1

Tool Fundamentals

Drafting tools should be treated with meticulous care, with the goal of making them last a lifetime. Always purchase the best quality that you can afford. These tools are a necessity for clarity of graphical expression.

The intent of this chapter is to show the variety of instruments that are available and how to use them properly.

The following are some of the important skills, terms, and concepts you will learn:

How to use a drafting pencil
How to use drafting instruments
How to use different kinds of scales
How to set up a workstation

Contour lines
Contour intervals

Tool Fundamentals

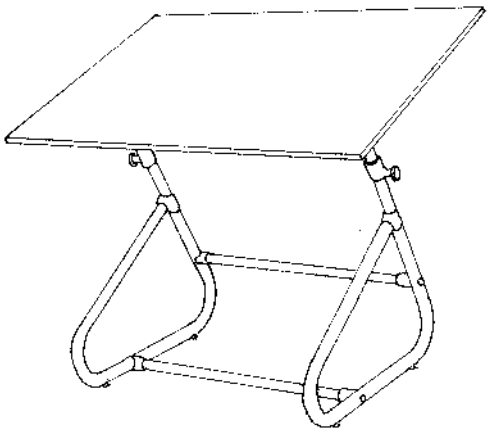
TOPIC: SCALES

Orr 1995.

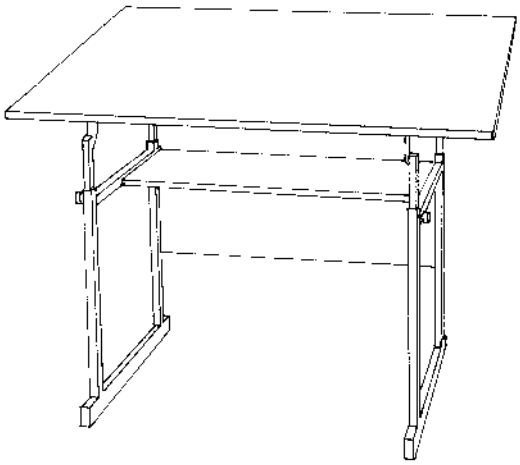
Adler 2000.

Chapter Overview

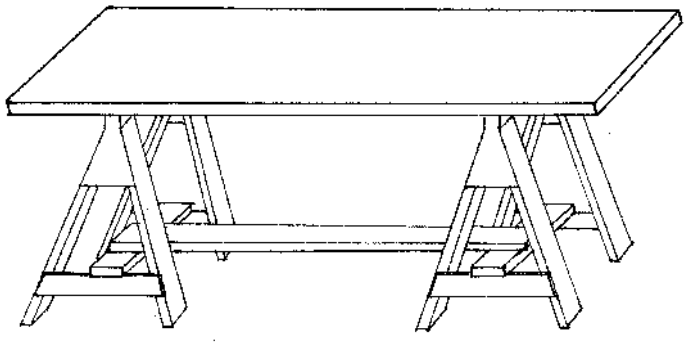
By studying this chapter and doing the related exercises in the book's final section, you will learn how to use drafting equipment; how to measure with architects', engineers', and metric scales; and the meaning of contour lines.



A **metal drafting stand** is characterized by an adjustable tabletop, which can be fitted with a parallel straightedge (see p. 14).



A **four-post table** has an adjustable whiteboard surface that can be moved to any comfortable work angle. It can function as a drafting table, computer workstation, or a reference table.



An economical **homemade table** can be made using a flush hollow core door placed on top of two metal or wooden sawhorses.

Types of Drawing Table or Drawing Board Covers

Vyco is a five-ply vinyl **drawing table or board cover** that counteracts eye strain and self-heals when dented, scratched, or punctured. The cover softens the lead when you draw. The two sides are either green and cream, gray and white, or translucent. Another option for a cover is an illustration board that is hot press, white, heavy, and dense. Board covers can be kept like new with special board cleaners that can do double duty as drafting-instrument cleaners. Remember never to draw on hard surfaces such as glass, wood, or hard plastic.

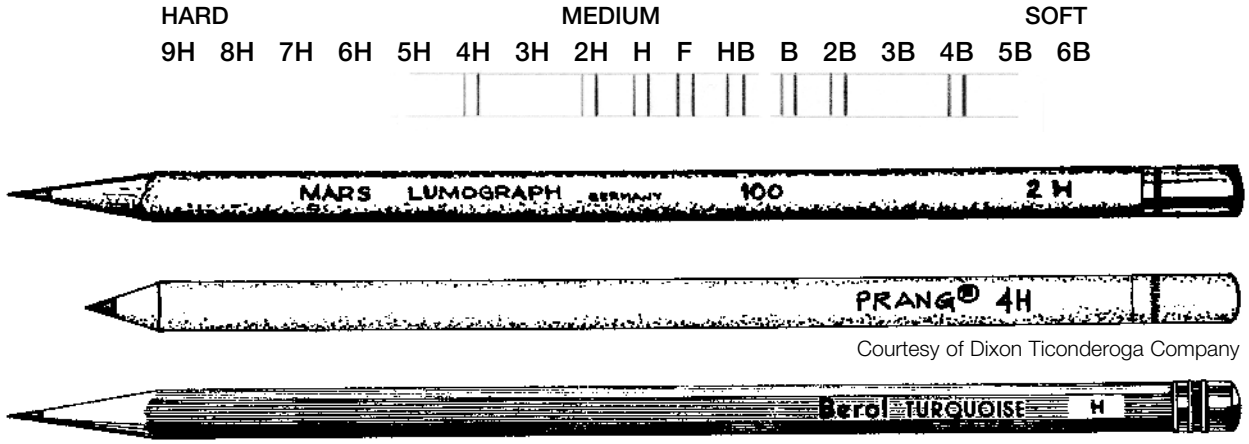
There are many different types of **drawing boards.** They can have a metal edge with a laminate surface and solid-core construction; a hard, smooth surface that resists chemicals, stains, and scratches; or a basswood surface on both sides with an ultralight weight core.

The technology for producing drawing tables, drawing boards, and table and board covers is continually changing—check art and drafting supply catalogs for the latest materials. Use the catalogs as a guide for important accessories, such as chairs, lamps, plan files, and Spiroll (a product that attaches to the front edge of the table or board, allowing drawings to be rolled for protection and providing more work room).

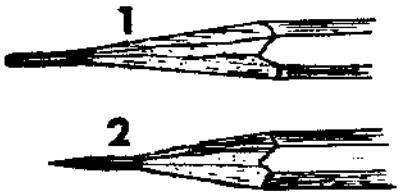
In an office setting, the preferred (and most common) arrangement is a large, flat surface (approximately 3' × 6'8") not more than 30" above the floor, although it can be higher in some offices. Pencils and pens tend to roll down a tilted work surface if you set them down while you're working.

GRAPHITE DRAFTING PENCILS

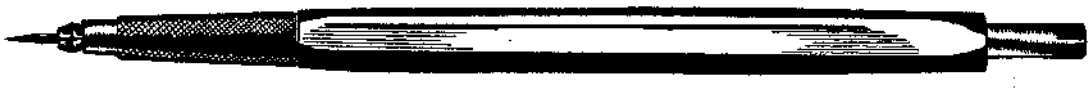
Cylindrical pencil leads range from the smallest diameter (hardest: 9H) to the largest diameter (softest: 6B). Architectural drawings (drafted or sketched) are produced by using leads in the grade range from 4H to 4B. Shown below are three equally good types of pencils that are commonly used. Try each one to determine which is most suitable for you.



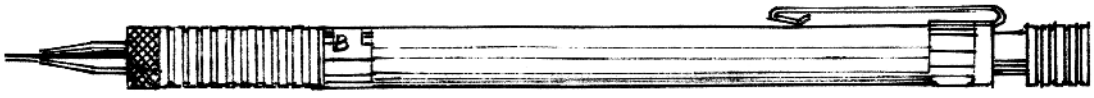
Courtesy of Dixon Ticonderoga Company



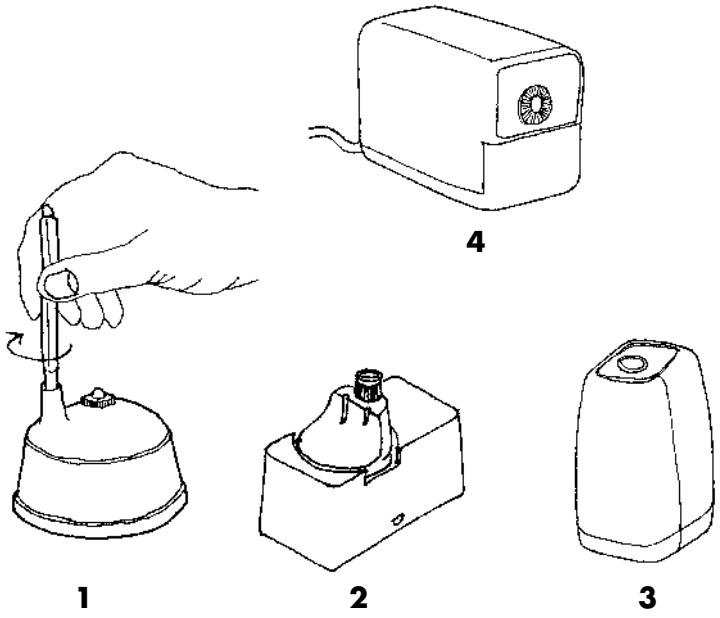
Graphite lead that contains carbon is adaptable enough to produce everything from a very thin line to heavily shaded tones. There are many good brands of **woodcase** graphite drawing pencils; three are shown above. H is the code for hardness and B is the code for softness (blackness). F and H are the most commonly used multipurpose grades of lead. The softer leads (B to 6B) are used primarily for freehand sketching; B is especially good for lettering. A woodcase pencil must be sharpened by first (**1**) cutting away the wood (exposing about ⅝" of the lead) with small, deliberate movements using a scalpel, mat knife, or razor blade, and then (**2**) making a conical point on a sandpaper pad. Clean the graphite from the lead with paper or cloth. Small handheld conical sharpeners are also available.



