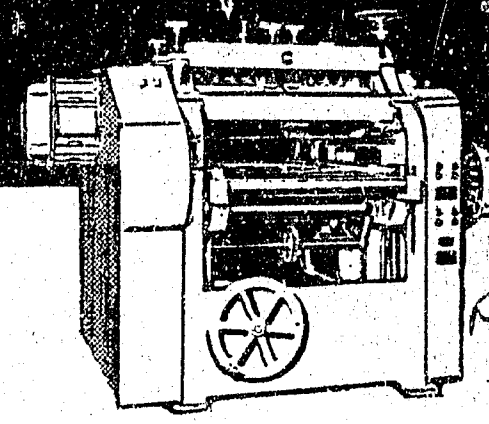
ISN=17340; PC49

CAPITAL REQUIREMENTS, TECHNIQUES AND OPERATIONS

PLANING MILL

DRESSED OR FINISHED LUMBER



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December 1956

A REFERENCE FOR USE IN PLANNING NEW INDUSTRIAL FACILITIES

Technical Aids Branch
Office of Industrial Resources
INTERNATIONAL COOPERATION ADMINISTRATION
Washington 25, D.C.

Reference Center
Room 1656 NS

FOREWORD

The purpose of this report is to present basic information for establishing and operating a small plant to be located in a foreign country, to engage in the finishing of lumber as it comes in rough form from the sawmill. The information includes a general description of the usual steps in the manufacturing process with notes on methods, machinery, layout, and generalized costs, based on the assumptions contained in this report.

As an essential preliminary, potential plant operators should determine whether or not an ample supply of raw material would be readily available and if there were a market for the products of this plant.

Naturally, a plant owner must be willing to assume the risks inherent in any business. However, lumber products are definitely essential in the welfare of any community, and experience has shown that even the smaller plant can be operated profitably when well managed.

For further information and technical assistance, readers should contact their local Productivity Center, Industrial Institute, Servicio, or United States Operations Mission.

This report is one of a series prepared for the INTERNATIONAL COOPERATION ADMINISTRATION by the Wolf Management Engineering Company, Chicago, Illinois.

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PLANING MILL

INTRODUCTION

The function of a planing mill is to produce dressed or finished lumber from the rough-sawed lumber that comes from the sawmill. Many of the large logging and sawmilling operations throughout the world have facilities for planing lumber after air seasoning or kiln drying. The majority of planing mills, however, purchase their raw materials from several sources in order to obtain a variety of species and grades of lumber at competitive prices.

There are large planing mills which restrict their operation to one or a few kinds of finished products, thereby producing exclusively various grades of flooring, finished boards, or structural lumber. Local market conditions and demands may determine the character and scope of a planing mill operation. For example, mills have been established to produce only cooperage or tanks, or box lumber, or building and cabinet materials.

In the present booklet, it is not the intention to discuss such specialized or mass production operations, but rather to deal in generalized terms with a small planing mill which might remanufacture the lumber received from several typical small sawmills. There would likely be a large number - perhaps 20 to 30 - of species of woods to be processed, and to utilize the material to the best advantage, quite a wide variety of sizes and types of finished lumber would be sold.

Actually, because of the many factors involved, it would be quite impossible to predict what the nature of the operations would be in a planing mill dealing with unfamiliar woods in a foreign country, and selling in a market where requirements and demands were unknown.

Under these conditions it would be rash to make categorical statements. To do so might misinform the reader rather than enlighten him.

THIS REPORT IS DESIGNED ONLY TO PROVIDE A GENERAL PICTURE OF THE FACTORS THAT SHOULD BE CONSIDERED IN ESTABLISHING AND OPERATING A PLANING MILL. THIS BROCHURE IS NOT DESIGNED AS AN ENGINEERING GUIDE. PLANS FOR ACTUAL INSTALLATIONS WILL REQUIRE DEFINITE, EXPERT ENGINEERING AND FINANCIAL ADVICE IN ORDER TO MEET SPECIFIC LOCAL SITUATIONS.

Bearing in mind these limitations, some of the more important subjects which may be treated in a general way will be considered on the following pages.

GENERAL ASSUMPTIONS

All statements and comments made in this booklet are based on the following general assumptions:

1. It is assumed that a small planing mill will be established in a foreign country.

2. The term "planing mill" means an establishment primarily engaged in producing dimension stock, surfaced lumber, such as ceiling, partition, siding, matched and shiplap lumber, and flooring. (This follows Industry Classification No. 2421 of the United States Department of Commerce.)

3. It is assumed that the prospective operator has made a study to determine that a potential market exists in his area for the products which he may be able to turn out from the materials available to him.

4. It is assumed that sufficient funds are available to establish such a plant or that funds can be secured at a fair rate of interest.

5. It is assumed that a suitable building can be leased or constructed. However, in order to simplify the thinking, it will be further assumed that the land and buildings will be owned by another corporation, and that instead of a cost for real estate, a rent charge will be made.

6. It is assumed that there is an adequate supply of rough lumber available from nearby sources. The planing mill would probably receive its lumber from several small sawmills, in the green state or only partially air dried. Lumber would probably be the run of the mill, that is, random length and width of various sizes, and would be an assortment of both softwood and hardwood.

7. It is assumed that an adequate supply of labor can be found locally and can be trained to perform the necessary duties with reasonable efficiency.

8. It is assumed that lumber will be delivered to the planing mill by car, on a railroad siding, or on trucks which can be unloaded in the yard.

9. It is assumed that the plant will be located on a highway and that utilities such as electric power and water are available.

10. Although this booklet is written in terms that should be understandable to the layman, it is assumed that the reader will possess an elementary knowledge of lumber and woodworking principles and will have some acquaintance with the operation of woodworking machinery. To supply all the detailed information required for the successful operation of a planing mill would be beyond the scope of this booklet.

As this is not a technical treatise or an engineering guide, it must be assumed that the manager will consult competent engineers and technicians to guide him in the selection of machinery best suited for his individual requirements, and to advise him in regard to the most efficient operating procedures to be followed.

The profitability of the enterprise would, however, be largely dependent on the technical knowledge and managerial ability of the owner or operator.

FUNCTION OF THE PLANING MILL

It may be well to consider for a moment the real functions of a planing mill and the reasons for its existence. Even if it is located in the sawmill itself, the planing mill is really a separate factory, devoted to remanufacturing, as the industry refers to it.

Remanufacturing takes rough lumber as it comes from the sawmill - although it may have been partially seasoned or kiln dried - and transforms it into a finished product, such as flooring, or it surfaces the stock and ships it to other factories, such as millwork plants, for further fabrication.

The practical and economic advantages gained by the remanufacturing operations in the planing mill may be briefly stated as follows:

1. Maximum utilization of the lumber. As lumber is cut from the log, many different grades are obtained. Through the process of remanufacture, different grades can be used for the purposes for which they are best fitted. Some of the lumber may be alright for building construction; lower grades and short pieces may be suitable only for boxes and crates. A remanufacturing plant serving a number of customers can obtain maximum utilization of the lumber because of the large variety of different-sized cuttings required.

2. Surfaced lumber brings a much higher price in the market than rough lumber because it is more desirable and usable, even considering the added cost of seasoning and machining.

3. Because the weight has been reduced, through seasoning and surfacing, considerable transportation costs have been eliminated.

4. Rough lumber cannot be painted, and paintability is a necessary feature. Therefore, this factor is one of the most important advantages of surfacing lumber.

LUMBER

For planing mills, lumber is the only raw material purchased, processed or sold. It is assumed that the planing mill will receive the lumber in rough form as it comes from the head saw in the sawmill. It would be unseasoned or, perhaps, partially air dried. The rough lumber would probably be received as (1) boards, which are less than 2 inches thick and 8 inches or more wide, (2) strips, which are boards less than 2 inches thick and less than 8 inches wide, (3) dimension, comprising lumber from 2 inches up to 5 inches thick, and of any width, and (4) timbers or cants, which are 5 inches or more in least dimension.

The lumber might come either from the softwoods, which are the conifers or needle-bearing trees like pine, fir or hemlock, or from the hardwoods, which are broad-leaved trees such as oaks, maples or gums. Actually, relative hardness is not the chief characteristic designating the two, as some of the softwoods are harder than some of the so-called hardwoods.

In the United States, about four-fifths of the lumber produced is softwood, and only one-fifth is hardwood.

It has been said that over 1,000 recognizable species of trees are found in the United States. However, the commercial varieties, while numerous, do not constitute quite such a formidable list. Wood production in the United States for the year 1953 is reported by the Department of Commerce to be as follows:

Softwoods	Thousands of Board Feet
Cedar, Port Oxford	9,185
Cedar, Western Red	303,364
Douglas Fir	10,366,636
Fir, White	1,576,691
Hemlock	1,440,786
Larch	402,455
Pine, Ponderosa	3,783,401
Pine, Southern Yellow	7,581,259
Pine, Sugar	432,597
Pine, White	1,353,705
Redwood	969,447
Spruce, Engelmann	404,412
Spruce, Sitka	101,629
Other Softwoods	836,486
Total	29,562,053

Hardwoods	Thousands of Board Feet
Ash	111,597
Beech	235,630
Birch	131,515
Cottonwood and Aspen	406,367
Elm	210,509
Gum, Black and Tupelo	530,445
Gum, Sweet	330,747
Maple	551,492
Oak	3,338,969
Sycamore	71,111
Yellow Poplar	708,870
Other Hardwoods	552,904
Total	7,180,156

The American planing mill buys and sells lumber by the board foot measure. A board foot is the quantity of lumber contained in, or derived from, by planing or otherwise, a piece of green, rough lumber which is 1 inch thick, 1 foot wide, and 1 foot long, or an equivalent volume in long, wider, or thicker lumber. This applies except in the case of lumber with a nominal thickness less than 1 inch, for which the number of board feet equals the nominal width in feet multiplied by the length in feet. Where the width of lumber is expressed in inches, as is usually the case, it is necessary to divide the inches by 12 to convert them to feet or a fraction of a foot. Lumber prices are generally quoted in dollars per thousand board feet, which is abbreviated to Mbf.

As stated before, the planing mill would probably get its rough lumber directly from the mill, or perhaps partially air dried. Only in rare instances could the planing mill utilize such lumber. It should first be seasoned.

LUMBER SEASONING

Lumber, as it comes fresh from the log, contains much sap and water. It might be said that, on the average, the moisture content will be equal to about 50% of the dry weight of the wood. This moisture is removed by seasoning or conditioning.

