FOOD AND AGRICULTURE ORGANIZATION
OF THE UNITED NATIONS

INFORMATION NOTE II

TIMBER USAGE FOR TSUNAMI RECONSTRUCTION IN INDONESIA

Guideline I

Guideline II

Information Note I

This information note was produced jointly by the Food and Agriculture Organization of the United Nations (FAO), the Ministry of Forestry (MoF) of Indonesia and the Provincial Forest Service (DISHUT) of Nanggroe Aceh Darussalam (NAD) Province under the "Forestry Programme for Early Rehabilitation of Asian Tsunami Affected Countries" (OSRO/GLO/502/FIN), financed by the Government of Finland.

This information note is part of a series of guidelines and information notes prepared to assist with the procurement and use of suitable timber for rehabilitation and reconstruction in NAD and Nias. They are:

Guideline 1	:	Required Documentation for Transportation of Timber within Indonesia for Tsunami Reconstruction;
Guideline 2	:	Clearance Procedures for Timber Imported into Indonesia for Tsunami Reconstruction;
Information Note 1	:	Procurement of Timber for Tsunami Reconstruction in Indonesia; and
Information Note 2	:	Timber Usage for Tsunami Reconstruction in Indonesia.

These documents are available at: http://www.fao.org/forestry/site/tsunami/en

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PURPOSE

The purpose of this information note is to provide information on timber classification (referred to as "timber grading") and timber usage. The information note is limited to definition of grading criteria for structural and construction timbers.

TIMBER GRADING

Overview

The following information on timber grading is provided :

1. Recommended standard timber dimensions;
2. Classification system for timber by strength and durability properties;
3. List of common species with their respective strength and durability classifications;
4. Information on allowable visual quality attributes for structural timbers.

Timber dimensions

- Timber is routinely sawn into standard sizes that are multiples of 5cm and 7cm[1], e.g. 5cm x 5cm, 5cm x 7cm, 5cm x 10cm, 10cm x 10cm, 15cm x 5cm, 15cm x 10cm;
- It is recommended that large dimensions are used for load-bearing timbers, e.g. 10cm x 5cm, 10cm x 10cm, 15cm x 10cm etc;
- Non-load bearing timbers can be 5cm x 5cm and 5cm x 7cm;
- Using 12mm plywood for flooring and 4mm plywood for internal walls is generally recommended.

Structural strength classification

- A classification system for sorting timber by its structural strength is shown in the table on the next page.
- Note: the maximum bending moment is a direct measure of timber strength. However, maximum bending moment can only be measured by destructive testing. Specific gravity (density) and stress resistance (stiffness) are used as a proxy for strength. These parameters are directly related to strength, but this relationship differs among different species.

Table 1. Timber Strength Grade Classification

Grade	Specific Gravity	Maximum bending moment (kg/cm^2)	Maximum stress (kg/cm^2)
I	> 0.90	> 1100	> 650
II	0.60-0.90	725-1100	435-650
III	0.40-0.60	500-725	300-425
IV	0.30-0.40	360-500	215-300
V	< 0.30	< 360	< 215

[1] This applies in countries using the metric system. Countries using imperial measurements (e.g. USA and Malaysia) produce different sizes based around quarter inch (0.75cm), inch (2.5cm), and feet (30cm) dimensions.

Durability classification

A classification system for sorting timber by its durability is shown in the table below.

Table 2. Timber Durability Grade Classification

Environmental Conditions	Durability Grade				
	I	II	III	IV	V
Exposed to weather, but kept dry and ventilated	8 years	5 years	3 years	Very short	Very short
Always in contact with ground	20 years	15 years	10 years	<10 years	Very short
Under the roof, no ground contact and well ventilated	No limit	No limit	Very long	Some years	Short
As above, but with good maintenance and regularly painted	No limit	No limit	No limit	20 years	20 years
Attacked by termites from soil	No	Rare	Fast	Very fast	Very fast
Dry Rot	No	No	Almost never	Insignificant	Very fast

Source: OEY DJOEN SENG (1951)

Species strength and durability characteristics

The table below lists common timbers used in construction in Indonesia[2]. The common name may refer to specific species but more often refers to a group of species with common or similar attributes.