A mechanical leadholder or **clutch pencil** is shown above. It uses a standard-size 2-mm lead that can be drawn out or pulled back by the push-button on the end. Some variations include pocket clips and double-end holders. Leads in most tone qualities can be interchanged to suit drawing conditions. Use a pencil pointer to sharpen the leads to a taper similar to that on a common wood pencil.

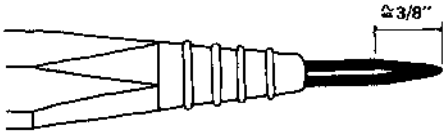


A **fine-line leadholder** with a push-button (propelling) lead advance is shown above. It uses a 0.3-mm to 0.9-mm lead (0.5 mm is a popular size). The lead is protected by a sliding sleeve. This type of pencil does not need to be sharpened. Lead sizes 0.7 mm and 0.9 mm can be used for sketching as well as drafting.



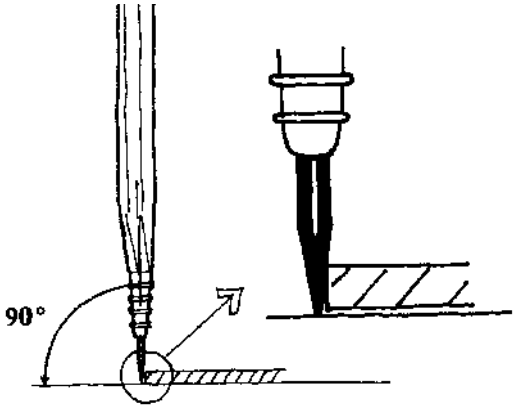
Avoid a taper that has a needle-sharp point; the point will easily chip.

Avoid an extremely dull point.



Strive to produce a **conical** point that is very slightly rounded at the tip. Achieve this by **rotating** the pencil when drawing lines.

To sharpen your lead to a conical point, use either (**1**) a sandpaper desktop pointer; (**2**) a cutting-wheel lead pointer; (**3**) a vertical electric pencil sharpener (a good brand is Panasonic); or (**4**) a Boston electric pencil sharpener. The more costly electric sharpeners are much faster. The sandpaper pointer works well with graphite lead but not with polyester lead. Use the sandpaper pointer by rotating your pencil-holding hand clockwise. The cutting-wheel pointer has one slot that creates a sharp point and one that creates a slightly dull point (for lettering). Very small handheld conical sharpeners are also available.

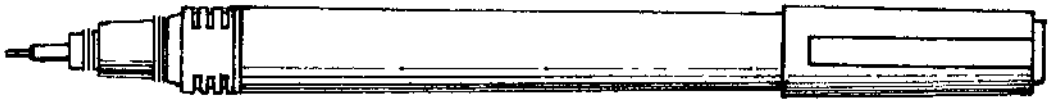


Always draw with a small space between the conical lead point and the straightedge (T-square, parallel bar, or triangle). This is best achieved by either keeping the pencil in a 90° vertical position or tilting the pencil toward you at a slight angle from the vertical. Never tilt it away from the straightedge. Horizontal, vertical, or oblique (slanted or angled) lines are best achieved by leaning the pencil at approximately 60° from the drawing surface. The pressure should be adequate to give a dark and crisp line.

A typical sandpaper block is shown above. It is a piece of wood with sandpaper sheets stapled to one end. Rotate the pencil and move it side-to-side to obtain a tapered, conical point. Apply minimal pressure to avoid snapping the lead. Also use this block to produce a tapered compass lead point (see p. 10).

A

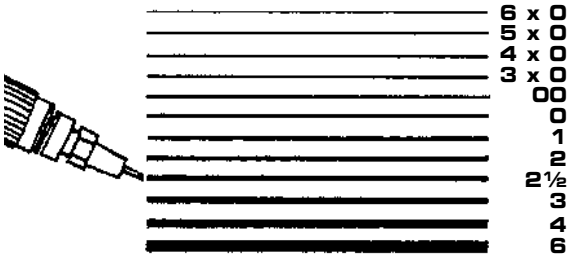
B



TECHNICAL PENS

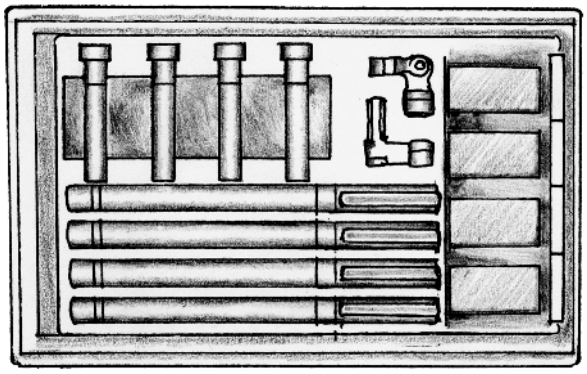
Technical pens are designed with a tubular point within which is a fine wire that controls the ink flow. The tubular point is long enough to clear the thicknesses of T-squares, parallel rules, and triangles. They provide excellent control, producing clear, even lines of constant width without requiring applied pressure. Koh-I-Noor's Rapidograph pens (**A**) are widely used. Koh-I-Noor's Rotring Rapidograph pens (**B**), with their prefilled ink cartridge, are virtually maintenance free. Pens are labeled by their point diameters. The most commonly used pen points are 000 through 4. A four-point set is a good, economical start (**C**); buy a larger set if it is affordable.

Use clog-free, waterproof drawing inks (**D**) that will not fade if exposed to light. Use Koh-I-Noor Liquid Eraser (**E**) for removing ink from drafting film (see p. 16). When not in use, store pens vertically, with the point tips up and the cap on.

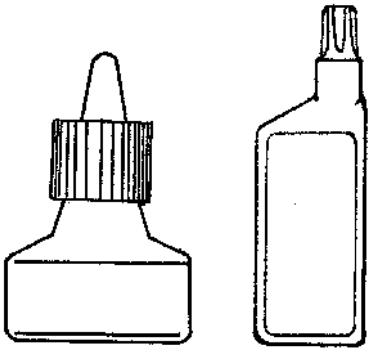


Some metric width equivalents:

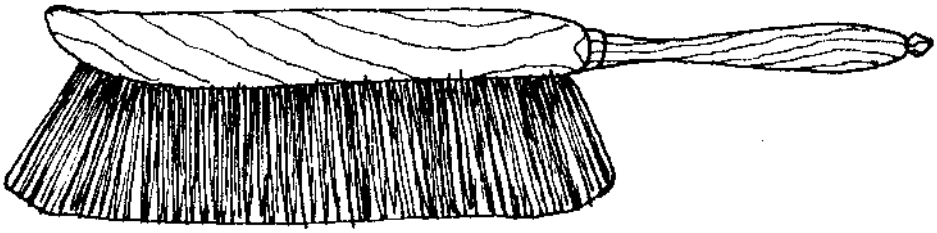
6 × 0	0.13 mm
4 × 0	0.18 mm
00	0.30 mm
0	0.35 mm
1	0.50 mm



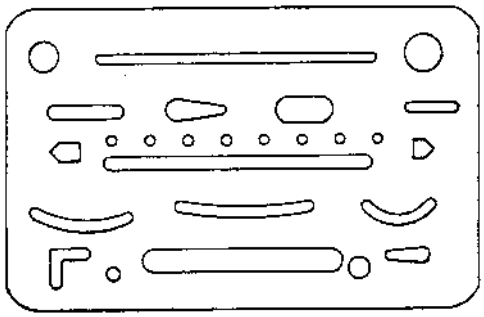
C



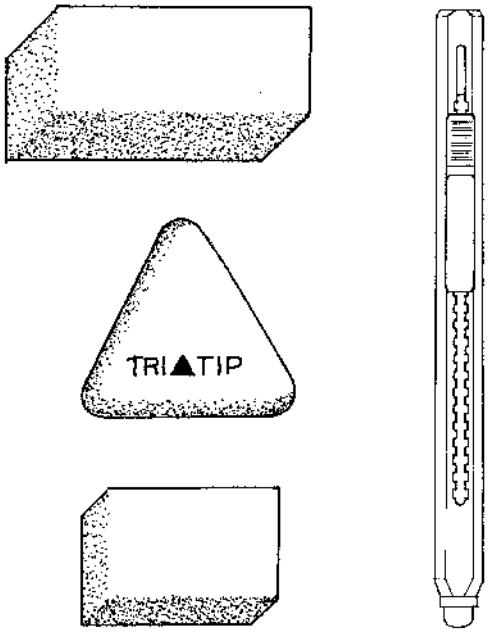
D E



A drafting **duster** with horsehair or natural bristle is used to keep the drawing surface clean of graphite and eraser residue. Quic-Kleen is a finely ground white powder that keeps a drafting surface free of smudges, dirt, and dust. Similarly, Pounce cleaning powder can be used to prepare a surface for inking.

