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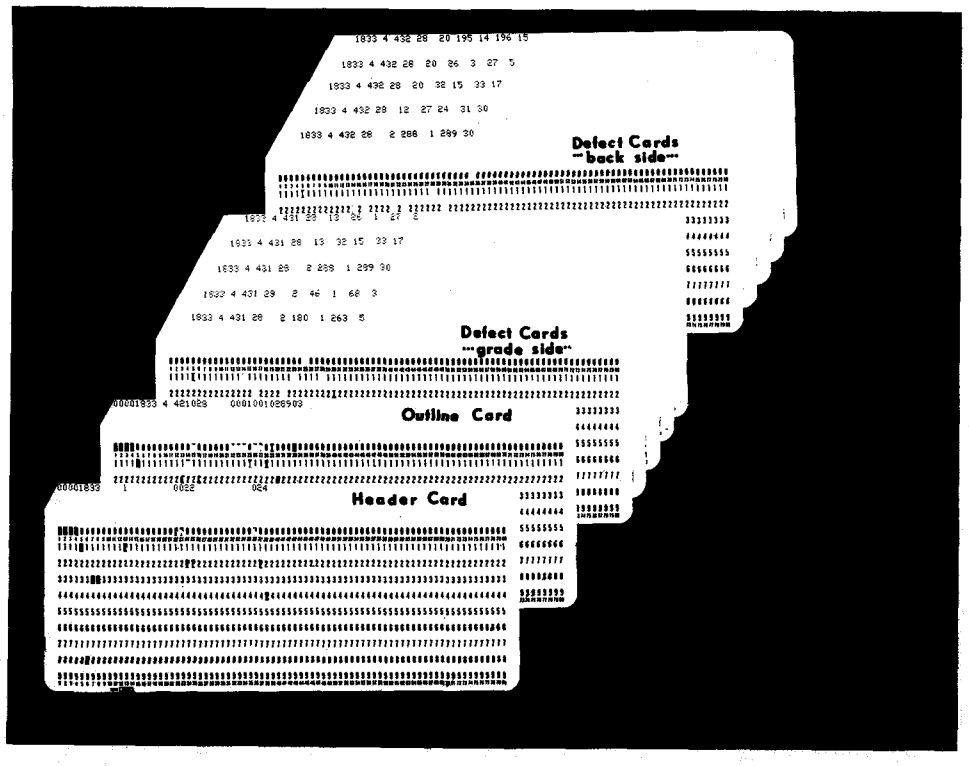
A Comprehensive DEFECT DATA BANK For No. 2 Common Oak Lumber



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Abstract

Computer simulation of rough mill cut-up operations allows low-cost evaluation of furniture rough mill cut-up procedures. The defect data bank serves as input to such simulation programs. The data bank contains a detailed accounting of defect data taken from 637 No. 2 Common oak boards. Included is a description of each defect (location, size, and type), as well as the length and width of the board. All information is recorded on data-processing cards. Though the data bank applies directly to No. 2 Common oak, it can be used to evaluate the yields of most species of No. 2 Common lumber that are graded according to the standard rules.

INTRODUCTION

MORE THAN HALF of the hardwood lumber produced in the sawmills of the Appalachian Region is graded No. 2 Common or lower. One-fourth of the total volume is No. 2 Common, and the volume of No. 2 Common is expected to increase during the next decade.[1, 2] New ways of converting this material into products or product parts are needed to assure future markets for this lumber. Effective research to develop new conversion procedures will require new approaches. Conventional case studies are impractical because of the difficulty in obtaining matched samples.

Computer simulation of rough mill cut-up operations allows low-cost evaluation of new manufacturing procedures. This report describes a board defect data bank for No. 2 Common oak lumber which we have compiled for use in these simulation studies. This data bank contains an extensive collection of board defect data and is available for use by researchers and wood industry firms.

[1] Goho, Curtis D., and Paul S. Wysor. 1970. Characteristics of factory-grade hardwood logs delivered to Appalachian sawmills. USDA Forest Serv. Res. Paper NE-116, 17 p., illus. NE. Forest Exp. Sta., Upper Darby, Pa.