The durability and strength characteristics of each species have been identified. Note that durability and strength characteristics are estimates only and actual performance may vary greatly from that stated in the list.

[2] There are several hundred forest tree species in Indonesia, however less than 100 common species groupings are used by the timber industry for species identification purposes. There are significant regional differences in Indonesia in the naming of species. Common names vary between and even within provinces although the most prominent species such as *Meranti* and *Keruing* are universally used. Also, the botanical species composition of species groups of the same name (e.g. *Meranti merah*) can be markedly different in different regions.

TIMBER SPECIES FOR HOUSE AND BOAT CONSTRUCTION

SPECIES	BOTANIC NAMES	FAMILY	DURABILITY CLASS	STRENGTH CLASS	Used for House Construction						Used for Boat Construction			
					FLOOR	FRAME	WINDOW	WALL	DOOR	ROOF TIMBERING	KEEL	BODY PLANK	STEM	RIB
Ampupu	Eucalyptus alba Reinw	Myrtaceae	II-III	II-I	√				√					
Bangkirai	Shorea laeviforea	Dipterocarpaceae	I-II	I-II	√							√		
Bawang	Melia excelsa Jack	Meliaceae	III-IV	II-III	√	√								
Bayur	Pterospermum javanicum	Sterculiaceae	III	I			√		√					
Berumbung	Adina minutiflora Val	Rubiaceae	II	II-I	√	√			√					
Bintangur	Callophylum spp	Guttiferae	III	II-III	√				√					
Bungo	Artocarpus glauca El	Moraceae	III	III-V								√		
Cemara Laut	Casuarina equisetifolia Forst	Casuarinaceae	I-II	II-III							√			
Cengal	Hopea sangal	Dipterocarpaceae	II	I	√							√		
Jati	Tectona grandis	Verbenaceae	I-II	II						√				
Kapur	Dryobalanops spp	Dipterocarpaceae	II-III	II-I	√			√			√			
Keruing	Dipterocarpus spp	Dipterocarpaceae	III	I-II					√	√				
Laban	Vitex pubescens	Verbinaceae	I	II-III							√	√	√	√
Medang	Litsea spp	Lauraceae	III-V	II-V	√	√		√	√					
Medang Ara	Artocarpus altissima	Moraceae	IV	I			√							
Meranti Batu	Parashorea	Dipterocarpaceae	III	II-III										√
Meranti Merah	Shorea teysmanniana	Dipterocarpaceae	IV	IV				√	√	√		√		
Meranti Merah Ringan	Shorea spp	Dipterocarpaceae	III-IV	II-IV	√									
Meranti Putih & Kuning	Shorea spp	Dipterocarpaceae	III-IV	II-IV	√				√					
Merawan	Hopea mengarawan	Dipterocarpaceae	II-III	II			√							
Merbau	Intsia palembanica Mig	Caesalpiniaceae	I	I	√			√						
Nangka	Atocarpus heterophyllus	Moraceae	II	II-III							√		√	√
Nyatoh	Palaquium spp	Sapotaceae	III-IV	II-III	√	√			√					
Pulai	Alstonia spp	Apocynaceae	III-V	IV-V					√					
Resak	Vatica rassak	Dipterocarpaceae	III	II-III			√							
Sawo Kecik	Manilkara kauki Dub	Sapotaceae	I	I	√				√					
Semantok	Shorea spp	Dipterocarpaceae	II-III	I-III	√	√							√	
Sentang	Aglaia	Meliaceae	II	I	√			√				√		
Sungkai	Peronema carescens	Verbenaceae	III	II-III						√				
Suren	Toona sureni Merr	Meliaceae	III-V	III-IV		√			√					
Tanjung	Mimosops elengi L	Sapotaceae	I-II	I	√				√					
Ulin	Eusideroxylon zwergeri	Lauraceae	I	I										√

