic and other loadings.
- Development of random field model to study the within member variation of strength properties in lumber.
- Establishing in-grade based test data to evaluate mechanical properties of wood products.
- Development of advance grading techniques to improve strength predictions of lumber.
- Reliability-based evaluation of performance.

## Projects

**Strategic Network on Innovative Wood Products and Building Systems**

*NSERC*

### **Reliability of Timber Structure Under Seismic Loading**

*NSERC*

### **Performance of structural composite lumber**

*Ainsworth Lumber Co.*

### **Size effect adjustment factor of glulam**

*NRCAN Value to Wood*

### **Development of Technology for Cross Laminate Timber Building Systems**

*FII program*

### **Study of production of laminae and performance of laminated structural products from BC coastal hemlock**

*FII program*

### **Structural Performance of Japanese Post and Beam Shear Wall Systems**

*Coast Forest Lumber Assoc.*

## **Unit Associations**

Institute for Computing Information and Cognitive System (ICICS)

## **Professional Affiliations**

Association of Professional Engineers and Geoscientists of BC APEGBC

Canadian Society of Civil Engineers CSCE

Fellow International Academy of Wood Science IAWS

Fellow, Institute of Wood Science

## **Awards**

L.J. Markwardt Wood Engineering Award, Forest Products Society – for distinguished contribution to the knowledge of wood as an engineering material and to the enhancement of the efficient utilization of this renewable resource 1999

Japan Science and Technology Agency (STA) Research Fellowship, Government of Japan Science and Technology Agency 2001

## **Current Graduate Students**

**Yuan (Alex) Li, PhD**

**Jingjing Liu, PhD**

**Hyung-Suk (Thomas) Lim, PhD**

*Seismic performance assessment of wood composite post-and-beam shear wall.*

**Xiaoqin (Lisa) Liu, PhD**

## Current Courses

Winter 2013

### **WOOD376 Mechanics of Wood Products** [Sections](#)

Introduction to the strength of materials with emphasis on the elastic properties and ultimate strength of wood and wood products.

Winter 2013

### **WOOD386 Applied Mechanics of Materials** [Sections](#)

Beam analysis, shaft analysis, columns, stress/strain transformations, thin-walled pressure vessels, material strength failure, criteria, fatigue, design and sizing, ISO standards.

Winter 2013

### **FRST576 Advanced Wood Mechanics** [Sections](#)

Analysis and design of structural wood products, influences of material inhomogeneity and variability; creep and time dependent fracture phenomena; structural performance of wood products such as panel products, lumber, glued laminated timber and I-Beams. Impact of codes on marketing of structural wood products.

## Selected Publications

*He M., Z. Li, F. Lam, R. Ma, Z. Ma* (2013). **Experimental investigation on lateral performance of timber-steel hybrid shear wall systems** – -Journal of Structural Engineering ASCE Accepted for publication April 2013

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*Closen M. and F. Lam* (2012). **Performance of Moment Resistance Self-tapping Screw Assembly under Reverse Cyclic Load.** – -In Proc. 12th WCTE Auckland , New Zealand. CD-ROM Proceedings.

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*Liu X. and F. Lam* (2012). **Reliability Based Evaluation of Single Lateral Bracing Forces in Compression Web Members of Metal Plated Wood Trusses.** – -In Proc. 12th WCTE Auckland , New Zealand. CD-ROM Proceedings.

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*Zhu E. , Z. Chen, J. Pan, F. Lam* (2012). **Structural Performance of Dou-Gong Brackets of YingXian Wood Pagoda under vertical loading.** – In Proc. 12th WCTE Auckland, New Zealand. CD-ROM Proceedings.

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*Robertson A.B., F. Lam, and R.J. Cole* (2012). **A Comparative Cradle-to-Gate Life Cycle Assessment of Mid-Rise Office Building Construction Alternatives: Laminated Timber or Reinforced Concrete.** – -Buildings 2:245-270.

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*Chang F-C, F. Lam, J.F. Kadla* (2012). **Using master curves based on time-temperature superposition principle to predict creep strains of wood-plastic composites** – -Wood Science and Technology. Accepted October 4, 2012. 10.1007/s00226-012-0518-3

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*Chang F-C, F. Lam, J.F. Kadla* (2012). **Application of time-temperature-stress superposition on creep of wood-plastic composites** – -Mechanics of Time-Dependent Materials. DOI 10.1007/s11043-012-9194-9

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*Chen Y. and F. Lam* (2012). **Bending performance of box based cross laminated timber systems** – -Journal of Structural Engineering. ASCE Accepted for publication Dec 2012

*Song X+ and F. Lam (2012). Stability analysis of metal-plate-connected wood truss assemblies –* Journal of Structural Engineering. ASCE. 138(9):1110-1119.