[2] Vaughan, C. L., A. C. Woolin, K. A. McDonald, and E. H. Bulgrin. 1966. Hardwood log grades for standard lumber. USDA Forest Serv. Res. Paper FPL-63, 52 p., illus. USDA Forest Prod. Lab., Madison, Wisc.

THE DATA BANK

The data bank is a collection of board defect data taken from 637 No. 2 Common oak boards totaling 4,487 board feet. All data are recorded on punched cards. Included is a description of each defect by location, size, and type, as well as the length and width of the board. The data bank provides input for computer analysis of rough mill cut-up procedures.

The Sample

In developing the data bank, our goal was to select a sample that was representative of the population of No. 2 Common oak boards. The sampling schedule used for this study

was similar to one developed by Dunmire and Englerth.[3] This schedule calls for grouping boards into seven length classes and seven width classes, a total of 49 sampling cells. The prescribed number of boards per cell was 16. Thus, the total number of boards called for by the schedule is 784 (49 x 16).

Each of the 49 sampling cells was divided into four utility groups. These utility groups, or strata, separated boards according to their clear area as follows:

Utility group	*Clear area in the board[4] (percent)*	*Number of observations (boards)*
1	50–60	3
2	61–70	6
3	71–80	5
4	81+	2

[3] Dunmire, Daniel E., and George H. Englerth. 1967. Development of a computer method for predicting lumber cutting yields. USDA Forest Serv. Res. Paper NC-15, 7 p., illus. N. Central Forest Exp. Sta., St. Paul, Minn.

[4] To be included in the calculation, a clear area must be at least 2 by 18 inches or 3 by 12 inches.

This technique emphasizes the more commonly found boards—those in which between 60 and 80 percent of the surface area is clear wood.

Our collection of 637 boards totaled over 4,400 board feet, and although it is the largest documented sample of No. 2 Common oak lumber available, we were unable to fill all cells in the schedule (table 1). Boards were selected from four widely dispersed mills in West Virginia and Virginia. The production runs from which our sample was taken totaled approximately 300,000 board feet. Our inability to fill all cells in the schedule was partly due to the naturally limited occurrence of very wide boards and very narrow long boards. So we believe the sample represents No. 2 Common oak lumber adequately for practical purposes (table 2).

Table 1.—*Number of 4/4 kiln dried No. 2 Common oak boards in the data bank, by length and width classes.*[a]

Width classes (inches)	Length class (feet)							All lengths
	4	5–6	7–8	9–10	11–12	13–14	15–16	
3–4	14	16	12	13	11	9	5	80
5–6	13	21	18	23	17	15	14	117
7–8	16	19	18	15	21	15	16	120
9–10	17	19	18	17	17	16	16	120
11–12	14	16	19	20	22	12	12	115
13–14	6	6	14	11	13	5	3	58
15+	2	2	5	5	6	4	3	27
Total	82	92	104	103	107	80	69	637

[a] In the shaded area the number of boards sampled met or exceeded the prescribed number (16) for each sampling cell.

Table 2.—*Volume of 4/4 kiln dried No. 2 Common oak boards in the data bank, by length and width classes*

[*In board feet*]

Width classes (inches)	Length class (feet)							All lengths
	4	5–6	7–8	9–10	11–12	13–14	15–16	
3–4	14	30	32	46	43	45	27	237
5–6	26	45	66	100	95	103	105	540
7–8	36	56	90	96	157	159	155	749
9–10	51	81	117	132	161	172	198	912
11–12	54	88	145	187	256	163	177	1,070
13–14	26	35	126	120	176	74	55	612
15+	10	13	51	65	93	71	64	367
Total	217	348	627	746	981	787	781	4,487

Data Collection and Description

All lumber was kiln dried to a moisture content of 7 percent before defect data were collected. After kiln drying, the lumber was graded by a certified inspector of the National Hardwood Lumber Association (NHLA) using the NHLA Special Kiln Dried Rule.[5]

All defects in each board were recorded and coded by size and kind, according to the 21 defect classifications listed in table 3. In addition, the side of the board on which the defect occurred (grade side or back) was recorded. This procedure was used because the grading rules for dimension parts specify allowable defects for both the face and reverse side of parts.

