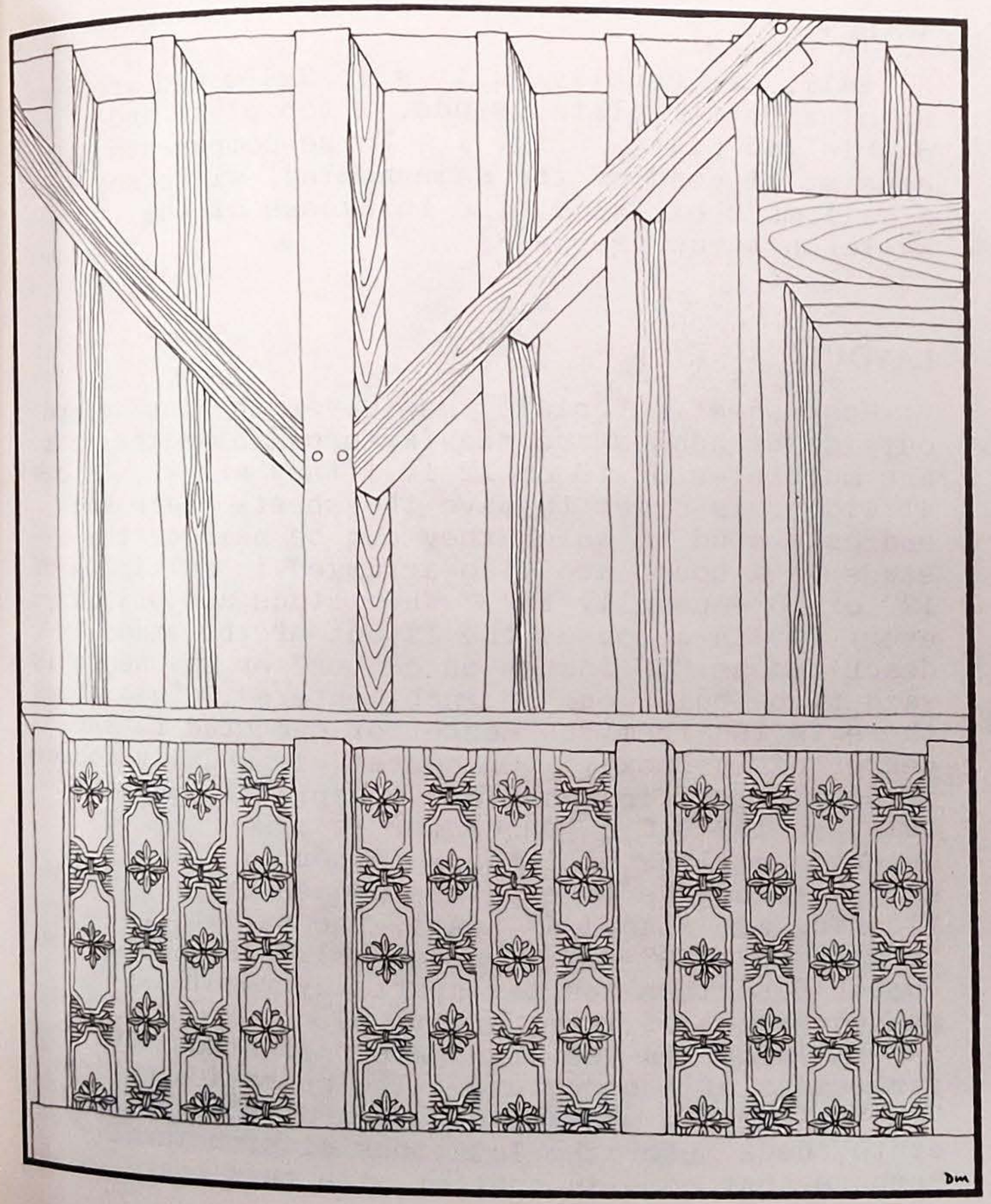

Chapter 5

Walls

Bottom plate
Stud
Top plate
Double top plate

Nominal size--See Using This Book

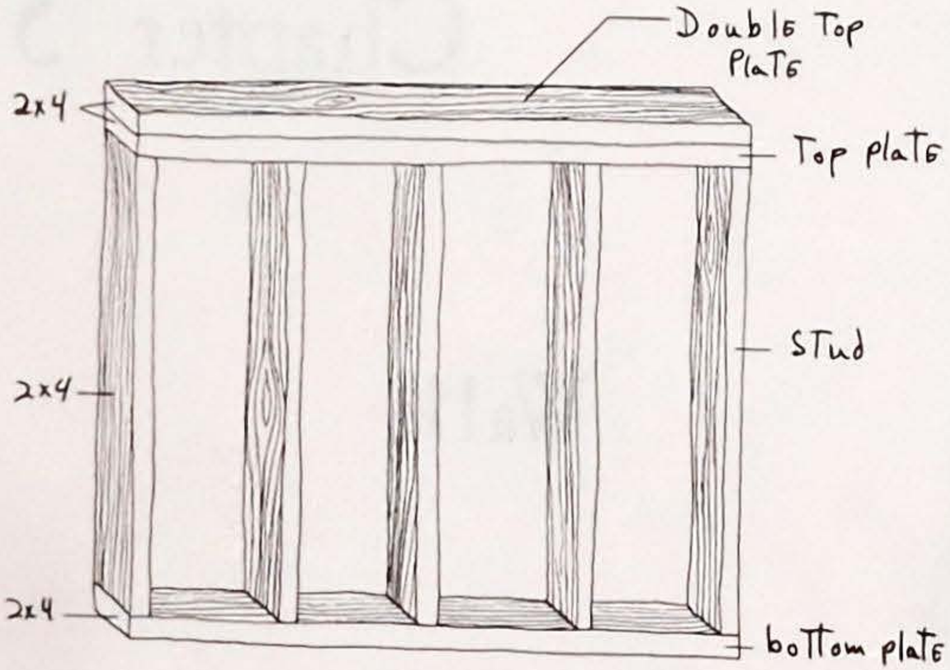

Fig.1 - The Structural Parts of a Wall

On center (O.C.)

Layout

2x6 walls--See Putting It All Together: Joists

WALLS

Walls are usually built with 2x4's and are made up of a bottom plate, studs, a top plate and a double top plate. Fig. 1. These components all consist of wood of the same nominal width so, for a wall made of 2x4's, the thickness of the skeleton structure is $3\frac{1}{2}$".

LAYOUT

Most sheet materials that cover the inside and outside of houses are manufactured in widths that are multiples of 16 or 12 ie., they are 2', 3' or 4' wide. In order to have the sheets begin and end on a stud to which they can be nailed, the studs in a house are also arranged in multiples of 12" or 16"--usually 16". When studs are placed every 16" in a house, the layout of the studs is described as "16 inches on center" or the house is said to be built on "16 inch centers". This means there is 16" from the center of one stud to the center of the next. "On center" is usually abbreviated O.C.; so in books and blueprints you will only see 16" O.C.. On center is also used to describe nailing patterns. (Appendix II.) If nails around the edge of a 4'x8' sheet of plywood flooring are placed 4" apart, the nailing pattern is said to be 4" O.C. (on center). In general, on center describes how far apart any regularly spaced series of items are to be.

The layout is the arrangement of studs and partitions of a structure. The operation called "laying out" is marking on a board, slab of concrete, deck, etc. the locations of structural members that come in contact with that board, slab,

or deck. For instance, the bottom plate of a wall is "laid out" for the locations of the studs and intersecting partitions before the wall is built. The stud locations are marked on the bottom plate as in Fig. 2.

The "X" indicates on which side of the line the stud goes. 16" centers are marked on most measuring tapes, but you cannot just hook your tape around the end of the plate and begin marking 16" centers. Well, you could, but if you did, you would be marking the center of each stud. When you went to nail the studs in place, the stud would be covering the mark and as you nailed you would have no way of knowing if the stud were in the right place or off 3/4".

It is easier to mark the sides of the studs. In this method the first measurement is 15¼" and then all the rest are 16". Hook the tape over the end of the bottom plate and mark 15¼" with a crows foot. This is the edge of the second stud (the first one is at the end of the plate); make the "X" on the side of the line away from the first stud on the plate. Notice that even though the side of the stud is 15¼" away from the end of the plate, the center of the stud is 16" away from the plate's end. Fig. 2. Now hold the end of the tape on the 15¼" mark and go on down the plate marking the 16" centers: 16", 32", 48", 64", 80", etc. Have someone hold the end of the tape or pound in a nail at the 15¼" mark and hook the end of the tape over it as you layout the rest of the studs. It will eliminate errors if you use a tape that is long enough to layout all the studs in that particular wall instead of sliding a short tape along the length of the plate. A 50' or 100' tape is a good thing to have for layout.

Layout--See Putting It All Together: Sheathing layout, plate layout, and lapping the double top plate

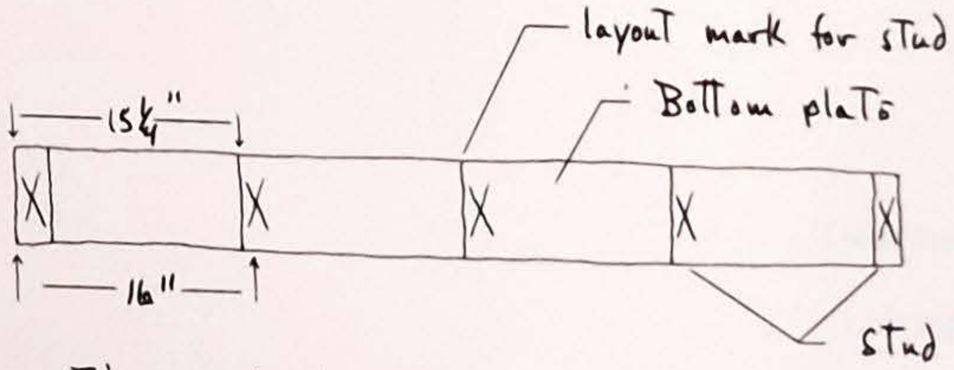

Fig. 2 - Laying out the bottom plate

Crow's foot--See Tools: Fig. 7

Estimating material--See Putting It All Together: Estimating

The first stud spacing is less than 16" by one-half the thickness of a stud so that the first sheet of wall covering can begin flush with the end of the wall (instead of beginning at the center of the first stud and leaving a gap) and still end at the center of a stud.

Always check and recheck your work. First, draw up plans and then check the plans and figuring for mistakes. Pay special attention to the joints and how they will be constructed because this is where most mistakes are made. Taking the time to thoroughly plan and think out a job before you begin will pay off double in time, materials and frustration saved. Sit down in a quiet room, close your eyes and try to imagine in detail (slowly--step by step--how the structure will be constructed. Through this process, you will realize the inadequacies of your plan before you begin: measurements that are wrong, fasteners & joints that are inappropriate, and methods of construction that will not hold up. For me the best time to think through plans is in the morning before I get up. My mind is clear and unencumbered by the day's concerns. I usually catch one or two mistakes in planning when I think through a project in the morning. As you build, continually check your layout, measurements and cuts. Consult with the plan, make the measurement, check the measurement, make the cut, and check the measurement of the piece cut.

