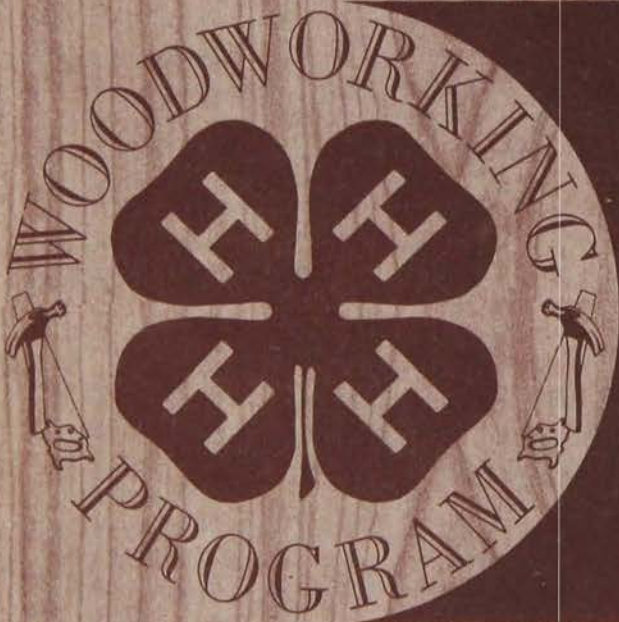
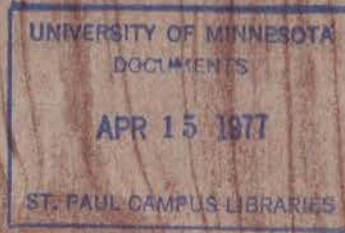


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Members' Manual

UNIT

3



BUILDING BIGGER THINGS

4-H Engineering Woodworking Program

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A Look Ahead

Introduction

This is your book for the third unit of the 4-H Engineering Woodworking Program. It contains information on types of wood, additional woodworking tools and drawings for articles. Your leader and parents may have ideas for other things. It is important to make articles useful to you or other members of your family. Next year you will receive another book with more information and drawings. However, you should keep this book and the books of previous years for reference material.

Your woodworking project leader may ask you to come to his home or shop to do some of your project-work or you may have to do it all at home. You will enjoy the project more if you have a work area in the shop, basement or garage. Be sure to provide storage of some kind for your woodworking tools. The tools described in Units One and Two will make a good start on a tool set.

Work Safely

1. Review the safety rules in Units One and Two.
2. Have your leader or parents destroy the rags or cloths you use to apply wood finish. Rags containing wood finishing oils may start burning by spontaneous combustion.
3. Read the labels on the glue, wood finish and paint or varnish remover containers. Some list precautions about inhaling vapors and prolonged contact with the skin.

Materials

You may use lumber, plywood, building fiber-boards and particle boards in your project work.

Ask your parents or leader to help you select the right material.

use dry lumber

Make sure your lumber is dry before you start working with it. Wet or green lumber may warp, twist and crack as it dries. You can decrease the amount of warping by stacking the lumber above ground on a frame that is level with other heavy pieces on top of it. Extra drying is especially important if the articles you make will be used indoors.

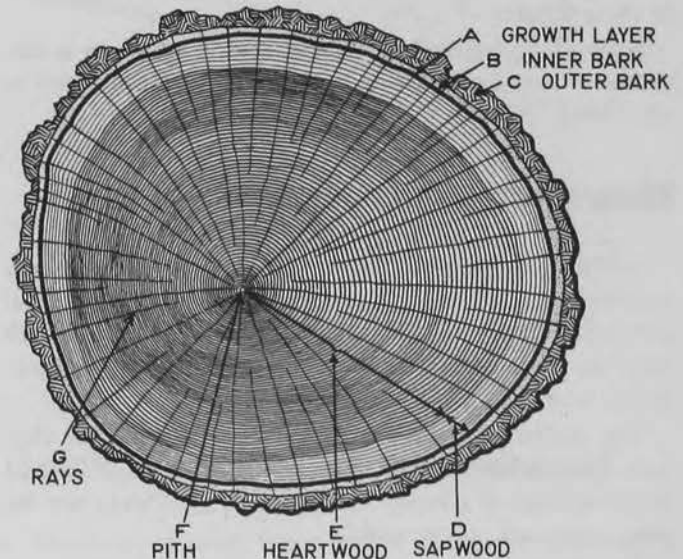
Lumber freshly sawed from logs must dry all summer to be ready for outdoor use. This is called air-dried lumber. Lumber for outdoor use can be stored in the garage, or other building.

Lumber you use for indoor articles should be drier. Place air-dried lumber in a heated room of the house for two or three weeks in the winter. Place it in a ventilated attic for one to three weeks in the summer. In hot dry weather, one week will probably be enough. Keep it there three weeks in cool, damp weather.

If your attic is not ventilated or too hard to get the lumber into, put the lumber up close to the roof boards of the garage for the extra heat for better drying.

Structure of Wood

When people talk about trees and lumber, they often speak of bark, heartwood and annual rings. Let's look at a picture to learn the meaning of these words.



When looking at the end of a log or the top of a tree stump, you will notice light and dark circles. The circles are annual rings or the amount of growth for each year. The light ring was formed in the spring of the year when the tree was growing rapidly. The darker ring was formed when the tree was growing slower in the summer. One light colored ring and one dark colored ring show how much the tree grew in one year. You can tell the age of a tree by counting the rings on the log or stump.

A Growth layer (cambium) is a thin layer in which all the growth of wood and bark takes place. It is located between the sapwood and bark. This layer is so thin you need a microscope to see it.

B Inner bark is soft and moist. It carries food from the leaves to all growing parts of the tree. Years ago boys used to chew the inner bark of slippery elm as gum.

C Outer bark consists of dry dead cells. It protects the growing areas from outside injuries.

D Sapwood, or outer layer of wood next to the bark, is usually lighter colored than the rest of the wood. The sapwood contains living cells and acts as a storehouse for the tree's food.

E Heartwood is generally darker in color than sap-

wood. Early in the life of the tree it was sapwood, too. But as the tree grew the cells of the inner layers of sapwood died and turned into heartwood. Heartwood is strong and helps hold up the weight of the tree.

F Pith is a soft center in the tree. It may be round, oval, three cornered or star shaped. It is usually less than 1/4" across. It is the soft tissue about which the first wood growth takes place in newly formed twigs.

G Rays are strips of cells extending from the center of the tree to the bark. They carry sap across the grain of the tree. In some woods the rays are extremely small, and in others very large.

Resin is the sticky reddish-brown gum that some times oozes from wet lumber. It was sap which is now becoming dry and hard.

Kinds of Wood

Wood is probably the most commonly used building material in the world today. When our forefathers landed in America the whole continent was nearly covered with virgin forests. But, unwise logging and the destruction by insects, fires and storms have removed many of these forests.

Now second-growth forests are being grown as a tree crop in many areas. They will help furnish our wood in the future.

Hardwood and Softwood

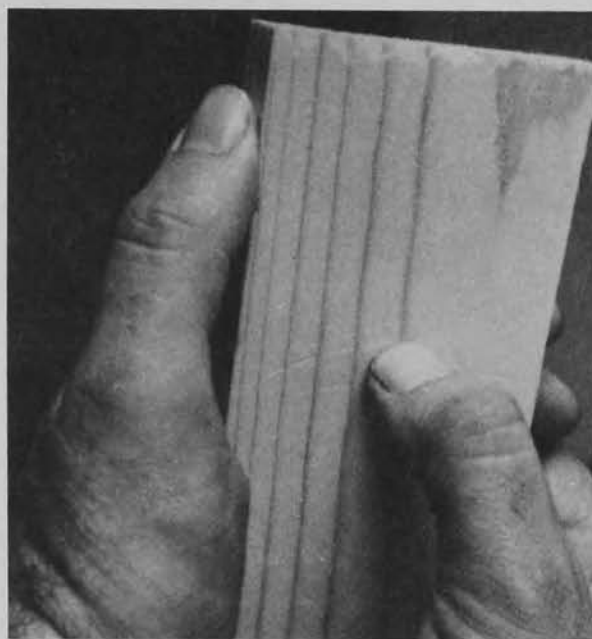
When people talk about kinds of wood, they usually mention hardwood and softwood. These terms also provide the basis for classification of all woods. As such they do not actually indicate the hardness or softness of the wood.

The softwood (coniferous) group includes trees that have needle-like or scale-like leaves and produce seed in some kind of a cone. Examples of such trees are the pine, tamarack, cedar and fir.

The hardwood (deciduous) group includes the trees that have broad leaves such as the oaks, maples and basswood. The name has no reference to the hardness of the wood.

You can easily tell the trees apart when the leaves are visible. But, it is more difficult to tell the kind of wood when working with a piece of lumber.

Often a thumbnail test is used to separate the hardwoods and softwoods. Push down hard with your thumbnail and pull it across the grain of a smooth piece of wood.

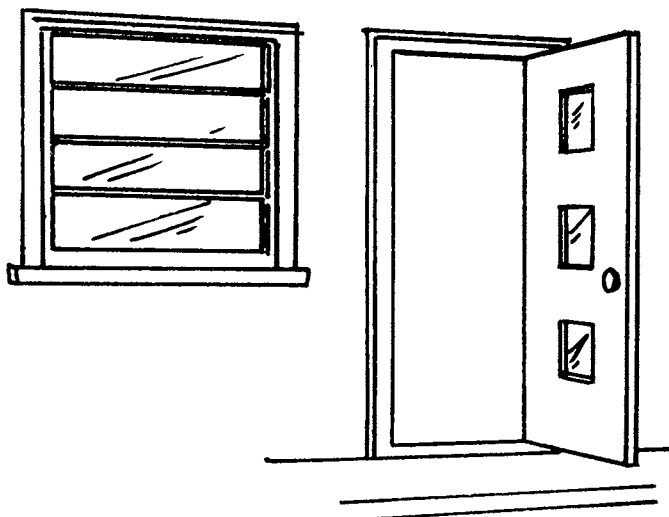


Running the thumbnail across the grain of the wood

The alternate layers of soft spring wood and hard summer wood of most softwoods will give a bumpy feeling to your fingernail. It will remind you of riding your bicycle across railroad ties. Your thumbnail will glide smoothly across the grain of the hardwood like riding your bicycle on smooth pavement. Try separating pieces of wood into hardwood and softwood groups.

The following are short descriptions of some of the woods available.





Ponderosa Pine – A Softwood

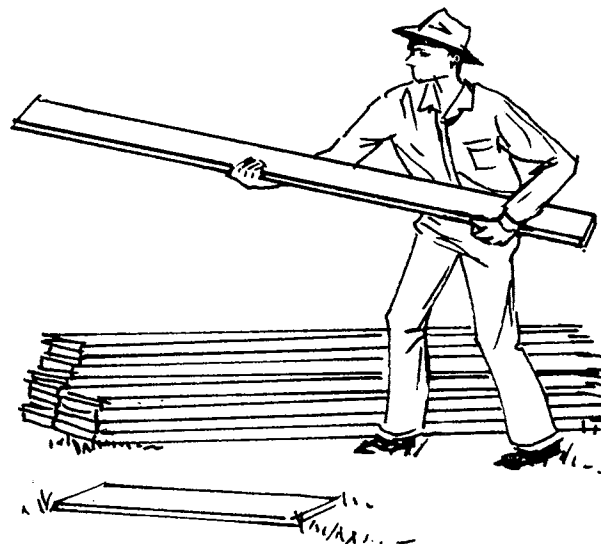
Ponderosa pine is also a good choice wood. It is a little harder to work than white pine, but a little easier than red pine. It is available at most lumber yards. Ponderosa pine grows in the western United States.

Spruce – A Softwood

Spruce wood is another wood which is rather easy to work with. It is light, soft, straight grained and non-resinous, but decays easily.

This group includes the eastern or Great Lakes' white and black spruces, the red spruce of New England and the Appalachian mountains. Sitka spruce from the northwestern part of the United States and Engelmann spruce from the high Rocky Mountains are also included.

Spruce is used principally for pulpwood, general construction lumber and box lumber.



White Pine - A Softwood

White pine is the nicest wood for you to use, but it is rather expensive. It is easily worked with sharp tools. It doesn't split easily and is lightweight and soft.

The wood is cream-colored to light reddish-brown.

White pine is more in demand for carpentry and building than any other kind of wood. The best of this wood is used for building siding, paneling, exterior and interior building trim, sash and doors, cabinet work and foundry patterns. It is even preferred for wooden matches because the wood burns evenly and without sputtering.

Because of its general all-around usefulness, the lumber industry of this country was founded on this tree. The eastern white pine, western white pine and sugar pine are included in the white pine group.

Red Pine – A Softwood

Red pine, commonly called Norway pine, is a good second-choice wood for you to use. It is a little heavier and harder than white pine. It splits easier. It is darker in color and more resinous.

Red pine is often used for the same purposes as white pine. It is used as siding, flooring, general millwork and construction lumber. It is also used for piling, poles, pulpwood and cabin logs.

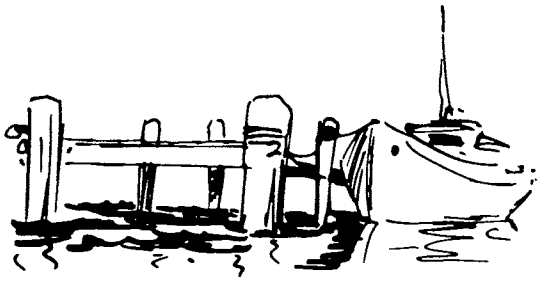
Red pine grows in the New England and lake states regions. It is a very important tree in the reforestation program, because it can grow on poor soil and has few natural enemies.

Jack Pine – A Softwood

Jack pine lumber has a rather coarse texture and is generally knotty. It is cream to pale orange-brown in color, hard and somewhat resinous. It is more apt to split from nailing than red or white pine.

Jack pine is used principally for pulpwood, poles, piling and lumber.

It grows in the lake states region and a large part of Canada. This tree matures in about 60 years. It can not grow in dense shade but grows well in the sun. It can grow on poor, sandy soils. It is a heavy seed producer. Because of these characteristics, it has seeded itself in thousands of acres of cut-over and burned forest land.

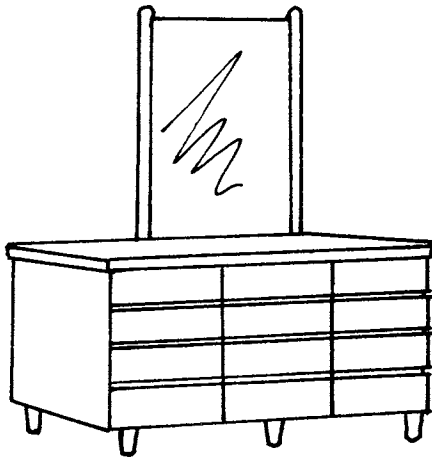


Southern Yellow Pine – A Softwood

Ten species of pine growing in southeastern United States are referred to as yellow pine. Only four of these are important. Longleaf and slash pines are generally heavy, hard and resinous. They are the major source of our resins and turpentine. Shortleaf and loblolly pine are generally light, soft and only moderately resinous.

The yellow pine wood is characterized by a dark summerwood band in the annual ring. The wood color varies from yellow-orange to reddish-brown. Yellow pine has a tendency to split during nailing.

The wood of yellow pine is used in heavy structures such as bridges, warves, docks and ship frames. It is also used for construction and box lumber, poles, piling, veneer and pulpwood.