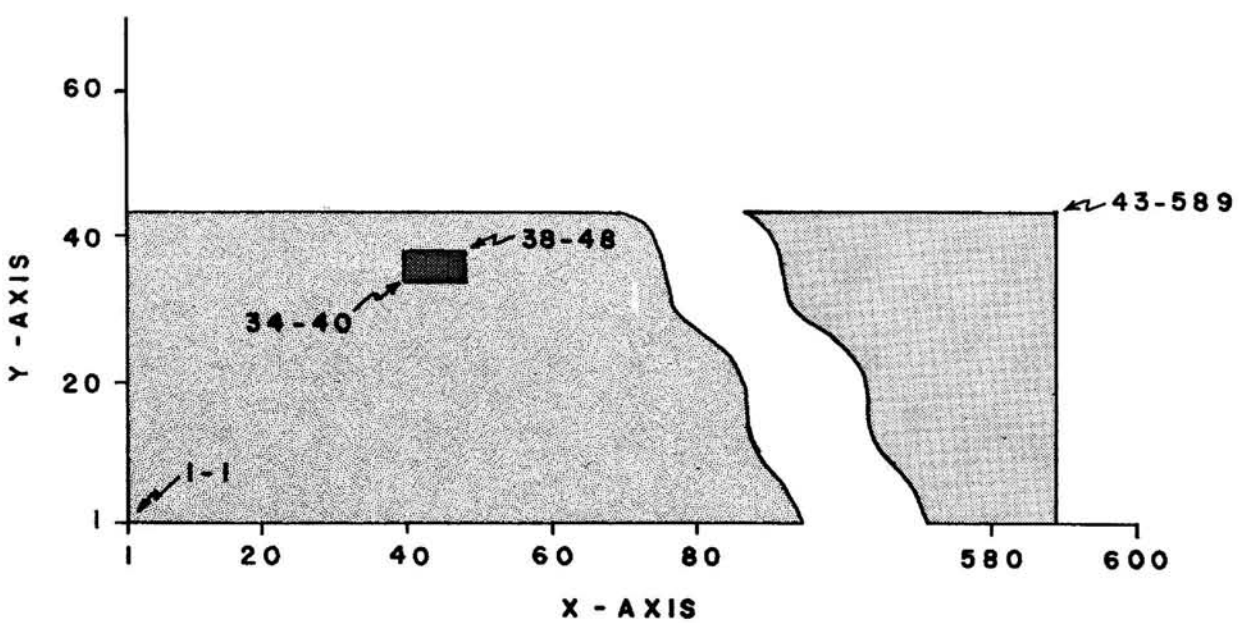
The board dimensions and the location and dimensions of each defect were recorded, using a cartesian coordinate system graduated in ¼-inch units (fig. 1). Boards were placed with the lower left corner at the point 1-1, with the width of the board along the posi-

Table 3.—*Board defect descriptions and code numbers*

Code No.	Defect description
001	Mechanical damage
	Dog hole
	Felling notch
	Felling tear-out
002	Void
003	Pith
004	Decay
005	Shake
006	Split
007	Machine-made split
008	Wane and scant thickness
009	Sawline
010	Bark pocket
011	Grub hole; ¼ inch and over
111	Shot worm hole; greater than 1/16 inch, less than ¼ inch
211	Pin worm hole; 1/16 inch or less
012	Unsound knot
013	Burl with bark or check
014	Surface check
015	Sound knot
016	Machine-chipped or torn grain
017	Machine snipe and tear-out
018	Incipient decay
019	Sticker stain
020	Bud trace with bark or check
021	Callus wood

[5] National Hardwood Lumber Association. 1967. Rules for the measurement and inspection of hardwood and cypress lumber. 116 p., Chicago, Ill.

Figure 1.—The outline of a 10½ inch board 12¼ feet long is described by the points 1-1 and 43-589; the location of a defect 1 inch by 2 inches is described by the points 34-40 and 38-48.



