FABRICATION OF WOOD PRODUCTS AT SMALL SAWMILLS AND WOODWORKING PLANTS

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An increasing number of inquiries received at the Forest Products Laboratory request information on the manufacture of wood products at small sawmills and woodworking plants. Small timberland owners and small sawmill operators are among those who desire to establish small plants to utilize local timber supplies, or mill and woods waste.

In all regions of the United States the small sawmill is assuming a very significant position not only in numbers, but in total lumber production, and in influence on timberland management. Simultaneously, strong trends are developing, in connection with both small and large mill operations, toward the manufacture of finished or semifinished products at the sawmill rather than only a raw material to be processed elsewhere. Also a trend toward increased development of rural industry gives further emphasis to the subject. Underlying all other factors is, of course, the nature and distribution of timber, a raw material that lends itself to a scale of manufacture which starts small and grows as talent and experience develop.

Accelerated by war needs that resulted in many small sawmills engaging in the manufacture of fabricated products, such as pallets, boxes and crates, the combined small sawmill and woodworking plant is assuming a more prominent position in all regions. Many have been very successful in converting to peacetime products, thereby stimulating the interest of others.

Printed information on these subjects is not very plentiful, and what is available is scattered in various publications. The purpose of this publication is to aid those seeking this information. The publication emphasizes certain factors of business planning usually given too little attention, suggests some possible lines of manufacture, and briefly discusses equipment requirements. It gives references to publications which under other titles contain worthwhile details on particular aspects of the general subject.

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[1] Maintained at Madison 5, Wis., in cooperation with the University of Wisconsin.

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Fundamental Business Factors

Dominant in many requests received at the Forest Products Laboratory is the question of what product can be manufactured and how to make it. But the problem is not so simple as that. All accumulated knowledge with reference to the small wood products industry emphasizes the more basic importance of attention first to factors relating to adequacy of financing, management, raw material supplies, and marketing possibilities. These are matters of business planning that do not come within the sphere of specialization of the Forest Products Laboratory, and which each individual has to work out for himself in his own way. Only its importance can be dealt with here.

To provide merely a comfortable living for the owner of the plant may be a logical objective in many cases. A net return of some fairly definite amount may be what is in the mind of the prospective owner. The volume of business that must be done to net the anticipated income is obviously a first thing to consider, along with the capital investment required to produce the intended volume and the margin of profit realizable on each unit of production. Processing lumber to a product yielding a profit of $2.50 per M board foot involves handling 2 million board feet per year to net $5,000. The equipment required to process the two million board feet may cost $1,000 for some products or $50,000 for others. Obviously the product requiring a $1,000 plant investment is more attractive than the one requiring $50,000, other things being equal. But the product of the latter may be easier to market, less competitive, and in more stable demand. Thus capital investment, volume of business, and operating costs, as well as salesmanship and market demand, are a large part of the questions of what to make and how to make it. To these questions there can be no generalized answer. An attempt is made, however, to point out some of the main facts required so that the individual may work out the answers for his own particular set-up.

Capital Investment

The amount of capital required to operate profitably is fully as important as that required to establish the plant. Thus careful analysis is needed of the total finances required, to insure that adequate funds are provided for current operating expense, and for a reserve to meet unforeseen emergencies, as well as for purchase of facilities. For some plants these requirements amount to more than 100 percent of the amount invested in equipment.

Because some lines of manufacture require a relatively small investment, they are often launched when inadequately financed, and poorly equipped and manned. This frequently results in fluctuating production and often an inferior product. Because consumers demand a constant and dependable

supply of well-manufactured goods they quickly lose confidence in such a plant and turn to other more reliable sources, often to a larger plant in a distant area or to a substitute material.

Operating Costs and Accounting

Nearly 25 percent of the total operating costs of some small plants consist of such items as interest on capital, taxes, depreciation, and maintenance and repair of equipment. Many small plant owners, however, completely ignore many of these cost items because of inadequate records. Such cases account for the high percentage of failure occurring among small businesses. It is obvious that the adoption of more complete accounting will insure that indirect as well as direct operating costs are figured in the cost charges. For the small plant with limited personnel and facilities, bookkeeping can be reasonably simple, requiring primarily a systematic recording of financial transactions. A simple system is described in U. S. Department of Agriculture Handbook No. 27, "Small Sawmill Operator's Manual."[2] Also U. S. Department of Commerce Bulletin, "Establishing and Operating a Small Woodworking Shop," Industrial Series No. 47,[3] contains additional material on simple systems for shop records.