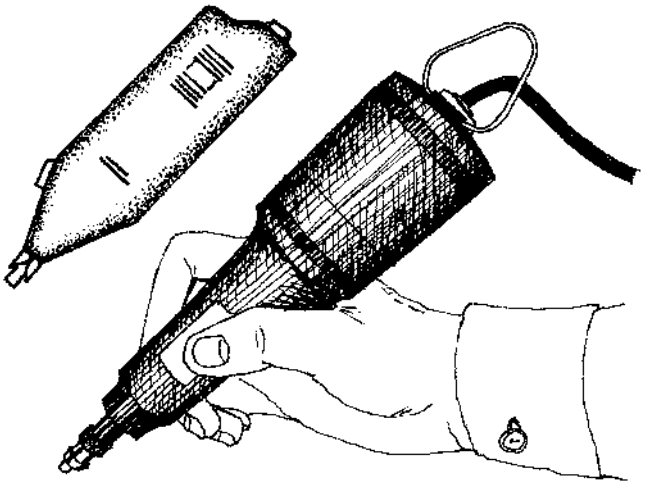


An **erasing shield** is a thin metal cover that protects drawn lines while erasing unwanted lines and areas with handheld or electric erasers. Not common—but more efficient—are those with rectilinear-cut openings.

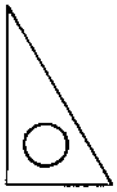


Soft vinyl or plastic **erasers** that are pliable and smudge free yield the best results. Staedtler Mars, Magic Rub, Koh-I-Noor, and Helix are some excellent brands.

General's Tri-Tip eraser is nonabrasive and an excellent tool when sketching with pastels or charcoal. Kneaded erasers are great for charcoal and are quite malleable. Radett's pencil-style stick/click eraser is most suitable for use with an erasing shield, as are electric erasers, which are sold both with cords and in cordless—or portable—varieties. Electric erasers are very effective for ink drawings. The portable ones are about 5½" long and use AA or AAA batteries.

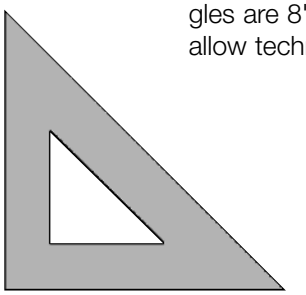


All of the small equipment mentioned in this chapter can be stored and transported efficiently in an art box or a fishing tackle box. Drawings (especially those on large sheets) should be transported using protective tubes, which can be purchased commercially.

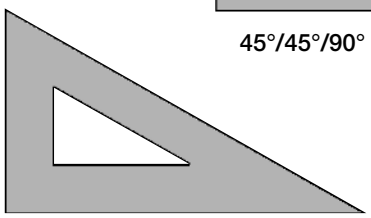


Small triangles (4") are ideal for producing vertical strokes for hand lettering and for producing cross-hatching.

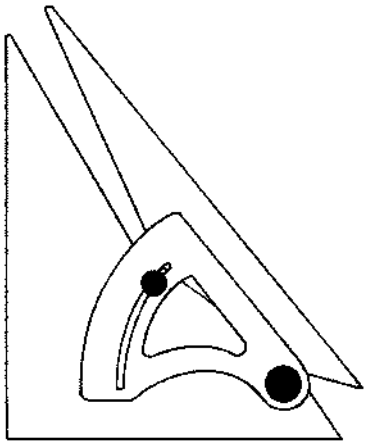
Plastic triangles come clear or fluorescent, with or without finger lifts. The most commonly used triangles are 8" to 10" in length. Some with raised edges allow technical pens to clear them for inking.

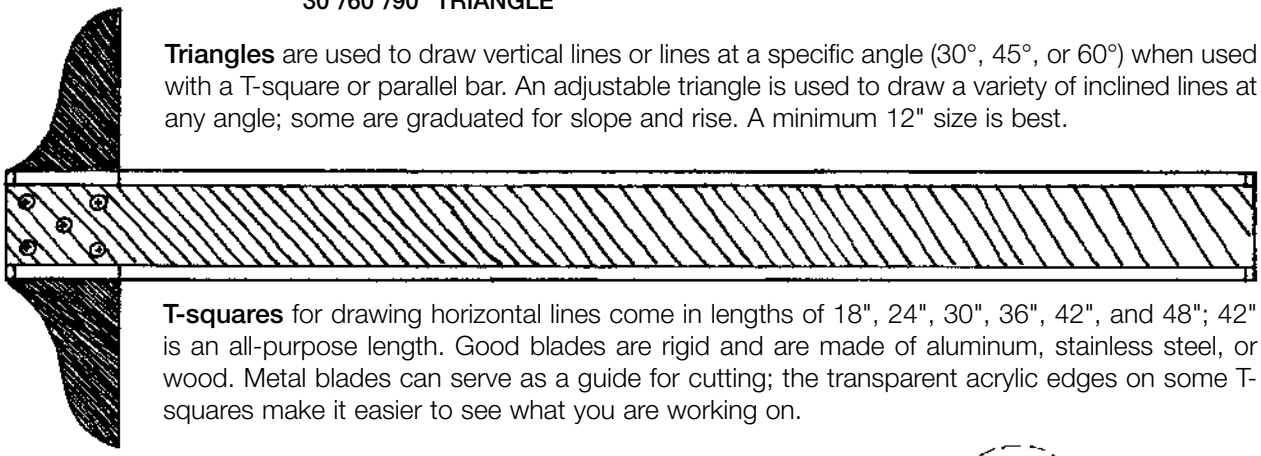


45°/45°/90° TRIANGLE



30°/60°/90° TRIANGLE

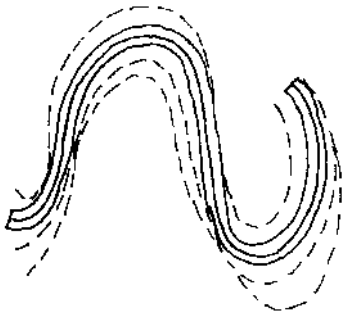




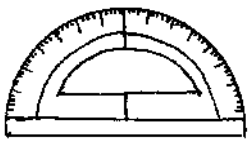
Triangles are used to draw vertical lines or lines at a specific angle (30°, 45°, or 60°) when used with a T-square or parallel bar. An adjustable triangle is used to draw a variety of inclined lines at any angle; some are graduated for slope and rise. A minimum 12" size is best.

T-squares for drawing horizontal lines come in lengths of 18", 24", 30", 36", 42", and 48"; 42" is an all-purpose length. Good blades are rigid and are made of aluminum, stainless steel, or wood. Metal blades can serve as a guide for cutting; the transparent acrylic edges on some T-squares make it easier to see what you are working on.

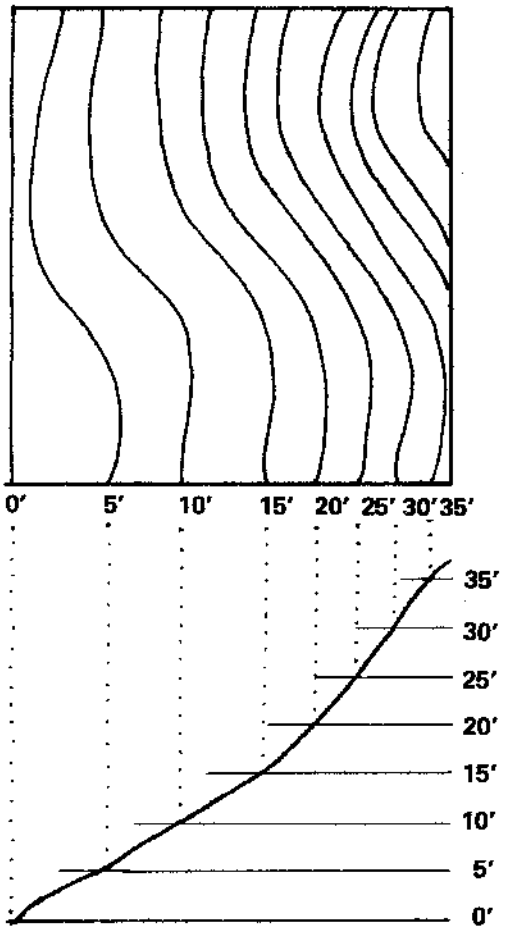
French curves are irregular curves that have no constant radii. Those made of clear, polished acrylic are best.



By shaping and bending it, a **flexible curve rule** can be used to draw almost any curve. The curve rule is made of plastic with a flexible core.



