SDA FOREST SERVICE RESEARCH NOTE NE-222
1976

Northeastern Forest Experiment Station

FOREST SERVICE, U.S. DEPT. OF AGRICULTURE, 6816 MARKET STREET, UPPER DARBY, PA. 19082

STUB—A MANUFACTURING SYSTEM FOR PRODUCING ROUGH DIMENSION CUTTINGS FROM LOW-GRADE LUMBER

BY EDWIN L. LUCAS AND CHARLES J. GATCHELL

Research Forest Products Technologists
USDA Forest Service
Northeastern Forest Experiment Station
Forest Products Marketing Laboratory
Princeton, West Virginia

Abstract.—A rough mill manufacturing system for producing high-value furniture parts from low-value raw material is described. Called STUB (*S*hort *T*emporarily *U*pgraded *B*oards), the system is designed to convert low-grade hardwood lumber into rough dimension parts. Computer simulation trials showed that more than one-third of the volume of parts produced from No. 2 Common oak lumber is recoverable in 40-inch long or longer cuttings. A pilot line of the STUB system is being established to evaluate operator and equipment efficiency, production rates, and cutting yields from other species of lumber.

The quantity of low-grade hardwood lumber produced by sawmills in the Appalachian Region is increasing, and the trend is expected to continue during the next decade. With improved secondary manufacturing techniques, high-valued furniture parts can be produced from this low-value raw material.

At the Forest Products Marketing Laboratory, we are developing a system we call STUB (*S*hort *T*emporarily *U*pgraded *B*oards). STUB is designed specifically for converting low-grade hardwood lumber into rough dimension parts and will produce as much as one-third of the total yield in the longer (40 inches and longer) and more desirable furniture cuttings.

Low-grade lumber is generally defined by the industry to mean any lumber below No. 1 Common. Of the lower grades, No. 2 Common lumber has the best potential for expanded use in the manufacture of furniture. More than one-fourth of the graded hardwood lumber produced in the sawmills of the Appalachian Region is graded No. 2 Common.

In the manufacture of furniture, No. 2 Common lumber is used primarily for the shorter length clear-one-face (CIF) cuttings and for interior parts. Seldom is No. 2 Common used to produce 40-inch or longer CIF parts. And it is these longer and more valuable cuttings that are needed by the production manager. To get these long cuttings, he has traditionally processed the higher and more expensive grades of lumber.

The production manager strives to produce a given quantity and quality of furniture at the least cost. The first temptation in many industries today is to lower production costs by automating, which is less labor-intensive. The furniture industry cannot afford to indiscriminately go about automating. In doing so, there is a danger that the significance of the bigger costs represented by the raw material itself will be undervalued or lost.

Some furniture rough mills are moving away from evaluating performance of the rough mill on a percent-yield basis and are evaluating performance on a cost-per-part basis. Thus they are concerned with the yield of parts produced from the lumber as well as the costs associated with the lumber and its manufacture into parts.

STUB can make a great contribution toward reducing total costs by concentrating on the bigger cost item—the raw material. The STUB concept is aimed at reducing manufacturing costs by increasing the yield and utility of the lumber processed for furniture.

Conventional Rough Mill

The rough mill in a furniture plant is where lumber is processed into rough dimension parts. Input to the rough mill is standard graded hardwood lumber, usually of random width and random length.

The first step is usually to crosscut the board to specified lengths. The cut-to-length board sections are then rough-planed and sent to a ripsaw where random or specific-width parts are produced. The off-fall from the ripsaw, if the lengths permit, is then sent to a salvage station where it is crosscut back to a shorter length, thus salvaging some of the residue produced at the ripsaw.

The conventional rough mill is too often inefficient because boards are processed on line to completion. For example, if a board comes through the line with a 60-inch clear length and the longest cutting needed at that particular time is 36 inches, then that 60-inch long section is cut to a 36-inch length, and the remainder is cut to a shorter secondary cutting. In effect, a 60-inch long cutting is wasted.

