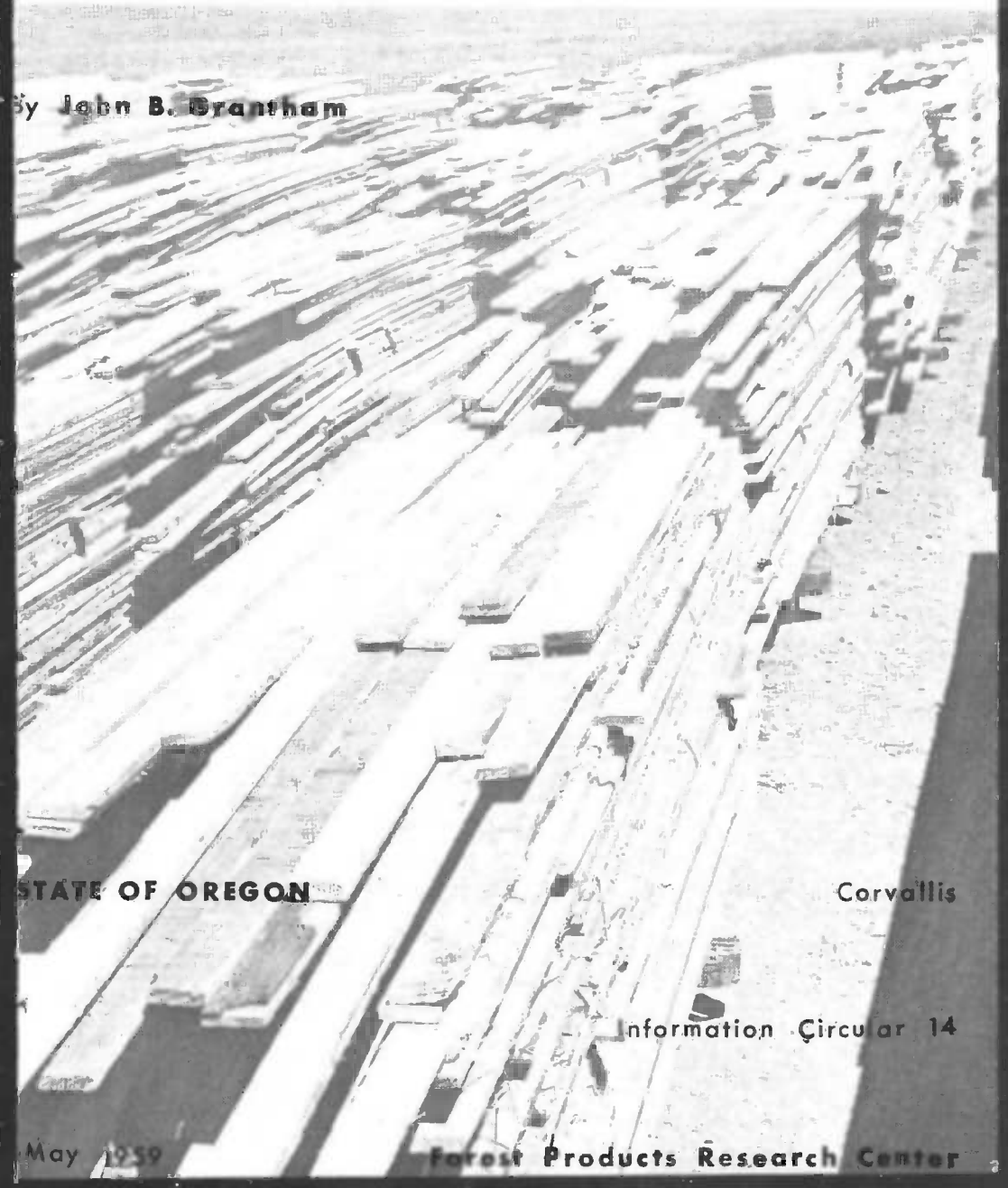
Procedures

to study

LUMBER RECOVERY



By John B. Grantham

STATE OF OREGON

Corvallis

Information Circular 14

May 1959

Forest Products Research Center

Forest Products Research Center

. . . Its Purpose

Fully utilize the resource by:

- developing more by-products from mill and logging residues to use the material burned or left in the woods.
- expanding markets for forest products through advanced treatments, improved drying, and new designs.
- directing the prospective user's attention to available wood and bark supplies, and to species as yet not fully utilized.
- creating new jobs and additional dollar returns by suggesting an increased variety of saleable products. New products and growing values can offset rising costs.

Further the interests of forestry and forest products industries within the State.

. . . Its Program

- Accelerated air drying of lumber with fans, to lower shipping costs.
- Kiln schedules for thick Douglas fir lumber, to speed drying.
- Bevel siding from common lumber, to increase sales.
- End gluing of dimension lumber, to utilize shorts.
- Effect of spacing and end distance on strength of bolted joints.
- Production and bleaching of high-yield pulps from Douglas fir mill residues.
- Strength of wood and wood structures.
- Douglas fir wood and bark lignin and bark extractives for full recovery.
- Ammoniated wood and bark as improved soil amendments.
- Service tests of treated and untreated wood products.
- Floor tile from wood and bark residues.

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SEGREGATION OF LOGS of one species by grade and diameter class yields the most information for time invested in a study of lumber recovery.

PROCEDURES TO STUDY LUMBER RECOVERY

by

John B. Grantham

INTRODUCTION

Studies of lumber-grade recovery from carefully selected samples of logs can provide the basis for important management decisions concerning timber purchases or changes in milling practice. To encourage such valuable studies by lumber manufacturers, the Forest Products Research Center has prepared this guide to mill-study procedures. Since an effective study of lumber-grade recovery requires considerable time to plan, conduct and analyze, this guide should prove useful. Contributions of other agencies, notably the Pacific Northwest Forest and Range Experiment Station, and individuals who have shared mill-study experiences are acknowledged gratefully.

Procedures described herein mainly are those involved in determining yields of unseasoned or dry lumber from batches of logs. Complicated procedures required to conduct a study by individual logs are mentioned, but not described.

