UNIT 4

KEY TERMS

dimensioning
isometric
orthographic
single-line technique

After studying this unit, the student should be able to:

Define the purpose of a simple piping sketch and its important elements.

Define the different types of sketches.

Explain how a sketch is made.

Understand dimensioning and correct piping symbols.

A sketch is a simple drawing with a minimum of detail. Its purpose is to preserve information. Sometimes the information is for the maker of the sketch. Often it is passed on to someone else to make the actual installation. The maker of the sketch must always make it so that someone else will be able to make, or at lease understand, the installation from the sketch. It seems at the time that details of the job will easily be remembered when it is time to install the system. Frequently the time between sketch and installation is longer than anticipated. The information that was omitted from the drawing because one was in a hurry or was sure that one would remember

ELEMENTARY SKETCH MAKING AND READING

OBJECTIVES

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often must then be rediscovered.

If the maker of the sketch, the draftsperson, always makes the assumption that someone else will be required to make the installation from the sketch, even if he/she knows otherwise, missing information and obscure drawings will be avoided.

Sketches are important to the pipe trades. A simple, clearly executed drawing can convey more information on one page than many pages of written words. The plumber often works from sketches.

Sketches may be orthographic or isometric.

An , as it applies to building plans, separates horizontal piping from vertical piping. Piping which runs horizontally, for the most part is best represented with a *plan* view. For those who have studied *mechanical drawing* the plan view corresponds to the *top* view. Piping which runs mostly up and down (vertically), would be shown with an *elevation* view. A drawing of a room with the viewer's eye at the ceiling looking down toward the floor would be a *plan* view. If the viewer's eye was in the center of the room looking at pipe arrayed against one wall then this would be an *elevation* view. Again, for people with mechanical drawing this would correspond to a *front* or perhaps a *side* view.

An shows piping both horizontally and vertically in the same view. In order to accomplish this the angles are distorted as in Figure 4–1. All the corners of the box which Figure 4–1A represents are actually 90 degree or right angles. But if a protractor were laid on this figure it would be discovered that none of the visible corners of the box are actually drawn at 90 degrees.

By distorting the angles the draftsperson can represent pipe systems which run both horizontally and vertically on one view. Because of its resemblance to a picture, this is often the drawing which is easiest for the reader to visualize, if the system is not complicated.

The isometric drawing is, however, the more difficult to draw. Keep in mind a few basic facts about isometric lines when doing this kind of a drawing.

1. *All lines which are vertical on the object being drawn are drawn vertically on the drawing.* Note: If the drawing is on a flat surface like a table, the term *vertical* would be indicated on the drawing by lines drawn toward

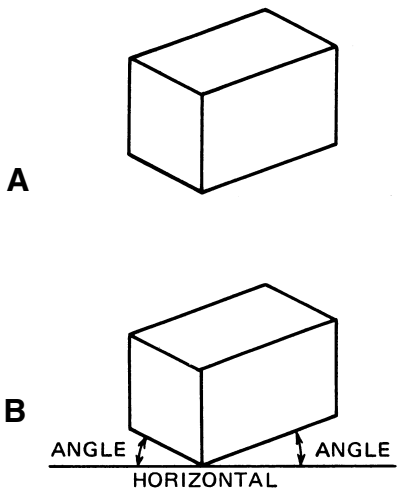


Figure 4–1 An isometric drawing of a box

TYPES OF DRAWINGS

Orthographic

orthographic drawing

Isometric

isometric drawing

the viewer and away from the viewer as it sits on the table.

2. *All lines which are horizontal on the object being drawn are drawn with a 30-degree slope on the paper.* Note: The lines which are meant to represent horizontal lines on the box in Figure 4–1B, are represented by lines which slope up from the lowest point in two directions. Which 30-degree angle used is determined by the direction the edge is running. If the box was positioned so that some horizontal lines ran in a north/south direction and some in an east/west direction, then, depending on the drawing's perspective, the north/south lines might slope up to the left and the east/west lines would slope up to the right.

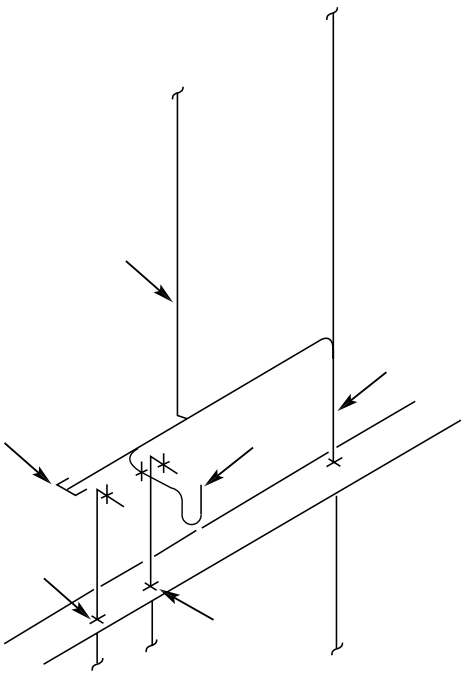


Figure 4–2A

Compare the two sketches Figures 4–2A and 4–2B. Figure 4–2A is an isometric sketch of a simple lavatory pipe layout, without measurements. Sketch 4–2B is an orthographic sketch of the same thing. Notice how much more clearly the isometric sketch shows the orientation of the 1 1/4" "P" trap. The orthographic drawing is more precise especially when dimensions or measurements are included. However, in order to show all of the dimensions necessary for installation the orthographic sketch requires another view. In the orthographic sketch in Figure 4–2B, would you be able to tell how far out from its horizontal waste line the outlet of the trap would be placed? Could you tell how far back into the wall the holes must be cut in the floor for the vertical supply lines to pass through?

The isometric drawing technique can create confusion if *crosses* are not supplied by the sketch maker where the piping penetrates walls and floors (these are called *pipe penetrations*). Notice that in the isometric sketch, Figure 4–2A, the draftsperson even makes imaginary lines, the crosses and the wall surface lines conform to the principle that edges which are vertical are

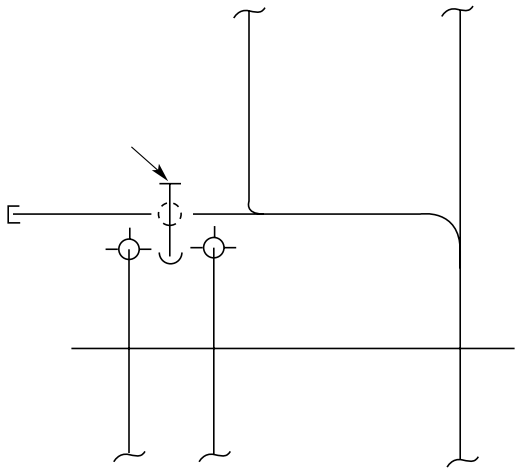
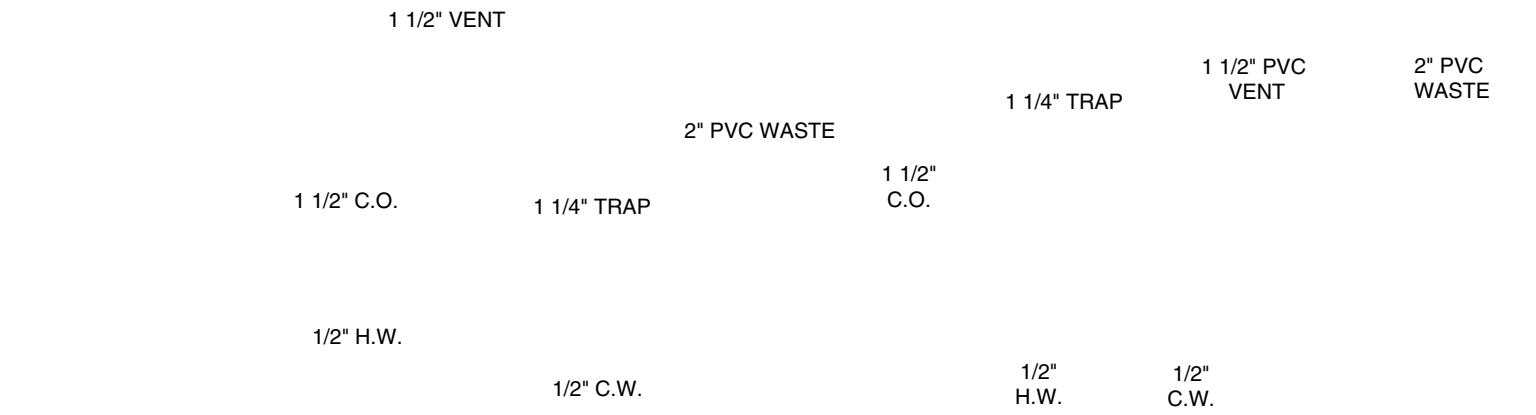


Figure 4–2B



represented by "vertica" drawing lines, and edges which are horizontal slope up to the left or up to the right on a 30-degree angle, depending on whether they run north/south or east/west. Dimension lines are also imaginary lines. They would also run according to the isometric drawing rules.

Sketches are ideally made on graph paper which aids neatness. However, some sketches will be made on opened-up lunch bags and other emergency drawing materials. Nevertheless a sketch must be neat and readable enough so that anyone can understand it. It must contain enough information so that the job can be accurately identified even if the maker of the sketch is not present. While sketches are rarely made to scale (the drawing being precisely proportional to the object being drawn), measurements placed on the drawing must be accurate and carefully recorded.