BUILDING A WALL

There are two kinds of walls that women usually

need built in their dwellings: walls between rooms in a house or apartment that divide one open space into two separate living spaces and walls built in basements or garages where the ceiling joists are exposed. Joists are structural members (along with studs, beams, rafters--they hold up the house) that are parallel to each other and support the weight of the floor above. They are usually 2x10's or 2x12's and run horizontally from one side of the structure to the other under each floor and support the dead load (the weight of stationary construction in a building--walls, plaster, floor covering) and the live load (the weight of moveable objects--people, furniture, snow on the roof) of each floor.

A load bearing wall (a wall that carries weight) is one that supports the weight of the building above, i.e., side walls that carry the weight of ceiling joists and rafters. A non-load bearing wall, for instance an interior partition, supports no weight except its own.

Joist

Dead load

Live load

Load bearing wall

Non-load bearing wall

Walls Between Two Rooms

The height of beams or doorways that divide two rooms are usually lower than the height of the ceilings of the two rooms. This means that the wall can be built lying prone on the floor, raised to a vertical position and be maneuvered within the room until it can be eased into the doorway or underneath the beams--all without hitting or scratching the ceiling in the room.

Measure the distance from the floor to the top of the doorway or to the underside of the beam dividing the rooms--whichever is the case. This is the overall height of the wall. From this

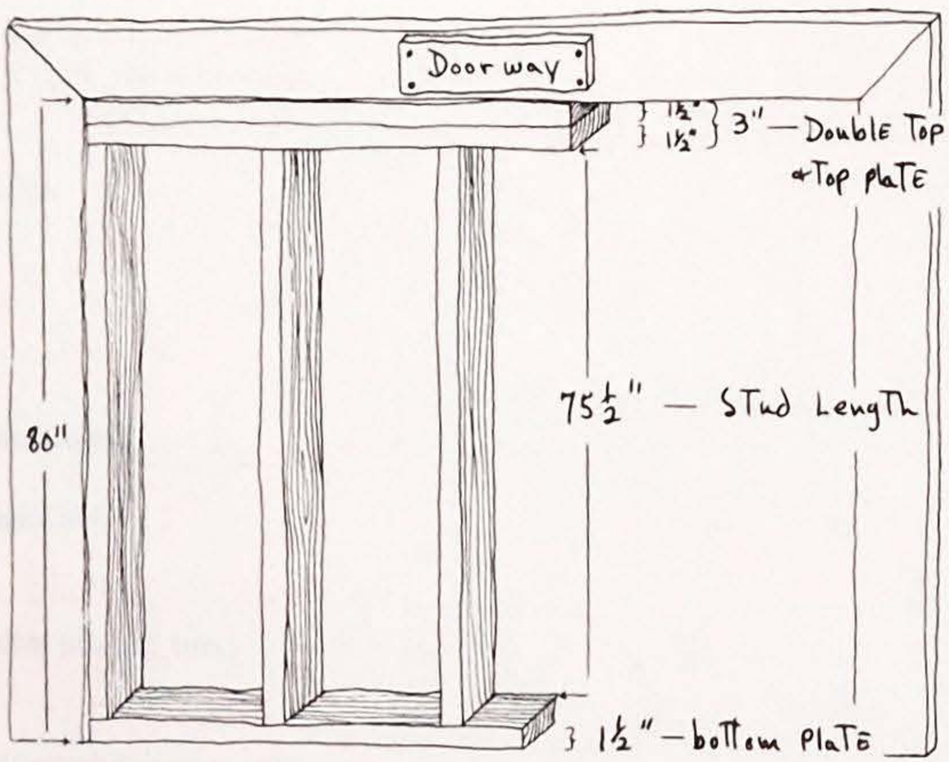

Fig. 3 — Measurements of a Wall in a Doorway

Jamb

Try square--See Joining: Figs. 4 & 26

End nail--See Metal Fasteners And Glues: Fig. 6

figure the length of the studs can be calculated. Let's say the height of the doorway is 80". Subtracting for the thickness of the bottom plate, the top plate, and the double top plate--a total thickness of 4½"--we arrive at 75½" as the length of the studs. Fig. 3.

The stud length is the wall height minus the combined thicknesses of the plates.

After having cut and laid out the bottom plate, cut a top plate exactly the same length as the bottom plate (the length of the wall or the distance between the side jambs of the doorway) and lay it down next to the bottom plate. Even up the ends of both plates and with a try square transfer the layout lines on the bottom plate to the top plate (transfer the "X"'s too).

Now lay the two plates parallel with each other on the floor about a stud's length apart and lay the studs in between the plates, one for every X on the bottom plate. If there are two women working on the wall, the next step--nailing the plates to the studs--will be easier. One woman straddles the studs facing the bottom plate; the other straddles the studs facing the top plate. The layout marks on the two plates should be toward the studs. The stud is placed against the plate on the side of the layout line that has an X. The width dimension of the stud is aligned with the lay out line and the stud is end nailed to the plate with two 16d nails. Both women work on the

same stud while kneeling or standing with one foot on the stud and plate to keep the structure from sliding across the floor. As more studs are nailed in place the wall won't slide and will be easier to work with. If there is only one woman working, place the other end of the wall against a wall or unmoveable object so that the wall won't move away from you as you nail and you won't be fighting your work.

Nailing patterns–See Appendix II: Fig. 9

The Double Top Plate

Face nail the double top plate, which serves to strengthen and stiffen the wall, to the top plate with 16d nails 16" O.C. and staggered from one side of the plate to the other. Fig. 4. The ends of the double top plate should be nailed with two 16d nails. If more than one board is used for the double top plate, the breaks in the double top plate should be 4' away from any breaks in the top plate. (This applies mainly to longer walls.) Angle the 16d nails slightly so that they don't protrude from the underside of the top plate. Fig. 4.

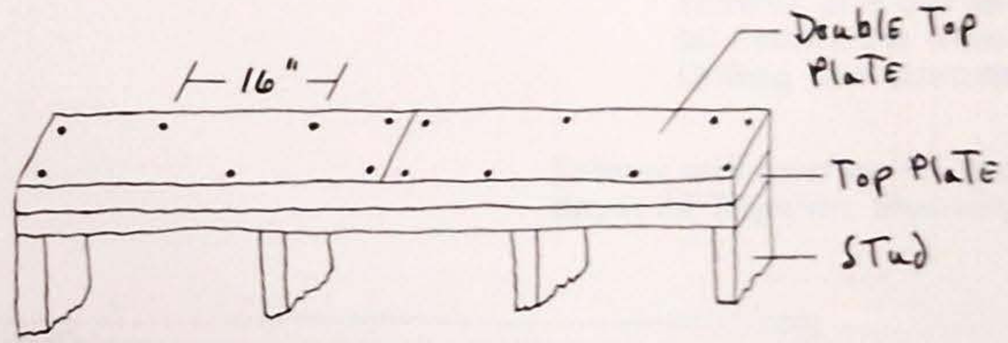

Fig. 4- Nailing Pattern for Double Top Plates

Raising a wall–See Putting It All Together: Raising The Walls

Raise the wall to a verticle position and ease it into the doorway being careful not to mar the finish surfaces such as wood trim, paint or plaster. If the wall is fitting a little tight and there is a compressable material on the floor such as rug or linoleum, insert a flat crow bar between the double top plate and the underside of the doorway. Using the stationary door jamb as a fulcrum to use this lever against, pry down on the double top plate as someone hits the top of the wall with a hammer near where you're prying. The prying action pushes the wall down into the com-

Crow bar

Prying

Plumb–See This Chapt.: Plumb And Plumbing

Face nail--See Metal Fasteners & Glues: Fig. 6

pressable floor giving a little clearance at the top. The pry bar must be flat because the wall slides along the bar until it is started in under the doorway. When part of the double top plate is under the door jamb, the bottom of that part of the wall should be beaten over until it is plumb with the top. This pry--hit in--plumb up the bottom-method is used on down the length of the wall until the whole wall is worked into place. The whole procedure tends to tear the hell out of the paint and woodwork. It is much less work to take time and measure and cut accurately than it is to pry the wall in and then fix the damage that is done to the existing finish. Always check your measurements and cuts.

If there is a non-compressable surface on the floor and, when the wall is raised and placed near the doorway you find that it is 1/4" or even 1/8" higher than the doorway, the only thing to be done is to knock the bottom plate off and shorten the studs accordingly.

When the wall is in place and plumb, face nail through the bottom plate into the flooring and hopefully into at least some of the joists below with 16d nails spaced 16" O.C. Also face nail from the underside of the top plate with 16d or larger nails spaced 16" O.C. into the jamb and header.

WALLS PERPENDICULAR TO EXPOSED JOISTS

A wall dividing a basement or garage can either be built on the floor and raised into place or built in place.

Building The Wall In Place

The location of the wall is marked on the floor and the bottom plate is nailed in place along these marks using a power actuated tool or bolted in place using concrete fasteners. Drill the holes in the bottom plate most of the way through with a wood bit in a brace or electric drill. Then with the appropriate masonry bit, a bit made of extra hard steel designed for drilling into concrete, in a hammer drill, drill through the rest of the wood and into the concrete--be careful that the bottom plate doesn't move throughout this operation or the hole alignment will be off. Remove the plate and place the expansion part of the bolts down into the holes in the concrete, replace the plate, insert the bolts and tighten.

Using a plumb bob, plumb up from one side of the bottom plate to a corresponding point on the bottom of a joist and make a mark. Repeat this plumbing operation a couple of places along the length of the plate. The mark is made at the point where the string is held against the underside of the joist when the point of the plumb bob is hovering directly over the edge of the bottom plate.

The double top plate is lined up with these marks and face nailed to the joists with 16d nails (two per joist). Make sure that you align the double top plate with the correct side of the marks or else the double top plate will be out of plumb with the bottom plate by 3½". Fig. 5.