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*Li M., F. Lam, B.J. Yeh, T. Skaggs, D. Rammer and J. Wacker (2012). Modeling Force Transfer around Openings in Wood-frame Shear Walls –* Journal of Structural Engineering. ASCE. 138(12):1419-1426.

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*Li M. +, F. Lam, R.O. Foschi, S. Nakajima, T. Nakagawa (2012). Seismic Performance of Post and Beam Timber Buildings I: Model Development and Verification –* Journal of Wood Science. 58:20-30.

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*Li M. +, F. Lam, R.O. Foschi, S. Nakajima, T. Nakagawa (2012). Seismic Performance of Post and Beam Timber Buildings II: Reliability Evaluations. –* Journal of Wood Science. 58:135-143.

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*Li, M. +, Foschi, R. O. and F. Lam. (2012). Modeling hysteretic behaviour of panel-sheathed wood shear walls with protocol-independent nail connection algorithm –* Journal of Structural Engineering. ASCE. 138(1):99-108.

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*Lam, F., M. Li, R.O. Foschi, S. Nakajima, T. Nakagawa (2011). Performance of Timber Buildings in Earthquakes –* In Proc. 11th Int'l Conf. on Applications of Statistics and Probability in Civil Engineering. Zurich Switzerland.

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*Skaggs, T., B.J. Yeh, F. Lam, M. Li, D. Rammer, J. Wacker (2011). Modelling Force Transfer Around Openings of Full-Scale Shear Walls –* In Proc. Int'l Council for Building Research and Innovation in Building and Construction Working Commission W18-Timber Structures, Alghero, Italy. CIB-W18/44-15-3. pp10.

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*Hong J.P.+ , J.D. Barrett and F. Lam (2011). Three-dimensional finite element analysis of the Japanese traditional post and beam connection –* Mokuzai Gakkaishi (Journal of the Japan Wood Research Society). 7:119-125.

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*Wang J.B. +, F. Lam, R.O. Foschi (2011). Duration-of-load and creep effects in strand-based wood composite: experimental research. –* Wood Science and Technology. 46:361-373.

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*Wang J.B. +, , R.O. Foschi, F. Lam (2011). Duration-of-load and creep effects in strand-based wood composite: a creep-rupture model –* Wood Science and Technology. 46:375-391.

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*Tannert T, Lam F and Vallée T (2011). Structural performance of rounded dovetail connections: experimental and numerical investigations –* European Journal of Wood and Wood Products. 69:471–482.

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*Song X. and F. Lam (2010). Stability capacity and lateral bracing requirements of wood beam-columns –* Journal of Structural Engineering. ASCE. 136(2):211-218

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*Tannert T., Lam F., Vallee T* (2010). **Strength prediction for rounded dovetail connections considering size effects** – ASCE Journal of Engineering Mechanics, 136(3):358:366

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*Chang, F.C. and F. Lam* (2010). **Feasibility of using mountain pine beetle attacked wood to produce wood-plastic composites: preliminary work** – Wood and Fiber Science. 42(1):107–116.

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*Song X.+, F. Lam., H. Huang+, and M. He* (2010). **Capacity of Metal Plate Connected Wood Truss Assemblies.** – Journal of Structural Engineering. ASCE. 136(6):723-730.

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*Gehloff M. +, M. Closen +, and F.Lam* (2010). **Reduced edge distances in bolted timber moment connections with perpendicular to grain reinforcements** – In Proc. 11th WCTE Riva del Garda, Italy. CD-ROM Proceedings

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*Lam F., M. Li, R. Foscho, S. Nakajima, N. Kawai C. Minowa, M. Okabe, N Yamaguchi, and T. Nakagawa* (2010). **Seismic performance of post and beam buildings** – In Proc. 11th WCTE Riva del Garda, Italy. CD-ROM Proceedings.

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*Vallee T., T. Tannert and F. Lam* (2010). **Probabilistic design method for timber joints** – In Proc. 11th WCTE Riva del Garda, Italy. CD-ROM Proceedings.

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*Song X. and F. Lam* (2010). **Reliability analysis of metal plate connected wood truss assemblies concerning buckling failure** – In Proc. 11th WCTE Riva del Garda, Italy. CD-ROM Proceedings.