Source :

1. Forest Product Research Institute CIRI UMUM, SIFAT DAN KEGUNAAN JENIS-JENIS KAYU INDONESIA, 1977
2. DAFTAR NAMA POHON-POHONAN ACEH - SUMATRA, Suwanda.R, Tantra
3. Dinas Kehutanan NAD
4. Balai Sertifikasi Penguji Hasil Hutan Wil. I, NAD. Departemen Kehutanan

Visual grading guidelines for structural timbers[3]

a. Sizes

Any rectangular section of sizes normally used in load-bearing structures, e.g. 10cm x 5cm, 12cm x 12cm, 15cm x 15cm, 20cm x 10cm, 30cm x 15cm, etc.

b. General

Visual grading requirements relate to the visual attributes that are acceptable for timber used in construction. These may be used in addition to strength and stress grading tests.

Table of grading requirements for construction

KIND OF DEFECT	COMMENT – Acceptable limits
	1 in 8
Sound knots	1/3 dimension of face, to maximum of 10cm diameter. 1 per meter in length
Unsound knots or knot holes	1/4 dimension of face, to maximum of 7cm diameter. 1 per 3 meters in length
Decay (Rot)	None, except in an unsound knot
Sound sapwood, including wane	1/3 sum of width and thickness
End splits	Longest split, 15cm at each end
Stain free from decay	Unlimited
Twist	1 cm in 3 meters
Compression failures	None
Brittle heart	1/4 of cross-section at ends
Open shakes, surface checks and end checks	1/2 of thickness
Seasoning/drying	Timber should be dried to 15% moisture content or less

Glossary of timber grading terms

Bending moment	:	a measure of material strength. The maximum bending moment determines the load a beam will carry before it breaks. The maximum bending moment given to a grade will be the minimum value that must be exceeded by the timber to be classified in that particular grade.
Brittle heart	:	the defective core of a log, characterized by abnormal brittleness, which occurs in certain types of tropical hardwoods.
Checks	:	small separations of the wood fibres in a longitudinal direction, not penetrating as far as the opposite or adjoining side of a piece of sawn timber.

[3] This information has been adopted from Malaysian Timber Council grading rules for structural timbers.

Common name	:	the trade name used to identify individual species or species groups. Species groups with a common name will normally share the same family and produce timber with similar visual and physical properties.
Compression failures	:	fractures across the grain in which the fibers are broken transversely or crushed by compression.
Decay	:	the disintegration of wood resulting from the action of wood-destroying fungi including Wet Rot and Dry Rot. Decay usually accompanied by discoloration, even in the early stages of attack. Infection by sap-stain fungi is not classed as decay.
Sapwood	:	the outer layers of wood adjacent to the bark that, in the living tree, contain living cells and reserve materials (e.g. Starch).
Seasoning (drying)	:	the process that reduces the moisture content of timber by either air-drying (air-season), or kiln-drying (kiln-season). Timber is fully seasoned when its moisture content has dropped to the equilibrium moisture content of the local climate; in South East Asia this varies between about 15 and 18 percent.
Shake	:	an expression used to describe a split, crack or deep check.
Sloping grain	:	a deviation of the grain (fibres) from the longitudinal axis of the timber when the deviation is in the same direction throughout the depth of the piece.
Sound knot	:	a knot that is free from decay.
Specific gravity	:	the density of a substance compared to that of water. Generally the higher the specific gravity the higher the strength. However, this relationship is not universal and varies between and within species.
Spring	:	the curvature of a piece of sawn timber in the plane of its wide face: known also as *Crook* or *Free side bend*.
Stress	:	a measurement of material stiffness. Generally the higher the stiffness, the higher the strength. However, this relationship differs from species to species. Stiffness is a useful unit of measure, because it can be used to test timber non-destructively. The maximum stress value given to a grade will equal the minimum value that must be exceeded by the timber to be classified in that particular grade.
Twisting	:	the spiral distortion of a piece of sawn timber; it may be accompanied by either bowing, spring or both.
Unsound knot	:	a knot that has some decay.

