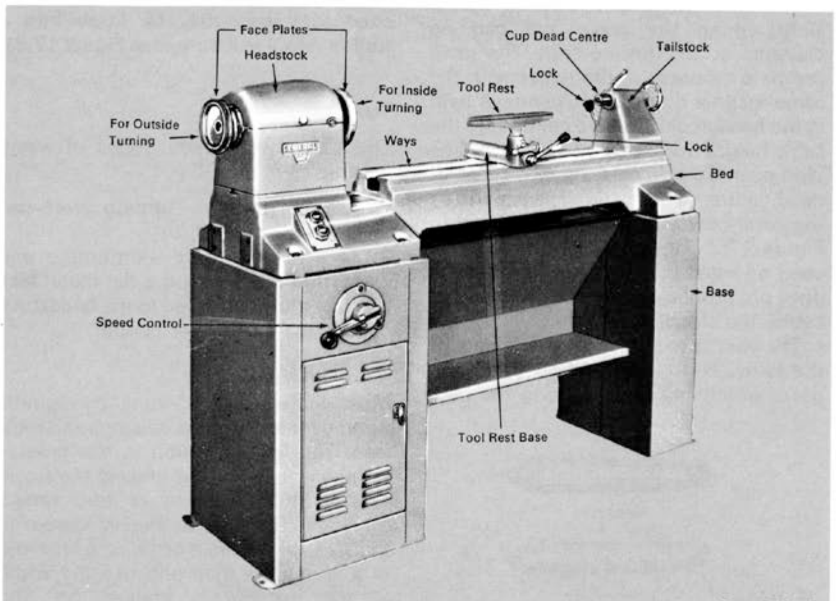
CHAPTER SEVENTEEN

wood lathe

The wood turning lathe enjoys a special place among all woodworking machines. It is probably the oldest of all furniture-making and craft machines, a crude hand-operated lathe having been invented about 1000 B.C. The lathe combines the art of hand tool work and the mechanical operation of a modern machine, and may be considered as a single manufacturing unit in itself on which a complete project may be made without the aid of other machines.

Most other woodworking machines have revolving knives or blades that pass over or through the work. The operation of the lathe is different: the work is revolved and the cutting tools are held firmly on a rest.

The lathe is not a difficult machine to operate, but the ability to produce good turnings quickly and accurately requires considerable skill. This can be acquired only by a knowledge of the correct methods of turning, and practice in the use of the lathe. The art of wood turning depends largely on the skilful manipulation of the chisels by hand.



General Mfg. Co.

Fig. 17:1 Wood Lathe

Parts of a lathe

The wood lathe is often referred to as a *speed lathe*. This distinguishes it from a screw-cutting metal lathe. A typical wood lathe is shown in Figure 17:1. The principal parts are the bed, the headstock, the tailstock, and the tool rest. The *bed* is the main "I"-beam-shaped cast iron base; the upper surface is machined and is called the *ways*. The *headstock* is the business end of the lathe that makes the wood revolve. It consists of a hollow spindle on which the *pulley* is attached at one end and the *spur* or *live centre* at the other. The spur on most lathes is held to the hollow spindle by a friction fit, the spindle being internally ground to a No. 2 morse taper and the shank of the spur having an identical taper to fit into it. The spur can easily be removed by inserting a lathe rod through the hollow shaft from the pulley end and tapping the spur.

The *tailstock* is machined so that it slides along the ways and can be clamped at any desired spot. The *dead centre* is mounted in the tailstock in the same manner that the live centre is held in the headstock. The two centres are the same height from the bed and are in line with each other. There are two types of dead centre: (a) the *cup centre*, and (b) the *cone centre*. These are illustrated in Figure 17:2. The cup centre is the one used on most modern lathes because it does not require that a hole be drilled to centre the stock.