Drawings are subject to rough usage, and measurements can sometimes become difficult to read. Lettering style and the methods of entering dimensions should be given special attention. Building drawings which have feet and inch measurements will show the feet and inches with a hyphen in between, i.e., 7'-9 3/8". This is not a "minus" sign but a separator of feet and inches. Figure 4–2C shows a way to write numbers which results in maximum readability for drawings even when faded or partially smudged. Experience has shown that this method results in consistently legible numbers even when applied with a paintbrush over concrete, wood, and steel. The small numbers and the arrows on this figure indicate the order and the direction the strokes should take for right-handed draftspersons. Left-handers should take note that pencil strokes are always toward the body or toward the palm of the hand. The student is urged to practice making numbers in this fashion until he/she is proficient.

Sometimes the sketch is made from a larger, more complex drawing. The overall dimensions of a particular area, such as a cellar, are laid out on the sketch sheet. Then, the particular piping system is sketched in and a few important dimensions are noted. This becomes the working sketch for the plumber installing the systems. This usually occurs on new construction.

At other times, the dimensions of the space to be worked are obtained at the job site. This often occurs when the home has already been constructed and the plumbing will be some type of alteration.

The drawing is usually made on graph paper with a lead pencil. The lead pencil makes erasing and correcting mistakes easy.

A title block, Figure 4–3, is always included at the bottom of the sketch. All important infor-

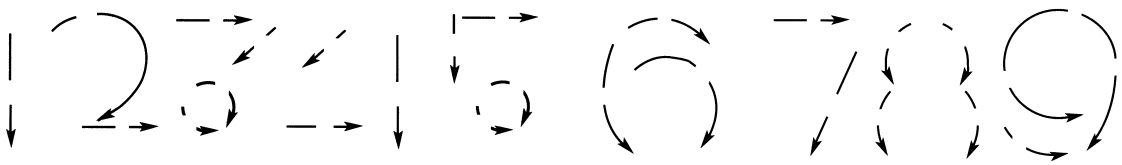
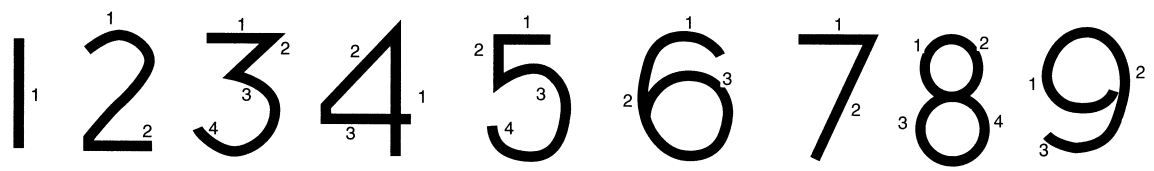


Figure 4–2C

ELEMENTS

HOW A SKETCH IS MADE



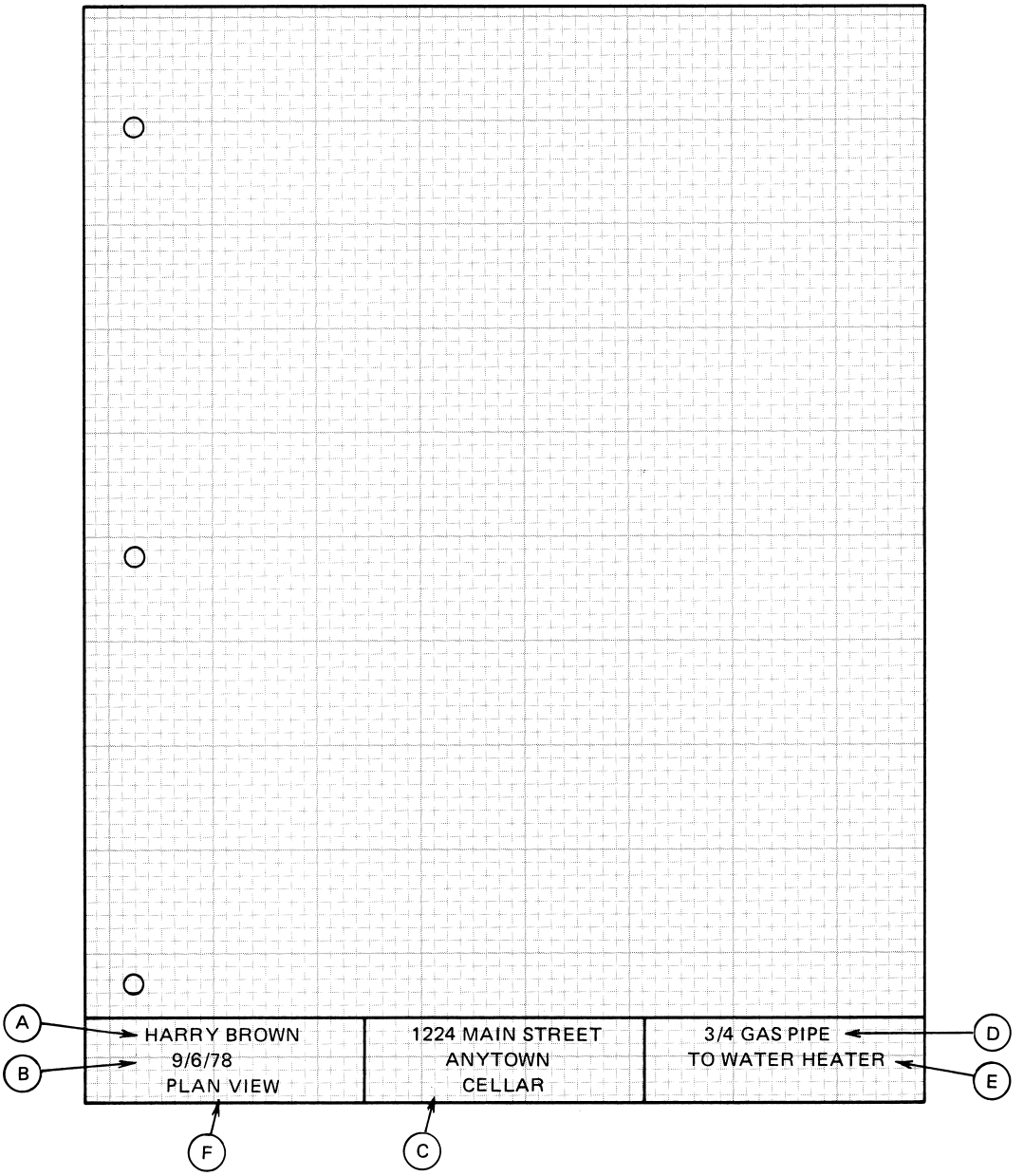


Figure 4–3 8 1/2 × 11 quadrille lined pape

mation is then located in one area where it can be easily picked out. To make a title block, draw a straight heavy line across the page about 1 inch to 1 1/2 inches up from the bottom. The title block can be divided further with short vertical lines to keep the information separated.

The title block should contain the following points:

A. the name of the person who made the sketch.
B. the date that the sketch was made.
C. the address of the building and the particular area of the building involved.
D. the material to be used.
E. the system being altered or installed.
F. the particular view shown.

There are four other points a good drawing must have, Figure 4–4.

It must be readable by anyone familiar with sketches.

It must contain all of the necessary measurements.

A direction should be supplied to orient the reader in the building. An arrow placed on the floor plan pointing north is helpful, Figure 4–4.

On elevation views, a notation should be made as to which direction is shown, for example, "The northeast laundry room wall."

Pipe sketches are made by using the This means that the pipeline is represented by a single pencil line. This line depicts the centerline of the pipe. Fittings are indicated by short crossing lines, Figure 4–5. On a plan view, a vertical pipe is depicted by a circle. When the pipe is facing up, the full circle is visible, Figure 4–6. When the pipe is facing down, part of the circle is obscured by the centerline of the pipe, Figure 4–7. On an elevation view, the circle is used for pipes that face toward or away from the viewer.

Figure 4–8 gives the single-line symbols for a wide variety of pipe fittings.

refers to the placement of measurements on the drawing. Dimensions are usually taken from the centerline of the pipe or a fitting to the centerline of another pipe or fitting. They may also be from a pipe or fitting to a part of the building. It is often advisable to first make a rough sketch with the dimensions of the space being worked in on it. Then only the essential space dimensions should be put in the working sketch. Dimensions are indicated by the measurement being written on the drawing, Figure 4–9. The measurement is placed between two arrows as in Figure 4–9. It is understood that the measurement indicated goes from the point of one arrow to the point of the other arrow. Often a light extension line is drawn to clarify the point from which the measurement is to be taken. The extension line should not touch the object being measured. Observe that in Figure 4–9 the extension line does not quite touch the 90-degree elbow.

DIMENSIONING

Dimensioning

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- ❑

single-line technique.