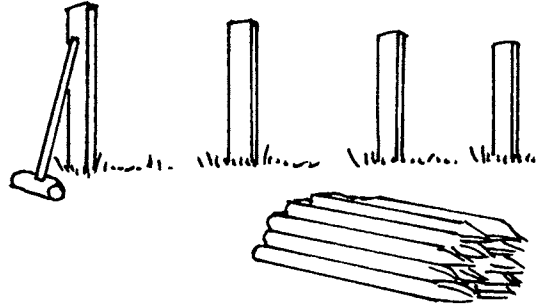
Douglas-fir – A Softwood

Douglas-fir is strong, moderately hard and heavy, and very stiff. It is rather difficult to work with using hand tools because it splits easily. Probably your first use of Douglas-fir will be as plywood or 2" x 6" material.

Douglas-fir is used for structural timbers, piling, plywood, lumber, furniture and pulpwood.

The sapwood is white and the freshly cut heartwood is light reddish-yellow in color. Exposure to light and air changes the heartwood to a reddish color and sometimes to cherry-red or reddish-brown. Most Douglas-fir has a distinct odor.

Douglas-fir is one of the largest and most important trees native to North America. Some trees have been found to be 1,000 years old, 300 feet tall and 10 feet in diameter. They grown in western United States and Canada.



Aspen (Quaking and Big Tooth) and Cottonwood – Hardwoods

The aspens grow in northern United States and Canada. The cottonwoods grow in the eastern and north western United States. The cottonwoods usually grow in areas that are warmer than the areas where aspens are common. The heartwood of the aspens and cottonwood is grayish white to light grayish brown. The sapwood is slightly lighter in color. The wood is light in weight, weak, soft and generally straight grained. The aspens have a strong odor prior to seasoning. Aspen and cottonwood lumber when sawed has a wooly or fuzzy surface. When finished it has a silky luster.

These species are used principally for paper pulp, lumber and excelsior. The lumber or veneer goes largely into the manufacture of boxes and crates. Considerable amounts, however, are used in the manufacture of low cost furniture.

Red Oak – A Hardwood

Red oak is hard, coarse, porous, strong and heavy. Large open pores between the annual ring and the broad rays make this an attractive wood.

The heartwood is light red in color.

Red oak is used for furniture, interior trim, all types of cabinet and millwork, veneer, lumber, railroad ties and fence posts.

Some kinds of red oak grow in all the wooded areas of the United States. Old growth wood is softer, more easily worked and takes a better finish than second growth timber.



White Oak – A Hardwood

White oak is strong, tough and rather easy to work.

White oak is grayish brown, with a reddish tinge and, like red oak, has open grain. The rays running out from the center of the log are very distinct. Because the pores in annual rings are plugged with deposits, white oak can be used for barrels.

White oak is used for interior trim, cabinet work, furniture, flooring, untreated fence posts, railroad ties and heavy construction timbers.

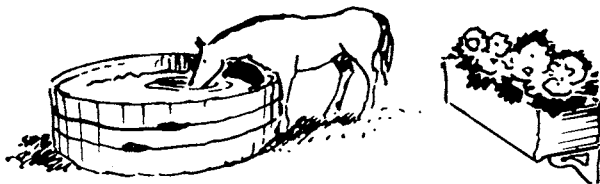
Redwood – A Softwood

The heartwood of redwood varies in color from light cherry red to dark mahogany red. The sapwood is almost white. Redwood is light in weight, fairly strong.

The wood is easy to work, and generally straight-grained. However, you must be careful when nailing or using screws because it splits easily.

The heartwood is very resistant to decay and holds paint well. Because of these characteristics it is used a great deal for outdoor furniture, flower boxes, picket fences, water tanks, shingles, siding, etc.

Redwood grows only in the extreme western part of the United States. It grows to enormous size. It is one of the largest growing trees known.

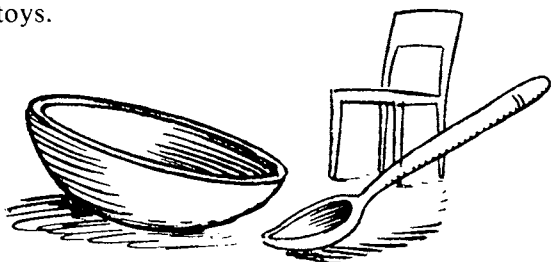


Birch – A Hardwood

Yellow birch has white sapwood and light reddish-brown heartwood. It is fine and uniform in texture, heavy, hard and strong. It is used for both lumber and veneer for plywood. Birch shrinks considerably in drying, works well and takes a good finish. It takes a good natural finish as well as a good stained finish, and is often stained to imitate mahogany and walnut.

Birch lumber and veneer are used in the manufacture of furniture, doors, interior finish, woodenware, boxes and baskets.

White birch is used for turned products such as spoons, and toys.

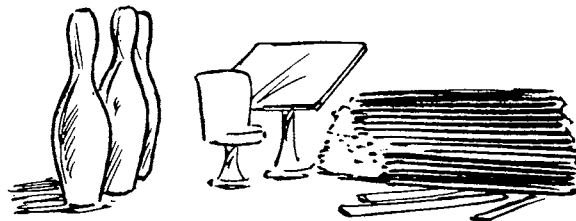


Maple – A Hardwood

Maple is generally divided into two main groups: hard and soft maple. The most common hard maple is sugar maple. Its sap is used for making maple syrup and maple sugar. Soft maple is of lesser importance. Red maple and silver maple trees are classed as soft maples.

The wood of hard maple is light brown to white in color, the heartwood is the darker color. Maple is either straight or curly-grained. When hard maple contains a figure, it is called bird's eye, landscape or curly maple. It is capable of taking a high polish because of the fine, uniform texture. Although it is hard and not easy to work, it can be brought to a good surface and will turn well on a lathe.

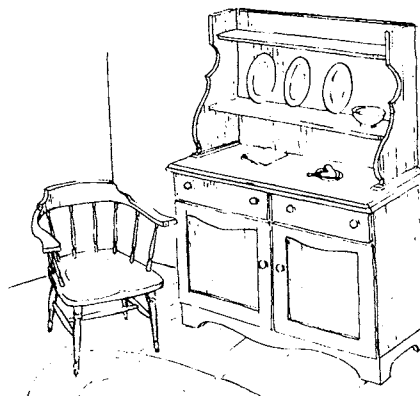
Besides being used in millwork products such as flooring and fine interior trim, its wood is used extensively for veneering, furniture, cutting boards, musical instruments, woodenware, tool handles, ships, bowling pins, athletic equipment and school apparatus.



Walnut – A Hardwood

Black walnut, the ideal American cabinet wood, is noted for its rich color, durability and beauty. It grows mainly in the eastern half of the United States and requires a deep, rich soil. Stump and burl walnut are very valuable for veneers and panel work.

The heartwood of black walnut is rich chocolate brown. It does not warp or check when properly seasoned. The wood is heavy, brittle, hard, strong and coarse grained. The sapwood is pale brown and must be artificially darkened to match the heartwood. Walnut is used in fine furniture, cabinets, interior trim, gun stocks, musical instruments, fine boats and many other articles.



Butternut – A Hardwood

Butternut is a close relative of black walnut. The wood resembles black walnut in texture, but is lighter in color and weight, and is not as strong or hard as black walnut. The heartwood is a light chestnut brown and occasionally has a reddish tinge. The narrow sapwood varies in color from white to light brown. Butternut is very easily worked. It is used chiefly in the manufacture of furniture and for interior trim.

Black Cherry – A Hardwood

Black cherry is often called cherry, wild black cherry, wild cherry or choke cherry. It grows throughout the eastern half of the United States.

The heartwood varies in color from light to dark reddish brown; the sapwood is nearly white. Black cherry is strong, stiff and moderately heavy and hard.

Cherry is used principally for furniture, woodenware novelties and hardwood veneer for paneling, etc.

Western Redcedar – A Softwood

Western redcedar grows along the Pacific Coast of the United States and Canada. The heartwood is reddish brown in color and has the characteristic odor of cedar shingles.

The wood is light in weight, moderately soft, generally straight-grained, but has a rather coarse texture. The heartwood is very resistant to decay.

Western redcedar is used principally for shingles, exterior siding and lumber for greenhouse construction, ship and boat building. It is also used for posts, piling and poles.

Eastern Redcedar – A Softwood

Eastern redcedar is in the eastern half of the United States except in Maine and Florida. The heartwood ranges in color from dull to bright red, and the sapwood is nearly white. The wood is fairly heavy, and the heartwood is very resistant to decay. It is fine and uniform in texture.

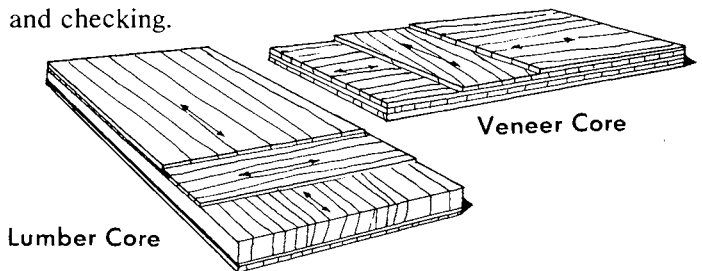
Eastern redcedar lumber is used in the manufacture of chests, closet linings, pencils and small boats.

Plywood

Thin layers or sheets of wood called veneer are used in the manufacture of plywood. The veneer is made by sawing or slicing these thin layers from a log or bolt. The veneer can be cut into almost any thickness. The most common veneers are 1/32 to 3/16 of an inch thick.

Plywood is made by gluing three, five or any odd number of layers together. The grain of the outer layers go in the same direction. The grain of each layer goes at right angles to the adjoining layer.

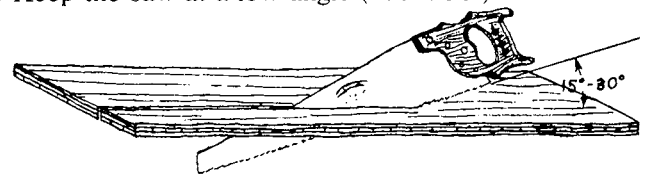
The alternating grain directions tend to reduce warping, shrinking and expanding of the plywood due to moisture change, and creates a resistance to splitting and checking.



The various veneer plies may be of the same or different thickness. The center ply is called the core. If the core is a ply of veneer, the product is called all veneer plywood. If the core is made of pieces of lumber glued together, the product is called lumber core plywood. The outer layers are called face-and-face or face-and-back veneer. In five ply construction, the plies between the core and the outer plies are called crossbands.

Different glues are used in plywoods manufactured for use indoors than in those made for outdoor use. Therefore, select exterior grade plywood for articles that will be used outdoors.

Always use a fine tooth saw for cutting plywood. To cut plywood with a handsaw, have the good side or face up. Keep the saw at a low angle (about 30°).



For Indoor Use

A-D

GROUP 1
INTERIOR

PS 1-66 000

The registered American Plywood Association grade-trademarks shown here identify quality-tested plywood. Look for them on every panel you buy.

For Outdoor Use

A-C

GROUP 2
EXTERIOR

PS 1-66 000



Particle and Fiberboard

Many materials are included in this group and are known by various trade names.

Rigid Insulation Board

The lightest and softest of the group are the rigid insulation boards. They may be used as insulating ceiling or interior wall materials, sheathing and lathe for plaster base. You may use some of this material for bulletin board material or a backboard for a dart game.

Hardboards

The fibrous hardboards (such as masonite or the equivalent) are much harder and heavier than insulation boards. They are usually available in sheets 1/8 to 5/16 inch thick.

Hardboard may often be used as you would thin plywood. However, with moisture change it will expand and contract more than plywood. You may want to use it for sides of small boxes, drawer dividers, platter files, etc.

Some hardboards are given an additional treatment with drying oils and then baked in an oven. This is called treated or tempered hardboard. The treatment increases strength and water resistance. Therefore, use the treated or tempered hardboard if your product will be used outdoors.

Particle or Chipboards

Particle or chipboards are formed by bonding wood particles or chips into a solid sheet. The resulting boards take paint and stain finishes well and can be cut and glued as other woods. They may be used in place of plywood in many jobs. However, it is important to remember they shrink and swell more than plywood when the moisture content changes. The humidity difference in the air between summer and winter may cause moisture change in articles in the home during the year.

Board Measure

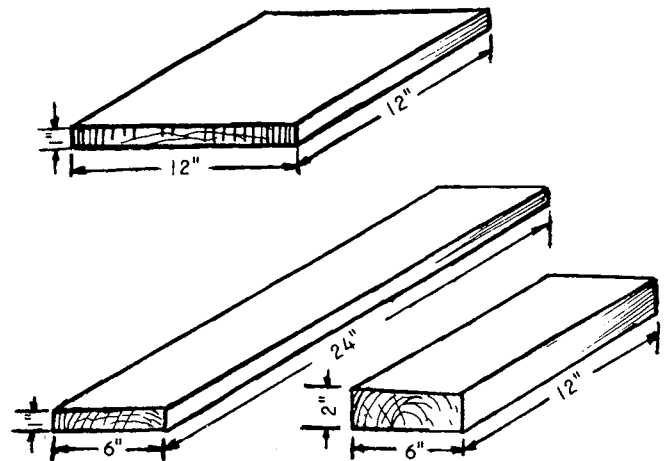
Lumber commonly cut and sold as boards and plank is rough-sawed to nominal size, and dressed to actual size. It is sold by the board foot in either nominal size or dressed form.

For example one inch pine board eight inches wide is cut approximately 1" x 8" at the saw mill. This is called its nominal dimension. As it dries, it shrinks in both width and thickness. When it is planed or surfaced on all four sides with a planer or milling machine, the size is further reduced.

Dried, it is about 3/4" thick and 7 1/4" wide. This is called the actual dimension. Two inch nominal material such as two-by-fours and two-by-sixes are usually dressed to 1 1/2" thick. The 2" x 6" is usually 5 1/2" wide.

When you buy standard dimension lumber the nominal dimension size is used in figuring board feet. For example: A board foot is a piece 1 inch thick, 12 inches wide, and 12 inches long or its equivalent. This would be the nominal dimension, but dressed it would be about 3/4" thick, 11 1/4" wide and a foot long.

Each of the following illustrations contain one board foot or 144 cubic inches on the basis of nominal dimensions.



Two simple formulas are used in figuring board feet. The first is used when the length is given in feet:

$$\frac{T'' \text{ (Thickness)} \times W'' \text{ (Width)} \times L' \text{ (LENGTH)}}{12} = \text{Board feet}$$

When the length is given in inches the following formula is used:

$$\frac{T'' \text{ (Thickness)} \times W'' \text{ (Width)} \times L'' \text{ (Length)}}{144} = \text{Board feet}$$

Either of these formulas can be used. Remember to divide by 12 if the length is given in feet, or divide by 144 if the length is given in inches.

To find out what a piece of pine lumber 1" x 6" x 8' would cost, first determine the board feet. Then multiply this times the cost. Let's try it at \$300 per thousand board feet, which is often written \$300 per M. This is the same as 30 cents per board foot.

$$T'' \times W'' \times L' = \text{Board feet}$$

12

$$1'' \times 6'' \times 8' = 4 \text{ Board feet}$$

12

$$4 \text{ board feet} \times 30\text{¢ per foot} = \$1.20$$

Can you figure out the board feet in a 1" x 8" x 12'; a 2" x 4" x 8'; and a 2" x 6" x 10'?

