MOULDING PROPERTIES OF SOME MALAYSIAN TIMBERS

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HO, K.S. & SAID AHMAD 1991. Moulding properties of some Malaysian timbers. Moulding properties of rubberwood,light red meranti, ramin and nyatoh were investigated with seven cutting angles starting from 15^0 to 45°. The surface quality and the occurrences of machining defects for each cutting angle are presented. The best cutting angle for each species is also determined.

Key words: Moulding properties - cutting angles - Malaysian timber

Introduction

Moulding properties of timbers are usually derived from the results of planing trials. The planing properties of some Malaysian timbers have been investigated and documented by Lee and Lopez (1980). In their work, the properties were evaluated by feeding the timbers at a speed of 6 $m\ min^1$ (20 $ft\ min^{'1}$) through a surface thicknesser which is equipped with two- knives-circular-cutterhead with a cutting angle of 30° rotating at 4000 rpm. No consideration was made with respect to the effect of the cutting angle on the surface finish and hence the suitable cutting angle for the particular species.

Most of the circular cutterheads used in the moulding industry are supplied with cutting angles ranging between 25° to 30°. With the introduction of high speed moulders, it is felt that the use of correct cutting angle becomes important and critical to ensure good surface quality. This is especially important for those refractory species with interlocked grains or prone to have woolly grains.

This paper presents the moulding properties of some Malaysian timbers with respect to the effects of different cutting angles on the machined surfaces.

Materials and methods

Timber species

Four species were selected. They were nyatoh *(Palaquim* spp.), ramin *(Gonystylus* spp.), light red meranti *(Shorea* spp.), and rubberwood *(Hevea brasiliensis).* The air dry density of nyatoh was 681 kgm^3. Its texture was slightly coarse with straight to slightly interlocked grains. The air dry density of ramin was 701 $kg\ m^3$. It had a fine and even texture with straight grains. Light red meranti had an air dry density of 573 $kg\ m^3$. Its texture was coarse but even and the grains were interlocked. The air dry density of rubberwood was 718 $kg\ m^{'3.}$ Its texture was coarse but even and the grains were interlocked. At test their moisture content ranged between 15 to 19%.

Machine

A high speed moulder equipped with six cutterheads was used. The speed for all cutterheads was kept constant at 5760 rpm. Each cutterhead of 125 mm diameter was fixed with two cutting knives. All the knives were made from high speed steel and shaped and set to produce a profile as given in Figure 1. Except the top profile cutterhead, a cutting angle of 30° was used. For the top profile cutterhead the cutting angles used were 15, 20,25, 30,35,40,45". The feed speed of the moulder was set at 9.5 *m* min^{1}.

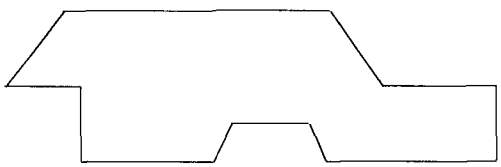

Figure 1. Moulding profile

Moulding procedure

Sawn boards brought from a local sawmill with cross-sectional dimensions 18 x 80 *mm* for each of the four timber species were fed into the moulder to produce the required profile (12.5 x 75 *mm).* The length of boards for nyatoh, ramin and light red meranti ranged from 2 to 4 m long, while rubberwood was 1.8m long. For each cutting angle at least five boards from each species were fed into the moulder. The total lengths of board in metre fed through the moulder for each angle are shown below:

Angle	Nyatoh	Ramin	Light red meranti	Rubberwood
15	35.0	15.0	11.5	36.0
20	27.5	15.0	10.0	26.0
25	25.0	15.0	15.0	15.0
30	10.0	10.0	10.0	9.0
35	30.0	15.0	12.0	9.0
40	25.0	12.5	23.5	30.0
45	25.0	12.5	20.0	36.0

For each cutting angle, the knives were sharpened and set before the moulding process commenced.

