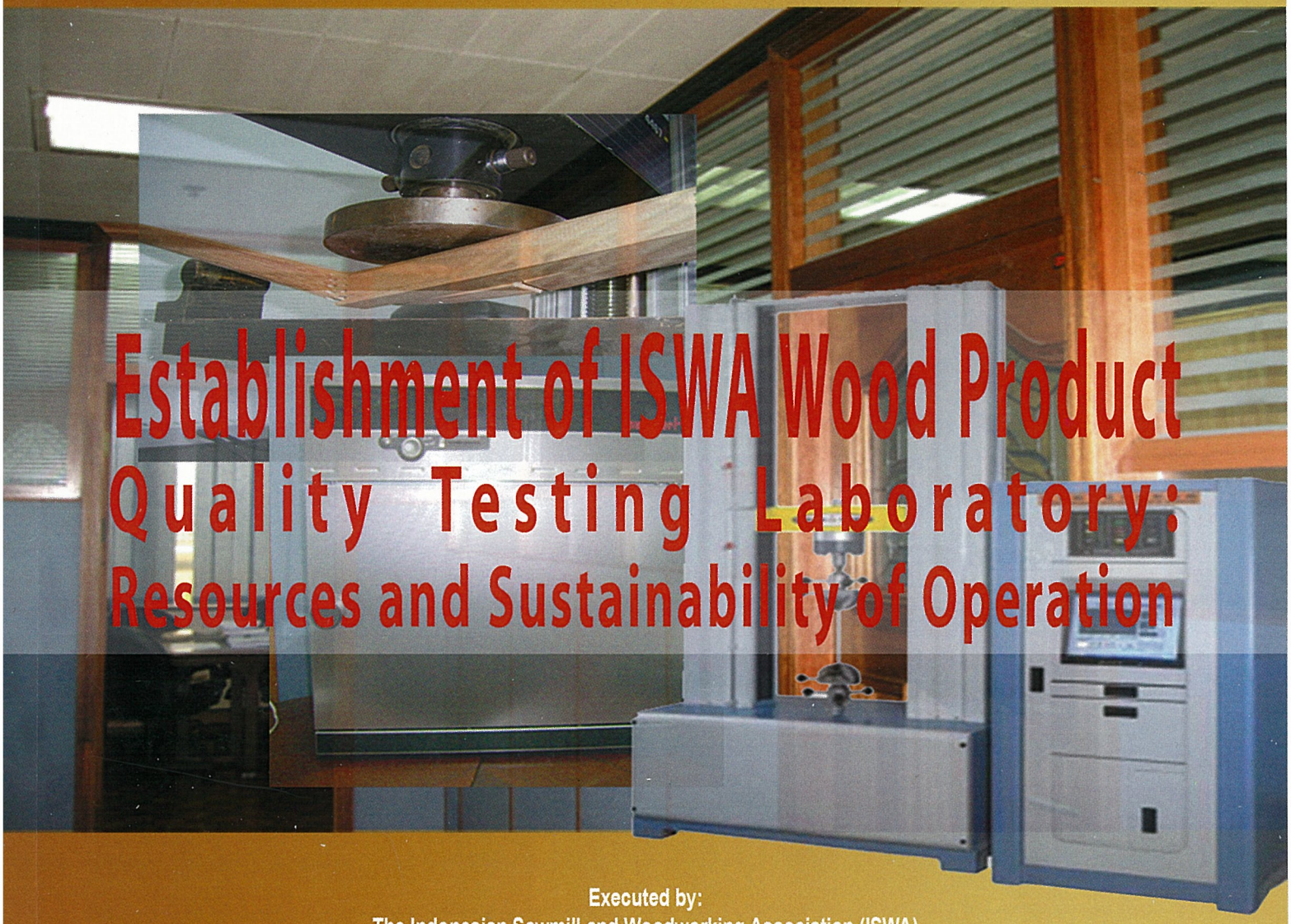
Technical Report No. 5



Establishment of ISWA Wood Product Quality Testing Laboratory: Resources and Sustainability of Operation

Executed by:
The Indonesian Sawmill and Woodworking Association (ISWA)
in collaboration with
The Ministry of Forestry of Indonesia (MOFI)
with the assistance of
The International Tropical Timber Organization (ITTO)

ITTO-ISWA Project PD 286/04 Rev.1 (I)
"Strengthening the Capacity to Promote Efficient Wood Processing Technology in Indonesia"

Jakarta, June 2009

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FOREWORD

This Technical Report presents the execution of Activities 1.3 through 1.6 of Project PD 286/04 Rev. 1 (I) "Strengthening the Capacity to Promote Efficient Wood Processing Technologies in Indonesia" which has been implemented by ISWA since August 2005. Execution of the activities had experienced some delay for technical reasons including difficulty in identifying the strategic site for the laboratory in light of the geographical distribution of ISWA member mills, procurement of equipment and facilities through importing procedures and operational management consideration.

In acordance with the Project Document, a product quality testing laboratory was to be installed at the existing wood processing mill, owned by ISWA member, in Java. Upon consultation with its members, ISWA decided to install the said laboratory at its headquarters in Jakarta for the following reasons: i) operating a laboratory in Java would be discriminatory in nature as users in Java would pay less for the same service as opposed to users from the Outer Islands; ii) it would be fair to all members to have a laboratory installed at ISWA headquarters in Jakarta; iii) control of daily operation is best to be performed by ISWA Executives in Jakarta; and iv) procurement of equipment and facilities is easier to be handled from Jakarta ISWA Office.

Therefore, ISWA had proposed to ITTO to install the laboratory at its headquarters in Jakarta and this proposal was approved by the Project Steering Committee at its third meeting held in Jakarta. The activities had been implemented with the assistance of the Project Experts, in close consultation with the Project Leader.

This report is organized as follows. The first Part highlights the essential role of the laboratory to support the marketing of wood products produced by ISWA members. Part 2 presents the design of the laboratory covering site, room design, selection of equipment and facilities and capabilities of the laboratory. In Part 3 conduct of the training of ISWA personnel on technical and managerial skills is described. Part 4 provides information on technical manual while Part 5 portraits the sustainability aspect of the laboratory covering supply and demand estimation as well as management of laboratory operation. The report is concluded with presentation of recommendations on test standards for future development in view of the development taking place in the global demand for wood product.

I would like to take this opportunity to convey my sincere gratitude to the Project Experts for their excellent service and to all Project Staffs for their contribution to the editing and designing work prior to printing of the Technical Report.

Jakarta, June 2009

Dra. Soewarni
Chairperson of ISWA

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ESTABLISHMENT OF ISWA WOOD PRODUCT QUALITY TESTING LABORATORY:

RESOURCES AND SUSTAINABILITY OF OPERATION

I. INTRODUCTION

Establishing a wood product quality testing laboratory is one of the activities of Project PD 286/04 Rev.1 (I) "Strengthening the Capacity to Promote Efficient Wood Processing Technologies in Indonesia". Most of the ISWA member companies are in need of this laboratory to help them comply with the quality requirements imposed by their respective buyers. The laboratory also will enable them to assess quality of lesser wood species which have been used as the raw material in larger volume in recent years in midst of dwindling supply of the commonly used such natural wood species as meranti, keruing, etc.

In essence, the main function of the laboratory is to gauge quality of the various wood products produced by the ISWA members using commonly accepted testing techniques and procedures. By knowing the quality level of their products and the quality specifications set by buyers, ISWA members should be able to take the necessary measures to improving quality of their products thus satisfying their buyers and securing their markets.

Mechanical strength of wood and wood-working products is one of the most important features valued in the wood-working business. Many countries and regions have developed the required strength standards that must be met by wood working manufacturers and exporters. These standards are exclusive and different from one country to another in accordance with the need of respective countries. Development of quality standards by a country takes into account such national factors as weather conditions, end use, place, building codes, etc.