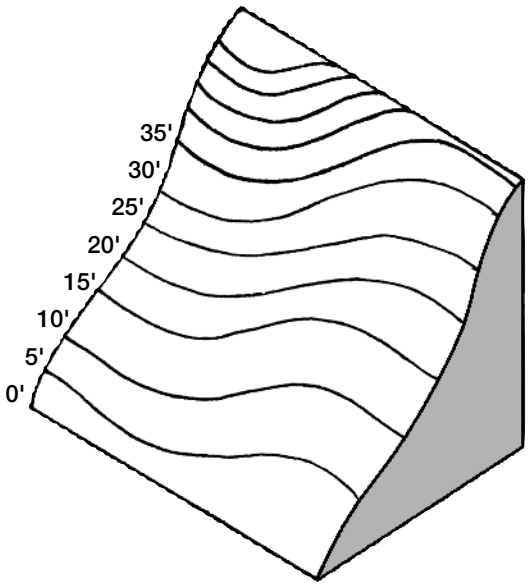
Protractors measure angles and can be either circular or semicircular.



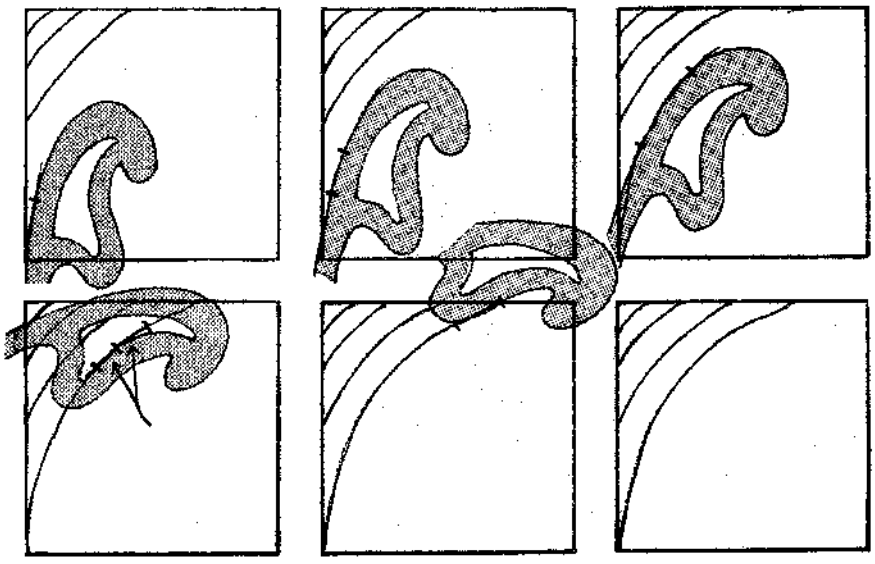
Contour lines are lines of constant elevation. Every point passes through the same elevation on the surface of the ground.

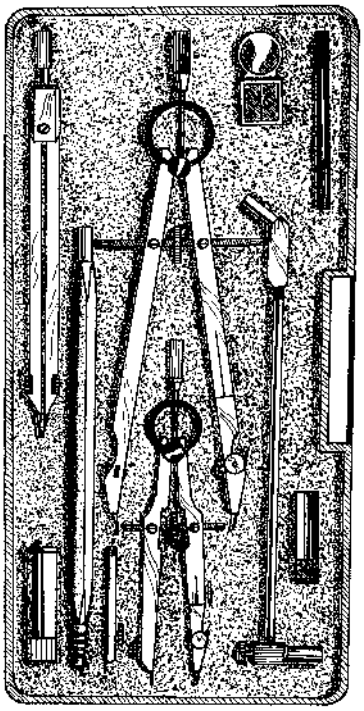
Contour intervals can be 1', 2', 5', or 10', depending on the conditions of the terrain and the size of the area being studied.

In the drawing on the left, note how the slope steepens when the contours become more closely spaced. It is less steep at the bottom since the spacing here is greater than at the top. Remember that contour lines should never cross one another.

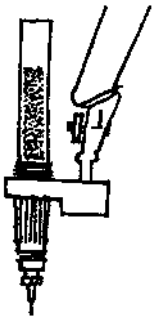


Contour lines can be drawn accurately by using a french curve. The **french curve** is used for noncircular curves. When fitting the curve through a series of points, be sure that the direction in which its curvature increases is the direction in which the curvature of the line increases. Tangents at each conjunction should coincide to avoid breaks and to provide continuity. At sharp turns, a combination of circle arcs and french curves may be used.

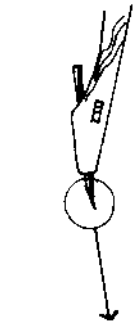




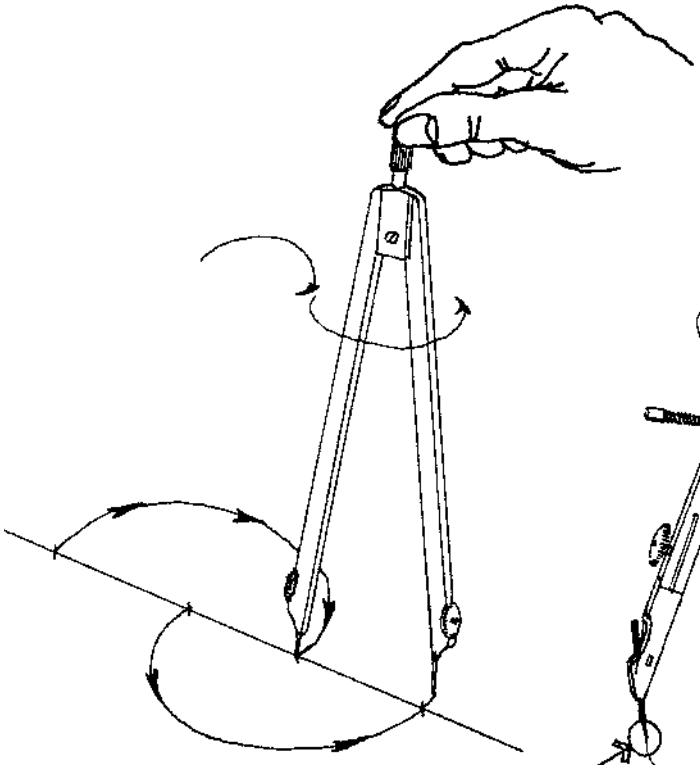
The primary instruments in a typical large drafting set include a large and a small pen/pencil compass, a divider, a 6" extension arm (for very large circles), a lead pencil pointer, and spare leads. A **divider** divides lines and transfers lengths. A **compass** is used for drawing small- and intermediate-size circles. The instruments are enclosed in a protective case. Alvin and Chartpak are excellent brands.



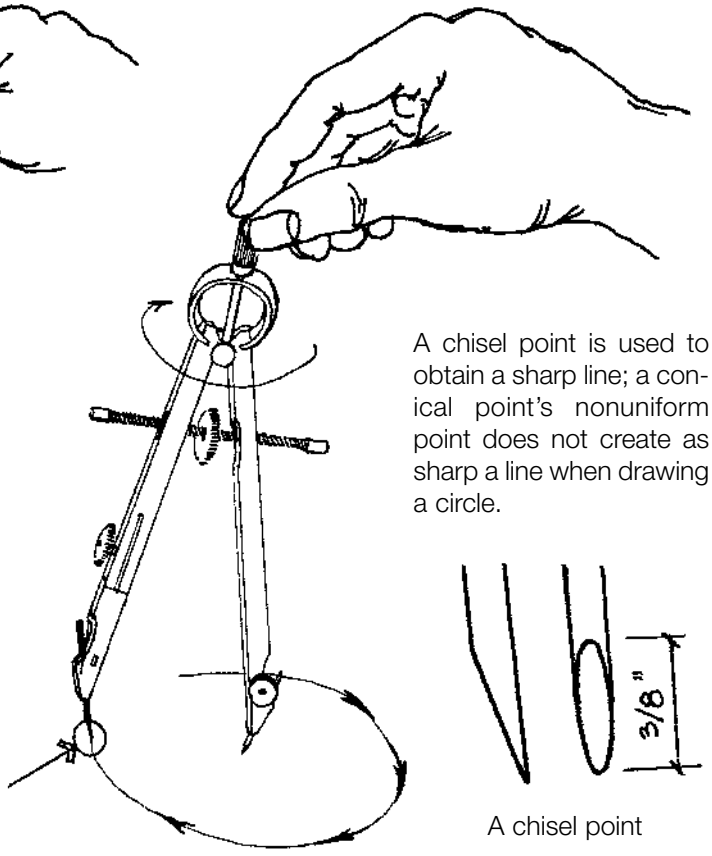
Be sure your compass has an ink attachment.



Keep a low angle when tapering the compass lead.