Assessment of results

The surface quality of the top moulded profile was examined visually for the occurrence of machining defects, *viz* chipped grain, woolly grain, and fuzzy grain at every 30 *cm* length throughout all the moulded boards. The chipped grains (torn grains) were the defect in which chips formed during machining were torn from the wood surface below the intended plane of cut. The woolly grain surface had bundles of frayed loose fibres, while the fuzzy grain surface

had very fine and short raised fibres that were not cleanly severed during cutting but could be sanded off easily. At the same time, the percentage of areas free of these machined defects over every 30 *cm* interval was estimated to represent the degree of smoothness of the moulded surfaces. The surface quality was then graded by the average percentage over all the areas examined according to the following classification:

Surface quality	% defect-free area	Grade
Smooth	> 75	A
Moderately smooth	55 - 74	B
Rough	40 - 54	C
Very rough	<40	D

The different grades of the surface quality can be seen from Figures 2 to 5.

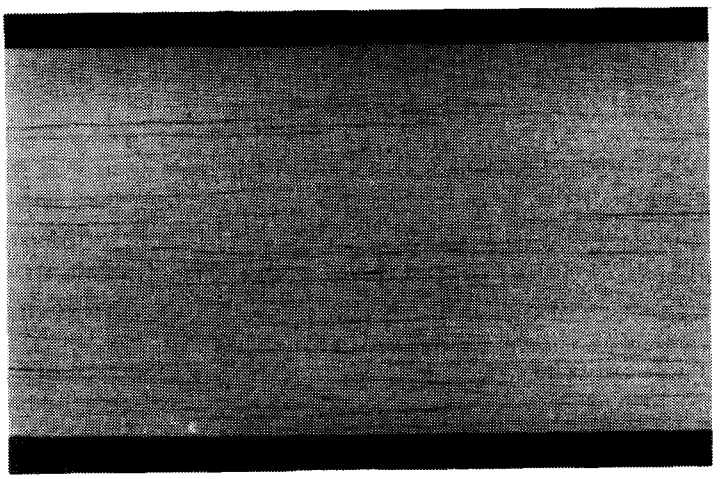

Figure 2. Grade A - smooth surface

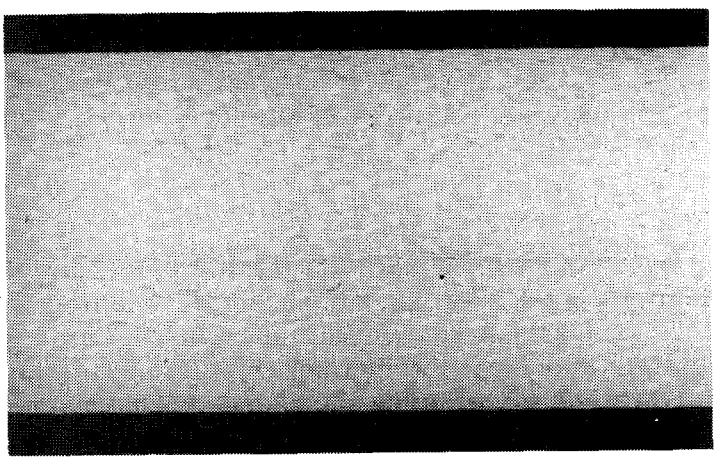

Figure 3. Grade B - moderately smooth surface

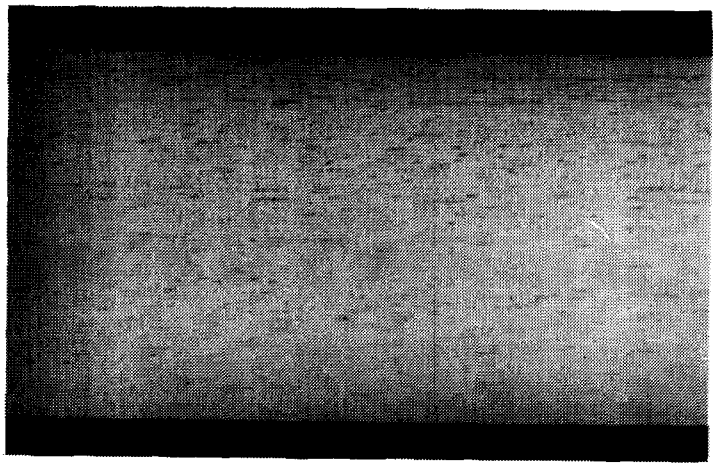

Figure 4. Grade C - rough surface

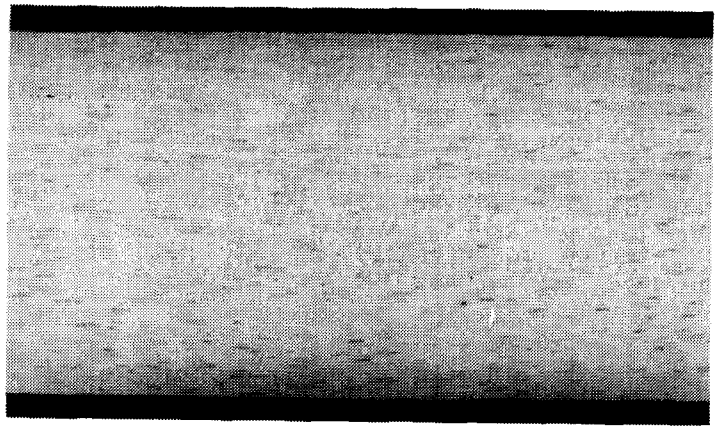

Figure 5. Grade D - very rough surface

Results and discussions

The types of machining defects, their percentage of occurrence and the overall surface quality for each species moulded under different cutting angles are given in Table 1.

Nyatoh and ramin are not greatly affected by changing the cutting angles from 15 to 45° as the surfaces remain smooth or moderately smooth at these cutting angles. At 20, 25 and 30°, the moulded surfaces of nyatoh are smooth. But at the angle of 30° the surfaces are with only slightly fuzzy grain, no chipped grain and woolly grain as compared to angles of 20 and 25°. Hence, the suitable cutting angle for moulding nyatoh is at 30°. On the other hand, both the 25 and 30° cutting angles produce smooth surfaces on ramin. With 30° cutting angle there is no occurrence of woolly grain and less fuzzy grain as compared to that from the angle of 25°.

Table 1. Moulding properties of some Malaysian timbers