The *tool rest* is an important part of the lathe. It consists of two parts: the base, which can be slid along the bed,

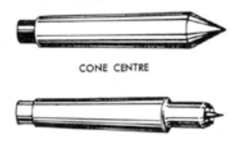


Fig. 17:2 Lathe Centres

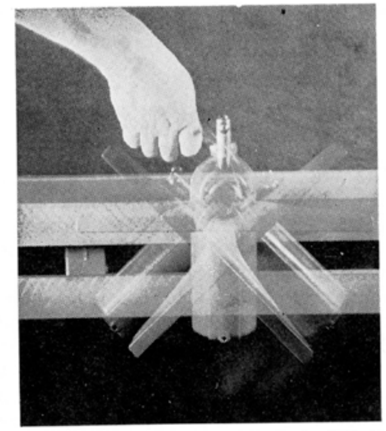


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Fig. 17:3 Movement of the Tool Rest

and the tool rest, which fits into the base and may be raised or lowered. Different-sized tool rests may be fitted into a standard tool rest base (see Figure 17:3).

Turning

There are two general types of wood turning:

1. *Spindle turning*—turning work between centres.
2. *Face plate turning*—mounting and turning the work on a flat metal face plate that is attached to the headstock in place of the spur centre.

Spindle turning

Most lathe work is done by spindle turning for such things as lamps and table legs. The first operation in this type of turning is to centre the ends of the stock. This is done by one of two simple methods. The first method is shown in Figure 17:4, where a distance a little less or a little more than one-half the width of the material is marked off; the centre of the small square thus formed

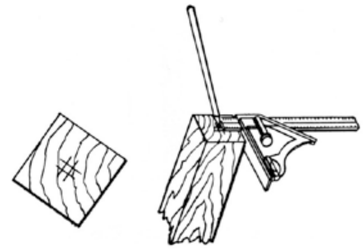

Fig. 17:4 Centring Stock

can easily be found and used as the true centre of the work. The second and simpler method of locating the centre is to draw diagonal lines from corner to corner, the centre being at the intersection of the lines.

After the centre has been located on both ends of the work, use the scratch awl to definitely mark this centre. If hardwood is used, drill a small hole in one end, and make a saw cut about 3 mm deep on the diagonal lines. The spur is then placed against the end and tapped with a mallet so that it is well seated, with the spur teeth firmly in the saw cuts.

To mount the work in the lathe
Hold the material against the spur and move the tailstock to within 25 mm of the end of the piece and lock it in position.

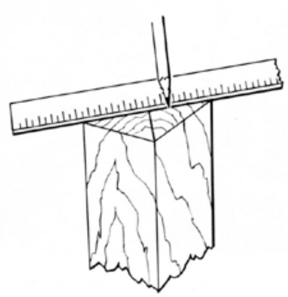

Fig. 17:5 Centring Stock

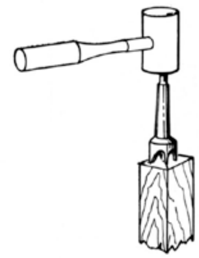

Fig. 17:6 Centring Stock

Turn the tailstock spindle until it makes contact with the wood. Place a few drops of oil or grease on the centre and continue turning out the centre until it is snug; then loosen it off slightly. Before locking the tailstock spindle, check to see that the work turns freely but has no side play or looseness between the centres.

Set the tool rest so that it is slightly above the centre of the work (not more than 6 mm). It should be set from 2 mm to 8 mm from the work and parallel with it.

Face plate turning
Work such as lamp bases and bowls, which cannot be turned between centres, is mounted on a face plate.

The face plates used vary in diameter according to the work to be turned, from the screw plate shown in Figure 17:7 to a 200 mm plate used for large work on outside turning. The work may be mounted directly on the face plate with short but heavy wood screws, or a backing block may be used (see Figure 17:8). When a backing block is used, it may be screwed to the work, or it may be glued with a piece of paper between it and the work. When the finished work is separated from the backing block, the paper will split, leaving the finished turning undamaged.