Many wood working manufacturers in Indonesia have little information about the background and features of these standards. They do not know much about the technical details of the standards or how to perform the quality testing. As many complaints or claims they received had to do with unsatisfactory mechanical strength quality required by buyers, due attention should be given to this particular feature of product. It should be noted that mechanical strength has a number of elements including bending strength, shear strength, modulus of rupture (MOR), delaminating, solvent resistance, nail and screw holding resistance, etc.

The laboratory of mechanical strength testing for wood and wood working products in Indonesia is very few in number compared to other such developing countries in Asia and the Pacific region as China, India, Malaysia and Vietnam. Although some Universities own and operate such laboratory with adequate equipment and facilities, they hardly provide quality testing service to the national wood industry suspectedly due to the lack of proper testing procedures. In addition, technical training on wood quality testing is indeed insufficient and has resulted in scarce skillful laboratory technicians.

PT Mutuagung Lestari is the most popular wood working laboratory in Indonesia and has been offering a variety of quality tests for wood and wood working products. However, this laboratory has traditionally focused only on quality testing based on Japan Standards; no quality testing is provided using the standards applied by other regions such as the US, EU and Australia that require application of different methods and procedures. In the past, Japan was the most important market for Indonesia's wood products. While market destination has shifted and expanded to other regions since the end of the 1990s, this change in market situation has not been reflected in the service offered by the laboratory.

Due to the dwindling supply of the common natural wood species, many wood working manufacturers in Indonesia have to start using lesser used species like akasia (*Acacia mangium*), sono kembang (*Pterocarpus indicus* Willd) and durian (*Durio* spp) as the raw material in order to stay in business. For example, many factories in Sumatra and Kalimantan islands have been using '*mixed wood*' or *meranti rimba* to replace the adored red *meranti* (*Shorea parvifolia* Dyer) both in their scarf veneer composer and veneer splicing applications. Similarly, most plywood factories in Java have replaced red meranti with fast growing species like *sengon* (*Albizia* sp.). Furniture manufactures that mostly located in Java

also are facing the problem of short supply of lumber for raw material and forcing them to utilize several lesser used species like *durian* (*Durio currinatus*), *mahoni* (*Swietenia macrophylla*) and *akasia* (*Acacia mangium*) as the substitute for the historical wood species, Javanese teak (*Tectona grandis* L.f).

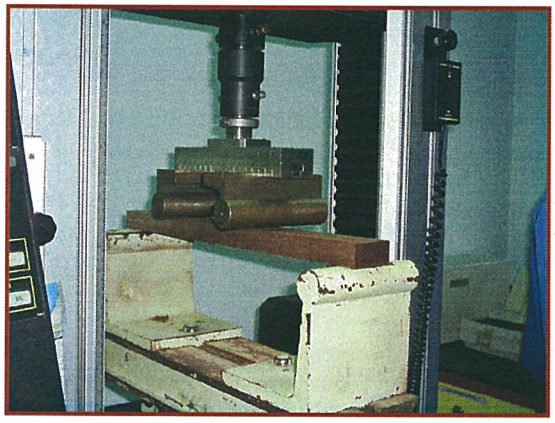


Figure 1. BRL 1704 Finger Joint Bending Strength Test developed by SKH / KOMO for Holland market. The minimum strength required is 25 N/mm2 after soaked into the boiling water

Efficiency is the heart and target of all value adding processes in any wood or wood working industries. It could be achieved through new processing methods and techniques, new wood raw materials and other means which all need testing laboratory. The main purpose of improving efficiency in any wood working industries is to do cost saving in every single process by minimizing wood waste, utilizing waste, increasing recovery and reducing idle time during the manufacturing process.

Figure 2. Interior furniture made from *akasia* wood as an alternative to optimally using lesser used species.

Making sure that quality of products are tested before exporting is the most crucial step in wood working business for which a laboratory is surely needed. Quality testing will increase the confidence level of the wood product exporters during bargaining process and competition with other suppliers from other countries. Many buyers also require the testing certificate for every good sent to them. Operation of the ISWA laboratory will assist its members in judging the final performance of their products as required by their buyers and can help them choosing the right materials for production, developing new products (diversified) and marketing products.

The importance of ISWA Wood Products Quality Testing Laboratory are as follows:

- To conduct laboratory testing and laboratory evaluation of ISWA members' products according to the world wide standards such as Japanese Agricultural Standard (JAS), Japanese Industrial Standard (JIS), European Norm (EN), American Society for Testing and Materials (ASTM), Australia/New Zealand Standard (AS/NZ), British Standard (BS), and Indonesia Industrial Standard (SII/Standard Industri Indonesia).

  As the laboratory is equipped with adequate testing facilities, it will be able to conduct any mechanical strength tests as requested by ISWA members.

Figure 3. Jabon wood (*Anthocipalus cadamba*).

- To evaluate and develop the use of lesser used species. Results of these activities are essential to making further recommendation to the Indonesian wood working community. Several lesser used species that need to be laboratory tested include *akasia* (*Acacia mangium*), *leda* (*Eucalyptus deglupta*), *trembesi* (*Samanea saman*), *puspa* (*Schima wallichii*), *jabon* (*Anthocephalus cadamba*), *duren hutan* (*Durio currinatus*), *kemiri* (*Aleurites moluccana*), *rambutan* (*Nephelium lapaceum*), *kecapi* (*Sandoricum koetjape*), *asam jawa* (*Tamarindus javanicum*) and *tata* (*Gmelina arborea*).

- To develop any possible testing methods for products which have not yet had standardized testing procedures such as furniture, plastic overlay and fiber board.

  In Figure 3, jabon tree plantation is shown. Jabon wood has the strong potential to replace ramin wood considering its good performances in veneering, drying process and finishing of many wood working products. ISWA laboratory has to explore more on this direction and to include larger number of wood species in order to lessen the raw material supply problem facing ISWA members.

II. THE LABORATORY DESIGN

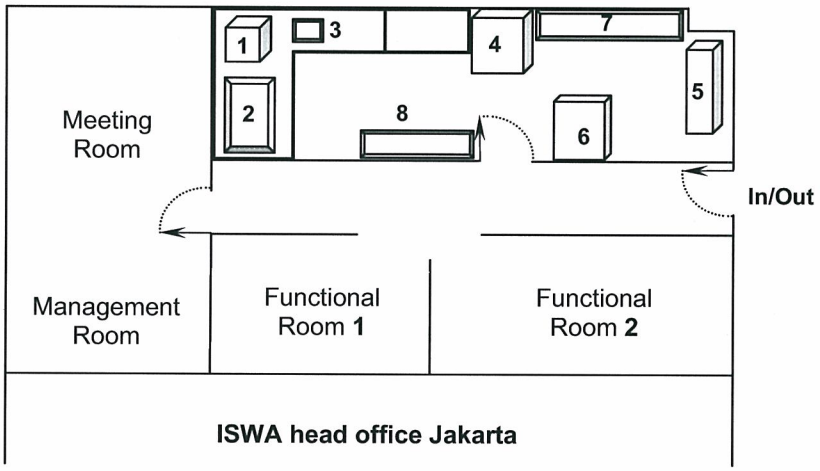
2.1 Site and Space

The laboratory is located at the ISWA headquarters in Jakarta for the following reasons:

- ✓ Easy access to all ISWA members operating in Java and the Outer Islands. ISWA headquarters is located at the center of woodworking and forestry related business 0ffices.
- ✓ Complete facilities available. This laboratory is equipped with meeting room and other functional rooms, mailing address and other communication facilities.
- ✓ Safety aspects. The laboratory has a good safety level as the standard applied for high-risk building are met such as smoke-detector, water sprinkle, fire extinguisher (APAR) and hydrant, which all might be required during the laboratory operation, and are fully observed.

