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MALAYSIAN TIMBERS FOR WOODEN TOOL HANDLES

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LIM, S.C. 1988. **Malaysian timbers for wooden tool handles.** Current trends and usage of wooden tool handles in Malaysia are discussed here. The performance and property requirements of various tool handles, whether for heavy impact, low impact or non-impact purposes are indicated. Criteria for the selection of timbers for the three classes of tool handles based on the factors that are found to influence the properties are formulated. Malaysian timbers suitable for the three classes of tool handles are indicated.

Key words : Tool handles – Malaysian timbers – three usage classes.

Introduction

General guidelines and standards governing the manufacturers of tool handles are still lacking in Malaysia, and as such the market is flooded with tools using handles made up of various types of timber. In a survey carried out in 1983 (Anonymous 1983), it was revealed that a large number of timbers such as kempas, red meranti, penaga, balau, penarahan, tualang, mersawa, meransi, nyatoh, kedondong, merawan, chengal and merbau are being used for the manufacture of 'changkul' (a tool used locally for hoeing) handles. Ramin has been used for chisel handles and kempas, red meranti, penarahan and mengkulang for spade handles. These timbers range from heavy to light hardwoods.

Tools which are imported are normally accompanied by the handles. Timbers popularly used for the imported items are birch *(Betula* spp) and willow *(Salix* spp.) for paint brushes, oak *(Quercus* spp) and hickory *(Carya* spp.) for striking tools such as hammers, maple (*Acer* spp.) for screw drivers and oak, hickory and chestnut (*Castanea* spp.) for spade handles (Anonymous 1983). Timber handles for tools imported from countries such as New Zealand, Australia and United Kingdom are generally manufactured according to their respective standard specifications [(NZS 2249 : 1968) (Anonymous 1968 ; AS 1729 : 1975 (Anonymous 1975); BS 876 : 1981 (Anonymous 1981); BS 3823 : Pt 1 : 1965 (Anonymous 1965) *etc.*].

By comparison, local items are manufactured haphazardly without following any fixed set of end use requirements or standards. The timbers used are found to be either unnecessarily strong for a specific purpose, example, kempas for spade handles, merbau for knife handles or may be too weak, example, mersawa, red meranti, kedondong, *et cetera,* for the 'changkul' handle. A set of guidelines is therefore necessary to ensure a more prudent use of local timbers for tool handles.

Performance and property requirements

When selecting timbers for tool handles, strength, shock resistance and ability to absorb vibration are the essential qualities. Smooth working and non-splitting characteristics are also required. The grain of the timber should be fairly straight since small deviation of the direction of the grain produces a decided reduction in strength. However, straight grained timbers tend to split under extremely high impact usage. Thus if non-splitting characteristics are needed, it would perhaps be necessary to use timbers with interlocked grain which will stop checking fairly rapidly at the next bend of the grain.

The timbers used for handles should be properly air or kiln dried. Natural defects and imperfections such as abrupt dipped grain, blackheart, brashness, cross-grain, decay, shake, wormhole and many other defects [listed in the British Standard B.S. 3832 : Pt 1 : 1965 (Anonymous 1965)] should be avoided. Defects, blemishes and imperfections introduced in drying, conversion and fabrication such as case hardening, chip-marks, collapse, machine burn, split, torn grain, twist and woolly grain are also undesirable.

For handles exposed to the weather during use, the timbers should be fairly durable or amenable to preservative treatment. The timbers must be fairly stable in service as any movement may result in distortion and render the handles useless.

Durability and strength requirements of the timber are normally unimportant for tools used only for short periods or little subjected to impact and bending forces, for example, brushes and screw drivers.

Classification of wooden tool handles

Wooden tool handles can generally be divided into:

(a) handles for heavy impact purposes;

(b) handles for low impact purposes; and

(c) handles for non-impact purposes.

Generally, it is important that handles for impact tools such as axe and hammer possess good strength properties. To withstand impact shock, high density and the right direction of grain are required. On the other hand, tool handles for non-impact purposes, such as for rake, shovel, spade, garden fork and some other small hand tools, require properties which are less stringent and timbers of lower quality can be used.

Selecting timbers for tool handles

Various factors are found to influence the properties of tool handles and they are summarized as follows: strength properties, density, direction of grain, working properties, dimensional stability and toughness or ability to withstand shock.

Strength properties

The strength of the timber is especially important when tool handles are subjected to impact forces. Timbers which are lacking in strength, particularly in impact stresses and normal bending load, are likely to fail or give rise to premature failure in usage. For tool handles which are meant for non-impact purposes, the conditions on the strength properties of the timber are less rigid. The strength properties of Malaysian timbers by Lee *et al.* (1979) and the different strength groups by Engku Abdul Ahmad (1980) and Wong (1982) are useful guides to the selection of timbers.

Density

Density of timber has always been taken as directly related to the general strength and hardness of wood. Thus, depending on the actual usage, for tools which are subject to severe impact forces in usage, it is advisable to use timber with high density. Timbers with lower density may be used in cases where tool handles are not subject to any form of impact forces.