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*Tannert T., T. Vallee, F. Lam* (2010). **Probabilistic capacity prediction of timber joints under brittle failure modes** – In Proc. Int'l Council for Building Research and Innovation in Building and Construction Working Commission W18-Timber Structures, Nelson N.Z. CIB-W18/43-\*. pp13.

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*Skaggs, T., B.J. Yeh, F. Lam, D. Rammer, J. Wacker* (2010). **Full-scale shear wall tests for force transfer around openings** – In Proc. Int'l Council for Building Research and Innovation in Building and Construction Working Commission W18-Timber Structures, Nelson N.Z. CIB-W18/43-\*. pp10.

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*Lam F., M. Gehloff M.+, and Closen M.+* (2010). **Moment resisting bolted timber connections** – Proceedings of the Institution of Civil Engineers – Structures and Buildings 163(4):267-274.

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*Chang F.C. and F. Lam* (2009). **Use of mountain pine beetle killed wood to produce cement-bonded particleboard.** – Journal of Wood and Fiber Science 41(3): 291-299

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*Song X.+ and F. Lam* (2009). **Laterally braced wood beam-columns subjected to biaxial eccentric loading** – Computers and Structures. 87:1058-1066.

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*Y. Chen, J.D. Barrett and F. Lam* (2009). **Mechanical properties of Canadian coastal Douglas-fir and Hem-Fir –**

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*Song X., F. Lam, H. Huang, and M. He (2009). Stability Capacity and Lateral Bracing Force of Metal Plate Connected Wood Truss Assemblies.* – In Proc. Int'l Council for Building Research and Innovation in Building and Construction Working Commission W18-Timber Structures, Meeting Forty-two Zurich, Switzerland. CIB-W18/42-15-3. pp10.

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*Li M., F. Lam and R.O. Foschi (2009). Seismic Reliability Analysis of Diagonal-braced and Structural-panel-sheathed Wood Shear Walls* – Journal of Structural Engineering. ASCE 135(5):587-596

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*Tannert T, Lam F (2009). Self tapping screws as reinforcement for rounded dovetail connections* – Progress in Structural Engineering and Materials, 16(3):374-384

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*Beck, K. and F. Lam (2009). The variation of the tensile strength and the modulus of elasticity through the thickness of oriented strand lumber* – Journal of Materials in Civil Engineering. ASCE 21:625-630

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*Li M. and F. Lam (2009). Lateral Performance of Nonsymmetric Diagonal-braced Wood Shear Walls* – Journal of Structural Engineering. ASCE. 135(2):178-186.

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*Lam F., M. He, and C.C. Yao. (2008). Example of Traditional Tall Timber Buildings in China – the Yingxian Pagoda* – Structural Engineering International. Journal of the International Association for Bridge and Structural Engineering. 2:126-127

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*Anastas, H., T. Tannert, F. Lam, J.D. Barrett (2008). Effect of manufacturing on the quality of rounded dovetail joints.* – In Proc. COST E53 Conference, 29-30 October 2008, Delft, The Netherlands. pp51-58.

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*Li M. and F. Lam (2008). Modelling Post-and-beam Wooden Buildings under Seismic Loads* – 18th Analysis and Computation Specialty Conference. ASCE Structural Congress 2008 Crossing Borders. Vancouver Canada. CD-ROM Proceedings.

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*Tannert T. and F. Lam (2008). Design Guideline for Rounded Dovetail Connections* – 18th Analysis and Computation Specialty Conference. ASCE Structural Congress 2008 Crossing Borders. Vancouver Canada. CD-ROM Proceedings.

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*Song X. and F. Lam (2008). Stability analysis of eccentrically loaded wood beam-columns* – 18th Analysis and Computation Specialty Conference. ASCE Structural Congress 2008 Crossing Borders. Vancouver Canada. CD-ROM Proceedings.

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*Lam F., M. Schulte-Wrede +, C.C. Yao and J.J. Gu (2008). Moment resistance of bolted timber connections with perpendicular to grain reinforcements* – In Proc. 10th WCTE Miyazaki, Japan. CD-ROM Proceedings.

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Gu J.J., C.C. Yao, F. Lam and P. Sutter (2008). **An application of Panel Web Beams for Long-Span Timber Construction** – In Proc. 10th WCTE Miyazaki, Japan. CD-ROM Proceedings.

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Gu J.J., F. Lam, C.C. Yao (2008). **Seismic Analysis of Probability Based Life Cycle Cost for Wood Frame Structures** – In Proc. 10th WCTE Miyazaki, Japan. CD-ROM Proceedings.