Figure 4. ISWA Wood Products Quality Testing Laboratory

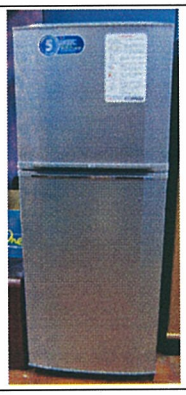
2.2 Room Design and Equipment Layout



Explanation:

1. Universal Oven & Thermostat drier
2. Water bath
3. Bench for small equipments such as digital balance, moisture content (MC) meter, thickness meter etc.
4. Freezer & Refrigerator
5. Universal Testing Machine (UTM)
6. Integrated CPU and display
7. Wardrobe for tools
8. Table

2.3 Selection of Equipment and the Technical Specifications

Equipment Name	Picture	Function	Feature and Specifications
Water bath		To boil the test specimen and to do warm water immersion test	Memert Germany Type WNB 45 2800 wattage bath temperature range : 20 - 100 °C Completed with *condensed* drainage stainless still cover
Oven		To do moisture content analyze, specific gravity and to drying the test specimen	Memert Germany Type UNB 200 1600 wattage Drying temperature range 30 – 250 °C
Universal Testing Machine		To test the strength of various finished products such as compression, tensile, fold resisting, flaking, shearing etc. Function of yield point, MOE (elasticity modulus), Young's modulus (MOR), grinding etc	Universal – Taiwan Type CY-6040A4 Maximum load cell 20 ton
Freezzer		To test the weather resistance as the simulation of the condition in the four seasons countries and to do the cycling test	Minimum temperature ability -20 °C

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Equipment Name	Picture	Function	Feature and Specifications
Thermo-Hygro meter		To do regular internal calibration on water bath and oven	Digital type with temperature metering in range 0 – 600 °C. Display with back light and provide K-type single thermometer input
Thermo-couple		To monitor the equilibrium moisture content (EMC) of the laboratory during the testing processes. Several testing methods have requirement on a certain relative humidity as the test condition	Analog type
Analitical digital balance		To weighing the test specimen in moisture content (MC) and specific gravity (SG) tests	With 0.01 gram accuracy

The other tools and facilities are:

- Lux meter
- Anemometer
- Vibration meter
- Moisture content (MC) meter
- Tachometer
- Digital caliper

2.4 Testing capabilities

The laboratory has the capabilities to do testing for almost any quality types of wood and wood working products produced by ISWA members.

Kinds of prepared testing facilities and procedures include:

a. Group of saw milling and molding

Kinds of the test are moisture content (MC) test, hardness and stiffness test, specific gravity test, shear resistance test, modulus of rupture (MoR) test, peeling resistance and maximum load resistance test.

b. Group of millwork (wood working)
Kinds of the test are bending strength, boiling water resistance, delamination test, shear strength test, cycle test, ift kantel test.

c. Group of panel and furniture
Kinds of the test are screw holding strength test, flate plane tension test, water resistance test, cycle test and peeling strength test.

d. Group of plywood
Kinds of the test are immersion plywood type I and type II

e. Group of flooring (solid and engineered)
Kinds of the test are bending strength test, water immersion test and water soak delamination test.

f. Group of window and doors
Kinds of test are cycle test, flush doors NWWDA test and peeling strength test.

Figure 5. Kind of flooring as one of the woodworking products.

III. TRAINING OF ISWA STAFFS

Trainings for the ISWA staffs been conducted by the equipment suppliers and the national expert. The purpose of the training was to prepare selected ISWA staffs to become managerially and technically skillful laboratory personnel capable of managing and operating the laboratory in a sustainable and profesional manner.

Trained ISWA staffs are listed below :

No	N a m e	Position
1.	Edi Setiarahman	ISWA Staff
2.	Fenny Rasmita	ISWA Staff
3.	Fitrianti Estiningsih	ISWA Staff
4.	Diah Herlinawati	ISWA Staff

Subjects of the training included:

a. Test specimen preparation (**module 1**)

The focus of this subject was to teach the trainees on how to prepare acceptable test specimens in the right size and number including the kind of machineries used in preparing the specimens.

b. Introduction to the testing standards (**module 2**)

The focus was to teach the trainees about the Indonesia and some international standards in wood and wood products quality testing which are widely adopted in the international

woodworking business. Included were Japanese Agricultural Standard (JAS), Japanese Industrial Standard (JIS), European Norm (EN), American Society for Testing and Materials (ASTM), Australia New Zealand Standard (AS/NZ), British Standard (BS), Indonesia Industrial Standard (SII/Standard Industri Indonesia).

Figure 6. Test specimen preparation training for the laboratory personnel.

c. Application (**module 3**)

The purpose is to train the trainees on how to do the overall test including equipment operating, simple trouble shooting and how to compose the testing report.

The wood products for the test divided into six groups as detailed below:

1) Group of saw milling and moulding
Kinds of the test are moisture content (MC) test, hardness and stiffness test, specific gravity test, shear resistance test, modulus of rupture (MOR) test, peeling resistance and maximum load resistance test.

2) Group of millwork (woodworking)
Kinds of the test are bending strength, boiling water resistance, delamination test, shear strength test, cycle test and ift kantel test.

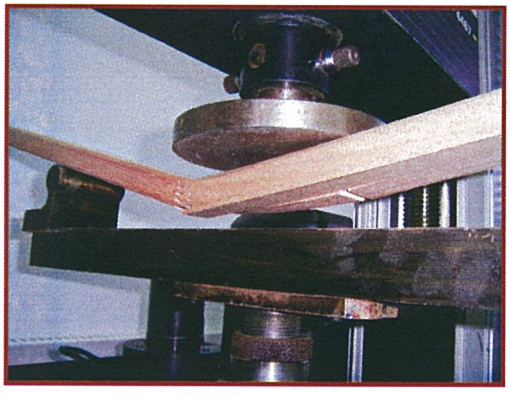


Figure 7. Pressure test on the finger jointed laminated board products.

3) Group of panel and furniture
Kinds of the test are screw holding strength test, flate plane tension test, water resistance test, cycle test and peeling strength test.

4) Group of plywood
Kinds of the test are immersion plywood type I and type II

5) Group of flooring (solid and engineered)
Kinds of the test are bending strength test, water immersion test and water soak delamination test .

6) Group of window and doors
Kinds of test are cycle test, flush doors NWWDA test , peeling strength test.

d. Laboratory safety and calibration (**module 4**)

The focus was on how to set up the safety procedures for the laboratory operation and the personnel including on how to do an internal calibration of the equipments.

e. Laboratory management (**module 5**)

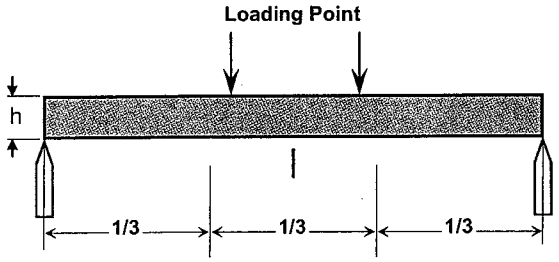
The focus was on how to do an efficient and accurate testing treatment, as well as controlling and managing of the daily activities of the laboratory.

IV. TECHNICAL MANUALS

The technical manuals as described below were used during the training and during the laboratory trial operation:

a. Bending Strength Test based on Australian Standard AS 1491 : 1996

The finger joint is in the centre of the test sample piece and the four points are depicted in the attached bending test equipment drawing. Two arrows up are rest point and two down are the applied load.



Strength = PL^2 / BD

Where, **P** = Fail load maximum (N)
B = Breadth of sample (mm)
D = Depth of sample (mm)
L = Span of bending test, 900 mm is optimum.

Test sample 950 mm minimum.
The span is greater than 12 x the sample nominal depth.