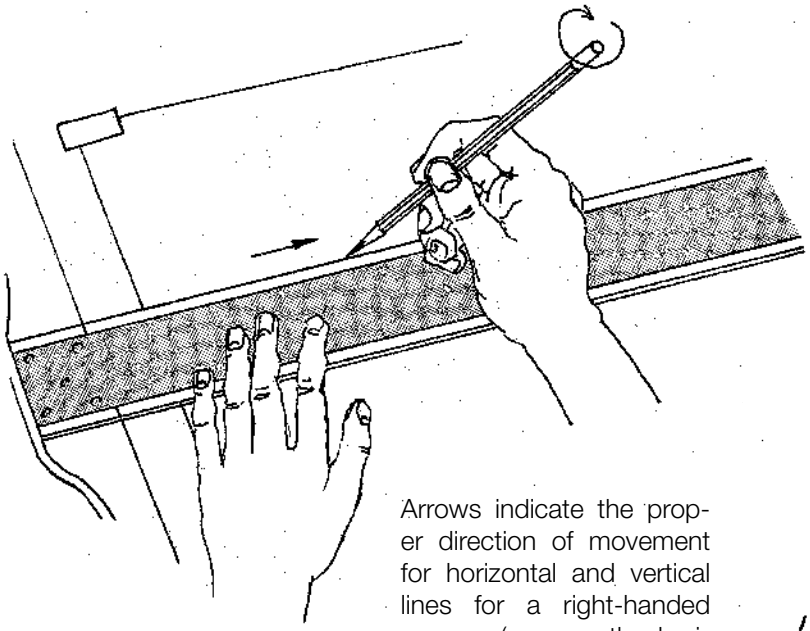
How to use the dividers



How to use the compass

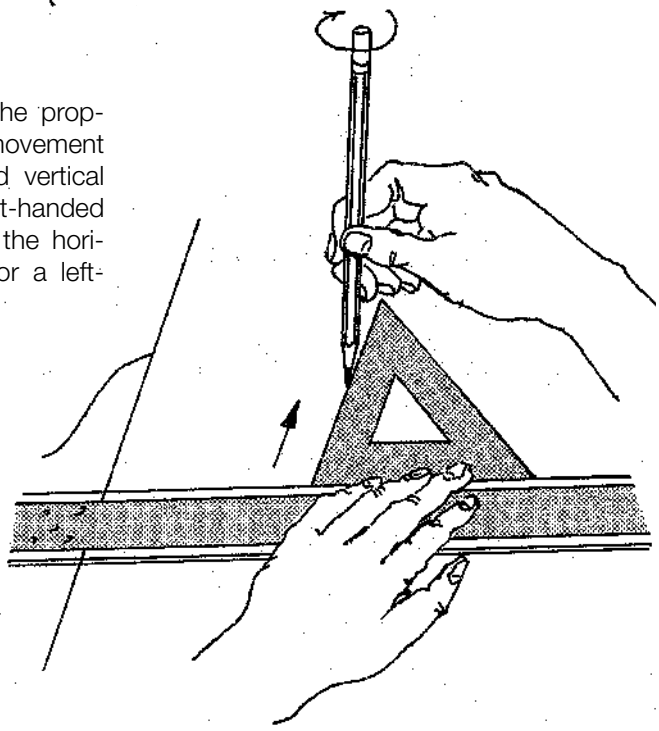
A chisel point is used to obtain a sharp line; a conical point's nonuniform point does not create as sharp a line when drawing a circle.

A chisel point

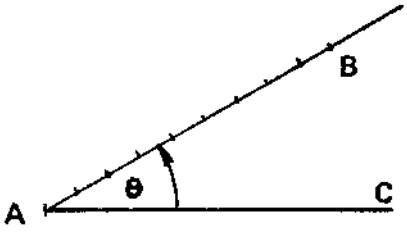


Always draw your lines on the top edge of the T-square or straightedge, and with wooden or clutch-type pencils, twirl the conical point to produce an even wear on the tip. To fasten drawings, always use drafting or masking tape, and never use clear tape (see p. 15).

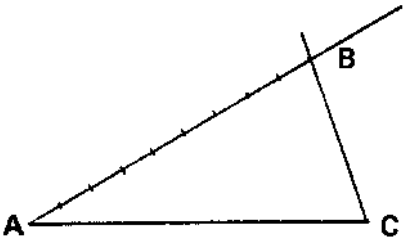
Arrows indicate the proper direction of movement for horizontal and vertical lines for a right-handed person (reverse the horizontal direction for a left-handed person).



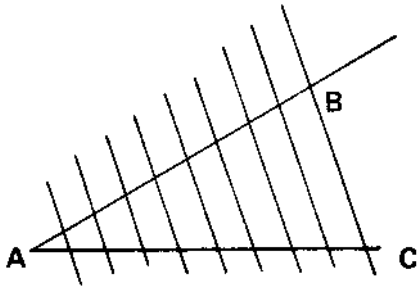
1 With a given line, sketch a line at any angle θ (preferably less than 90°).



2 Between points A and B, choose a standard unit and mark off the amount of parts into which the given line is to be divided.

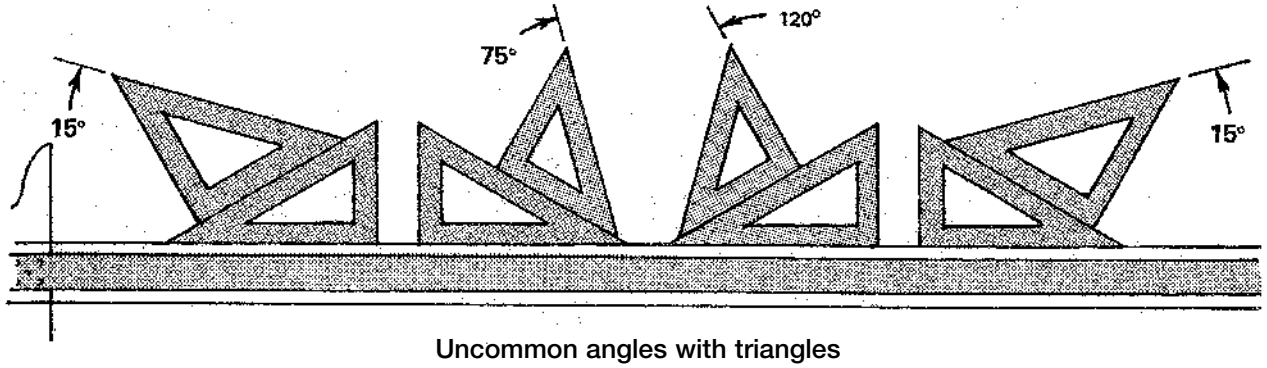


3 Connect the last point marked off to the endpoint of the given line.

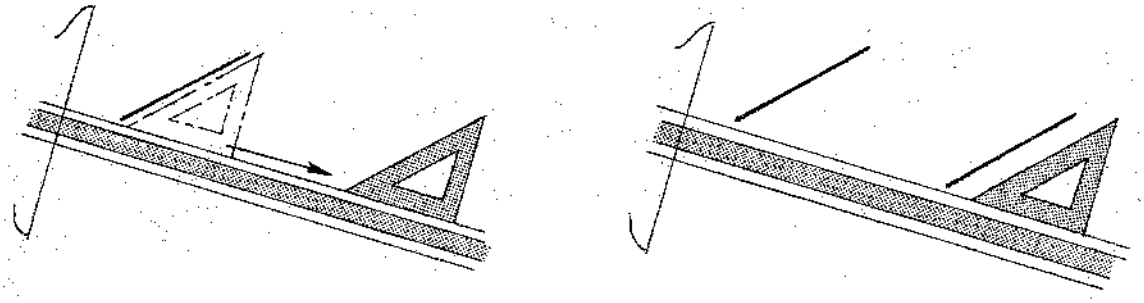


4 Through each remaining point, draw lines parallel (use a roller ruler) to the previous line segment BC.

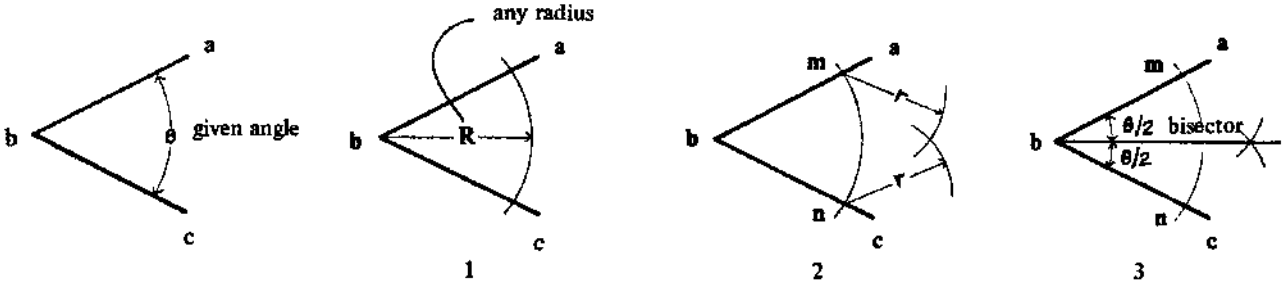
5 The line has been divided equally into the number of parts desired.



