Grade distribution and drying degrade of sweetgum and yellow-poplar structural lumber

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Abstract

The fact that the supply of southern pine timber is changing to include more lower quality plantation stock may provide incentive for utilizing lower density hardwoods for structural lumber. Yellow-poplar and sweetgum are potential substitutes for southern pine. A major problem in utilizing soft hardwoods for structural lumber is the difficulties associated with drying. A study of the grade distribution and drying degrade of yellow-poplar and sweetgum structural lumber was completed. The results indicate that grade distribution was much higher for yellow-poplar than for sweetgum, and grade loss after drying was lower for sweetgum. Proper drying is especially critical for reducing degrade of hardwoods.

Dwindling reserves of high quality pine sawlogs may result in shortages of machine stress rated (MSR) lumber in the future. Yellow-poplar and sweetgum are potential substitutes for pine for use as structural lumber. Both species have "clear wood" strength properties comparable to southern pine(6). Currently, stand inventories are abundant and growth is exceeding removals(7). Distribution of yellow-poplar and sweetgum stands is sufficient to furnish current mills with an adequate supply of wood at least to the year 2000 (7).

The use of yellow-poplar as dimension lumber has been investigated (1,4). Relatively little quantitative data are available on the use of sweetgum as structural lumber. The characteristics of interlocked grain, abundant knots, and high volumetric shrinkage would suggest that sweetgum may be difficult to utilize for structural lumber on a commercial basis. Sweetgum is listed as a moderately difficult species to dry (6).

This study was part of a comprehensive study (2) to investigate the utilization of sweetgum as structural lumber. An important aspect of its utilization is to determine expected grade distribution and degrade in the drying process. Approximately 23 thousand board feet (MBF) of sweetgum and yellow-poplar structural lumber (2 by 4, 2 by 8,12 ft. long) was manufactured at a mill in the North Carolina piedmont region. Grade distribution based on defects (knots, splits, slope of grain etc.) and warp (bow and crook) was evaluated from this lumber. After drying, all lumber was regraded for warp and splits.

Materials and procedures

Timber was selected from stands of mixed hardwoods and stands containing both mixed hardwoods and softwoods. The intent was to select trees in a similar fashion to most commercial harvesting operations. Logs were bucked to nominal 12-foot lengths in the woods and transported to a modern hardwood mill for processing.

Breakdown of the log is illustrated in Figure 1. A pith-centered cant (nominal 8 by 8 in.) was produced by the primary headrig (bandsaw). The cant was reduced by double arbor resaw into four 2 by 8's. Two 2 by 4's were produced by ripping a 2 by 8 on a linebar resaw. Sideboards were retained for higher grade furniture lumber and were not included in the tally. Again the intent was to process the logs in a manner similar to a pine dimension mill.

The hardwood lumber was graded for defects and warp by a certified lumber grader. These grades were independent of one another. The defect grade accounted for knots, splits, and slope of grain, which affect strength properties. The warp grade accounted for bow, cupping, and crook, which affect its utilization for structural lumber. Lumber was graded according to pine grading rules (5) to determine their applicability to hardwood structural lumber and reference grade distribution to southern pine.

The sweetgum and yellow-poplar lumber was dried in a steam-heated kiln according to a nominal 8/4 redgum

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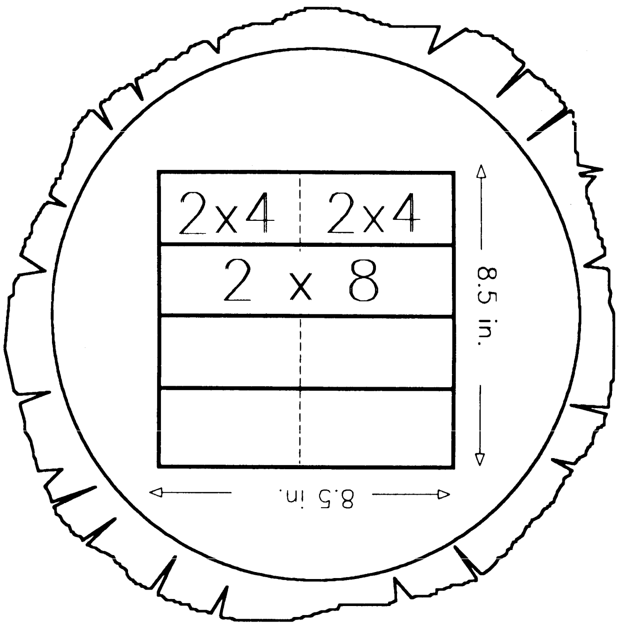

Figure 1. — Diagram of log and cant breakdown for producing sweetgum and yellow-poplar lumber.