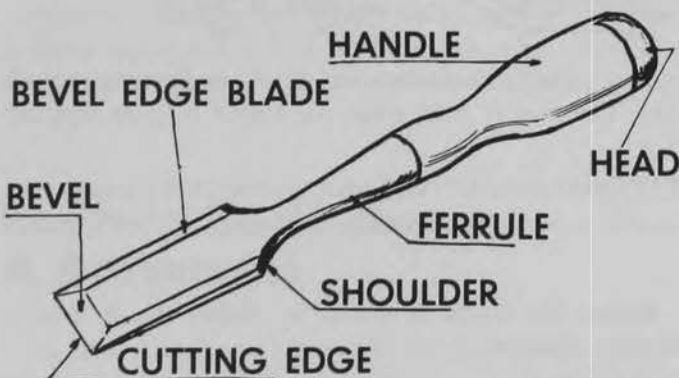
Moldings are usually sold by the lineal or running foot. Plywood, insulation board and hardboard are usually sold by the square foot.

Some lumber yards now sell dimension lumber by the lineal or running foot.

Your Tools

You were encouraged in Unit I, Adventures In Woodworking, to start a tool set of your own. Unit II gave you information on the use and care of more tools and equipment. This unit will explain how to use and care for additional tools, which you may like to add to your set.

Wood Chisel

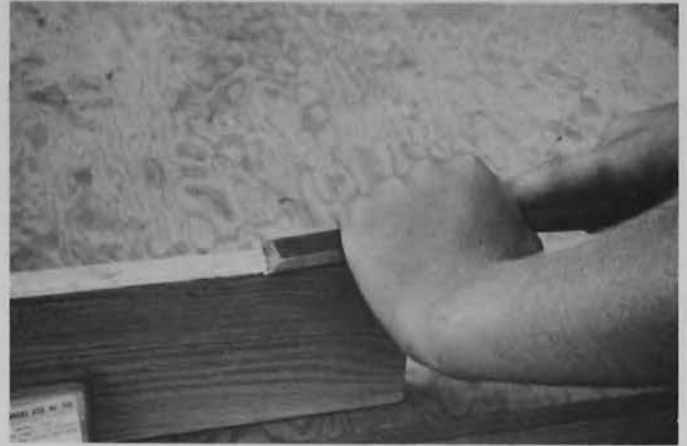


Wood chisels are made in various widths of blade, ranging from 1/8" to 2 inches.

There are also several different types of chisels available at various prices. All except the thin blade paring chisels are built so they can be pounded for rough cutting. When pounding a chisel head, it is advisable to use a wood, rubber, rawhide or plastic mallet.

Using Your Wood Chisel

A right handed person will guide the chisel with the left hand and apply the moving power with the right. Always push the chisel away from you, keeping both hands behind the cutting edge.



To cut with the grain, hold the chisel slightly turned to one side and push away from you. Hold with the bevel up for a fine cut and with the bevel down for a rough heavy cut.

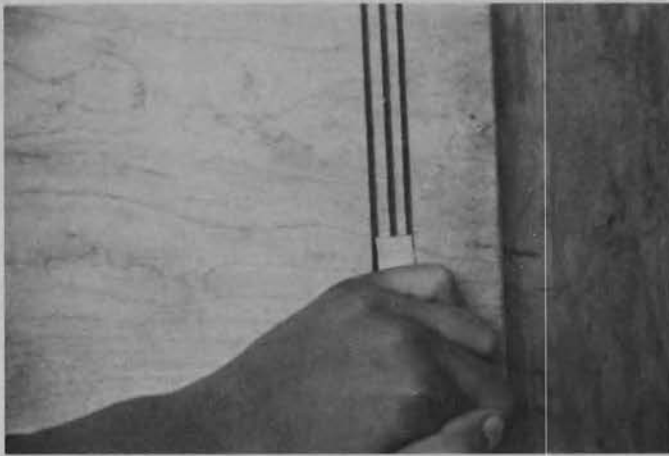


To cut across the grain of the wood, grasp the blade of the chisel between the thumb and the first two fingers of the left hand, to guide it and to act as a brake, while the pushing is done with the right hand.



To avoid splintering the corners, cut from each edge toward the center. Remove the center portion last.





For chiseling across wide boards, hold the chisel bevel down for finger room.



To cut a chamfer, hold the handle slightly to one side, or move it back and forth slightly, as the chisel is pushed

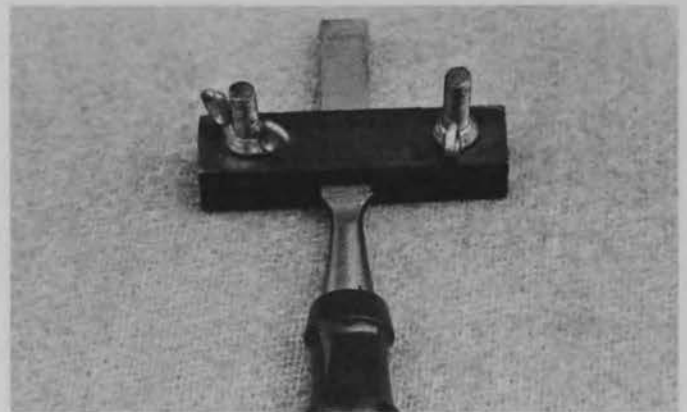


forward. This gives a sliding or slanting cutting action, which makes the chisel cut better and easier.

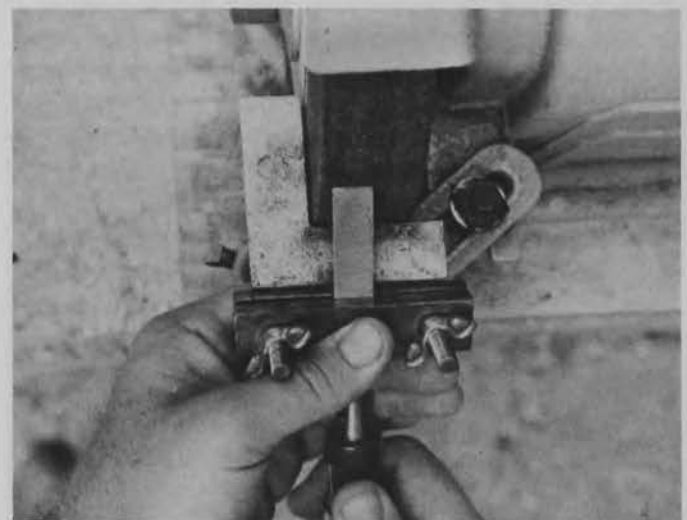
Sharpening the Wood Chisel and Plane Iron

Wood chisels and plane irons are whetted on the oil stone to give a very sharp cutting edge. When the cutting edge is nicked or the angle is incorrect, it is time to grind it. A grind stone is desired for this, but a fine grit emery wheel can be used. In either case, the grinding wheel should turn toward the chisel. The chisel or plane iron should be frequently dipped in water to prevent overheating.

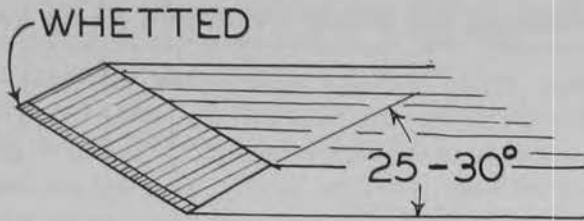
The cutting edge should be straight and square with the sides of chisel or plane iron. You may desire a clamp to grip the chisel and rest against the grinder guide for accurate positioning.



A clamp to hold the chisel or plane iron for grinding.



Chisel in position on grinder. Guide must be parallel to edge of wheel. Move chisel or plane iron across the face of the wheel from side to side. Caution: wear goggles unless the wheel is guarded with eye shields.



Both the plane iron and wood chisel should be ground to a 25° or 30° angle. This makes the bevel a little longer than twice the thickness of the chisel.

A bevel too short and thick will not enter the wood easily. A bevel too long and thin is weak and will nick easily.

After proper grinding, whet the chisel or plane iron on the oil stone for a very sharp cutting edge.



Apply enough oil to the stone surface to keep it moist. The oil prevents particles of steel from filling the pores of the stone. When the pores are filled, the stone does not cut well. Wipe off the oil before putting the stone away.

Place the chisel or plane iron on the fine grit oil stone with bevel flat on the surface. Raise handle slightly 5° or less, so you whet only the forward part of the bevel.

Move the chisel or plane iron with a circular motion back and forth lengthwise on the oil stone several times. The circular motion permits you to use the entire top of the stone so it wears evenly.

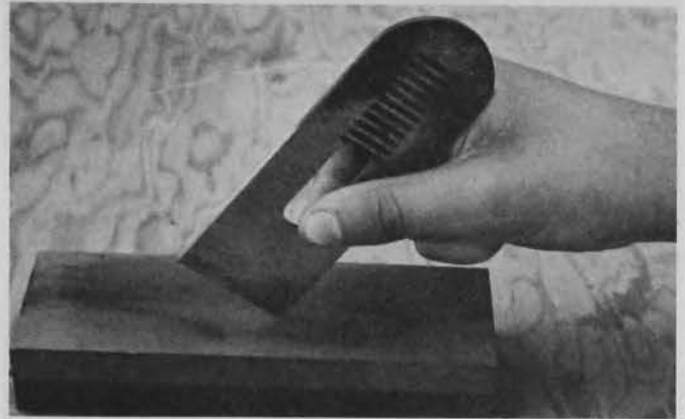


After whetting the bevel edge on the oil stone, remove the wire or feather edge. Turn the chisel over and hold the flat side flat on the oil stone. Move the chisel back and forth a couple of times in this position.

Now look at the cutting edge. If you see a nick or a shiny edge of bluntness, whet both sides again. Make a small cut in a piece of wood before taking a final look.

Use will dull the cutting edge. When it becomes dull, sharpen by whetting as described. The whetting process can be repeated until the bevel becomes too short and thick. Then, grind for the correct angle.

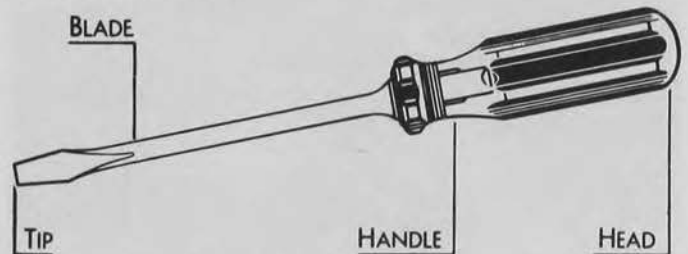
Plane marks will show less on a finished surface if the corners of the plane iron are slightly rounded. This can be accomplished by additional honing at the edges or just stroking the corner in a circular motion as illustrated.



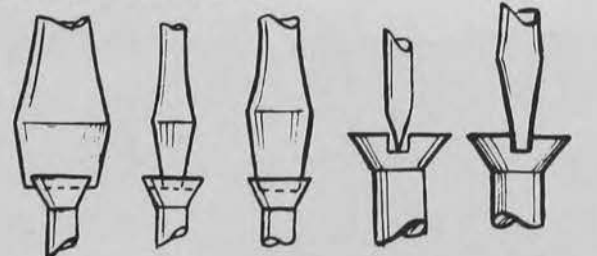
Screwdrivers

Grinding Your Worn Screwdriver

Screwdrivers are available in a large variety of sizes and shapes. The tip is usually in good condition when the screwdriver is new.



The screwdriver should fit the screw head slot as shown in the drawings below.



WRONG
Too wide.
Will damage wood.

WRONG
Too narrow.
Will damage screw.

RIGHT
Tip same width as slot.

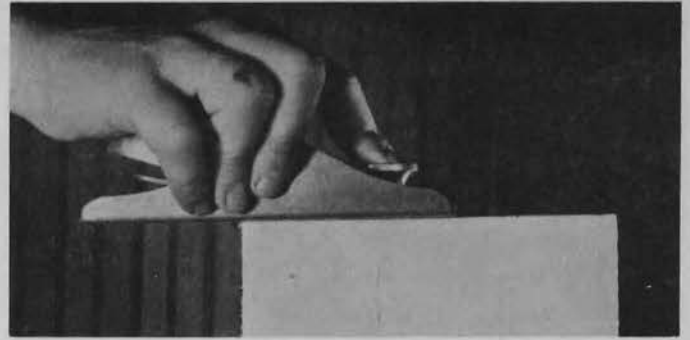
WRONG
Tip too sharp.
May slip out.

RIGHT
Sides of tip are parallel with sides of screw.



When the tip is too wide the wood around the screw will be damaged. A tip that is too narrow will slip out of the screw slot and damage the screw head. If the tip is worn to a sharp or chisel like shape it is very difficult to keep the screwdriver in the slot.

Therefore, it is often necessary to regrind the screwdriver tip. The following illustration shows the grinding action to blunt or square the tip.



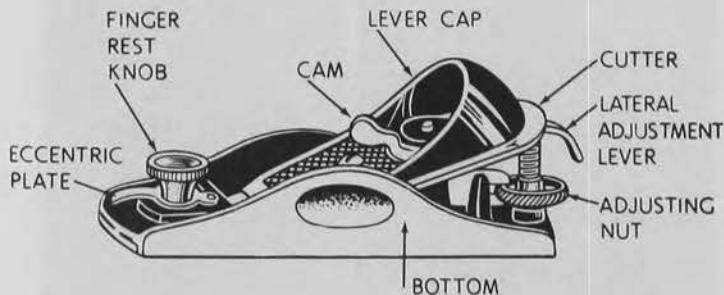
Because of the low angle, the block plane is used for fine work and end grain.

Planes

There are many different kinds of planes, the five most common ones will be discussed in this unit. These are the block, smooth, jack, fore and jointer planes.

BLOCK PLANE

The block plane is the smallest and the most practical for the young woodworker. It is about six or seven inches long which makes it easy to hold and ideal for fine work and cutting across end grain. The plane iron or cutting blade is placed in the body of the plane, the bevel side up. Position the lever cap and tighten the lever cap screw.

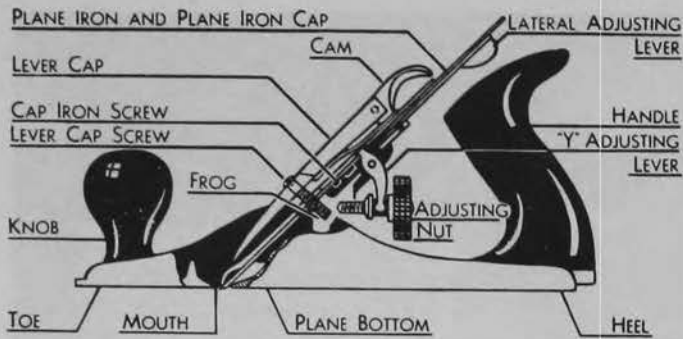


The block plane is used with the bevel side of the plane iron up.

The smooth, jack, fore and jointer planes have the blade assembled with the bevel down. They have a plane iron cap which most block planes do not have. They also have a higher blade angle than the block plane.



The block plane works well to cut chamfers and bevels.



SMOOTH PLANE

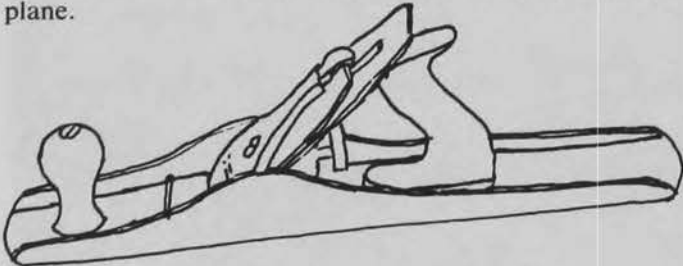
The preceding picture of a plane with the parts named is a smooth plane. Notice how the heel of the plane bottom ends at the handle. This is a characteristic of the smooth planes. The smooth planes are usually between 5 1/2" and 10" long.