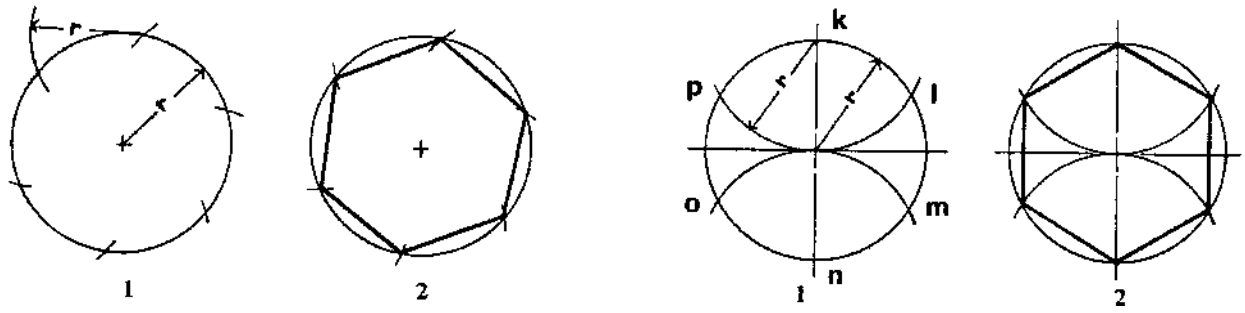
Uncommon angles with triangles



How to draw a line parallel to a given line

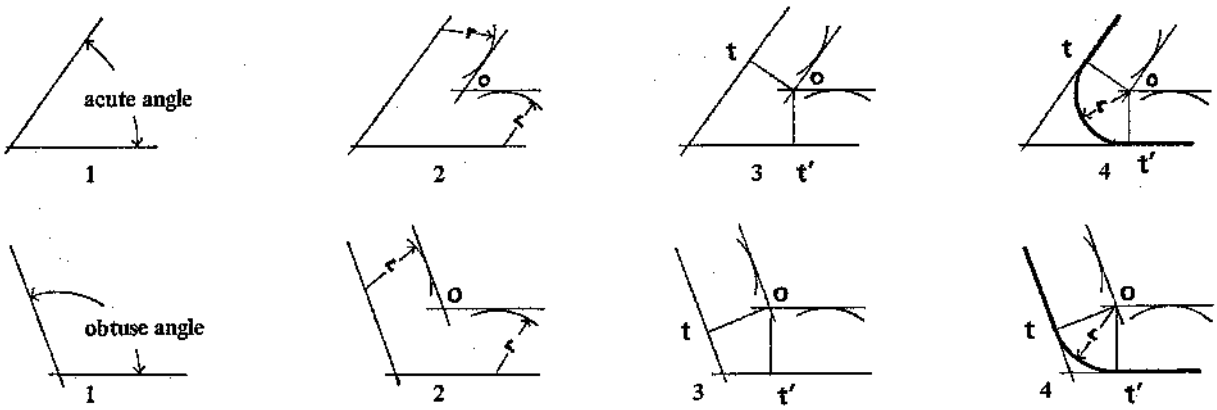


Bisecting an angle

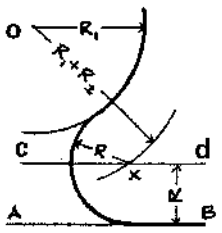


Constructing a hexagon

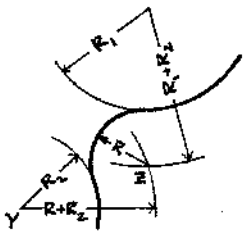
Familiarity with drafting tools can be achieved by doing simple geometric operations and constructing various geometric shapes.



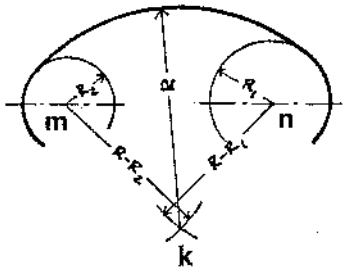
Constructing tangent arcs



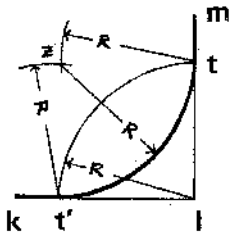
An arc tangent to a straight line and a circle. An equidistance is required.

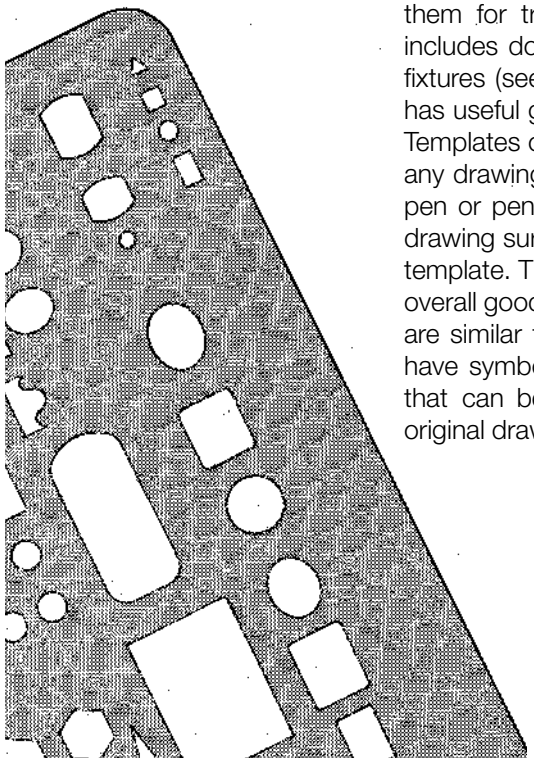


An arc tangent to two circles. The arc center must be equidistant from both circles.

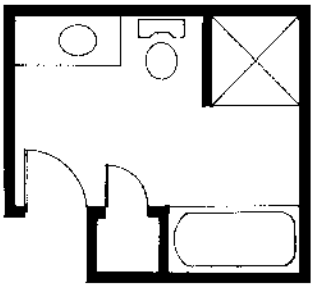


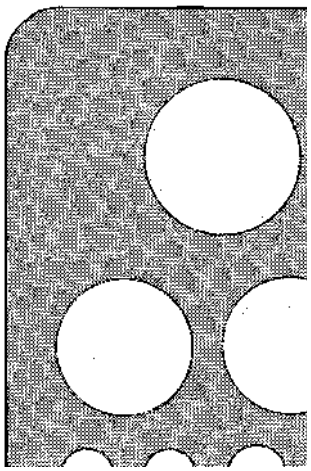
An arc tangent at a right-angle corner. An equidistance R is required.





Architectural **templates** have many standard plumbing and furniture symbols cut through them for tracing. This floor plan template includes door swings, sinks, and bathroom fixtures (see bathroom plan at right). It also has useful geometric forms, such as circles. Templates come in a variety of scales to suit any drawing requirement. Always keep your pen or pencil perpendicular (vertical) to the drawing surface when using an architectural template. This ensures a uniform line and an overall good result. **Underlays** and **overlays** are similar to templates. These time-savers have symbols printed or drawn on a sheet that can be traced or transferred onto an original drawing.





If the desired diameter of a small circle is known, a plastic circle template may be used in place of a compass. Other popular templates are classified as general purpose and elliptical.