The top plate is face nailed to the double top plate with 16d nails staggered 16" O.C. The studs are toe nailed to the bottom plate with four 8d nails--two on each side of the stud. The studs are toe nailed to the top plate using four 8d

Wall height--See Putting It All Together: Typical Wall Height

Masonry bit

Hammer drill--See Metal Fasteners & Glues: Drilling Into Concrete

Exterior wall covering--See Putting It All Together: Sheathing

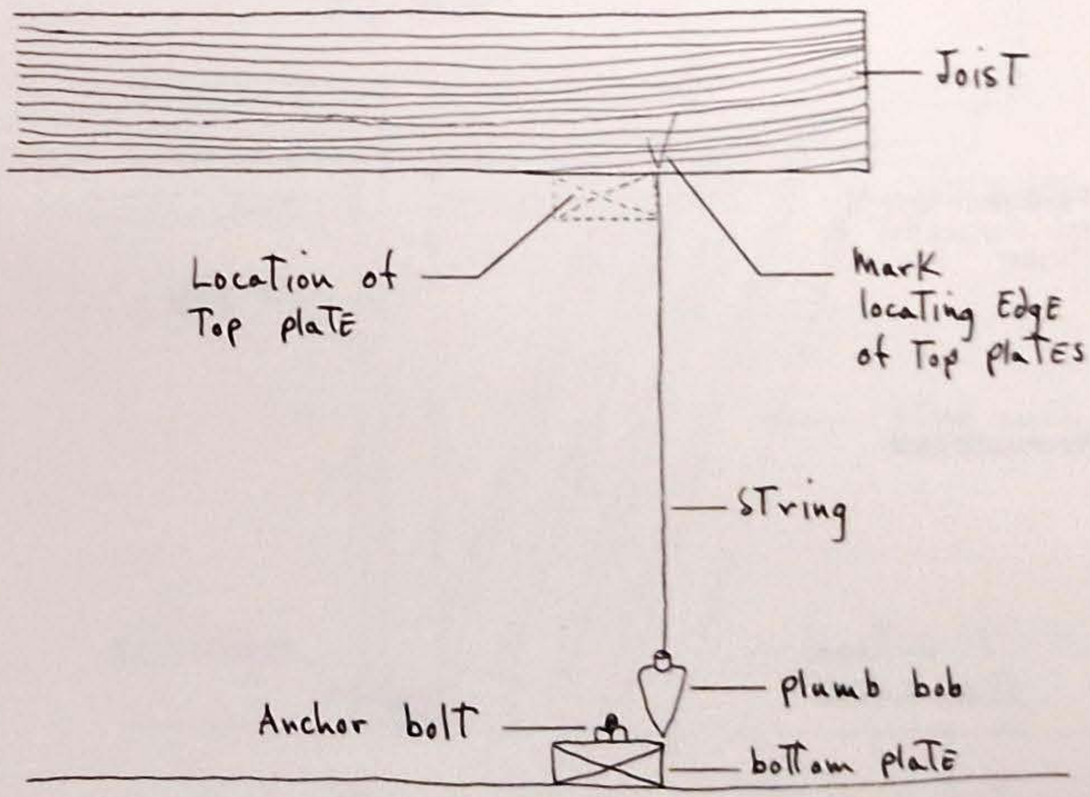

Fig. 5- Plumbing Up to Locate The Top plate

Toenail--See Metal Fasteners & Glues: Fig. 6

nails also.

Building The Wall and Raising It Into Place

Let's say that the wall or partition is to be perpendicular to the joists in a garage where the joists have sagged a bit, and that the auxillary purpose of the wall is to shore up the joists. The heights of the joists from the floor will most likely be different in different parts of the garage. Measure the heights of the joists at a couple of places along the side walls of the garage and take the average. The reason a couple of measurements should be taken is that it is entirely possible that the floor is not level in all parts of the garage and one measurement may not be accurate. Now measure the heights of the joists from the floor in a couple of places along the line where the wall will go. Compare the shortest of these measurements to the average of similar measurements taken along the perimeter of the garage. Depending on how old the garage is the difference will be between 1/2" and several inches. Ceiling joists can be raised only just so much and the amount depends on what dimension lumber they are (2x4" or 2x12"), what kind of tools you have (hydraulic jack or 4x4" wedges) and what the raising will do to the existing structure (basement joists cannot be raised much or the plaster on the floors above will crack and the structure will be weakened). If the garage has exposed joists made of 2x4's as most garages do, the joists can probably be raised from 1/2" to 1". The height that the wall is to be is calculated from the shortest joist height measurement taken along the line where the wall will go. The

Shore up

Hydraulic jack

height of the wall will be the shortest joist height measurement plus the amount it is reasonable to think the wall can be raised.

Since the wall is to be perpendicular to the joist, it will have to be beaten into place using an 8 lb. sledge hammer, a 2 lb. hammer, a 5' 4x4" or anything that is heavy and handy. Raise the wall where you want it to go (at this point the wall will be wedged between the joists and the floor at an angle). Fig. 6. Take the heavy hammer and tap the bottom plate in several places forcing it to move until it's plumb with the top plates. When the wall is vertical it can be more easily tapped into place and once it is where you want it, nail it to the ceiling joists and fasten it to the floor as previously described.

Sledge hammer

A Low Cost Jack

If you are having a lot of trouble beating the wall into place, cut a 4x4" about 1" shorter than the height of the wall and cut two wedges out of 2x4" material. Locate which joist is holding the wall most tightly, place the 4x4" under the joist just behind the top of the wall, and hold the 4x4" against the joist and place the wedges underneath it. The wedges are placed with their points facing different directions. If there are two women and two hammers present, they can each simultaneously drive a wedge in under the 4x4". As the wedges are driven together, they force the 4x4" upwards and it in turn forces the joist upwards. This takes pressure off the wall and allows it to be tapped into a slightly more vertical position. Knock the wedges out from under the 4x4" and move the operation over to another tight joist. Fig. 6.

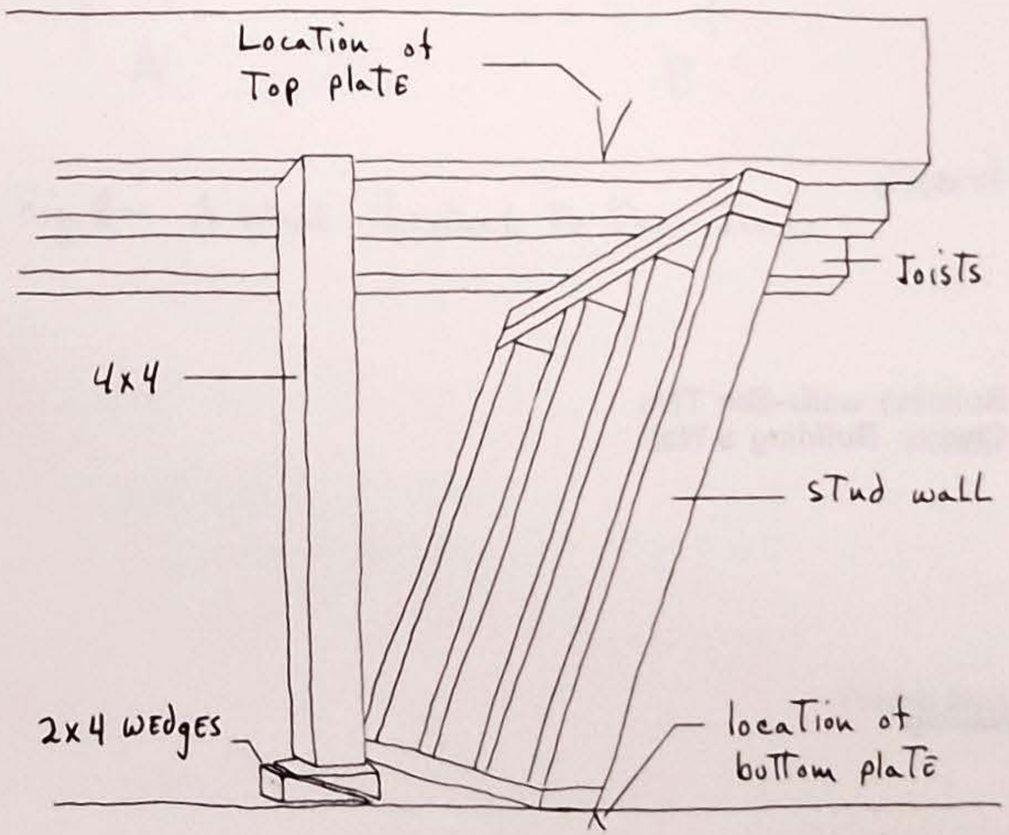

Fig. 6 — Using a 4x4 and wedges as a Jack

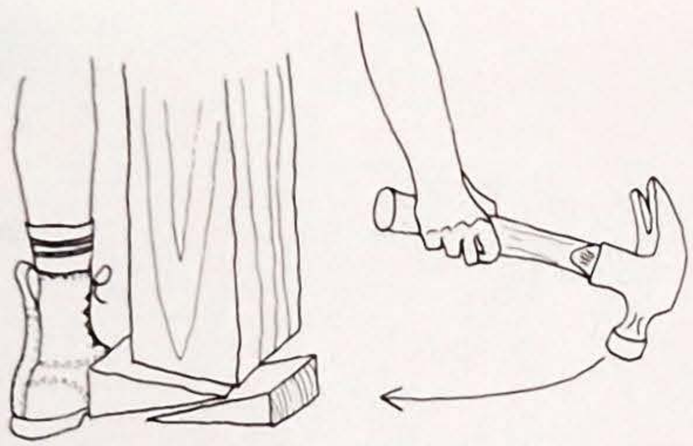

Fig. 7- Position for Driving Wedges

If there is only one woman working the jack, she should stand with one foot against the wedge she is not hitting so that it doesn't slide out from under the 4x4" as she drives the other wedge. Fig. 7.

Always use two wedges; using one will just push the 4x4" laterally (sideways). The second wedge stops the lateral motion and makes only a vertical motion possible. The upright should be at least a 4x4". If it is less thick and less sturdy the force you impart will only make the upright bend instead of forcing the joist up.

WALLS PARALLEL TO AND BETWEEN EXPOSED JOISTS

When the wall is to be built in our same garage with exposed joists and it is to be parallel to the joists, then it is attached to the joists by means of bridging. Bridging is pieces of 2x-- material that fit two joists. The wall runs parallel to and between two joists and is nailed to the bridging which is placed 24" O.C. along the length of the wall. Fig. 8A.

Build the wall as previously described and raise it into place between the joists. If you are also going to put a ceiling up in the garage, then there will need to be something to nail the ceiling to directly above the wall so that the edges of the ceiling material aren't floating loosely where they intersect with the wall. The something to nail to (which is called nailing) is a 2x6" that is nailed to the top of the double top plate so that it laps both sides of the plate. The underside of the 2x6" will be even and level with the underside of the joists. The ceiling

material is nailed to the underside of the joists and to the underside of the 2x6" nailer on top of the wall. Fig. 8B.

Installing The Bridging

Cut enough 2x4's to length X (Fig. 8a); it is usually 14½" for joists placed 16 O.C. Cut enough pieces of bridging to be laid out at 24" O.C. along the length of the wall. Get up on a ladder and push the 2x4" bridging into the space between the joists where the wall is and hammer them down until their width dimensions contact the 2x6" nailer. Face nail the pieces of 2x4" bridging to the joists on either side--two 16d nails on each end of each piece of bridging. When you have the wall where you want it and it is plumb, face nail down through each piece of bridging into the wall with two 16d nails or if there is no room, toe nail up through the 2x6" nailing into the bridging. Fig. 8B.

