

ANNOUNCEMENT

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The 3rd Announcement of the 68th Annual Meeting of the Japan Wood Research Society in Kyoto

Date: March 14 (Wed.)–16 (Fri.), 2018.

Venue: Kyoto Prefectural University, Shimogamo Campus (1–5, Shimogamo hangi-cho, Sakyo-ku, Kyoto, Japan)
Kyoto International Conference Center (422, Iwakura osagi-cho, Sakyo-ku, Kyoto, Japan)

Time Table:

Date	March 14 (Wed.)	March 15 (Thur.)		March 16 (Fri.)
Venue	Kyoto Prefectural University, Shimogamo Campus	Kyoto International Conference Center		Kyoto Prefectural University, Shimogamo Campus
Morning	Oral presentation	Poster presentation	Exhibition of related companies	Oral presentation Closing ceremony
Afternoon	Oral presentation	Poster presentation JWRS awards ceremony Symposium	Exhibition of related companies	Seminars for research groups
Evening	Wood Science Mixer (Kyoto Concert Hall)	Banquet		

Due Dates:

The entry of presentation with an abstract: 17:00 (JST), January 10 (Wed.), 2018

Early bird registration: 17:00 (JST), February 6 (Tue.), 2018

The Japan Wood Research Society (JWRS) takes great pleasure in inviting all members of our society with an interest in the science and technology of wood to attend the 68th Annual Meeting of the JWRS that will be held from March 14 to 16, 2018, Kyoto, Japan.

The society members may take oral and poster presentations during the meeting. The symposium and the exhibition of the related companies will also be held.

For more detail information, please visit <http://www.jwrs.org/wood2018/index-e.html>.

Organizing Committee:

Prof. Dr. Keiji Takabe (Chief)

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Mokuzai Gakkaishi (Journal of the Japan Wood Research Society)

Mokuzai Gakkaishi is another official journal of the Japan Wood Research Society. This journal publishes original articles, notes, review articles, and announcements from the Society in Japanese but with English abstracts, tables, and figure captions for original reports. Contents of volume 63 of *Mokuzai Gakkaishi* are as follows:

Volume 63 Number 1 2017

Review articles

Yuko Tsunetsugu, Eri Matsubara, Masaki Sugiyama

Evaluation of the impact of wooden living environments on humans

Wooden living environments are widely held to be human-friendly, warm, and relaxing. However, the scientific evidence supporting this social image is still sparse. Recently, there has been a growing desire among industry representatives, policy-makers, and consumers for scientific research that elucidates the positive influences of wood and wooden interiors in structures intended for human occupation. The aim of this review is to provide an overview of relatively recent research that examines human responses to wood in various living environments, with a focus on the methods used in such studies. We also review the methodologies used in several studies that have been conducted in related fields, such as architecture and public health, in terms of their applicability to the evaluation of wooden environments. Based on our review of the current state of research, we further consider future challenges that lie ahead in this field. These include accumulating data on vulnerable groups and individuals for a short-term exposure to wooden environments and exploring approaches to elucidate intermediate and longer-term impacts of wooden environments on health and well-being.

Category I

Tomoaki Kiryu, Naoko Matsuda, Keisuke Kojiro, Yuzo Furuta

The mechanism of improvement of physical properties of moso bamboo (*Phyllostachys pubescens*) with increasing age II: relationship between dynamic viscoelastic properties and cell wall components

This paper aims to elucidate the factors related to improvement of physical properties of bamboo as a material with increasing age. In order to achieve the purpose, the temperature dependence of the dynamic viscoelastic properties in the green condition of moso bamboo (*Phyllostachys pubescens*) at various ages (about 40 days–9 years since shooting) was measured. In addition, the content of

cellulose, hemicellulose, Klason lignin, acid-soluble lignin and hot-water extractives was obtained by chemical analysis. The results obtained were as follows: the dynamic modulus of elasticity and the loss modulus of elasticity increased and their temperature dependence changed with increasing age. From the temperature dependence of $\tan \delta$, it was found that the softening temperature rose with increasing age. The Klason lignin content increased and the acid-soluble lignin content decreased with increasing age. These changes were remarkable at early ages, and the temperature dependence was still changing little by little even as the bamboo became older. These results lead to the conclusion that, in the period up to about 80 days from shooting, the physical properties of moso bamboo are affected by the amount and the degree of polymerization of lignin, and after the ratio of components becomes constant, some changes of the quality of lignin affect the physical properties of moso bamboo.