Supervision and Labor

Supervision in the small plant is frequently handled by the plant owner or one of the crew designated by him, either or both of these men being skilled in machine set-up, maintenance, filing and tool conditioning, and capable of training labor in the processes of manufacture.

Good labor is essential to the operation of any plant but especially to the small one because the small group must work as a team. While it is desirable to have experienced workers, it is commonly found in many areas that the average rural worker can be readily trained to do a wide variety of jobs requiring patience and skill. Thus with only one member versed in the techniques of manufacture it is possible to develop fairly quickly a trained crew.

Raw Material Requirements

Obviously an adequate wood supply is required to insure steady and continuous operation. Whether standing timber, lumber, or wood waste is to be the source of supply, the weak spot often is lack of knowledge as to the

[2] Obtainable from the Superintendent of Documents, Washington, D. C., for 65 cents, cash only.

[3] Obtainable from the Superintendent of Documents, Washington, D. C., for 15 cents, cash only.

character, size, and amount available, and to meet the requirements of the product. For mill and woods waste this may be determined from a careful study of the amount and kind developing at the point of origin. For standing timber, a timber cruise may be necessary. Methods of estimating standing timber are described in U. S. Department of Agriculture Farmers' Bulletin No. 1989, "Managing the Small Forest."[4]

Selling

It has been frequently pointed out that a factor of great importance, which often does not receive the attention it deserves, is the need for more and better salesmanship and market analysis. More time should be spent trying to find additional or better markets for the specific items that can be produced from the material available. In normal times wood must meet the competition of other materials. The lumber industry, as a whole, was accused for many years of adopting the "come-and-get-it" attitude. Fortunately, this attitude is much less in evidence today. When a plant owner undertakes the task of searching out the markets for wood products of all kinds and determining which of these products can be produced and distributed by his own plant and then goes out and sells them, progress is made.

Long lists of forest products are available, but the mere listing accomplishes little. There must be action on the part of someone, first to find a buyer for some of these products and then to see that products are made and delivered at a cost that is mutually agreeable to the producer and user.

Selling products intended for local farm use in a farm area involves contact with local farm agencies, fruit and vegetable exchanges, farm foresters, and county agents to determine local needs. Likewise, the needs of local industries can be determined through contacts with purchasing agents or other buyers. Advertising in the local paper will keep the prospective consumer informed of the goods, services, and facilities available.

Lines of Manufacture

Products having good local demand and of simple construction are the ideal ones for manufacture at a small plant. From the standpoint of local demand for farming areas the products may logically be those used in and for agriculture; for industrial areas, those involved in manufacturing enterprises. In either case they may be products required in connection with packaging and shipping of produce and goods. Or they may be items for use

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[4] Obtainable from the Superintendent of Documents, Washington, D. C., for 20 cents, cash only.

in construction or in making a variety of products, such as handles, miscellaneous turnings, furniture parts, and the like.

From the standpoint of simplicity, the amount of machinery required is a contributing factor but the degree of seasoning required is even more of a factor. Products produceable from only roughly dressed, green or yard dry material comprise a type that is easy to undertake. But such products are so easy to make that in normal times competition is heavy and the margin of profit extremely small. Products involving thoroughly seasoned material and accurate machining are of a type requiring more skill and experienced operators and also a larger investment. But they meet with less competition and are apt to be more profitable. They hold better prospects for the future.

In any case simple manufacture should not be confused with crude manufacture. The future prospects for the latter are not promising.

Little factual information can be given as to which lines of manufacture net the highest return in relation to raw material values or to invested capital or managerial talents. In general the more refined the product the larger the potential margin of profit. The newer or more glamorous products are what many are hoping to make, but they are not necessarily most profitable, particularly in the early stages of development. The relative position of different products varies from time to time. As a rule, if quality of material permits, refined building products are probably more profitable than rough factory dimension stock, and factory dimension more profitable than box and crating items.