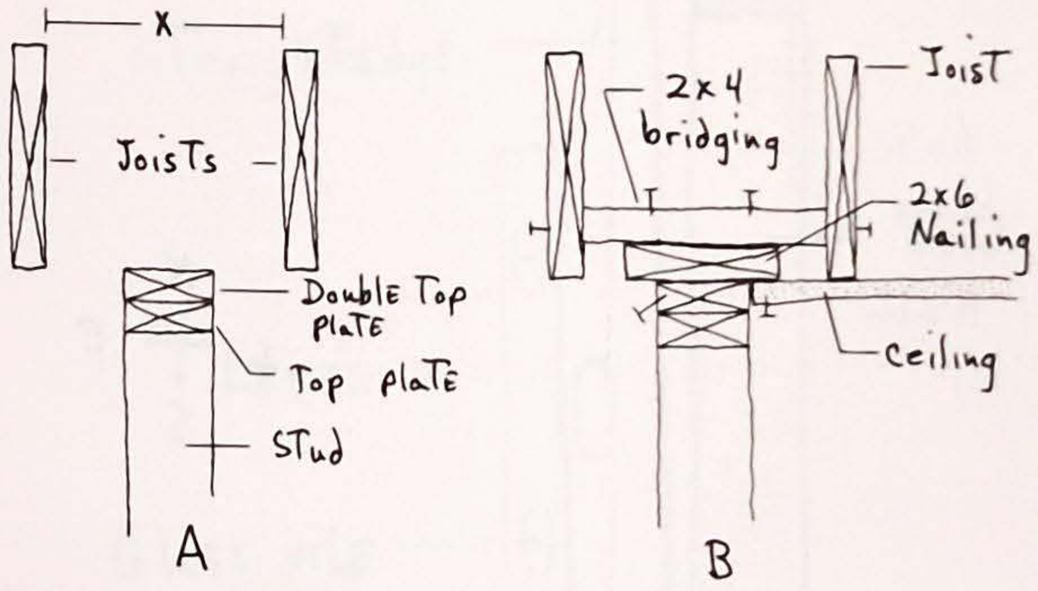

Fig. 8 – A Wall Parallel To The Joists

PLUMB AND PLUMBING

Plumb

To make sure the wall is plumb (straight up and down--vertical) use a plumb bob or a level and straight edge.

Plumbing With A Plumb Bob

Plumb bob

A plumb bob is a precisioned weight with a point which is tied to a string. It is used to check if walls, door jambs, concrete forms, columns etc. are vertical--that is, at right angles with the horizon or floor.

To plumb a wall or partition, drive a 16d nail

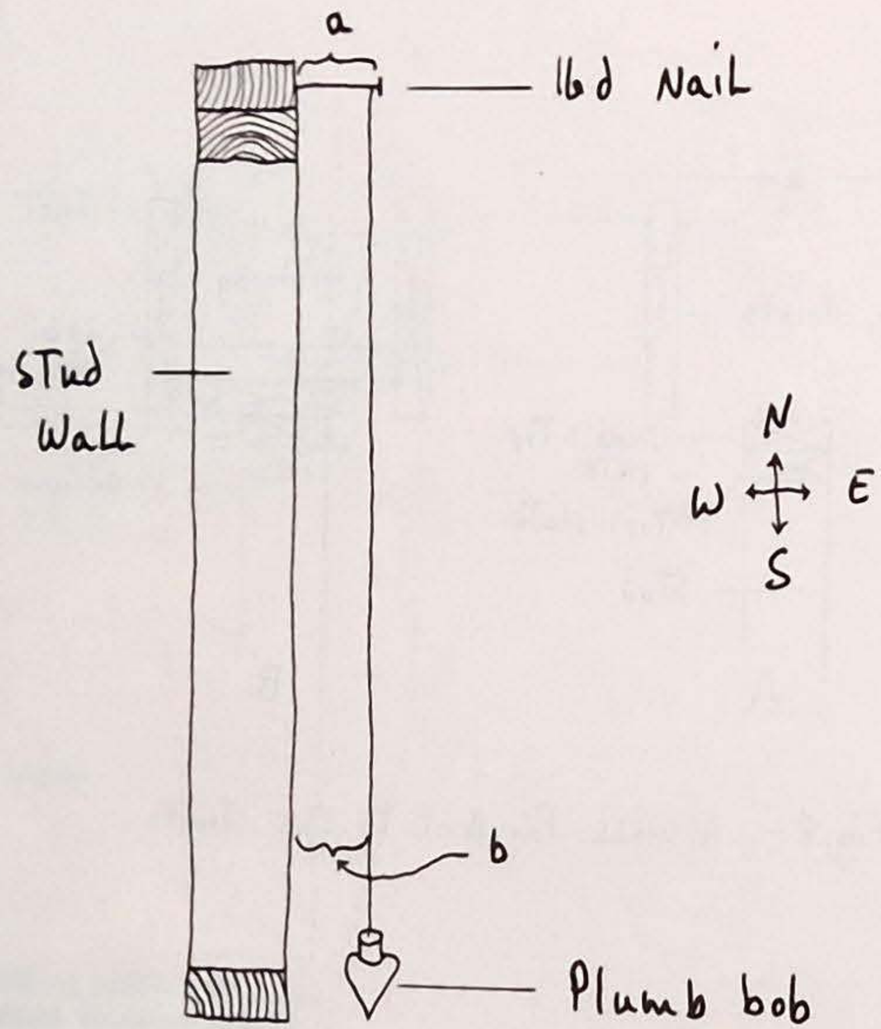

Fig. 9 - Using a Plumb bob

partially into the double top plate and tie the plumb bob string around the shank of the nail near the head. Fig. 9. Measure the distance "a", between the top plate and the string, and compare it to the distance "b" taken at the bottom of the partition between the stud and the string. If "b" is more than "a", the top of the wall needs to go "west" (assuming the bottom of the wall is where you want it). If "a" is greater than "b", the top of the wall need to go "east". When "a" and "b" are equal, the wall is plumb. Nail it.

Plumb bobs work on the principle of gravity and they are never wrong if you watch to make sure the string isn't hung up on something. Levels, on the other hand, can be out of wack and have limitations: a level is only as accurate as its length.

Plumbing With A Level

If you have a level, be careful of it: always lay it down flat so that it can't fall down, don't hit it; never nail or hammer on a surface that you are holding a level to--it will jar the level and throw it out of kilter. When you carry a level from job to job, keep it in the level holder in your tool box or if you have an extra long level, make a foam cover for it to protect it from being jarred. The best levels are those that have the glass viles puttied in--not screwed in. American, which makes wooden bricklayer's levels, and Sand's metal carpenter levels are both very good precis-

ion tools.

A level is only as accurate as its length. If you have a 24" level and want to plumb an 8' wall with it, there will be a large inherent error. The level may show that the wall is plumb, but it is really only those 24" that are plumb. If the surface under the level is warped, then as far as the whole wall goes, the reading is inaccurate.

A person has to get into some pretty strange positions sometimes in order to read a level properly. To get an accurate reading from a level your eyes should be even or a little above the vile. The level indicates something to be plumb or level when the bubble within the vile is exactly in the middle of the black reference marks scratched into the vile.

The best way to plumb a wall with a small level is to use it together with a long straight edge--6' or so. Fig. 10.

Make a straight edge similar to the pattern in Fig. 10. It should contact the surface only at the top and bottom. Make the straight edge out of an 8" or so strip cut off the factory edge of a piece of plywood or make it out of a very true (straight) 1x6". The length of the straight edge adds accuracy to the 24" level and with it you are reading the plumbness of the whole wall, not just 24" of it.

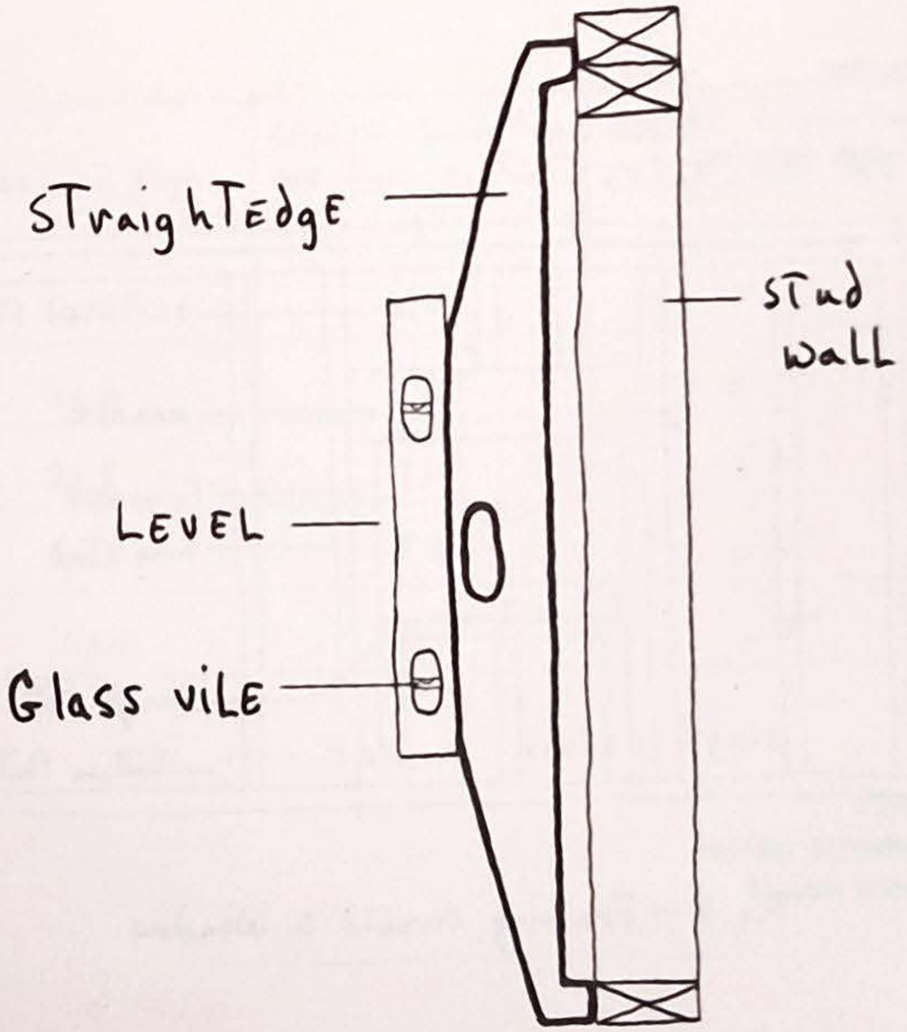

Fig. 10 - LEVEL and STraighTEdgE

WALLS WITH DOORS AND WINDOWS

Walls with doors and windows are built using the same methods and principles as walls without. The only difference is that the structural void where the door or window will go must be compen-

