AIR DRYING STUDIES ON 1" AND 2" GARJAN (DIPTEROCARPUS SPP.) LUMBER.

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Introduction :

Air drying in East Pakistan will continue to be a widely practised method for seasoning of lumber because of its simplicity and low cost in operation. Small wood based industries and average consumers can adopt this natural process if proper procedures are known to them.

Garjan (Dipterocarpus Spp.), an important timber species of East Pakistan, is preferably used in construction work where lumber needs to be air dried. Uptil now neither any work on the air drying of Garjan under the climatological condition of East Pakistan has been reported nor it is known whether this species can be dried economically in the open pile outside the drying shed without causing excessive degrade. Therefore the present study was undertaken to evaluate the drying characteristics of Garjan lumber under open and shed drying conditions prevailing in the campus of Forest Research Institute at Chittagong, East Pakistan.

Objectives :

Principal objectives of this study were (i) to determine the rate of air drying 1" and 2" lumber during various seasons of the year and (ii) to evaluate the time required to air dry lumber of these two thicknesses from green condition to a moisture content of 15% during different seasons of the year under conditions prevailing in the Forest Research Institute campus. Additional objective was to determine the effect of drying shed on the rate and total drying period.

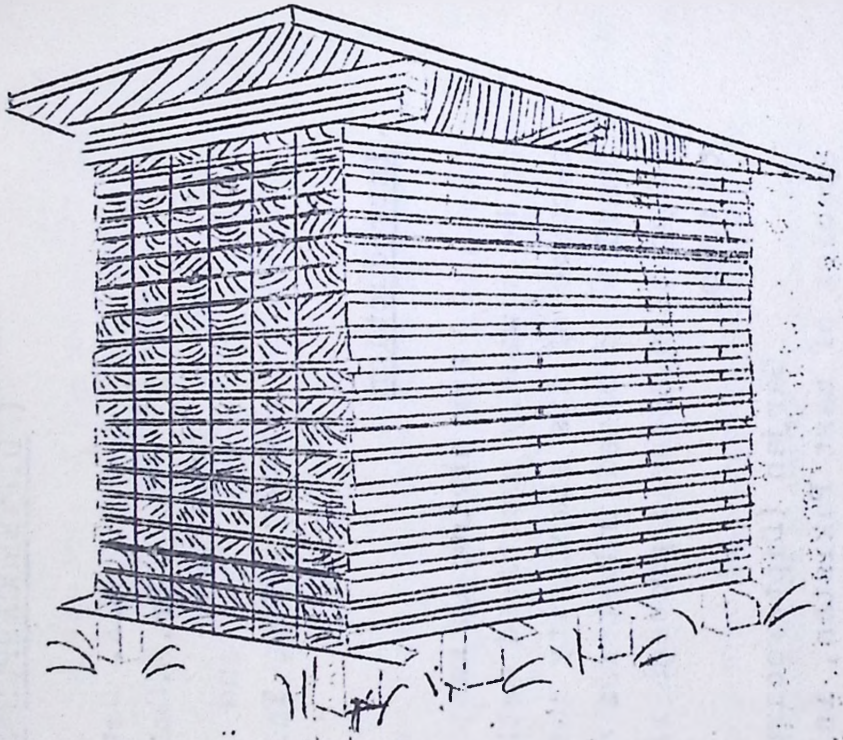

Fig. 1.

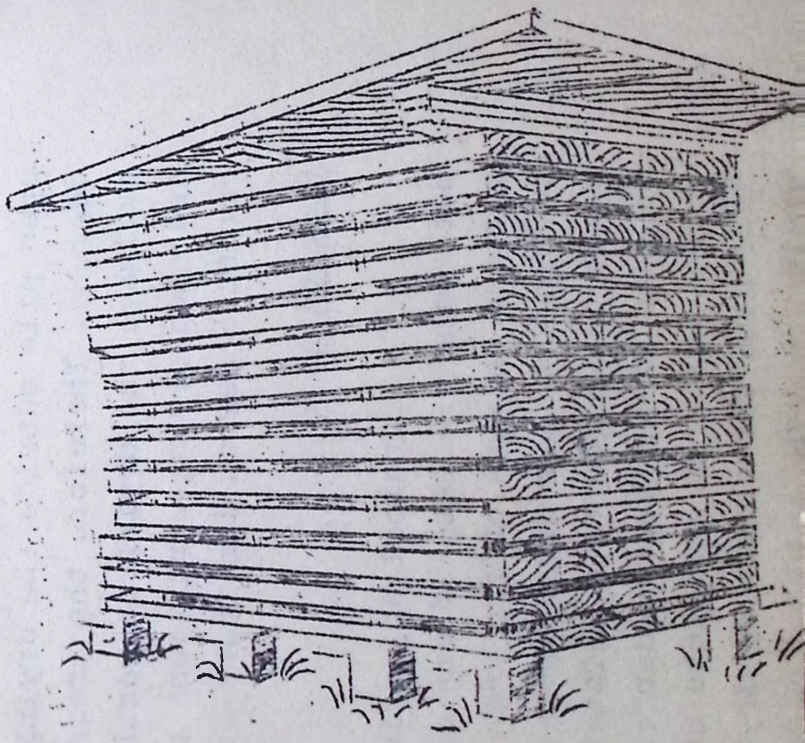

Fig. 2

Diagram of experimental piler of 1" and 2" lumber.