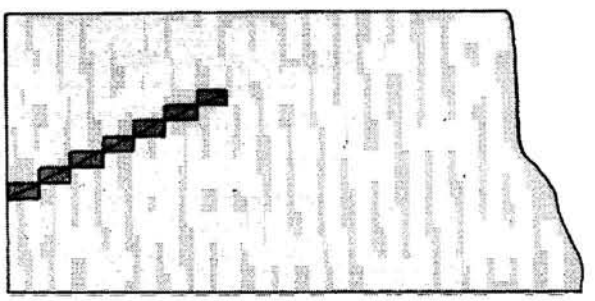
tive Y-axis and the length along the positive X-axis. Each board or defect was described as a rectangle. Each rectangle was located by its lower left and upper right corners. Thus, only two pairs of points are necessary to describe each board and each defect. For example, a board 10½ inches wide and 12 feet 3 inches long is described by the set 1-1 and 43-589.[6]

Certain large defects were treated as a series of small defects (fig. 2). This provided for a more accurate description of the defect and minimized the amount of clear wood recorded as defective.

Data Format

All information pertaining to a board was recorded on 80-column punch cards. Each board's complete data deck contains, in order, one header card, one outline card, and one defect card for each defect in the board (fig. 3). The defect cards are arranged so

Figure 2.—To minimize the amount of clear wood recorded as defective, certain large defects were treated as a series of small defects.



[6] Note: The dash separates, in order, the "Y" and "X" units.

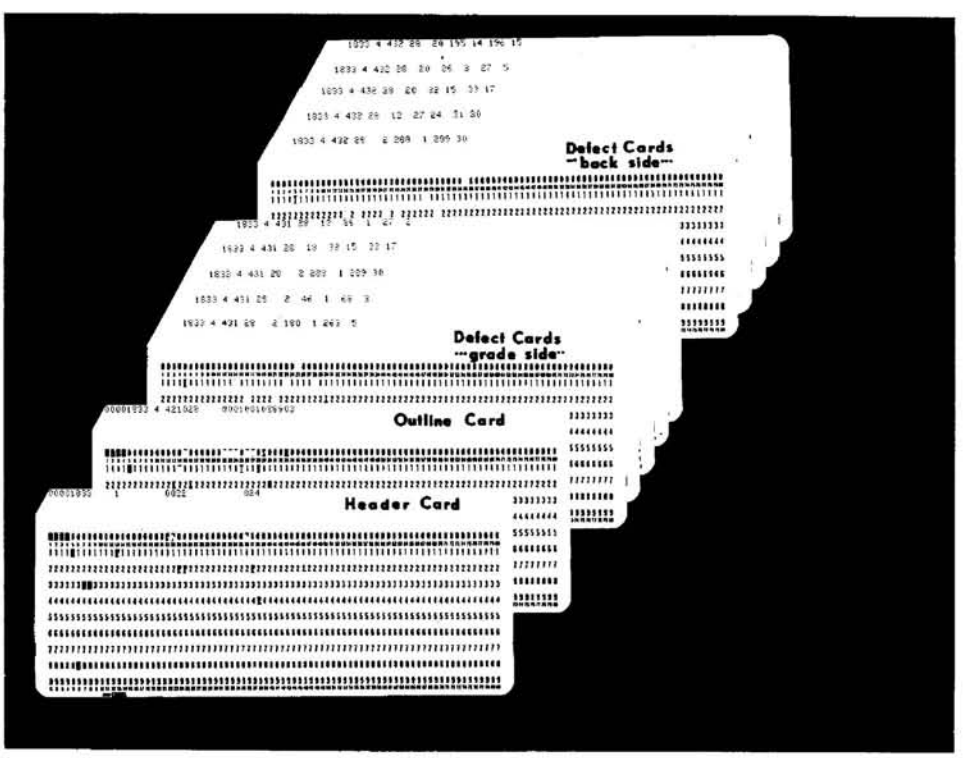


Figure 3.—Data cards for each board are arranged in the following sequence: (1) header card, (2) outline card, (3) defect cards, grade side, and (4) defect cards, back side.

that defects on the grade side of the board come before those on the back of the board. A detailed description of all information contained in the cards is in the Appendix.