The following classification may be of assistance in considering specific products in greater detail:

Square-edged items from green or yard dry stock

Slat and lath products (fencing, vegetable and fruit crates, shooks, industrial crates)

Lumber products (grain doors, cribs, bins, crating, car blocking)

Square products (stakes; handle, furniture turning, and dowel stock)

Patterned and shaped items from well-seasoned stock

Lumber products (pallets, agricultural implements and repair parts, prefabricated farm structures)

Turned products (handles, dowels)

Fabricated products (bed slats, lawn and garden furniture, play equipment, novelties, specialties)

Additional items to be considered in connection with the above classifications are contained in Forest Products Laboratory Reports R1666-2 "Uses for Slabs, Edgings, and Trims,"[2] and R1666-3 "Uses for Forest Waste."[2]

Equipment and Operating Requirements

It is generally recognized that a small plant is at a disadvantage with a large plant when making the same product because the larger plant has more and better equipment, can produce at a lower unit cost, and can operate on a smaller margin of profit.

However, the small plant has a chance to offset this disadvantage when it operates close to raw materials and in close proximity to markets. In other words, small plants often can find places to operate profitably where large plants cannot. The disadvantage is more fully offset when the small plant is equipped with the proper machines and uses efficient methods of operation.

There can be no set pattern for accomplishing this because of the many variables of location, raw materials, markets, and the like. However, only a few standard machines and simple procedures are required to fabricate a wide variety of products.

Types of equipment and certain combinations of machines to make various products, largely based on observation of plants which are being successfully operated in various sections of the country, are dealt with briefly in the following pages. Such information together with personal experience and observation at other plants should be of help to the prospective small plant owner in formulating plans for his own plant.

Milling Equipment

Plants obtaining their raw materials in the form of logs, bolts, or woods waste use some form of headsaw, usually one of the following types:

(a) Standard circular mill, for sawing larger logs.
(b) Bolter or short log mill, for small diameter logs less than 9 feet long (mill is patterned after the standard circular).
(c) Shingle machine, for bolts less than 2 feet long.
(d) Barrel heading saw, for bolts less than 2 feet long.

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[2] Obtainable from the Forest Products Laboratory, Madison 5, Wis.

Cut-up Equipment

Crosscutting and rip saws are the basic machines used in small cut-up plants utilizing lumber and mill waste as raw material. These in combination with surfacing machines largely determine the production scope of the plant. While there is no standard combination of machines for any group of products, certain combinations are encountered often enough in small plants to indicate three general types.

Type 1 (Simplest equipment).--The simplest equipment consists of a crosscut saw, ripsaw, and for faster production a gang ripsaw. This combination permits making such items as grain doors, rough crating lumber, car blocking, lath, and slat products. A slab resaw or a lath bolter saw is required when utilizing mill waste.

Type 2 (Medium equipment).--The medium equipment consists of a jointer and planer plus the machines indicated for Type 1. This combination permits making such items as pallets, box shooks, surfaced lumber items, in addition to those indicated in Type 1. As some box shooks require side matching, this operation can be done with a light planer-matcher-molder substituted for the planer thus also permitting additional items, such as low grade flooring and patterned items, to be made.

Type 3 (Full equipment).--The full equipment consists of dry kilns, gluing equipment, bandsaws, sanding equipment, drill press, tilting table variety saw plus the equipment mentioned in Types 1 and 2. This combination permits making core stock, furniture parts, farm implement repair parts, prefabricated farm structures, various specialties and novelties, and a wide variety of other finished and semifinished products.

Equipment is required to facilitate handling and conveying materials in and around the plant in all of these groups. This may range from factory trucks to conveyor belt systems.

Shop type machines of medium weight are best suited for the small plant of this type although light portable equipment may be practical for a limited amount of light work. A list of small machines and tools used in the small plant is contained in the bulletin "Establishing and Operating a Small Woodworking Shop."[6]

Production Methods

Efficient production methods are generally considered the key to successful plant operation, and involve placing machinery and equipment in proper relation to each other to eliminate unnecessary lifting, carrying, and

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[6] Obtainable from the Superintendent of Documents, Washington, D. C., for 15 cents, cash only.

back-tracking of materials. Of considerable importance in this respect is an analysis of the product to be made. Such an analysis will indicate the machine requirements as well as the number, size, and form of the individual parts of the product. This last will be of value in determining the most economical form, size, and grade of raw material to use.