Experimental procedure :

Material : The experimental material consisted of freshly sawn Garjan lumber of 1" and 2" thicknesses procured from EPFIDC timber depot at Kalurghat, Chittagong. The lumber was 8" wide and 8' long. The total amount of lumber employed in the study were 570 cft. and 320 cft. for 2" and 1" thicknesses respectively.

Pile foundation : The foundation pillars were made of brick in two rows 3' apart and raised 12" above the ground level having the base dimension of 12" x 12". Four such foundation pillars placed equidistantly were used for each row in each pile. The top of the pillars was in a horizontal plane.Four creosote treated 4' long M.G. sleepers were used on the top of the pillars and across the width of the pile (Fig.1).

Lumber piles : Initially, three piles of 1" lumber were erected in the open air drying yard during the monthof May,1962 and three identical piles were erected in the air drying shed during June, 1962. Unit package method of piling was followed with the dimension of 4' width, 8' length and 3' height.Boards in each tier were close piled for 1" and open pile for 2" lumber. Three additional piles of 1" lumber each at three monthly intervals were added in both the open drying yard and the air drying shed.

During December,1963, one 2" lumber pile was erected in the open yard and another pile was built inside the shed. A second set of 2" pile was added to both inside and outside the drying shed after six months.

All the piles were stacked in the Forest Research Institute campus and were oriented in the East-West direction, i.e. across the available wind direction.The piles in the open yard were roofed with the preservative treated lumber nailed together. Slant roof was used (Figure 2).The spacings between the lateral and rear alleys were 3' and 4' respectively.

Stickers : 1" thick and 1½" wide kiln-dried Garjan stickers were used.Four stickers each 2' apart were used in between two tiers.

Samples : For 1" lumber, four full length moisture loss sample boards were selected from representative material and placed in sample pockets within the unit package to determine the drying rate. Two samples were placed at 6" above the bottom layer and 8" inside the edge of the pile. The other two samples were similarly placed 6" from the top and 8" inside the edge.

For 2" lumber, ten full length moisture loss samples were taken and put in the individual sample pockets in the pile. Two pockets were made on two consecutive layers 6" from the bottom layer and 16" inside the edge on both sides of the pile. Similar set of sample pockets were made 6" from the top and at the middle of the pile.

Each sample board in the pile was numbered and its exact position in the unit package was marked.

Experimental data :

Before placing the samples inside the pile, two 1" strips were cut from each sample board 6" from both ends. The individual sample board and the moisture sections were then weighed separately. The latter were oven dried to estimate the initial moisture content. After the weights were taken, the sample boards were placed in the respective pockets in the pile.

The weights of each sample were recorded after every 15 day interval. From these data, moisture content values and drying rates were computed. At the end of the study, the piles were dismantled and final weights of all the individual sample boards were taken. Three 1" strips, one from the centre and two from 2' from both ends of each board, were cut. The sections were oven dried for the determination of final average moisture content of the sample board.