Figure 8. Bending test on Australian Standard **AS 1491 : 1996**

The details of each test should be kept in a log book (or test sheets) for future reference. The orientation of the joint during the test should also be recorded, i.e. whether the joint is broken through or across (the joint). The percentage wood failure should also be evaluated and logged after the bonding test is carried out.

Finger joint machine calculations

Marks Per Inch (MPI):

MPI the means of calculating the optimum feed rate of the timber past the cutters (or the cutters past the timber). By adjusting the cutter speed trough the wood the best joint surface can be attained. Knife mark spacing of 25 to 17 MPI (1.0 to 1.5 mm mark length) is ideal for most conditions.

$$\text{MPI} = \frac{\text{RPM x Number of Cutters}}{\text{12 (inches) x Feed Rate in Feet per Minute}}$$

Force Calculation for Timber End Section:

Correct pressure to squeeze up finger joints is important, as over pressing can split the timber and under pressing can fail to close the joint properly.

Common end pressures used for finger jointing in New Zealand range from 5 to 7 MPa.
1 Mpa = 1 N/mm^2, Force = Pressure x Area.
So if we have a cross section of 100 x 50 mm this is 5000 mm^2 x 5 N/mm^2 = 25000 N, Thus 25000 N of force is needed to finger joint 100 x 50 mm timber shooks properly.

A hydraulic ram is used to apply the force in end pressing the finger joints. The required pressure can be calculated using the formula:

$$\text{Gauge pressure required} \quad \frac{25000\ \text{N}}{\text{Area of Hydraulic Piston (mm}^2\text{)}} = \text{Hydraulic ram pressure (MPa)}$$

It may be advisable to get the pressure gauge tested regularly to check its accuracy. The instrument can lose calibration over time.

b. Bending Strength after Boiling Cycle Test based on KOMO BRL 1704 : 2004 Finger jointed timber for non load-bearing constructions

From the samples test pieces **25 x 50 x 500** mm shall be sawn / planed with a finger joint in the middle of the test piece. Consequently the test pieces shall be treated according to the following cycle :

- 4 hours immersing in water of 100 °C
- 20 hours of drying in an oven 65 ± 1 °C
- 4 hours immersing in water of 100 °C
- 1 hour immersing in water of 22 ± 4 °C

Immediately after the last step the bending strength shall be determined by means of a four point bending machine. The load cell shall be evenly and executed at such a speed that collapsing takes place between 3 and 7 minutes after the start of the loading. The load of collapsing shall be determined of each test piece.

The bending strength shall be calculated with the formula :

$$\delta B = \frac{3 \times F \times (L - L')}{2 \times b \times h^2}$$

Hereby is:

δB	=	the bending strength in N/mm^2
F	=	collapsing load in N
L	=	distance between the two seating points in mm (450 mm)
L'	=	distance between the two pressure points in mm
b	=	width of the timber in mm
h	=	thickness of the timber in mm

After the boiling cycle a minimum bending strength for hardwoods of average 25 N/mm^2 with a minimum of 20 N/mm^2 per individual test piece.

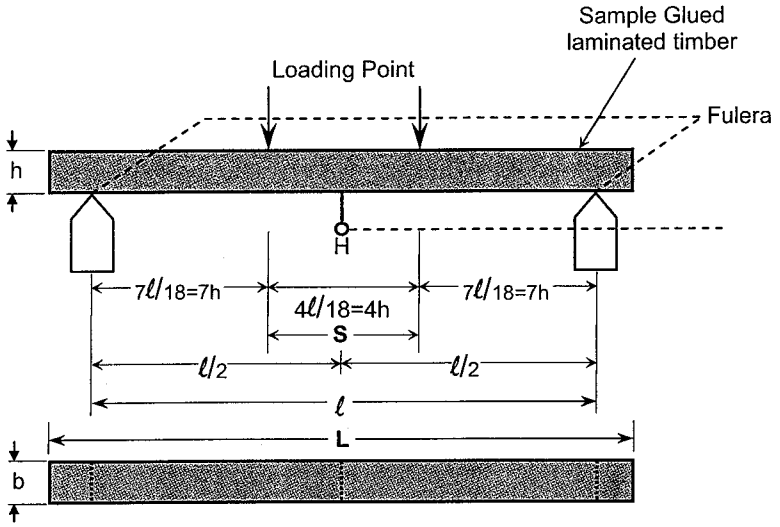
c. Bending Strength Test based on JAS Glued Laminated Timber, 2003

1) Method of testing

The bending test shall be conducted in a manner shown in the following Figure 9a and Figure 9b. The direction of the load shall be parallel to the direction of lamination. In this case, the average loading speed shall be not more than 14.7 MPa per minute.

The length of span shall be not less than 18 times of the thickness of sample laminated timber in the case of Figure 9b and 14 times in the case of Figure 9a. When testing the moisture content of test piece shall be 12 % as a standard.

(a) In the case of the test following the method shown Figure 9a, the Young's Modulus of bending and bending strength shall be calculated by the following equations respectively :



Where, L : Difference between loads of upper and lower limits (N)
ℓ : Length of span (mm)
h : Thickness of sample glued laminated timber (mm)
S : Distance between loading points (mm)
b : Width of sample laminated timber (mm)

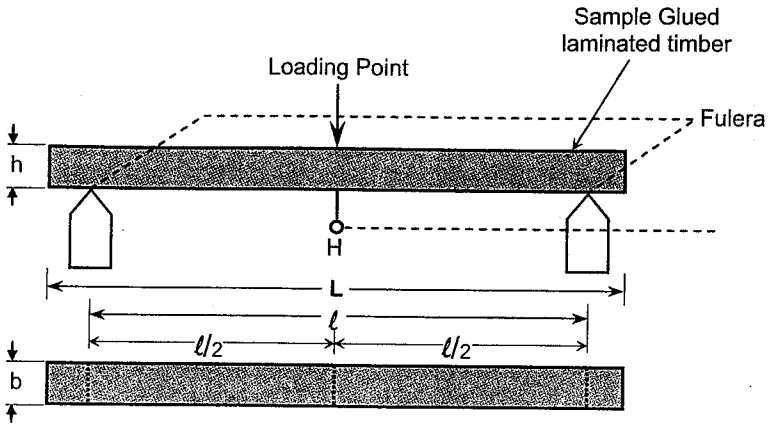
Figure 9a. Bending test with on the Glued laminated timber products.

$$\text{Young's Modulus of Bending (MPa or N/mm}^2) = \frac{\Delta P\ (\ell - S)\ (2\ell^2 + 2\ell S - S^2)}{8bh^2\Delta y}$$

$$\text{Bending Strength (MPa or N/mm}^2) = \frac{3Pb\ (\ell - S)}{2bh^2}$$

Where, ΔP : Difference between loads of upper and lower limits (N)
Δy : Defflection of the center of span corresponding to the Δ P (mm)
ℓ : Length of span (mm)
S : Distance between both loading points (mm)
b : Width of sample laminated timber (mm)
h : Thickness of sample laminated timber (mm)
Pb : Maximum load at failure (N)

(b) In the case of test following the method shown in Figure 9b, the Young's Modulus of bending and bending strength shall be calculated by the following equations respectively:



Where, L : Difference between loads of upper and lower limits (N)
ℓ : Length of span (mm)
h : Thickness of sample glued laminated timber (mm)
b : Width of sample laminated timber (mm)

Figure 9b. Bending test with on the Glued laminated timber products.

$$\text{Young's Modulus of Bending (MPa or N/mm}^2\text{)} = \frac{\Delta P \ell^3}{4bh^3\Delta y}$$

$$\text{Bending Strength (MPa or N/mm}^2\text{)} = \frac{3Pb\ell}{2bh^2}$$

Where, ΔP : Difference between loads of upper and lower limits (N)
Δy : Defflection of the center of span corresponding to the ΔP (mm)
ℓ : Length of span (mm)
b : Width of sample laminated timber (mm)
h : Thickness of sample laminated timber (mm)
Pb : Maximum load at failure (N)

2) Standard requirement

Wood Species Group	Young's Modulus of Bending (GPa)	Bending Strength (MPa)
Dipterocarpus spp (including species which have equivalent strength to the above)	13.0	46.5
Acer mono *Betula maximowicziana* *Fagus crenata* *Quercus crispula* *Zelkova serrata*	11.5	40.5

Continued....