Purposes of Lumber-Grade-Recovery Studies

The general purpose of a study of lumber-grade recovery is to determine value of lumber yield from selected logs--the logs being representative of:

One species,
A given quality or size, or
A particular area.

Lumber-recovery studies for a species are the broadest in scope, usually requiring sampling from several areas to establish average recovery values. Because of their broad extent, these studies usually are left to some public agency such as a federal forest experiment station.

Logs of a given quality or size usually are studied to determine value of their lumber yield:

In relation to the cost of producing such lumber, or
In relation to the value of the logs for some product other than lumber, such as plywood or pulp.

Studies of this type are the particular interest of individual mills. Rough logs, defective logs, or small logs may be the subject of study to determine the margin of profit or loss.

Logs representing a particular area are studied to check value of their lumber yield against anticipated cost of such lumber, or against lumber value of logs from other areas. Studies of this third type have major interest to a particular mill, although at times both sawmill operator and timber owner may be concerned, if value of a given lot of timber is in question.

The purposes of a lumber-recovery study should be set forth clearly as the first step in planning. Failure to consider at the start each objective of the study may prevent obtaining all information desired. Conversely, the study procedure may be simplified, if only limited information is needed. For example, if only total lumber recovery from a given grade of log is desired, study procedure is much simpler than if lumber recoveries from several grades or diameter classes are needed.

Choosing the Mill-Study Method

Since sawmill operators are interested primarily in lumber yield from particular types or classes of logs rather than that from individual logs, study methods can be simplified by sawing logs in batches or groups. Batch-study procedure involves the following steps:

1. The mill is cleared of nonstudy logs and lumber in those areas where the study is to be made.
2. A study batch is processed through the mill.
3. All study lumber in the batch is cleared before succeeding batches or nonstudy logs are sawed.

Note: When batches are small, the lumber from each batch may be identified by marking, and successive batches can be sawed continuously.

A batch of study logs may be:

- o Woods-run sample representing all grades and sizes of one species. A woods-run study is the simplest to conduct, but as much, or more, care is required to collect the log sample and results are less useful than by other methods. Unless care is taken to ensure the sample includes a representative portion of each log grade and diameter class, results may be misleading.

- o Log-grade sample representing one grade of some species, but including all sizes. Because lumber values from a log grade are influenced by log diameters included in the sample, it is important to include a representative range of diameters.

- o Log grade and diameter class representing one grade and one diameter class of one species. Batches selected to show lumber recovery by log grade and diameter class enable mill management to estimate value of any timber stand that has been cruised accurately. This moderately detailed study procedure provides management with relative values to its mill of various log sizes as well as grades. All things considered, this type of study yields the most information for the time invested. For sake of brevity, this procedure will be referred to as a log class method of study.

- o Individual logs to provide lumber yield and value of each log studied. This degree of refinement is seldom necessary. The method requires several additional men to keep lumber separated, calls for added computations, and increases the chance of error. It is recommended only for comprehensive studies.

Conceivably, a company might desire to saw individual batches of study logs at odd times rather than consecutively. Experience indicates, however, that once study logs are ready to saw, they should be sawed continuously while the crew is alerted to the job at hand. An almost mandatory arrangement is that all study logs be sawed at one time if dry-surfaced-lumber recovery is desired, because intermittent sawing of study logs greatly increases chances of loss or confusion of study lumber during seasoning and machining.

Bases for Recovery Values

Lumber recovery may be based on the yield in unseasoned grades or on the yield of dry-surfaced grades. The latter is difficult to obtain, but more informative. A compromise method, sometimes employed, is to base recovery studies on yield of unseasoned lumber and correct to a dry-surfaced basis by established factors. Correction of unseasoned values to dry values, however, should be based on the mill's own experience in seasoning and machining comparable lumber. Correction fac-

tors are best established by carrying some studies through to dry-surfaced recovery, or by conducting studies on dry-surfaced-grade recovery from carefully graded, rough, unseasoned lumber.*

Changes in grade and value of dry-surfaced lumber, as compared with unseasoned stock from which it originated, result from three influences, namely:

1. Reduction in grade and losses due to development of seasoning defects,
2. Degrade and losses caused by manufacturing and machining operations, and
3. Errors in original grading of rough-green stock because of difficulty in seeing such characteristics as shake, broken grain, decay, and stain, or changes in knot size as they appear on surfaced stock.

The third element is influenced by the rate at which grading is done, or the pressure under which the grader is working. If, for example, rough-unseasoned study lumber is moved to the yard for careful grading, the grader is under no pressure, and errors in grading will be fewer than when grading is done on the chain. An important proviso, therefore, is that in applying previously obtained data on fall-down or value change, the grade recovery of unseasoned lumber be obtained in the same manner in both previous and current studies.

Lumber-recovery values may be calculated by use of: the mill's current price list, the mill's average sales realization over a period of six months, or the industry average selling price, as reported by the appropriate association. Whichever system of pricing is chosen, the prices used for calculation should be shown, so that lumber-recovery values may be adjusted in the future. Adjustments often are made by determining the percentage change in price of important grades and then making an average percentage adjustment in value of each log grade or class.

* A detailed example of determining degrade developed in drying and machining 4/4 pine heart common is included in the article, "Locating and Reducing Degrade in the Mill" by John P. Krier. Proceedings of Northwest Wood Products Clinic. Missoula, Montana. 1956.

MECHANICS OF STUDYING LUMBER-GRADE RECOVERY

Activities during a mill study have to do with choosing logs, accounting for lumber sawed, and compiling data on milling and lumber recovery. Each category is described here more or less in chronological sequence.

Selecting and Grading Logs

Selecting logs for study

Selection of the log sample is the key to a worthwhile mill study. The log sample should be adequate to satisfy all objectives, since considerable expense is incurred in making any study. At times, several weeks may be needed to accumulate the required sample, particularly to provide enough logs in certain types or sizes not sawed commonly. Less time is required to accumulate a so-called woods-run sample, but those concerned with this type of study should be sure the selected batch of logs is truly representative of the timber in question.