It is a fine utility tool and works well for rough or preliminary planing as well as for planing end grain, chamfers and other edge shaping. However, if the board is long and a little wavy or irregular, the plane will smooth out all areas but not necessarily cut off the high spots. In other words, it will ride up and down on the irregularities like a small boat rides the crest and valley of a large wave.

A plane with a longer plane bottom, such as the jack, fore or jointer planes, will do less riding up and down on the irregularities and produce a truer surface. The top of high spots are cut off each time until the surface becomes straight.

JACK PLANE

The heel of the bottom of the jack, fore and jointer planes extend back beyond the handle. The jack planes vary in length, but are usually from 11" to 15" long. It is a fine utility tool. Because of its greater length it will true up irregular surfaces or edges better than the smooth plane.



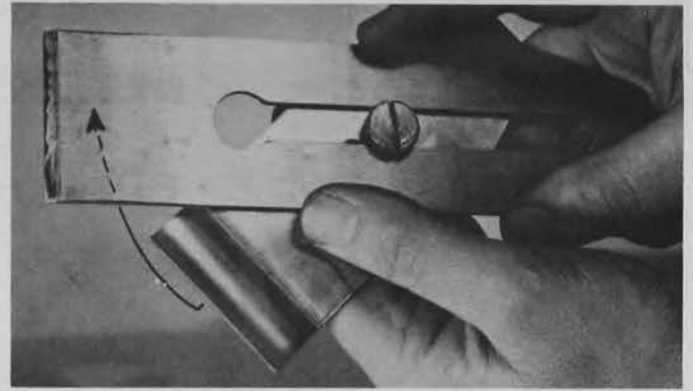
FORE PLANE AND JOINTER PLANE

The length of the plane bottoms of the fore and jointer planes are longer than the bottom of the jack plane. They are used predominantly to cut an edge or surface perfectly straight. The fore planes are usually about 18" long and the jointer plane 22" to 24".

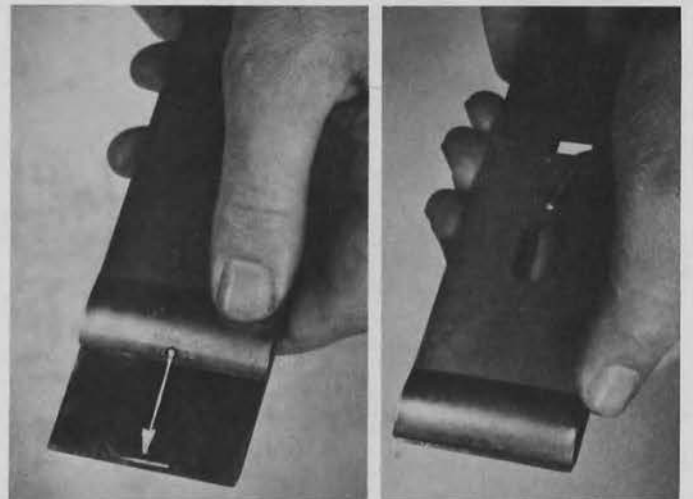
Assembling Your Other Planes

For satisfactory performance the plane iron must be sharp, properly assembled and adjusted. Plane iron and wood chisel sharpening was described earlier. Therefore, we will start with plane assembly. You will remember that when the block plane was assembled, the plane went together with the bevel up. The other 4 planes are different. They have a plane iron cap and the plane iron goes into the plane with the bevel down.

First, hold the plane iron cap crosswise with the plane iron. Slip the plane iron cap screw through the round hole in the plane iron. Slide it up the slot in the plane iron. Then rotate the plane iron cap so it is straight with the plane iron.



Move the plane iron cap forward to a position about 1/16 of an inch from the cutting edge. Be very careful, so the cap does not slip over the cutting edge. This would dull it.

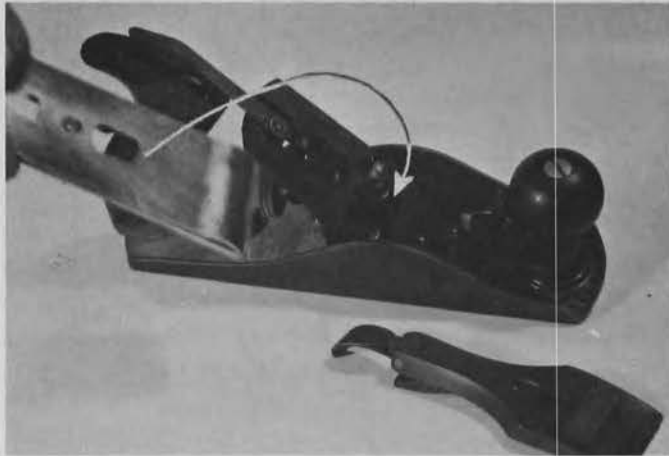


After making this adjustment use a screwdriver or lever cap to tighten the plane iron cap screw to hold the pieces together.

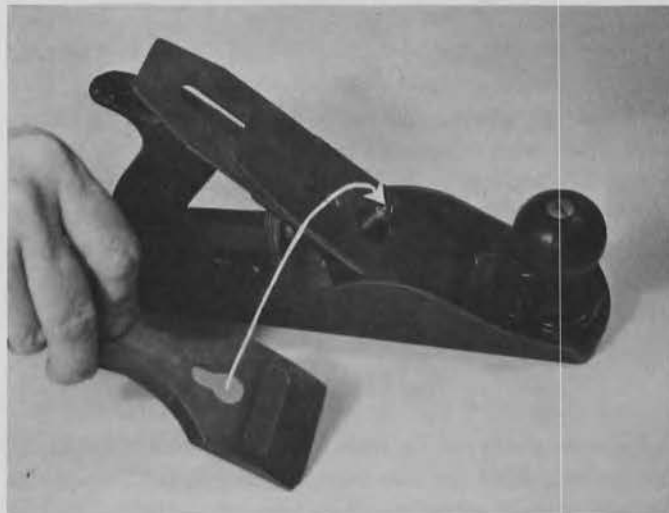




Carefully place the plane iron and plane iron cap, with the cap up, in position over the cap iron screw. Avoid striking the edge of the opening or mouth with the cutting edge of the plane iron.



Place the lever cap in position and lock in place with the plane iron cap cam. If it is too tight or too loose, loosen or tighten cap iron screw slightly.



Adjusting Your Planes

BLOCK PLANE

To check the adjustment, turn the plane upside down and sight along the bottom. The blade should project through evenly and just about the thickness of a sheet of paper.

Turn the adjusting knob clockwise to push the plane iron out. To pull the plane iron in, turn the knob to the left until the blade is in proper position. Then turn it clockwise until it starts to push the plane iron out. The plane iron will stay in the right place when the plane is used.

To adjust for an even blade, loosen the lever cap screw. Turn the plane over and sight along the bottom. Press the plane iron to the right or left until it is even. Tighten the lever cap screw.



RIGHT



WRONG

SMOOTH, JACK, FORE and JOINTER PLANES

The information given pertaining to the block plane also applies to these planes. However, these planes have a lateral adjustment lever which makes for an easier even blade adjustment.

To adjust the plane, turn it over and sight along the bottom. The cutting edge of the plane iron should protrude about the thickness of a sheet of paper. The ad-

justing nut moves the blade to adjust thickness of cut. The lateral adjusting lever will move the blade sidewise to obtain equal exposure of the cutting edge.



To take the plane apart for sharpening, reverse the procedure outlined above. The plane iron cap performs two tasks in this type of a plane. It breaks and curls the shaving. This action and the metal of the toe of the plane at the mouth opening prevent the wood from splitting ahead of the cutting edge. The plane iron cap also stiffens the plane iron.

To keep the plane straight press on the finger rest at the beginning of the stroke. Press on the lever end at the end of the stroke.

Hold the plane level when planing a square edge.

Planing Flat Surfaces and Board Edges

Plane with the grain of the wood to make smooth surfaces. Remember the old saying, never rub a cat the wrong way. The grain of the wood will ruffle up just like the fur on the cat's back.

If the grain is rough and torn after the first stroke, reverse the board so you will be planing with the grain.

Hold the board being planed by clamping it securely in a vise or by placing one end against a bench stop.

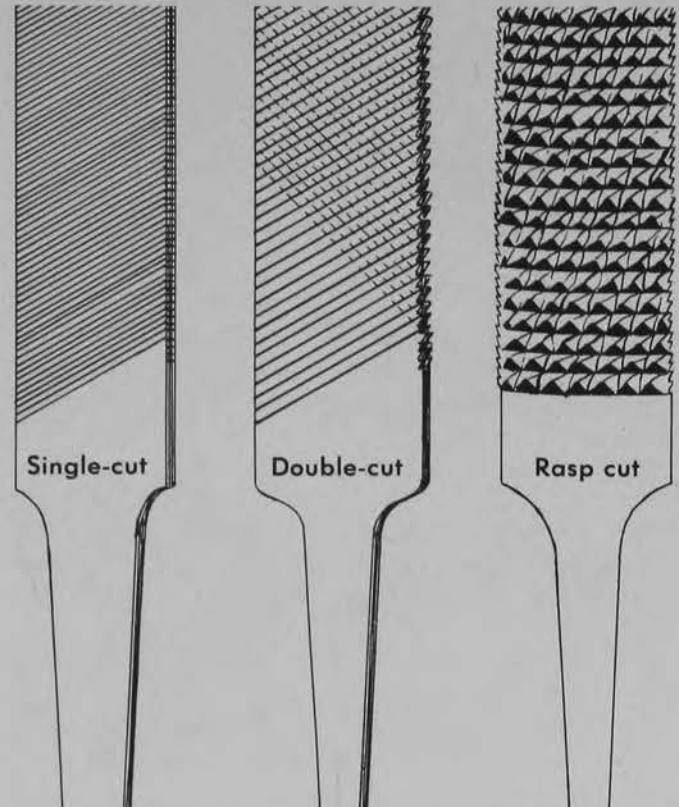
Planing End Grain

To plane end grain start at the edges and plane to the center. Then plane from the other edge to the center.

If the plane is pushed all the way across the end of the board the corner will split.

Rasps and Files

Rasps and files are useful in woodworking as well as in metal work. Many workers and hobbyists use them to smooth wood after it has been roughly cut. Most of the files on the market have teeth cut as illustrated.



The size of a file or rasp is designated by its length, measured without the tang or tapered shank.

A file with one series of chisel-like teeth running diagonally across the face is known as a single-cut file. A double-cut file has a second series crossing the first at nearly right angles. A third kind, used on rasps, consists of raised points on the surface, rather than chisel-like teeth.

The fineness or coarseness of files is commonly designated by the following series of terms, which are arranged in the order of coarsest first; rough, coarse, bastard, second cut, smooth and dead smooth.

The rough, coarse and bastard cuts are used on rough work. The others are used for finishing work.

The double-cut types are usually used with heavy hand pressure for fast cutting. The single cut types are used with light pressure to produce a smooth surface finish on metal or keen edges on knives, saw teeth or other cutting implements.

Clamps

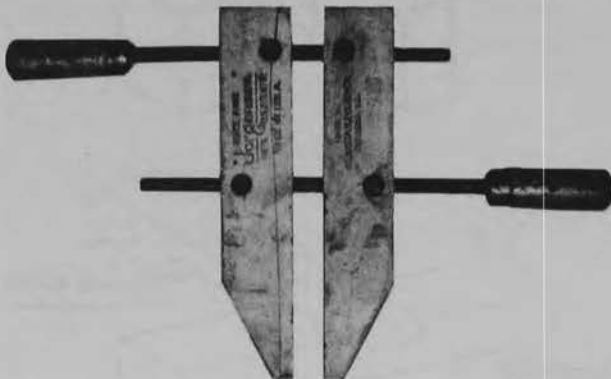
Clamps are used to hold pieces together for certain operations. They are also used in gluing to hold the pieces under pressure while the glue dries.



Butt Joint

The C-clamp was described in Woodworking Unit 2.

HANDSCREW



In using this clamp apply pressure with leverage from the back screw.

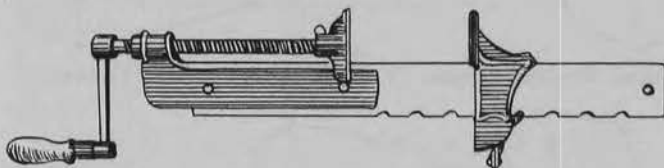
PIPE BAR CLAMP



Pipe forms the backbone of this clamp. Different length pipes may be used for different purposes. They are often used to glue boards together, furniture repair, etc. Pressure is applied by the crank screw. Size adjustment is made with the adjustable stop.

Similar fittings are available to make a wooden bar clamp. The wood bars are usually 1 3/8" x 2 1/2".

ADJUSTABLE BAR CLAMP

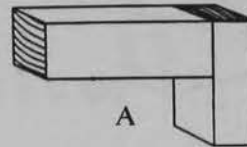


This clamp is commonly called a cabinet clamp and may be used for the same purpose as the bar clamps.

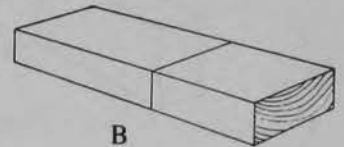
Wood Joints

Construction and repair of wood equipment and buildings require a knowledge of joints. Some of the common easy-to-make joints will be discussed in this unit.

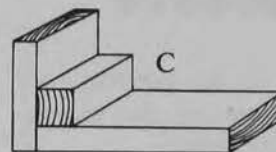
The butt joint is the simplest. It may be constructed end grain to side grain as "A"; or end to end grain as "B". The end grain to end grain butt joint must be strengthened with dowels or a piece of material attached to the side. The piece attached to the side is often called a scab, splice or gusset plate. A block may be placed in the corner of end to side grain joint for additional strength. See "C". This is called a slip or lock corner joint. The joint formed by gluing two pieces edge to edge may also be called a butt joint. The end to side grain joint may be strengthened with dowels. See "D".



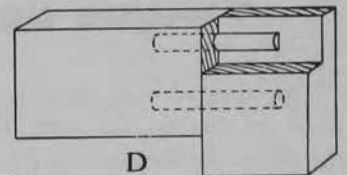
A



B



C

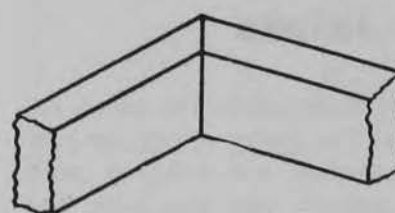


D

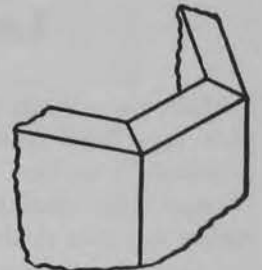
Butt Joints

Miter

The miter joint is a form of butt joint which changes direction of the different pieces. It is often used on picture frames and other fine work. Dowels may be used in this type of a joint.

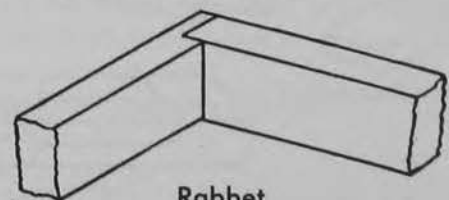


Miter



Rabbet

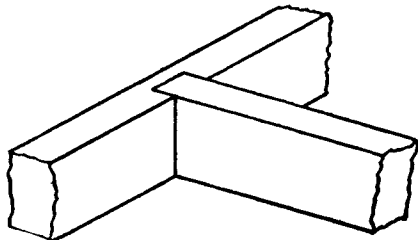
The rabbet joint is another form of butt joint. It is often used to fasten the sides of a drawer to the front piece, and in other furniture work.