Header

Rough opening

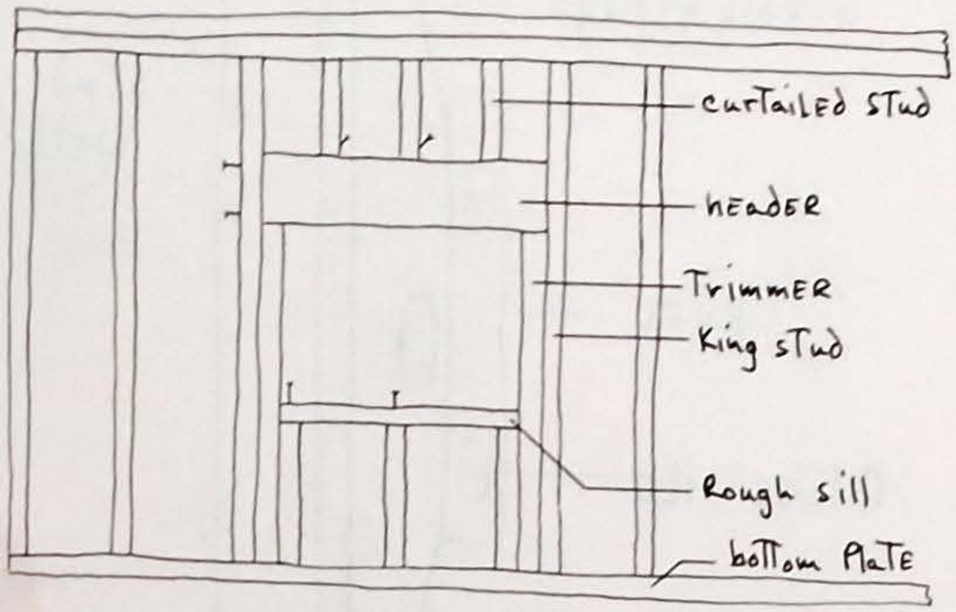

Fig. 11 – Framing around a window

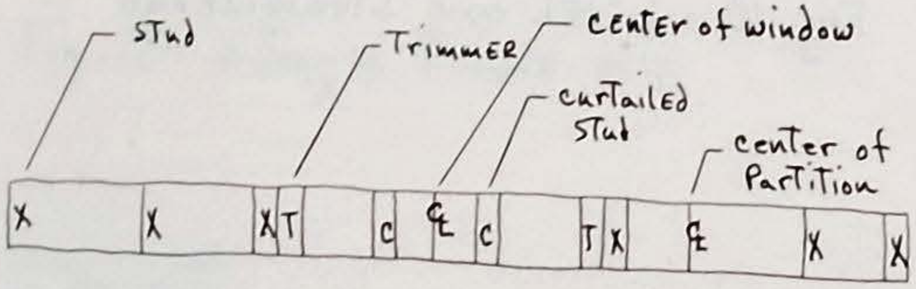

Fig. 12 – Laying Out for Windows & Partitions

sated for. The loss of strength caused by the replacement of studs by a window or door is compensated for by a header, which acts as a bridge from one side of the rough opening to the other. A "rough opening" is the opening formed by the framing members (studs) for a window or door. The studs are doubled on either side of a rough opening and a header, made up of two pieces of 2x-- material, spans the gap. Fig. 11. The studs bordering the rough opening are called trimmers or trimmer studs. They support the header and are in turn nailed to the full length studs next to them called king studs. The trimmer is nailed to the king stud with 16d nails 24" O.C. and staggered.

Laying Out The Plate For A Wall With A Window Or Door

First, lay out the bottom plate as you would for a regular wall, marking the 16" centers and placing an "X" on the side of the line where the stud will go. Check your plan and determine how far from the end of the plate the center line of the window or door is located. Measure from the end of the plate and mark the center of the wall opening. It's good to use a different color when marking center lines of wall openings and partitions. Measure on either side of the center line a distance equal to one-half the rough opening needed for the window or door and make a mark. Square across this mark with a try square and write a large "T" on the non-window side of the line. This is where the trimmers will go. Next to the trimmers make a mark for the king stud, but write an "X" in its space as with any other full length stud. Fig. 12. Re-mark the originally

laid out stud spaces between the trimmers with large "C's" to designate the curtailed studs--studs that don't extend from bottom plate to top plate but are interrupted along the way by headers or rough sills. The traditional carpentry term for these studs is "cripple studs", but I find that term offensive and have taken the liberty of changing it.

Curtailed stud

Headers

The header is made of two 2x4's, 2x6's, 2x8's, 2x10's, or 2x12's depending on the width of the rough opening. Fig. 13.

The actual thickness of a stud wall is 3½". The sum of the thickness dimensions of two 2x--s is only 3". Therefore a couple of 1/2" spacer blocks must be inserted between the 2x--s so that the header is flush with the surface of the studs on both sides of the wall. If the header isn't flush, the sheetrock, paneling, or trim will crack and cup as it is nailed over surfaces that are uneven. Fig. 14.

The plywood spacers should be placed 16" O.C. across the length of the header and the header should be nailed together with 16d nails through these spacers. The number of nails across the width of the header depends on the width of the wood. For 2x4's use two nails, for 2x6's and 2x8's use three. For 2x10's and up use four. The header must be strong and well put together because it carries the weight over the structural void of a window or door and transfers it to the trimmer and king studs.

Lumber on Edge	Header Supporting one floor, ceiling and roof	Header Supporting ceiling & roof only
2x4	3'0"	3'6"
2x6	5'0"	6'0"
2x8	7'0"	8'0"
2x10	8'0"	10'0"
2x12	9'0"	12'0"

Fig. 13 – Table of Header Spans

Flush
Header schedule
Spacer block

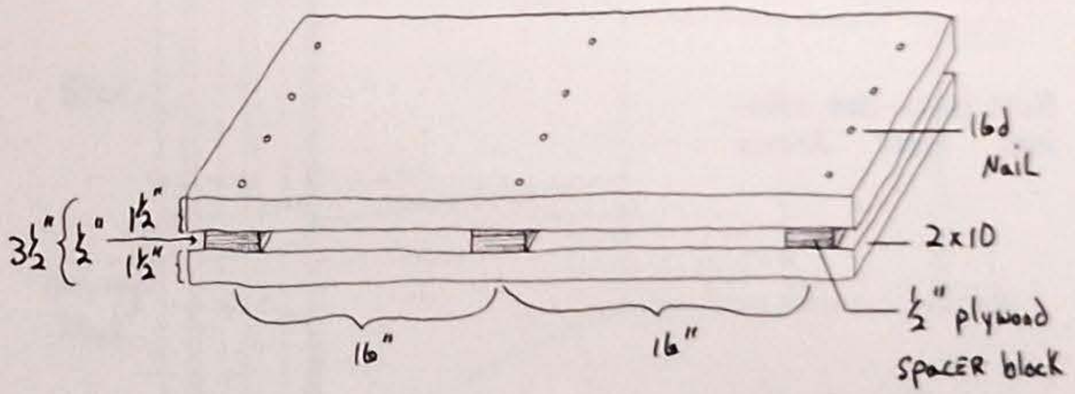

Fig. 14- Construction of a Header

King stud--See This Chapt.: Fig. 11

Outside dimension

Inside dimension

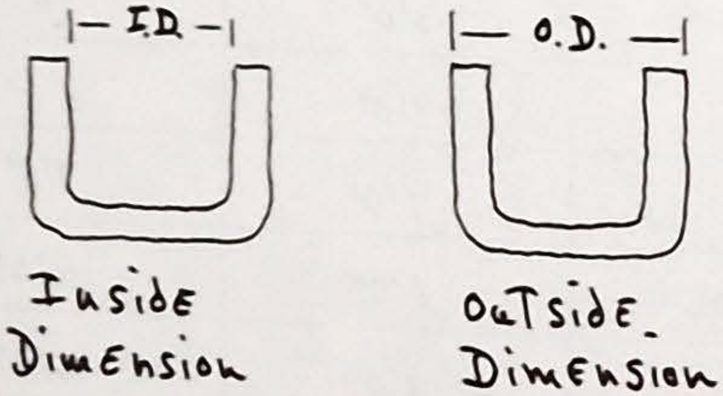

Fig. 15 – Inside & Outside Dimension

Butt joint–See Joining: Butt Joints

Rough Opening

The rough openings in walls must be larger than the outside dimension of the door or window to allow for leveling and plumbing them within the rough opening. The inside dimension of anything is the distance between two things. The outside dimension is the distance across and including the thickness of the two things. Fig. 15. In blueprints inside dimension is abbreviated ID and outside dimension--OD.

The rough opening for a window should be 1/2" larger on all sides than the outside of the window jamb. The width of the rough opening for an exterior door is 2½" wider than the width of the actual door and 2¼" wider than the width of an interior door. The height of the rough opening for either type of door should be at least 2" longer than the actual door height.

The header will measure 3" more than the rough opening because it must bear on the trimmers which form the sides of the rough opening.

When building a wall (especially load bearing walls), never break, that is, end, a board directly over a joint below it. In other words, never place the butt joint between two boards that make up the continuous top plate directly above a similar joint in the bottom plate. Always break the bottom plate over a joist, break the top plate over a stud or header, and break the double top plate 4' past any joint in the top plate. In this way there is continuous bearing all the way up. The structure is strong because there are no weak points: all joints occur over members that carry the weight down to a sturdy base.

When the partition you are building is a non-load bearing wall, you may be able to conserve

wood and scimp a little: 2x4" headers and 24" O.C. stud spacing.

PUTTING THE FINISH COVERING ON THE WALL

Dry Wall

Sheetrock

Sheetrock (also known as drywall) is sheets of white, chalky gypsum covered with thick treated paper on both sides. It comes in 4x8' and 4x10' sheets of thicknesses varying from 1/4"-5/8". 1/2" or 5/8" sheetrock is generally used in houses as an interior wall covering. Sheetrock is fire resistant and is fairly inexpensive (approximately $3 per sheet). The edges of the sheets are tapered and form a channel when butted to another sheet. During the taping process, joint compound and tape are laid in the channel to totally hide the joint.

Taping--See This Chapt.: Taping

Applying the sheetrock horizontally (the long dimension of the sheet perpendicular to the studs) results in fewer joints between sheets and stronger construction. Sheetrock can also be applied vertically; and when 8' sheets are used, one sheet covers the distance from floor to ceiling in usual 8' wall construction.

When sheetrocking an entire room or house, the ceiling is covered with dry wall first before the walls are. It is a lot easier to sheetrock a ceiling if two people are working at it. The sheets are awkward and heavy; one person cannot adequately hold up a sheet and at the same time nail it in place. However, if you find yourself having to sheetrock a ceiling alone, all is not lost. Two braces should be made in the shape of a "T" to support the sheetrock while you nail it.