Of obvious importance to the efficient operation of a plant is proper machine maintenance, sharpness of saws and cutter knives, and correct machine speeds. A well recognized reference manual on this subject is "Saw and Knife Fitting," published by the Hanchett Manufacturing Co., Big Rapids, Michigan.

Products and Methods of Manufacture at Typical Plants

A brief description follows of the methods observed in use at representative small plants making products of the types previously discussed. The description is supplemented with additional information pertaining to general industry products, specifications, and the like.

Slat Products

Slat products are usually produced directly from short logs or bolts rather than from standard size lumber.

Vegetable, fruit, and perishable food shipping storage containers.--This class of products is about the simplest to make, consisting primarily of rough sawed slats and cleats. Specifications for them vary considerably, each locality or community generally having its own. The species used and the commodity to be shipped influence the sizes of the individual pieces. Slats are 1/2 to 5/8 inch thick and 2 to 5 inches wide; cleats are 1 by 2 inches in cross section. Squares and corners are often 1 inch square stock. The wood is green or yard dry depending on the use. Grade is unimportant as knots and discolorations have little effect on the use.

Definite specifications for shipping containers applicable to rail shipments are set up by the Association of American Railroads. Information on commercial fruit and vegetable containers is contained in U. S. Department of Agriculture Farmers' Bulletin No. 1821, "Containers for Fruits and Vegetables."[7]

Practically all commercial species are used, except that those imparting flavor or odor to the contents are not used for some food products. In the West the pines, firs, and spruces are most commonly used. In the East and South both hardwood and softwoods are used. In the Central States and in

[7] Obtainable from the Superintendent of Documents, Washington, D. C., for 10 cents, cash only.

the North hardwoods predominate, the common species being elm, soft maple, gum, beech, basswood, cottonwood, sycamore, aspen, and oak.

For this group of products the following examples are cited.

Celery shipping crates were observed in production at one commendable mill operation. This example represents the practice of segregating good and poor logs at a small sawmill, the poorer logs being cut into slat products and the better logs into lumber. The slats are made from sawed flitches. The plant produces 25,000 crates and about 150,000 board feet of lumber per year with four men, using a standard circular sawmill plus a swing cut-off saw, gang ripsaw, bundle-tying equipment, large-wheeled factory dollies and a 40 horse-power tractor. Logging is done in the winter. The high-grade logs are separated out and sawed first in the spring months into graded lumber. The low-grade logs are sawed into flitches the thickness required for the width of the crate slats. These are crosscut to the length required on the swing cut-off saw and piled on the dollies. The pieces are then ripped on the gang ripsaw into slats of the desired thickness, and passed directly to the bundling table, bundled into convenient 5-crate bundles, and stacked for shipment. No trimming is necessary. The plant is completely housed in a 28 by 70 foot building, the sawmill at one end and the fabricating machines at the other. A space of about 20 by 24 feet is provided for stacking material and bundles. No extra storage space is required as crates are shipped as soon as made.

Vegetable and fruit field and storage crates are the product of another mill worthy of description. This example represents the use of a heading saw as the main break-down equipment for producing slats from bolts and short logs. Large limbs from tops have been used in part. With five men this plant produces 150,000 crates per year from about 1,000 cords (500 M board feet) of small logs or bolts purchased from local farmers. A pendulum-type heading saw is used together with a swing cut-off saw, gang ripsaw, bundle-tying machine, large-wheeled factory and yard dollies, and yard tractor.