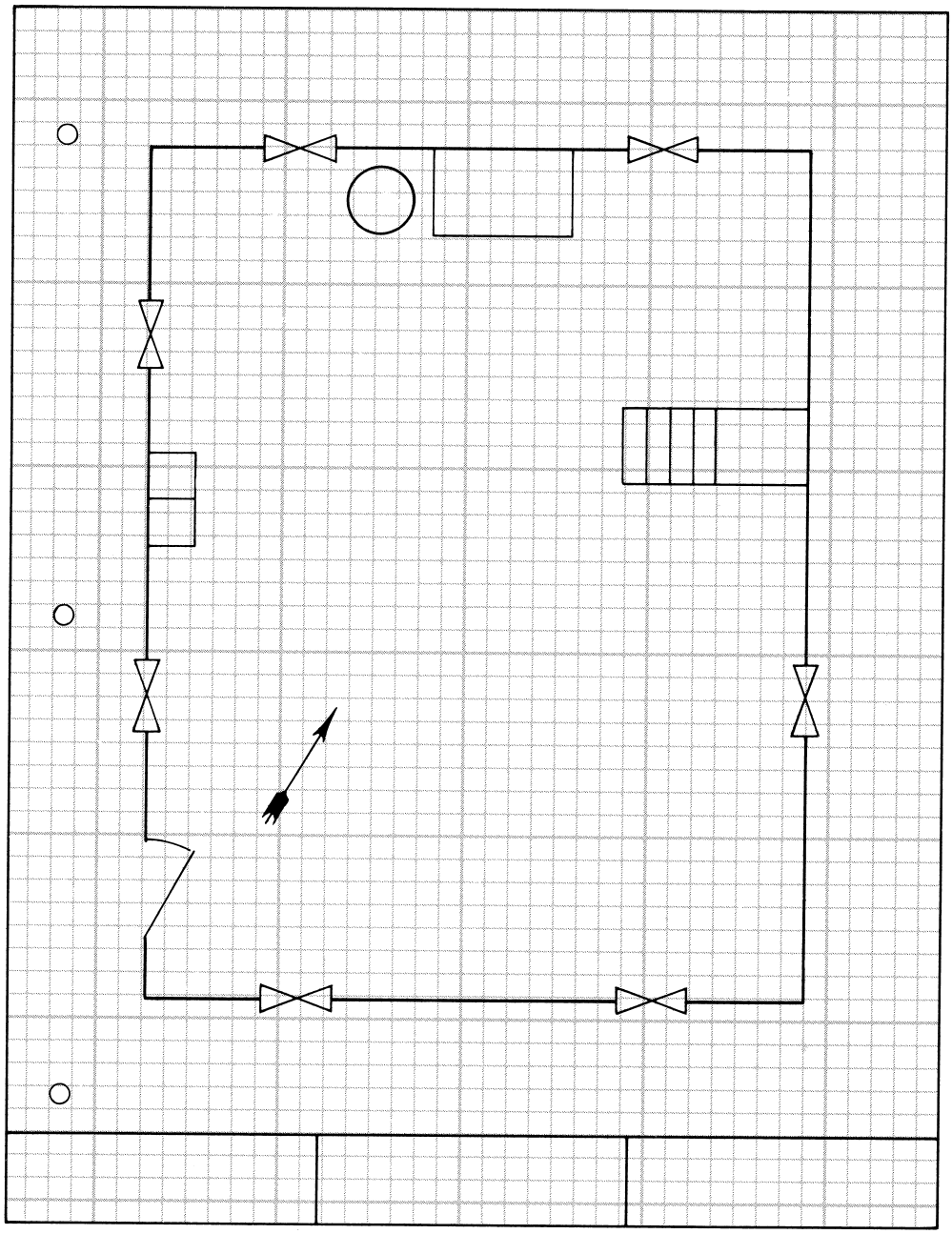
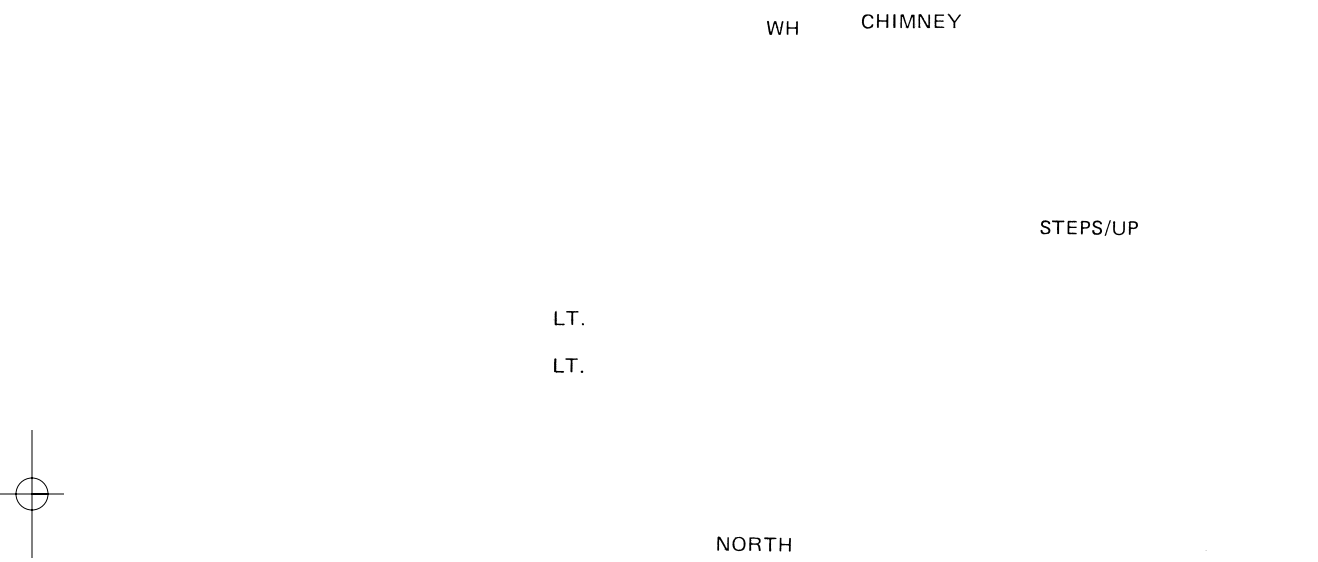