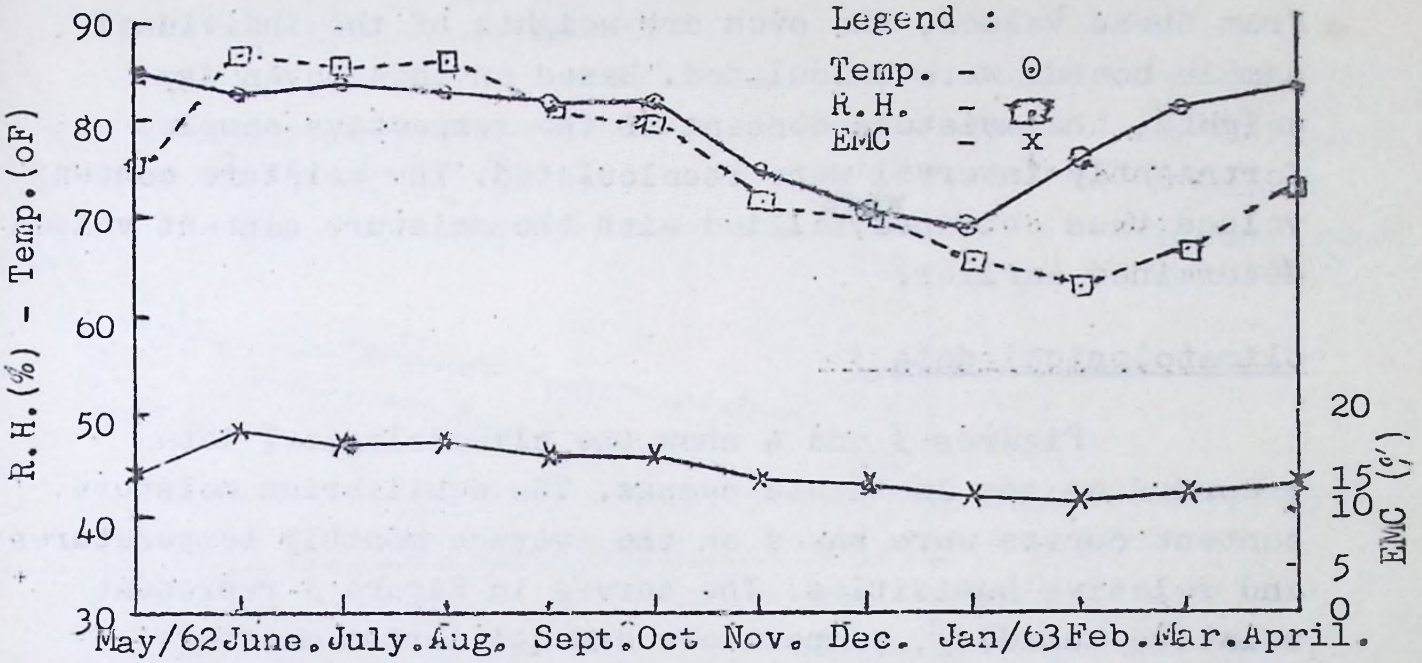

Fig. 3 - Climatological data recorded at F.R.I. campus , Chittagong, (1962/63).

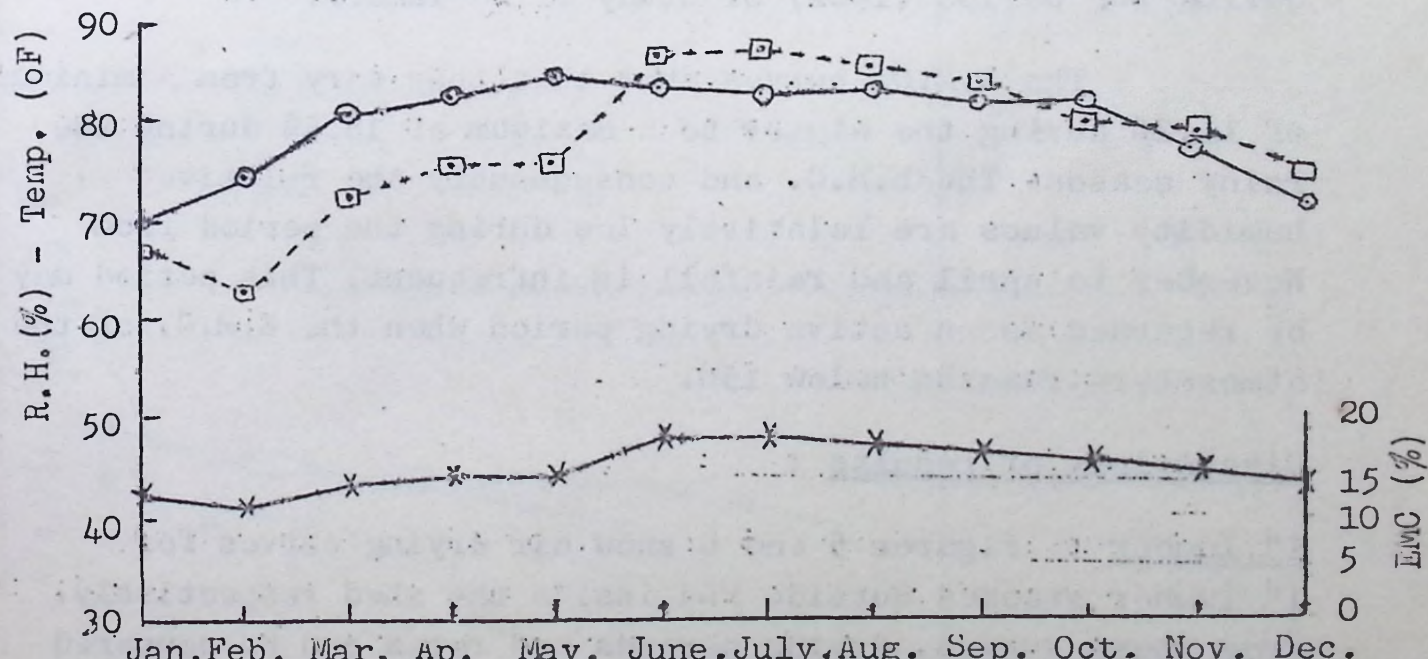

Fig. 4 - Climatological data recorded at F.R.I. campus, , Chittagong, (1964)

From these values, the oven dry weights of the individual sample boards were calculated. Based on these oven dry weights, the moisture content of the respective samples at fortnightly interval were recalculated. The moisture content values thus obtained were tallied with the moisture content values determined earlier.

Climatological data :

Figures 3 and 4 show the climatological data recorded at the Institute campus. The equilibrium moisture content curves were based on the average monthly temperatures and relative humidities. The curves in Figure 3 represent relative humidity, temperature and quilibrium moisture content from May, 1962 to April, 1963 i.e. during the period of study of 1" lumber . Figure 4 represents similar data during the period (1964) of study of 2" lumber.

The E.M.C. curves show that they vary from a minimum of 11.2% during the winter to a maximum of 18.5% during the rainy season. The E.M.C. and consequently the relative humidity values are relatively low during the period from November to April and rainfall is infrequent. This period may be regarded as an active drying period when the E.M.C. of the atmosphere remains below 15%.