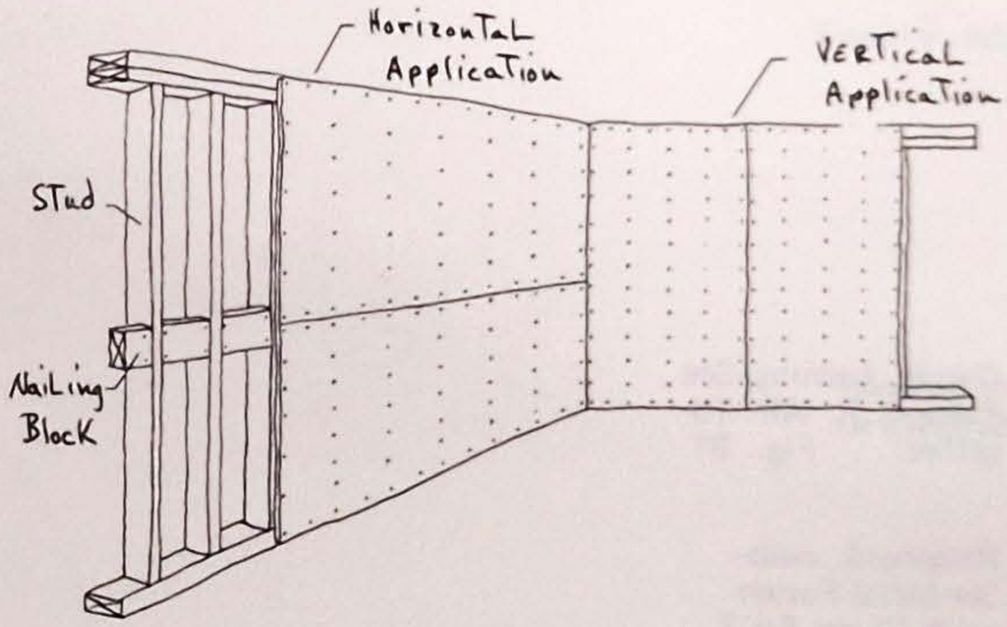

Fig. 16 - Methods of Installing Sheetrock

They can be made of 2x-- or 1x-- material. The cross piece of the "T" should be about 3' long and the upright should be the height of the walls. The addition of the sheetrock to the ceiling makes the brace too long by the thickness of a piece of sheetrock. This extra 1/2" allows the brace to be wedged between the sheetrock and the floor, thereby holding the sheet tightly to the ceiling.

Before hanging the sheetrock, install blocks similar to those in Fig. 16. between the joists so that all edges of each sheet are supported. Also install nailing blocks around all fixtures and openings so that the sheetrock can be securely nailed at these places.

Begin sheetrocking in one corner and apply the sheet so that the long dimension is perpendicular to the joists. Hold the first sheet so that its edges are against the intersecting double top plates at the corner and anchor it in place with a few 8d ringshank nails. After the sheet is secure, fill in the nailing pattern of a nail every 7" along the joists and edges. Continue "hanging" the sheetrock in this way until the ceiling is covered. The edges that break on a stud should be centered on it, and there should be only moderate contact between the edges of two sheets that butt together.

If the walls are to be covered with sheetrock, butt the edge of the first sheet to the corner framing and nail it with a couple of 8d ringshank nails to hold it in place. Once the sheet is anchored, fill in the nailing pattern--a nail every 8" on all studs for walls and every 7" for ceilings. All nails should be at least 3/8" from the edges. Ring shank nails 1¼" long with 1/4" head are used because the rings grip the wood fibers like a fish hook. This keeps the nails

Corner framing--See Putting It All Together: Fig. 31

Ringshank nails--See Metal Fasteners & Glues: Fig.3

from popping out with changes of temperature and moisture. Drive each nail down below the surface of the sheetrock so that the surface is just dimpled by your hammer face. This ensures that the taping compound, which is applied later, will completely hide the nails. Fig. 16.

Cutting Sheetrock

For irregular shaped pieces or partial sheets, careful measurements should be taken on either side of each panel. Taking two measurements instead of assuming that one remains constant across the entire opening saves time in fitting and re-fitting. The two measurements should be transferred separately to the top and bottom of the sheet to be cut. Lay a straight edge across the sheet over the two marks and run a utility knife along the straight edge scoring the paper and cutting into the gypsum a little. (A straight edge is a piece of wood or metal that has a perfectly straight or factory edge. An example of a factory edge is the 8' edge or 4' end of a piece of plywood.) Move the sheet so that the scored line is over the edge of a table or something similar and break the sheetrock by pushing gently down. Finally, take the knife and cut the paper on the other side of the sheet to disconnect the two pieces. When holes must be cut out for pipes or electrical outlets, a key hole saw or dry wall saw (which has a stiffer blade) should be used. The saws are pointed so they can be pushed through through the sheetrock to begin the cut.

When partial sheets must be cut and it is known that the walls in the room are square, one measurement can be taken and transferred to the top of the sheet to be cut. A 4' long T-square, made to

Straight edge

Utility knife

Factory edge

Keyhole saw
Dry wall saw

Joint compound

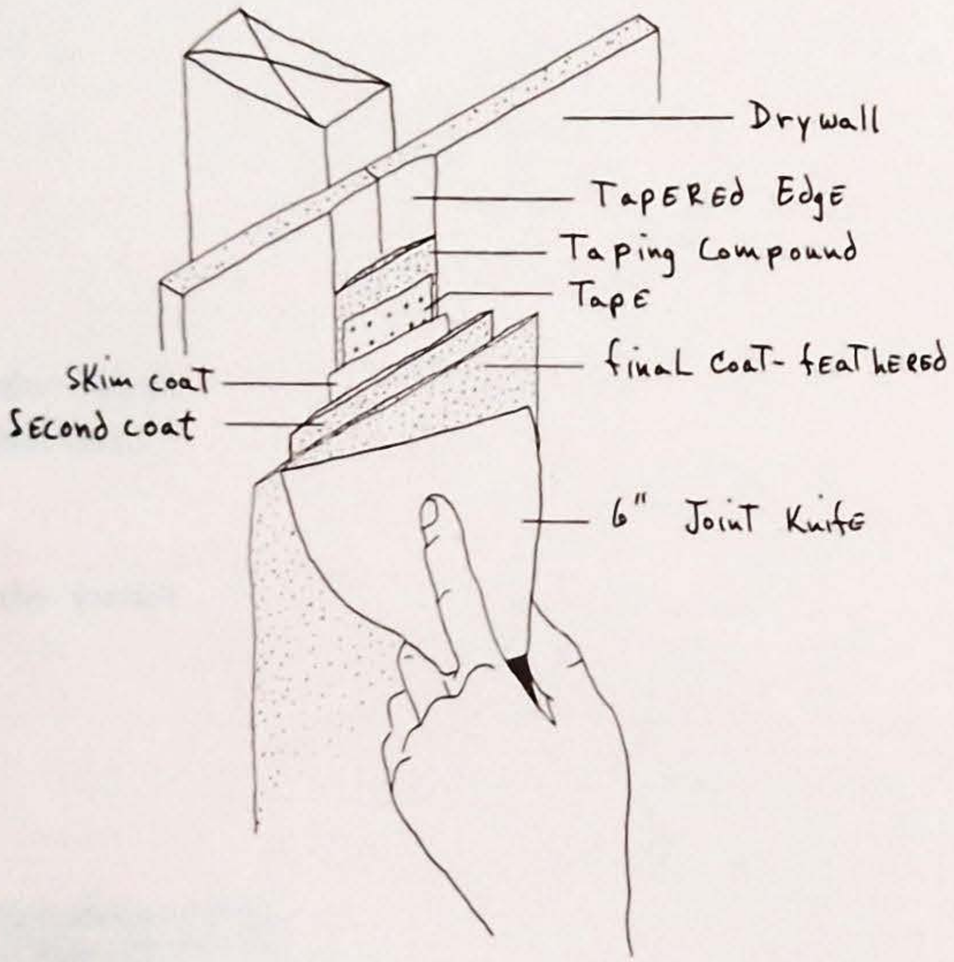

Fig. 17 - Taping

Joint knife

Skim coat

be used with sheetrock, can be used as the straight edge. The "T" slides along the top edge of the sheet, the 4' upright is aligned with the mark and the utility knife is drawn along the 4' length to cut the sheet.

Taping

Taping is the way sheetrock is finished to cover all joints and nails. The process combines the use of cash register-like tape and joint compound, a substance similar to but more gooey than spackling compound or plaster. When taping is well done, the wall surface is completely smooth and the joints are hidden.

Using a 5" or 6" joint knife (like a big putty knife), apply an embedding coat, or first coat, of joint compound over the length of a butt joint between two sheets. Cut a piece of reinforcing tape to the length of the joint, center it over the joint, and embed the tape in the compound by drawing the joint knife along the joint. The tape is available in two varieties: perforated or plain. Fig. 17. Press firmly enough to push the tape into the compound and to remove excess compound as the joint knife is drawn along the joint. With some taping compound on your knife, draw the knife along the joint to apply a thin skim coat over the tape. The tape comes in rolls like cash register tape.

When this first coat is dry, apply a second coat of joint compound to the tape and feather it out 2" beyond the edges of the first coat. A steel trowel is sometimes used in applying the second coat. Because the trowel is wider than the joint knife, it extends the edges of the joint

compound so that the width of the taped joint at this point is 6"-8". This is what is meant by feathering. After the second coat is dry a third and final coat is applied over the tape, with the edges of this coat feathered out at least 2" beyond the edges of the second.

No tape is needed over the hail heads; just two or three similarly applied coats of joint compound. Usually the first coat is applied to both joints and nails; and when it is dry, the second coat is begun, etc. After the third coat is dry, the surface can be smoothed with sand paper (grit number 220-320).

For inside corners, an embedding coat is applied to both sides of the corner and then the tape which has been creased down the middle is pushed into the corner. Excess joint compound is removed, and this inside corner is finished in the same way as the other joints. Outside corners are reinforced with prefabricated metal corners called corner bead. They are installed over the sheetrock and nailed into the studs. Fig. 18. The flanges of the corner bead are concealed with joint compound in the same way as other joints.