Bolts hauled from the storage yard are crosscut on the swing cut-off saw into short billets to the lengths required for the individual parts. These billets are placed in the pendulum-type carriage of the heading saw and cut into thin flitches of the thickness of the pieces required. These are piled on a wheeled dolly, hauled to the drying yard, and piled for drying. Each size and thickness is piled separately. Proper piling methods are extremely important to this type of operation. The principles of good piling methods are described in the U. S. Department of Agriculture Technical Bulletin No. 174 "The Air Seasoning of Wood."[8]

After drying these unedged flitches are hauled from the yard to the gang ripsaw and ripped into slats and cleats of the desired widths. They are

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[8] Obtainable from the Superintendent of Documents, Washington, D. C., for 35 cents, cash only.

then stacked on the dollies ready for bundling. Bundles are of convenient handling size, such as pieces for five crates, and are trimmed to exact length on the swing cut-off saw, which is provided with a false bed for this purpose. Shipping is immediate so that extra storage space is not required other than the three acres required for the drying yard. A building 25 by 50 feet houses all equipment, and provides extra work space.

Fish boxes are the product of a third plant of this class. This mill uses a short log headrig and short logs or bolts as raw material. This plant employs seven men and produces about 18,000 boxes per year from about 130,000 board feet of short logs or bolts purchased from local farmers. A short log sawmill or bolter is used together with a swing cut-off saw, gang ripsaw, belt conveyor, wheelbarrow with large pneumatic tires, and assembly jig benches.

Bolts are hauled from the yard on a wheelbarrow and are stacked adjacent the bolter. On the bolter they are slabbed three sides to the thickness required for the shook width for sides, bottoms, tops, and ends. The 3-sided cants are stacked next to the swing cut-off saw to be cut to the required lengths. When cut to length the cants are stacked next to the gang ripsaw and ripped into thin shooks. These shooks are dropped to a belt conveyor. The conveyor carries them to the second floor where they are piled for drying. Slabs are resawn into cleats on the gang ripsaw, and stored the same as the shooks. After air drying the parts are returned to the first floor and nailed into boxes on assembly jig benches arranged around the outside wall. A nearby packing plant takes the boxes as assembled, thus no storage space is required other than the one acre required for log storage. The building used is about 35 by 55 feet, the second floor space being sufficient for air drying and shook storage.

Snow fence lath.--A plant producing 20,000 snow-fence lath per day with six men uses a machine which combines a bolt headsaw rig, heavy gang ripsaw, and a lath machine. In addition a bundle tying cradle and an equalizer trim saw are used. Power is derived from an 80 hp. engine which also serves to operate a small sawmill. Bolts are slabbed 2 sides, and are fed into the gang ripsaw, which saws them into flitches 1-1/2 inches thick. The flitches are passed through the lath machine and sawed into slats 1/2 inch thick which are piled next to the bundle tying machine. After tying the bundles are trimmed to length on the equalizing trim saw and sent to the storage yard for seasoning. The bundles are piled crib fashion for quick drying.

The slats used in this product are generally 1/2 inch thick, 1-1/2 inches wide, and 48 inches long and usually have not more than three knots of 3/4 inch diameter (or their equivalent in smaller knots) well scattered. Most commercial species can be used except those having a tendency to warp badly when haphazardly dried. Heavy woods are seldom used because they make fence rolls heavy. Slats are made from logs, bolts, and from waste incident to lumber manufacture.

Weaving the lath into fencing, which is done at another town, entails feeding slats into a machine between five double strands of wire. The machine puts a twist in the wire between adjacent slats (spaced 2 inches apart) the finished fencing is passed through a tank of paint and rolled into bundles. Each roll is cut according to the length desired and is then ready for distribution.

A more detailed discussion of the manufacture of the slat roll fence is contained in Forest Products Laboratory Report No. R1085 "Wood Slat Snow Fence."[9]

Lumber Products

Simple products machined or fabricated from lumber comprise another important group of which only a few of many possible items will be mentioned.

Grain doors.--Grain doors are used to supplement railroad car doors in grain shipment. They are double thickness panels 20 inches by 7 feet in size made of rough 1-inch boards of grades below No. 2 Common selected more for grain tightness than for strength.

Although softwoods are generally used, practically any species may be used either green or air dried, depending on demand.

One small mill producing 8,000 board feet of lumber per day with three men, other than the mill crew, makes 200 grain doors per day from about 5,000 feet of lumber. Equipment used other than the sawmill consists of a swing cut-off saw, bench ripsaw, bench assembly jigs, and lumber dolly. For fabricating the doors, lumber is piled from the headsaw to the lumber dolly and one man hauls it to the cut-off saw, cuts it into the various lengths required, and piles them into adjacent open end bins. On the opposite side of the bins two men assemble these pieces on jig benches and nail them into assembled panels. The completed doors are piled ready for transportation or storage. Boards are ripped to assembly width on the ripsaw as needed.