Discussions of results :

1" lumber : Figures 5 and 6 show air drying curves for 1" lumber stacked outside and inside the shed respectively. From these curves, drying periods and rates can be compared for different piles erected during May-June, August, November and February. Tables 1 and 2 give the time required to dry from green condition to a moisture content of 15% and average drying rates per day for different periods of drying respectively.

Fig. 5 - Drying Curves for 1" Garjan(outside shed)

Legend:

May stack - .
Aug. " - ⊖
Nov. " - *
Feb. " - ⊗

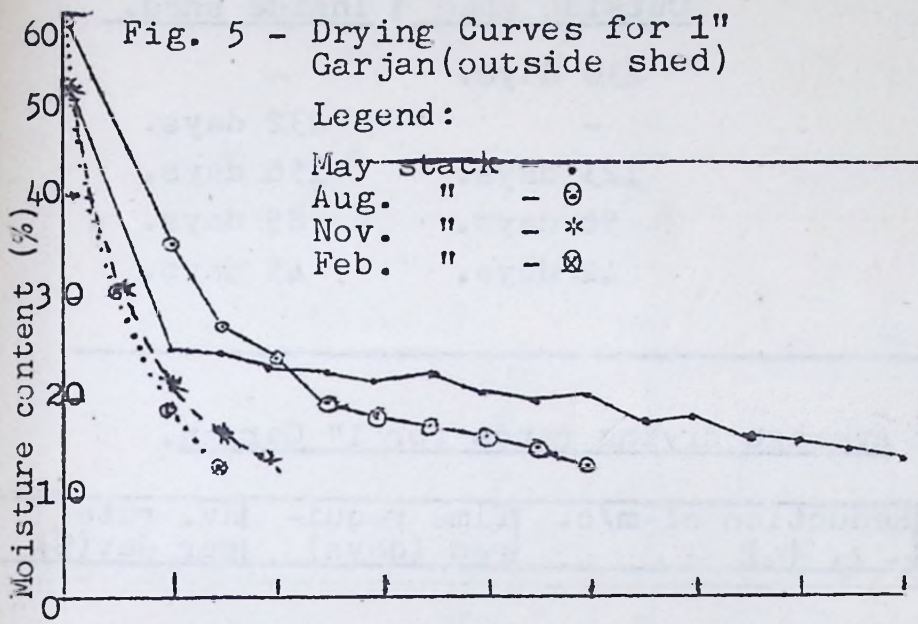

Fig.- 6- Drying curves for 1" Garjan (inside shed)

Legend :

June stack - .
Aug. " - ⊖
Nov. " - *
Feb. " - ⊗

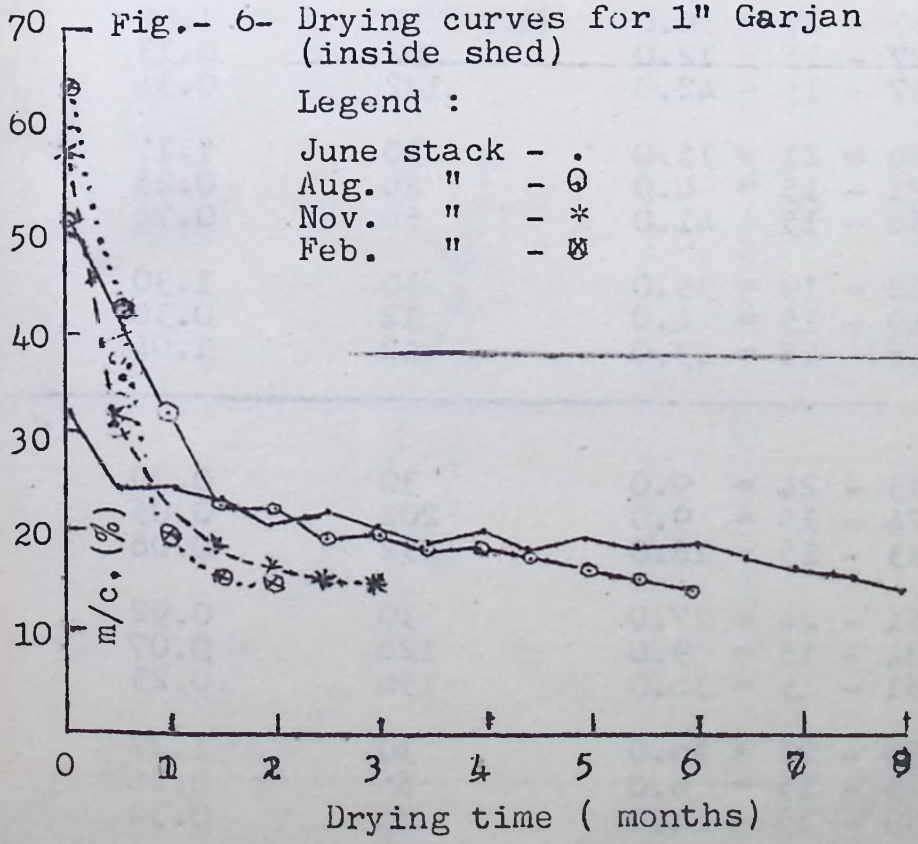

Fig.7 - Drying time to attain 15% m/c (1" Garjan)