The terms *inside turning* and *outside turning* refer to the location of the face plate on the lathe, as shown in Figure 17:1. For an inside face plate turning, the

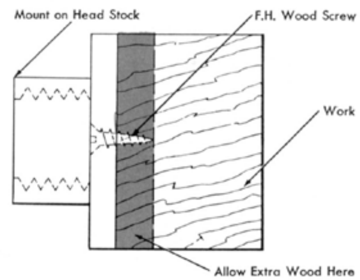

Fig. 17:7 Screw Plate

spur is removed and the face plate screwed to the spindle at this point, as shown in Figure 17:10. The size of the work that can be turned here is determined by the distance from the bed to the lathe centre. This is called the *swing* of the lathe, which designates the size of the machine. On most general-purpose lathes this distance is 150 mm, so that 300 mm is the maximum diameter for inside turning. For outside turning, work of a larger diameter is turned on the outboard end of the headstock, as shown in Figure 17:11. A floor stand rest must be used for this outside turning.

Methods of wood turning
There are two generally accepted methods of wood turning: (a) the *cutting method* and (b) the *scraping* or *pattern maker's method.* The cutting method is the one used most often as it is faster and easier on the cutting tools, although it requires more skill. The scraping method is a slower but more accurate method. Both have their advantages and each should be used for specific operations. When using the cutting method, the chisel should be held at an angle, with the handle lower than the cutting edge. This makes the cutting edge tangential to the circle or surface of the cylinder to be cut, so that the wood is sliced or peeled off. The scraping tool

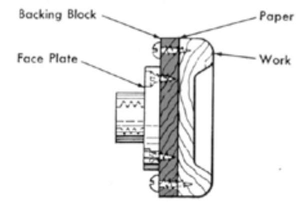

Fig. 17:8 Use of a Backing Block

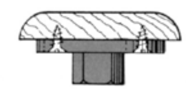

Fig. 17:9 Work Mounted Directly on Face
Plate

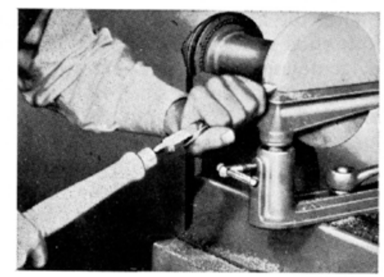

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Fig. 17:10 Roughing the Work to Size with
a Gouge

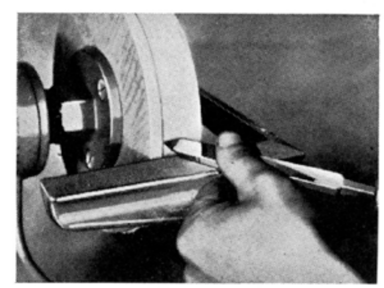

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Fig. 17:11 Making the Finishing Cut with a
Spear-Point Chisel

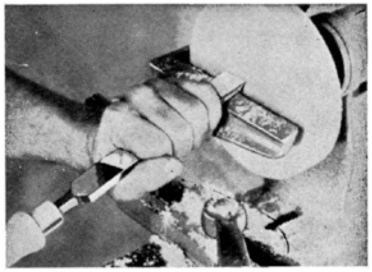

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Fig. 17:12 Facing the Work with a Square-Nosed Chisel. A skew chisel could also be used.

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Fig. 17:13 Shaping the Face with a Round-nosed Chisel. Note the position of the hands and the firm grip on the chisel.

should be held in a horizontal position and flat on the tool rest to make a fine, smooth, scraping cut (see Figures 17:14 and 17:15).

Wood turning tools

The standard set of wood turning tools consists of the six shapes illustrated in Figures 17:16 and 17:17. Although there are several sizes of each type, practically all turning can be done with these six basic chisels. The *gouge* is used for roughing the square stock down to about 3 mm larger than the diameter required. It can also be used for cutting grooves or for any heavy cutting. When starting to remove the rough stock with a gouge, take small cuts, working from the centre

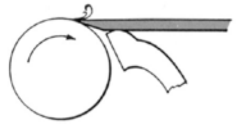

Fig. 17:14 Cutting Method of Turning

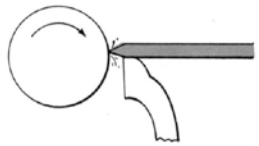

Fig. 17:15 Scraping Method of Turning

toward the end of the stock to prevent splintering the wood at the ends. The cutting edge of the gouge must be ahead of the handle as it is pushed across the work. The gouge should be held as shown in Figure 17:18.