The crosscut operation is the key work station, and the memory and judgment of the crosscut operator are critical. It is not unusual for a cutting order to contain as many as 40 different cutting lengths. A crosscut operator cannot work efficiently with such a large number of lengths. To make such an order manageable, it is divided into operating cutting bills of 4 to 5 lengths, and it is these cutting bills that the crosscut operator uses. Thus the selection of cutting lengths and the skill of the crosscut operator are significant factors in determining yield recovery.

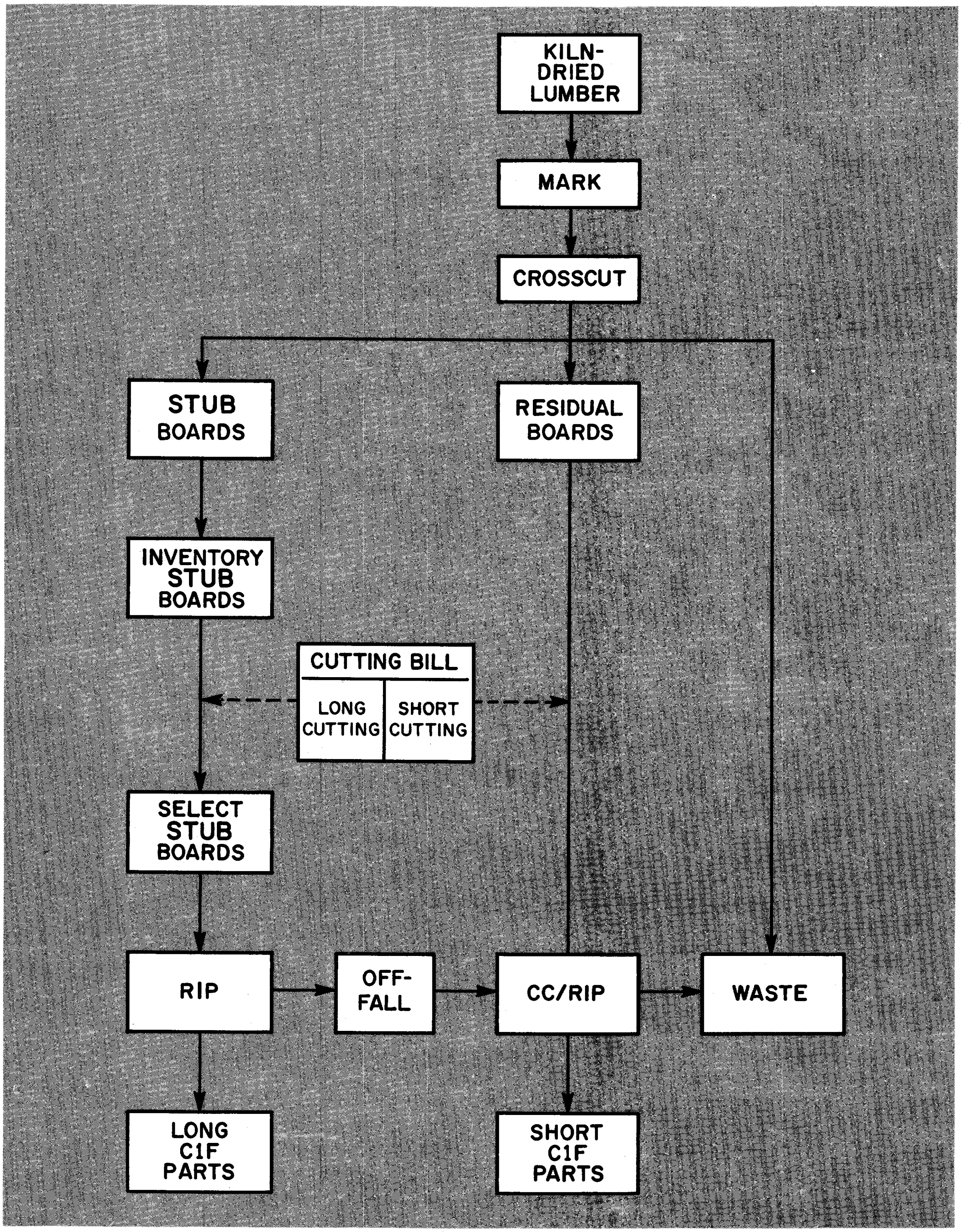
It is not the yield of long cuttings that restricts the use of No. 2 Common lumber. Rather it is the combination of processing a board on line to completion and the physical limitations at the crosscut station that limit the usefulness of No. 2 Common lumber. Our work shows that more than one-third of the volume of No. 2 Common oak lumber can be recovered in cuttings that are 40 inches long and longer *(Lucas 1973)*. To achieve in-plant yields approximating our results requires a different approach to the processing of lumber into furniture parts.

