A MODEL WOODWORKING SHOP

Seminar Report

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June, 1922.

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OREGON STATE COLLEGE
CORVALLIS, OREGON
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One of the best examples of an efficient woodworking shop is found in the chair plant of P. Derby & Co., of Gardner, Massachusetts. This factory is devoted entirely to the manufacture of a high grade of gum and oak rockers, diners, bedroom and office chairs. The plant, while not among the very largest, is one of the medium sized exclusive chair plants, and can be taken as a typical example of the foremost developments in the woodshop practice in the chair industry.

The factory was started in 1884. Since that time it has been in continuous operation, and it has gradually expanded in size. The plant in general is up-to-date. Mr. Derby, the president of the company, and Mr. Nichols, the superintendent, are men who are always working for the highest efficiency in factory methods and management. Mr. Nichols is recognized as one of the four leading chair makers of the United States.

Mr. Derby has the confidence of his workmen, and has established himself by his interest in the employees around the shop. For example, the shop has a school where foreigners are instructed in English and government so that they can become citizens of the United States. The workers get one-half hour two times a week on the company's time, and
they are required to remain one-half hour on their own
time at every class in order that they may get the benefits
of the company's school. Competent instructors are furnished
to conduct these courses. Mr. Derby pays his workmen a
higher average pay than do other shops in the city. He
has had one man in his employ for thirty six years, and
employees that have been with the firm from twenty to
thirty years are common. Mr. Derby, it is said, knows all
his employees personally, and is very considerate in his
dealings with them. As a result he never has had any
labor troubles.

The company was not built up as a modern unit
with all the "Henry Ford" ideas of efficiency and methods.
It is rather the result of a continuous growth in which many
possible improvements have been tried out and the best
ones have been adopted.

They have a very thorough system of cost accounting.
Each workman keeps account of the number of pieces going
through his particular machine, and records the number of
hours or minutes of direct labor that he performs on the
order. A card is filled out as soon as a job is started, and
this card follows the stock all the way through the factory.
On this card the time record is kept, and also a description of the number of pieces and sizes, both rough and finished, kind of wood, order number, shop order number, and a detailed list of the operations through which the various parts will have to go. Accurate cost records are maintained so that the selling price and manufacturing costs of various lines of chairs can be correctly ascertained at any time.

They have a planning department in connection with the cost accounting work. In this department the cost of new lines of chairs contemplated is worked out, and the estimate of the selling price is made before the chair is put on the market or exhibited at the various furniture shows. When an order is received the planning clerk records on the process card the number of pieces to be manufactured; e.g., 200 pcs. front legs, red gum, Queene Anne diner, order No. 452, shop order No. 1748, rough dimension size, $2\frac{1}{2}\times2\frac{1}{2}\times19"$. On the card the clerk writes the symbols of the various operations through which the material will have to pass before the machining will have been completed.

The symbols that they use are abbreviations or the first letters of the various operations. The following are examples:

- C.O.1-2: Cut off sawing
- RB: Rip sawing
- Stk: Stickering
- R.S.B.: Sawing and boring.
In a short time the workmen become familiar with the symbols. On each factory floor or unit there is one man employed to keep track of the various orders that progress through the shop, delivering same to the various machines, and recording the machine time at the various operations, where this is not taken care of by the machine operator.

The lumber requirements of the factory are secured from the South or from the woodlots in Massachusetts or New Hampshire. The grades that can be utilized are of interest to the forester. Through the New England factories, flitch lumber, (otherwise known as live edge or waney edge) was used quite extensively. They utilized square edge or trimmed lumber in grades of No. 2 Common and better only when they had to buy their requirements from the mills in the West and South.

The flitch stock is obtained locally. It is secured by slabbing logs in small portable sawmill operations, where the lumber is not trimmed. In this way trees of inferior size and quality can be utilized. In fact forestry practice in New England is well advanced over that of any other part of our country. The following photograph shows how some of the boards look that were received at the factory:
Boards with a decided sweep or even reverse curve are included in these shipments, as at the chair factory where small lengths can be utilized, the good material can be sawed out from the planks. If some of the boards were trimmed, as is the practice in the sawmill operations in the West, little or nothing would be left of the boards.
Also any lumber that would be produced would be of a No. 2 or No. 3 Common grade. Most of the flitch stock is of red oak, though some beech and maple is also sawed in this manner. Manufacturers will go into the country and buy woodlots and contract with small sawmill operators to slab the timber to the thicknesses that they can use in their factories. Jacket boards are usually made 1-1/8" thick, and the better cuts are made 1-3/4 and 2" thick. These thicknesses furnish material for the majority of the chair parts as are required in the ordinary lines of chairs.