The *skew* is probably the most useful and versatile of all wood turning tools. It can be used for many operations. One of these is to bring a cylinder to exact size after it has been rough-turned with the gouge. This should be done with a shearing cut by holding the chisel at an angle, as shown in Figure 17:20. Start the cut 30 mm or 40 mm in from the end, and work toward either end. To be able to make a good shear cut with the skew tipped at this angle takes considerable skill, which is only gained from practice and effort. The cutting of shoulders, V's, and beads, and the squaring of an end are some of the other uses of the skew chisel.

The *parting tool* is a lathe tool easy to use. It cuts with a scraping action and needs only to be pushed into the wood. For better cutting, lower the handle so that the cutting edge is slightly above centre. This tool is used mainly for depth cuts and is used in conjunction with calipers. When making a deep cut with the parting tool, a clearance cut must be

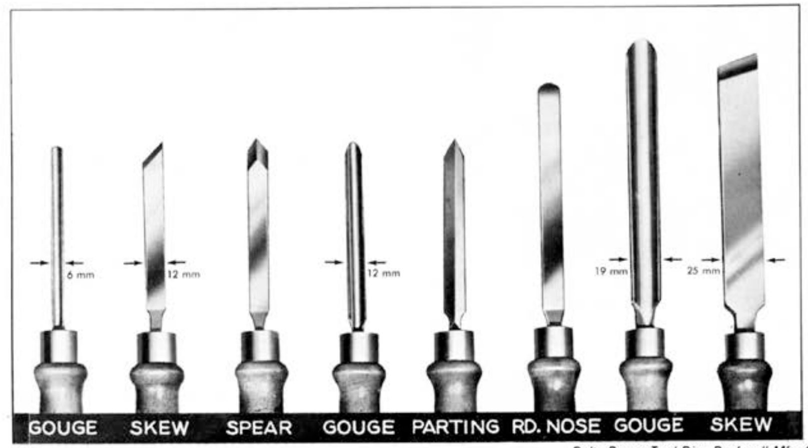

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Fig. 17:16 Set of Turning Chisels

Fig. 17:17 Square-Nosed Turning Chisel

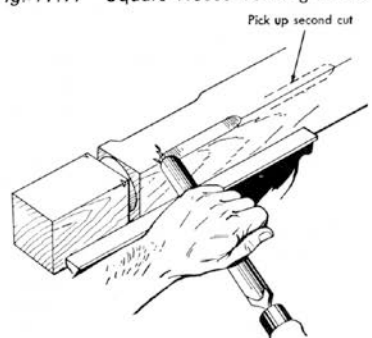

Fig. 17:18 Rough Turning with Gouge

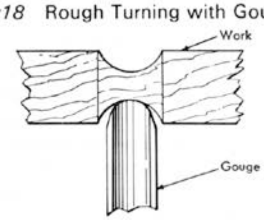

Fig. 17:19

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Fig. 17:20 Bringing Work to Size with Skew

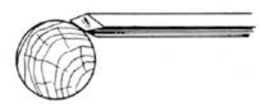


Fig. 17:21 Angle of Skew for Shearing C

Delta Power Tool Div., Rockwell Mfg.

Fig. 17:22 Care must be taken not to allo the toe or point of the skew to be caught the revolving work.

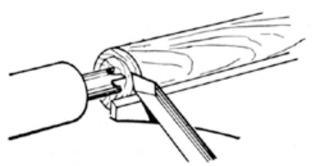


Fig. 17:23 Squaring the End of the Stock with a Skew Chisel

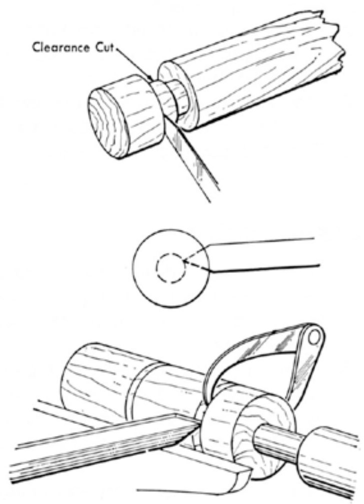


Fig. 17:24 Parting Chisel Used to Make Sizing Cuts

made beside the first cut to prevent overheating of the point.