Working properties

Ideally, timbers for tool handles should be easy to plane and saw in order to produce smooth surfaces without any tearing of fibres. Smooth working, machining and finishing properties are required for the making of tool handles. Tool handles with rough and splintering surfaces may injure the hands of the users. However, timber species with both good machining and finishing properties are uncommon. Although the surface quality of the timber can usually be improved by sanding or some other treatment, the cost of such additional processing is undesirable. Information pertaining to the machining properties of some Malaysian timbers has been published (Lee & Lopez 1980) and should be used as a guide for timber selection.

Besides woodworking properties of timber, a less important feature to be considered is the irritation caused by wood dust and chemicals during sawing. Some Malaysian timbers do possess irritants which cause dermatitis among woodworkers during processing (Orsler 1979). However, the irritation is mainly confined to the processing of the timber and has little effect on the users of tool handles.

Direction of grain

One of the most important characteristics of tool handles is high shock resistance or ability to withstand the effect of severe blows. A major cause of failure in such articles is the presence of sloping grain, which lowers shock resistance. Accordingly, where high shock resistance is important, it is desirable that the grain should be straight. If the deviation of grain cannot be avoided totally, the extent of grain deviation should not be so great as to reduce the overall performance of the tool handle. Generally, the degree of grain deviation is specified in the standard specification of the country concerned.

In New Zealand (Anonymous 1968), the diagonal slope of the grain for handles which are subject to impact as well as bending loads should not have a gradient exceeding 1 in 20. In Australia (Anonymous 1975), handles for striking tools using hickory timber, the slope of grain should not exceed 2 *mm* in 820 *mm* for AAW grade, 5 *mm* in 100 *mm* for AW and AR grades, 3 *mm* in 820 *mm* in BW and BR grades; for hardwood timbers other than hickory, grade A handles should not have slope exceeding 3 *mm* and grade B should not have slope exceeding 10 *mm* in 100 *mm*. British Standard (Anonymous 1965) which specifies only the timbers of ash (*Fraxinus* spp.) and hickory (*Carya* spp.). gives the requirement of slope of grain as equal to half the diameter of handle for grade A handle, equal to two-thirds the diameter of grade B handle and equal to diameter of handle for grade C handle. For striking tools however, handles of up to 18 inches long should not have grain exceeding 1 in 20 inches. For hickory striking tools of up to 42 inches length, the slope should not exceed one-half the diameter.

The direction of grain is therefore, a very important factor in determining the strength, shear and cleavage, splits, toughness *et cetera,* of a timber. Thus, one must look at the actual usage of the tool handle in its proper perspective. Straight grained timber, as explained earlier, should be used for purposes where high shock resistance is required. However, there is a tendency for straight-grained timbers to split more readily than timbers with interlocked grain under very high impact.

Timbers with interlocked grain, on the other hand, may be useful for the type of usage where the timbers are prone to cleavage failure. The presence of interlocked grain will render the timber to be very difficult to split since a cleavage crack tends to follow the course of the elements (Jane 1970). Timbers with interlocked grain have been known to be elastic and absorb shock well when subjected to impact forces. However, too much of interlocked grain may weaken the overall strength of the timber.

On the other hand, sloping grain may reduce the strength of timber considerably. Jane (1970) noted that diminution in tension becomes appreciable when the slope exceeds 1 in 25; in the case of compression, a slope of more than 1 in 10 has a serious effect. The most likely failure to occur in items with sloping grain is the breaking off of the edges where the grain run out.

Timbers with grain deviation can even influence the processing and strength properties. For example, when working on a cross-grained material, rough surface or picking up of grain will give rise to zones of smooth and rough surfaces on the radial side. In the strength properties of the timber, a small deviation in the direction of the grain produces a decided reduction in the strength.

In practice, however, it is very difficult to obtain many perfectly straight grained timber species in Malaysia. In fact, most of the timber species in this country show at least some degree of grain deviation in the form of interlocking, wavy or sloping grains. Hence, a certain degree of flexibility should be adopted to ensure that the timber species are not rejected unnecessarily.

Stability in service

The stability of timber in service is vital for all types of timber use including tool handles. Timbers which shrink or swell considerably may give rise to undesirable movement leading to distortion. Thus, to prevent this timber defect in usage, it is best that the timber is seasoned to the conditions in which they will be finally used. Grewal (1979) listed the shrinkage values and drying characteristics of some of the Malaysian timbers and this can serve as a guide to the end users.

Toughness

Toughness or shock resistance properties are essential for tool handles which are subject to impact stresses. Toughness of timber depends largely upon the amount of wood substance present. It is the property not found in very light wood with very thin-walled elements example, jelutong (*Dyera costulata*) or terentang (*Campnosperma* spp.) since these timbers fail easily under impact stresses. On the other hand, for timbers with thick-walled fibres, example, bitis (*Madhuca utilis* and *Palaquium* spp), pauh kijang (*Irvingia malayana*) and chengal (*Neobalanocarpus heimii*), very high impact stresses have been recorded (Lee *et al.* 1979).