USE OF THE DATA BANK

The board defect data bank offers both researchers and industry an opportunity to develop greater efficiency in the utilization of No. 2 Common hardwood lumber. It can be used with existing rough-mill computer simulation programs to determine the yield of dimension parts for any desired cutting bill. The U. S. Forest Products Laboratory's simulation program, YIELD, is available for this use.[7] In addition, researchers at the Forest Products Marketing Laboratory (FPML) have expanded program YIELD. This expanded version allows the program to simulate processing of boards with more defects and is thus well suited for evaluating No. 2 Common lumber.

The data bank contains descriptions as well as measurements of all defects found on the boards. Thus it can be used to determine the yields of various grades of cuttings. The entire deck will give the yield of dimension parts that satisfy the clear-two-sides (C2S) grade requirement. However, because defects can be selected by size, type, and board face, yield data need not be limited to C2S cuttings. Yield figures can also be determined for other grades of dimension parts such as C1S, paint, core, and sound. This flexibility is valuable for evaluating the economics of alternate uses for No. 2 Common lumber.

While the data we have collected apply directly to No. 2 Common red and white oak lumber, their use is not limited to these species. Field tests of the Forest Products Laboratory's system for calculating dimension yields from hard maple lumber,[8] have shown that the predictions apply not only to hard maple lumber, but to most species graded by the standard rules. Thus, the results obtained by use of our data bank should be applicable to most species of No. 2 Common hardwood lumber graded according to the standard rules.

Copies of the data bank are available. The enclosed card may be used to request information on how to obtain a copy and its cost.

[7] Wodzinski, Claudia, and Eldona Hahm. 1966. A computer program to determine yield of lumber. 34 p., illus. USDA Forest Prod. Lab., Madison, Wisc.

[8] Englerth, George H., and David R. Schumann. 1969. Charts for calculating dimension yields from hard maple lumber. USDA Forest Serv. Res. Paper FPL-118. 12 p., USDA Forest Prod. Lab., Madison, Wisc.

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APPENDIX

Description of Board Input Data[9]

I. Header Card: One card for each board.

Item	*Card Column*	*Description*
Board number	1–5	Up to a five digit number to indicate board number.[10]
Card type	13	One digit number to identify the card as a header card. There will be a 1 in this column for all header cards.
Number of defects	22–25	Up to a four digit number to specify the number of defects contained in the board.
Number of cards	36–38	Up to a three digit number to specify the total number of cards pertaining to the board; the count to include the header card, outline card, and all defect cards for the board.

II. Outline Card and Defect Card: One outline card for each board and one defect card for each defect.

Item	*Card Column*	*Description*
Board number	1–5	Five digit number to indicate board number.
Species	6–8	Three digit number to identify species group: 833 red oak and 834 white oak.
Inspected grade	10	One digit number to identify the grade of the board as determined by NHLA inspector: FAS = 1, SEL = 2, No. 1 Common = 3, and No. 2 Common = 4.
Verified grade	12	One digit number to identify the grade of the board as determined by laboratory techniques. Same code as for inspected grade.
Card type	13	One digit number to identify the card as either a defect card or the board outline card: outline card = 2, a defect card = 3.
Board side	14	One digit number to indicate if the defect is on the grade side of the board (the side that the NHLA inspector uses in determining grade of the board) or on the back side: grade side = 1, back side = 2.
Board width	15–17	Three digit number indicating the width of the board to the nearest ¼ inch, i.e. a board 12 inches wide would be recorded as 048.
Defect code	18–21	Four digit number to identify the type of defect. See table 3 for a listing of the defect codes.
Lower left X	22–25	Four digit number to indicate the position of the lower X coordinate of a rectangle that would (a) enclose the board if the card is an outline card, or (b) enclose a defect if the card is a defect card.
Lower left Y	26–28	Three digit number to indicate the position of the lower Y coordinate of the rectangle.
Upper right X	29–32	Four digit number to indicate the position of the upper X coordinate of the rectangle.
Upper right Y	33–35	Three digit number to indicate the position of the upper Y coordinate of the rectangle.
Card number	36–38	Three digit number to serialize the cards of each board.

[9] All data entries are right justified.
[10] For identification, each board was assigned a number.

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