Figure 17:25 shows the *round-nosed* and *spear turning chisels* being used to advantage. These tools are used more in face plate turning than in spindle turning because the scraping operation is safer and easier when cutting end grain.

Pointers on spindle turning

1. After mounting work in the lathe, rough-turn it to the largest diameter with the large gouge.
2. Make a smoothing cut with the skew and check the diameter with outside calipers.
3. Mark off the positions of the required dimensions. If the pencil marks are made about 12 mm long, they can be seen while the work is rotating. Lines all the way round the piece can be made with the pencil point while the work revolves.
4. With the parting tool, cut the work to the correct diameter at the marks, as shown in Figure 17:24 (bottom diagram).
5. With the appropriate tool, cut away the wood between the parting tool cuts.
6. Remove the tool rest and sand the work. When several turnings of the same pattern are required, cardboard or metal patterns are often made so that exact duplicate turnings can be made (see Figure 17:26).

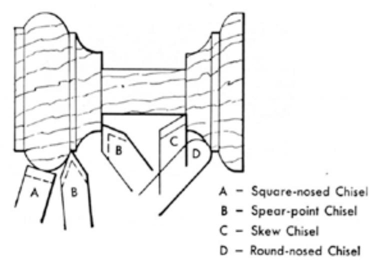


Fig. 17:25 Uses of Chisels

Safety precautions for the lathe

The lathe is a comparatively safe machine to operate. However, there are precautions that must be observed when using it.

1. One of the most important safety devices on the modern lathe is the variable speed arrangement, which consists of a cone pulley on the lathe and a corresponding cone pulley on the motor. The more modern lathes are equipped with a variable speed V pulley arrangement whereby the lathe speed can be changed by means of turning a lever, without the necessity of changing the belt. Many accidents have occurred because the work was revolving too fast. The speed of the lathe should be determined by the diameter of the work being turned; the smaller the diameter of the work, the greater the r/min should be. The following table will serve as a guide for turning speeds.

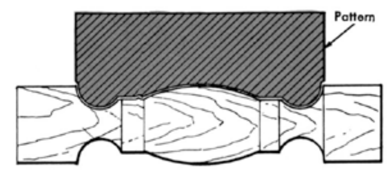


Fig. 17:26 Work Turned to Fit Pattern

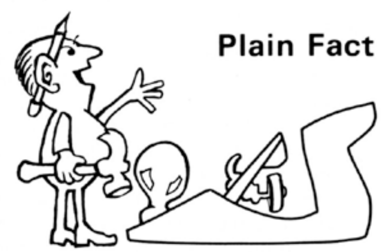
Diameter for Spindle Turning	*Diameter for Face Plate Turning*	*Recommended r/min*
175 mm and over	275 mm and over	750
100 mm–175 mm	225 mm–275 mm	1100
50 mm–100 mm	150 mm–225 mm	1600
50 mm and under	150 mm and under	2600

2. Keep the tool rest close to the worl never more than 10 mm from th largest diameter.
3. Hold the turning chisel firmly, wit one hand near the end of the handl and the other hand near the tool res as shown in Figure 17:10.
4. Remove the tool rest before sandin the work.
5. Safety goggles must be worn whil operating the lathe.
6. Do not wear loose clothing thi might get caught in the revolvin work. Tie back long hair.
7. Do not make adjustments on th machine while it is in operation.
8. Keep the turning tools sharp.

ASSIGNMENT

1. How does the lathe differ in princip from other woodworking machine
2. What are the four main parts of wood lathe?
3. What are the two general types wood turning? How do they diffe
4. With the aid of a sketch, explain tw methods of centring stock for th lathe.
5. List the steps in setting up the stoc in the lathe for spindle turning.
6. Where should the tool rest be s in relation to the work?

Plain Fact



WOOD TURNING IS AN ART FORM THAT IS DEVELOPED BY ONE'S IMAGINATION IN DEVISING PLEASING SHAPES AND ONE'S SKILL IN THE USE OF TURNING TOOLS.