Legend :

Inside shed *
Outside " -⊖

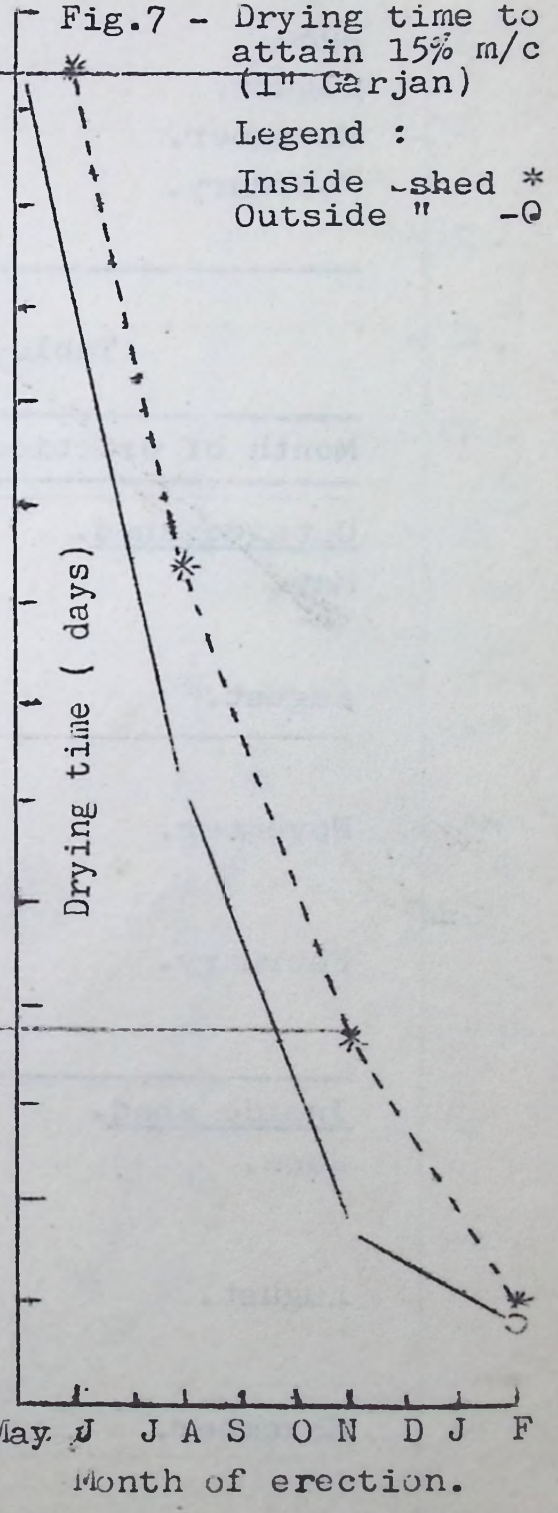

Table 1 : Time required to air dry 1" Garjan to a moisture content value of 15%

Month of erection.	Drying periods.	
	Outside shed	Inside shed.
May.	230 days.	-
June.	-	232 days.
August.	123 days.	156 days.
November.	56 days.	85 days.
February.	42 days.	45 days.

Table 2 : Average drying rates for 1" Garjan.

Month of erection.	Reduction of m/c. i.e. (%)	Time required (days)	Av. rate per day(%)
Outside shed.			
May.	52 - 25 = 27.0	30	0.90
	25 - 15 = 10.0	200	0.05
	52 - 15 = 37.0	230	0.16
August.	57 - 27 = 30.0	30	1.00
	27 - 15 = 12.0	92	0.13
	57 - 15 = 42.0	122	0.34
November.	56 = 21 = 35.0	30	1.17
	21 - 15 = 6.0	26	0.25
	56 - 15 = 41.0	56	0.74
February.	58 - 19 = 39.0	30	1.30
	19 - 15 = 4.0	12	0.36
	58 - 15 = 43.0	42	1.04
Inside shed.			
June.	33 - 24 = 9.0	30	0.29
	24 - 15 = 9.0	202	0.05
	33 - 15 = 18.0	232	0.08
August.	51 - 24 = 27.0	30	0.92
	24 - 15 = 9.0	126	0.07
	51 - 15 = 36.0	156	0.23
November.	59 - 23 = 36.0	30	1.22
	23 - 15 = 8.0	55	0.14
	59 - 15 = 44.0	85	0.52
February.	64 - 19 = 45.0	30	1.51
	19 - 15 = 4.0	15	0.30
	64 - 15 = 49.0	45	1.10