Green lumber with its high percentage of moisture is used for such items as posts, mine timbers, concrete forms and rough and temporary structures. All lumber requires at least partial seasoning; thoroughly air seasoned lumber can be used for sheathing, roof boards, boxes and crating. However, all hardwoods and softwoods which will be remanufactured into furniture, cabinet work, and millwork in general, must have moisture removed in the dry kiln.

AIR DRYING

Most lumber is first seasoned in open piles out of doors. This is especially true of the hardwoods. Air-dried lumber is a loosely-used term meaning lumber that has diminished its moisture content to such a point that it is nearly in equilibrium with the outside air. Such lumber still contains from 15% to 30% of its weight in water.

During the process of air seasoning, several results are accomplished:

1. Removal of the excess moisture means that the weight of the lumber has been reduced from a quarter to a third of the green weight, which effects a saving in transportation costs.

2. All wood shrinks while drying, and it is essential that the moisture content be brought to the equilibrium moisture content* of the factory in which it is to be used.

3. Because lumber shrinks during the seasoning process it may be degraded by checks, cracks, and other defects due to the process; hence, buyers prefer to purchase lumber that has been inspected and graded after seasoning.

4. Seasoning increases the strength and hardness of lumber.

5. When lumber is thoroughly dry, destructive fungus cannot grow.

The time required for air drying lumber depends on many factors, such as:

1. The species.

2. The size of the individual pieces.

3. The climate and the time of the year. Lumber dries quickest in warm, dry, windy weather.

4. The method of piling, the arrangement of the yard, and the protective covering given.

Bearing in mind these factors which affect drying, the following may be used as a guide:

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* Equilibrium moisture content is the moisture content at which wood neither gains nor loses moisture when surrounded by air at a given relative humidity and temperature.

Drying Period for 1-Inch Lumber

	Days Required to Air Season to Approximately 20% Moisture
Hardwoods	
Birch	150 - 200 days
Maple	150 - 200
White Ash	70 - 110
Basswood	30 - 60
Chestnut	85 - 125
Walnut	120 - 170
Red Oak	170 - 250
White Oak	240 - 300
Swamp Oak	360 - 400
Softwoods	
Spruce	45 - 90
Redwood	60 - 180
Douglas Fir	40 - 70
Southern Pine	40 - 70
Ponderosa Pine	45 - 90
Northern Pine	60 - 150
Cypress	200 - 275

Air seasoning has the advantage of being a simple process and requires no special equipment. On the other hand, the disadvantages of air drying against kiln drying are many:

1. The long drying time ties up capital in stock waiting to be shipped.

2. It is difficult to prevent discoloration due to sap stain during some seasons of the year.

3. The process cannot be controlled, as in a kiln.

4. For most purposes, such as for flooring, furniture, and interior trim, lumber needs a final kiln drying.

Actually, most lumber which is kiln dried has had a preliminary period of air drying.

Air Drying Process

Lumber is air dried by properly stacking green rough lumber in areas exposed to the free circulation of the outside air for varying lengths of time. Care must be exercised in each location where lumber is air dried to conform to the stacking methods which the nature of the area imposes to prevent warping, checking, straining and effect of fungus.

The stacking area should be easily accessible and on ground suitable for handling lumber. The soil should be sufficiently compact to permit laying foundations capable of supporting the weight of the lumber piles. Soil that drains quickly tends to lower the moisture content of the air above, thus hastening the drying.

The ground should be kept free of debris and vegetation, since these harbor fungi and insects, and materially interfere with the movement of air over the ground surface and beneath lumber piles. The area layout should provide for wide alleys and ample space between piles to insure good air circulation and adequate room for hauling and handling lumber. Alleys should be at least 16 feet wide, and piles should be separated by at least 10 feet.

Whenever possible, lumber piled for drying should be located on the highest areas to afford free air circulation, and piling should never be done in narrow hollows or valleys where moisture might settle and where the free movement of air is prevented.

The best practice to follow is to pile according to species, grade, thickness, width and length. Where volume handled is great enough to warrant it, separate piles of dried lumber should be available, containing each market rating by grades. There are several ways to stack lumber, suitable to individual climatic conditions, species and dimensions, and each operator must determine the degree of segregation which he can afford to follow. Therefore, it is suggested that an operator obtain publications dealing with this subject from the Forest Products Laboratory, Madison, Wisconsin, and from local sources.

In humid climates, green lumber may deteriorate rapidly from fungus and insect attack. The speed and extent of deterioration depends largely on temperature and the moisture content of the surrounding atmosphere, because fungi and insects are quite active during warm weather, less active during cool weather and comparatively dormant in extreme cold.

Fungicides and insecticides are available for treating freshly cut lumber, and when these chemicals are properly used, fungi and insects are not

apt to attack even sap wood. When chemicals are used to prevent deterioration, it is wise to learn how such chemicals accomplish their purpose to prevent misuse. When properly employed, chemical treating of lumber may be economically feasible; conversely, when chemicals are improperly used, the cost of treatment becomes excessive.

When the moisture content of wood falls below 20%, fungi cannot develop and the wood is less attractive to insect attack. Therefore, insect and fungus attack may be prevented by drying, at least the surface of the wood, to 20% moisture content as quickly as possible.

The foundation upon which drying piles are erected is important. Most species of lumber are rather dense, and the total weight of piles is directly proportional to their heights and the amount of lumber in the pile. Where the nature of the soil is such that compactness varies over the surface area, piles are apt to settle more deeply in some spots than others, thus imposing strains at varying places within the pile.

Such strains, if excessive, will warp and frequently fracture wood fibres to a degree which might downgrade the product appreciably. The foundation should be constructed so as to provide at least 20 inches between the ground and the first course of lumber.

Lumber should be piled so that its weight bears on the widest face, not on edges or ends. Level piling is usually the quickest and less costly method. However, stacking piles lengthwise of the lumber provides for quick run-off of water caused by rain, thus tending to reduce stains. Lumber should not be piled with one board resting upon another. To prevent boards from resting closely one to another, narrow stacking strips, called stickers, should be spaced crosswise of each course of boards from 3 feet to 4 feet apart. These strips should be uniform in thickness and not exceed 3 inches wide. Using wider strips may cause undesirable staining of the wood and tend to hold an excessive amount of moisture at the area where they contact the wood.

Stickers should align parallel to the front edge of the pile, and each row of stickers should be located directly above the one below. When stickers are offset to any appreciable degree, the weight of the upper courses of lumber may warp layers of boards which are not supported properly.

When laying the courses of boards, care should be exercised to space boards at least 3 inches apart to provide for a free circulation of air. Good sticker alignment and uniform spacing are essential to obtain uniform drying results with a minimum amount of damage to the product.

Several piling practices are possible, any of which, if properly followed, should bring desirable results. The principal practices are box piling, unit-package piling, end piling, random-length piling, crib piling and end racking. Experience gained over a period of time in particular climates usually results in developing individual refinements to reduce costs and acquire better grades of products by reducing checking, warping, blue staining and decay.

A considerable amount of literature has been published on methods of piling lumber. To achieve suitable results in specific climates where certain other physical conditions must be dealt with, it is advisable to study this literature to ascertain the practice most suitable for the prevailing conditions.

The libraries of forestry departments of most universities contain such literature, and the agricultural or forestry ministries of most governments have accumulated such information.

It should be remembered that the relative amount of profit from a lumbering project is greatly dependent upon the success attained in upgrading raw green lumber. Good green lumber may be downgraded by poor treatment or faulty handling and drying practices, and, oftentimes, relatively inferior grades of green lumber may be upgraded by care in the way lumber is piled, dried and handled.

It should be borne in mind that the degree of success achieved in a lumber operation, like in every other business enterprise, is dependent upon the amount of knowledge and experience acquired by the operator, and the degree to which this information is utilized in the conduct of the enterprise.

KILN DRYING

The objectives sought in kiln drying are as follows:

1. To shorten the time required for drying, thereby releasing capital and obtaining funds more quickly.

2. To prevent staining and to kill insects.

3. To eliminate some of the losses due to degrading. Defects which sometimes occur during the air curing should not occur in kiln drying where the conditions of heat and humidity are controlled.

4. To reduce transportation costs because the weight will be less as moisture is removed.

5. To bring the moisture content to the level which is required in furniture factories, millwork plants, and other types of wood fabricating plants.

Kiln Drying Time for 1-Inch Lumber

	Days to Kiln Dry	
	From Green to 6% Moisture	From Air Dried 20% Moisture to 6% Moisture
Hardwoods		
Birch	11 - 15	5 - 8
Maple	10 - 14	5 - 7
White Ash	12 - 18	4 - 7
Red Gum	16 - 24	5 - 9
Basswood	7 - 10	3 - 5
Chestnut	8 - 12	4 - 8
Walnut	12 - 18	6 - 8
Red Oak	16 - 26	4 - 8
White Oak	20 - 45	6 - 12
Swamp Oak	20 - 50	6 - 14
Softwoods		
Spruce	4 - 7	3 - 5
Redwood	7 - 10	4 - 7
Douglas Fir	4 - 8	2 - 4
Southern Pine	3 - 6	2 - 4
Ponderosa Pine	3 - 5	3 - 5
Northern Pine	5 - 8	3 - 5
Cypress	6 - 10	4 - 6

Kiln Drying Methods and Costs

A relatively small investment in equipment and facilities is required to air dry lumber, while, to erect and operate a dry kiln, it is necessary to invest a substantial amount of capital in plant and facilities. Expenses

also are incurred during the plant's operation. To justify an investment in dry kiln equipment, therefore, a careful study of governing factors is necessary. There is no established premise upon which to base arbitrary conclusions. Specific situations must be studied individually, but the study may be helpfully guided by the wealth of economic and technical data already available in published literature, and from manufacturers of dry kilns.

The art of kiln drying lumber has advanced to a degree where excellent results may continuously be obtained almost automatically, but to properly design a kiln requires the application of sound engineering principles. It is suggested that when an installation is contemplated, a reputable manufacturer of such facilities be consulted.

The leading American designers of dry kilns supply questionnaires on which may be recorded information pertinent to requirements for proper design. From this preliminary data, it is usually possible for a manufacturer to furnish information on kilns which should comply with individual conditions. Usually manufacturers' recommendations are accompanied by price and delivery quotations; also, they furnish opinions concerning the economic feasibility of acquiring a kiln to comply with specific situations.