Pallets.--Pallets are portable platforms, used with lift trucks, upon which materials are placed for convenience in handling and storage. Many large industries, as well as small factories, have converted to this method of materials handling creating a considerable market. It is a highly competitive product, usually netting only a slim margin of profit.

There are numerous types of pallets, including the simple rectangular skid type used in paper mills, the type having upright members, or the flat type which may be square, rectangular, or octagon shaped having bottom and top decking.

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[9] Obtainable from the Forest Products Laboratory, Madison 5, Wis.

Air-dried or kiln-dried stock is generally used although some temporary pallets are made of green stock. Grades No. 2 Common and lower are generally used but some consumers are requesting a higher grade product. Planing, jointing, chamfering, or other machine work are required on most types. Deck boards may be 3/4- to 2-inch lumber, while skids, stringers, and upright members may be dimension lumber. Parts are fastened together with nails and screws and in some cases glue is used. The size, number, and location of fasteners are very important in pallet construction. The information on fasteners as well as other pertinent data contained in U. S. Department of Agriculture Technical Bulletin No. 171 "Principles of Box and Crate Construction,"[2] is applicable to them.

Practically all species are used although hardwoods, such as oak, elm, hickory, and gum, are preferred for stringers and some deck boards.

The plant discussed here represents a larger investment than previous examples, but it originated as a plant similar to the one discussed first for making celery shipping crates. From two million board feet of lumber about 26,000 units are made annually, consisting of skid type pallets, small industrial pallets, small industrial boxes, and industrial crating. A crew of 10 men log, yard, saw, and pile the lumber required from local grown species. A crew of 14 men operate the fabrication plant, the equipment consisting of a cut-off saw, ripsaw, table cut-off saw (equipped to mount dado saws), planer, jointer, bundle-tying equipment, hand-operated lift truck, and a yard truck.

Air-dried stock is hauled from the yard to the planer. This is put through the planer and piled next to the cut-off saw. The boards are cut to length, and piled adjacent the ripsaw. When ripped the pieces are placed on skid pallets according to lengths, widths, and thicknesses. Pieces requiring notching are moved to the dado saw (table ripsaw) and pieces requiring chamfering to the jointer. Materials are conveyed on skid pallets with a lift truck. Nailing is done on assembly jig benches, each worker hauling his own parts and stacking the assembled pallets.

A report, "The Wood Pallet Industry, Its Development and Progress Toward Standardization," available at the Forest Products Laboratory, contains additional information on pallets including types, construction designs, and the like.

The industrial crating at this plant is produced similar to the parts for pallets eliminating the dado, chamfering, and nailing operations, the individual pieces being bundled for shipment. The procedure followed for making boxes of this plant is similar to that for the crating, through the ripsaw operation. Wide slats are sawed on the ripsaw instead of the dado operation. As these are minor items they serve to fill in between orders for pallets. Boxes are assembled as orders are filled.

A building 48 by 55 feet in size houses the fabricating equipment, and provides storage. About 3-1/2 acres provide storage for logs and lumber. The sawmill is not sheltered.

Prefabricated small farm buildings and farm implement repair parts.--Prefabricated structures and parts are products that present an opportunity to utilize farm timber for local use. A knowledge of good building construction methods, however, is necessary for making the small farm structures. For making equipment repair parts it is essential to know the types of farm equipment in use in the area.

Prefabricated small farm structures include such items as chicken houses, brooder and shelter houses, corn cribs, small barns, and the like. The design of these buildings may be patterned after farm building designs recommended by the state agricultural college or well-designed structures in use in the vicinity. The larger structures can be made in sections and the smaller buildings may be completely assembled. All stock should be thoroughly dried.

Farm implement repair parts include such items as wagon and truck boxes, truck beds, harrow beams, and wagon tongues. These repair parts are usually rough cut from green stock according to definite patterns and are thoroughly dried, usually 4 to 8 months in the shop loft. The final machining may not be done until the individual repair job is done.