When a study is by log grade and diameter class, the log sample should include an adequate number of each grade and size. Ideally, the sample should include a minimum of 10 logs in each grade and diameter class. On the other hand, there is little need to include more than 20 logs in one category, as inclusion of more than 20 usually will give needless refinement.

The diameter classes chosen will depend upon the purpose of the study. For instance, in a study of small logs to determine marginal log size for a mill, segregation of logs by 1- or 2-inch diameter classes may be in order.

As a general rule, however, enough expedience and accuracy will be gained by separating logs into diameter classes with a range of 3-6 inches, thus permitting the sample to include a full range of log sizes without requiring a tremendously large study. Limits and midpoints of diameter classes may be adjusted to fit the timber under consideration and to facilitate plotting the data, but should be decided during the planning stage. The following classes are examples:

Log-diameter Classes.

Six-inch range		Three-inch range	
Limits	Midpoint	Limits	Midpoint
Inches	Inches	Inches	Inches
6-11	8 1/2	6-8	7
12-17	14 1/2	9-11	10
18-23	20 1/2	12-14	13
24-29	26 1/2	15-17	16
30-35	32 1/2	18-20	19
36-41	38 1/2	21-23	22
42-47	44 1/2	24-26	25
		27-29	28
		30-32	31

Grading and describing logs

To ensure lasting value from results of a mill study, the logs selected for study should be graded carefully. Qualified graders, representing both buyer and seller, should grade the study logs whenever timber values are the subject of question. Explanatory notes on log quality should be added to the scale book for reference in event logs show any lumber-recovery values either higher or lower than those anticipated. Studies made to establish or check recovery values for a species usually require that surface characteristics of each log be diagramed for reference.

If defective logs, as well as sound logs, are included in a study, an experienced scaler should make the deductions for defect. In any event, inclusion of defective logs complicates obtaining accurate grade-recovery data. Depending upon major objectives of a study, the sample may well be confined to sound logs.

Log grading in standing trees

In some instances, decision may be to select and grade logs in standing timber or to apply an over-all grade to the tree.

If logs are graded in the standing tree, the logs should almost mandatorily be regraded at the mill. Inaccuracies in estimating log grade or defect in standing timber will affect comparative lumber-grade recovery and greatly complicate the problem of determining log-grade values. Lumber-yield values, therefore, should best be based on log grades determined on the ground or at the mill. Comparisons between

log grades estimated in standing timber and those established on the ground can be made independently and as often as desired. Such comparisons do not require a mill study, once the values of log grades (determined on the ground or deck) have been established.

If, on the other hand, the desire is to establish or check over-all tree grades based on external characteristics of the tree as a whole, a mill study can be made as though each tree were an individual log or log class. Experience in studying tree grades is limited largely to ponderosa pine and eastern hardwoods. Consequently, the complications that may arise in analyzing comparative lumber values from whole trees are difficult to predict.

Identifying Logs and Lumber During a Study

Logs at time of selection

Since, as pointed out earlier, several days or weeks may be required to assemble logs desired for a given study, identifying marks should be permanently visible. Paint sticks, such as those made by the Markel Company of Chicago 12, Illinois, and distributed by many hardware or mill supply firms, provide a convenient means of identification. If logs are scaled or graded before the date of sawing, such details as log number, diameter, length, and grade can be marked on the log end. The marks will remain visible even if the logs are in water for a considerable time.

Logs at time of sawing

When actual sawing is to begin, the selected logs are moved to mill slip or deck as one group for a woods-run study, or by log grade and diameter class if lumber yield is to be determined by log class.

If strictly a woods-run study, one must only be sure that all study logs (but no others) are sawed during the study period and that all pertinent log data such as size, scale, and grade have been recorded prior to sawing.

If the study is to be made by log class, each log of a given grade, or grade and diameter class, must be sawed with others in its class. Any class may be sawed first, so long as the order of sawing each class is recorded. For example, grade 2 logs from 30- to 35-inch diameter might be the first group sawed. This group might be followed by grade 3 logs from 18- to 23-inch diameter, for example. Each time sawing a new log class begins, the ends of the first log should be marked distinct-

ly. If a heavy daub of color is applied, this same identifying color may serve to mark lumber from this log class. As with any system of study, all log data should be recorded before sawing.

Unseasoned lumber

When a mill study is made by log classes, little lumber marking is needed. Lumber must be marked only at the beginning and end of sawing a given log class. If mill layout is simple, a distinguishing mark on the first and last piece of lumber cut from a log class will enable the tallyman on the green chain to make the separation in lumber yield. If, however, the mill is equipped with resawing equipment, one may be compelled to mark all lumber from the first and last log in a given class--to avoid mixing pieces from the last log of one class with pieces from the first log of the next class being sawed. An alternative system of making a study by log classes is to delay sawing one log class until all lumber from the preceding class has cleared the mill.

If the study is designed to determine lumber yield on a dry-surfaced basis, the green-chain grade should be marked plainly on each piece as it is graded. Identifying grade marks can be those normally used on the green chain, or a system of lines, checks, and other marks developed for the study. These marks need not be in different colors to distinguish between log classes, since all study lumber can be handled as one lot once the tally by log class is made on unseasoned lumber.

Seasoned lumber

Rough-dry lumber requires re-sorting based on unseasoned grade prior to planing, but little additional marking is required. All that is necessary is that the loads of study lumber be identified clearly to prevent loss or mixing with nonstudy lumber.

Loads of study lumber should be marked clearly on the ends to insure against loss or confusion, even though inclusion of a small amount of nonstudy lumber, or loss of a small amount of study lumber, will not affect accuracy of results--if the green-chain tally is accurate. If a tally of unseasoned lumber is not made, as in some woods-run studies, inclusion of nonstudy lumber or loss of some study lumber will affect the final lumber yield. As there may be difficulty in avoiding some chance mixing during the several handlings required in seasoning and machining, the worth of an unseasoned-lumber tally is evident.