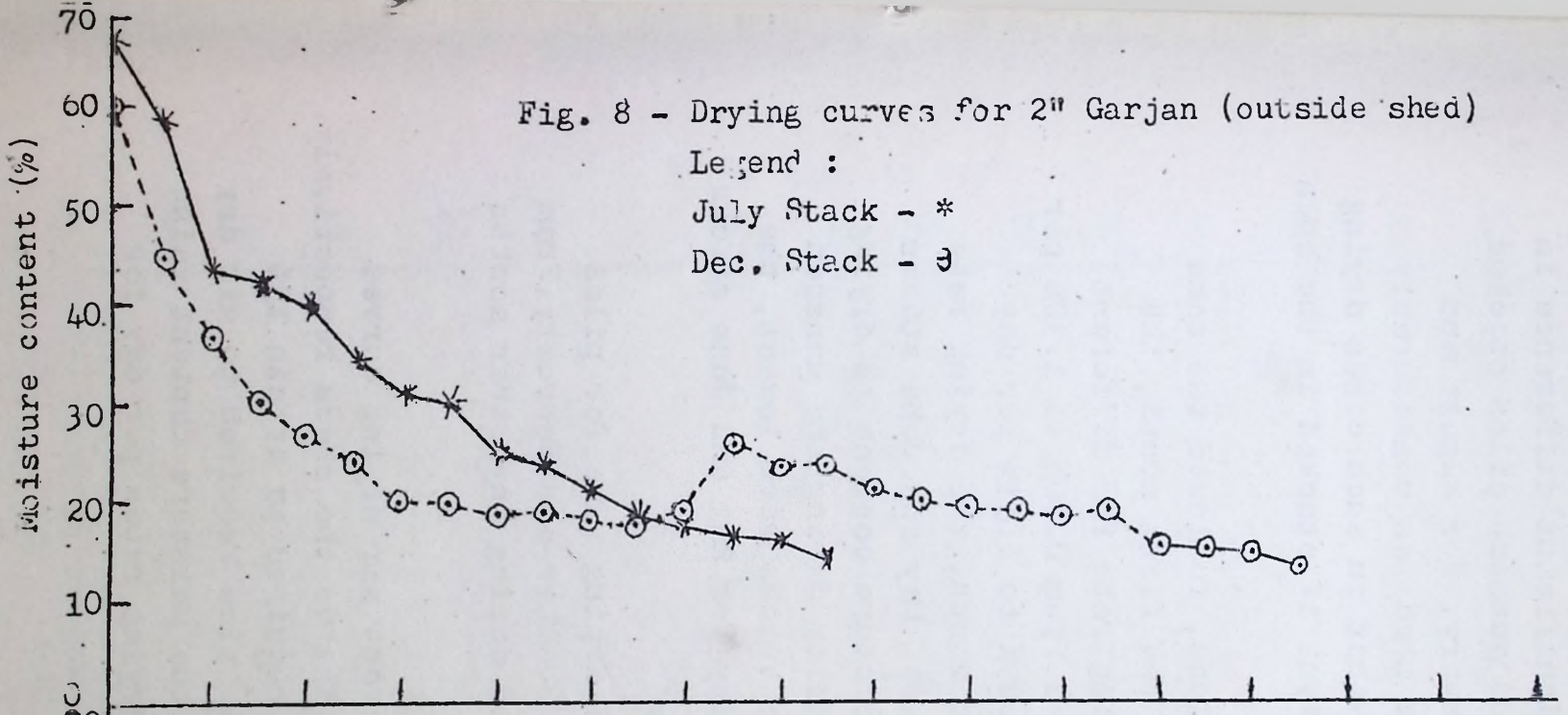

Fig. 8 - Drying curves for 2" Garjan (outside shed)

Legend :