There is considerable waste in cutting up this lumber. Mr. Derby has conducted careful cost and waste studies on this flitch stock, and as a result of his studies he is a firm advocate of the waney edge stock. Though there is a waste of from 40 to 60% of the commercial scale in this lumber, the factory can get out its wood requirements without an expenditure of an excessive amount of labor and capital. The waste can be worked up into stretchers and smaller sized pieces, many of which are needed in the manufacture of chairs. The remaining waste is not a complete loss, as it can be used under the boilers. This fuel item alone is an important one, as this region is remote from the coal fields and fuel prices are very high. The freight haul on this flitch stock is a short one, thus eliminating the
usual obstacle in shipping low grades of lumber. The price is also very low. Mill run red oak could be purchased, f.o.b. Gardner, in September, 1921, at $50 to $60 per M. for 8/4, and $40 to $50 per M. for 4/4 lumber. About sixty per cent of the wood requirements of the chair factories in this vicinity is purchased in flitch stock.

Chestnut stock for seating for chairs and stools is also used. A study on some of this material showed a waste of 60% of the commercial scale. The stock was cut from trees, as was evidenced from a count of their growth rings, ranging in age from 30 to 40 years. Some of the stock had been cut from chestnut trees that had been blighted, and which had been deteriorating rapidly because of insect and fungus attacks.

When buying square edged or trimmed lumber the Derby Co. usually bought in grades of No. 1 Common and better. Mr. Derby said that this was the lowest grade on which they could afford to pay the price of lumber shipped from the West and South, as cuttings from lower grades did not prove a paying proposition. Waste on this No. 1 Common lumber ranges from 20 to 35%. A cheap grade of red gum is purchased. In some cases it was necessary to cut out the red or heart wood of the gum lumber so as to complete orders which specified this material. This red or heart wood is much better suited to furniture manufacture than is the soft, white sapwood, which is very brash and
difficult to finish.

The lumber yards were right adjacent to the factory. Most of the lumber unloaded from the cars is placed directly onto dry kiln trucks, where it can be kept until ready for placing in the kiln. The boards are skidded from the car on a roller board and are run right onto the dry kiln truck, which is loaded 3 or 4 feet below the level of the railroad track. The oak lumber is placed on stickers which are spaced about 3 feet apart, and in the case of gum lumber the stickers are placed 2 feet apart. Stickers are made of 1-1/8x1-1/8" beech. Trucks are usually piled 9 to 10 feet high, and are made 5 ft. 4 ins. wide. A roof of sheet iron is contemplated for the storage yard where these kiln trucks are placed. A roof is almost a necessity, as the lumber is flat and if the rain beats in on the lumber, it will soon cause rotting under the stickers. The following pictures show the loaded kiln trucks in the yards:
When the stock is received air dried, it is piled without stickers. This seems to be the common custom in New England. They aim to turn over the stock in the yard every two or three years so that deterioration will not set in because of the close piling of the boards. When green material is received, and it is not desired to run same through the kiln, it is carefully placed on stickers in the yards. The accompanying photograph illustrates how air dried lumber is piled in the yards:
The factory operates a wagon to haul the small lumber orders to the cut-up room. The lumber is loaded on the wagon and is hauled to the entrance to the dry kiln room. Here they have an unloading device which enables the workmen to pick up bodily the load of lumber and place it on a truck to be shoved along the track into the woodshop. The accompanying photograph shows this device;
This device consists of an endless chain pulley suspended over the roadway. A rectangular iron pipe frame enables the workmen to sling the chains around the load and balance the load as it is shifted to the truck.

There is an incline from the storage yard up to the entrance to the dry kilns. A car is operated on this incline by means of an electric winch and cable, so that a loaded dry kiln truck can be moved from the lower yard level to the level of the dry kiln floor in a very short time.

They have a battery of six Tiemann water spray kilns and six National kilns. The National kilns give good results if most of the stock is from 15 to 25% moisture content upon arrival at the kilns. The water spray kilns were installed during the war to dry 3 to 4" oak wagon stock for artillery purposes. The Tiemann kilns give good results, particularly with green stock. In these water spray kilns they had used automatic control instruments, but it was found that they required too much attention for adjustment, so were discarded. The kiln operator has been on the job for four years, and knows his kilns and his drying problems from A to Z. The National kilns were of the compartment re-circulating type. The kilns were operated during the day by exhaust steam, and during the night by pressure steam. Steam treatments were given at
the beginning of the run, and also at intervals during the run. The kiln capacity is about 10 M feet per day, having a total charge capacity of 120 M feet. They had heated rooms in various parts of the buildings for drying small dimension stock and band sawed stock. These drying rooms were not well suited for drying dimension stock of oak, as no means was provided for humidity control. To avoid honeycombing of 1 1/2 and 2" oak squares, this material had to be carefully piled in one of the Tiemann kilns to be dried. They found that a moisture content of from 5 to 6% gave the most satisfactory results in their factory. With their wood seat stock they took special care, as they contended that nearly all of the warping and subsequent checking of the glued up seats can be attributed to improper drying.