The STUB System Rough Mill

In the STUB system, we start by crosscutting long boards into short boards. But here the similarity between the STUB rough mill and the conventional rough mill ends. Instead of producing cut-to-length dimension, the crosscut operator produces three random length products: STUB boards, residual boards, and waste (fig. 1). STUB boards differ from standard hardwood lumber boards in that each STUB board has at least one CIF cutting of *a specified minimum width* that runs its full length.

Just as the crosscut operator is the key to the yield of parts in a conventional rough mill, the crosscut operator is likewise the key to success in a STUB rough mill. However, the

Figure 1.—Flow diagram of the STUB rough mill line.



STUB crosscut operator's job is not nearly as complex. In the STUB system, instead of giving the crosscut operator a list of specific cutting lengths, we give him a set of three STUBBING rules:

1. The minimum width of the STUB clear area.
2. The minimum length of the STUB board.
3. The maximum length of the STUB board.

Let's see how a crosscut operator in a STUB rough mill would process a board—in this case a board 12 inches wide and 12 feet long (fig. 2). In this example, the STUBBING rules in effect are:

1. Minimum width of clear area = 3 inches.
2. Minimum length of STUB board = 36 inches.
3. Maximum length of STUB board = 60 inches.

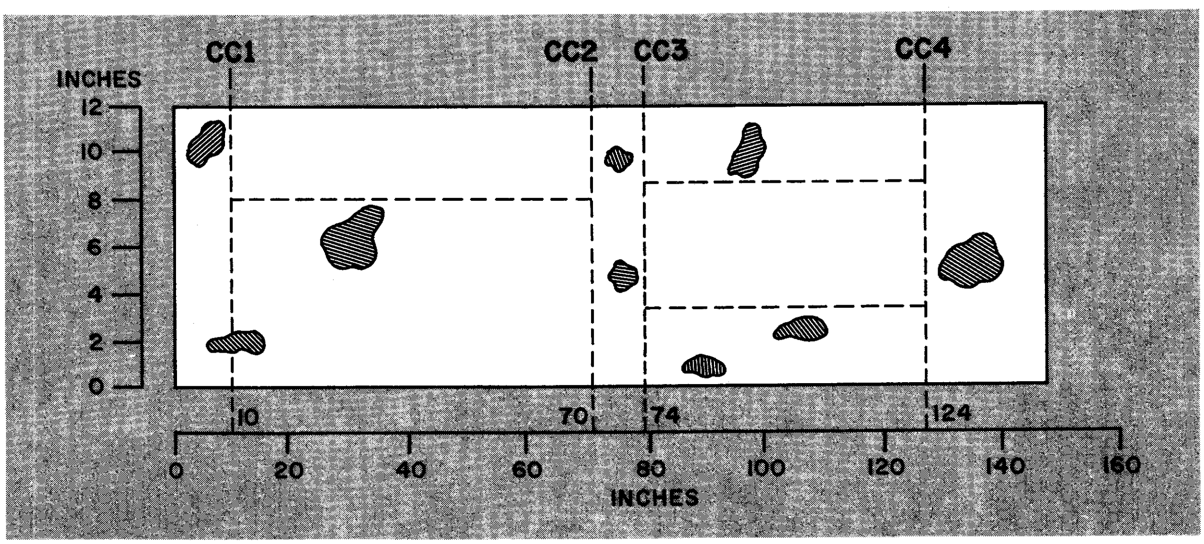
The operator starts scanning the board from left to right, looking for the first section of the board that meets the minimum requirements. When the first area that meets the minimum requirements is found, the operator marks the beginning of this area (cc 1, fig. 2) and continues to scan down the length of the board until he finds a defect or until he reaches the maximum STUB board length requirement, where he will again mark the board for crosscutting (cc 2, fig. 2).