Wane	:	the lack of wood on any face or edge of a piece of sawn timber, usually caused by a portion of the original rounded surface of a log remaining on the piece; bark may or may not be present.

TIMBER TREATMENT

Timber treatment overview

Different species and types of timber have varying levels of natural durability. Timber treatment enhances the durability of timber because preservative chemicals that are absorbed into the surface of the timber provide additional protection against insects and fungi.

The requirement for timber treatment is determined by an assessment of three main factors:
1. environmental conditions to which the timber will be exposed;
2. required level of durability/desired hazard level; and
3. natural durability and treat ability/permeability of the timber.

This note includes the following information on timber treatment:
1. list of allowable treatments in Indonesia;
2. level of protection provided by each treatment; and
3. hazard level classifications.

Approved timber treatments

Approved timber treatments in Indonesia are described in timber standard SNI 01-5010.1-1999. Only two types of chemical treatments are allowed under this standard. These are CCB and CCF treatment. The allowable chemical formulations and application rates are shown in the table below:

APPROVED CHEMICAL TIMBER TREATMENTS FOR INDONESIA

Type	Active Ingredients	%	Form	Chemical retention rates (kg/m3)	
				Internal use	External use
CCB1	$CuSO_4.5H_2O$ $K_2Cr_2O_7$ H_3BO_3	33.0 37.0 25.0	Powder	8.0	11.0
CCB2	$CuSO_4$ $K_2Cr_2O_7$ H_3BO_3	34.0 38.0 25.0	Powder	8.0	11.0
CCB3	$CuSO_4$ $Na_2Cr_2O_7$ H_3BO_3	28.6 43.9 27.5	Powder	8.0	11.0
CCB4	$CuSO_4.5H_2O$ $Na_2Cr_2O_7.2H_2O$ H_3BO_3	32.4 36.0 21.6	Paste	8.0	11.0
CCF	$CuSiF_6.4H_2O$ $(NH_4)_2Cr_2O_7$	36.3 63.7	Powder	6.0	8.6

CCA and BFCA treatments have been banned by Minister of Agriculture Decree № 326/Kpts/TP.270/4/94. This decree bans the use of timber that has been treated with arsenic based chemicals.

Common treatments that are not included on the list of approved treatments are ACQ, Tanalith-E/CuAz, and LOSP. It is assumed that these treatments cannot be applied to timber in Indonesia. The Ministry of Environment is currently reviewing the list of allowable timber treatments. No extension of the list is allowed until the relevant authority passes a decree or the standard is officially revised.

The status of imported ACQ, Tanalith-E/CuAzand LOSP treated timber is unclear. The regulations do not appear to ban the importation or use of these timbers, only the application of the treatments in Indonesia.

Level of Protection Provided by Each Treatment

Treatment	Hazard Level	Note
CCB	I	Currently allowed
CCF	II	Currently allowed
CCA	V	Banned
BFCA	III	Banned
ACQ/Tanalith-E	V	Status of imports to be verified
LOSP	III	Status of imports to be verified
CuAz	V	Status of imports to be verified

Hazard level classification

Hazard level is an international classification for timber preservation. It closely relates to the natural durability classification shown in table 2.

Hazard Class	Exposure	Service Conditions	Biological Hazard
I	Inside above ground	Fully protected well ventilated	Borers only
II	Inside above ground	Protected from wetting and leaching	Borers and termites
III	Outside above ground	Moderate wetting and leaching	Decay, borers and termites
IV	Outside above ground	Severe wetting and leaching	Severe decay, borers and termites
V	Ground Contact	Extreme wetting and leaching	Very severe decay, borers and termites

Glossary of timber treatment abbreviations

ACQ Alkaline Copper Quaternary
BFCA Boron Fluoride Chromium Arsenic
CCA Copper Chrome Arsenic
CCB Chromated Copper Boron
CCF Chromated Copper Fluoride
CuAz Copper Azole
LOSP Light Organic Solvent Preservatives

For further information, please contact:

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