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Barrett J.D., Lam F., and Y. Chen (2008). **Comparison of machine grading methods for Canadian Hemlock** – In Proc. 10th WCTE Miyazaki, Japan. CD-ROM Proceedings.

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Chang, F.C. and F. Lam (2008). **Suitability of fibers from mountain pine beetle attacked wood in wood-cement composite materials** – Forest Products Journal. 58(3):85-90

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Wang, B., X. Liu, and F. Lam (2008). **Computational Modeling of the Lateral Load Transfer Capacity of Rimboard** – Journal of Testing and Evaluation 36(4): 256-363

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Anastas, H., Tannert, T., Lam, F. and D. Barrett (2008). **Effect of manufacturing parameters on the structural performance of rounded dovetail connections** – Conference COST E53, October, Delft, The Netherlands.

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A. Oudjehane J. Wang C. Zhang G.D. Smith F. Lam (2008). **Development of thick strand-based mountain pine beetle wood composites: Duration of load and permeability analyses** – BC Journal of Ecosystems and Management , 9(3) 2008, 178-180.

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Lam, F., and N. Mohadevan (2007). **Development of New Construction of Glulam Beams in Canada.** – In Proc. Int'l Council for Building Research and Innovation in Building and Construction Working Commission W18-Timber Structures, Bled, Slovenia. CIB-W18/40-12-1. pp10.

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*Tannert T, Lam F (2007). Performance of laminated strand lumber for rounded dovetail connections – Forestry Products Journal. 57(9):63-67*

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*Tannert T, Prion H, Lam F (2007). Structural performance of rounded dovetail connections under different loading conditions – Canadian Journal of Civil Engineering. 34(12):1600-1605*

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*Li, M., F. Lam, and G. Lee (2007). Structural assessment of trailer floor systems with aluminum frame and wood decking – International Journal of Heavy Vehicle Systems. 14(2):213-226*

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*Lam, F., J. Gu, and I. Zakurecky (2006). Performance of posts laminated with mountain pine beetle transmitted blue-stained lodgepole pine – Forest Products Journal. 56(9):60-64*

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*Leijten, A.J.M, S. Ruxton, H. Prion and F. Lam (2006). Reversed-Cyclic Behavior of a novel heavy timber tube connection – Journal of Structural Engineering. ASCE 132(8):1314-1319*

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*F. Lam (2006). State of earthquake research in North America and Japan – In Proceedings of the 12th International Wood Construction Conference Holzbauforum Garmisch-Partenkirchen Germany Nov 6, 2006*

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*Song, X. and F. Lam (2006). Three dimensional stability analysis of wood beam-columns – In Proceedings of the 9th WCTE. Portland USA CD-ROM Proceedings*

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*Tannert, T. and F. Lam (2006). Geometry parameters of rounded dovetail connections – In Proceedings of the 9th WCTE. Portland USA CD-ROM Proceedings*

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*Gu, J., F. Lam and R.O. Foschi (2006). Comparison of seismic performance of Japanese wood shear walls – In Proceedings of the 9th WCTE. Portland USA CD-ROM Proceedings*

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*Lam, F., M. Li and J. Gu (2006). Structural performance of one storey Japanese Post-and-Beam Building – In Proceedings of the 9th WCTE. Portland USA CD-ROM Proceedings*

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*Wang, B., X. Liu and F. Lam (2006). Computational modeling of lateral load transfer capacity of rimboard – In Proceedings of the 9th WCTE. Portland USA CD-ROM Proceedings*

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*Chen, Y., F. Lam and J.D. Barrett (2006). Bending strength and modulus of elasticity of BC coastal timbers – In Proceedings of the 9th WCTE. Portland USA CD-ROM Proceedings*

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*Barrett, J.D., F. Lam, F. Rouger and Y. Wang (2006). The proposed ISO strength class system: An update – In Proceedings of the 9th WCTE. Portland USA CD-ROM Proceedings*

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Wang, Y., F. Lam, J.D. Barrett, and M. He. (2005). **Comparisons of Different Stress Class Systems and Test Methods on Bending Properties.** – -Forest Products Journal. 55(12):66-71

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Byeon H.S., H.M. Park and F. Lam (2005). **Nondestructive evaluation of strength performance for finger-jointed wood using flexural vibration techniques.** – -Forestry Products Journal. 55(10):37-42

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Leijten A., Ruxton S., Prion H., and Lam F. (2004). **A Novel Timber Connection With Exceptional Properties.** – - In Proc. 13th World Conference on Earthquake Engineering. Vancouver, Canada. Paper 3174 7 pp. CD-ROM Proceedings.