Category II

Masaki Sugiyama, Yutaka Kataoka, Tadao Yatougo, Masahiro Matsunaga

Impression of and preference for portable assistive devices with wooden, plastic or metal outer panels among mothers of individuals with autism

To evaluate the suitability of wood for welfare use, the impression of, and preference for mobile phones with three different outer panel materials (metal, plastic, or wood) were examined using the Semantic Differential method. The mobile phones are intended to be used as portable assistive devices for mothers of autistic individuals. The results were subjected to factor analysis using the following four factors: “durability and maintainability”, “image of material”, “quality” and “surface texture”. The following results were obtained using multiple regression analyses: (1) both favorable impression and one’s interest to purchase are highly affected by the surface texture, (2) although the image of material affects favorable impression, it does not influence one’s interest to purchase, and (3) stain resistance contributes significantly to one’s interest to purchase, but does not affect favorable impression. It was found that the unique texture of the wood surface affects both favorable impression and one’s interest to purchase; however, the image of material of the wood affects the favorable impression but does not influence one’s interest to purchase.

Category II

Yasuo Yanagawa, Mitsuyoshi Harata

Outdoor exposure test for sugi glued-laminated timber manufactured using 7 adhesive resins I: shear strength and wood failure ratio

Five-ply sugi (*Cryptomeria japonica* D.Don) glued-laminated timbers were manufactured using three resorcinol resin adhesives, three aqueous polymer-isocyanate resin adhesives, and a vinyl acetate-based resin emulsion adhesive (VAE). They were impregnated with wood-preservative (ACQ), and exposed under outdoor conditions with their glue-layers at level position for ten years. Block-shear tests were conducted after 1, 3, 5, and 10 years of exposure. After 10 years of exposure, significant differences were recognized for shear-strength among adhesive resins as the result of analysis of coefficient variance (AOCV). Results for pair-comparison of AOCV between adhesive resins, showed significant differences in four pair-comparisons and those included VAE. Standard deviations of shear-strength tend to increase with exposure year, and for VAE they were larger than for the others. Results of goodness-of-fit tests of shear-strength for normal, log-normal, 2P-Weibull, and 3P-Weibull distributions, showed that none of these forms fit VAE after 1 year of exposure. Wood-failure ratio decreased gradually with exposure duration; however, even after 10 years of exposure, it was more than 80% regardless of adhesive resin.

Category II

Ryu Noda, Chihiro Kayo, Masato Yamanouchi, Naoaki Shibata

Life cycle greenhouse gas emissions of wooden roadside noise barriers in Nagano prefecture

The local government of Nagano prefecture, which leads the field of wooden noise barriers in Japan, has developed two types of wooden noise barriers (Japanese larch-made and Japanese cedar-made). It targeted these wooden noise barriers and concrete noise barriers to evaluate greenhouse gas (GHG) emissions throughout their lifecycle. The effect of replacing concrete noise barriers with wooden noise barriers on the reduction of GHG emissions was evaluated. The results showed that the total amount of GHG emissions, from raw material procurement to construction, by Japanese larch-made noise barriers was lower as compared to concrete noise barriers over an evaluation period of 30 years. After the service period ended, a GHG emission reduction effect by using disposed wood, steel and concrete as fuel and recycled material could be obtained. The results indicated that replacing concrete noise barriers with Japanese larch-made and Japanese cedar-made noise barriers resulted in emission reductions of 91 and 62 kg CO₂-eq, respectively, for every 1 m length of the noise barrier.