Figure 4–4



HARRY BROWN
9/6/78
PLAN VIEW

1224 MAIN STREET
ANYTOWN
CELLAR

3/4'' GAS PIPE
TO WATER HEATER

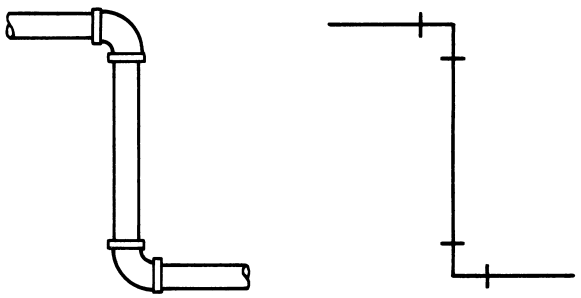


Figure 4–5

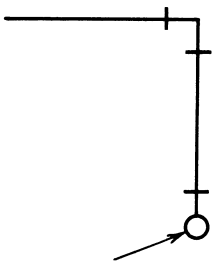


Figure 4–6

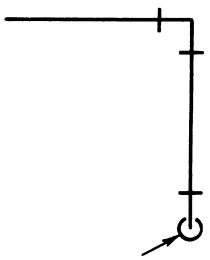


Figure 4–7

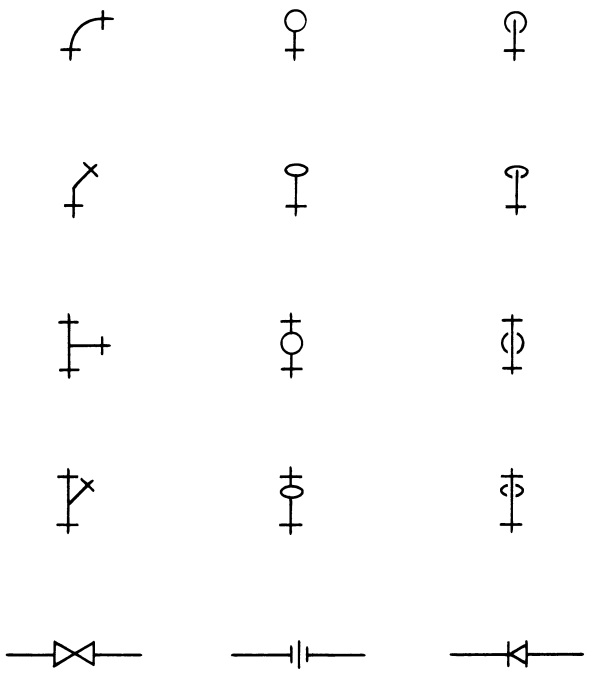


Figure 4–8 Some single-line pipe symbols

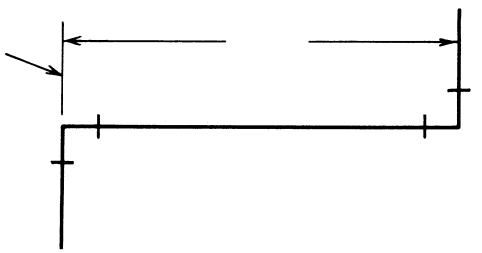
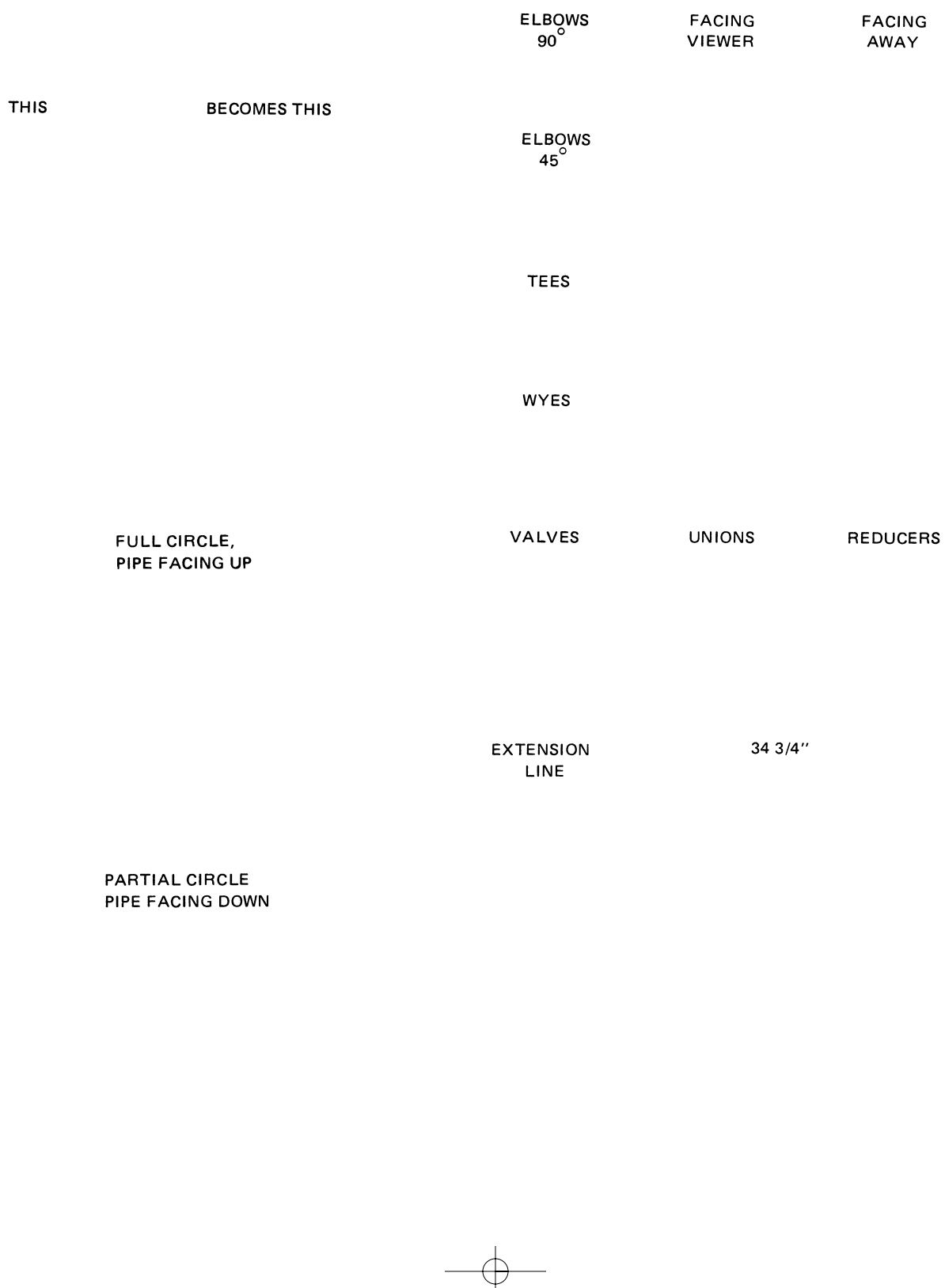


Figure 4–9



Test Your Knowledge

1. Who needs to understand a sketch?

2. What is the advantage of an isometric sketch?

3. The terms *top view, front view,* and *side view* in mechanical drawing correspond to which views in architectural drafting?

4. Aside from the location of the job and its orientation, what element on the sketch should be given the greatest care?

5. What do dimension, extension, and hidden lines have in common?

6. What should you include with the sketch's title?

7. What is a single-line pipe drawing?

UNIT 5

KEY TERMS

balloon construction
frost line

After studying this unit, the student should be able to:

Describe the reason for various construction practices.
Identify the names of construction members.
Define the parts of a building's construction.

Much has been learned about making buildings that will be safe, dry, and warm, Figure 5–1. Many years ago it was felt that the proper home had to be constructed only from stone or masonry. Of course, vacation or summer houses and peasant cottages might be of rough log or sawn lumber construction. But, a real home was usually made with stone walls. The stone was very solid and safe but lent itself to a damp, cold interior environment in winter months. Modern frame-type construction was a result of a scarcity of craftsmen and materials. It was originally thought that frame construction would have a short life span. It had the advantage, however, of being inexpensive and quick. It has been discovered that, with the proper building practice, this type of home will last indefinitely. Indeed, many homes built before this country was called the United States of America are still in use

BUILDING CONSTRUCTION

OBJECTIVES

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RESIDENTIAL CONSTRUCTION PRACTICES

Figure 5–1

today. The term was given to this construction method early in the country's development. This was a disparaging term used to describe the speed with which a house of this type could be built. While some still refer to all frame construction as balloon construction, strictly speaking, the term only applies when the corner posts of the building run from the base of the first floor to the roof line. Many barns are built in this manner, Figure 5–2.

It has been discovered through trial and error over many years that a building, if it is to last, must have a solid foundation that will not heave or shift. Many soil types will shift when damp. All soil types will heave when frozen. The power of freezing water to expand is considered limitless by some authorities. To avoid the problems associated with freezing and shifting soil, building codes specify that foundations must extend down below the frost line. The is the depth below the surface to which the soil can be expected to freeze in winter, Figure 5–3. On deep shifting type soils, many times the only acceptable foundation is the floating type. This means that the foundation will be a solid, poured concrete pad upon which the house is built.

For the house to have a firm foundation, the soft upper soil is removed. This layer must be removed until (1) the depth is below the local frost line and (2) firm rock or undisturbed virgin subsoil has been reached. A concrete footing is then poured. The width of the footing is determined by the solidity of the soil at that point. A common ratio between the width of the footing and the width of the foundation wall is about 1 1/2 to 1. An 18-inch-wide footing

balloon construction

frost line

FOUNDATIONS

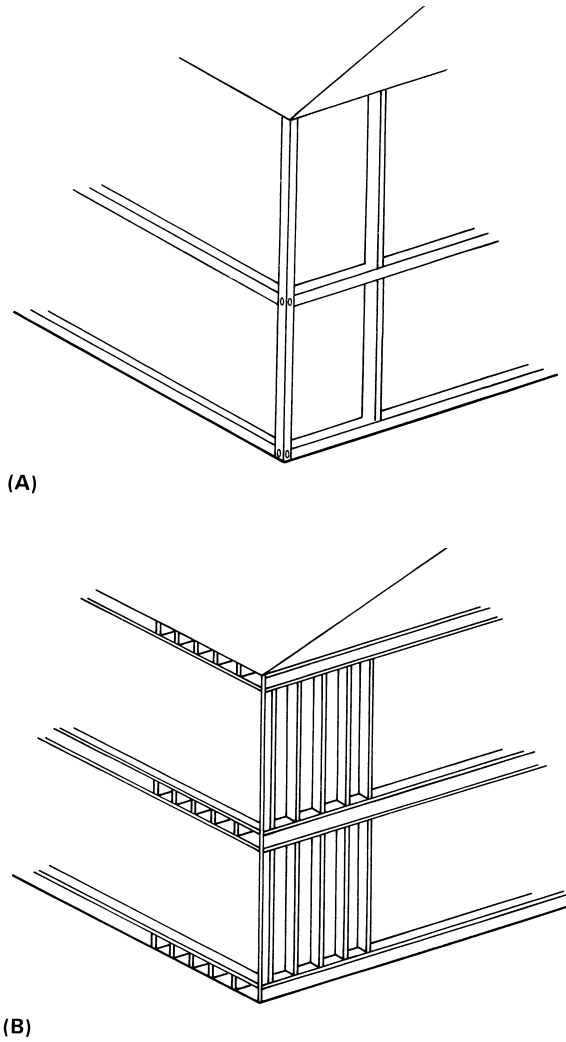


Figure 5–2 (A) Early balloon or barn construction, and (B) modern frame construction

might be used to support a 12-inch-wide foundation wall. The job of the footing is to distribute the weight of the house or building over a wider area. When installing pipelines, this footing should never be disturbed. If a pipeline must be run under a footing, an absolute minimum of earth should be removed beneath the footing. Even though great care in the excavation may have been exercised when the original foundation trench was dug, some settling of the foundation usually takes place. Therefore, the pipe should be run inside an iron pipe. This *sleeve* should be two pipe sizes larger than the line being run, Figure 5–4. The same sleeve arrangement should be used when running through a foundation wall. The pipe should be sealed inside of the sleeve with bituminous compound or a similar material. Remember that it is a responsibility of the tradesman that *the building will be as strong after any installation as it was before.*