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Gu J. and F. Lam (2004). **Simplified mechanics based wood frame shear wall model.** – -In Proc. 13th World Conference on Earthquake Engineering. Vancouver, Canada. Paper 3109 11 pp. CD-ROM Proceedings.

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Gu J. and F. Lam (2004). **Seismic reliability analysis for wood shear walls.** – -In Proc. 8th WCTE Lahti, Finland. 2:395-400.

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Schreyer A., F. Lam and H.G.L. Prion (2004). **Comparison of slender dowel-type fasteners for slotted-in steel plate connections under monotonic and cyclic loading.** – -In Proc. 8th WCTE Lahti, Finland. 2:107-112.

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Wang Y., J.D. Barrett, F. Lam and M. He (2004). **Wood product test methods and stress class systems in the world.** – -In Proc. 8th WCTE Lahti, Finland. 2:167-172.

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Lam F., J.D. Barrett, and S. Nakajima (2004). **Influence of Knot Area Ratio on the Bending Strength of Canadian Douglas-Fir used in Japanese Post and Beam Housing** – -Journal of Wood Science. Japan Wood Society. 51(1):18-25

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Lam F., A. Filiatrault, N. Kawai, S. Nakajima, and N. Yamaguchi (2004). **Performance of timber buildings under seismic load – Part II Modeling** – -Journal of Progress in Structural Engineering Materials. 6(2):79-83

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Mindess S., P. Sukontasukkul, F. Lam and N. Banthia (2004). **Fracture of Fully Saturated Parallel Strand Lumber (PSL) under Impact Loading** – -Journal of Wood Science and Technology. 38:277-235

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Lam F., J.D. Barrett , and S. Nakajima (2004). **Influence of Knot Area Ratio Based Grading Rules on the Engineering Properties of Hem-Fir used in Japanese Post and Beam Housing** – -Journal of Wood Science and Technology. 38:83-92

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Saboksayr H.S., A.A. Saravi, P.D. Lawrence, F. Lam (2003). **Implementation of a Neural Network Based System for Estimating the Strength of a Board Using Mixed Signals of MOE and X-Ray Images.** – -In Proc. IEEE-PACRIM 2003 conference, August 28-30, Victoria, BC. Canada, pp 342-347

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*Lam F., G. Lee, H. Yan, J. Gu, A.A. Saravi (2003). Structural Performance of Stair Stringers – -In Proc. International Conference on Forest Products IAWPS2003 April 2003. Daejeon Korea 1:239-245.*

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*Garcia, P., Avramidis, S. and F. Lam (2003). Horizontal gas pressure and temperature distribution responses to OSB flake alignment during hot-pressing. – Holz als Roh- und Werkstoff, 61(6): 425-431*

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*Lam F., A. Filiatrault, N. Kawai, S. Nakajima, and N. Yamaguchi (2002). Performance of timber buildings under seismic load – Part 1 Experimental Studies – -Journal of Progress in Structural Engineering Materials. (4(3):276-285*

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*Richard N. , L. Daudeville, H.G.L. Prion, and F. Lam (2002). Timber shear walls with large openings: experiment and prediction of the structural behaviour – – Canadian Journal of Civil Engineering. 29(5):713-724*

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*Durham, J.P., F. Lam and H.G.L. Prion. (2001). Earthquake resistance of shearwalls with large OSB panels. – ASCE J. Struct. Engin. 127(12):1460-1466.*

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*Schreyer, A., F. Lam, H.G.L. Prion, and L. Bathon. (2001). Strength capacities and behavior of a new composite timber-steel connector. – ASCE J. Struct. Engin. 127(8):888-892.*

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*Dawitt, L.D., F. Lam and S. Nakajima. (2001). Material strength properties for Canadian species used in*

**Barrett, J.D., F. Lam and S. Nakajima. (2001). Material strength properties for Canadian species used in Japanese post and beam construction.** – In: Proc. Internat. Council for Building Research and Innovation in Building and Construction Working Commission W18-Timber Structures, Venice, Italy. CIB-W18/34-6-1. 17 pp.

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**Lam, F., J.D. Barrett and S. Nakajima. (2001). Engineering properties of Hem-fir used in Japanese post and beam housing.** – For. Prod. J. 51(10):79-87.

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