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DEFINITIONS AND CLASSIFICATIONS OF WASTE
IN CUTTING UP FACTORY LUMBER



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FOREWORD

Throughout the wood-using industries there is a general recognition of a need for research dealing with waste incident to the conversion of rough board lumber into cuttings or parts required in the fabrication of the many items produced by woodworking factories.

Substitute materials for lumber are now being produced in large quantities by highly mechanized industries. Such substitutes constitute a threat to the industries now using lumber as a major raw material. If the lumber industries are to match their products in competitive markets with lumber substitutes, intensive study must be made so that reliable data on lumber as a raw material may be made available. Such a study at this time is necessary in the interest of labor engaged in milling and in the conversion of lumber into finished products, and to protect capital invested in timber and in woodworking plants.

Individuals and groups have been groping with the problem of waste in lumber conversion for years without reaching satisfactory solutions. Outstanding among handicaps has been a lack of common understanding and agreement in the matter of what constitutes waste and how waste should be classified. Such understanding is basic to the entire problem.

In an effort to organize uniformity of thought, a group of interested woodworking representatives met early in 1937 and discussed the waste problems. As an aftermath of this meeting, A. O. Benson of the Forest Products Laboratory and L. J. Bosse of the Hardwood Dimension Manufacturers' Association have undertaken the preparation of a statement presenting their unified judgment of what the term "waste" should imply, the correct method of computing waste, and more or less incidentally other matters believed essential in clarifying thought among those concerned with problems involving manufacturing waste factors. The statement is in no manner an attempt to introduce new opinions or untried methods of accounting, for the proposals are already widely accepted as proper. The statement is simply an effort to eliminate confusion through the adoption of standards. With this step accomplished, a firm footing will have been established for detailed studies of factory waste which, it is hoped, will follow.

This statement does not concern itself with the personal element which looms large in all woodworking processes. It is recognized that a skillful, efficient operator may be able to produce four cuttings from a board where a less skillful operator would produce but three, but such matters are quite apart from a recitation of basic principles. Actual studies of cutting practices should yield information upon which recommended methods for cutting and handling of lumber could be based and submitted to the industries with the view and intent of reducing and controlling lumber

waste. The attainment of these objectives should result in reduced costs and selling prices, increased profits, and a greater degree of industrial stability.

Definition of Waste

Technically, waste is the difference between the volume of rough lumber as it comes delivered from the mill and the portion which actually remains in the finished product after all factory operations have been performed on it.

From practical applications to the lumber waste problem, however, waste is the difference in volume between the gross cutting sizes (rough dimension blanks) and the gross amount of lumber needed to produce these sizes. Therefore, when determining and referring to lumber waste, it should only be understood as the difference between the rough dimension blanks and the gross lumber used.

Definition of Utility

The rough dimension blank represents a square-edged piece cut to the least possible dimensions necessary to yield a finished part ready for assembling. For instance, a rough 2" x 2" x 19" square may be the blank from which a turned chair leg of considerably smaller dimensions is produced.

The term "utility" is used, therefore, to designate the volume of rough dimension blanks crosscut or ripped or both from rough lumber. Such a blank is usually of one piece for length, but it may be glued for width or thickness. Utility is expressed in terms of percentage of gross lumber footage. If from 1,000 board feet of rough lumber there is obtained 600 board feet of usable rough dimension blanks, the yield is 60 percent or in other words, the "utility" of the rough lumber is 60 percent.

To convert utility as a percentage of rough material into dollar values the term "utility value" is used. "Utility value" is defined as the cost per board foot, or per thousand board feet, of the rough dimension blanks actually recovered from a board foot or a thousand board feet of rough lumber. As an illustration, if the cutting required to yield a certain part has a volume of one board foot before put through finish machining operations, it is obvious that more than one board foot of rough lumber will be needed to produce it. If, as in the above illustration, utility is taken as 60 percent, that is, 40 percent waste, the amount of rough lumber needed would be 1 foot divided by 0.60 (60 percent) or 1.666 board feet. With lumber worth \$48.00 per thousand board feet, or \$0.048 per board foot, the utility value of the usable cuttings, or rough dimension blanks, would be 1.666 x \$0.048 or \$0.08 per board foot. The same answer may be obtained directly by dividing the rough lumber cost by the percentage of utility. ($\$48.00 \div 0.60 = \80.00 , or \$80.00 per thousand board feet of dimension blanks, or \$0.08 per board foot.)