Between the dry kiln rooms and the cut-up room they have a storage room. This space is open and air freely circulates into it from the rest of the factory. Here the lumber is transferred from the main line track onto a parallel track system, which is 10 tracks wide, and about 80 feet long. They have here a storage space for about 140 M feet. Under each track is a return bend steam coil which, when necessary, will give sufficient heat to keep the lumber down to the required moisture content. In this place the lumber can be stored on the tracks according to the species and thickness. Trucks can
be run across to the cut-up room very easily when a small order is required to be filled, and then returned to its place in the storage room without great difficulty. Also the lumber is given a chance to cool and is given ample time to adjust its moisture content to the conditions of the shop. In this way they keep a supply of kiln dried material on hand so that they are able to take care of small rush orders.

The cut-up operation shows careful planning and high efficiency. The trucks, benches and saws are located as follows:

The kiln truck can be moved up right between the two saws. Here is located a platform which can be raised or lowered by means of a set of four jack screws operated by an electric motor. This enables the pile to be kept at the
right height all the time so that there will be no waste of time or energy in taking off the high boards or lifting up the boards from the lower part of the kiln truck load. One man can stand at the end of the truck and can place the lumber onto the cut-off benches at either side of the truck as fast as they are sawn. One man is stationed at each saw, pulling the saw across the board with the right hand and shoving the cutting along onto a table with the left hand. Here another man is kept busy piling the short cuttings from the two saws onto sleds. They use the J.A. Fay & Egan Co. swing cut-off saws, which measure 14" in diameter, have a kerf of 1/8", and rotate at a speed of 2800 to 3000 r.p.m. This arrangement permits the cutting of from six to eight M. feet of lumber per day.

Small sleds are used instead of trucks to move the cuttings about the shop. A small dolly or transveyor, so constructed that it can be run in under the sleds, makes it possible for one man to move a truck containing several tons of cuttings without a great deal of difficulty. These sleds are built of light material and they are desirable in that they are cheap and that they can be piled up when not in use. This leaves more room around the shop than when trucks are used.
In the rip sawing or re-saw department they have six machines. Only four of these are operated continuously, however. The company has five different makes of rip saws, including four band rips and two circular rips. They favor the band rip saws because of the saving in saw kerf, and because of the advantage of the re-saw attachment. The band rips do not give as straight a cut as is obtained with the circular rip saw, as there is always a little vibration of the saw. However, this uneven cutting is more than offset by the saving in saw kerf, which in the case of the band saw is 3/32" and in the case of the circular saw 5/32". The most satisfactory saw was a band saw manufactured by the Frederick A. Cheney Co., of Boston, Mass. This saw had a saw speed of 8,700 feet per minute, and had a feed varying from 50 feet at low speed to 132 feet per minute at high speed. This rate of feed can be varied with the nature of the work to be done. The circular saws have a more rapid feed, and are very satisfactory for one inch and one and one-quarter inch material. In the case of ripping thicker stock, the band rip is preferred.

With the re-saw attachment they are able to rip chair panels and spindles out of one inch and one and one-quarter inch material, working this material down to 3/8" and 1/2" in thickness. This saves a good deal of lumber, as the thicker lumber is relatively cheaper, and there is
less loss as is occasioned in 1/2" and 3/4" lumber from surface checking and splitting.

From the rip saw department the cuttings are taken into the machining room where the rough dimension chair parts are further planed, moulded, band-sawed or turned to suit the requirements of the particular order.

All the power in the wood shop is furnished by electric motors. Some of the machines have individual drives, while others are grouped so as to secure the best advantage of the motor installations. Each machine has its own lighting arrangement. The walls of the room are painted with white paint, and the working conditions are very agreeable. The following photograph shows one corner of the woodshop:
They have a foreman in charge of the woodshop who supervises the labor and checks the materials and sizes of cuttings on the various orders. There is always a forward movement of material in the shop, and there is no congestion. All material is cut only on special orders. The waste material is always worked up at the first opportunity into rails, stretchers, and other small chair parts.

As compared to some fifteen other chair plants visited, this factory excels in arrangement and efficiency in handling their lumber and getting it cut up into small rough dimension sizes. This shop system was worked out with the growth of the factory, and is proof that better methods in factory efficiency and management can be worked out gradually. It is not necessary to throw out the old system and start everything anew. Careful planning and experimenting will solve the individual problems of every factory.