Many attempts have been made by operators to construct kilns without technical assistance under the mistaken notion, perhaps, that there are no essential principles involved and that a plant may be acquired without an expenditure for engineering advice. Most operators who have gone unaided in this fashion usually are willing to admit that they took an unwise course and may cite instances where costly and undesirable conditions resulted.

There are technicalities involved in the design of a kiln to perform satisfactorily and the data accumulated by manufacturers of this equipment are the result of experience gained over a period of many years designing and operating a wide variety of kilns in all parts of the world, operating under nearly all climatic conditions, and drying almost every species of wood.

The required investment for dry kilns ranges from a minimum of about $10,000 to over one million dollars for large installations. A small kiln (26 feet wide by 20 feet long and 11 feet high) capable of handling from 6,000 to 7,000 board feet of 1-inch thick lumber, is sold for a price varying from $2,500 to $5,000 for the equipment and from $3,000 to $5,000 additional for the structure to house the facility.

At the other extreme, it costs $50,000 to construct a brick kiln, with all equipment and controls, of 20,000 board feet capacity. Perhaps a fair

estimate would be approximately $2,000 per thousand board feet of capacity, but this figure might vary greatly for different installations.

The price of the equipment varies according to the design of the heating system and the steam pressure available. Where low pressure steam is available, the heating system contains more and larger pipe than would be required where high pressure steam is obtainable. The structure cost varies according to the materials available at the location where construction takes place. Wood, concrete blocks, bricks or sheet metal may be used for all construction, and where wall insulating material is required, this item may be economically obtained locally.

Since the price of fuels vary, the cost of steam produced is dependent upon local fuel costs Wood waste may be used as fuel, if available in sufficient quantity and means are provided to stoke the boiler continuously. Oil or gas is used almost universally in the United States because these fuels may be consumed automatically without requiring the attention of labor.

Classes of Kilns

Kilns generally are classified according to the method used to dry the stock, that is to say, the regulation of humidity and circulation within the kiln. Heat is obtained by the use of steam radiators or coils. In ventilated kilns, humidity is supplied by steam spray pipes, and chimneys are used for both the circulation of air and elimination of moist air. In forced-draft or blower type kilns, fan blowers are used for circulation and spray pipes for humidifying the air, or steam jet blowers are used for both circulation and humidification.

Kilns also are classified according to the method used in loading and unloading. In the progressive type, lumber is loaded in one end while an equal amount is removed from the opposite end daily. This type is probably the cheapest to operate, but, on account of the opening and closing of the doors at both ends, the humidity and temperature conditions cannot be regulated too accurately.

In the compartment type, the entire kiln is charged at one time. When the lumber has reached the desired state of conditioning, it is all discharged and a new charge is loaded into the kiln. Because there is no opening or closing of doors during the drying period, a closer regulation of heat and humidity is possible.

Figure 1 provides a series of views of three sizes and two varieties of dry kilns, one being trackless, which requires that the lumber be handled with mobile equipment, and the other equipped with tracks on which lumber may be moved into and out of the kiln.

Kiln Drying Costs

	1-Inch	1-1/4-Inch	1-1/2-Inch	2-Inch	2-1/2-Inch	3-Inch	4-Inch
Class 1 Basswood Cottonwood Cypress Spruce	$15	$16.50	$17	$18	$20	$24	$28
Class 2 Chestnut Cherry Fir Pine	$16	$17	$18.50	$20	$22	$25	$30
Class 3 Ash Beech Birch Gum Maple (Hard) Hickory	$17	$18	$20	$22	$25	$30	$35
Special Oak (Red) Oak (White) Walnut	$19	$20	$21	$24	$28	$39	$40

Notes: Above prices are for lumber containing 30% moisture and less.
Add 25% to above prices for lumber containing 31% to 40% moisture.
Add 50% to above prices for lumber containing over 40% moisture.
1-inch price prevails on all stock less than 1 inch.
Add $6.00 per thousand feet for narrow widths and short lengths.
This is actual price list of a medium-sized company in the Midwest United States.

The principal results from a properly designed kiln are uniform moisture conditions, improved product and the possibility of upgrading, continuous compliance with desired production schedules, freedom from loss of downgrading caused by checks, stains and fractures of wood fibers, a faster drying cycle, and, usually, a lower ultimate cost.

Kiln Drying Cost

The actual cost is difficult to determine because of the varying conditions under which kiln drying is done. Operators of small to medium size kilns (drying up to 1,000,000 board feet per year) report total costs of from $16.00 to $26.00 per M board feet, based on 1-inch boards (softwoods).

Perhaps the best approach to the actual cost of kiln drying is to refer to the price list of a medium-sized company in the Midwest. This plant does custom drying; that is, the lumber is all owned by manufacturers who contract to have the kiln drying done. The price list, somewhat condensed, is shown on the preceding page.

The extra price charged for kiln dried stock by wholesale lumber dealers checks fairly closely with the figures shown.

By deducting approximately 10% from the kiln drying costs in the price list to allow for a nominal profit, one can obtain a fairly good idea of the actual costs for kiln drying in an efficiently operated plant.

GRADING LUMBER

Fundamentally, to "grade" lumber means to assort lumber and to classify it according to quality. "Grading Rules" are the specifications by which lumber is classified according to quality.

"Standard Lumber Grades" means a system of classification of lumber based on quality. That used for a given species is given in the grading rules of a lumber association. A considerable degree of uniformity between the different associations is maintained through the use of American lumber standards as a recognized guide.

American Lumber Standards for Softwood Lumber, published by the United States Department of Commerce, Washington, D.C., should be consulted.

Lumber generally is inspected and graded when green as it comes from the sawmill. Some mark of identification is placed on the face side near one end, and lumber of the same species, grade, and size is separated from other pieces and piled together.

After lumber has been seasoned, numerous checks, cracks, and perhaps stains will be found, which necessitate another grading. In the small plant being considered, this second grading would probably come after the planing and sawing operations.

One of the reasons for the sawing operations is to cut out knots and other defects that appear in the lumber, so as to produce as much high grade stock as possible. By judicious trimming, the stock can be upgraded to a considerable extent, and higher prices may be obtained for the lot of lumber, as a whole.

This is one of the reasons why some planing mills are more profitable than others. There is always a market for any grade of lumber, but the better grades command higher prices and return a larger profit to the planing mill operator.

It has been mentioned that standard grades have been established for all the usual kinds of lumber, and the planing mill operator must know and observe these standards, or there will be complaints from the customers. Realizing the impossibility of grading every single board exactly right, it is customary in some markets to permit 5% of the total contents of the shipment to be off grade. In case of dispute between buyer and seller, it is customary to agree on a reinspection made by a qualified person, with the cost of handling and reinspection to be borne by the one found to be in error.

MACHINERY AND EQUIPMENT

The specific products to be made in each plant, the species of wood to be used, the desired output, and the degree of finish required are but a few of the factors which must be considered before buying any kind of machinery.

The makers of planing mill machinery will furnish suggested layouts and equipment required for a plant designed for the most efficient manufacture of:

1. Boards surfaced 4 sides, or
2. Dimension lumber, that is, 2X4, 2X6, 2X8, and 2X12 structural lumber, or
3. End-matched flooring and pattern stock.

Such plants would be conveyorized and mechanized with specialized machinery because it would be a mass-production operation.

This brochure is concerned with a less definite type of operation, namely, a small plant able to do a fairly efficient job on all types of rough lumber as it comes from one or more sawmills, and to utilize the rough lumber to the best advantage by turning out all kinds of planing mill products, such as flooring, siding, structural lumber, or graded lumber which will go to other plants, such as millwork plants, for further manufacture.

When all the requirements are known, any reputable manufacturer or sales agent will recommend the best type of machine for the purpose. Therefore, this should be noted and followed:

> Manufacturers, or their sales agents, should be consulted for complete information on costs, special equipment, weights, location of the mill and other specifications to provide the most efficient operation and to produce the most salable products.
>
> Capable consultants and engineers will recommend the proper equipment, furnish technical data, and design the layout to meet the specific requirements. Then the machinery may be ordered and installed.

Because of the impossibility of knowing all factors in advance and because there are a large number of manufacturers making machinery, no attempt is made to recommend any individual product. However, a particular well-known brand is mentioned under each type of machine, and this indicates that the named machine, or a similar one, is suitable for the purpose.

The prospective plant operator should study the technical details in the manufacturers' catalogs. All the machines mentioned are well constructed, with ball or roller bearings wherever necessary, and come equipped with individual electric motor drives.

Planer

This machine is used to reduce stock accurately to the required thickness and at the same time produce a smooth finish. The planer, or double surfacer, essentially includes a mechanism that holds the stock flat and feeds it through revolving cutterheads. Planers are operated by two men. One feeds the rough lumber into the machine, and the other puts the surfaced boards on trucks for delivery to the lumber pile or to the next machine.

A large part of the planer work would probably be devoted to the remanufacture of 1-inch boards. Surfaced lumber sells at higher prices than rough lumber, and because of the reduction in freight cost by removal of the excess stock, it more than pays to perform this planing operation.

Rough surfacing lumber before it is ripped also has the following advantages:

1. A better facing job (taking out the twist or "wind") is obtained.

2. Glued-up panels require less stock to be removed to bring them to a smooth surface on both sides and at the same time hold them to the close tolerance in thickness required.

3. Loose or semi-loose knots are easily seen and cut out.

All this results in a more desirable product which can be sold at higher prices.

Planers are made in all sizes, from small to very large. The output is dependent on many factors, among which are the species and condition of the lumber, the amount of stock to be removed (depth of cut), the number of knives in the cutterhead, and the quality of finish desired (knife cuts per inch). The rate of cutter speed and the feed rate determine the capacity of these machines.

It can be assumed that the number of cuts per inch required for various finishes is as follows:

Timbers and construction dimension lumber, 8 to 12.
Lumber for exterior use as weather boards, siding and similar items, 12 to 16.
Flooring, ceiling and similar items, 16 to 20.

Actually, the number of knife marks per inch is equal to the revolutions per minute (r.p.m.) of the cutterhead times the number of knives divided by the feed rate (in feet) per minute (f.p.m.) times twelve. Expressed as a formula:

$$\text{Knife cuts per inch} = \frac{\text{r.p.m.} \times \text{Number of Knives}}{\text{f.p.m.} \times 12}$$

It could be expected that a machine (such as considered suitable for the small planing mill) with 4 knife-cutting units, revolving 3,600 times per minute, which is attained using the standard 2-pole electric motor operating at 60-cycle frequency, would have an output capacity of approximately 100 linear feet per minute. (On narrow stock, two or more pieces can be fed through the machine simultaneously.)