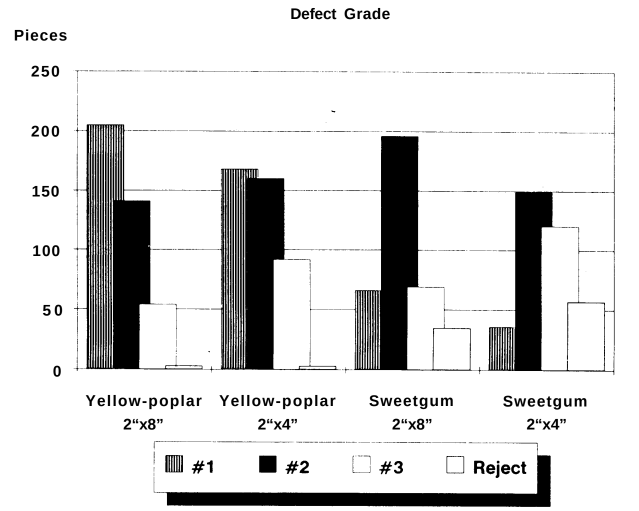

Figure 2. — Distribution of defect grade for sweetgum and yellow-poplar structural lumber.

TABLE 1. – *Raw tally of sweetgum and yellow-poplar dimension lumber grades (southern pine rules).*

Species	Dimension	No. 1	No. 2	No. 3	Reject	Totals[a]
Defect grade						
Yellow-poplar	2 by 8	205	141	54	3	403
	2 by 4	168	160	92	3	423
Sweetgum	2 by 8	66	196	69	35	366
	2 by 4	36	149	120	57	362
Totals		475	646	335	98	1,554
Warp grade (green)						
Yellow-poplar	2 by 8	404	3	0	0	407
	2 by 4	294	115	14	0	423
Sweetgum	2 by 8	364	25	0	0	389
	2 by 4	221	110	27	3	361
Totals		1,283	253	41	3	1,580
Warp grade (dried and planed)						
Yellow-poplar	2 by 8	186	19	11	177	393
	2 by 4	265	109	39	20	433
Sweetgum	2 by 8	265	105	17	4	391
	2 by 4	185	130	37	12	364
Totals		901	363	104	213	1.581

[a]Totals for grade tally show some discrepancy due to some error in the grade marking and tally procedures that were carried out during lumber manufacturing.

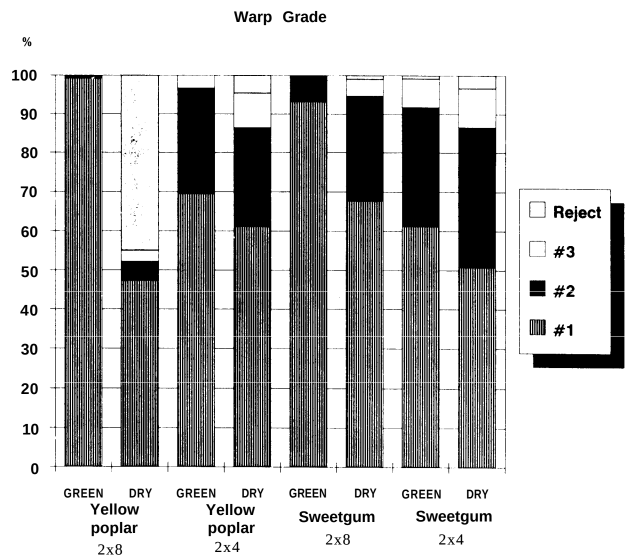

Figure 3. — Cumulative distributions for green and dry warp grades of sweetgum and yellow-poplar lumber.

(trade name for sweetgum heartwood) schedule (3). Targeted final moisture content (MC) was 12 to 15 percent. All lumber was dressed to nominal dimensions and re-graded for warp and splits. Dressed lumber was marked with defect grade and pre-dry and post-dry warp grades, for a total of three grade marks. A tally of each grade mark was made.

Results and discussion

Processing of sweetgum and yellow-poplar lumber was carried out as planned, except for some problems in the drying schedule. Errors in calculation of initial MC led to a lower than expected final MC of 6 to 11 percent. The yellow-poplar averaged around 6.5 percent, while the sweetgum averaged 10.5 percent final MC. The yellow-poplar dried more rapidly, resulting in the lower MC. The schedule required 6 weeks to complete due to intermittent loss of steam and the errors in estimating the initial MC. However, at no time during the schedule was the lumber subjected to temperatures higher than the schedule called for. Due to scheduling problems, neither equalizing nor conditioning steps were employed at the end of the schedule. Some collapse was evident in the sweetgum lumber. Cupping was evident in the 2 by 8's.