Rabbet

Dado

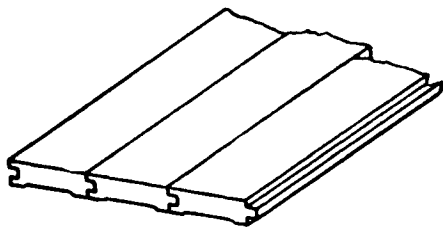
The dado joint is made by making a groove across the grain of the stock, but not at the end, allowing the second member to fit into the groove. The groove at the end of the stock makes it a rabbet joint, as the position so often determines the name. These joints are used in bookcases, step ladders and other furniture where a stronger type butt joint is required.



Dado

Tongue and Groove

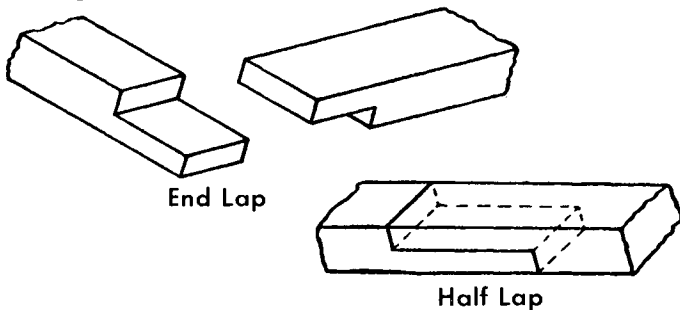
The tongue and groove joint is the familiar type used on flooring — one side containing the groove, the other the tongue that fits into the groove.



Tongue and Groove

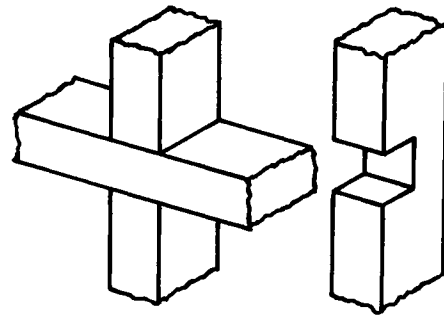
Lap Joints

There are several types of lap joints. The names depend upon their positions. The corner or end lap joint is found in corner construction and makes a much stronger joint than the ordinary butt type joint. The middle lap joint is similar to the corner lap except that it is located elsewhere than the ends of the stock. It also forms a right angle. The cross lap joint is a more complicated form of the lap joint. The parts are grooved to one-half their width and when assembled, the grooves overlap to form a cross.

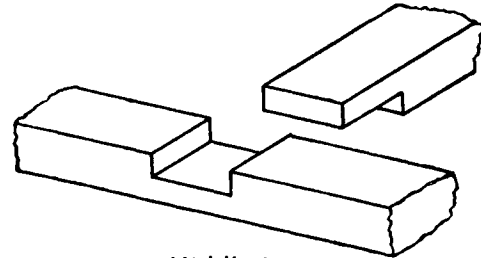


End Lap

Half Lap



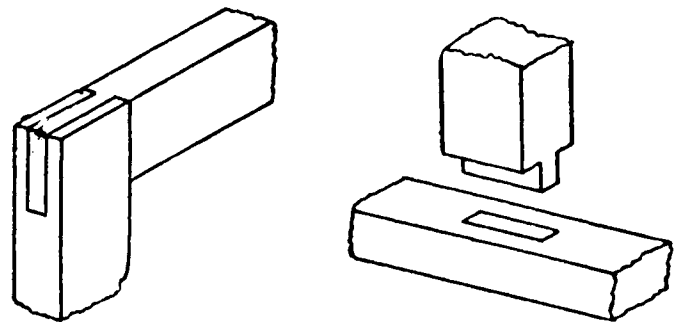
Cross Lap



Middle Lap

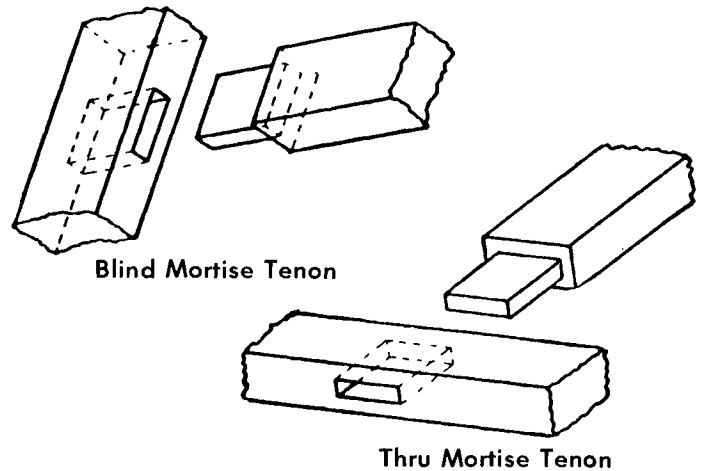
Mortise and Tenon

Mortise and tenon joints are most common in furniture where the rails of a table fasten into the legs. It is perhaps the strongest possible joint but like all others, it must be very carefully made and fit. There are many types of mortise and tenon joints but each has its merits. Probably the blind mortise and tenon is most used. The open type is often called the slip joint.



Open Mortise Tenon

Stub Mortise Tenon



Blind Mortise Tenon

Thru Mortise Tenon

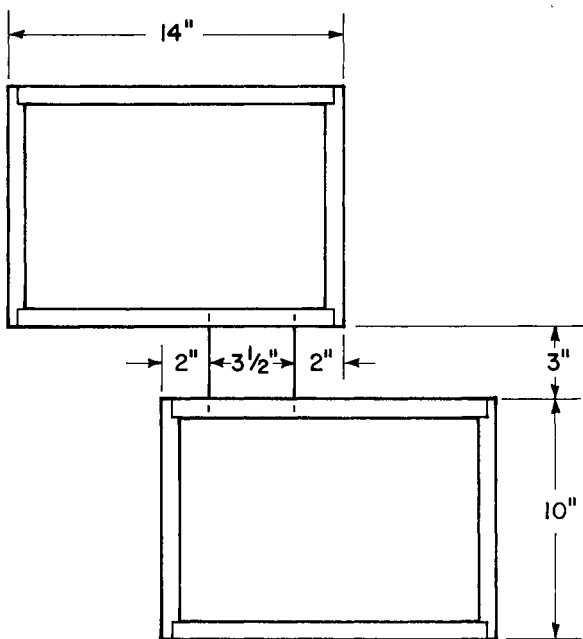


Selecting Drawings

On the following pages you will find plans for items to make in your woodworking project. You may make other items besides the ones shown in this book. Like-

wise, you may alter the plans shown. The material list for the individual plans gives the lumber in nominal dimension size.

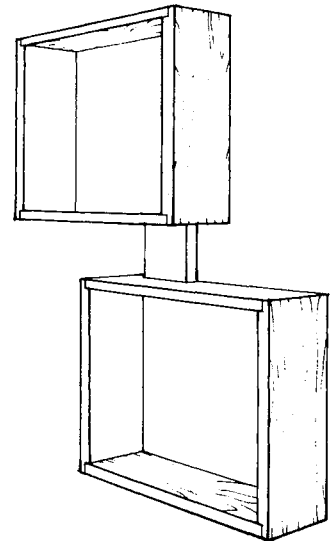
Shadow Boxes



FRONT VIEW



SIDE VIEW



Materials:

1 pc. 1" x 4" x 10' (actual dimensions about 3/4" x 3 1/2")
6d finishing nails
Penetrating wood finish or as desired

Procedure:

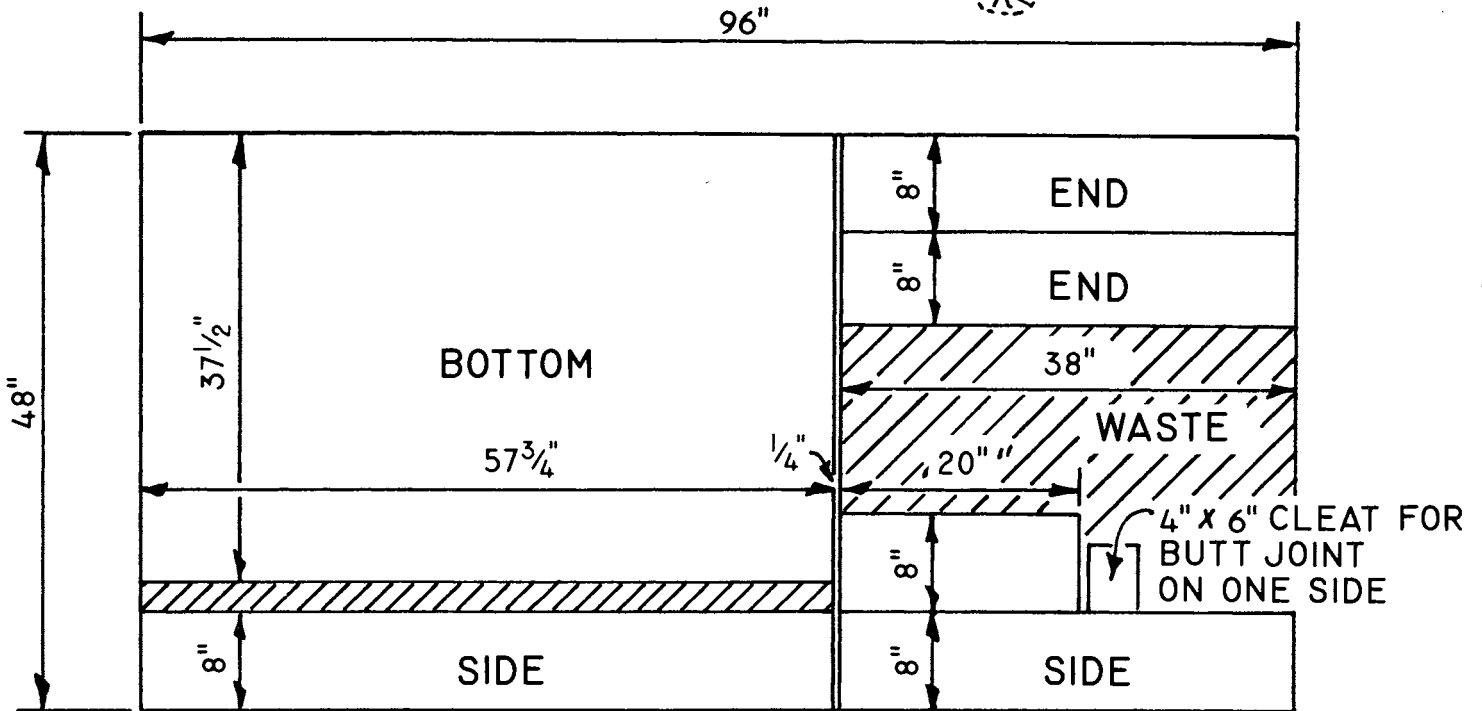
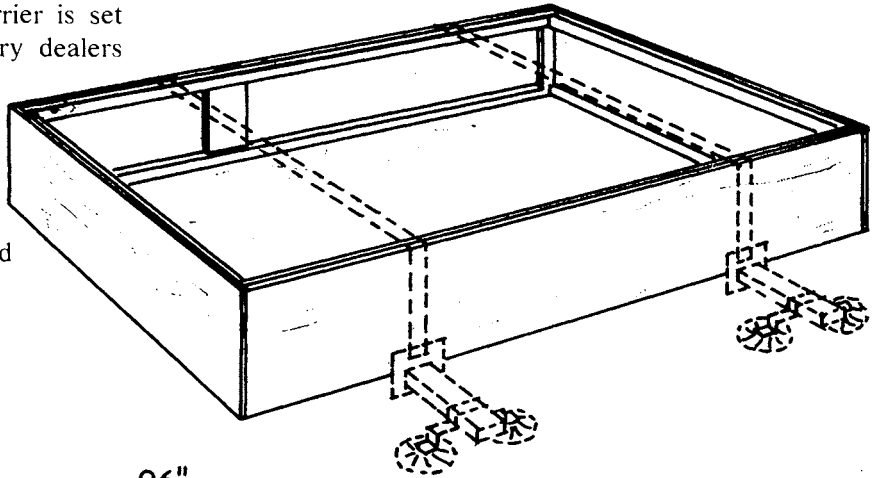
1. Measure, mark and cut sides of boxes.
2. Add the thickness of top and bottom pieces which contact the spacer block to 3" (The space desired between boxes). Mark and cut.
3. Cut notch for spacer in bottom board of top section and top board of bottom section.
4. Sand pieces smooth.
5. Assemble with 3 nails at each joint.

Car Top Carrier

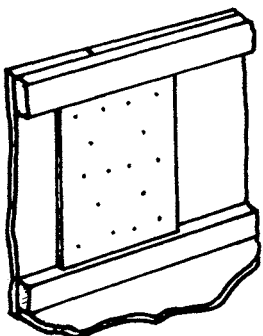
This is a lightweight car top carrier for camping equipment or other general purpose use. It is designed to obtain maximum width and length from one sheet of plywood. However, the height may be increased two inches from that given in the plan. Top carrier is set on rack frame available from auto accessory dealers or mail order catalog.

Materials:

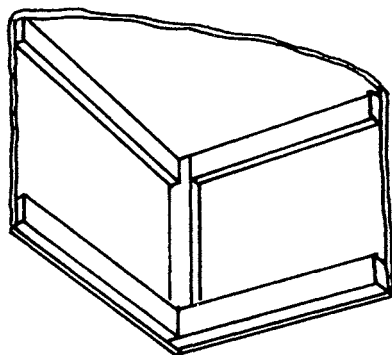
- 1 pc. 4' x 8' sheet 1/4" exterior grade plywood
- 4 - 3/8" x 3/4" strips 10' long
- Resorcinol resin glue (waterproof)
- 5/8" wire nails
- Finishing materials as desired



CUTTING DIAGRAM OF 4' x 8' x 1/4" PLYWOOD SHEET



Cleat Detail



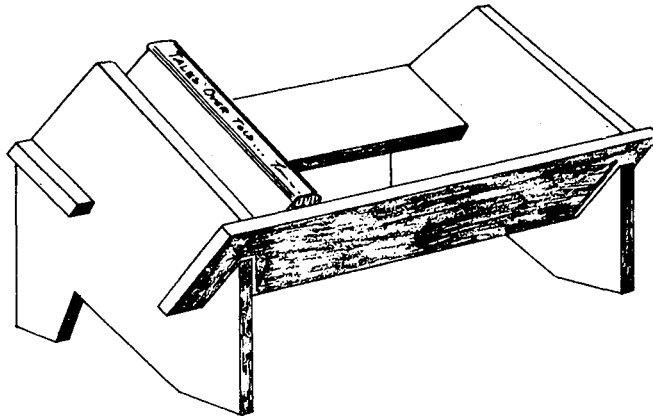
Corner Construction

Procedure:

1. Cut out pieces.
2. Assemble side pieces. Space wire nails about five inches apart to hold the pieces together while the glue dries.
3. Assemble end pieces.
4. After glue on side and end pieces is dry, assemble all pieces as a unit. Glue and nail as indicated above.