The planer should have sheet-metal hoods to collect the shavings, built-in grinding knives to keep lost time at a minimum and variable speeds to give feeds from 32 to 173 linear feet per minute. This would give knife cuts as follows:

Feet Per Minute	Knife Cuts Per Inch
32	37
42	28
46	26
61	20
75	16
101	12
128	10
173	7

Note: The above is based on 3,600 r.p.m., with 4 cutterheads.

Capacity, in thickness, from 1/8-inch to 14 inches; in width, up to 30 inches.

Suitable: Buss Machine Works
No. 55 Fast Feed Heavy Duty Double Surfacer.

Matcher or Molder

A matcher or molder is essentially a double surfacer, but it has additionally two side heads so that the stock can be finished on all four sides. Profile attachments permit working the sides of the stock to the various contours or patterns required. Specially designed matchers are available for cutting a tongue and groove on the edges (for flooring), or V-shapes for ceiling, partition, and sheathing material. But for an all-purpose planing mill, which might be expected to turn out a large variety of products, a more versatile machine, known to the trade as a "molder," would be suggested.

The general remarks made about the planer also apply to the molder; the principal difference is in the number of cutterheads.

In the typical molder, the top cutterhead cuts first so that the stock will be of uniform thickness before further machining. A device known as a holddown, controlled by springs, holds down the stock before it passes under the cutterhead, and also prevents the stock from splintering by controlling the chips. The top cutterhead, as well as each of the others, has a sheet metal hood which connects to a suction system to carry the chips to the main blower line.

The next cutterhead to be applied to the stock is the one on the left side; then the cutter on the right side does its work. After the top and the two side cutterheads have surfaced the stock, or cut their patterns, the stock is of such uniform dimension that it can be held firmly while it is being advanced over the bottom cutterhead, and the amount of material being removed will always be the same. The stock is then pushed off the machine by the following piece.

With properly ground knives, the molder can produce finished stock with accuracy limits of a few thousandths of an inch.

Suitable: Diehl Machine Works
12-inch Molder
Variable speed drive giving standard feeds
from 20 feet to 150 feet per minute.

Rip Saw

The rip saw, for cutting boards or other pieces lengthwise (with the grain), will be a necessary piece of equipment in the planing mill. Not only can wide boards be reduced to desired widths, but stock can be trimmed to eliminate loose knots, thereby producing a better grade of lumber which can be sold at a higher price.

The rip saw should be of sturdy construction with an 80-inch table. It should carry a 14-inch to 18-inch diameter saw as standard and be equipped with a jointing device. The saw should be capable of handling stock from 1/8-inch to a maximum of 4-1/4-inch in thickness. The chain drive should give standard feed speeds from 58 to 180 feet per minute.

Suitable: The G. M. Diehl Machine Works
No. 750 Rip Saw

Cutoff Saw

The cutoff saw (crosscutting) also will be in use most of the time in the planing mill for trimming boards and other stock to the proper lengths, as well as cutting out knots and other defects, thereby upgrading the quality of the lumber.

Considerable fatigue, with low production, is occasioned when the operator manually pushes the stock against the saw, and then pulls the saw back through the cut. Hence, a machine is recommended which automatically performs these operations, as follows:

The worker positions the lumber against the adjustable cutoff stops and steps on an electrically-operated foot pedal. The saw blade, mounted on a hydraulically-operated carriage, automatically moves forward making the cut, and then returns to its original position. Cutting speeds may be adjusted to make from 0 to 45 cuts per minute, depending on cutting requirements and conditions.

Suitable: C. O. Porter Machinery Company
43-20J Hydracut Saw

Cost of Machinery and Equipment

Number	Item	Estimated Cost	Actual Cost
1	Planer	$ 10,000	
1	Molder	14,000	
1	Rip Saw	4,000	
1	Cutoff Saw	1,600	
1	Double End Emery Grinder	250	
	Spare Knives and Saws (estimated)	750	
	Small Tools, Benches, etc. (estimated)	400	
	Total	31,000	
Add:	Export crating and packing (10% of machinery cost)	3,200	
60	Platform Trucks, 4-Wheel, 3 feet × 6 feet, @ $30	1,800	
	Grand total	$36,000	

Note: The above cost is based on first-class machinery, with ball or roller bearings where necessary. It also includes all individual motor drives, complete for operation on 220 volt, 60-cycle, 3-phase current.

All illustrations in this brochure are intended only to show the types of machines which are considered suitable for installation; in no case is it meant to recommend any particular machine.

Note: While the machinery mentioned on previous pages is equipped for direct electric drive, it is possible to obtain belt-driven types. The belt-driven machines may be driven either collectively or individually by Diesel, steam or gasoline power units.

Usually planing mills are equipped with collector systems for the removal of sawdust and shavings. Such systems consist of hoods, piping and blowers, and a refuse burner is often used.

BUILDINGS

The planing mill is generally a one-story structure which must have wide doors to facilitate the movement of stock in and out. Storage sheds or covered areas are necessary to protect dried and finished lumber from the weather before it is shipped to customers.

It is desirable to have a spur track for the shipment of carload lots. Because of the fire hazard, wooden buildings should be well separated from each other.

The layout of a planing mill will depend on many factors, but principally on the type of products to be manufactured and the desired output. The following points are axiomatic and are offered only as a basis for efficient mill arrangement:

1. Machine Arrangement. The arrangement of the machines should be such that the lumber can be routed through the mill with a minimum of back-tracking. Any unnecessary handling or movement of material increases manufacturing costs without returning additional income.

2. Machine Operating Space. Each square foot of floor space costs money, and an over-allowance may be as detrimental to efficiency as over-crowding. However, in a planing mill, long boards are constantly being moved about and processed, and sufficient space must be provided to permit efficient operation. It is also important to realize that congested working areas create hazards that contribute greatly to the occurrence of accidents.

3. Storage and Accumulation Space. The question of storage space is frequently neglected by persons making layouts. As a result, over-crowding occurs, movement of material is slow and uncertain, and productivity is decreased. Ample storage space must be provided for storage of kiln dried material, for stock ahead of the surfacers, for stock ahead of and between

sawing operations, and for stock between the mill and loading dock. Secondary storage space may also be necessary at various points, for example, for the accumulation of scrap and defective stock to be reworked. Storage space and accumulation space have an important bearing on production. A machine capable of high output is no more valuable than one with lesser capacity unless sufficient accumulation space is available to take care of its production.

In order to estimate the amount of floor space that would be required for the machinery assumed to be necessary in this plant, a diagrammatic layout is presented as Exhibit 1. This layout shows the square footage required:

	Estimated Cost	Actual Cost
Main Building, 40 X 88 feet = 3,520 square feet, @ $3.00	$10,560	_____
4 Dry Kilns, 26 X 20 X 4 feet = 2,080 square feet, @ $2.00	4,160	_____
Covered Areas, 20 X 80 feet and 20 X 42 feet = 2,440 square feet, @ $1.00	2,440	_____
Boiler House (estimated), 460 square feet, @ $4.50	2,070	_____
Total	$ 19,230	_____
Allow extra for Drying Sheds: 20 X 40 X 4 feet = 3,200 square feet, @ $1.00	3,200	_____
Total building cost	$ 22,430	_____

Not shown in the sketch is the ventilating system which is necessary to collect the shavings and sawdust produced. This refuse, which has high heating value, would go to the boiler house and probably would be sufficient in volume to supply all the heat necessary to operate the drying system.

Drying sheds to partially air dry stock and to protect dried stock from the weather would be needed. (These are not shown on the sketch, as they would be apart from the other buildings because of the fire hazard.) Allowance has been made in the cost estimate for 4 sheds, each 20 by 40 feet. Estimated cost for all buildings is $22,430.

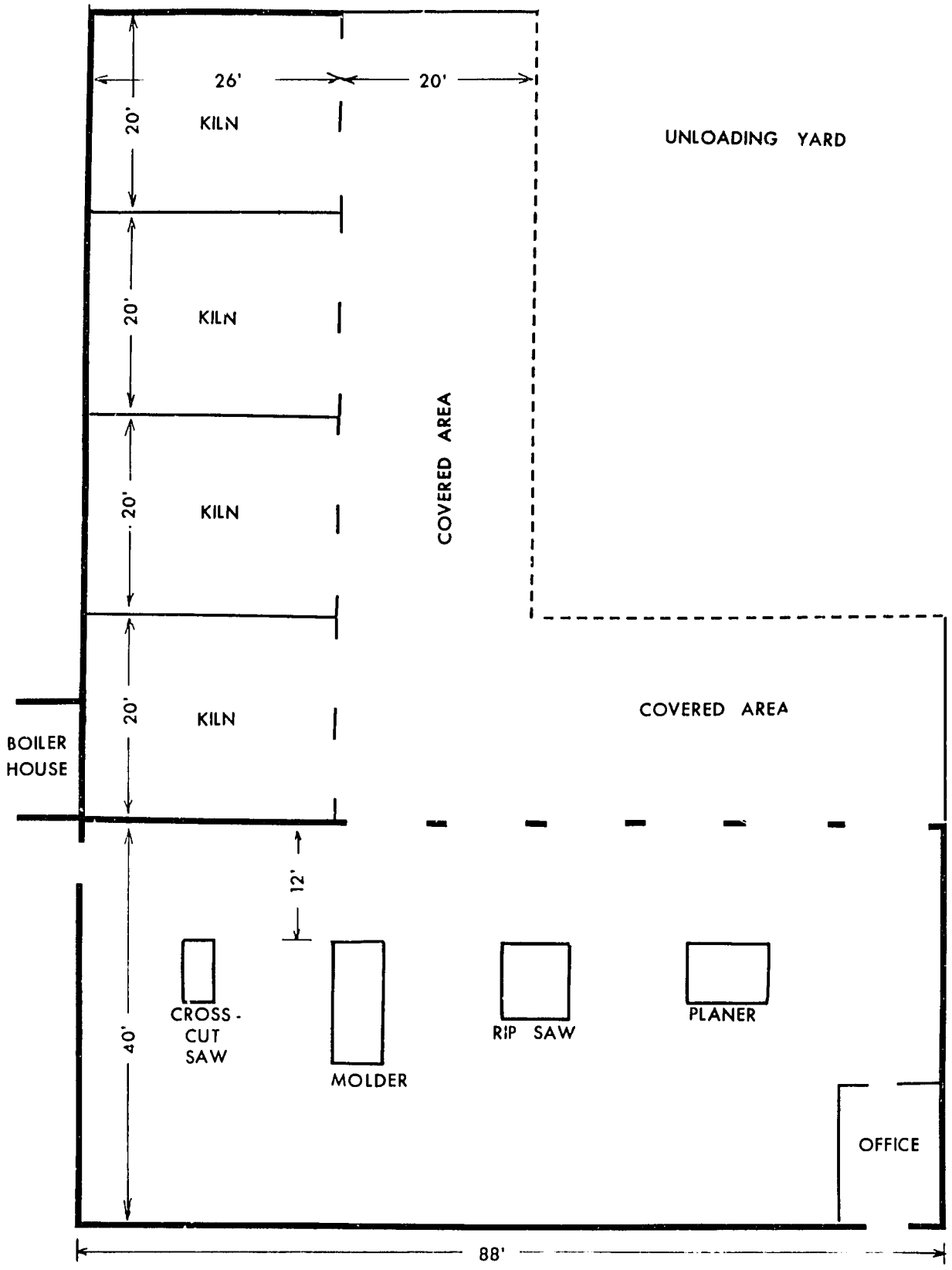


EXHIBIT 1

DIAGRAMMATIC LAYOUT FOR SPACE REQUIREMENTS

PERSONNEL

Labor Rates

The straight-time average hourly earnings for men in the millwork industry were reported by the United States Department of Labor to be:

	Chicago, Illinois 1952	Minneapolis, Minnesota Nov. 1951	St. Louis, Missouri Jan. 1952
Cutoff saw operators	$2.19	$1.57	$1.62
Molder operators (setup and operate)	2.28	1.68	1.77
Off-bearers (machine)	1.49	1.41	1.31
Planer operators (setup and operate)	2.10	1.52	1.50
Rip saw operators	2.11	1.56	1.52
Stock handlers and truckers (hand)	1.24	1.41	1.27

The above figures show a considerable variation by region and also a non-uniformity by job classification. An independent survey of small planing mills in the smaller towns in the Midwest in 1956 indicated current rates were approximately $2.00 per hour for machine operators, $1.60 per hour for off-bearers and yard laborers. There is usually a setup man for the molder who also acts as the chief mechanic on all machine operations. His rate is about $2.50 per hour.

Incentive pay plans are rare in small mills.

Woodworking operations are considered hazardous, and one of the important items in the factory burden is the cost of accident insurance. The rates vary greatly in different states. The premium for accident insurance has been reported as being anywhere from 2% to 12% of the total payroll.

Labor Force Required

It is estimated that staff requirements for the plant would be as follows:

		Per Week	Actual Cost
1	Manager	$ 200	
1	Clerk	60	
1	Fork lift truck operator @ $1.75 per hour	70	
4	Machine operators @ $2.00 per hour	320	
4	Off-bearers @ $1.50 per hour	240	
4	Yard men @ $1.50 per hour	240	
1	Kiln operator @ $1.75 per hour	70	
16	Total	$1,200	

Note: Where labor rates are low the handling of lumber by manual means might be low enough not to justify an investment in fork lifts or extensive mechanical conveyor equipment.

RESEARCH

Research, as the term is ordinarily used, would not be a recognized function in the organization of a small woodworking plant. The owner or operator would not have the time, facilities or technical training to conduct a program of research. Nor would that be necessary, as there are associations and organizations who are active in searching out new facts regarding the trade and technical problems of the industry and who distribute this information to their members and others engaged in the lumber business.

The National Lumber Manufacturers Association, 1319 - 18th Street, N.W., Washington 6, D.C., is a federation of 16 regional lumber manufacturers' associations, representing major regions, species, and products of the industry. Every important species of lumber has been represented in the association since its inception.

The following federated associations make up the membership of the National Lumber Manufacturers Association:

American Walnut Manufacturers Association, Chicago, Illinois
Appalachian Hardwood Manufacturers, Inc., Cincinnati, Ohio
Fine Hardwoods Association, Chicago, Illinois
Hardwood Dimension Manufacturers Association, Nashville, Tennessee
Hardwood Plywood Institute, Chicago, Illinois
Mahogany Association Inc., Chicago, Illinois
Maple Flooring Manufacturers Association, Chicago, Illinois
National Oak Flooring Manufacturers Association, Memphis, Tennessee
Northeastern Lumber Manufacturers Association, Inc., New York, New York
Northern Hemlock and Hardwood Manufacturers Association, Oshkosh, Wisconsin.
Northern Pine Manufacturers Association, Minneapolis, Minnesota
Southern Cypress Manufacturers Association, Jacksonville, Florida
Southern Hardwood Producers, Inc., Memphis, Tennessee
Southern Pine Association, New Orleans, Louisiana
West Coast Lumbermen's Association, Portland, Oregon
Western Pine Association, Portland, Oregon

Most of the associations have established grading rules for the lumber or other products they represent, and they issue pamphlets and other literature describing the characteristics, qualities, and uses of these products. Technical departments are maintained to develop new and better uses for lumber and wood products, and statistical information is compiled on a regular and continuing basis. Research covers such aspects as domestic and foreign markets, economic trends, and wood technology.

Certain other lumber associations operate at the national level. These include:

> The National American Wholesale Lumber Association, New York City, which is concerned with matters affecting the distribution of lumber, and carries on trade promotion work for the maintenance and extension of lumber markets.
>
> The National Retail Lumber Dealers Association, Washington, D.C., consists of state and regional organizations of retail lumbermen. Its primary purpose is to encourage the efficient and economical distribution of materials handled by retailers.
>
> The National Hardwood Lumber Association, Chicago, Illinois, is composed of manufacturers, wholesalers and industrial buyers of hardwoods. The grading rules of this association are recognized as the standard for almost the entire industry.

Boxes and crates, woodwork, cooperage, caskets, handles, lasts, furniture, cedar chests, pianos, railway ties, shingles, wood toys, and many other forest products have their own associations. The magazine Wood-Working Digest in the October 1952 issue listed over 60 woodworking associations and described their aims.

One should not ignore the many governmental agencies which supply statistical data and technical information of great importance. Pamphlets are issued by the United States Department of Commerce and the United States Department of Agriculture. Especially well known for technical excellence are those issued by the Forest Products Laboratory, Madison, Wisconsin.

The industry is fortunate in having a number of superior trade magazines. Among those which might be of greatest interest to the woodworking plant are: American Lumberman and Wood and Wood Products, both published by the Vance Publishing Company, 139 North Clark Street, Chicago, Illinois; Wood-Working Digest, Wheaton, Illinois, and The Wood-Worker, 2232 North Meridian Street, Indianapolis, Indiana.

The leading manufacturers of machinery and equipment list their products in these magazines, and in each issue there are articles contributed by staff writers or operating executives, giving important technical information. Careful reading of trade magazines is necessary if one is to keep abreast of the times and informed of new developments, processes and techniques.

ACCOUNTING INSTRUCTIONS

The general accounting principles used in any manufacturing concern can be applied to the planing mill and should present no difficulties for a trained accountant. However, the procedures used in cost accounting peculiar to the woodworking industry should be understood and followed, so the company can make accurate cost estimates, price the product intelligently, and operate profitably.

A complete Chart of Accounts is shown in the appendix. The Chart and also the data which follow in this section, are, of course, subject to some variation and change to meet individual conditions. The cost system of whatever nature should interlock with the regular bookkeeping system, and the accounts recommended will enable the company to accurately compute the various burden rates for any period.

The Chart of Accounts - and much of the data in this section - have been adapted and abridged from the Cost Finding System installed by the Millwork Cost Bureau, 332 South Michigan Avenue, Chicago, Illinois. This organization specializes in furnishing accounting service and standard cost data to millwork plants.

At least four basic burden rates are required in a planing mill, and the following information sets forth the method to obtain proper allocation of the various costs to establish these rates.

Fixed Charges

In order to distribute the fixed charges to the different departments, there should be prepared a schedule of distribution of investment similar to the following:

Schedule of Distribution of Investment

Department	Land	Brick Bldgs.	Wood Bldgs.	Machinery and Equipment	Trucks and Autos	Average Stock	Department Totals
Lumber yard	xxx		xxx	xxx		xxx	xxxx
Machine dept.	xxx	xxx		xxx		xxx	xxxx
Bench dept.	xxx	xxx		xxx		xxx	xxxx
Garage	xxx		xxx		xxx	xxx	xxxx
Warehouse	xxx		xxx	xxx		xxx	xxxx
Office	xxx	xxx		xxx	xxx	xxx	xxxx
Totals	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxxx

Note: The average stock is found by striking an average between the high and low total value in slack and busy seasons.

1. Insurance. Where the fire rate is common to all sections of the plant and yard, the total amount is prorated on all values, except land. Workmen's liability insurance is prorated on actual labor involved, and all special insurance premiums, such as boiler, auto and so on, are chargeable against their respective unit values.

2. Taxes. Real taxes are distributed on land and building values, and personal taxes are prorated on all machinery, equipment and average stock values. Special items are charged according to the plant unit involved. (Taxes based on profits are not an element of cost and are therefore eliminated here.)

3. Depreciation. Rates of depreciation recognized by the Federal Government are used. These are as follows:

Brick buildings	3%
Wood buildings	5
Machinery and equipment	10
Automobiles	25

4. Interest on Investment. Whether funds for the erection and equipment of the plant are from the sale of stock, private capital, or advanced by a bank loan, an interest charge must be accounted for. This includes 6% of the combined capital and surplus and also the interest paid on borrowings. The total figure is prorated over all values. Note this figure is never entered into the books; it is added only in the compilations necessary to arrive at burden rates.

Yard Lumber Burden

The total amount of burden (Account No. 420) includes the fixed charges applicable to the yard, plus all other costs incidental to unloading, piling, and loading the lumber. The Yard Lumber Burden is found by dividing the gross board footage of lumber handled during the period by the total cost. Note that the burden rate is expressed in dollars per thousand gross board feet.

Kiln Burden

The total amount of burden (Account No. 425) includes the fixed charges applicable to the kiln, plus all other specific costs. The total amount of Kiln Burden is divided by the total footage of lumber put through the kiln during the period. This gives a Kiln Burden expressed in dollars per thousand gross board feet.