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Category I

Ken Watanabe, Hideaki Korai, Isao Kobayashi, Takashi Yanagida, Keisuke Toba, Kosei Mitsui

Estimation of drying time for air-drying of logs and evaluation of log properties affecting drying characteristics of logs using a hierarchical Bayesian model

Air-drying is one of the most frequently used operations to dehydrate logging residues for production of wood fuel chips. This study developed a drying curve model for the air-drying of logs in order to estimate drying time to reach a given moisture level, and to evaluate the influence of log properties on drying characteristics of logs. Log piles of sugi (*Cryptomeria japonica*) were air-dried in Tsukuba city, Japan, from November 2014 to August 2015. A hierarchical Bayesian model was used to estimate the moisture content of individual logs as a function of initial moisture content, diameter, length, heartwood ratio, and drying time. The measured mean moisture content fit well to the estimated drying curve, indicating that the developed model is

a potentially useful method to estimate the drying time for any moisture content within the limited range of climate conditions studied here. A comprehensive evaluation of log properties affecting the drying characteristics of logs showed that initial moisture content, diameter, and length have an influence on the drying rate of logs.

Category II

Yasuhiro Utsumi, Yasuki Shiiba, Ikue Murata, Yuko Yasuda, Shinya Koga, Satoshi Nagai, Susumu Inoue

Evaluation of physical and mechanical properties and durability of wood in traditionally used trees in Shiiba Village, Miyazaki Prefecture

In Shiiba Village, Miyazaki Prefecture, people have used many trees growing in their living area for their traditional life. We interviewed four elder informants who were expert in wood handling on wood physical and mechanical properties and durability in commonly used trees. The informants discriminated 99 tree species empirically and evaluated their toughness, cleavability, warping, checking, abrasion

resistance, hardness, machinability, combustibility and durability. Overall the highest rated species were *Torreya nucifera* and *Sciadopitys verticillata*, and the next-best species were *Taxus cuspidata* and *Zelkova serrata*. On average, coniferous species were evaluated better than hardwood species, and in hardwood, the arbor trees were evaluated better than shrubs. Air-dry density from previous literature was correlated with empirical toughness, machinability, cleavability, hardness, abrasion resistance and combustibility. Brinell hardness in the literature was correlated with empirical hardness, and decay resistance in the literature was correlated with empirical wood decay and termite resistance.

Category II

Rie Yamashita, Satoshi Sakuragawa, Yukie Saito, Hiromu Watanabe, Motoi Yasumura

Formation of quality indoor air in wooden buildings with domestic wood

The change over time of the indoor air quality of a special elderly nursing home made of wood was investigated. The direct measurement of indoor air revealed that the main component was terpenes, a known source of woody aromas. The contribution of each part of the woody interior to the quality of the indoor air was investigated using an emission test cell method. The results showed that α -Pinene, the main component of the detected terpenes, was emitted from Hinoki timber used for the post and brace, and that sesquiterpenes (α -Muurolene, Calamenene, δ -Cadinene, etc.), which counted for 10–40% of the detected aroma, were emitted from the sugi lumber used for flooring and roof sheathing. A year after construction, the concentrations of some sesquiterpenes, including Calamenene, which is a source of woody aromas, had increased although the total amount of terpenes had decreased. Consequently, it was found that of the indoor air components the woody aroma mainly derives from terpenes.

Category II

Ken-ichi Sugimoto, Noboru Nakamura, Yasuyuki Sano, Eiichi Fujino, Satoshi Shindo, Takahisa Kamada, Seiichiro Ukyo, Masaya Gonda

Relationship between the vertical load properties of floors and human sensory evaluations of walking vibration in wooden schools and offices II: possibility of a tentative design target for large-span wooden floors according to human sensory evaluations of walking vibration

Walking is an essential part of life or work and causes floor vibrations. Recently, the need for large-scale wooden buildings has been increasing. However, there is no guide to design for floor vibrations caused by walking of large-span wooden floors. Therefore we considered the relationship between vertical vibration and properties of wooden school and office floors and human sensory evaluation. We found that the percentage of persons indicating perception of vibration, expecting those who answered unnoticed, was larger than the perception probability indicated in Guideline for the evaluation of habitability to building vibration published by Architectural Institute of Japan (AIJ). When the floor response acceleration was over 4 cm/s^2 , the percentage of persons who perceived the vibration was 100%. At the next step, we considered the relationship between the weighted acceleration level according to frequencies and the ratio of deflections including creep to spans, calculated by the experimental stiffness. Finally we suggest a tentative design target for large-span wooden floor as follows. In order to get the weighted acceleration level to be 65 dB, we must set the ratio of beam deflections including creep to span at less than 1/500 according to Building Standards Law and at less than 1/600 according to Standard for Structural Design of Timber Structures by AIJ. We also must set the floor natural frequency to be over 12 Hz. These values are available under the condition that the natural frequency of wooden floors is from 9.5 Hz to 12.5 Hz.