7. What is the purpose of using a backing block for face plate turning?
8. Explain what is meant by inside and outside face plate turning.
9. List the advantages and disadvantages of the scraping and the cutting methods of wood turning.
10. List the six basic chisels used in wood turning.
11. List the chisels in the order in which you would use them in turning this design on a piece of stock. Indicate where you would use each.

12. Why are scraping tools generally used for face plate turning?
13. If you wish to turn twenty baseball bats to exact regulation size, what method would you use to ensure a uniform size?
14. What should the r/min of the lathe be if you were spindle turning a piece of stock (a) 75 mm in diameter? (b) 200 mm in diameter? If you were face plate turning a piece of stock (a) 125 mm in diameter? (b) 250 mm in diameter?

CHAPTER SIX

project design, bill of material, and lumber calculations

Any worthwhile project requires considerable planning and a well-dimensioned drawing or a working model. The completed plan or model may be available to you. However, it will be more meaningful and give you more satisfaction if you design and possibly research the project to be made. This planning should involve creative design, including freehand sketches and investigation into the best material to be used, before a working drawing is made. For design details, see Chapter 29.

The ability to design useful woodworking projects will be of value to you whatever your line of work will be. This ability could well lead you into some branch of the important field of industrial design.

Bill of material

From the working drawings a *bill of material* should be made. It should be complete, listing each piece required, its exact thickness, width, and length, and the type of wood. For example, a bill of material for the small table shown in Figure 6:1 is listed in the chart in Figure 6:2. A *rough stock list* or *cutting list* should then be made from the bill of material, allowing extra material for planing and squaring. The amount added will depend on the stock size of the lumber and whether or not the material from which the lumber is to be cut has been planed, or *dressed*. A general rule is to add 6 mm to the thickness and 6 mm to the width and 12 mm to the length of each piece. The allowances for thickness are sometimes omitted when cutting from dressed lumber. For example, if the finished size for a certain piece for a

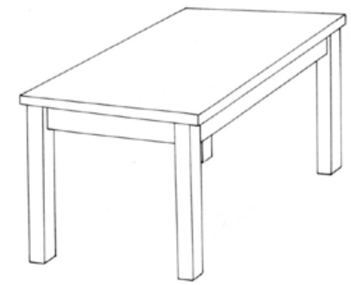


Fig. 6:1 A Sketch of a Table

NO. OF PIECES	NAME OF PART	THICKNESS	WIDTH	LENGTH	TYPE OF WOOD
1	TOP	19	450	750	BIRCH
2	RAILS	19	50	400	BIRCH
2	RAILS	19	50	712	BIRCH
4	LEGS	38	38	450	BIRCH

Fig. 6:2 Typical Bill of Material. All sizes are in mm.

NO. OF PIECES	NAME OF PART	THICKNESS	WIDTH	LENGTH	TYPE OF WOOD
3	TOP	21	156	762	BIRCH
2	RAILS	21	54	412	BIRCH
2	RAILS	21	54	724	BIRCH
4	LEGS	40	42	462	BIRCH

Fig. 6:3 Typical Cutting List. All sizes are in mm.

project is 19 mm, no allowance would be made on the cutting list for thickness, since the finished stock size is 19 mm. A cutting list is shown in Figure 6:3.

The correct order in stating the dimensions of lumber is (1) thickness, (2) width, and (3) length.

The width of the lumber is always measured across the grain; the length is measured along the grain.

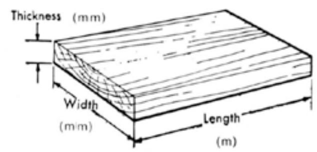


Fig. 6:4

Lumber sizes and calculations

Much has already been said about the growth of trees and the nature of wood and how it is cut and seasoned for use. You should also be familiar with lumber measurements, terms, and grades, as well as the method of estimating lumber and lumber cost.