Machine Burden

The total amount of burden (Account No. 440) includes the fixed charges applicable to the Machine Department plus all other specific costs, and is found by dividing the total burden cost by the number of direct Machine Department labor hours. Machine helpers' and off-bearers' time is considered as direct machine labor and, as such, should be included in the number of direct machine hours. The burden rate is expressed in dollars per machine labor hour.

Commercial Burden

The commercial expense is found by adding the delivery expense (Account No. 650) to the selling and office expense (Account No. 700). This total is added as a percentage of and to the factory cost, which is made up of labor, material, and their respective burdens, to obtain the total cost. The commercial burden percentage is found by dividing the total commercial expense by the total factory cost.

Summary

The application of cost to any order involves the following procedure:

Lumber Cost		
Delivered purchase price	xxxx	
Yard lumber burden	xxx	
Kiln burden	xxx	
Total - no waste	xxxx	
Waste	xxx	
Total lumber cost		xxxx
Machine		
Direct labor, xx hours @ xx	xxx	
Burden, xx hours @ xx	xxxx	
Total machine cost		xxx
Total factory cost		xxxx
Add: commercial burden at xx%		xxx
Total cost		xxxx

Note: Yard Burden and Kiln Burden are added to the delivered purchase price (per thousand board feet) to get the total lumber cost, before waste.

Waste Allowance

Waste percentages occasioned in the production of surfaced lumber run quite high, perhaps to 25%. There is approximately a 5% unavoidable loss in kiln drying, plus what is lost in planing, ripping, and cutting. The amount of waste would depend on many factors, such as the species of rough lumber, the condition in which it was received, the amount of dressing required (that is, 2 sides or 4 sides), the thickness of the stock, and so on. The planing mill manager should maintain a simple record which would enable him to evaluate all the various factors for his particular type of operation and to establish his own standards for waste allowance.

Notes on Cost

It may be interesting to note that in American mills the mill overhead cost (exclusive of yard burden and kiln burden) may be estimated at 150% to 100% of the direct labor cost.

A review of a number of wholesale lumber dealers' price lists shows that the following extras are charged over the quoted prices for rough lumber:

	Per 1,000 Board Feet	
	Softwood	Hardwood
For surfacing 1 or 2 sides	$12	$15
For surfacing 3 or 4 sides	15	20
Crosscutting	7	10
Ripping	7	10
Resaw	14	18

The price list from a prominent custom planing mill is as follows:

Resaw	$10.75 per 1,000 board feet
Surfacing (one or two sides)	11.50 per 1,000 board feet
Molding	15.00 per 1,000 linear feet

INVESTMENT AND WORKING CAPITAL REQUIREMENTS

This subject embraces so many undeterminable features that any general comment might be entirely misleading to a prospective operator. Specific figures could be given only after a knowledge of the conditions under which the enterprise would be operated.

The cost of kiln drying equipment, as has been noted, varies greatly and could be determined only after consultation with the manufacturers of the machines who would recommend suitable equipment for the capacity desired and the species of wood to be dried.

Value of inventories would depend on the type of business. Some plants work with no inventory at all. In other words, they do not own the lumber but simply dry the lumber and perform the milling operations under contract with the owners of the lumber.

On the other hand, the planing mill owner might conduct a business which would place him in the category of a wholesale lumber dealer; he would buy green lumber as he needed it or as it was offered to him and fabricate it into marketable finished lumber, thus making his profits as a merchant and assuming the usual risks due to changing trade conditions.

In some plants, the lumber arrives on freight cars or on trucks owned by the sawmill owner. The finished lumber leaves by freight car or on trucks owned by the purchasers of the finished lumber. Whether or not an investment in automobile trucks would be required by the planing mill operator would depend on the type of business he operates.

With the foregoing factors in mind, an estimate of the cash requirements for starting the business might be stated as follows:

Cash Requirements for Starting the Business

	Estimated Cost	Actual Cost
Cost of machinery and equipment	$36,000	_____
Fork lift truck, 7,000-lb. capacity (for yard use)	5,800	_____
Building cost	22,430	_____
Office equipment (desks, chairs, typewriter, files)	800	_____
Installation of machinery, including wiring	1,000	_____
Shavings and dust collecting system	4,000	_____
Payroll for one month	5,000	_____
Power, supplies and incidentals for one month (estimated)	.300	_____
Organization expense (estimated)	1,000	_____
Sundry and contingent cash requirements (estimated)	3,000	_____
Investment	79,330	_____
Working capital	10,000	_____
Total	$89,330	_____

CHART OF ACCOUNTS

ASSETS

CURRENT ASSETS

Cash

1. Petty Cash Fund
2. Bank
3. Bank

Securities

4. Bonds and Stocks

Receivables

5. Accounts Receivable
6. Notes Receivable
7. Accrued Interest Receivable

Inventories

10. Materials
    - A. Lumber
    - B. Machine Parts
    - C. Operating Supplies
11. Work-in-Process
12. Finished Goods

Other Current Assets

15. Cash Value Life Insurance
16. Deposits on Insurance, etc.
17. Due from Employees
18. Advances to Salesmen, etc.

FIXED ASSETS

30. Land
31. Land Improvements
32. Railroad Siding
33. Buildings (list separately)

LIABILITIES AND CAPITAL

CURRENT LIABILITIES

Payables

51. Notes Payable - Banks
52. Notes Payable - Individuals
53. Accounts Payable
54. Notes Receivable Discounted

Accruals

60. Accrued Payroll
61. Accrued Taxes
62. Accrued Interest Payable
63. Accrued Sales Commissions
64. Accrued Rent

Other Current Liabilities

66. Dividends Payable

LONG-TERM LIABILITIES

68. Mortgages Payable

RESERVES

70. Reserve for Bad Debts
73. Reserve for Depreciation: Buildings
74. Reserve for Depreciation: Machinery
75. Reserve for Depreciation: Tools
76. Reserve for General Equipment
77. Reserve for Yard Equipment
78. Reserve for Autos and Trucks
79. Reserve for Furniture and Fixtures

ASSETS

FIXED ASSETS (Cont'd)

34. Machinery
35. Tools
36. General Equipment (which cannot be charged to specific departments)
37. Yard Equipment
38. Autos and Trucks
39. Furniture and Fixtures

DEFERRED EXPENSE

40. Unexpired Insurance
41. Prepaid Interest
42. Other Deferred Expenses (Prepaid Rent, Advertising, etc.)

OTHER ASSETS

45. Organization Expense, Good Will, Patents, etc. (Key by letters.)

LIABILITIES AND CAPITAL

CAPITAL AND SURPLUS

80. Preferred Stock Issued and in Treasury
81. Common Stock Issued and in Treasury
82. Stock Subscriptions
83. Stock Subscribers (Accounts Receivable)
90. Paid in Surplus
91. Earned Surplus
95. Profit and Loss (for closing period only)

OR

91. Partners' Capital
95. Partners' Personal Accounts

CHART OF ACCOUNTS

PROFIT AND LOSS ACCOUNTS

Sales

170. Sales
171. Returned Merchandise
172. Adjustments

Purchases

270. Rough Lumber (with footage)

Direct Labor

408. Direct Labor

Operating Departments

420. Yard Expense
425. Kiln Expense
430. Factory General Expense
440. Factory Machine Expense
500. Garage and Truck Expense
650. Delivery Expense
700. Selling and Office Expense

Fixed Charges

800.

Other Income

900. Interest Earned
901. Cash Discounts on Purchases
902. Dividends Received
903. Commissions Received
904. Bad Debts Recovered
905. Profit on Sale of Capital Assets
906. Sundry Other Income

Other Deductions

950. Interest Paid
951. Cash Discounts on Sales
952. Bad Debts Written Off
953. Special Losses
954. Sundry Deductions

CHART OF ACCOUNTS

ANALYSIS ACCOUNTS

FACTORY OVERHEAD ACCOUNTS

420. Yard Expense

- 421. Fixed Charges
- 422. Labor
- 423. Supplies
- 424. Expense
- 425. Maintenance and Repair

425. Kiln Expense

- 425. Fixed Charges
- 426. Labor
- 427. Supplies
- 428. Expense
- 429. Maintenance and Repair

430. Factory General Expense

- 431. Fixed Charges
- 432. Indirect Labor (General Foreman, Janitor, etc.)
- 433. Supplies
- 434. Expense
- 435. Maintenance and Repair (All charges in this group are prorated to the various departments.)

440. Factory Machine Expense

- 441. Fixed Charges
- 442. Indirect Labor
- 443. Supplies (Oil, Grease, Emery Wheels, Cutter Blades, etc.)
- 444. Expense
- 445. Maintenance and Repair

COMMERCIAL OVERHEAD ACCOUNTS

500. Garage and Truck Expense

- 501. Fixed Charges
- 502. Labor
- 503. Supplies (Gas, Oil, Tires, etc.)
- 504. Expense
- 505. Maintenance and Repair (All charges in this group should be prorated to the Yard and Delivery costs before final computation of those burdens.)

650. Delivery Expense

- 651. Garage and Truck Expense
- 652. Hired Trucks for Delivery

700. Selling and Office Expense

- 701. Fixed Charges
- 702. Salesmen's Salaries and Commissions
- 703. Salesmen's Expense
- 704. Advertising
- 705. Officers' Salaries
- 706. Office Salary
- 707. Postage
- 708. Stationery and Supplies
- 709. Telephone and Telegraph
- 710. Heat, Light, Water
- 711. Professional Fees
- 712. Dues and Subscriptions
- 713. Donations
- 714. Travel and Promotion
- 715. Office Maintenance and Repair
- 716. Sundry Office Expense

800. Fixed Charges

- 801. Depreciation Charged Off
- 802. Insurance (Fire, Compensation, Auto, etc.)
- 803. Taxes (Local and Federal)
- 804. Rent

APPENDIX 2

MOTION PICTURES AND FILMSTRIPS

PLANER
35mm si b&w 1944
Price $4.95*

The Jam Handy Organization
2821 East Grand Boulevard
Detroit 11, Michigan

This filmstrip illustrates the setting up and operation of the wood-planing machine with emphasis on safe procedures.

PLANING ROUGH SURFACES TO DIMENSIONS
16mm sd b&w 16 min 1944
Price $35.15*

USOE, Distributed by:
United World Films, Inc.
1445 Park Avenue
New York 29, New York

The film shows how to use the single-face surfacer in planing rough surfaces to dimensions.

LUMBER FOR HOMES
16mm sd color 21 min 1950
Price $120.00

West Coast Lumberman's Association
1410 S.W. Morrison Street
Portland 5, Oregon

This film covers lumber processing from the washing through the gang sawing, trimming, grading, drying and finishing stages.