Volume 63 Number 3 2017

Category I

Ayaka Murai, Takashi Tanaka, Masaaki Yamada

Nondestructive evaluation of water-based polymer-isocyanate adhesive distribution in glued laminated timber using X-rays

The objective of this study was to develop a nondestructive method using X-rays for evaluating the distribution of adhesive resin in laminated timber glued with a water-based

polymer-isocyanate adhesive (glulam). X-ray radiographs of laboratory-produced glulam were taken before and after gluing. The distribution of adhesive resin in glulam was evaluated by comparing brightness values on the radiographs. Two validation experiments revealed that the method showed high accuracy in estimating both the average and local spread rate and could provide a clear visualization of quantitative trends in the distribution of resin in glulam. The method allows us to nondestructively evaluate the distribution of the studied adhesive resin in each glulam, suggesting that X-rays are not only useful for various fundamental

studies relating to wood adhesives but also suitable for industrial application.

Category II

Kuniyoshi Shimizu, Yuri Yoshimura, Toshinori Nakagawa, Sayaka Matsumoto, Yuki Washioka, Eriko Haga, Akiyoshi Honden, Taisuke Nakashima, Hiromi Saijo, Koki Fujita, Yuichiro Watanabe, Genichi Okamoto, Shinshi Inoue, Shinji Yasunari, Juu Nagano, Yuki Yamada, Tsuyoshi Okamoto, Koichiro Onuki, Hiroya Ishikawa, Noboru Fujimoto

Analysis of volatile compounds and their seasonal changes in rooms using Sugi (*Cryptomeria japonica*) wood boards as interior materials

The evaluation of houses made of wood has been raised again in recent years. For houses made of wood, the odor of the wood is one of the important factors. The volatile compounds released from the wood can change over the year because of large variations in temperature and humidity in Japan with four seasons. In this study, volatile compounds in a room (A-room) using naturally processed sugi (*Cryptomeria japonica*) wood boards, which were free from chemical processing, and a room (B-room) using chemically processed wood materials, which were comprised of bonded or coated woods, were analyzed by Gas Chromatography/Mass

Spectrometry (GC/MS) and compared throughout the year. As a result, the amount of sesquiterpenes, which account for most of the volatile compounds of the wood, were found to be higher in summer than in winter in both A-room and B-room. The amount of sesquiterpenes in the A-room was always higher than that in the B-room throughout the year.

Category III

Hirokazu Ito, Shinji Ogoe, Masaki Okamoto, Shigehiko Suzuki, Yoichi Kojima, Hikaru Kobori, Akiko Isa, Takashi Endo

Properties of fibrillated wood flour, and of wood-plastic composites made with fibrillated wood flour

A newly developed production method for wood flour was proposed for a wood-plastic composite (WPC) and its mechanical properties were investigated. This production process consists of step-wise wet milling using a disk mill, drying, and dry milling by a disk mill. The developed method makes it possible to easily produce fibrillated and uniformly-sized wood flour. The mechanical properties of polypropylene-based WPC were improved by the addition of the produced wood flour. These results suggest that wood WPC has the potential to be introduced into the field of automotive plastics.

Volume 63 Number 4 2017

Category I

Minako Shitara, Hiroaki Yoshida, Masayoshi Kamijo, Goroh Fujimaki, Hodaka Yamaguchi

Formation of visual and tactile impressions when evaluating wooden specimens

When people encounter wooden products, they tend to unthinkingly take them in their hands and evaluate them in a multisensory manner based on both visual and tactile cues. Using specimens made of four types of wood and finished with two types of coating, we investigated the process of sensory inspection to identify which of these two perceptions plays the paramount role in the formation of subjects' visual and tactile impressions of wooden specimens. A multiple regression analysis of the relationship between the combined visual-tactile perception and its constituent visual and tactile components revealed that although visual perception played the dominant role overall, information from tactile receptors in the form of perceptions of the specimens' temperature, roughness, and moistness had a significant effect

on subjects' impressions. An investigation of the relationship between subjects' visual and tactile perceptions and the material properties of the specimens suggested that subjects' impressions of the wooden specimens were linked to tactile perceptions shaped by specimen roughness and visual perceptions shaped by specimen brightness.