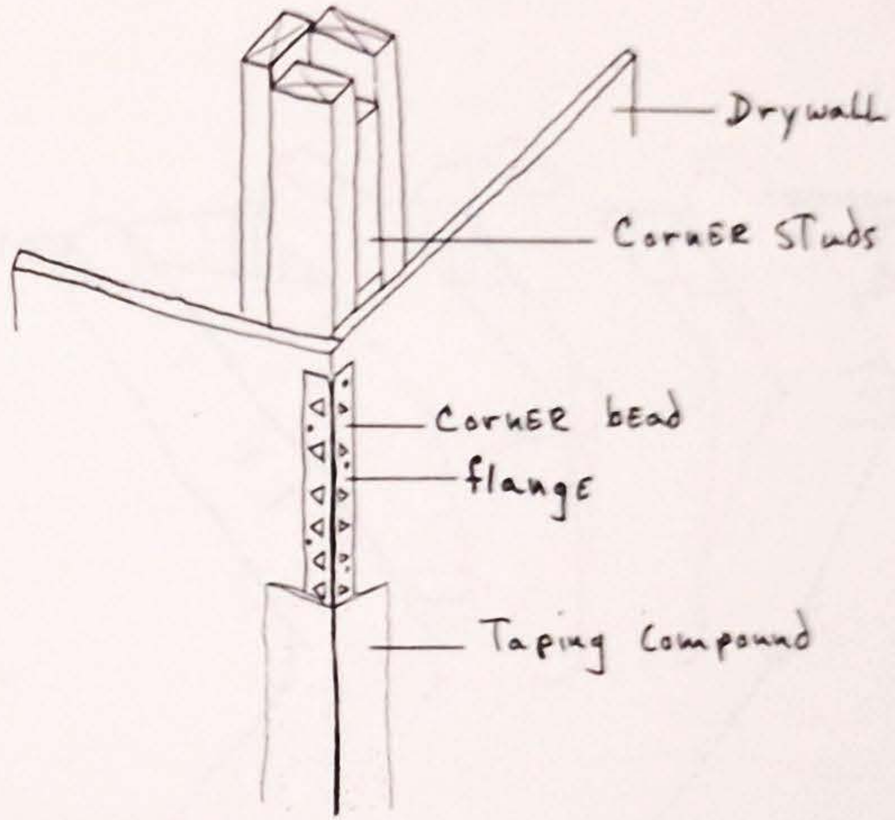

Fig. 18- Corner bead

Paneling

Another way of covering an interior wall is with sheets of paneling. The sheets are applied like sheetrock except that they are sawed, not cut, and should also break on studs. Depending on the thickness of the paneling, use 4d or 6d nails. Casing or finish nails that are $1\frac{1}{4}$" to $1\frac{1}{2}$" are used to nail the paneling to the studs and are spaced every 8" on walls and every 6" on ceilings. It is a good idea to use a 13 oz. hammer with paneling. Fig. 19 shows the maximum stud spacing

Stud Spacing	Paneling Thickness		
	Paneling	Plywood	Fiberboard
16" o.c.	$\frac{3}{8}$"	$\frac{1}{4}$"	$\frac{1}{2}$"
20" o.c.	$\frac{1}{2}$"	$\frac{3}{8}$"	$\frac{3}{4}$"
24" o.c.	$\frac{5}{6}$"	$\frac{3}{8}$"	$\frac{3}{4}$"

Fig. 19- Minimum Panel Thicknesses

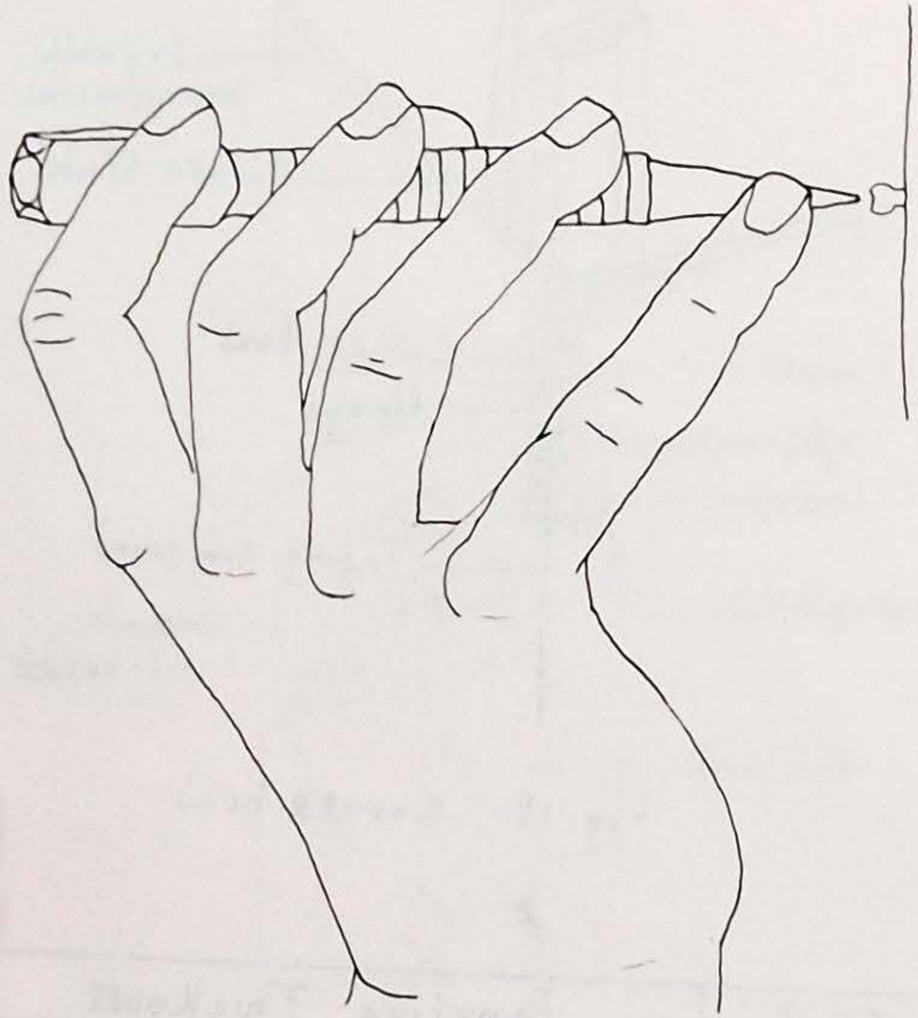

Fig. 20 - The Correct Way To Hold a Nail Set

for different thicknesses of paneling.

Drive the nails almost even with the surface, being careful not to miss the nail and mar the surface of the paneling. A carpenter friend of mine in Oakland invented a great way of protecting wood from hammer marks. Take a small piece of thin plywood (3x3" or 3x4", etc.) and drill a hole in it big enough for the nail head to fit through. Place the hole in the piece of plywood over the spot where the nail should go, start the nail through the hole and continue to pound in the nail while holding the plywood in place to protect the surrounding wood.

When all the nails have been driven "almost" home, they are pushed below the surface with a nail set. Nail sets are punch-like tools. They come in different sizes: 1/32", 2/32", 3/32", etc. For 4d and 6d nails use a 1/32" nail set. For 8d nails use a 2/32" nail set and so on.

Hold the nail set with four fingers along its length and your thumb on the other side. Let your little finger hang over the tip just a little so it can guide the nail set into the groove in the head of the finish nail. Finish nails are manufactured with groove indentations in their heads to keep the point of the nail set from slipping out. The point of the nail set must not slip out of the groove in the head of the nail or it will mar the wood. Hit the butt of the nail set with the hammer until the head of the nail is pushed 1/16"-1/8" below the surface of the wood. This hole can be left as it is or filled with a putty whose color matches the wall and which takes paint or stain.

Finish nail--See Metal Fasteners & Glues: Fig. 1

ATTACHING THINGS TO WALLS

Hanging pictures or bookshelves from walls is a common carpentry problem. How it is done depends on what the interior wall covering is made of. In older houses the walls are plaster and lathe. Thin 1/4"x1½" strips of wood called lathe were nailed to the studs in rows about an inch apart. This formed a lattice which would hold the plaster when it was applied to the lathe. In modern house construction, sheetrock is used directly over the studs and sometimes in more expensive houses a thin coat of plaster is applied over it. Plaster insulates well against both sound and heat loss. One way to tell which kind of wall finish your apartment has is to knock on the wall. If the sound is flimsy and hollow, then the walls are probably covered with sheetrock. If the sound is more solid, then it is plaster and lathe. Another way is to find an obscure corner of the room and gouge out a little place down past the surface. If the interior substance is chalky, it is sheetrock. If it is granular like fine cement or mortar, it is plaster.

Hanging Pictures That Aren't Too Heavy

Pictures that aren't too heavy do not have to be hung from a stud. If the wall is sheetrock, molly bolts or toggle bolts can be used anywhere on the wall. If the wall is plaster and lathe, toggle bolts are the only hollow wall fastener that will work. When calculating the length of toggle bolts needed, remember a plaster or lathe surface is approximately 1" thick. Plaster will usually hold screws and nails; and if they are

carefully put in, not too much plaster will chip out from the wall surface.

Hanging Heavy Things

When such things as bookshelves must be attached to walls, they should be screwed into the studs--no matter what the wall surface is. There are two ways to locate the studs in a finished wall. One is to use a little magnetized stud finder, which can be found in all lumber and hardware stores. These gadgets utilize a small magnet on a pivot that swings freely except when it is drawn to a nail in sheetrock, lathe or baseboard. Move the stud finder along the baseboard or wall surface until it reacts to a nail. A stud should be located at this spot. To make sure, measure 16" on either side of the suspected stud and pound in a nail where the hole won't be noticed, to see if the nail hits solid wood instead of going right through the wall surface.

Another way of finding studs is to measure 16" in from the corner along an interior partition and test with a nail to see if a stud is located there. An interior partition is chosen over a side or end wall because it is known for sure that the on center layout of the wall begins from the corner. The layout for a side or end wall begins from the corner of the building which may or may not coincide with the corner of a particular room. Sometimes studs are spaced 24" O.C.; so if a stud does not appear where it should in a 16" O.C. layout try a different layout.

When the studs are located, the supports for the bookshelves should be screwed into them with screws that are long enough to penetrate into the stud at least two thirds the length of the screw.

FURRING

Let's say you have a basement; or live in a basement apartment which has a bare stone or concrete wall. You want to cover it with sheetrock and insulation so your room will be dryer, warmer, prettier and less dirty. The problem is how to attach wood strips (furring) to the stone so you can nail sheetrock or paneling to them. (It is hard to nail to stone.)

The furring strips should be laid out at regular on center intervals: usually 16" O.C. or 24" O.C.. They can be installed horizontally or vertically--whichever will give the most support to the edges of the kind of wall covering that is to go over the existing stone wall. The strips should be attached to the wall by 3 or 4 fasteners or enough to make the furring solid. Furring strips are usually 1x3's or 2x4's. Using 2x4's would yield more dead air space, which acts as insulation, between the wall and wall covering; or more room for other forms of insulation. Rigid insulation like styrofoam works well as insulation between 1/3" furring strips. It is very efficient and its solid form lends support to the new wall covering other than that given by the furring strips.

The method of fastening the furring to the wall depends on the material that the wall is made of. If it is a concrete block wall, use toggle bolts because the blocks are hollow except for the webbing. Fig. 21. If the wall is solid concrete or stone, use a screw anchor, a lag screw shield or a saber tooth. A power actuated tool or industrial glue like mastik will also fasten furring strips to solid walls.