Wood Species Group	Young's Modulus of Bending (GPa)	Bending Strength (MPa)
Larix gmelini *Pinus spp* *Pseudotsuga* (including species which have equivalent strength to the above)	11.5	40.5
Chamaecyparis obtuse *Thujopsis dolabrata* *Larix leptolepis* *Pinus densiflora* *Pinus thunbergii* *Chamaecyparis lawsoniana* (including species which have equivalent strength to the above)	10.5	37.5
Tsuga sieboldii *Fraxinus mandshrica* *Fraxinus apaethiana* *Ulmus davidiana* *Chamaecyparis nootkatensis* *Pinus radiata* *Tsuga heterophilla* (including species which have equivalent strength to the above)	9.5	34.5
Abies firma *Abies sachalinensis* *Picea jezoensis* *Abies spp* *Picea spp* *Pinus contota* *Pinus koraiensis* *Pinus penderosa* *Pinus sylvestris* *Parashorea, Pentacme, Shorea spp* (including species which have equivalent strength to the above)	8.5	31.5
Criptomeria japonica *Thuja plicata* (including species which have equivalent strength to the above)	7.5	30.0

d. Boiling Water Soak Delamination Test based on JAS Glued Laminated Timber, 2003

1) Preparation of Test Specimen

Three (3) test pieces with a length of 75 mm and with a cross section of the end left as it is shall be prepared from each sample laminated timber.

2) Method of testing

Test pieces after immersed in boiling water for 4 hours and then cooled in water at room temperature for 1 hour, shall be dried in a thermostatic dryer for 18 hours or longer at temperature of 70 ± 3 °C.

Paying attention not to be stuffy with moisture in the dryer and the moisture content of test pieces after drying shall be made below the moisture content before testing.

Then, the length of delamination of bonding layers on the cross section of both ends (except those less than a length of 3 mm and except those whose gaps are less than 0.05 mm) shall be measured.

Ratio of delamination on both ends and total length of delamination on the same bonding layer (except bonding layers in the width wise direction (except step boards of stairs or others whose bonding layers laminated when manufacturing)) shall be calculated.

(a) The ratio of delamination shall be calculated by the wquation below :

$$\text{Ratio of delamination (\%)} = \frac{\text{Total of the length of delamination on both ends}}{\text{Total length of glue line on both ends}} \times 100$$

(b) When measuring the length of delamination, raptures caused by dried splits or knots shall not be considered as delamination.

3) Standard requirement

Delamination ratios on the both butt end faces shall be not more than 5 % and the total length of delamination on the same bonding layer shall be not more than 1/3 of the respective length.

e. Cycling Test

1) Method of testing

- Cut the test specimen in 20 cm length
- Store at in the freezer at least for3 days
- Dried at 60 ± 3 °C in thermostat drier at least for 3 days.
- Both above procedure cycled 3 times
- Both above procedure cycled 3 times

2) Standard requirement

- No crack, no delamination and no swelling in through the test panel

f. EN 204 based on EN standard

EN 204 Preparation of the Test Specimen

Timber sections :

Type of timber used	:	unsteemed white beech (*fagus sylvatica* L.)
Raw density	:	600 – 800 kg/m^3
Moisture content	:	11 – 13 %
Thickness of timber sections	:	5 mm

This specimen provide for block shear test method

Application of glue :

Coating weight	:	about 300 gr/m^2 (total), applied on both sides
Open assembly time	:	max 3 minutes
Closed assembly time	:	max 3 minutes
Pressing time	:	about 2 hours at 18 – 22 °C
Pressure	:	about 0.7 N/mm^2

EN 204 Test Procedure

1) Block shear test

The testing of the adhesive for the requirements of the requested durability class is carried out according to DIN EN 204:

Number of specimen	:	20 samples per conditioning sequence
Test device	:	corresponds to DIN EN 10002-2 class 1
Test speed	:	50 mm/min

2) Standard requirement

Conditioning Sequence	Type and Duration of Conditioning	Bond Strength in N/mm^2 Durability Class			
		D1	D2	D3	D4
1	7 days in standard conditions	≥ 10	≥ 10	≥ 10	≥ 10
2	7 days in standard conditions 3 hours in cold water 7 days in standard conditions	-*	≥ 8	-	-
3	7 days in standard conditions 4 days in cold water	-	-	≥ 2	≥ 4
4	7 days in standard conditions 4 days in cold water 7 days in standard conditions	-	-	≥ 8	-
5	7 days in standard conditions 6 hours in boiling water 2 hours in cold water	-	-	-	≥ 4
6	7 days in standard conditions 6 hours in boiling water 2 hours in cold water 7 days in standard conditions	-	-	-	≥ 8

Notes :

•) -* : no test needed •) day : 24 hours •) cold water : 18 - 22 °C

g. Flat Plane Tension Test for Plywood based on JAS for Plywood : 2003

1) Preparation of Test Specimen

From four square test pieces with a side length of 50 mm shall be prepared from each sample plywood.

2) Method of testing

On the center of test piece surface, a metal plate with a square gluing surface whose side length is 20 mm shall be glued by cyano-acrylate adhesive. After notching around the metal plate up to the depth reaching its base plywood, the test piece and metal plate shall be fixed between the chucks and tensile force shall be applied in the right angle direction

to the glued face at a loading speed of not more than 5880 N and the maximum load when a failure or delamination occurs shall be measured.

Then, calculate bonding strength of test piece using following formula up to the first decimal point and further obtain the average bonding strength of the test pieces prepared from one same sample plywood.

$$\text{Bonding Strength (MPa)} = \frac{\text{Maximum Load (N)}}{20 \times 20}$$

3) Standard requirement

Average bonding strength of specimen cut from each test panel should be not less than 4 kg/cm^2.

h. Durability of Construction of the Flush Door Test, Based on NWWDA–IS-1-87 Flush Door.

NWWDA-IS-1-87 TYPE I

1) Preparation of Test Specimen

The test specimens must be 6 inches by 6 inches by the thickness of the construction. The 8 specimens needed for testing must come from each corner and each edge of the door.

2) Method of testing

Boil 4 hours then dry 20 hours at 145 °F.
Cycle twice. Test dry and cool.

3) Approval Standard for Test Specimen

6 of 8 specimens must pass test.

NWWDA-IS-1-87 TYPE II

1) Preparation of Test Specimen

The test specimens must be 6 inches by 6 inches by the thickness of the construction. The 8 specimens needed for testing must come from each corner and each edge of the door.

2) Method of testing

Soak in water at 75 °F for 4 hours then dry at 125 °F for 19 hours.
Cycle three times. Test dry and cool.

3) Approval Standard for Test Specimen

6 of 8 specimens must pass test.

i. Immersion Delamination Test based on JAS Glued Laminated Timber : 2003

1) Preparation of Test Specimen

Three (3) test pieces with a length of 75 mm and with a cross section of the end left as it is shall be prepared from each sample laminated timber.

2) Method of testing

Test pieces after immersed in water at room temperature for 6 hours, shall be dried in a thermostatic drier for 18 hours or longer at a temperature of 40 ± 3 °C (in the case of decorative structural glued laminated post (except decorative veneer, 70 ± 3 °C).

Paying attention not to be stuffy with moisture in the dryer and the moisture content of test pieces after drying shall be made below the moisture content before testing. Then, the length of delamination of bonding layers on the cross section of both ends (except those less than a length of 3 mm and except those whose gaps are less than 0.05 mm) shall be measured.