Sawing time

Headsawing time is a useful index of production cost, since usually the headsaw determines the production rate of a mill. If a study is designed to find which logs are marginal for lumber production, such an index of milling cost is essential. In other mill studies, a record of sawing time may be desirable, although not necessary.

One man can measure and record sawing time for each log class. A stop watch facilitates timing, but is not necessary, for all that is needed is the time taken to saw a given log class (from time of loading the first log in a class until the carriage is ready to receive the first log of the next succeeding class), less any delay time (such as occasioned by a saw change or plugging of rolls). Thus, sawing the first log class may have begun at 8:00 A.M. and ended at 8:46 A.M., less 1 minute and 30 seconds lost for a slab caught in the rolls. Operating time for this log class would be 44.5 minutes. This figure, divided by the lumber yield for the log class, gives sawing time in minutes for each thousand board feet.

Lumber grade and tally (unseasoned)

The rough-unseasoned lumber tally, which provides a record of grade and size of each piece of lumber from each batch of study logs, is the basis for all computations and analysis. Vitally important, therefore, is accuracy of the tally. Normally, one experienced grader and one tallyman can grade and tally the lumber yield from each log class or batch. Where the mill has a large output and variety of products, an additional man may be needed. For example, if stock occasionally piles up on the green chain, an extra man can assist the grader in separating and turning stock and can help the tallyman obtain an accurate record.

When a mill cuts timbers from study logs, the log class from which each timber was cut must be marked. The timbers can be graded and tallied at another time, if thus marked. An alternative plan is to have one man tally timbers by log class at the timber cutoff saw--assuming timbers are cut to order, and their grade can be recognized by the trimmer operator or tallyman.

In studies where a large volume of logs are sawed, there may be advantage in grading and tallying lumber in the yard or elsewhere after it is pulled from the green chain. This procedure allows the grader to consider ripping and trimming that normally would be done if the lumber were sold unseasoned, thus giving a more accurate picture of rough, unseasoned lumber yield. If lumber is to be graded away from the chain,

each piece must be given an identifying mark to indicate its log class before it is pulled from the chain.

If necessary ripping, trimming, and resawing are done during course of the study, care should be taken that all reworked lumber is returned to the chain for grading and tallying in its proper log class. A short wait between sawing each lot class is the simplest way to handle this situation. Adequate color marking, however, of stock to be reworked will enable the tallyman to record it on the proper tally sheet for each log class when it finally reaches him.

The green-chain grade must be marked on each piece if the study is to be carried through to dry-surfaced recovery.

Special tally forms, prepared in advance, will aid in tallying the large volume of lumber that may be produced from one log class or batch. The form can best be prepared with advice of the grader, keeping in mind sizes and grades most likely to be produced. The tally form usually represents a compromise between one that will show detailed separation by grade, size, and length (to aid in summarizing data) and one practical to use on the green chain.

If, for example, the plan is to cut principally 2-inch dimension lumber, a tally form may be made up somewhat as follows:

1. Provide a large space for each grade, width and length of 2-inch dimension. Tallyman can record each piece as a dot in the appropriate box.

2. Provide a space for each grade and size to be produced in small quantity (such as B & Btr 1 by 3, 1 by 4, 1 by 6). Tallyman can record lineal feet of each piece in the appropriate box.

3. Provide a space for each grade and thickness of shop, or random-width selects. Tallyman can record thickness and surface feet of each piece in the appropriate box.

4. Leave space for tallyman to record items seldom cut, or overlooked when form was made up. Tallyman can record these by writing them in.

Collecting and Recording Dry-Lumber Recovery

One experienced grader and one tallyman can grade and tally surfaced-dry lumber if all stock is run on one machine. A special tally form designed to show...

Table 1. Tally Form Showing On-grade and Off-grade Dry-surfaced Lumber, by Cause.

Mill X Lumber Co. Date July 1, 1958

Species Douglas fir Item 2 x 8 Grade Standard

On-grade--full length

Length
16'
14'
12'

Off grade

Length	Grade	Trim	Defect	Cause*
16'	Const			
16	Stan	4'	shake	G
14	Util		knot hole	SM
16	Econ		shake	G
16	Econ		rot	G
14	Econ		warp	S
16	Econ		planer split	SM
14	Stan	2'	broken end - handling	M
16	Util		season check	S
16	Util		oversize knot	G
14	Stan	2'	endsplit	S
16	Econ		narrow	M

Rough vol. (Total recovered fbm + trim loss)_____

* Cause of change in grade, or of trim to maintain grade: G, misgrade; S, seasoning; SM, seasoning-machining; M, manufacturing.

rough-unseasoned grade fed to the machine,
footages of the several grades produced,
footage lost (or cull) in any given piece, and
reason for degrade or loss in any piece,

will aid in obtaining an accurate tally and will simplify the task of summarizing results of the study. Table 1 is an example of such a form.*

* Prepared by A. C. Knauss of the Pacific Northwest Forest and Range Experiment Station, on the basis of his long experience.

Table 2. Grade Recovery of Rough-Unseasoned Lumber by Log Class.

Diam class	No. logs	Gross scale	Net scale	Defect	Rough-unseasoned-lumber recovery											
					B & Btr		C		D		Con-struction		Stand-ard		Utility		Econ-omy	
Inches		Fbm	Fbm	%	Fbm	%	Fbm	%	Fbm	%	Fbm	%	Fbm	%	Fbm	%	Fbm	%
Log grade 2																		
30-35	15																	
36-41	11																	
42-47	10																	
Log grade 3																		
12-17	18																	
18-23	16																	
24-29	16																	
30-35	12																	
36-41	10																	
42-47	10																	

COMPUTING AND ANALYZING RESULTS

Automatic computation of mill-study data by electronic computers offers saving in time and expense. The more comprehensive the study, the greater the advantage in using electronic computers. Mill-study methods discussed here--woods-run, log-grade, or log-class--require fewer computations than do studies made by individual logs and, consequently, can be computed in reasonable time with electric desk calculators.

The following discussion assumes use of desk calculators. Those desiring to process data by electronic computers may obtain further details from the Pacific Northwest Forest and Range Experiment Station* in Portland, Oregon, or the Forest Products Research Center in Corvallis.