A wide variety of any species can be used for most of these products. For farm buildings, strength is an important factor in structural members. Specific information on the best species for these purposes is contained in U. S. Farmer's Bulletin No. 1756 "Selection of Lumber for Farm and Home Building."[10] Species suitable for farm implement parts are listed in Forest Products Laboratory Report No. R1298 "Guide to the Use of Wood as an Alternate Material in Agricultural Implements."[11]

A plant observed in a rural community making farm buildings and farm implement repair parts integrates logging, milling, and manufacturing. About 250,000 board feet of local timber is logged and sawed each year, of which about 75,000 board feet is used for implement repair stock and 175,000 board feet is used for small farm structures. In addition to the logging and milling equipment, a planer-matcher-molder, jointer, swing cut-off saw, radial cut-off saw, table ripsaw, drill press, band saw, small hand lathe, assembly jig benches, lumber buggy, small hand tools, and various hardware are required for fabrication. A crew of four men log, saw, and fabricate small buildings and three men make the implement repair parts and repair farm equipment.

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[10] Obtainable from the Superintendent of Documents, Washington, D. C., for 5 cents, cash only.

[11] Obtainable from the Forest Products Laboratory, Madison 5, Wis.

Logging is conducted so as to prepare material best suited for farm implement stock cut to length according to future use and to cut logs to the best advantage for building construction.

Rough blanks for implement stock are sawed on the headsaw, stored for drying, and finished on the individual job.

In the building fabrication operation, the stock is hauled from the drying yard, and the lumber and dimension for studding, rafters, siding, roof boards, and the like are surfaced for uniform size. These are cross cut to length according to the cutting bill prepared in advance containing cutting orders for several of one type of building. Necessary miter cuts are made in this operation. The parts are separated in racks according to size and use. In assembly, parts are arranged on large flat top jig benches having cleats spaced and fixed for several sizes of assemblies. Some parts require side matching and simple machine work which is done on the small planer-matcher-molder. One man assembles the parts on the jig benches and two men nail them. Finished sections are stacked for future assembly. Small barns are precut and assembled on the barn site. A 25- by 50-foot building houses the fabricating machinery, the second floor providing loft space for further air seasoning of implement stock. About 1 acre yard space is provided for initial seasoning. No yard space is required for log storage as sawing is done in the woods.

Considerable development is taking place in the field of laminated arch construction for barns and small farm buildings as well as larger structures. As developed thus far the fabrication of laminated arches is not adapted to really small-scale manufacture because of the necessary refinements involved in machining, gluing, and pressing. However, developments for smaller scale production may come and are worth watching for. For plants interested in this type of construction, information on methods of constructing laminated timbers is contained in U. S. Department of Agriculture Technical Bulletin No. 1069, "Fabrication and Design of Glued Laminated Wood Structural Members."[12]

Rough Small Dimension Products

Rough small dimension readily lends itself to manufacture at the small plant because of the relatively low investment involved, but requires rigid adherence to accurate sawing and correct seasoning practices. Furniture dowel, handle, and turning squares are most commonly referred to as rough small dimension but the term also includes other furniture and specialty parts as well as parts used in making crates, and the like.

The specifications vary according to the individual uses.

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[12] Obtainable from the Superintendent of Documents, Washington, D. C., for 60 cents, cash only.

The major species used are the hardwoods, such as oak, maple, gum, birch, hickory, and walnut in the East, and the softwoods, Douglas-fir and the pines in the West. In the West small dimension is generally referred to as "cut stock."

The equipment and methods used at small plants are similar to those indicated for the small sawmill setup discussed under Celery Shipping Crates. The high-grade material is sawed into flitches of the desired thickness which are resawed into small dimension stock. Also the gang ripsaw is set to handle larger pieces and these pieces piled for air seasoning before bundling. Storage for drying is under a shed and the ends of the pieces are coated to prevent end checking. Logically, the manufacture of celery crates and high-grade small dimension could be done at the same plant.

Finished or semifinished kiln-dried small dimension is distinctly different from the rough dimension referred to here. While adopted to manufacture at fairly small plants, higher investment and good equipment are required for finished and semifinished small dimension.