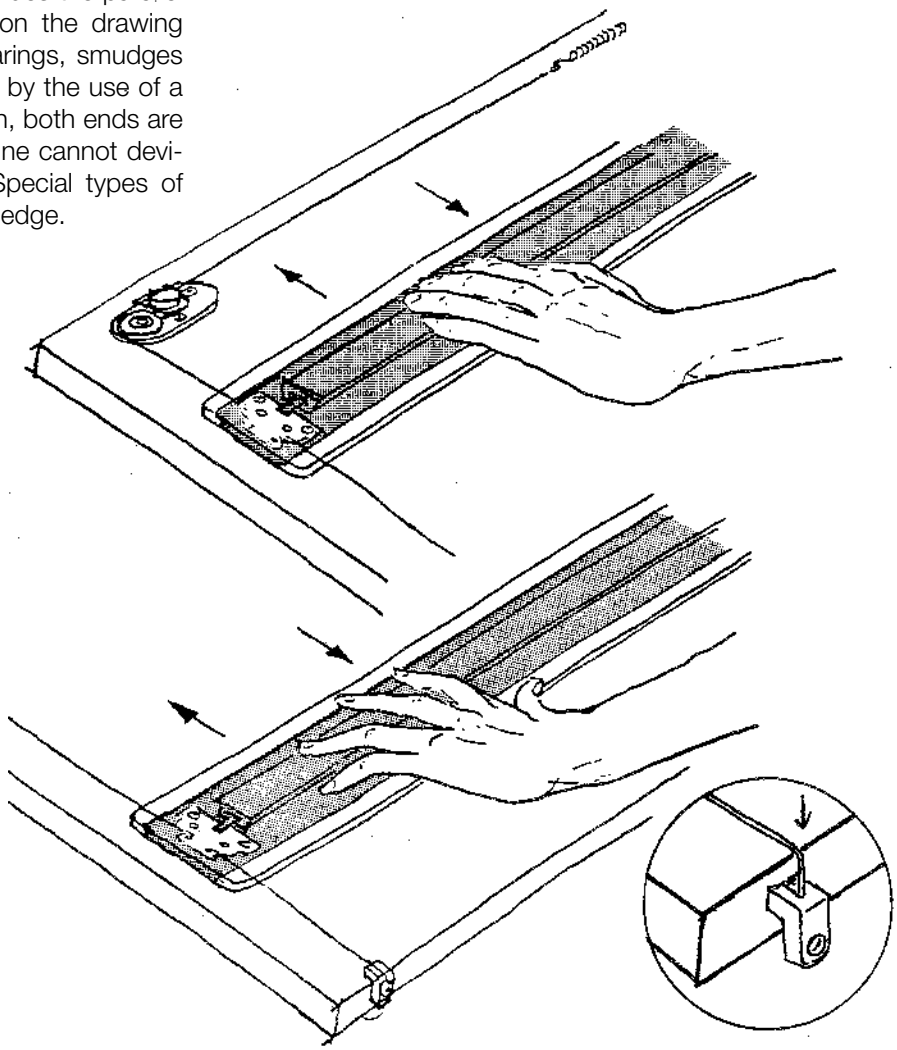
THE PARALLEL RULE

The **parallel roller rule,** with its effortless movement, has made the T-square relatively obsolete. A slight push with either hand glides the parallel rule into any desired position on the drawing board. Since it rolls on ball bearings, smudges on drawings commonly created by the use of a T-square are avoided. In addition, both ends are fixed; thus, a drawn horizontal line cannot deviate from its correct position. Special types of rules can have a built-in cutting edge.

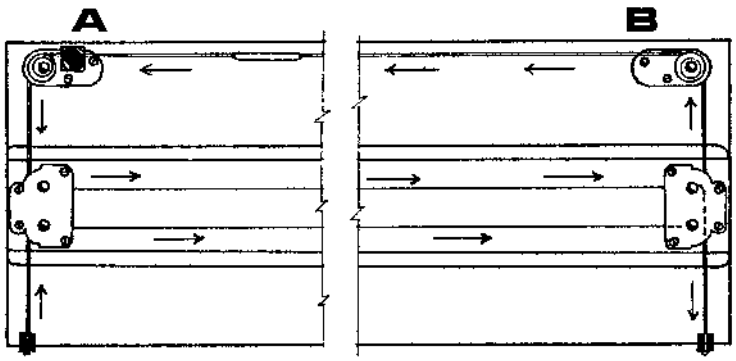
When installing the parallel rule (also termed bar or straightedge), be sure that:

1. Corner plates A and B are firmly attached with ½"-long screws.
2. The cable wire is parallel to the edge of the drawing board on both sides.
3. The cable wire passes between the clamping washer and the plate.
4. The spring is centered between A and B.
5. The cable wire is moved in the directions indicated below.

Keep abreast of new technology. Alvin's 6" and 12" rolling parallel rules combine the functions of a straightedge, compass, protractor, and angle template in one. These multipurpose drawing instruments allow you to measure in inches or centimeters.

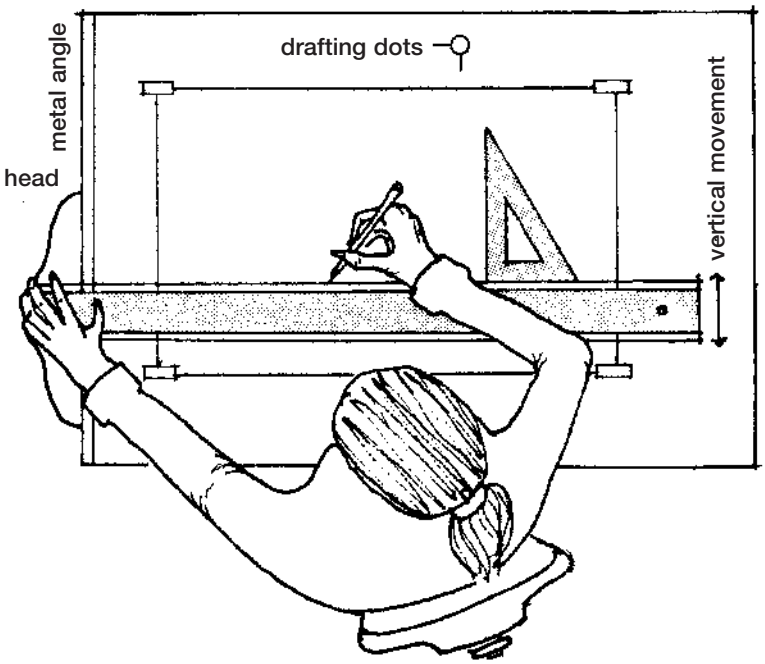


The cable wire is inserted through the hole on top of the stop and aligned with the slot on the rear of the stop. Trim excess cable, but leave enough for future adjustments.



Long, continuous, parallel horizontal lines frequently occur on architectural drawings. The rule can also be adjusted to many inclined positions slightly away from the horizontal. Rules come in lengths of 36", 42", 48", 54", and 60". Highly recommended is the 42" rule, which permits you to work on a 30" × 40" sheet.

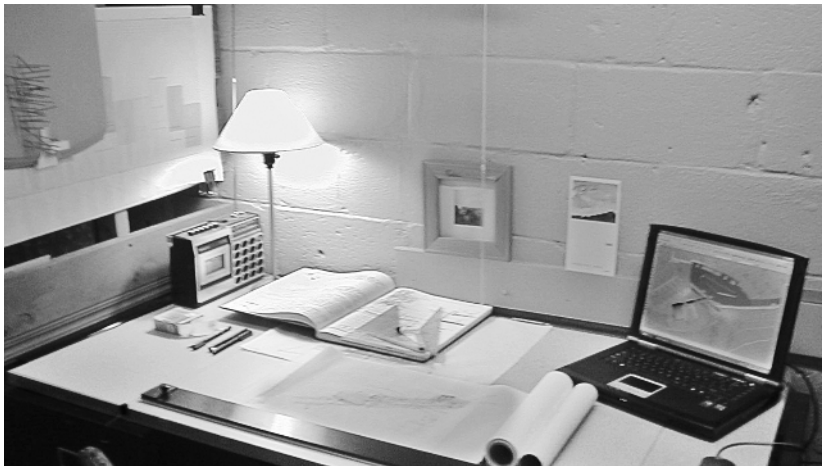
Provide yourself with a comfortable **work space** with adequate tack surface to pin up your work for reference. Architectural drawing is normally done in a sitting position, but it can also be done standing. Avoid slouching; don't arch your back and collapse your abdominal regions. Sit erect and maintain good posture. Designing and drawing require long hours of sitting in one position. Poor posture will lead to a tired feeling, reduced drawing capacity, and a deteriorated physical state.



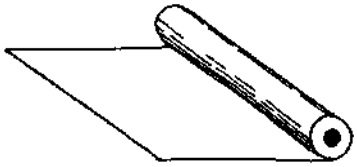
Most practitioners like a low-level, flat table surface; however, some prefer a tilted tabletop that reduces the need to lean over the work surface. A large surface gives you room for additional equipment like a laptop computer (see photo). An adjustable stool is ideal for varying the seat height and the backrest. If possible, place one foot on a pile bar or footrest in order to raise one knee above the hips. Elevating one leg at a time helps to keep the pelvic region tilted forward. It also preserves the natural curvature of the lower lumbar region, preventing undue physical stress and fatigue. Strive for ergonomic efficiency.

Purchase the best quality table light source that you can afford in order to prevent eyestrain. An incandescent/fluorescent combination light is excellent. The light should have an adjustable counterpoise to give it the flexibility to be positioned over your work.

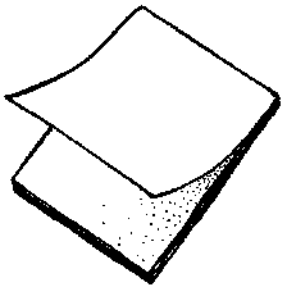
Line up the drawing sheet horizontally and vertically using a T-square or parallel straightedge and triangle. It is best to apply the drafting tape broadside (on the diagonal is also OK) to prevent the sheet from slipping. Drafting dots can also be used to secure drawings to a board or table. The head of the T-square should always slide firmly up against the edge of the drawing board or table. If the head is not firm, there will be vertical movement (play) at the end of the T-square. Use a metal angle with a

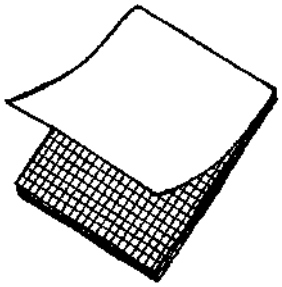


WORKSTATION SETUP: GETTING STARTED



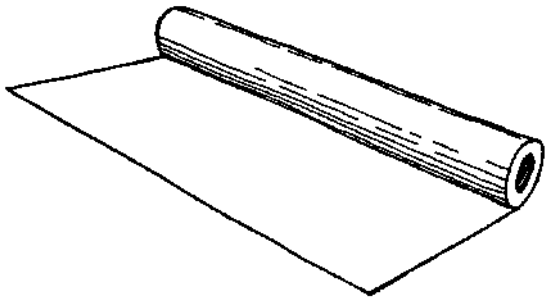
Transparent, lightweight **tracing paper** (commonly yellow or white and termed "flimsy" or "talking paper") is excellent for use with soft leads or markers. It is used for rough sketches, overlays, and preliminary drawings. Rolls range in size from 12" to 36".