Totaling and Checking Lumber Tally Sheets

The basis for lumber-grade recovery may be the tally of rough-unseasoned lumber if the study ends at the green chain, or of dry-surfaced lumber if the study is continued through seasoning and planing. If the study is based on dry lumber, it may be designed additionally to show seasoning and machining losses by lumber grade and size.

Since tally forms for either dry or unseasoned lumber have entries in lineal feet or surface feet, the first task is to total the lineal or the surface feet of each item on the tally. Each total on the tally forms should be checked before further computations are made.

Computations and Compilations by Grades (in Fbm)

When electronic computers are not used, common practice is to convert lineal or surface feet to board feet and enter board feet of each

* See Specifications for Processing Mill Scale Study Data on a Type 650 Electronic Machine. Floyd A. Johnson, Research Note No. 133. Pacific Northwest Forest and Range Experiment Station, 1956.

Table 3. Summary of Grade Changes from Rough-Unseasoned to Surfaced-Dry Lumber.*

Size	Unseasoned volume	Dry grades developed after seasoning and machining																Trim or cull loss		Total dry recovery	
		Finish lumber			Common boards				Dimension												
		B & Btr	C	D	Const	Standard	Utility	Econ	Sel Str	Const	Standard	Utility	Econ								
Inches	Fbm	Fbm	%	Fbm	%	Fbm	%	Fbm	%	Fbm	%	Fbm	%	Fbm	%	Fbm	%	Fbm	%	Fbm	%	Fbm	%	Fbm	%	Fbm	%
B and Better unseasoned grade																									
1 x 3	100	70		10		20																0		100	100
1 x 4	200	120		25		15				32												8		192	96
1 x 6	400	200		40		45				60		35										20		380	95
2 x 6	200	80		15		40										43		10				12		188	94
	900	470	52	90	10	120	13			92	10	35	4			43	4	10	1			40	4	860	96
C unseasoned grade																									
D unseasoned grade																									
Construction																									
2 x 4	7000													600	9	4780	67	1040	16	260	4	200	2	120			
2 x 6	5000													450		3500		800		200				50			
2 x 8	4000													350		2500		720		180		160		90			
2 x 10	2000													200		1320		340		60		40		40			
2 x 12	2000													200		1340		300		100				60			
	20000													1800	9	13440	67	3200	16	800	4	400	2	360	2	19640	98

* Source: Dry-surfaced-lumber tally forms. Each line of this table summarizes data from one dry-tally form. Average changes in grade for each unseasoned grade are used for next step--converting unseasoned-lumber grade recovery from each log class to dry-lumber recovery.

item on the lumber tally forms--using a colored pencil for these figures.

Unseasoned-lumber-grade recovery

A convenient means of compiling lumber recovery by grade is to use a preliminary table for each log grade or log class, with one column for each lumber grade recovered. The board footage of each item on the unseasoned-lumber tally form then can be entered in the appropriate lumber-grade column and each column totaled for transfer to a summary such as Table 2. If the study is continued only to unseasoned-grade recovery, a tabulation such as Table 2 serves to summarize results. If, however, the study is to be based on dry-surfaced-lumber recovery, this summary serves only as an intermediate step.

Dry-surfaced-lumber-grade recovery

Compilation of dry-lumber recovery is more complicated than that of unseasoned-lumber yield, but more information is obtained. In a woods-run study, one needs only to total lumber recovery by grade from the numerous dry-tally forms. Assuming, however, that a log-grade or log-class study has been made, some intermediate steps are necessary to obtain dry-lumber recovery by log grade, or by log grade and diameter class.

In a woods-run study, every piece of study lumber should be accounted for after drying and machining, and no nonstudy lumber should be included (see page 10). In a log-grade or log-class study, loss of a small amount of study lumber, or inclusion of a small amount of nonstudy lumber, is not critical. In the latter types of study, dry-surfaced-lumber recovery is used to adjust unseasoned-lumber recovery. Therefore, an accurate tally of unseasoned lumber, that can be obtained with little chance of error, is the basis for final lumber yield. Changes in grade and value during seasoning and machining provide data needed to convert the unseasoned-lumber tally to dry-lumber-grade recovery.

Summarizing dry-lumber recovery from unseasoned grade

Table 3 illustrates a sample form for summarizing grade changes after seasoning and machining. Recovery of dry lumber may be grouped into few or many grades, depending on amount of detail desired. For example, in Table 3, the one-inch common lumber has been separated from the two-inch. Some studies may require only that all boards, dimension lumber, and other items of one grade be grouped in a single column.

The form illustrated in Table 3 will be a large one, in any event, but does provide a convenient way of summarizing dry-lumber recovery from each unseasoned grade. Average values from Table 3 serve to adjust recovery of unseasoned lumber (which was separated by log classes)

Table 4. Lumber Yield by Log Class, Including Lumber Sold Unseasoned and Dry-Lumber Yield by Adjustment of Unseasoned-grade Recovery.*

Species Douglas fir Log Grade 3 Log Diam Class 12" - 17" Net Log Scale 7600 fbm

Rough, unseasoned grade	Unseasoned lumber volume	Dry-lumber yield: Finish lumber B&Btr	Finish lumber C	Finish lumber D	Common boards Const	Common boards Stand.	Common boards Util	Common boards Econ	Dimension lumber Sel St	Dimension lumber Const	Dimension lumber Stand.	Dimension lumber Util	Dimension lumber Econ	Dry-surf. lbr vol	Unseasoned Rgh or surfaced (grade)	(grade)	(grade)
	Fbm	Fbm	Fbm	Fbm	Fbm	Fbm	Fbm	Fbm	Fbm	Fbm	Fbm	Fbm	Fbm	Fbm	Fbm	Fbm	Fbm
Finish lumber																	
B & Btr	0													0			
C	50		24	11			9	4						48			
D	130		10	60		13	30	15						128			
Common boards																	
Const	200				80	85	20	6						191			
Stand.	400				6	220	150	10						386			
Utility	180					5	140	25						170			
Econ	60						10	46						56			
Dimension lumber																	
Const	6100								549	4087	976	244	122	5978			
Stand.	1200								120	790	240	30		1180			
Utility	440									24	300	90	16	430			
Econ	140											20	120	140			
Total fbm	8900	0	34	71	86	323	359	106	669	4901	1516	384	258	8707			
% total dry										56							
Value in dollars			4.90	8.50	5.20	19.40	15.10	2.30	53.40	373.95	101.10	19.50	7.00	610.35			

Value per M fbm, lbr tally $ 70.10 Value per M fbm, net log scale $80.30

Footage loss 193 fbm 2% Gain or loss in value $ ____ %

* Source: Green tally from Table 1; Average dry recovery (in per cent) from Table 3.

to recovery of dry lumber.