OVER PINE MOUNTAIN TRAILS
16mm sd color 29 min 1952
Price $180.00

Dierks Lumber & Coal Company
1006 Grand Avenue
Kansas City, Missouri

The film traces the manufacture of lumber from tree to finished product with substantial sequences on saw and planing mill operations.

TREE TO TRADE
16mm sd color 31 min
Price $195.00

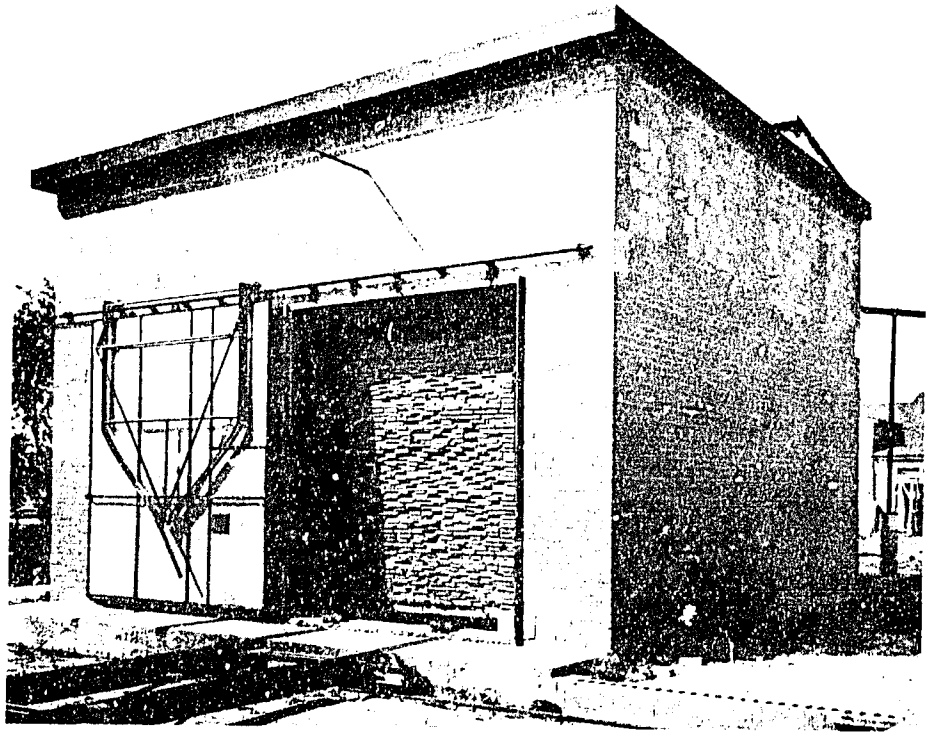
Long Bell Lumber Co.
Longview, Washington

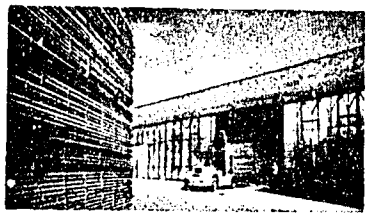
This film traces the development of forest products from trees to consumers with detailed sequences of planing mill operations.

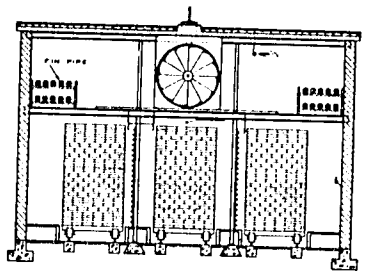
Key to Symbols

16mm	16 millimeter motion picture
35mm	35 millimeter filmstrip
sd	sound
b&w	black and white picture print
min	total minutes running time
si	silent

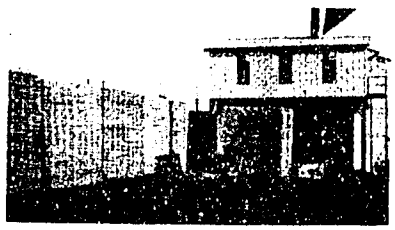
* Firm quotations. (Unless otherwise noted, all prices are estimated.)

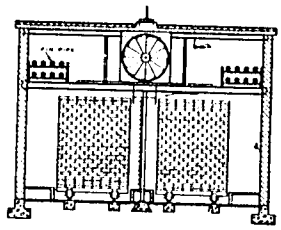




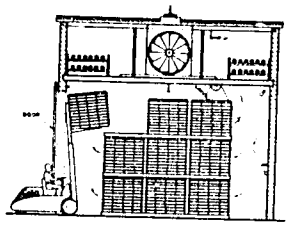


ILLUSTRATING TRIPLE-TRACK DRY KILN





ILLUSTRATING DOUBLE-TRACK DRY KILN



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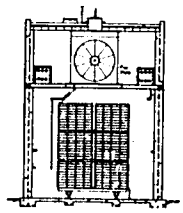
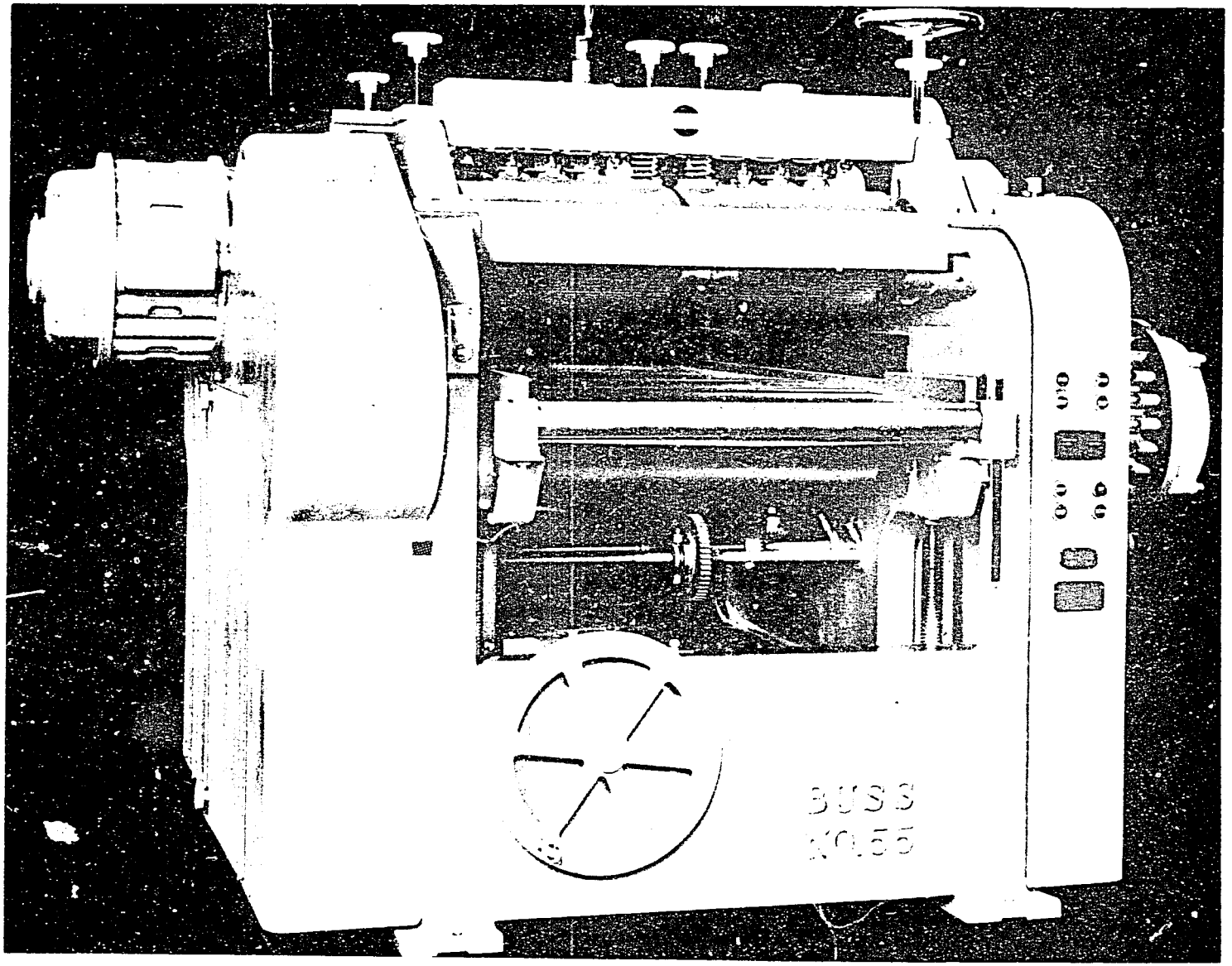