Ratio of delamination on both ends and total length of delamination on the same bonding layer (except bonding layers in the widthwise direction (except step boards of stairs or others whose bonding layers laminated when manufacturing)) shall calculated.

The ratio of delamination shall be calculated by the equation below :

$$\text{Ratio of delamination (\%)} = \frac{\text{Total of the length of delamination on both ends}}{\text{Total length of glue line on both ends}} \times 100$$

When measuring the length of delamination, raptures caused by dried splits or knots shall not be considered as delamination.

3) Standard requirement

Delamination ratios on the both butt end faces shall be not more than 10 % and the total length of delamination on the same bonding layer shall be not more than 1/3 of the respective length.

j. Peeling Strength test

1) Preparation of Test Specimen

From each test panel, pieces of dowel specimen 2.5 cm in width and 7.5 cm in length shall be cut off.

2) Method of testing

Put the specimen to the universal testing machine.
Set up for max 3000 kgf in load and speed 10 mm/min. Read the peeling strength shown for minimum 2 inches length peeling process.

3) Standard requirement

No international standard; each manufacturer applies different standards, mostly is 2.5 kg/inch

k. Flat Plane Tension Test based on Japanese Industrial Standard JIS

1) Preparation of Test Specimen

From each test panel, pieces of square specimen of 30 mm x 50 mm in size shall be cut off.

2) Method of testing

A square metal plate of 20 mm x 20 mm in size, which has a bonding surface, shall be glued on the center surface of test specimen by using cyanoacrylate adhesives (alteco). A notch penetrating to the substrate panel shall be made around the plate. After the

preparation of test specimen, plane tension test shall be carried out. Test specimen and metal plane are fixed by chucks. Maximum load of delamination or failure shall be measured.

3) Standard requirement

Average bonding strength of specimen cut from each test panel should be not less than 4 kg/cm^2.

V. SUSTAINABLE USE OF THE LABORATORY

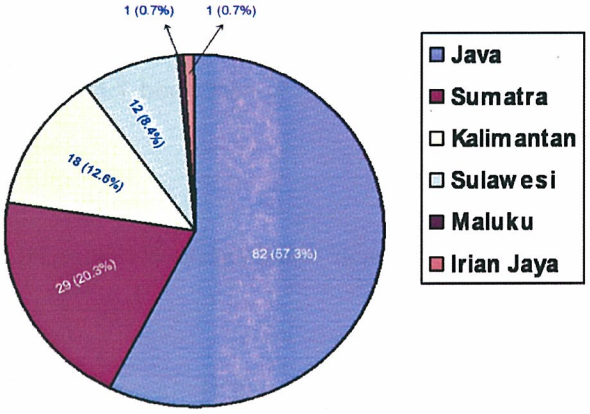
As the new player in laboratory service, this ISWA new woodworking products laboratory has to service its members by optimally utilizing the available equipment and facilities in the first phase of the program.

In the next phase, the management will have to expand and improve its service through improved human resource and equipment capabilities to facilitate introduction of new testing methods applicable to furniture and panel products. In further stage, the laboratory has to evaluate for mechanical attributes of some lesser used species to see the possibility of using them as the material that are acceptable to the wood working industry and its markets.

5.1 Supply and Demand Estimation

a. Location

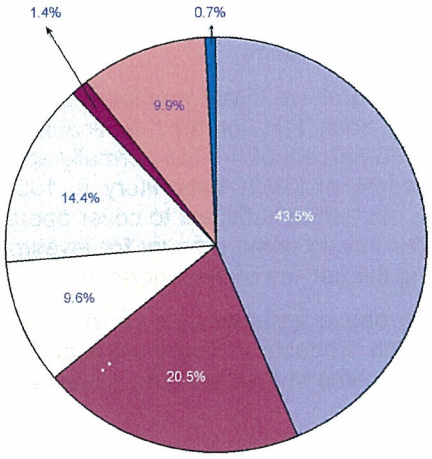
Based on the geographical distribution of the factories operated by ISWA members, the laboratory will have to provide quality testing service as follows:



Java	:	82 members (57.3 %)
Sumatra	:	29 members (20.3 %)
Kalimantan	:	18 members (12.6 %)
Sulawesi	:	12 members (8.4 %)
Maluku	:	1 member (0.7 %)
Irian Jaya	:	1 member (0.7 %)

b. Based on products group

Based on the kind of products the association member produce, the laboratory have to provide service for quality testing as follows :



Sawmill & molding	:	43.5 %
Millwork	:	20.5 %
Panel & Furniture	:	9.6 %
Flooring	:	14.4 %
Plywood	:	1.4 %
Window & Door	:	9.9 %
Picture Frame	:	0.7 %

The kinds of test service for the groups are:

1) Group of saw milling and molding
Kind of the test are moisture content (MC) test, hardness and stiffness test, specific gravity test, shear resistance test, modulus of rupture (MoR) test, peeling resistance and maximum load resistance test.

2) Group of millwork (wood working)
Kind of the test are bending strength, boiling water resistance, delamination test, shear strength test, cycle test, ift kantel test.

3) Group of panel and furniture
Kind of the test are screw holding strength test, flat plane tension test, water resistance test, cycle test and peeling strength test.

4) Group of plywood
Kind of the test are immersion plywood type I and type II

5) Group of flooring (solid and engineered)
Kind of the test are bending strength test, water immersion test and water soak delamination test .

6) Group of window and doors
Kind of test are cycle test, flush doors NWWDA test , peeling strength test.

c. Based on Standards

The standards that have to be complied with by individual ISWA members depend on the market destination as each country / region may apply different testing methods and standards for the same product. Based on the association member market / buyer, the laboratory will have to provide service for quality testing under the following standards:

d. Sustaining the laboratory operation

To sustain its operation, the laboratory must generate sufficient income stream to finance its operational cost and depreciation. For future expansion of service, the laboratory should also be able to set aside part of its income to install additional equipment and facilities. The laboratory owned and operated by Mutu Agung Lestari (MAL) has been providing service for wood quality testing based only on Japan Standards and it can financially self-sufficient and survive.

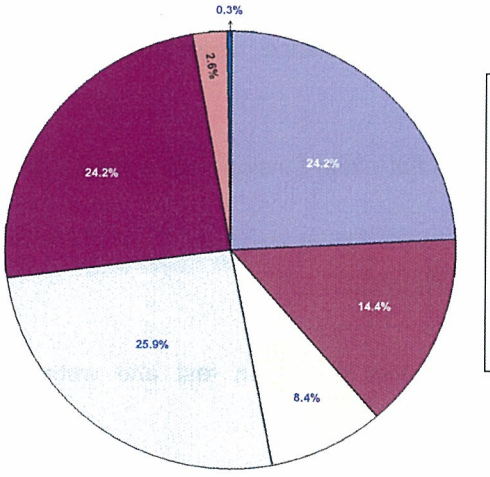
Compared to MAL, the ISWA laboratory can offer wider variety of test based on products groups and standards. Therefore, there is no doubt that the laboratory can be financially viable even if consumers are charged at cost, non-profit oriented operation.

Assuming that: i) 100 companies out of the currently 143 active ISWA members can sustain their business and need to perform monthly boiling soak test for their laminating board product; and ii) each test is charged Rp 200.000,- or 50 percent of the fee normally acsessed by other laboratory; then the expected monthly income of ISWA Laboratory is 100 x Rp 200.000,- = Rp 20.000.000,-. This amount should be more than sufficient to cover operational and depreciation costs of the laboratory and allow for saving some amount for invesment in additional equipment and facilities in view of extending the service of the laboratory.

In fact, potential income is much greater than the obove estimates as most millers are producing not only laminating board but also other such products as finger joints and dowels requiring mechanical test. Therefore, larger stream of income should increase sustainability of the laboratory.