Causes and Classification of Waste

Before making any effort to study the occurrence of waste, it is necessary to recognize, first, the factors that cause waste, and, second, to formulate a convenient classification of waste.

Causes of Waste

1. Defects.--This factor will vary with the grade and species of lumber used. Defects may be (a) inherent or natural defects, such as knots, wane, shake, wormholes, or discoloration; (b) manufacturing defects, such as bull ends, dog marks, or thick or thin lumber resulting from improper sawmilling; (c) air and kiln drying defects, such as split, check, honeycombing, stain, warp, sticker burn, or shrinkage.

2. Length or end waste.--This factor is the result of cutting standard length lumber into a specific range of shorter lengths. Length waste is constant for each length of rough lumber used. Such waste is greater in the lower grades. A 12-foot board, 144 inches, will yield a maximum of four pieces 30 inches long, and the 20-inch piece remaining will occur in any grade used. Location of defects may be such that less than four pieces will be obtained. The constant or minimum waste is 20 inches.

3. Width or edge waste.--Such waste is greatest when cutting pieces of specified widths from random width lumber and least when circumstances permit edge joining random width cuttings by gluing. When producing solid parts from lumber of definite width the amount of edge waste will be constant.

4. Thickness or surface waste.--Thickness waste results when reducing lumber of standard thickness to the thickness necessary in the finished piece. (Note: Thickness waste should not be taken into account when considering the cost of the rough dimension blank necessary to produce a finished piece.)

Classes of Waste

Waste falls in one of two classes; either it is variable waste, which is unmeasurable, or definite waste, which is measurable.

1. Variable waste.--Variable waste results in the following ways:

(a) In cutting rough lumber so as to eliminate defects not permitted in rough dimension blanks.

Such blanks ordinarily are cut for some specific use or part, and fall in one of the standard grades of hardwood dimension, namely, Clear,

Clear One Face, Paint, Core, or Sound. (Standards grades are set forth in Commercial Standard CS60-36, National Bureau of Trade Standards, U. S. Department of Commerce, Washington, D. C., which classifies practically all grades necessary to produce any part made of hardwood lumber.)

(b) In edging. Due to the fact that hardwood lumber is cut in random widths unavoidable edging waste cannot be definitely anticipated.

(c) In normal machine operations in the course of which some unavoidable machining culls are produced.

(d) In producing an excess of pieces over the actual number required.

2. Definite waste.---Definite waste, which may be accurately measured and determined, consists of the following items:

(a) Stock saw or end waste resulting in cutting specified dimension sizes from specified lengths of rough lumber.

(b) Edging waste resulting in producing specified dimension sizes from lumber of standard width. (Note: In all random width lumber edging waste must be treated as a variable waste.)

(c) Saw kerf waste. Such waste can be treated as a measurable waste in most instances both in cutoff and edging operations. It can be calculated closely by adding the thickness of one kerf to the length and one kerf to the width of the piece.

(d) Trim waste. The allowance necessary to add to the length and width of the nominal dimensions to provide for equalizing and squaring.

(e) Machine waste. Cutter head allowances for planing, moulding, shaping, turning, and the like which must be added to the width, length, and thickness of the blank.

(f) Spoilage allowance. The number of excess pieces of rough dimension blanks which must be provided as a safety margin to cover pieces that must be rejected because of hidden defects exposed by finish machining and machine spoilage.

Procedure in Determining Operating Waste

The following steps are essential in establishing waste percentages for any given lot or shipment of lumber:

1. Measurement and grading of rough lumber as received at factory.

2. Measurement and grading of rough lumber at the first mill room operation. This step will vary with step No. 1 by the loss in footage and grade due to seasoning and handling.

3. Measurement of stock after first mill room operations, crosscutting, or ripping as the case may be. In the case of crosscutting, measurement 2 minus measurement 3 gives the loss due to end waste, saw kerf, and defects.

4. Measurement of stock after second mill room operation. In the case of ripping measurement 3 minus measurement 4 gives the edging waste, width waste, defect waste, saw kerf waste, and joining waste.

The fourth measurement of usable material will enable the determination of those elements of waste that affect utility from the standpoint of variable waste. Aside from the losses established by the foregoing measurements there are:

- (1) Trim waste, machine waste, and other machine allowances.
- (2) Losses due to spoilage and excess production of parts.

In order that the results of individual operations may be checked against industry averages in the various phases of wood fabrication, it is of utmost importance that the procedure to be followed in establishing waste by classes and operations, as set forth herein, be adopted as standard.