July Stack - *

Dec. Stack - ∂

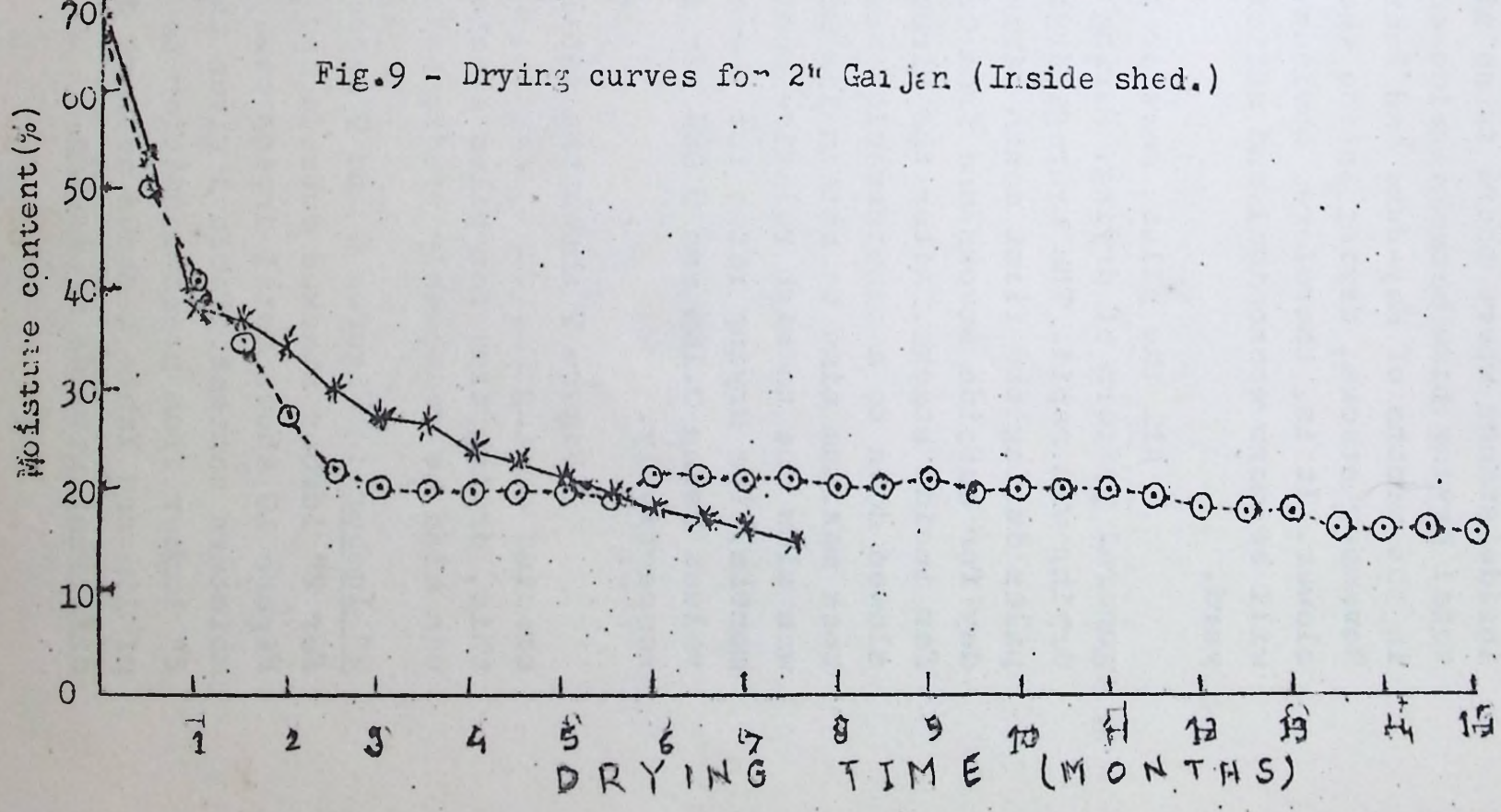

Fig.9 - Drying curves for 2" Garjan (Inside shed.)

The drying periods range from 42 to 230 days for inside stacks where there is no significant difference in total drying time between inside and outside piles stacked in the months of May-June and February. For August and November stacks, drying inside the shed was considerably slower. It is, therefore, obvious that in such cases drying will be more economical and efficient if stacked in the open yard.

All the piles, more or less, followed the same general pattern of drying. During the first month, the drying was rapid. The average drying rate for different piles during the first month varied from 0.90% to 1.30% per day for outside stacks and from 0.29% to 1.51% per day for inside stacks. After the first month, the drying rate slowed down to a considerable extent. May and June stacks took maximum time to attain 15% moisture content as drying was slow due to high relative humidity during the monsoon months. The drying rates for these stacks were lowest, the values being 0.16% and 0.08% per day for May and June stacks respectively.

Figure 7 shows the total drying time for piles erected during May-June, August, November and February. From this, drying time for piles erected during any other months can also be reasonably predicated.

2" lumber : Figures 8 and 9 represent air drying curves for 2" lumber stacked outside and inside the sheds respectively. Figure 10 shows total drying time required to attain 15% moisture content. Table 3 gives the time required to air dry 2" lumber from green condition to the moisture content value of 15% and Table 4 shows average drying rates per day for different periods of drying.

Fig.10 - Drying time to attain 15% m/c (2" Garjan).