By expanding the service that can be offered by the laboratory, income stream will be furthered increased. This can be achieved by performing the various tests needed by members of ASMINDO and APKINDO and by other such organizations as the Ministries of Industry and Forestry.

5.2 Operational Management

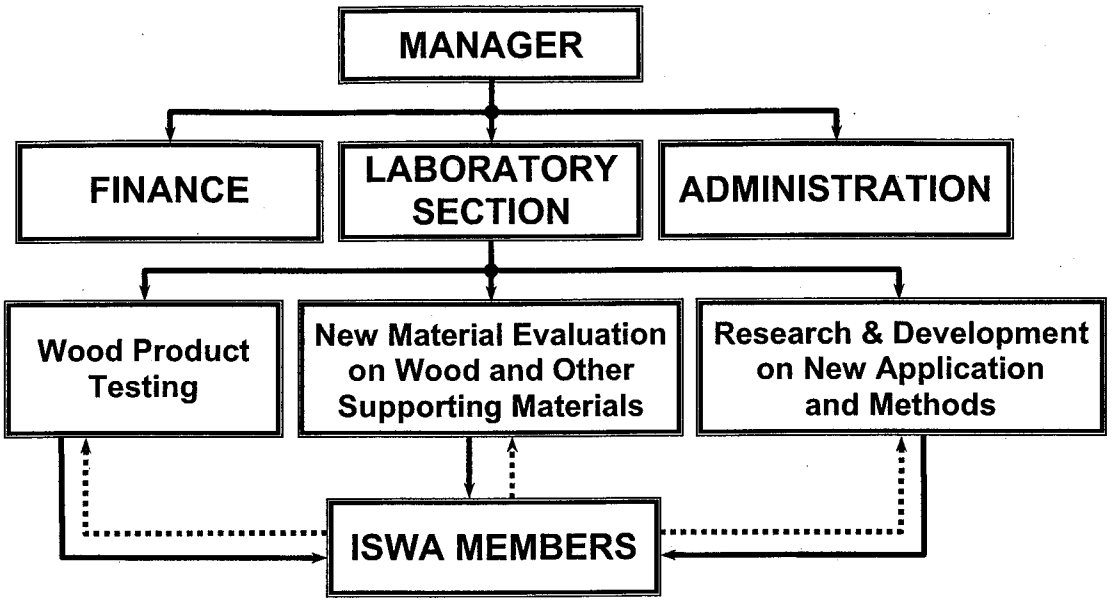


Japan Standard	:	24.2 %
USA & Canada Standard (ASTM)	:	14.4 %
Australia & New Zealand Standard (ANZI)	:	8.4 %
Asian Standard	:	25.9 %
European Standard (EN)	:	24.2 %
Middle East Standard	:	2.6 %
African Standard	:	0.3 %

The ISWA headquarters will manage the operation of the laboratory to provide service to all ISWA members in product quality testing as requested and required by their buyers. The laboratory shall also be able to develop testing methods needed to gauge the quality and judge the use of lesser used species as the alternative raw material to the common wood species to feed the wood industry in view of sustaining the industry and its benefits to the society.

The main function of the laboratory is to support ISWA members to maintain and increase their export in terms of quantity and quality; therefore it has to be managed efficiently. Proposed organizational structure is depicted below.

ISWA Wood Product Quality Testing Laboratory
Organizational Structure



Job description and function:

Manager is responsible for:

- Managing the laboratory on a day to day basis,
- Positioning the laboratory to serve ISWA members,
- Generating income stream by optimally utilizing the laboratory,
- Promoting the laboratory to Forestry Industries and Communities through effective such means as website, brochures and advertising.

Finance:

- Responsible for financial management through application of robust accounting system, assesment of reasonably reduced testing fee and development of effective communication with ISWA members.

Laboratory Section

- To perform any test requested by clients that are offered by the laboratory,
- To develop new testing methods in keeping up with advancement in wood technologies,
- To diversity the service of the laboratory to include testing of new product, new material and new species,
- To carry out continously R&D on new species, new products and new methods.

Administration

- To administer issued testing certificates,
- To design and prepare testing certificates as appropriate,
- To continously and effectively communicate with ISWA members.
- To collect information on new testing methods, importing regulations in major markets and technical specifications on new products.

VI. RECOMMENDATIONS

To keep up with the rapid processing technological development in wood and wood working industries, the laboratory will be gradually improved / developed to cover almost any testing methods required for mechanical strength tests. Considering the trend of global market demand for the kinds of wood and wood working products, the test standards that need to be prioritized for future practical application and development include:

6.1 American National Standards

ANSI/AITC A 190.1-1983 American National Standard for Wood Products - Structural Glued Laminated Timber.

ANSI/HPMA HP 1983 American National Standard for Hardwood and Decorative Plywood.

ANSI/ A208.1-1989 American National Standard – Wood Particleboard.

6.2 American Plywood Association

APA PRP-108 Performance Standards and Policies for Structural Use panels

6.3 American Society for Testing and Materials

ASTM D 2559-84 Standard Specification for Adhesives for Structural Laminated Wood Products for Use Under Exterior (Wet Use) Exposure Conditions.

ASTM D 3110-88 Standard Specification for Adhesives Used in Non-structural Glued Lumber Products.

ASTM D 3498-76 Standard Specification for Adhesives for Field-Gluing Plywood to Lumber Framing for Floor Systems.

ASTM D 3930-85 Standard Specification for Adhesives for Wood Based Materials for Construction on Manufactured Homes.

6.4 British Standards

BS 1088:1966 Specification for Marine Plywood Manufactured from Selected Tropical Hardwoods.

BS 1455 : 1972 Specification for Plywood Manufactured from Tropical Hardwoods.

BS 4169 : 1970 Specification for Glued laminated Timber Structural Members.

BS 5669:1979 Specification for Wood Chipboard and Methods of Test for Particleboard.

BS 6566:1985 Plywood.

6.5 Canadian Standards

CAN3-0188.1-M78 Interior Mat-Formed particleboard.

CAN3-0188.2-M78 Waterboard.

CSA 0115-M1982 Hardwood and Decorative Plywood.

CSA 0122-M1980 Structural Glued Laminated Timber.

CSA 0251-63 Hardwood.

6.6 Deutsches Institute fur Normung

DIN 68763 Particleboard : flat-pressed panels for building construction.

6.7 National Institute of Standard and Technology

PS 1-83 U>S. Product Standard for Construction and Industrial Plywood.

6.8 Council of the South African Bureau of Standards

SABS 096-1976 Code of Practice for the Manufacture of Finger-Jointed Structural Lumber.

SABS 1089-1976 Specification for SA Pine Stock Glued Laminated Timber (Stock Glulam).

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ANNEX

CURRENT AND FUTURE DEVELOPMENT OF THE LABORATORY: EXPANSION PROGRAMS

I. Current capacity of the laboratory

With the current laboratory equipment it possesses, ISWA wood product laboratory is ready to conduct around 26 kinds of test. It covers around 26 % of the 78 kinds of test targeted in the long-run. Details of the test are as follows:

1. Test methods under Japan Agricultural Standard (JAS):
   - ✓ Immersion test (with natural water)
   - ✓ Boiling soak delamination test
   - ✓ Bending Strength test
   - ✓ Tensile test for plywood
   - ✓ Compression test for panel
   - ✓ Flooring test
2. Mechanical tests for wood under Indonesia National Standards (SNI):
   - ✓ Compression test
   - ✓ Peeling test
   - ✓ Modulus test
3. Several tests methods under Japan Industrial Standard (JIS)
4. Several tests methods under American Society of Testing Materials (ASTM)
5. Immersion test under SKH/KOMO Standard (with hot water)
6. Peeling strength test developed by ISWA
7. Cycling test developed by ISWA

II. Introducing the ISWA laboratory to the members

ISWA has introduced the wood product laboratory to its members on October 2009 (during the marketing seminar organized under the project).