Adjusting unseasoned recovery to dry-surfaced recovery

Converting recovery of unseasoned lumber from each log class (as summarized in Table 2) to dry-lumber yield--using the average dry-grade recoveries (in per cent) from Table 3--completes compilation of essential data. This final step in calculating recovery of dry lumber from each log grade and diameter class will be facilitated by use of a form such as that shown in Table 4.

Note that lumber values are not applied until the adjusted dry-lumber recoveries are summarized by log classes as in Table 4. This procedure presupposes that average lumber prices for each grade will be applied. Where lumber width or thickness, as well as grade, determines value, reference to Table 3 will provide the relative percentages of widths or thicknesses in each grade, and a weighted average value for the grade can be calculated for use in completing Table 4. For example, in Table 3, the recovery of dry Construction grade dimension lumber included 8280 fbm of 2- by 4- and 6-inch pieces valued at $76.00 per M fbm; 2500 fbm of 2- by 8-inch pieces valued at $75.00 per M; 1320 fbm of 2- by 10-inch pieces at $78.50 per M; and 1340 fbm of 2- by 12-inch pieces at $77.50 per M. The weighted average value of $76.30 per M fbm would then be used in calculating the value of Construction dimension lumber in each log class.

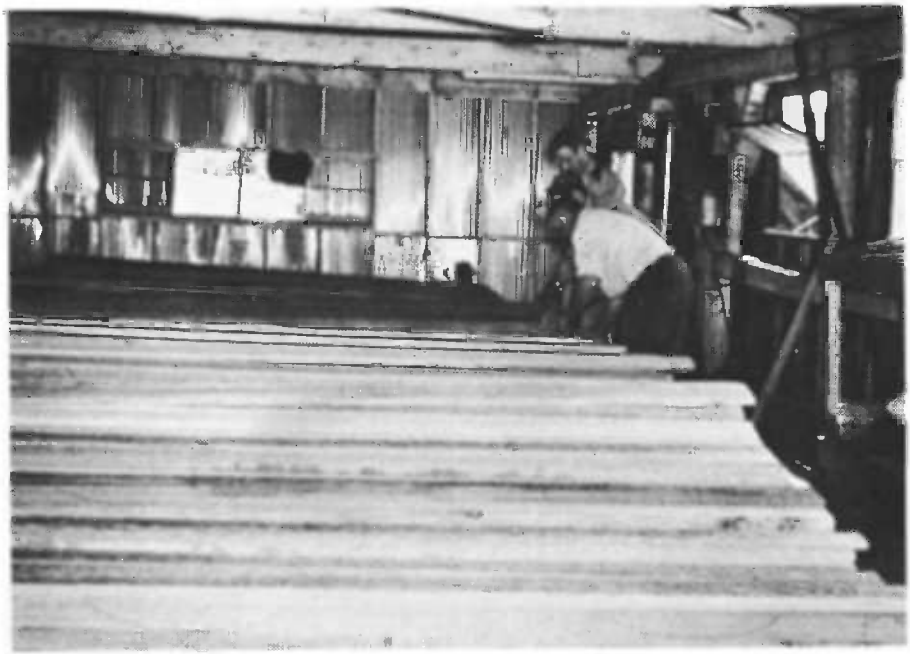
Lumber to be sold unseasoned requires no adjustment, but must not be overlooked in summarizing final recovery by log class. Unseasoned items such as timbers may be entered in the extreme right-hand columns of Table 4.

Studies ending at the green chain

An early statement was that, once data on grade changes during seasoning and machining have been developed at a mill (as in Table 3), management may choose to apply such data to other mill studies that were carried only to the green chain.

Data developed on grade changes during seasoning and machining always are applicable to the logs under study, but may or may not be applicable to future studies. Presence of characteristics such as shake in study logs may produce abnormal degrade in seasoning and machining, and such data should not be used to adjust recovery of unseasoned lumber from average logs. On the other hand, the seasoning and machining degrade determined in sawing average logs should not be used to adjust recovery of unseasoned lumber from low-grade logs. Furthermore, if degrade information developed in one study is used to adjust recovery of unseasoned lumber from another study, then:

COMPARABLE GRADING CONDITIONS are desirable if degrade information developed in one study is to be used to adjust recovery of unseasoned lumber from another study. Time to inspect each piece carefully, as above, may provide results differing from situations where the grader is under considerable pressure, as below.



1. In each instance, the green-chain grade must be the unseasoned grade, or

2. In each instance, the green-chain grade must be an estimate of final, surfaced, dry grade, and

3. In each instance, the grader should be working under comparable pressure. That is, he either should have ample time to determine the grade of each piece, or equivalent limited time to make his decisions.

When a firm does decide that previously developed degrade figures are applicable, an adjusted value for unseasoned lumber may be valuable as an index to comparative value of the lumber yield from each log class. To obtain an adjusted value for a given grade of rough, unseasoned lumber, convert the unseasoned grade to estimated dry-lumber recovery by use of percentage grade changes during seasoning and machining (shown in Table 3). Place a value on each dry grade developed by means of current prices, total the value of the dry lumber, and divide by the footage of unseasoned lumber to give an adjusted value per M fbm for each unseasoned grade. These values can be applied to the summaized grade recovery of rough, unseasoned lumber from any log class (as shown in Table 2) thereby providing an adjusted value for unseasoned lumber for the class.