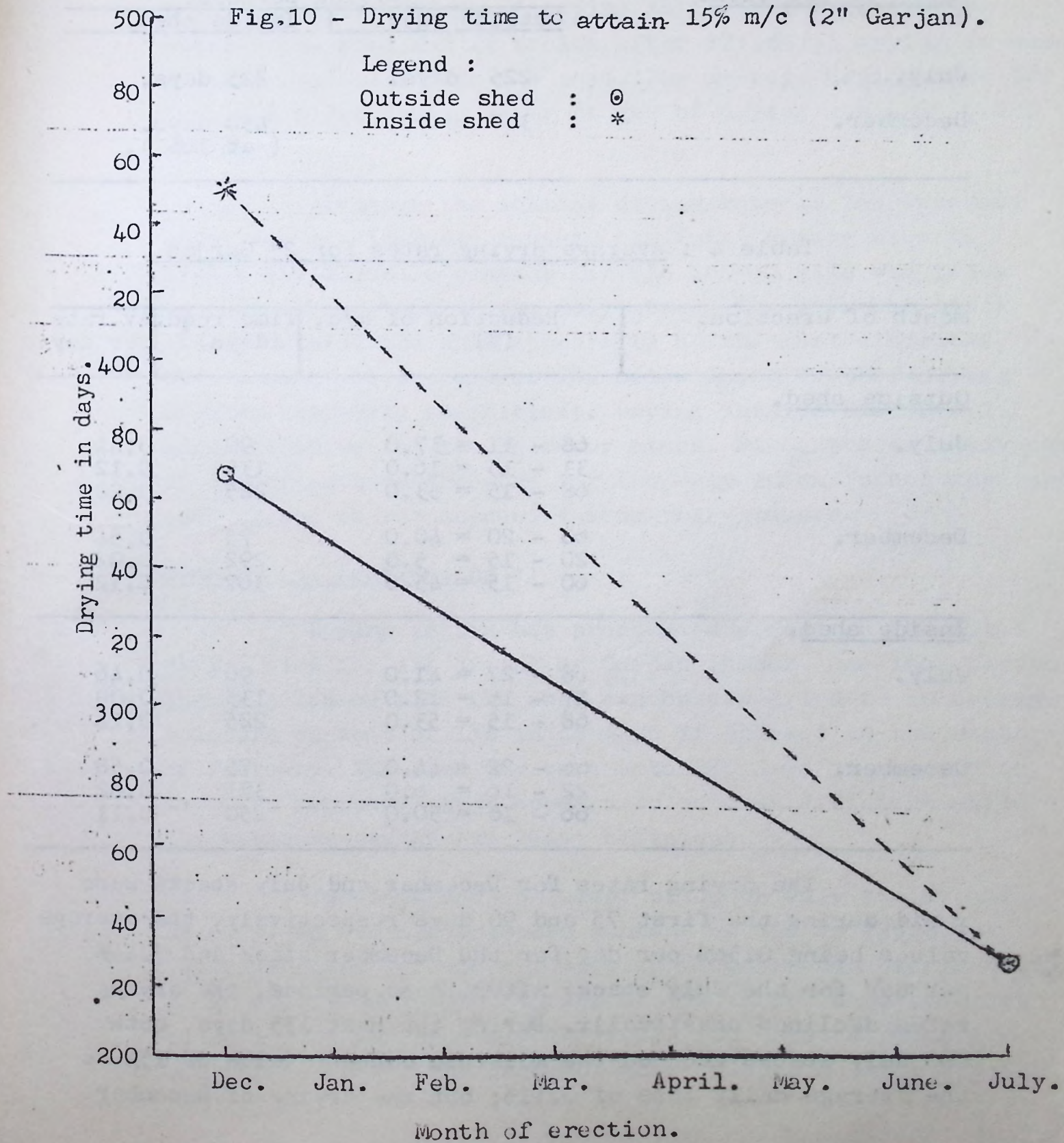

Table 3 : Time required to air dry 2" Garjan to a moisture content value of 15 and 16 percent.

Month of erection.	Drying periods.	
	Outside shed.	Inside shed.
July.	225 days.	225 days.
December.	367 days.	450 days. (at 16%).

Table 4 : Average drying rates for 2" Garjan.

Month of erection.	Reduction of m/c. (%)	Time reqd. (days)	Av.rate per day (%)
Outside shed.			
July.	68 - 31 = 37.0	90	0.41
	31 - 15 = 16.0	135	0.12
	68 - 15 = 53.0	225	0.22
December.	60 - 20 = 40.0	75	0.54
	20 - 15 = 5.0	292	0.02
	60 - 15 = 45.0	367	0.12
Inside shed.			
July.	68 - 27 = 41.0	90	0.46
	27 - 15 = 12.0	135	0.09
	68 - 15 = 53.0	225	0.24
December.	66 - 22 = 44.0	75	0.58
	22 - 16 = 6.0	375	0.02
	66 - 16 = 50.0	450	0.11

The drying rates for December and July stacks were rapid during the first 75 and 90 days respectively, the average values being 0.56% per day for the December stack and 0.44% per day for the July stack. After these periods, the drying rates declined drastically. During the next 135 days, both the July stacks reached the moisture content value of 15% at the average daily loss of 0.11%; but the drying of December

stacks after the first 75 days practically stopped for a period of about 7 months due to high relative humidity resulting from rainfall. The moisture content dropped from 20 to 15% after 292 days' drying in case of pile stacked outside the shed and 22 to 16% after 375 days' drying in case of pile stacked inside the shed. The average drying rate for both the piles during later stages of drying was only 0.02% per day.

Although the initial drying rate in the December stack was considerably faster, the total drying time to attain 15% moisture content for the inside pile was twice as compared to that of the July stack. The December stack placed outside the shed appears to be the most efficient upto a moisture content of 20% below which further drying becomes extremely inefficient. Drying outside the shed is more effective for the December stack. Since the effectiveness of drying outside the shed for the July stack is not apparent, shed drying is recommended during rainy season.

Summary and Conclusions :

Drying season has pronounced effect on the total drying time for air drying of Garjan lumber. One-inch Garjan lumber piled outside the shed can be air-dried to an average moisture content of 15% in 42 days if stacked in the month of February. The same may take upto 230 days if stacked in May. The February stack appears to be most efficient while the May-June stacks are least efficient.

Two-inch Garjan lumber piled in July can be air dried to an average moisture content of 15% in 225 days. The same piled outside the shed in December can be air dried to an average moisture content of 15% in 367 days and that piled inside the shed may take upto 450 days to reach 16% moisture content. The December stack placed outside appears

to be most efficient upto a moisture content of 20% below which further drying becomes uneconomical.

Drying outside the shed is more effective during winter. Shed drying is recommended during rainy season since the effectiveness of drying outside the shed is not apparent during this period.

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