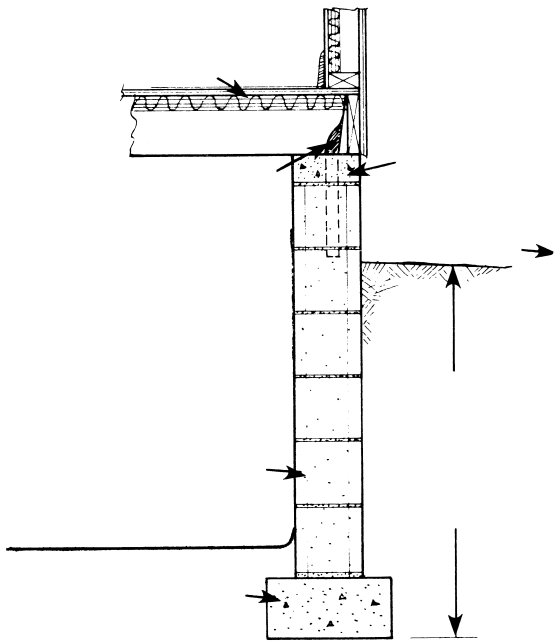
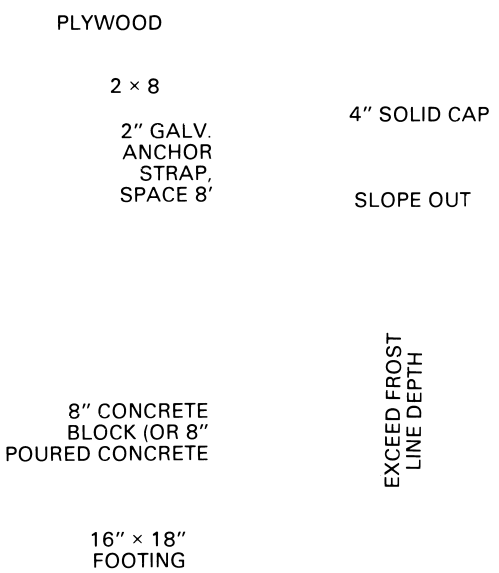


Figure 5–3



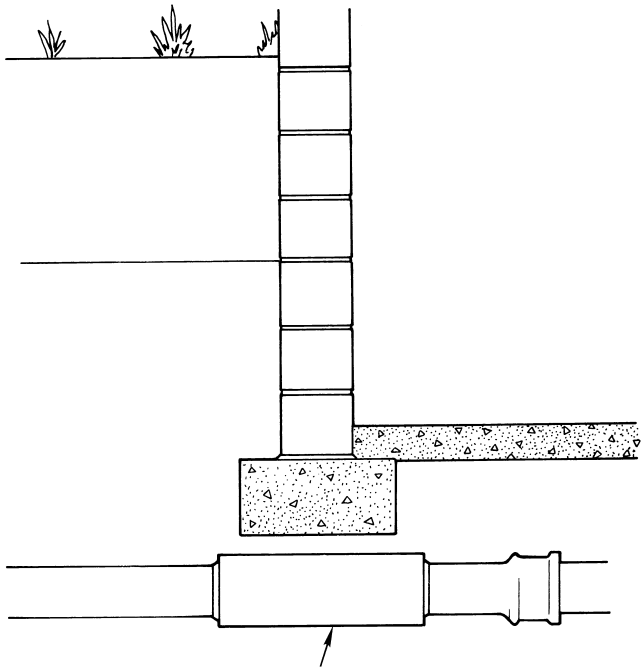


Figure 5–4

If a slab of concrete is poured for the weight of the house to rest upon, the weight of the house is distributed over a very large area. The system works well over soft soil types. The homeowner, of course, must live without a cellar. This type of foundation presents its own problems for the plumber. The main house drain and its branches must be installed and inspected before the slab is poured, Figure 5–5. Many times, water supply lines and even heat-circulating lines must be installed beneath the concrete foundation slab. These pipes will be very difficult to get to in the future. Therefore, the plumber must pay close attention to the following considerations:

Is the material of high enough quality to last for the life of the building?

Are the rough-in measurements exactly right? There can be no adjustment after the slab is poured.

Will the various joint materials withstand the lime that will leach from the concrete?

Are the pipes touching any of the steel-reinforcing rods in the concrete? Remember, dissimilar materials will cause electrolysis, which will corrode the pipes.

Are there enough cleanouts? Are they properly placed?

FROST LINE 36″
IN PENNSYLVANIA

IRON PIPE SLEEVE 2 SIZES
LARGER THAN DRAIN

THE PAD OR SLAB FOUNDATION

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- ❑
- ❑
- ❑
- ❑

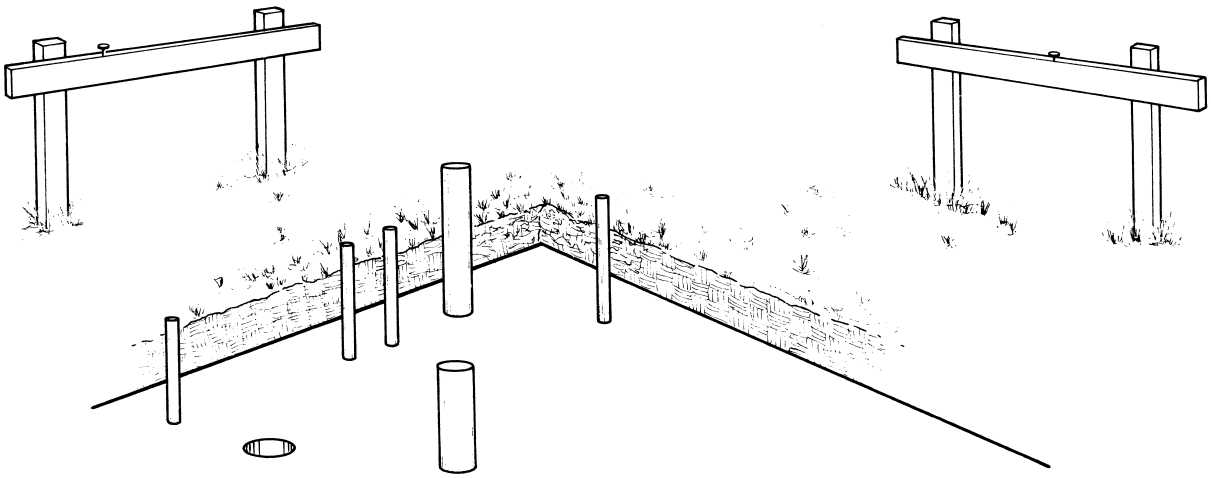


Figure 5–5

The student should examine the drawings carefully. In this manner, he/she will become familiar with the names of the parts of the construction. There are many names for the various members of a building, Figure 5–6. A few commonly used names that the plumber should be familiar with are presented here.

The finish of a room where the wall joins the floor.

Pieces of wood fitted between each joist to keep them from twisting.

The equivalent of a board 1 foot square and 1 inch thick.

The trimming around a door or window opening.

An artificial building material consisting of sand, cement, gravel, broken stone or other aggregate, and enough water to cause the cement to set.

Pipes that carry rainwater from the roof to the ground.

This is where the rain gutter is fastened.

This is usually a soft metal strip used to seal the roof from rain. Plumbers place a roof flashing on their vent pipes where they go through the roof.

This is usually a temporary plywood structure in which the concrete is poured to form the footing and foundation walls.

The rough wooden structure of the house.

Thin wooden strips often used to make a wall thicker to accommodate pipes.

A short joist that supports the ends of other longer joists. Also, timber used across the top of a window or door to form a lintel.

Timbers that support the flooring and the ceiling materials.

This piece of timber goes from the joists in the attic floor to the rafters. It helps to support the roof.

This is most often a steel mesh that is laid over the studs to support the plaster in a wall. In older homes, this may be made from thin

DECKS, ROOF, AND FRAMING

Base:

Bridging:

Board Foot:

Casing:

Concrete:

Conductor:

Fascia Board:

Flashing:

Form:

Framing:

Furring:

Header:

Joists:

Knee Brace:

Lath:

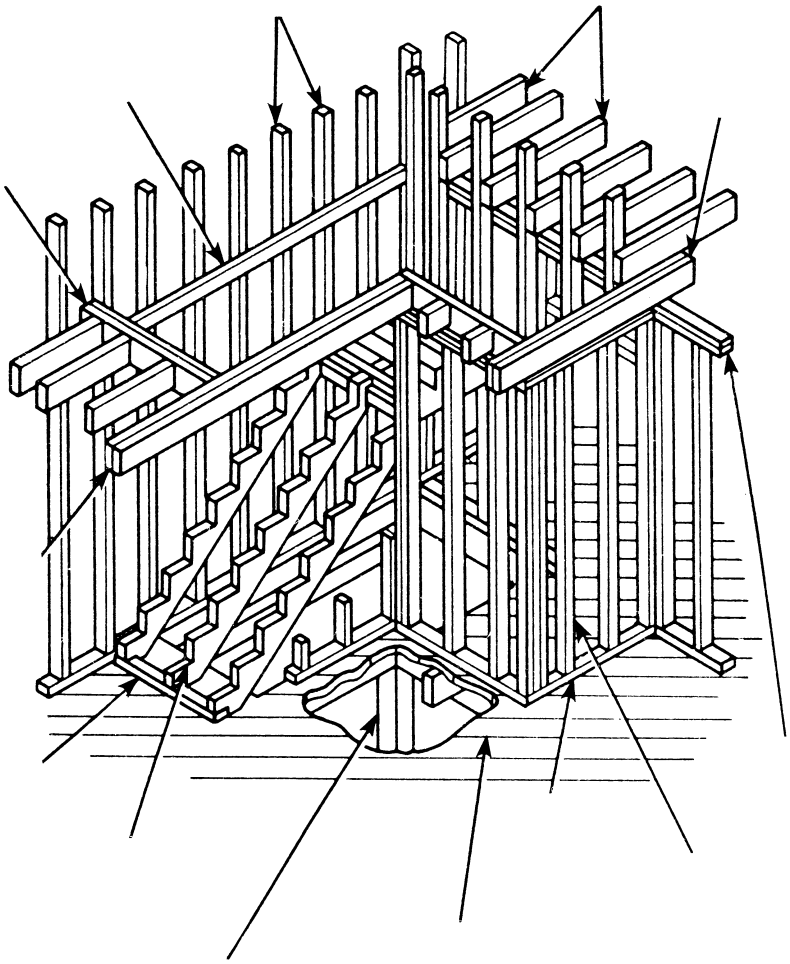
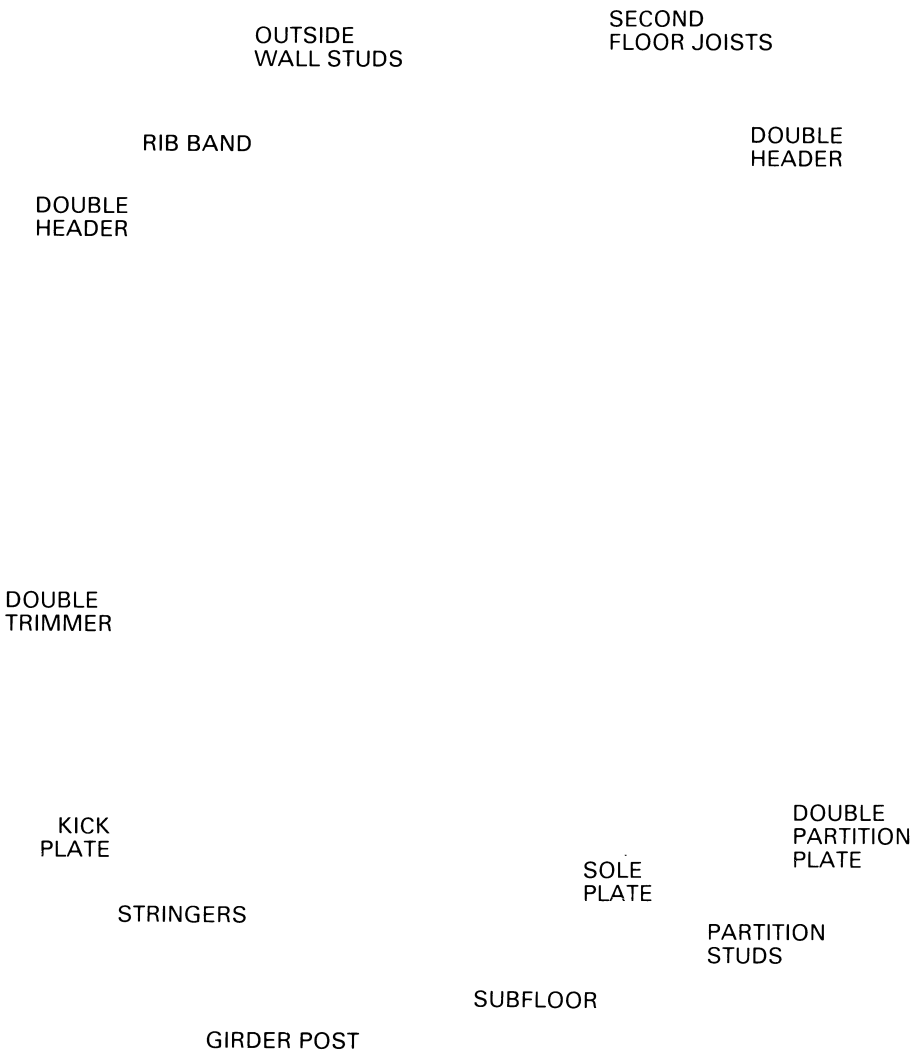


Figure 5–6



wood strips.

A horizontal timber fastened in place to provide a ledge. Some plumbers secure a ledgerboard to the studs in the bathroom wall to support the bathtub.

These are wood strips of various widths. They are used to give a finished appearance around doors, windows, and any rough joining.

Masonry supports.

Poles that are treated and driven into soft, swampy ground to provide a firm base for a footing.

A mixture of cement, sand, and lime used to cover walls.

This means on a vertical line.

These timbers support the roof.

A short piece of lumber used to splice or support two pieces of wood.

A temporary platform erected to work at heights.

Any material used as a covering over wall studs. Sheathing is also placed over rafters to provide a base for roofing material.

These are horizontal timbers that support the framing above.

These are vertical timbers used to form walls and partitions.

This is nailed directly to the joists. The finished flooring is laid on top of this.

These are a few of many terms that the student will have to become familiar with to function in the residential plumbing trade.

Ledgerboard:

Molding:

Piers:
Piles:

Plaster:

Plumb:
Rafters:

Scab:

Scaffold or Staging:

Sheathing:

Sills:

Studs:

Subfloor:

Test Your Knowledge

1. Houses using frame-type construction use _____ as a primary building material.

2. Balloon construction was an early derogatory term for _____ _____.

3. Barn construction can be distinguished from modern frame construction by _____.

4. Foundations prevent buildings from settling in soft soil and _____ when the soil freezes.

5. Because a wider base gives greater support, a _____ is at least one and a half times as thick as the stone, block, or concrete wall it supports.

6. To prevent frost heave, a footing must be deeper than the local _____ _____.

7. Pipes running through foundation walls or under footings must be protected by a/an _____ two pipe sizes larger than the pipe.

8. To distribute the weight of a house evenly over a large area in soft soil, a concrete ____ may be used as a foundation.

UNIT 6

KEY TERMS

bid
elevation
front elevation
plan view
scale

After studying this unit, the student should be able to:

Explain the different kinds of drawings.
Visualize the completed building.
Find architects' specifications.
Make pipe sketches from building plans.
Describe the material requirements from a blueprint.

Any building craftsman must be able to read blueprints. Much of the information necessary to accomplish the job must be gleaned from sketches or blueprints. As is often the case, the plumber may find that the only direction that the draftsman has supplied for the plumber is the location of fixtures and equipment. It is left up to the plumber to properly route and install the rough-in piping. The plumber may then take his or her copy of the drawings and sketch in

ELEMENTS OF BLUEPRINT READING

OBJECTIVES

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- ❑
- ❑

INTRODUCTION

pencil where the pipes must go. This might seem more simple than it really is.

Many young craftspeople are dismayed upon opening a blueprint and finding so much information there. Many times their first impression is that they will never be able to read blueprints. It takes time to understand a building drawing. It takes careful inspection and study to get all of the information necessary to do the plumbing in a house. To make quick judgments about the placement and routing of piping can be disastrous. A particular wall may be too narrow to contain the proposed vent line. Or perhaps there will be insufficient fall if a pipe is run in the wrong location. Blueprint reading requires great concentration and methodical search methods.

The plumber needs to know a lot about the construction of the building so that he or she can plan the kinds of installations that would be appropriate. Some questions that the plumber would have in mind are as follows:

How much space is in the walls?
What are the construction materials?
How is the building situated on the site?
How thick will the wall and floor covering materials be?
Where will the fixtures and equipment be located?
In which direction do the joists run?
Where will the service piping be located?

These are just a few of the questions that need answering. The blueprint can answer many of these questions for the person who can read it. Reading drawings is not difficult, but it takes a good deal of patience.

Throughout this unit we will be using some terms that may be unfamiliar. For the sake of clarity, we will define some of them now.

The drawings, or the blueprints, for the building. This includes a number of sheets of plans and elevations.

At one time, blueprints were actually white lines on a blue background or blue lines on a white background. The copying machines that turned the draftsman's inked drawings into "blueprints" were responsible for this. Now, "blueprints" can also be black or white or any combination. Any formal drawing made to build or manufacture a product can be called a blueprint.

A structure designed or sales, rental, or manufacture of a product. A building meant to provide office or warehousing space. An apartment building or condominium. In other words, a building to either house a business or to provide a service to the public.

An area of the drawing set aside to make a part of the main drawing more clear. It is usually enlarged and shown from a different angle.

This is a portion of the drawing that shows a vertical surface of the building.

Notes are distributed throughout the drawing. They often contain vital information for the craftsman.

Technically, a plan shows a horizontal surface of the building, for instance, a floor plan. However, the term "plans" is often used to refer to all of the architectural drawings.

The place where people live. An apartment house could answer this description. But the term"residentia" when referring to blueprints usually designates a one- or two-family home.

These are small but formal drawings of fixture layouts. They are provided by the manufacturer of the fixture. They show the craftsman all of the essential measurements that are needed to install the pipelines prior to the arrival of the fixtures themselves.

Blueprint:

Commercial Building:

Detail:

Elevation Views:

Notes:

Plan Views:

Residence:

Rough-in Sheets:

❑
❑
❑
❑

❑

❑
❑

Architectural Drawing:

This is a ratio between the size of the drawing and the size of the building. A scale of 1/8″ = 1′-0″ means that a distance of 1/8 inch on the drawing is equal to 1 foot in the actual building.