So long as dry-surfaced lumber prices remain the same, these adjusted values may be applied to any unseasoned-lumber-recovery studies--if the study logs have characteristics related to those logs used in developing grade changes during seasoning and machining.

The procedure outlined gives results comparable to those of a study that is carried through the planing mill. However, calculation and use of the term adjusted unseasoned-lumber value indicates recovery of unseasoned lumber adjusted by means of previously obtained information. These values thus are distinguished from dry-lumber values per M fbm, shipping tally, obtained by carrying lumber from the study logs through the kilns and planing mill.

Pond Values by Log Class

Information frequently is desired on the pond value of each log class--obtained by deducting production cost from total lumber value, and converting to a net-log-scale base.

For example, in Table 4, No. 3 Douglas fir logs in the 12- to 17-inch diameter class had a value of $70.10 per M fbm. Production cost per M fbm lumber shipping tally from pond to car (including selling cost) should be the plant average adjusted on the basis of sawing time for the log class.

Lumber-production cost should be adjusted for the log class, especially where the study involves small logs, rough top logs, highly defective logs, or other logs likely to be submarginal. Sawing time for the log class, and dry-lumber yield in M fbm provide data for making such adjustment. A convenient way for calculating production cost of a given log class is by the following procedure:

$$\frac{C \times P \times S}{(480-d) \times T}$$

where:

C = Average production cost per M fbm
P = Average lumber cut in 8-hour shift
480 = minutes in 8-hour shift
d = Average lost time in 8-hour shift
S = Sawing time for a given log class in operating minutes (total, less delay)
T = Dry-lumber tally from the log class, in M fbm

For example, if

Total production cost averages $25.00 per M fbm (incl. sales & overhead costs) and
Average production in 8 hours = 100 M fbm
Average lost time in 8 hours = 30 minutes
Sawing time for log class = 52 minutes
Dry-lumber tally from log class = 8.71 M fbm (Table 4)

$$\frac{25 \times 100 \times 52}{450 \times 8.71} = \frac{1300}{39.2} = \$33.16 \text{ per M fbm}$$

Stated another way, cost is based on (average production cost for an operating minute) multiplied by (minutes required to saw the study logs in a given class) divided by (lumber yield from the log class).

This somewhat simplified method assumes all production costs are directly proportional to headsawing time required per M fbm. Where production is governed by the headsaw, sawing time serves as a fair index of cost, but may require modification where a log type yields lumber that requires long drying periods, more than normal time in surfacing, or the like.

Since log costs usually are kept on a net-log-scale basis, the pond value of a log class should be adjusted from a lumber tally to net-log-scale base. Referring again to the example given in Table 4; lumber value of No. 3 Douglas fir logs in the 12- to 17-inch diameter class was $70.10 per M fbm. This value, less the $33.16 production cost, gives a pond value of $36.94 per M fbm, surfaced-dry lumber tally. But $36.94 x 8.707 M fbm is the pond value of 7600 fbm net log scale, so--

$$\frac{\$36.94 \times 8707}{7600} = \$42.32 \text{ per M fbm net log scale.}$$

The pond value per M fbm, net log scale, then can be compared with the cost of a grade and size of log in the pond to determine profit margin of the class for lumber production. It also can be compared with the value of this type and size of log for other utilization, such as for veneer or pulp.

GRADING AND TALLYING usually can be done by two experienced men, with an additional man to help where there is a large output, or variety of products.

Table 5. Log Volume and Recovery of Surfaced-dry Lumber by Log Grade and Diameter Class.*

Diameter class	No. logs	Log volume		Lumber tally		Lumber grades (based on total dry tally)										
						Select		4/4 Common				Dimension				
		Gross	Net	Green	Dry	C & Btr	D	Stand. & Btr	Util	Econ	5	Sel Str	Const	Stand.	Util	Econ
Inches		Fbm	Fbm	Fbm	Fbm	%	%	%	%	%	%	%	%	%	%	%
Log grade 1																
18-23																
24-29																
30-35																
over 35																
Log grade 2																
18-23																
24-29																
30-35																
over 35																
Log grade 3																
12-17																
18-23																
24-29																
30-35																
over 35																
Log grade 4																
6-11																
12-17																
18-23																
24-29																
30-35																
over 35																

* Source: Summary of lumber yield for each log class (Table 4).

PRESENTING RESULTS

Results of a mill study should be presented in brief, understandable form. Included should be:

Basic information, such as---

- Date of study
- Equipment; i.e., headsaw, kiln, planer,
  - used where mill has variety of equipment
- Log sample
  - source of logs
  - number of logs by grade and diameter class
- Names of those making the study--graders, computers

Findings of the study---

- Lumber-recovery data
- Current value of lumber yield
- Lumber-productiong cost
- Log values in the pond
- Degrade during seasoning and machining

Lumber-Recovery Data

Lumber-recovery data may be reduced to one final table showing only the percentage in each grade of dry-surfaced lumber recovered from each log class. In this event, basic log data can be included in the first few columns (as in Table 5) and dry-lumber-grade recovery (in per cent, based on total dry lumber) shown in subsequent columns. Overrun, if wanted, can be shown with one additional column.

On the other hand, all tables developed in calculating final lumber recovery may be included in the report.

Lumber Values

Dollar values of the dry-lumber yield from each log class should be shown in a separate table, for value will change with shifts in lumber

Table 6. Lumber Values, Production Costs, and Pond Values by Log Grade and Diameter Class.

Log diameter class	Lumber value	Production cost	Pond value, lbr tally	Lbr tally, net log scale	Pond value, net log scale
Inches	$/M fbm	$/M fbm	$/M fbm	M fbm	$/M fbm
Log grade 2					
30-35	80.30				
36-41	84.00				
Log grade 3					
12-17	70.10	33.16	36.94	1.145	42.32
18-23	72.00	30.00	42.00	1.100	46.20
24-29	72.50	25.00	47.50		
30-35	76.50				

prices, but lumber-grade-recovery data can provide the basis for a new value table at any future time. Tabulated lumber values may show total values, pond values, or both, depending upon management's chief interests. Value tables should be arranged so differences between values of log grades and log-diameter classes are seen readily. A form to summarize values is illustrated in Table 6.