Lumber is cut from the log in standard thicknesses, widths, and lengths, which make it convenient to store and to measure. The *stock size* or *nominal size* of boards is the size that is originally cut from the log. This is also known as the *rough size*. When it is dressed, approximately 3 mm is taken off each planed surface. The nominal size into which lumber is cut is 25 mm or 50 mm thick and from 50 mm to 300 mm wide in 25 mm intervals, and in lengths of 2.440 m, 3.050 m, 3.660 m, 4.270 m, 4.880 m, and 5.500 m. The lengths are soft conversions from the imperial measure, and eventually will be rounded to the closest 100 mm sizes. Lumber is often sawn or planed to sizes other than these for special purposes.

For estimating purposes the dimen sions of most construction lumber i stated in millimetres for the thicknes and width and in metres for the lengtl as shown in Figure 6:4.

Under the metric system lumber wi be sold (a) by the *lineal metre*; that is a piece of stock of a stated size wi cost so much for each metre of it length. For larger amounts of stock i may be sold by 100 lineal metres. (b For lumber required in still large amounts, it will be sold by the cubi metre (m^3). To estimate the volume o lumber in cubic metres (m^3) the fol lowing equation can be used:

$$\text{Volume} = \frac{\text{thickness in mm} \times \text{width in mm} \times \text{length in m}}{10^6} = m^3$$

For example, the number of m^3 in 10(pieces of stock 38 mm thick, 89 mn wide, and 4.880 m long would be

$$\frac{100 \times 38 \times 89 \times 4.880}{1\,000\,000} = 1.650\ m^3$$

The cost per cubic metre can also b included in this equation when estimat ing costs.

Sheet stock such as hardboards an plywoods are sold by the square metr (m^2) or by the sheet, which is generall 1200 mm × 2400 mm, the cost dependin on the thickness and the quality.

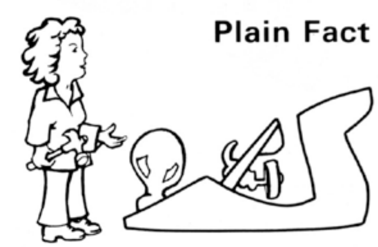
Roofing shingles, made from eithe asphalt or wood, are estimated as t quantity and cost by the square metr (m^2). They are packed in bundles, th number of square metres of shingles in bundle depending on the type of shingl

Lumber is sold either in the rough or a dressed stock. The code D.4.S. or S.4.S may appear on a lumber bill, whic indicates that the material is dressed c surfaced on four sides. Lumber may be dressed on two surfaces or four surfaces.

Grades of lumber

The grading of lumber is complicated and varies according to different standards and different types of wood. However, in general it is graded from the best quality downward in this order: #1 Clear, #2 Clear, Selects, #1 Common, #2 Common, #3 Common, and #6 Common. In many cases the grades will be mixed; that is, the lumber will be labelled as Number 1 and 2 Common, meaning that there is some of each grade in the shipment. The number of defects or blemishes in the wood determines the grade.

Plain Fact



THE QUALITY OF YOUR WORK WILL DEPEND ON HOW WELL IT IS PLANNED. GOOD WORK REQUIRES GOOD PLANNING.

ASSIGNMENT

1. State two reasons for making a bill of material.
2. What is the difference between a bill of material and a cutting list?
3. What order should be used in stating the dimensions of a piece of stock?
4. What are the advantages of cutting lumber into standard thickness, width, and length?
5. What does the abbreviation D.2.S. indicate when written on a lumber bill?
6. If the nominal size of a piece of stock is 50 mm × 200 mm and it is D.4.S., what would its actual size be?
7. What are the nominal sizes into which lumber is cut?
8. How many cubic metres would there be in 50 pieces 50 mm × 200 mm × 3000 mm?
9. What would be the cost of the lumber in question 8 at $110 a cubic metre?
10. What would be the cost of quarter round for a room 2.462 m wide and 3.540 m long with one door 710 mm wide at 20 cents a lineal metre?
11. What would be the cost of a sheet of 19 × 1200 × 2400 mm plywood at $6.20 per square metre?
12. How many square metres of shingles will be required to cover both sides of a gable roof 8 m long if the rafter length is 4 m?
13. List in order the general grades of lumber.
14. Make out a complete bill of material and a cutting list for the nail box shown below.