One of a number of charts placed on the drawing to display information about materials or design loads to make this information easily available.

This is a detailed drawing as in "cross-section." A portion of the main drawing is "sliced" and then turned at a 90-degree angle to make its construction clearer.

Usually these are found in a separate report that is meant to accompany the drawings. They provide detailed information about materials, requirements, and workmanship. The specifications, applicable codes, and the blueprints provide the basis for the contract between the builder or owner and the tradesman. Specifications can also be found on some drawings under "General Notes."

These are all of the plans and elevation sheets that make up the "blueprint."

The specifications and the blueprints form the basis upon which estimates or job bids are made. If the tradesman overlooks a specification, he or she may very well be called upon to correct the job to conform to specifications out of his or her own pocket. Careless reading of the blueprints can also create problems. The plumber must make a materials list by looking at a blueprint that may not have the actual piping drawn on it. From this list and his or her experience with time requirements for different plumbing jobs, the plumber comes up with a

This is submitted to the builder or general contractor with bids from other plumbers. The plumber who submits the lowest bid price and who will also conform to specifications will usually get the job. If the plumber submits a bid that is too high he or she will not get the job. If on the other hand the bid is too low, he or she will get the job but will not make a profit or perhaps even lose money. Errors of blueprint reading are almost always costly.

Plumbers must submit drawings to the inspecting authority. Many architectural drawings do not have the piping systems indicated. Therefore, the plumber is called upon to do the drawings. Drawings must also be provided for the craftsmen who are to work on the job. There are computer programs available to aid in the production of accurate drawings. Advantages of using computer-aided drafting programs include:

Neat, clean drawings.
Information to produce a drawing is stored on a magnetic disk. Therefore, a fresh unmarked drawing can be produced quickly and easily.
Changes are automated by the program and are easily accomplished.

To visualize something, so far as the craftsman is concerned, is to understand enough about an object or a design to make an exact copy; in other words, to know everything about it structurally. Listening to a spoken description of a plumbing job will only do for the smallest projects. Having an accurate drawing gives us more information about an object or a building than if we had the object or building before us.

To properly visualize a building, some skills must be learned. First, let us define two terms: vertical and horizontal. A vertical line goes up and down. A wall is constructed on a vertical

Scale:

Schedule:

Section:

Specifications:

❑
❑

Working Drawings: ❑

VISUALIZATION

bid.

plane. Horizontal is parallel to the earth's surface. A floor is constructed on a horizontal plane. When you are examining a you are looking at a drawing of something that lies mostly horizontally. Looking down at a roof or a floor drawing would be looking at a plan view. are drawings of objects in a mostly vertical plane. Looking at a drawing of the front wall of a house might be described as looking at the Drawings of buildings are composed of plans, elevations, and details.

A sketch is an informal drawing often made directly onto the blueprint using a 6-foot folding rule as a straightedge. Or if more than this is needed, a piece of tracing paper might be placed over the blueprint and a penciled sketch made on that. The drawing on the tracing paper can then be copied on common office duplicating equipment. Often, a sketch is not more than a line drawing on a paper bag. While the proportion and the angles of a sketch may be incorrect, the measurements indicated must be as accurate as possible.

Building plans are generally drawn in what is called *orthographic projection.* This kind of drawing shows plans and elevations in separate views in the manner that has been presented here. There is another type of drawing called *isometric projection.* This type distorts the angles of the object in order to show three views in one drawing. The isometric drawing, while being harder to draw, is generally much easier to visualize. Complex drawings will show more detail if done in orthographic projection.

Essential tools needed for doing presentable drawings are not very complicated or expensive. Some basic drawing tools are:

1. Straightedge. This can be a 12-inch rule. In this way it can serve two purposes: to measure on the drawing and to draw straight lines.
2. Pencils. A couple of pencils of different softness.
3. Triangles. 30, 60, 90 triangles and a 45, 45, 90 triangle.
4. Tee square, for drawing parallel lines.
5. Large, soft eraser for erasing and cleaning the drawing.
6. Erasing shield. So that lines that are to remain are not inadvertently erased.
7. Scaling ruler or architect's rule.
8. Pencil sharpener.
9. Drawing compass, for drawing circles.
10. Protractor, for laying out angles.

Isometric projection, Figure 6–1, is used widely for schematically showing small piping areas and also for large systems. Many plumbing inspectors ask for an isometric sketch before issuing the plumbing permit. As has been noted, three views of an area can be shown with one isometric drawing. When making isometric drawings, the student should keep in mind lines that are actually vertical are drawn vertically. However, *every* horizontal line on the object or in the space being drawn is going to be on a 30-degree angle from the true horizontal of the drawing. This includes imaginary lines like extension lines; dimension lines; lettering lines; x's, which denote wall or floor penetrations, and any other line that would be horizontal as we visualize our drawing. A little thought will show that horizontal lines from any corner of the room can run in two directions that are at 90 degrees to each other. On the drawing this will be shown as slanting the 30-degree line up from

plan view,

Elevations

front elevation.

SKETCHING

DRAWING

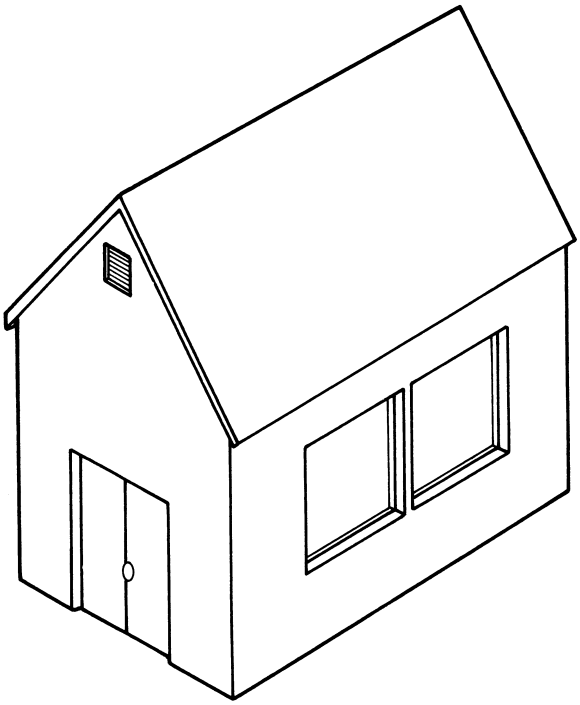


Figure 6–1 An isometric drawing

the left or up from the right, depending on whether the line is running east and west or north and south.

A handy way to start an isometric drawing is to start with an inverted "Y" figure. The stem of the "Y" should be vertical and the two branches should be drawn 30 degrees from the horizontal in two directions. Now when making the drawing over this figure *all* horizontal and vertical lines should be parallel to one of these lines. It helps to draw the x's denoting pipe going through a wall or a floor before drawing the actual pipe line.

When the term is used in blueprint reading, it is a reference to the size of the drawing compared to the size of the object or building, which the drawing represents. While scale can be expressed as a ratio, i.e., 1:12, on architectural drawings, this would be described as 1″ = 1′-0″. The reader of this blueprint would then know that an actual measured distance on the drawing of 1 inch would be equal to 1 foot or 12 inches in the building. The dimensions or measurements that are written on the drawing are measurements of the actual building. When necessary dimensions are not on the drawing, the reader can calculate the distance that would be in the actual building by placing a rule or tape measure on the drawing itself. A *scaling rule* or *architect's scale* is marked in such a way that when it is placed on the drawing the scale will indicate actual building dimensions.

Building plans are given in a number of sheets. Ordinarily, each *view* is placed on a sheet by itself. There will usually be floor plans for each story of the building, and at least one front elevation and one side elevation. The side of the building facing the street is usually given the designation When a right side or a left side elevation is given, the reader must imagine standing at the front of the house. Then, if he or she walked to the right side of the building and faced that wall, he or she would be looking at the right elevation. Three views are the minimum number in orthographic projection drawings to safely indicate all necessary measurements. The student should take note that at

SCALE

scale

VIEWS

front elevation.

least three dimensions are required to locate any given point. These are:

Above or below a reference point that may be the earth's surface or the floor level of the space being worked in or even down from the ceiling.

This could be represented by the directions east and west or north and south.

This could also be represented by the directions east and west or north and south. However, if side to side is east and west, this must be north and south. Or, if side to side is north and south, this must be east and west.

The student should also take note that all of these directions are at right angles, or at 90-degree angles, to each other. When making a sketch, a question should be constantly asked: "Have I indicated the location of this point in three directions?"

Some line symbols used in drafting are:

This is used to indicate the center of an object.

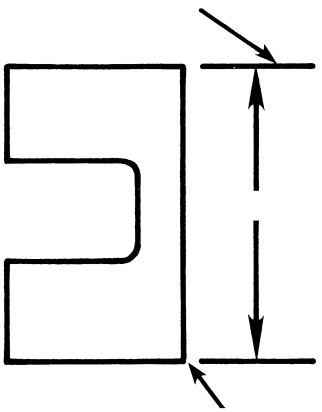
This indicates that the line cannot be seen from the vantage point taken but is behind the surface.

This indicates where the drawing has been cut in order to show a detail.

This indicates that the object is longer than what the drawing shows. The part between the break lines has been removed to make the drawing clearer.