ILLUSTRATING SINGLE-TRACK DRY KILN

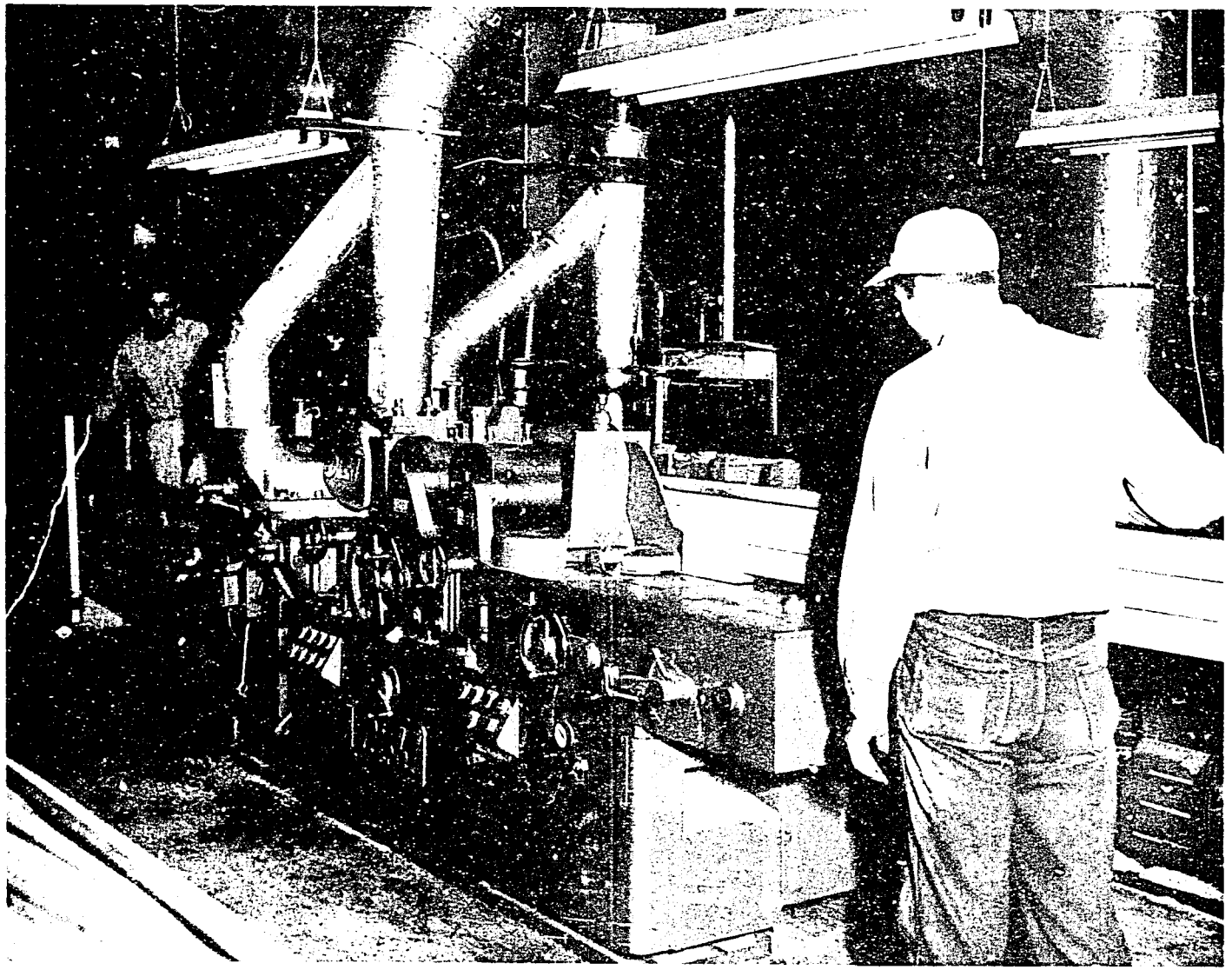
FIGURE 1. Courtesy of Moore Dry Kiln Company
Jacksonville, Florida



ILLUSTRATING FAST FEED HEAVY DUTY DOUBLE-SURFACE PLANER

FIGURE 2.

Courtesy of Buss Machine Works
Holland, Michigan



ILLUSTRATING MOLDER IN OPERATION

FIGURE 3. Courtesy of The G. M. Diehl Machine Works, Inc.
Wabash, Indiana

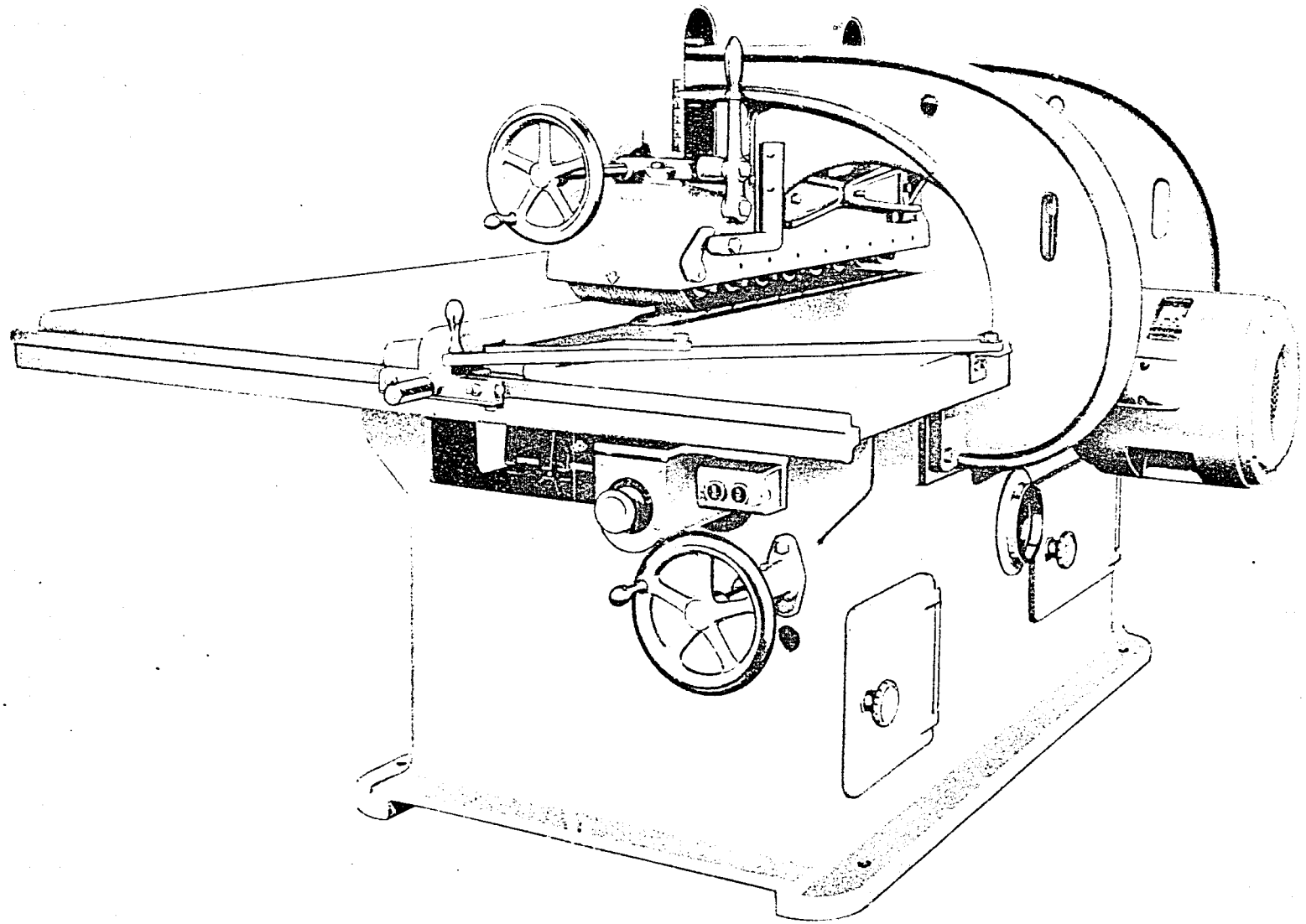
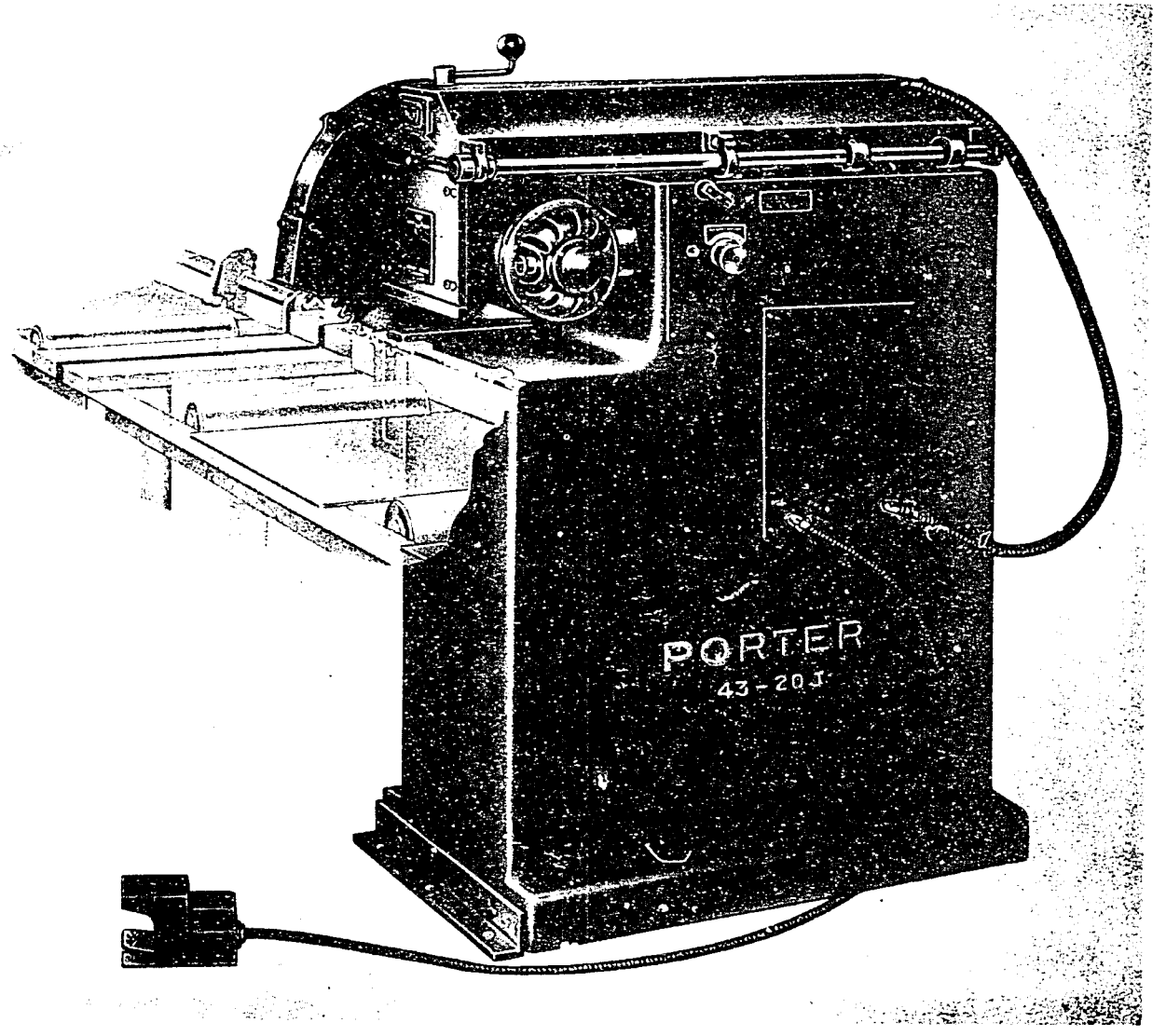


FIGURE 4. ILLUSTRATING RIP SAW

Courtesy of The G. M. Diehl Machine Works, Inc.
Wabash, Indiana



ILLUSTRATING CUTOFF SAW

FIGURE 5.