Category III

Doppo Matsubara, Yoshiaki Wakashima, Yasushi Fujisawa, Hidemaru Shimizu, Akihisa Kitamori, Koichiro Ishikawa

Tightening torque calculation method for plastic clamp force of bolted timber joints

A method for calculating plastic clamp force from tightening torque was presented by considering a bi-linear model obtained from experimental tightening torque-clamp force relationships. The practical applicability of the calculation method was verified by tightening tests of *Cryptomeria japonica*-bolted joints using metal washers of various sizes. Results were as follows: it was found that a ratio of side-length (diameter) to thickness of metal washers ranging from 7.8 to 16.0 did not affect the torque coefficient. In

addition, the ratio of maximum plastic torque coefficient to maximum elastic torque coefficient, γ_{\max} and the ratio of minimum plastic torque coefficient to minimum elastic torque coefficient, γ_{\min} , which are elements of the calculation method, tended to increase depending on embedment into timber of metal washers in side-length (diameter) to thickness ratios of 10.0 (washer size $32 \times t$ 3.2 mm), 10.9 (washer size $35 \times t$ 3.2 mm) and 7.8 (washer size $35 \times t$ 4.5 mm). Furthermore, calculated tightening torque values were verified by tightening tests using a digital torque wrench. As a result, plastic clamp force values obtained by experiment agreed with calculated values ranging from minimum clamp force F_{\min} to maximum clamp force F_{\max} . However, the method of reducing variation in γ_{\max} and γ_{\min} remained to be investigated.

Category III

Yoshitaka Kubojima, Takashi Yanagida, Takahiro Yoshida, Makoto Kiguchi

Simple estimation method for determining weight reduction in torrefied wood chips by color data

In this study, we investigated the relationship between weight reduction and color change in torrefied wood chips. We heated Japanese cedar (*Cryptomeria japonica* D. Don) heartwood and sapwood specimens with dimensions of 29 mm \times 29 mm \times 5 mm at 200, 230, and 250 °C for 0–360 min and then obtained color data. We found correlations between L^* and the oven-dry weight ratio after/before heating (W/W_0), $L^* + a^*$ and W/W_0 , and $L^* + b^*$ and W/W_0 . The values of L^* , $L^* + a^*$, and $L^* + b^*$ after torrefaction were suitable for accurately and simply estimating the weight reduction of the torrefied chips. Both heartwood and sapwood samples can be used for these estimations without the need to separate them because we found the relationships between the color data and W/W_0 for the heartwood to be very similar to those for the sapwood. However, it is necessary to separate the LR–, LT–, and RT–planes because their corresponding color data and W/W_0 were not similar. Although the torrefied chips become darkened, their grains remain visually distinguishable.

Volume 63 Number 5 2017

Category II

Saki Komine, Kei Maeda, Satoshi Shida

Relationship between epidermis color and vibration properties of *Arundo donax* for bassoon reed materials

For the purpose of validating cane selection of *Arundo donax* L. based on epidermis color and spot pattern, we investigated the relationship between epidermis color properties and vibration properties of commercial cane for bassoon reed. Average and standard deviation of L^* , a^* and b^* of scanned images of cane epidermis were measured as epidermis color properties. In areas free of spot, light and pale colored epidermis showed low Young's modulus and high $\tan\delta$. This result matched the existing cane selection method. On the other hand, there was only a low correlation between vibration properties and amount of spot area.

Category II

Masaaki Yuki, Takao Momoi, Jun Kobayashi, Hiroya Ohbayashi.