Criteria for selection

Several factors have to be taken into consideration when selecting the timber species for the appropriate type of tool handles. For the three classes of tool handles mentioned earlier, the general criteria are as follows:

(I) *Tool handles for heavy impact purposes*

i) Density (air dry) = 800 kg/m^3 and above

ii) Strength group = A or B (see below)

iii) Grain direction = Sloping grain may only be permitted when grain does not deviate by more than one-half of the larger diameter of the handle

iv) Impact bending = high (see below)

(II) Tool handles for low impact purposes

i) Density (air dry) = $> 700\ kg/m^3 < 800\ kg/m^3$

ii) Strength group = B (see below)

iii) Grain direction = same as (I) above

iv) Impact bending = moderate (see below)

(III) Tool handles for non-impact purposes

i) Density (air dry) = $> 600\ kg/m^3 < 700\ kg/m^3$

ii) Strength group = C (see below)

iii) Grain direction = same as (I) above

iv) Impact bending = low (see below)

The strength groups are as defined below:

Strength Properties	Strength group		
	A	B	C
Bending and tension parallel to grain	> 20 MPa	> 17 MPa	> 12 MPa
Compression parallel to grain	> 17 MPa	> 14 MPa	> 9.6 MPa
Compression perpendicular to grain	> 2 MPa	> 1 MPa	> 0.7 MPa
Shear parallel to grain	> 3 MPa	> 2 MPa	> 1.4 MPa

Source: Engku Abdul Rahman bin Chik (1980)

Table 1. Timber Suitable For Tool Handles

	Timber	For Impact Purposes		Non-Impact Purposes	Other Conditions*
		Heavy	Low		
1	Bakau	**	*	*	b, d
2	Balau	**	*	*	b
3	Balau, Red	**	*	*	b
4	Bekak		**	*	–
5	Berangan		**	*	a, b
6	Bitis	**	*	*	b
7	Chengal	**	*	*	b
8	Dedali		*	*	–
9	Delek		**	*	b
10	Derum		**	*	b
11	Dungun		**	*	b
12	Durian			*	a
13	Giam	**	*	*	b
14	Kapur		**	*	b
15	Kasai		**	*	–
16	Kedondong			*	a
17	Kekatong	**	*	*	b
18	Kelat		**	*	–
19	Keledang		**	*	–
20	Kembang semangkok			*	a
21	Kempas	**	*	*	b, e
22	Keranji	**	*	*	b
23	Keruing		**	*	b, c
24	Kulim		**	*	–
25	Kungkur			*	–
26	Mata ulat	*	**	*	b
27	Melunak			*	–
28	Mempening	**	*	*	b
29	Mengkulang		**	*	–
30	Meransi		**	*	–
31	Meranti, Dark Red		*	*	b, r
32	Meranti, White			*	a
33	Merbatu	**	*	*	b
34	Merbau	**	*	*	b

	Timber	For Impact Purposes		Non-Impact Purposes	Other Conditions*
		Heavy	Low		
35	Merpauh			*	a
36	Mertas	**	*	*	b
37	Nyalin	**	*	*	a, b
38	Nyatoh		*	*	c
39	Pauh kijang	**	*	*	b
40	Pelawan	**	*	*	b
41	Penaga	**	*	*	b
42	Petaling		**	*	b
43	Punah		*	*	–
44	Putat			*	–
45	Ramin			*	a
46	Rengas		**	*	–
47	Resak	**	*	*	b
48	Rubberwood			*	a
49	Samak		**	*	–
50	Sepetir			*	a
51	Simpoh		**	*	–
52	Surian batu		**	*	–
53	Tembusu	**	*	*	a, b
54	Tempinis	**	*	*	b
55	Tualang	**	*	*	b, e

** denotes preferred usage
* denotes suitability

a. Preservative treatment against 'blue stain' fungi attack are essential.

b. May be too strong and heavy for non-impact purposes.

c. Due to the wide range of densities exhibited by these timbers the heavier members may be used for normal impact purposes and the lighter timbers for non-impact purposes.

d. The trees are generally small.

e. Included phloem to be avoided.

f. Prone to brittle heart.

Impact bending

The data on impact bending of Malaysian timbers can be found in Lee *et al.*,(1979), but for the purpose of the present report, the heights of drop of 22.7 *kg* hammer causing complete failure to timber of dimension 50 x 50 x 750 *mm* are classified into the following impact bending categories:

Impact bending	Height of drop
High	> 1000 *mm*
Moderate	> 875 *mm* < 1000 *mm*
Low	> 625 *mm* < 875 *mm*
Very low	< 635 *mm*

Conclusion

A good understanding of the properties of timber and the property requirements for the particular end use is essential for selecting a particular timber for its end use as tool handles.

Based as closely as possible on the criteria stated above, Malaysian timbers suitable for the three classes of tool handles may be properly selected according to the guide in Table 1.

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