Degrade Information

The summary of changes in grade from unseasoned to dry--as presented in Table 4, or some similar form--is an important part of a study and should be presented in the final report. Such a table reveals useful details of grade and value changes not shown elsewhere.

Use to simplify other mill studies

Detailed degrade information developed in one mill study may serve to simplify later studies. Having this information, a mill could

collect only data on green-chain recovery in a subsequent study, and, by means of the degrade information at hand, could convert recovery of unseasoned lumber to dry-lumber yield, as explained on page 19.

Grade changes by cause

The dry-surfaced-tally form (Table 1) gives a record of causes for change in grade. This information, which is not used in summarizing lumber yield in Tables 3, 4 and 5, may have real importance to the mill.

Degrade causes may be summarized to show value losses in each item surfaced by such categories as mismanufacture, warp, end splits, and planer split. Such a summary would indicate where serious loss is incurred, and particular phases of operation in need of attention. The form in Table 7 may serve to summarize degrade losses and causes of loss.

Curved Data

In many reports, relationships between log grades or log-diameter classes can be visualized easily if presented graphically. For example, helpful steps may be to plot such results as:

Defect in logs by log diameter
(one curve for each log grade)
Overrun by log diameter
(it may be of interest to calculate and graph overrun in sound logs only)
Sawing time in minutes per M fbm by log diameter (Figure 1) (log length affects sawing time, but fair accuracy is obtained by plotting only two curves--one for logs up to 24 feet long and one for logs over 24 feet)
Pond values by log-diameter class for each log grade.

Table 7. Loss in Potential Value during Seasoning and Machining, and Causes of Loss.

	Lin ft	Fbm	Value
On grade	62	41.2	5.94
On grade after trim	0		
Total on Grade	62	41.2	5.94

Species D F Green Grade B & Btr Date 9-20

Thickness 2 Width 4

Other grades developed after seasoning & machining	I. SEASON & MACHINE DEGRADE: Knot holes	Loose knots	Brkn. knots edge face	Splits	Checks	Warp	Torn Grain	Other Mach degrade	I. Totals* Lin ft	Fbm	Value	II. UNSEEN IN ROUGH BOARDS: Shake	Burly grain	Decay	Large knots	Worm holes	Bark & pitch Pockets, (breaks)	Sawing variations	Turner and dog marks (logng.mks)	II. Totals** Lin ft	Fbm	Value
B & Btr																				16	10.7	1.54
C														16								
D					16				16	10.7	1.33											
Structural					16				16	10.7	0.85											
Const																						
Stand																						
Util																						
Econ																						
5																						
I. Totals									32	21.4	2.18											

	Lin ft	Fbm	Value
Original Footage and Potential Dry Value	110	73.3	10.53
I. Totals	32	21.4	2.18
II. Totals	16	10.7	1.54
Total on Grade	62	41.2	5.94
Cull	0		
Net S4S Trim	0		
Total Footage & Value Recovered	110	73.3	9.66
Loss			0.87
Loss as % of Potential Value			8.3

	Lin ft	Fbm
Total S4S trim		
- Green trim		
Net S4S trim		

*Recovered footage & value of stock degraded by seasoning & machining

**Recovered footage & value of stock changed in grade because of factors undetected in rough-unseasoned state.

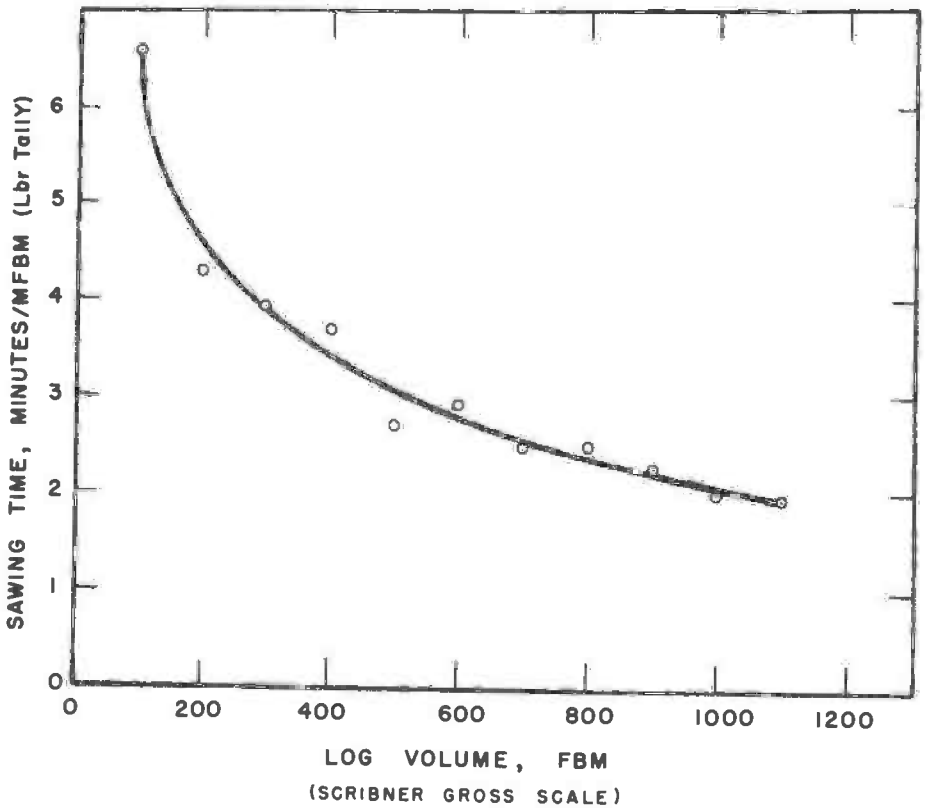


FIGURE I. INFLUENCE OF LOG VOLUME ON SAWING TIME.