The operator, having marked out one STUB board, now treats the remaining portion of the board as if it were a new board and again repeats the process of looking for another section of the board that meets the minimum requirements. Starting at the end of the STUB board (cc 2, fig. 2), he continues to scan along the remaining portion of the board and marks the board at the points where the next crosscuts are to be made (cc 3 and 4, fig. 2). The operator continues this scanning and marking process until the entire board has been viewed.

Since the crosscut operator has no specific cutting lengths to be concerned about, he need only develop a mental image of the width and length of the minimum clear area. Our trial runs of the STUB system show that the operator can quickly develop this mental image and consistently and quickly apply it for marking actual boards.

The crosscut operation in a STUB system consists of a marking station and an automatic mark-sensing crosscut saw. The crosscut operator is positioned at the marking station, where he scans the board and marks the board

Figure 2.—Marking a board for processing in a STUB rough mill. The board is scanned from left to right, and marks for crosscutting are made at points CC1, CC2, CC3, and CC4. From left to right, this produces 10 inches of waste, a 60-inch STUB board, 9 inches of waste, a 45-inch STUB board, and a 20-inch residual board.



with a conducting type of electrolytic solution at the places where he wants the board to be crosscut.

At the marking station, screens are used so that the operator sees only a portion of the board—not the entire length. The distance between screens corresponds to the maximum allowable length of the STUB board. These screens allow the operator to give his full attention to only that portion of the board he is currently inspecting.

Once a board has been marked, it moves past the marking station to a mark-sensing saw where it is automatically cut to length.

Application of the STUB System

We envision a STUB rough mill operating with standard graded hardwood lumber as input. The lumber will pass through the marking station and to a mark-sensing saw where it will be crosscut, producing random-length STUB boards and residual boards.

The STUB boards will then be inventoried by length classes—perhaps 2- to 4-inch classes. The rough mill foreman will draw from the STUB board inventory to satisfy his long-length cutting requirements, matching the STUB boards with the specific cutting lengths.

The selected STUB boards will then be sent to the ripsaw, where the full length cuttings will be ripped out. Since the ripsaw operator is concerned only about recovering the full-length cuttings (he knows there is at least one full-length cutting in each STUB board), he should be able to perform more efficiently and consistently.

The processing of the residual boards—a salvage operation—will be one line and will operate much the same as in existing rough mills; that is, specific part lengths will be cut directly.

We have developed a computer program (program STUB) to match the scanning and marking logic described. From the board-defect data bank developed at the Forest Products Marketing Laboratory *(Lucas and Catron 1973)*, the data for 100 randomly selected boards were processed through the program to determine the yield of CIF parts obtainable by using 10 different sets of STUBBING rules. The total yield of parts for the 10 different rules ranged between 56 and 65 percent, and the yield of long CIF parts (40 inches and longer) averaged 36 percent of the total yield.

These preliminary tests of the system have also shown that, by changing the STUBBING rules, you can change the size distribution of the CIF parts produced. This allows individual furniture plants to select the STUBBING rules that best fit their part size requirements.

We are now establishing a pilot STUB line at our Methods Testing Plant. We will use the pilot line to:

1. Evaluate operator and equipment efficiency and layout.
2. Develop yield data on other lumber species and grades.
3. Determine size and methods of controlling the STUB board inventory.

Literature Cited

Lucas, Edwin L.
1973. LONG LENGTH CUTTINGS FROM NO. 2 COMMON HARDWOOD LUMBER. USDA For. Serv. Res. Pap. NE-248. 5 p., illus.

Lucas, Edwin L., and Leathern R. R. Catron.
1973. A COMPREHENSIVE DEFECT DATA BANK FOR NO. 2 COMMON OAK LUMBER. USDA For. Serv. Res. Pap. NE-262. 8 p., illus.

☆ U. S. GOVERNMENT PRINTING OFFICE: 1976 -610-503/551

RECEIVED FOR PUBLICATION 6 FEBRUARY 1976