This indicates a measurement of the object. It is understood that the measurement is from the point of the arrow at one end to the point of the arrow at the other end.

When it is impossible or inconvenient to have the dimension arrow terminate at a line representing the outline of the object drawn, the draftsman will draw a witness or extension line as an imaginary extension of the outline. The arrow may terminate at this line. There must always be a space between the end of this extension line and the object to demonstrate that it is not a part of the object.

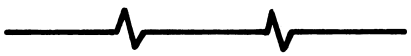


Up and Down:

Side to Side:

Nearer and Farther:

Break line:



Dimension line:

1-11/16″

Extension or witness line:

SYMBOLS

EXTENSION LINE

Centerline:

Hidden line:

4-1/4″

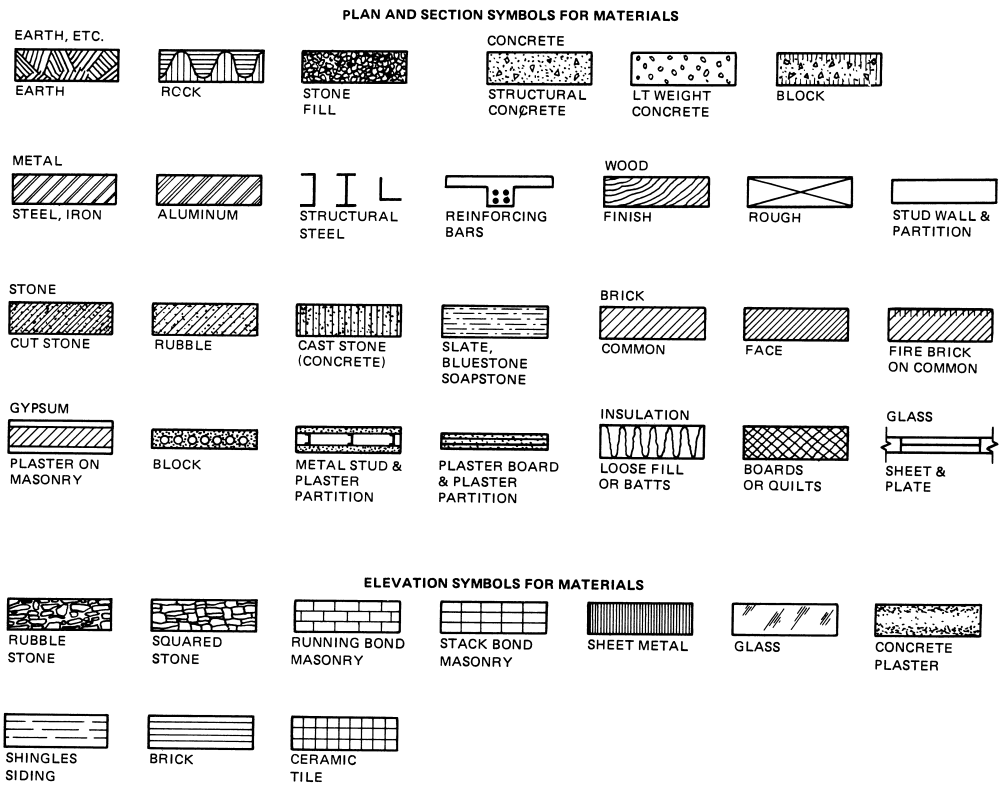
Cutting plane line:

SPACE

Because it is understood that the dimension indicated is always from the point of one arrow to the point of another arrow, dimensions can be indicated in a number of ways.

Because all notes on the blueprint as well as the architect's specifications are a part of the contract, the plumber must have a firm understanding of the requirements as well as the applicable plumbing code before making the materials list. As the *take-off sheets*, or materials list, are prepared, constant reference to the specifications and codes and blueprints may need to take place. Every wall or floor that is to be penetrated by pipe or is to support pipe must be completely understood. When a trench is to be dug, the question must be asked: "How deep?" Is the grade line, or the surface of the ground, in evidence going to be the finished grade line? Will there be danger of the pipes freezing? The answers to these questions and similar questions about every line of pipe in the installation can be found on a properly prepared set of architectural drawings.

ARCHITECTURAL SYMBOLS



DIMENSIONS

GETTING INFORMATION

ELECTRICAL SYMBOLS

SWITCH OUTLETS
S - SINGLE POLE SWITCH
S_2 - DOUBLE POLE SWITCH
S_3 - THREE WAY SWITCH
S_4 - FOUR WAY SWITCH
S_D - AUTOMATIC DOOR SWITCH
Scb - CIRCUIT BREAKER

CONVENIENCE OUTLETS
DUPLEX OUTLET
WP WEATHERPROOF
RANGE OUTLET
SPECIAL PURPOSE

LIGHTING PANEL
POWER PANEL
T POWER TRANSFORMER
PUSH BUTTON
TELEPHONE

GENERAL OUTLETS
CEILING WALL
OUTLET DROP CORD
D
S PULL SWITCH
J JUNCTION BOX

HVAC SYMBOLS

EXPOSED RADIATOR
RECESSED RADIATOR
THERMOSTAT T
THERMOSTATIC TRAP

THERMOMETER OR
PRESSURE GAUGE
RELIEF VALVE

FLOAT TRAP F
BOILER RETURN TRAP
REDUCING PRESSURE VALVE
AUTOMATIC AIR VENT

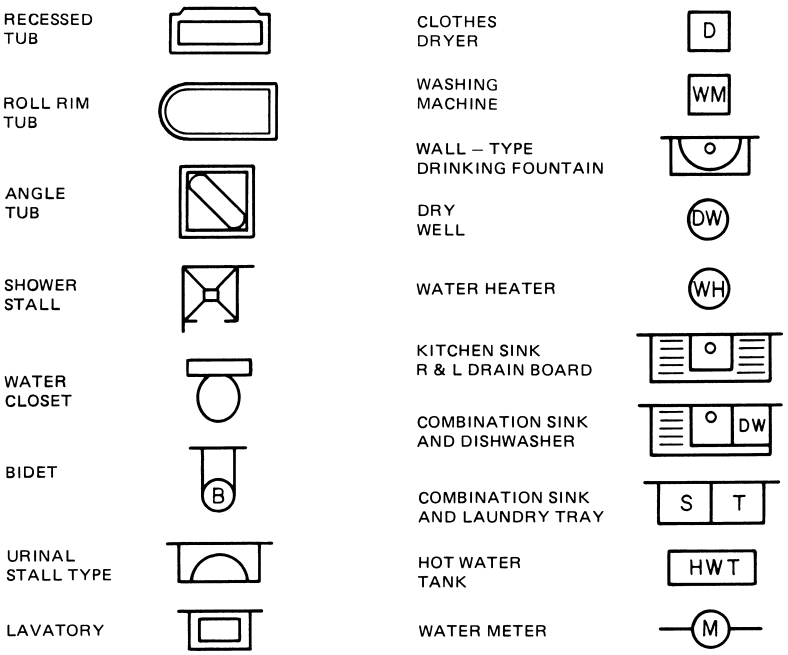
PIPING SYMBOLS

VENT
COLD WATER
HOT WATER
HOT WATER RETURN
SOIL OR WASTE (ABOVE GRADE)
SOIL OR WASTE (BELOW GRADE)

PIPE FITTING SYMBOLS

VALVE
HOSE BIBB HB
90° ELBOW
45° ELBOW
TEE
CLEANOUT CO
FLOOR DRAIN FD

PLUMBING FIXTURE SYMBOLS



Blueprints, or architectural drawings, can be intimidating. At first glance, there is a welter of information. Occasionally, the plumbing and pipefitting are only partially illustrated, and from experience, the craftsperson is expected to deduce a great amount of information. It is not unusual that the "plans" are drawings representing a "typical" home or a particular building and the actual layout of the services must adapt to the local building site and conditions.

The apprentice is advised to borrow a set of plans and to take them home after work. Follow out a single system on the plans. Starting with the lowest plan view that shows your system of choice (usually the basement), for example, choose the soil pipe. Determine where the terminal ends are on the particular plan view that you are following, then determine where the pipe becomes vertical to accommodate the next higher story. Go to the next higher plan view, perhaps the first floor plan view, and do the same thing. Do not be distracted by the large amount of information shown; simply follow the system that you have elected to learn. Occasionally, you will discover that the pipelines increase in number as the floors get higher in elevation. This is because they branch out in the vertical spaces between the floors or stories. This can be seen on the plan views but sometimes the elevation views show it better. When you have located the terminal ends, you might go back and look at the elevations anyway to discover how and where branching occurred.

Locate the notes, schedule, and specification areas to discover the materials that should be used on this system. If you are patient and trace out one system at a time, you will learn how to read blueprints quickly as well as learn much about plumbing.

SUMMARY

Test Your Knowledge

1. What blueprint views correspond to the mechanical drawing top, front, and side?

2. What kind of projection is used to make a traditional set of building blueprints?

3. How many dimensions are needed to locate anything in a building?

4. Can you name three different kinds of invisible lines?

5. The relationship between lengths on the drawing and lengths in the actual building is known as _____.

6. What drawing in the packet of blueprints would you first check to find the dimensions of the home's front entryway?

7. Name a kind of drawing that can show all of the required dimensions in a single view.

8. Architectural drawings are also called _____.