Measurement of wood vibrational properties by the central exciting method

The vibrational properties of wood are determined by the free-free flexural vibration or cantilever vibration methods. On the other hand, for damping materials, these properties are generally determined by the central exciting method. The central exciting method is rarely used for wood. In the present study, we measured the dynamic Young's modulus (E') and the loss tangent ($\tan\delta$) for the same Sitka spruce specimens by the central exciting (JIS-certificated apparatus), the free-free flexural vibration and the cantilever vibration methods, and compared the results from the perspective of the fixed condition, vibrational modes and other aspects. A simplified experimental apparatus for measurement using the central exciting method was also designed and constructed. The simplified experimental apparatus and JIS-certificated apparatus were verified by measured values (E' and $\tan\delta$). Measured values obtained by the simplified apparatus closely matched those obtained by the JIS-certificated apparatus. The E' values obtained by the central exciting method closely matched those obtained by the free-free flexural vibration method. The $\tan\delta$ values obtained by the central exciting method were higher than those obtained by the free-free flexural vibration method but close to those obtained by the cantilever vibration method.

Category II

Taku Okuda, Toshinori Nakagawa, Tomoya Murano, Yu Miyoshi, Hirohito Kamei, Takao Sasaki, Yasuhiro Saigusa, Yoshiyuki Wada, Syunji Minato, Syouichi Sakai, Taizou Chiri, Noboru Fujimoto, Kuniyoshi Shimizu.

Effect of heat drying treatment on extracts of sugi (*Cryptomeria japonica*) board: quantitative change of terpenes by moderate-temperature drying treatments

To investigate the quantitative change of terpenes in sugi (*Cryptomeria japonica*) board caused by moderate-temperature drying treatments, extracts of sugi board dried by vacuum, conventional kiln, electric heat and air were analyzed by gas chromatograph/mass spectrometer (GC/MS). Extract samples were prepared at 0–1, 1–2 and 17–18 mm from the surface of dried boards using a planer. The results were as follows. Total content of the extracts detected by GC/MS was less in vacuum-dried board than in air-dried board at all three surface depths. Content of sesquiterpene hydrocarbon at 0–1, 1–2 and 17–18 mm from the surface of vacuum-dried board, at 0–1 and 1–2 mm from the surface of conventional kiln-dried board and at 0–1 mm from the surface of electric heat-dried board was less than in air-dried board. Content of oxygenated sesquiterpene at 0–1 mm from the surface of vacuum-dried board and at 0–1 mm from the surface of conventional kiln-dried board was less than in air-dried board. Content of diterpene hydrocarbon: there were no significant differences between drying treatments. Content of oxygenated diterpene at 17–18 mm from the surface of electric heat-dried board was less than in air-dried board. In conclusion,

we showed that a portion of terpenes in sugi board exposed to different moderate-temperature drying treatments was less than that in air-dried sugi board.

Category III

Kaori Mimura, Tadashi Hara, Hideo Kato, Masahiro Noguchi, Akihisa Hirata, Kenji Honda, Toshiaki Matsuhashi.

Reuse of wood used in underground construction and suggestion of a method of differentiation

When demolishing a structure, reusable and secondary materials are obtained, such as lumps of asphalt and concrete, including articles of excavated construction wood. Most especially, waste woods should be aimed at recycling with the view of effective utilization of resources, controlling wastes generated and conserving the environment. However, they are disposed of as industrial wastes in many cases, because specific uses and methods are not standardized. On the other hand, underground use of wood for the purpose of ground improvement has been suggested as new utilization of logs in large quantities. However, there are few cases in which logs excavated from construction sites are recycled for underground use because their strength and soundness cannot be specified. This study suggests an economical judging method by which timbers generated during construction that would be available for recycling can be identified on site by including excavated materials generated from locations with high moisture content because always being buried in water.

Volume 63 Number 6 2017

Category I

Yo Ochiai, Kenji Aoki, Masahiro Inayama

Fundamental research of an evaluation method of splitting failure in timber: differences of wood species and evaluation method of splitting failure by the CT test specimen

Splitting is known as a kind of brittle fracture in wood. Many researchers tried to clarify its mechanism, but it has not yet been made clear. In this research, compact tension tests on some wood species, such as Japanese cedar, Japanese cypress, Japanese larch and Douglas fir, were conducted and the fracture parameters C_T of these woods were calculated. As a result, experimental values of Japanese larch were lower than calculated ones and were considered

as unsafe. Furthermore, an evaluation method of splitting strength with compact tension test specimens was proposed. As a result, values calculated by the method for Japanese cedar and Japanese larch corresponded well to experimental ones, and the values by the proposed method for Japanese cypress and Douglas fir were judged to be on the safe side.