Book Rack



Materials:

1 pc. 1" x 8" x 18" (actual dimensions about 3/4" x 7 1/2" x 18") or 3/4" plywood for ends

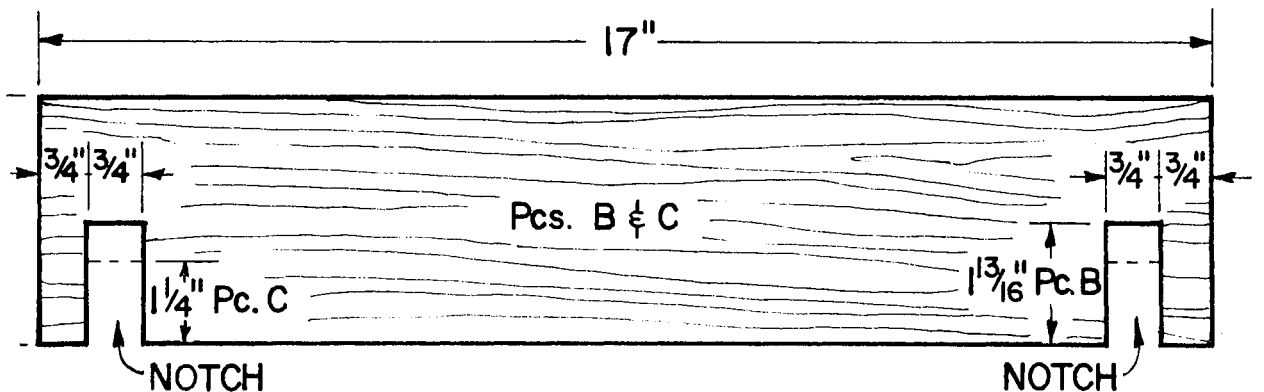
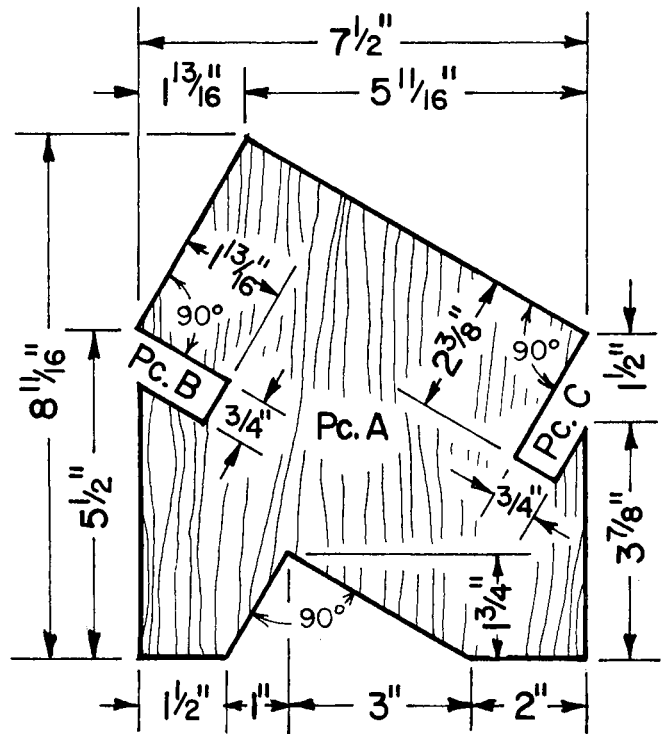
1 pc. 1" x 4" x 36" (actual dimensions about 3/4" x 3 5/8" x 36") or 3/4" plywood for strips

In Construction:

Note the notches in piece C are 1 1/4" deep and 1 13/16" on B. You may desire a wood screw near each end of piece C to hold the top snug against piece A.

Finish:

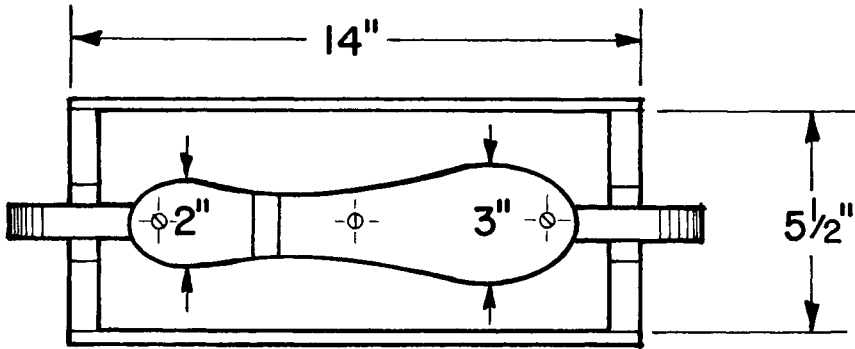
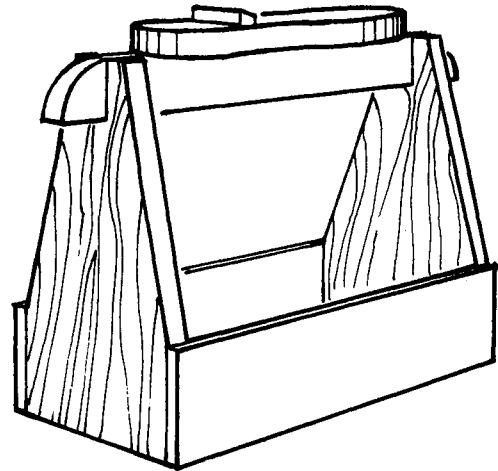
Apply wood seal or finish as recommended by your leader.



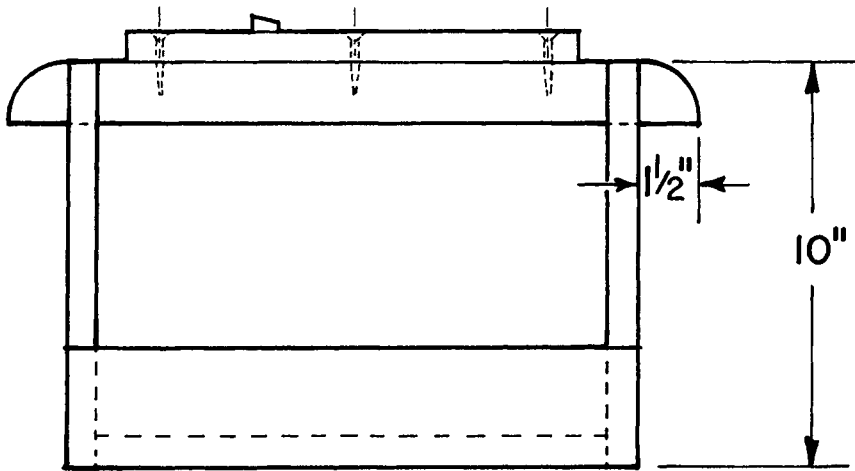
Shoe Shine Kit

Materials:

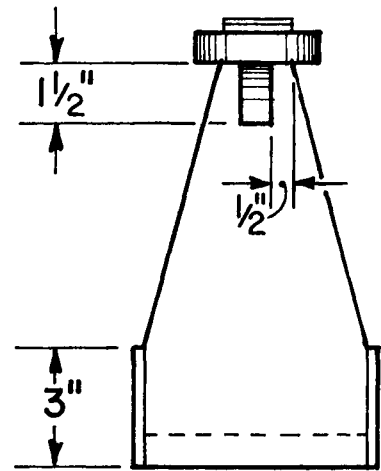
- 1 pc. 1" x 6" x 4'
- 1 pc. 1" x 2" x 18"
- Box lumber or 1/4" plywood for two pieces 3" x 14"
- 3 - 1 1/4" #8 flat head wood screws
- 1" wire brads
- 6d finish nails
- Glue
- Finish materials as desired



TOP VIEW



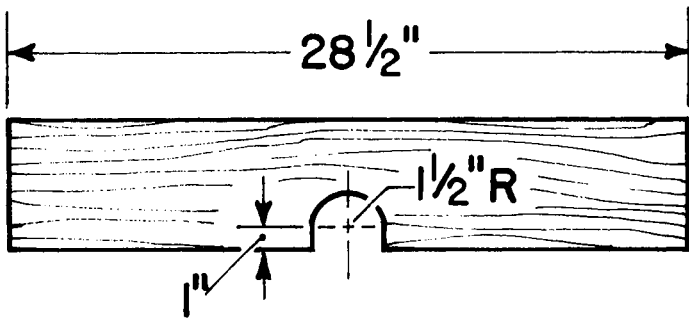
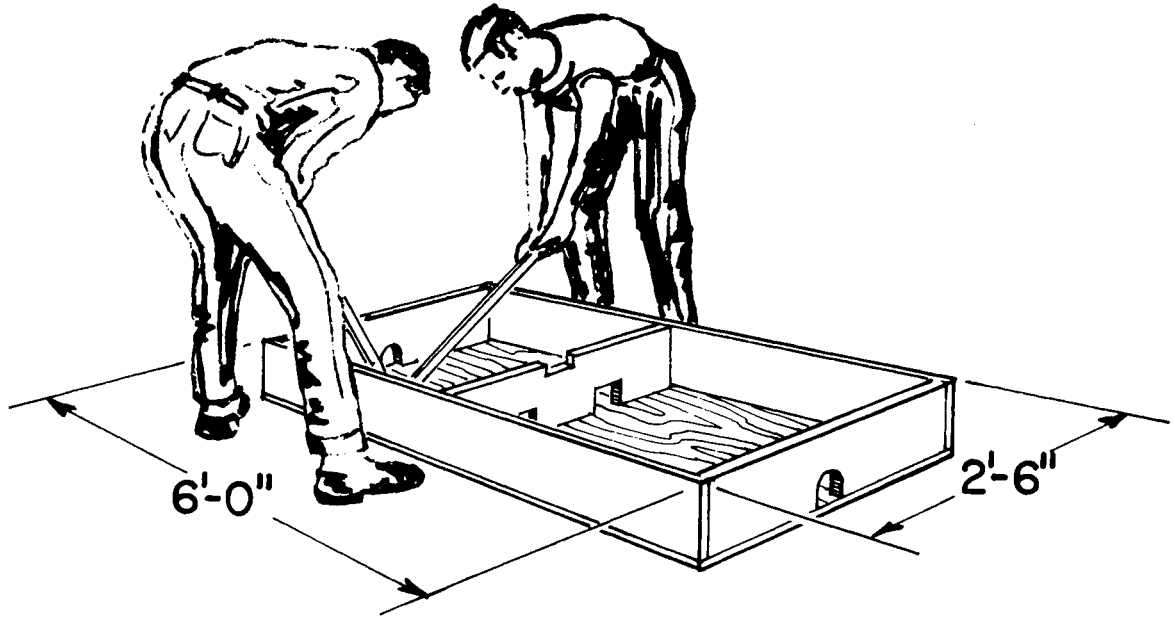
SIDE VIEW



END VIEW

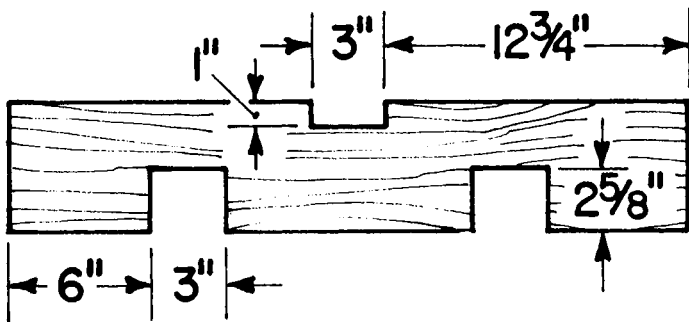


Box Hockey



Materials:

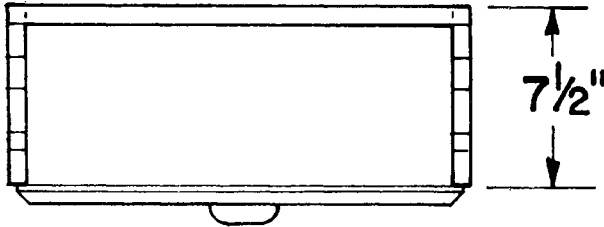
- 1 pc. 5/8" x 2'-6" x 6' exterior plywood for floor
- 1 pc. 2" x 6" x 8' ends and partition
- 2 pcs. 1" x 6" x 6' for sides
- 2 pcs. 1" x 2" x 2'-6" for sticks
- 1 puck 1" thick, 2" diameter, preferably rubber
- Resorcinol glue (waterproof) and nails for assembly



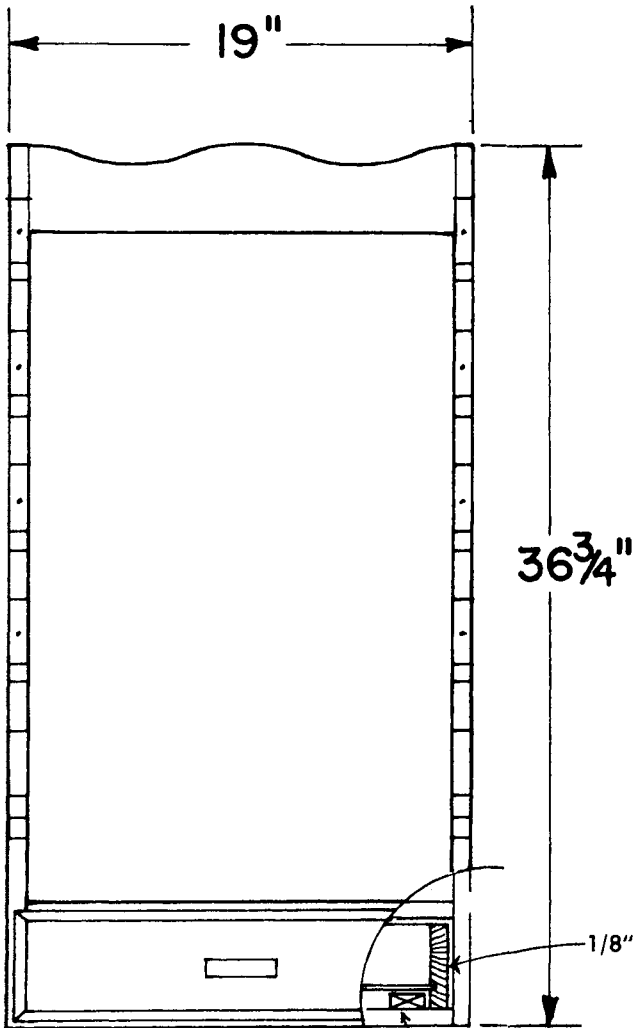
How to Play Box Hockey:

Players stand on opposite sides of box which is placed on the floor. Each player has a hockey stick and holds it at the end. The puck is placed in the notch in the center partition. To start the game, the players "shinny off." (i.e., they touch the bottom of the box and then each other's stick three times, counting 1-2-3 go.) The object of the game is to knock the puck out of the box through the end opening to the player's own left. When the puck goes through opening, the players start over. Best two out of three goals win.