Species	Cutting angle (degrees)	% of occurrence			Surface quality
		Chipped	Woolly	Fuzzy	
Rubberwood	15	36	76	33	D
(Density:	20	24	71	45	C
718 *kg m*^{3};	25	34	89	53	D
Interlocked	30	23	85	54	B
grains)	35	26	100	37	A
	40	35	75	72	B
	45	58	71	4	B
Light red	15	56	91	4	D
meranti	20	50	100	38	C
(Density:	25	3	90	41	B
573 *kg* m^3;	30	6	72	78	C
Interlocked	35	0	71	75	B
grains)	40	34	100	27	D
	45	3	100	5	D
Ramin	15	25	46	96	B
(Density:	20	33	7	89	B
701 *kg m3*;	25	15	23	69	A
Straight	30	17	0	33	A
grains)	35	12	42	88	B
	40	26	17	56	B
	45	30	10	55	B
Nyatoh	15	24	9	64	B
(Density:	20	14	2	49	A
681 *kg* m-^{3};	25	4	12	32	A
Straight to	30	0	0	35	A
slightly	35	3	25	80	B
interlocked	40	47	32	82	B
grains)	45	18	40	58	B

Note: A - smooth; B - moderately smooth; C - rough; D - very rough

Light red meranti can be moulded to a moderately smooth surface with cutting angles at 25 and 35°. The main defects are woolly grain and fuzzy grain and also very slight chipped grain. At 25° it produces more woolly grain than fuzzy grain, but at 35° the occurrences of woolly and fuzzy grain are almost equal.

Rubberwood behaves quite differently from the other timbers as it can be moulded with surfaces moderately smooth to smooth at cutting angles between 35 to 45°. The best cutting angle is at 35°, but the defect of woolly grain remains prominent on all the surfaces.

Table 2. Comparison of surface quality from planing and moulding trials

Species	Planing trial	Moulding trial
Rubberwood	A	B
Light red meranti	A/B	C
Nyatoh	A/B	A
Ramin	A	A

Note: A - smooth; B - moderately smooth; C - rough; D - very rough

Table 2 presents a comparison of the surface quality between the moulding trial from this study and the planing trial reported by Lee and Lopez (1980) at cutting angle of 30°. It can be seen that there are discrepancies in the results from these trials.

Conclusions

The results show that different cutting angles produce different surface qualities and different types of machining defects. The best cutting angles in moulding rubberwood, light red meranti, ramin and nyatoh are 35, 25 & 35, 30, and 30° respectively.

References

LEE, Y.H. & LOPEZ, D.T. 1980. The machining properties of some Malaysian timbers. *Malaysian Forest Service Trade Leaflet Number 35.* Ministry of Primary Industries, Malaysia.