Further, information on the laboratory will also be published in ISWA buletins and homepage in order to reach ISWA members and potential users.

ISWA wood product laboratory liftlet of promotion:

ISWA Wood Products Testing Laboratory

ISWA-ITTO Project PD 286/04 Rev.1 (I)

One of the activities of Project PD 286/04 Rev.1 (I), Indonesian Sawmill and Woodworking Association (ISWA) is to set up a woodworking products laboratory at the ISWA office in Jakarta. The laboratory will be servicing the ISWA members, Indonesian woodworking communities and other woodworking institutions.

ISWA Wood Products Testing Laboratory

The main functions of this laboratory include :

a. To conduct laboratory testing and evaluation of wood products in accordance with such International Standards as JAS, JIS, EN, ASTM, AS/NZ, BS and SII.
b. To evaluate and promote the utilization of commonly used and lesser used species. The result of this activity is essential to making a further recommendation to Indonesian woodworking communities.
c. To develop sound testing methods for any products which have not yet been standardized such as furniture, plastic overlay, fiber board etc.

The laboratory is equipped with several modern and high technology equipments and is capable of testing almost all wood and woodworking products. For many kinds of mechanical strength tests such as bending strength, shear strength, tensile strength, the laboratory has a new generation and fully computerised load machine .

While for visual tests such as delamination test, weather resistance, water resistance, the laboratory has high technology water bath, oven, dehumidifier and freezer.

With these facilities, the laboratory is available for association members and other woodworking communities who deal with manufacturing of sawn timber, furniture, construction etc. The finished products can be in the form of kitchen cabinet, laminating board, sawn timber and so on.

New generation load machine

By using the above equipment and facilities, ISWA laboratory can help its members to define the final performance of their products as required by their buyers, rectify kiln drying and gluing problems, also to help them choose the right materials for production and to develop new products (diversified) so that can help them in their marketing process.

For further information please contact :
ISWA Woodworking Products Laboratory
Manggala Wanabakti Building Block IV, 8th floor-Wing C
Jl. Gatot Subroto, Senayan, Jakarta 10270
Phone : (021) 5746336 / Fax : (021) 5711327
website: http://pd286.iwwn.com

III. Reporting and retaining design

ISWA wood product laboratory designed a testing certificate for all received test specimens. The sample for "Boiling soak delamination test" as follow:

1. Cover page
2. Identification & test result
3. Photos and/or UTM graphic

Map File Cover

LABORATORIUM UJI KAYU

I S W A

INDONESIAN SAWMILL AND WOODWORKING ASSOCIATION

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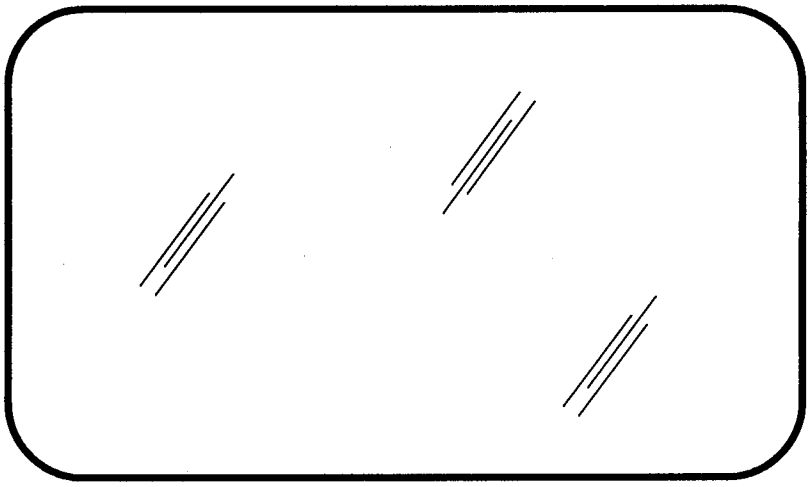

Report Sheet Cover

TESTING REPORT

Serial No.: xxx-zzz / Month / ISWA-2009

Prepared for:
PT. Yyyyyyyy Yyyyyyy Yyyyyyy
Address.....
.....
Province.....

Report Sheet, Page 1...

LABORATORIUM UJI KAYU

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INDONESIAN SAWMILL AND WOODWORKING ASSOCIATION

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projectpd286@iwwn.com / http://pd286.iwwn.com

TESTING REPORT

Serial No.: xxx / Month / ISWA-2009

Date of receipt: ..... **Date of test:.....** **Page: 1 of n....**

Wood / Product Type	:	..... / .....
Quantity / Size / Thickness	:	..... / ..... / .....
Description / Condition of Sample	:	.....
Tested for	:	.....
Standard Test Method	:	.....
Company	:	.....
Address	:	.....
Contact No.	:	.....
Supplier Sample	:	.....
Sampling method	:	.....

TEST RESULTS:

SPESIMEN IDENTIFICATION :

Sample Code	:	.....
Length of Glue Line (*example*)	:	.....
Number of Glue Line (*example*)	:	.....
Total Length of Glue Line (*example*)	:	.....
Number of Pieces	:	..... pieces

PICTURE SAMPLE .....

LABORATORIUM UJI KAYU
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projectpd286@iwwn.com / http://pd286.iwwn.com

Continued.....

Serial No.: xxx / Month / ISWA-2009

TEST RESULTS :

Place and date of issue: Jakarta, ... 2009

Bbbbbbbb Kkkkkkkkk
Manager of Laboratory

Report Sheet, Page: n ..etc...

LABORATORIUM UJI KAYU

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TESTING REPORT

Serial No.: zzz / Month / ISWA-2009

Date of receipt: ..... **Date of test:.....** **Page: 1 of n....**

Wood / Product Type	:	..... / .....
Quantity / Size / Thickness	:	..... / ..... / .....
Description / Condition of Sample	:	.....
Tested for	:	.....
Standard Test Method	:	.....
Company	:	.....
Address	:	.....
Contact No.	:	.....
Supplier Sample	:	.....
Sampling method	:	.....

TEST RESULTS:

SPESIMEN IDENTIFICATION :

Sample Code	:	.....
Length of Glue Line (*example*)	:	.....
Number of Glue Line (*example*)	:	.....
Total Length of Glue Line (*example*)	:	.....
Number of Pieces	:	..... pieces

PICTURE SAMPLE .....

Report Sheet, Page: n ..etc...

LABORATORIUM UJI KAYU

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TESTING REPORT

Serial No.: zzz / Month / ISWA-2009

TEST RESULTS :

Place and date of issue: Jakarta, ... 2009

Bbbbbbbb Kkkkkkkkk
Manager of Laboratory

IV. ISWA wood product laboratory innovations

The laboratory has other function to diversity the service of the laboratory to include testing of new product, new material and new species.

The laboratory also carries out continously R&D on new wood species, new products and new methods.

The other future plan is to develop the laboratory as a "Wood Clinic" for the members; it shall try to analyze and create best technical solutions for any questions or problems facing the members.

V. Other developing test methods

To maximize the service for the members, ISWA wood laboratory has planned to conduct tests as part of their future development. The targeted tests development include:

1. EN 204/205 Glue performance test,
2. Bending strength test after boiling soak under KOMO Standard,
3. Plane tension test under Japan Industrial Standard (JIS) for panel, and furniture products,
4. Shear strength test under Australian Standard (AS),
5. Bending strength test under Australian Standard (AS),
6. New test methods will developing by ISWA laboratory for furniture.
   This is include screw and nail test, dowelling test and mortise and tenon test.

VI. New test methods will be developed by ISWA Laboratory for other physical performances of wood, including specific gravity (SG) or density test, elasticity test for rattan, etc.

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