A Gun Rack



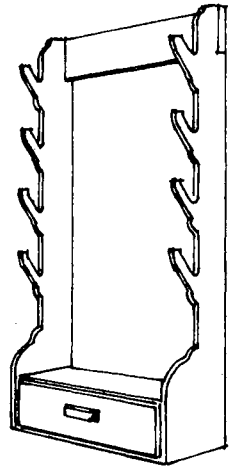
TOP VIEW



FRONT VIEW

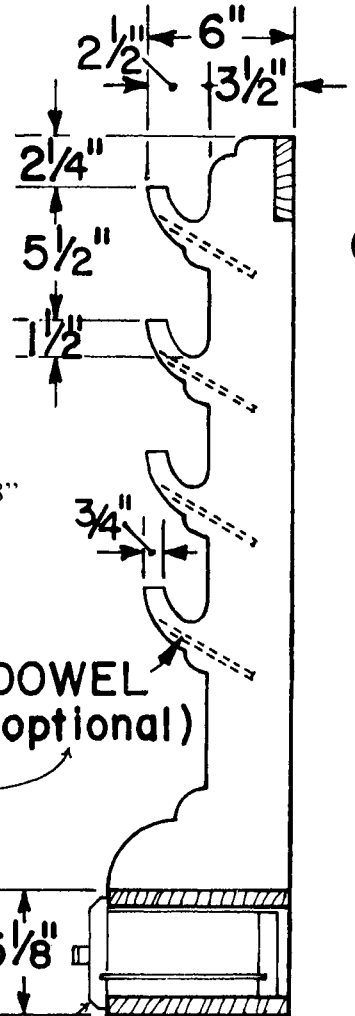
Materials:

- 1 pc. 3/4" x 3 1/2" x 19" (top)
 - 2 pc. 3/4" x 7 1/2" x 36 3/4" (sides)
 - 1 pc. 3/4" x 7 1/2" x 17 1/2" (shelf)
 - 1 pc. 3/4" x 7 1/2" x 17 1/2" (bottom)
 - 8 dowels 1/4" x 5" (optional)
- Nails and Epoxy glue or screws



Drawer Parts:

- 1 pc. 3/4" x 4 5/8" x 18 1/2" (front)
- 1 pc. 3/4" x 3 1/2" x 17 3/8" (back)
- 2 pc. 3/4" x 3 1/2" x 6 1/4" (sides)
- 1 pc. 1/8" Masonite 6 1/2" x 16 1/8" (bottom)
- 2 pc. 3/4" x 1 1/2" x 1 1/2" (guides)
- 1 pull, as desired



Strengthen gun pegs with dowels

1/8" Sawcut front, back and sides to receive drawer bottom

Drawer guides: cut drawer back to snug slip fit around guides

Bevel edges of drawer front



Garage Creeper

Materials:

1 pc. 16" x 40" exterior grade 1/4" plywood
 1 pc. 1" x 8" x 3-1/2' hardwood to be ripped for the following actual dimension material:

2 pc. 3/4" x 2" x 40"
 4 pc. 3/4" x 1-3/8" x 16"

1 set of 4 swivel caster or rollers special for creepers, etc. These are available from some mail order houses and most auto supply houses.

16-3/4" #10 flat head wood screws. (1/2" for optional plan)
 8-1/4" x 2" carriage bolts with nuts
 8-1/4" washers

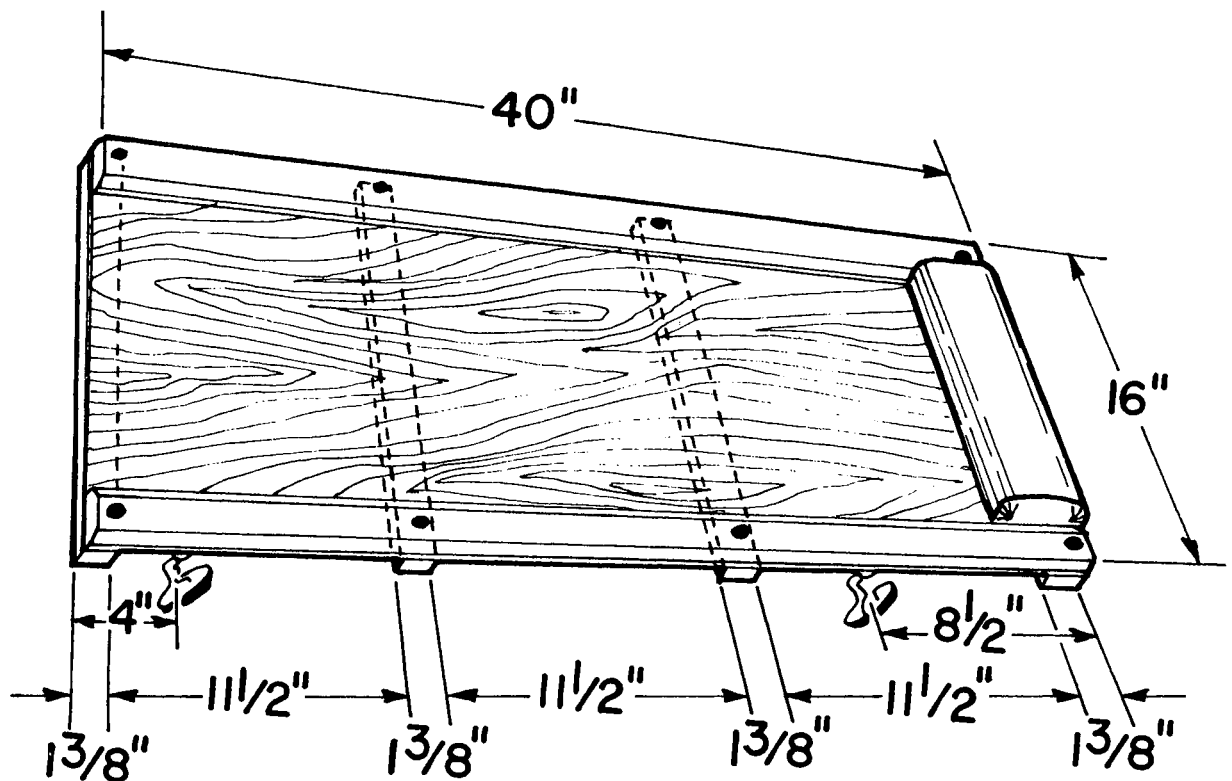
1 pc. 1" x 12" x 18" plastic foam to fold for head rest
 1/3 yd. vinyl plastic upholstery for head rest covering
 Upholstery nails
 24 - 5/8" wire brads
 Waterproof or water resistant glue
 Enamel or wood sealer finishing materials

Procedure:

1. Cut plywood and hardwood strips to size.
2. Round upper inside corner of the 3/4" x 2" x 40" side pieces.
3. Glue these side pieces to plywood sheet. Use 5/8" brads about 5" apart to serve as glue clamps.
4. To attach 3/4" x 1-1/2" strips: Clamp in place, and drill bolt holes. Release clamps and apply glue. Insert bolts and tighten. Use 3 brads across plywood area to hold plywood to strip while the glue dries.
5. Attach casters. Check to see they have clearance to swing in a full circle.
6. Fold and attach head rest.

Optional Plan:

Cut a 1/4" x 3/8" rabbet on lower inside edges of hardwood sides to accommodate plywood. Cut plywood to 15 1/4" width. This will reduce overall height 1/4 inch.



Miter Box

Materials:

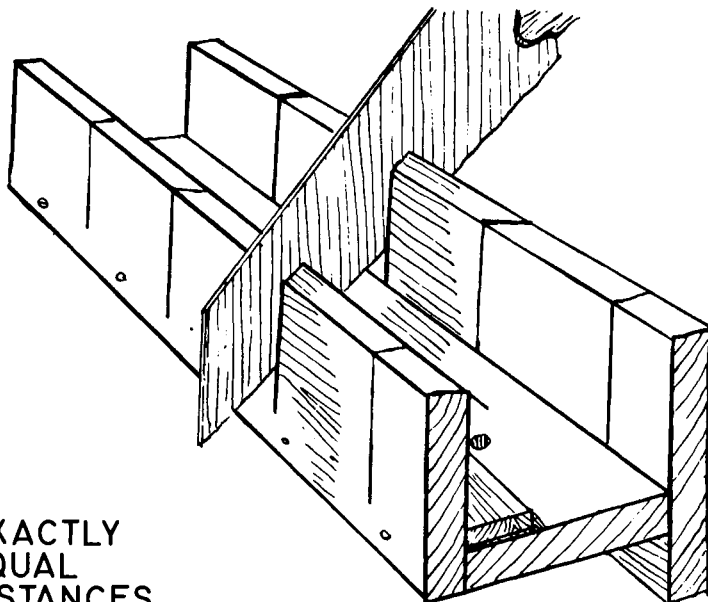
Plan "A"

- 1 pc. 1" x 4" x 36" hardwood
- 1 pc. 1" x 6" x 18" hardwood
- 1 1/2" or 1 3/4" flat head screws

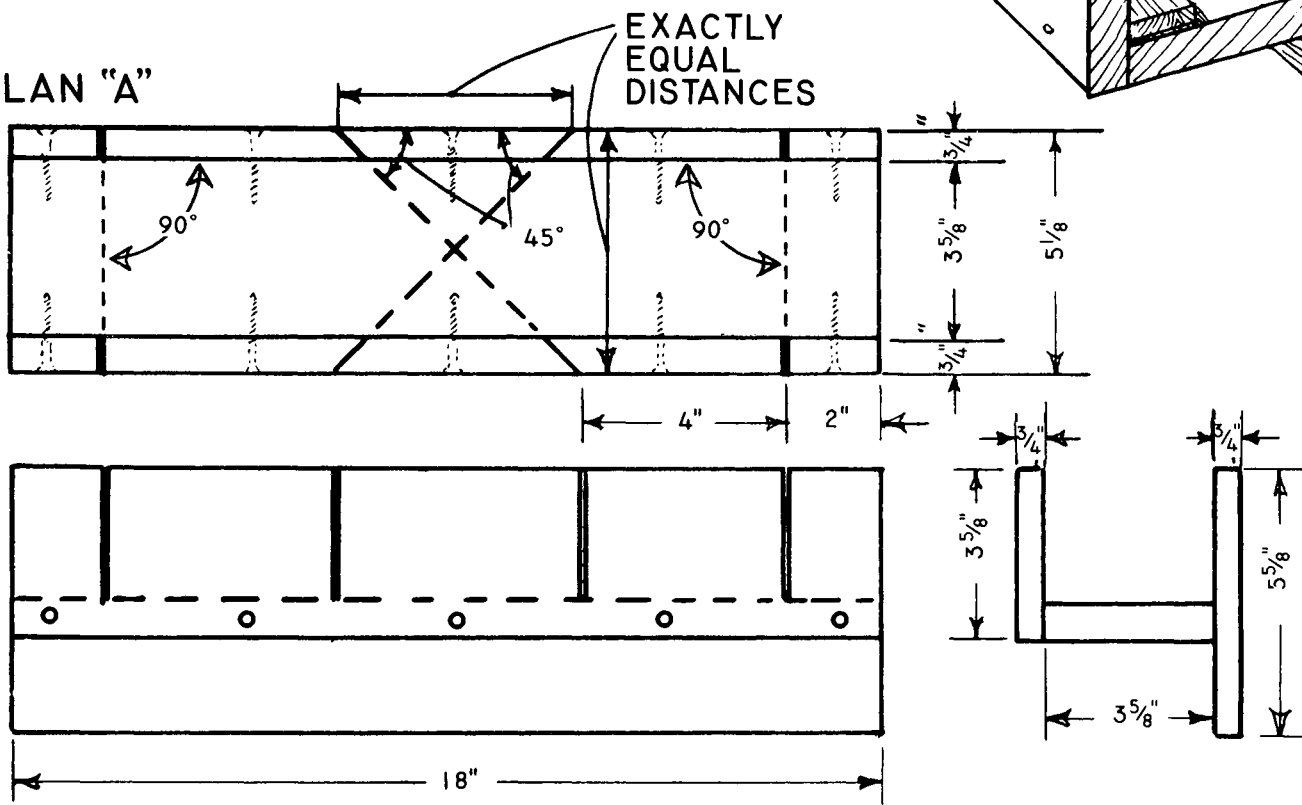
Plan "B"

- 1 pc. 6" x 20" } 3/4" plywood
- 1 pc. 5" x 20" }
- 1 pc. 4" x 20" }

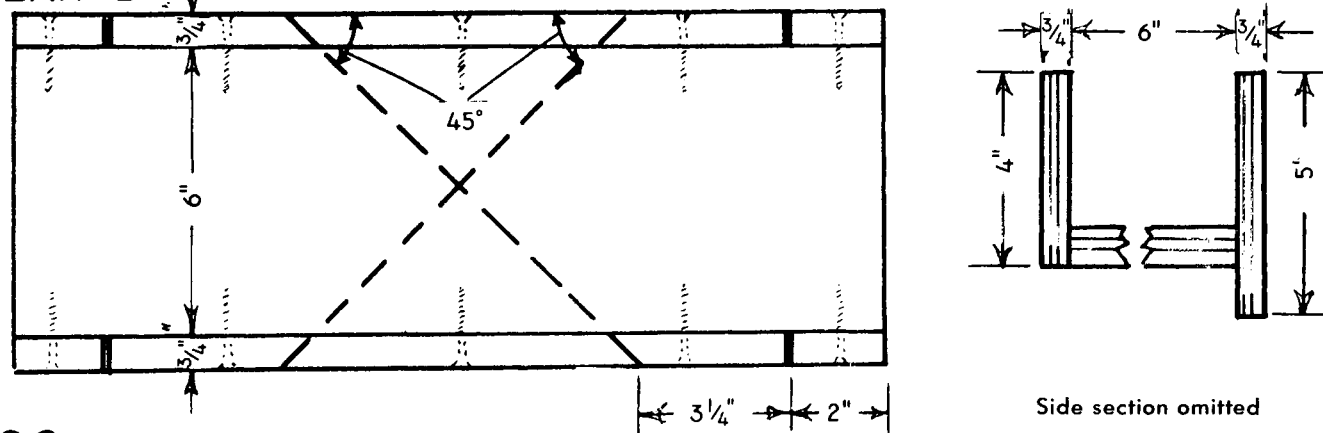
- 1 1/2" or 1 3/4" flat head screws



PLAN "A"



PLAN "B"



Sleeve Board

Materials:

Common hardwoods, 3/4" plywood, or pine low in pitch content

Material listed as common dimension lumber

1 pc. 1" x 6" x 4"