Lay out the position of the furring strips on

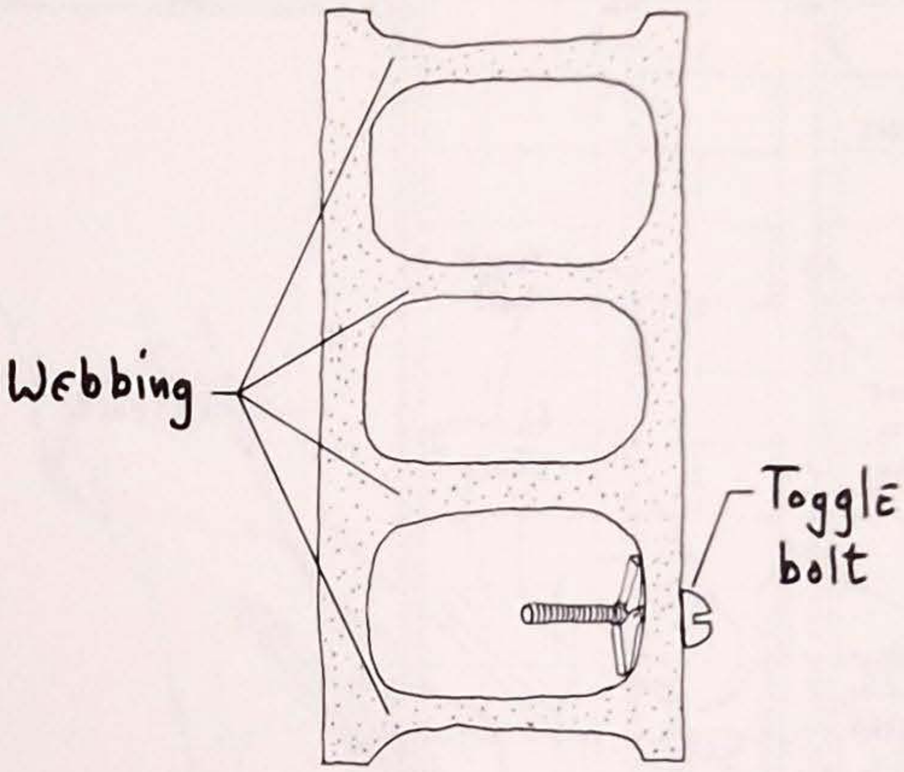

Fig. 21 - A Concrete Block (Crossection)

Insulation–See Putting It All Together: Insulation

Toggle bolts--See Metal Fasteners & Glues: Fig. 23

Screw anchors--See Metal Fasteners & Glues: Fig. 16

Power actuated tool--See Metal Fasteners And Glues: Fig. 22

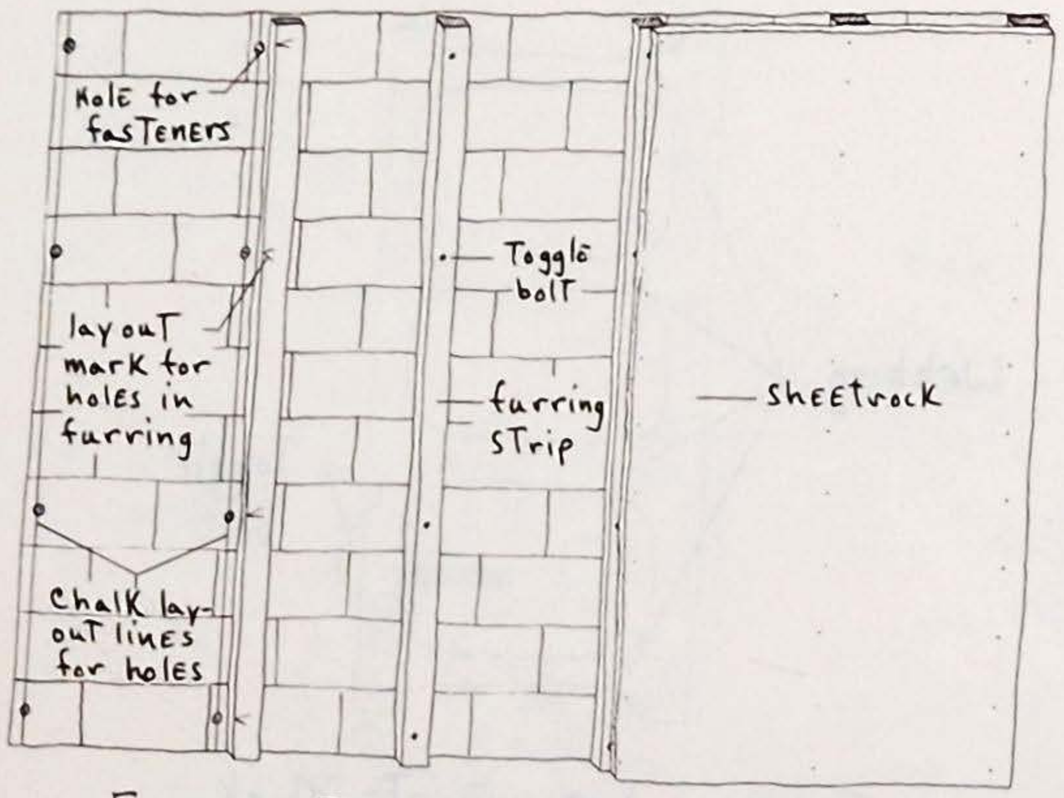

Fig. 22 - Block wall with furring sTrips

Hammer drill--See Metal Fasteners & Glues: Drilling Into Concrete

Marking gauge--See Joining: Fig. 11

the stone wall. If they are to be vertical, make the on center lay out marks on the wall near the floor. Using a level, plumb a line all the way up the wall by drawing a line along the level's edge as it is held plumb. If the furring strips are to be horizontal, measure up from the floor and mark the on center measurements at either end of the wall. Snap chalk lines between the corresponding layout marks at each end of the wall so that the horizontal lines are clearly visible.

At regular intervals mark the position of fasteners along the layout lines. At these points drill into the existing wall with the appropriate size bit for the type of fastener being used. A masonry bit and a hammerdrill are the right tools for the job. Hold the furring strips against the wall so that they are parallel to and a little below the layout line they will cover. On the furring strip mark the position of the center of the holes already drilled in the wall. Fig. 22. Square these points across the width dimension of the strip with a try square. Using your try square as a marking gauge, gauge a line down the center of the width dimension of the strip. Fig. 23. Where the lines intersect, drill holes with the appropriate size wood bit for the fasteners being used.

If toggle bolts are being used, take the toggle butterflies off the screws and insert the screws through the holes in one furring strip. Now screw the butterlies back on <u>just a little</u>. When all the bolts are assembled in this way, insert each of them into their corresponding holes in the concrete block wall. Don't begin to draw up the slack between the strip and wall until the butterflies of <u>all</u> the bolts have sprung open and are holding within the wall.

If expansion anchors such as lag screw shields are used to fasten the strips to a concrete wall, it is not crucial (as it is with toggle bolts) to put all the fasteners in the holes at the same time. Start at one end and work toward the other; do not fasten both ends and have to fight the middle if the holes are mis-aligned.

When all the furring strips are securely fastened to the existing wall, the sheetrock or paneling can be applied. It should be installed as it normally would be--nailed to the furring strips as if they were studs. If additional support is needed under edges that are not over furring strips, more strips should be added at these points.

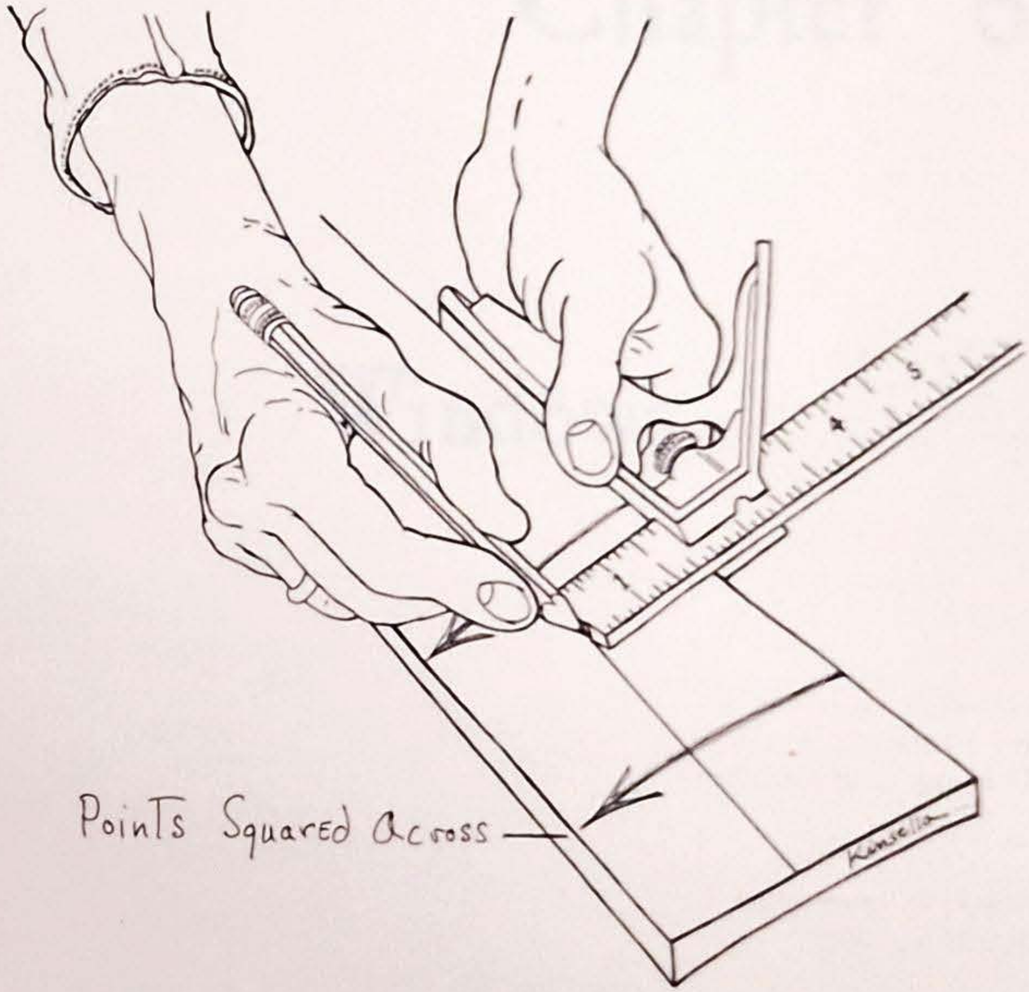

Fig 23 - Using The Try Square As a Marking Gauge