Category I

Hideaki Korai, Ken Watanabe, Katsuhiko Nakao, Tomoyuki Hayashi

Analysis of the modulus of rupture of particleboard subjected to outdoor exposure using a generalized linear mode

The Relationship between exposure time and modulus of rupture (MOR) of particleboard subjected to outdoor exposure was examined using simple regression analysis or a

generalized linear model (GLM). As for simple regression analysis, it suggested yields of negative values for predicted mean MOR and lower 95% prediction interval when the exposure time is extended, because of an assumption of linearity and homogeneity of normal distribution. By contrast, for GLM, the predicted mean MOR exponentially decreased, approaching zero. The lower 95% prediction interval did not yield any negative value. The GLM analyzed the relationship between the exposure time and MOR, and the effects of the exposure time on the reduction of MOR were evaluated suitably using the GLM.

Category II

Hirofumi Ido, Hideo Kato, Hirofumi Nagao, Masaki Harada, Yuji Ikami, Yukari Matsumura, Yosuke Matsuda, Shuetsu Saito

Grades and mechanical properties of dimension lumber for wood frame construction obtained from large-diameter sugi (*Cryptomeria japonica*) logs

In this study, we assessed the grades and mechanical properties of dimension lumber with size classifications of 206, measuring 38-mm thickness and 140-mm width, and 306, measuring 64-mm thickness and 140-mm width, for wood-frame construction, as obtained from 31 large-diameter sugi (*Cryptomeria japonica*) logs. The lumber, graded as class A in the Japanese Agricultural Standard, is visually graded dimension lumber primarily used for members requiring high bending performance. Numerous types of lumber have been ranked as select structural grade in terms of both size classifications. However, the ratio of select structural grade is higher in 306 than in 206. The mechanical properties of the lumber in each size classification showed no significant differences. In this study, by conducting bending tests, we investigated the effect of loading configuration, for which an international standardization is planned, with respect to the mechanical properties. Three loading configurations (Japanese Agricultural Standards (JAS), an international standard, and a different standard) were employed, and we found that the value of the Young's modulus in static bending could be adjusted using the adjustment ratios mentioned

in the JAS, irrespective of the type of loading configuration used. Our bending test results for different loading configurations showed small differences in bending strength. The 5th percentile lower limits of bending strength in both the 206 and 306 size classifications fell slightly below the specified design strength by the Ministry of Land, Infrastructure, Transport and Tourism. Finally, to facilitate the efficient collection of lumber from large-diameter logs, we compared the amount of lumber of class A, No. 2 grade and better obtained from logs via the estimation and measurement methods and found that the results matched well. As such, we can conclude that the estimation method is beneficial.

Category III

Harusa Tsutsumi, Shunji Oribe, Hirokazu Haga, Takaaki Fujimoto

Nondestructive evaluation of wood properties in standing trees using vibrational spectra

The objective of this study was to estimate the moisture content, wood density of corresponding moisture content and modulus of elasticity in standing trees using vibrational spectra. For the preliminary tests, fixed length and diameter logs were used for the following experiments. The logs were impregnated with water at normal pressure and the vibration tests were carried out at fixed intervals while the logs were left to dry under room conditions. The statistical models for the prediction of the wood properties were built using the vibration spectra generated from three excitation methods, namely, excitation of longitudinal vibration by hitting the transverse surface of logs, and excitation of lateral vibration or longitudinal vibration by hitting the log's lateral surface. The Lasso (least absolute shrinkage and selection operator) and PLS (partial least squares) models could predict the moisture content and density independently of the excitation, with the exception of the modulus of elasticity. The vibrational spectra obtained by hitting the lateral surface of logs could give good prediction models, indicating that the techniques suggested in this study have high potential for application to standing trees.