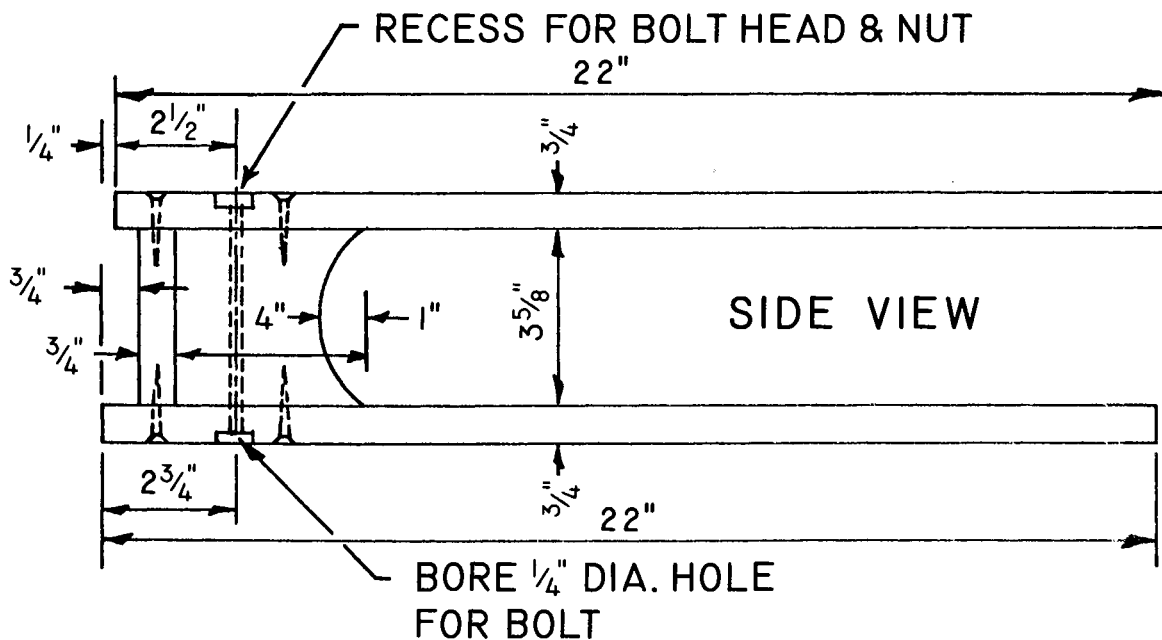
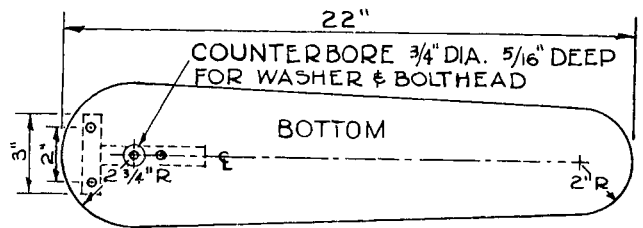
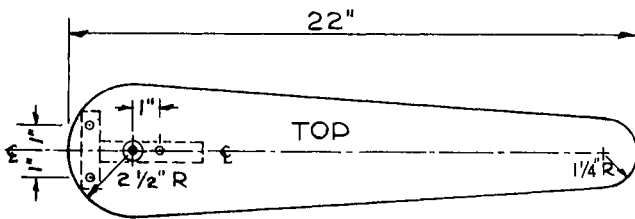
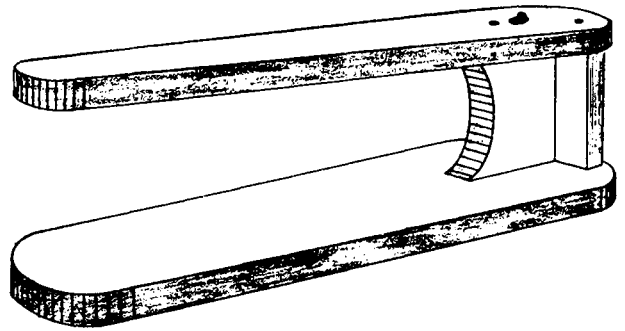
1 pc. 1" x 4" x 8" (or 1 pc. 1" x 3 1/2" x 8")

1 - 1/4" x 5" zinc-plated machine bolt

6 - 1/2" #8 zinc-plated flat head wood screws

2 - 1/4" flat washers

Floor seal or penetrating wood finish

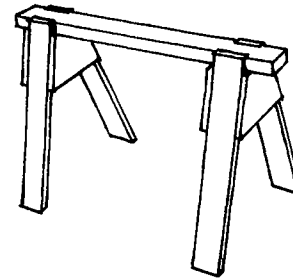
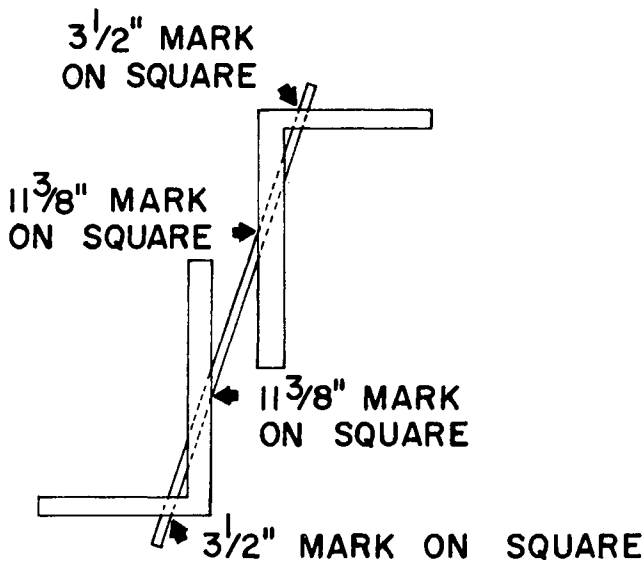


Workshop Saw Horse

This is a plan for a lightweight saw horse. It will serve for many jobs. Standard height of saw horses range from 18" to 24". A common length is 36". For a more rugged construction use 2" x 6" for crosspiece, 1" x 6" for legs, and increase the depth of the brace. This material should be split and knot free for maximum strength. Built as shown, the legs extend sidewise 1/2" for each 1-5/8" of height.

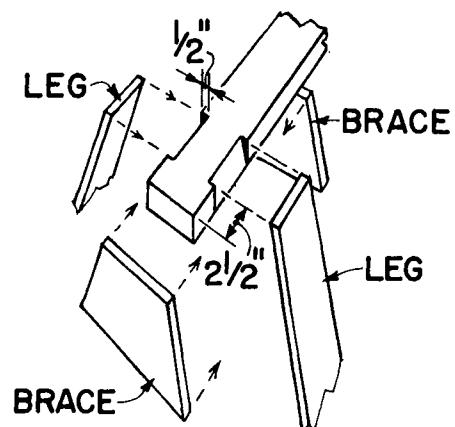
You may compute the length of the legs mathematically or use the following approximate table and process outlined in the procedure.

Horse Height	Leg Length
18"	18-7/8"
20"	20-15/16"
22"	22-1/16"
24"	25"-1/8"



Procedure:

1. Determine desired height.
2. Obtain necessary materials.
3. Mark and cut crosspiece. Before marking notches for the legs check the exact width of the leg material.
4. Mark and cut legs.
 - a. Position a square as indicated on edge of leg material to mark angle of top cut.
 - b. Square lines from this edge on face and back to use as guide lines in sawing.
 - c. Measure length of leg on either inside or outside face. Mark this at the proper edge.
 - d. Position square as indicated for bottom cut.
 - e. Note: An accurate cut will serve to cut the bottom of one leg and the top of another as these lines are parallel.
5. Attach each leg with four 1-3/4" #10 flat head wood screws.
6. Cut leg braces from 1" x 8" material or 1/2"-3/4" exterior plywood.



Materials:

- 2" x 4" or 2" x 6" x 36" for crosspiece
- 1" x 4" or 1" x 6" as required for legs
- 1" x 8" or 1/2"-3/4" exterior plywood for braces
- 16 - 1 3/4" #10 flat head wood screws
- 6d nails to nail braces



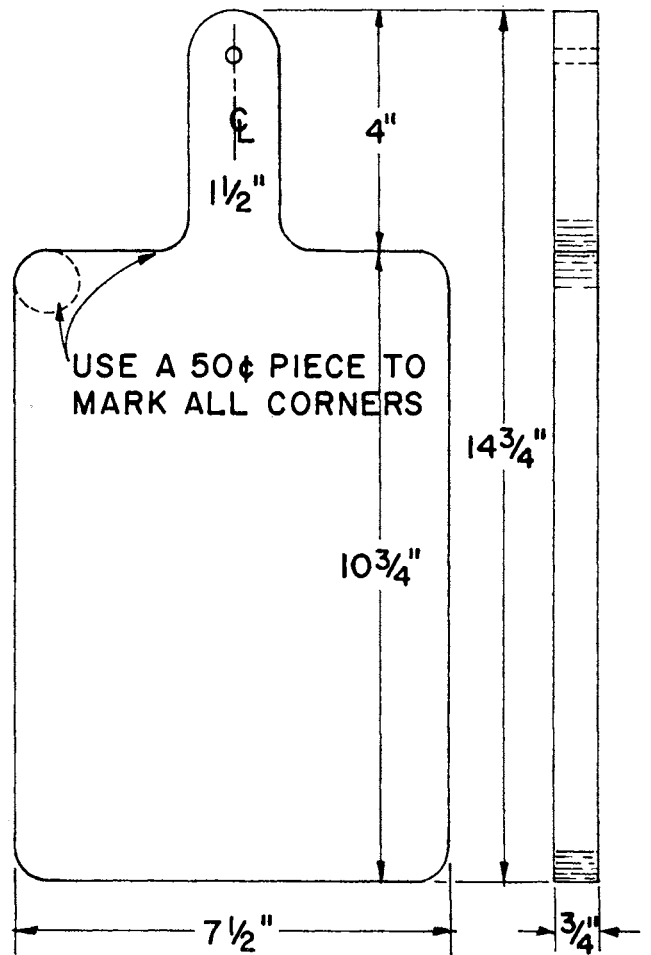
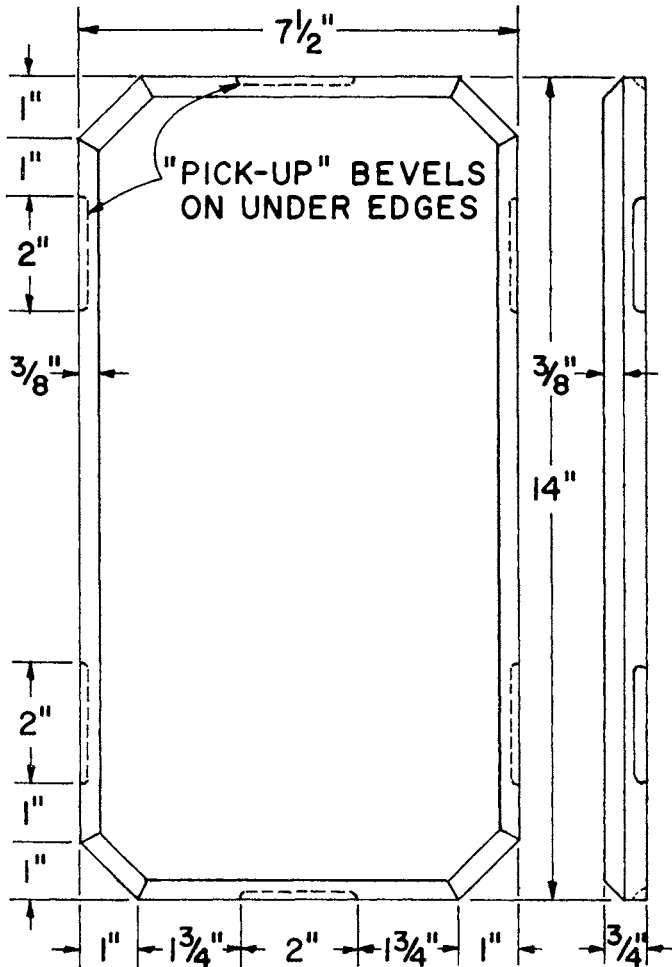
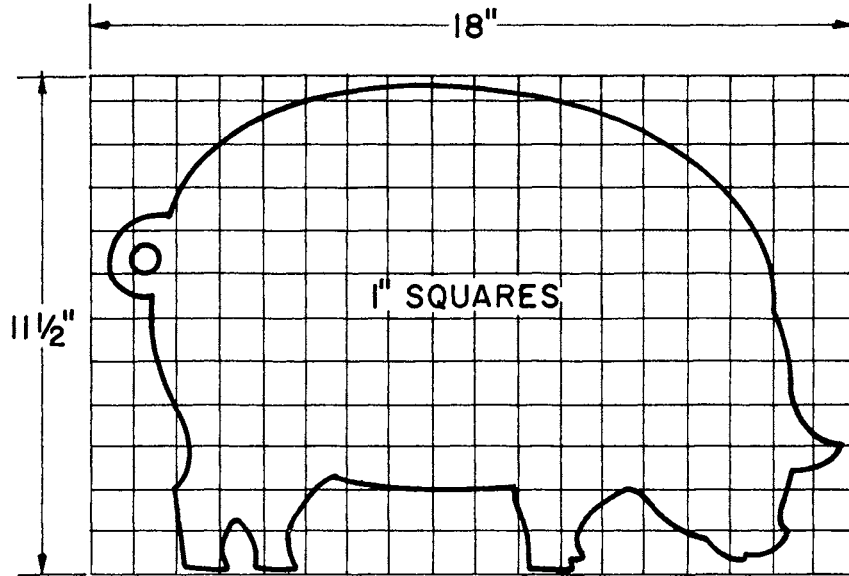
Cutting Boards

Change dimensions to fit available material or desired size.

Materials in order of preference: quarter-sawn beech, maple or birch lumber or glued stock; hardwood ply-

wood; quarter-sawn or glued pitch free softwood; or softwood plywood.

Apply several liberal coats of vegetable salad oil or cooking oil for a finish.



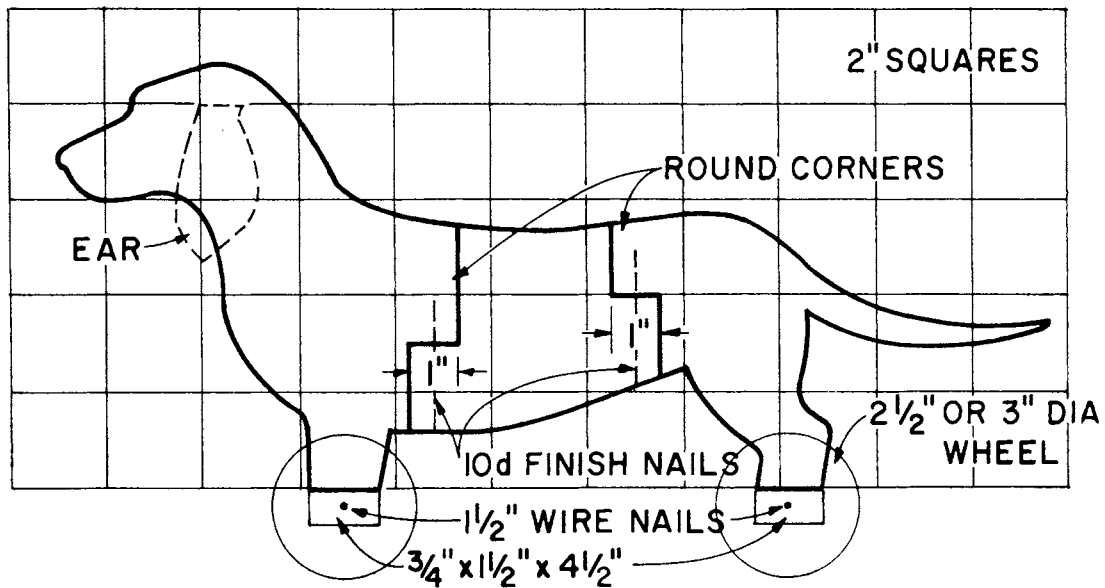
Get Along Little Doggie

Materials:

- 1 pc. 1" x 2" x 11" - axles (actual size about 3/4" x 1 1/2" x 11")
- 1pc. 10" x 22" x 3/4" plywood - body
- 1 pc. 6" x 8" x 3/8" or 1/2" plywood - wheels
- 2 - 10d finishing nails
- 8 - 1 1/2" wire nails
- Glue
- Cloth, leather, 1/8" plywood or fiber board for ears
- Linseed oil or other penetrating finish material

Procedure:

1. Cut out body, wheels and axles.
2. Cut body into three sections.
3. Drill loose fitting holes for hinge nails in bottom part of center section. Drill tight pilot holes for hinge nails in end sections.
4. Round the up and down edges of the hinged joints so the dog can waggle.
5. Sandpaper smooth.
6. Drill loose fitting holes for nail hub in wheels. Attach to axles. Attach axles with nails and glue.
7. Assemble sections of dog.
8. Apply finish.



NOTES

Lined area for taking notes, consisting of 20 horizontal lines.

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