Raw tally data for grades based on defects and warp are summarized in Table 1. Grade yield based on defects according to pine grading rules was lower for sweetgum than yellow-poplar as illustrated in Figure 2. The lower grade yield can be attributed in part to the slope of grain

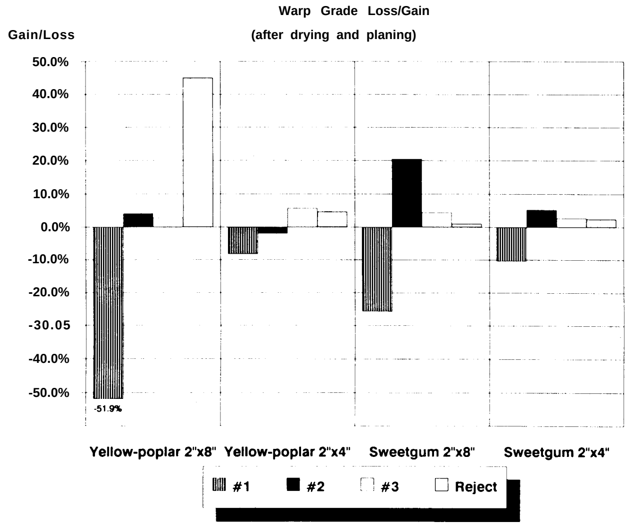

Figure 4. — Loss/gain of warp grade due to drying and planing.

of sweetgum. The certified lumber grader frequently downgraded sweetgum because of sloping grain. The 2 by 4's yielded slightly lower defect grade for yellow-poplar and sweetgum.

Grade yield based on warp for green and dried lumber is presented in Figure 3. Figure 3 represents the cumulative distribution of green and dry warp grades in a stacked-bar chart. Comparison of green warp grades shows that yellow-poplar yields are slightly higher than sweetgum and 2 by 8 yields are noticeably higher than 2 by 4's overall. The nature of the cant breakdown favored the 2 by 8's in terms of warp grade. Generally, the 2 by 8's were pith-centered, which balanced the growth stresses when 2 by 8's were cut from the cant. The growth stresses were unbalanced in the 2 by 4's because they were almost never pith-centered. Undoubtedly, the presence of interlocked grain in sweetgum contributed to the slightly lower yield in green warp grade overall.

The cost for improper drying of hardwood lumber is clearly evident in the warp grade tally for dried and planed lumber. Figure 4 illustrates the percentage loss or gain from each grade due to drying. Degrade of dry No. 1 yellow-poplar 2 by 8's was almost 52 percent. The majority of this degrade was mostly to reject, due to splitting around the pith. A large portion of the 2 by 8 lumber was pith-centered due to the nature of the cant breakdown. Cupping was evident in the 2 by 8's due to the lower final MC and pith (juvenile) wood centered in the boards. When the lumber was planed, the feed rolls forced the boards flat, causing the yellow-poplar 2 by 8's to split through the weaker pith wood. The sweetgum was apparently able to withstand the stresses of planing without splitting. Possibly the presence of interlocked grain in sweetgum helped to resist the pressures of the planer feed rolls. Proper drying practices would have reduced the magnitude of this loss.

Drying degrade of 2 by 4's is generally lower than 2 by 8's. Sweetgum 2 by 8 No. 1 showed a loss of 25 percent, mostly to No. 2 grade. Comparing degrade of yellow-poplar 2 by 4's with sweetgum 2 by 4's shows very little difference. The yellow-poplar lumber tended to degrade more than one grade level, which is probably a result of the higher occurrence of end splits.

Conclusion

The grade distribution for sweetgum was significantly lower than for yellow-poplar. The lower grade distribution is more a result of sweetgum's less desirable appearance than of its relative structural strength (2). It is probable that sweetgum structural lumber would have to be marketed for concealed applications in order to gain consumer acceptance.

Proper drying is critical for reducing excessive downgrading of sweetgum and yellow-poplar structural lumber. It is apparent that yellow-poplar and sweetgum cannot be mixed in the same drying schedule. The results of this study represent more of a worst case of drying loss for yellow-poplar due to problems in the drying schedule.

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