Tracing pad sizes are 8½" × 11", 11" × 17", and 17" × 22"

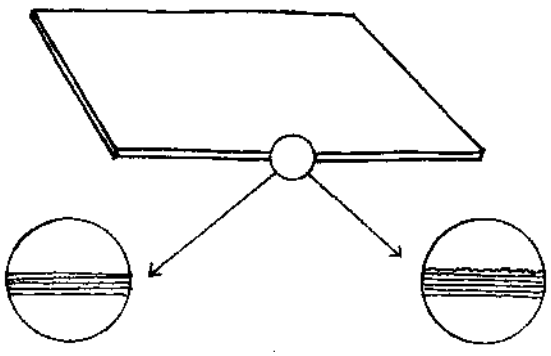
With a fade-out grid



Vellums are 100% rag tracing papers with excellent erasability. They are available in either rolls, pads, or single sheets. Clearprint 1000H is widely used. Vellum papers are classified by weight, color, and rag content. Heavyweight (20 lb) white vellum is normally used for finished drawings. Medium-weight (16 lb) is used for rough layouts. **Plastic film** from polyester (Mylar) yields the highest quality reproductions. It is highly appropriate for ink and some pencil leads. Use erasing fluid to remove ink lines.

Rag is the cotton fiber in the paper. The higher the percentage of rag content, the better the quality. The peaks and valleys (fiber arrangement) on a tracing paper's surface are its tooth quality. Graphite and ink are used on both translucent and transparent tracing papers. Slick paper with less tooth is better for ink work, whereas paper with more tooth is better for pencil work. Gridded tracing paper is used to make the drawing of horizontals and verticals much easier. Drawings on quality papers are not harsh on the eyes and show no "ghosts" (grooves) even after pencil lines are redrawn in the same location.

Original drawings must read well in order to reproduce well for the use of others. Keep in mind that traditional reprographics using diazo papers for prints will soon become obsolete with the advent of digital reprographic technology.

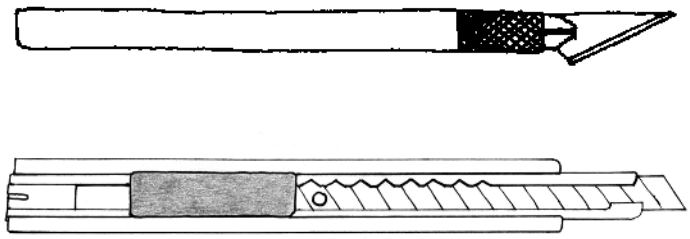


Hot press (less tooth)

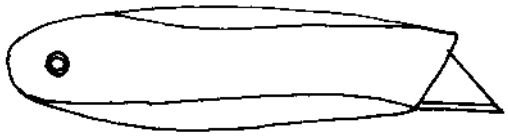
Cold press (more tooth)

White **illustration board** comes at 1/16" and 3/32" in thickness. This makes it suitable for both finished drawing presentations and fine presentation models. Cold-press boards have a more textured surface and take to pencil, whereas hot-press boards are smoother and take to ink.

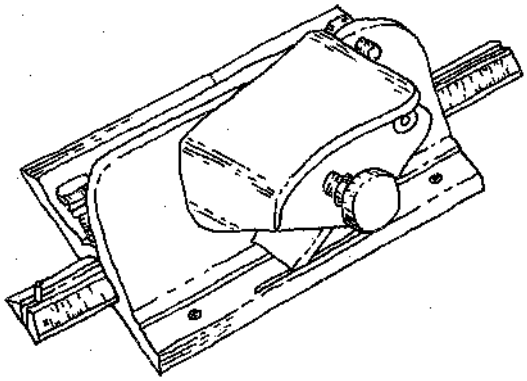
Preliminary study models are usually made of gray **chipboard**. Chipboard also comes in a variety of thicknesses. **Foam-core board** is a strong, lightweight board, excellent for model making.



An **X-Acto knife** uses blades of several different shapes. The illustration shows the one most commonly used. It is excellent for small, detailed cuts (small apertures). A pack of #11-size blades for refills is strongly recommended. Another alternative, especially for cutting cardboard or foam-core board, is an **Olfa knife.**



Utility knives are used primarily for long cuts on heavy materials such as thick illustration board, mat board, or cardboard. They are excellent for scoring. Stanley is a highly recommended brand. X-Acto's SurGrip utility knife is contoured to conform to your grip.



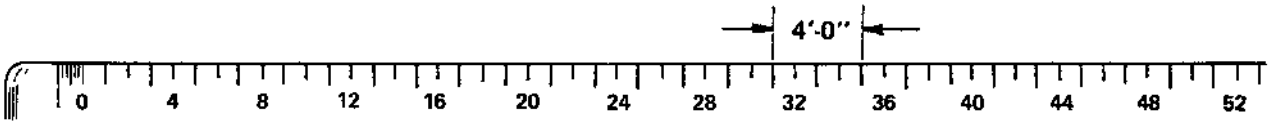
Good-quality **cutters** can make a clean, crisp 45° bevel. Highly recommended is the Logan Series 4000 mat cutter, which has a built-in marking system. With a pivoting blade holder, it can be used against any suitable straightedge. The less expensive series Logan Series 2000 push-style cutter has a start-and-stop indicator for precise corners. A **razor saw** with a thin blade and fine teeth is used for extrafine cuts on small pieces of wood, such as balsa. Zona Universal razor saws are highly recommended.

Adhesives, glues, and glue guns are used to fasten materials together for model making. A water-soluble glue is commonly used for cardboard. Rubber cement is excellent for collage work. Spray adhesives are most efficient for mounting drawings or photographs on cardboard, as well as for laminating smooth, porous sheets together. For a cutting guide, use an 18" stainless steel straightedge with a cork backing. A basic cutting rule of model making is to never make only one pass when cutting materials (especially thick cardboard). Make a series of light cuts. This will give you better control and accuracy. Cutting on a self-healing translucent plastic or rubber cutting surface (18" × 24" is a good mat size) will extend the life of your cutting blades.

The following are architect's scales:

12"=1'0"	**1"=1'0"**	**¼"=1'0"**
6"=1'0"	**¾"=1'0"**	**3/16"=1'0"**
3"=1'0"	**½"=1'0"**	**⅛"=1'0"**
1½"=1'0"	**⅜"=1'0"**	**3/32"=1'0"**

For architectural work, all of the above scales are used. Least used are the scales of 12"=1'0" and 6"=1'0". The scale is usually notated within the title block of an architectural drawing. It can also appear underneath the view of a particular detail. The choice of the proper scale size is dependent on the building size, the amount of detail to be drawn, and the size of paper used. Sometimes common practice dictates the size; for example, floor plans for residential buildings are normally drawn at ¼"=1'0". Construction details can use scales ranging from ½"=1'0" to 3"=1'0".



The actual size of the architect's scale. This scale is ⅛"=1'0"

The **architect's scale** is used primarily for drawing buildings, architectural details, structural details, and mechanical systems in buildings. The purpose is to represent large objects at a reduced scale to fit on drafting paper–size sheets. The best quality scale is unbreakable plastic with color-coded, engraved, calibrated graduations. Scales come in three beveled types, one triangular type, and one rapid rule type (see below). Choose the one most suited to your needs.

The **civil engineer's** or **engineer's scale** is used primarily for site plans, location plans, and land measurements in map drawing.

The following are civil engineer's scales:
10, 20, 30, 40, 50, 60, or 80 divisions to the inch, representing feet, 10 feet, 100 feet, rods, or miles.

Be careful not to confuse "scale" and "size."
¼"=1'0" is referred to as "quarter scale" in the architect's language, whereas ¼"=1" is referred to as "quarter size."

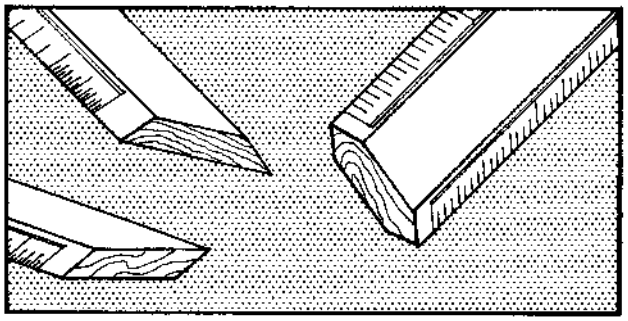
OPPOSITE BEVEL
Easy to pick up and handle

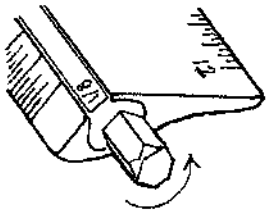
DOUBLE BEVEL
A good pocket scale

FLAT BEVEL
Easy to keep flat to a board

TRIANGULAR
Has many scales on the same stick.

Always observe a scale from directly above.





Rapid rule

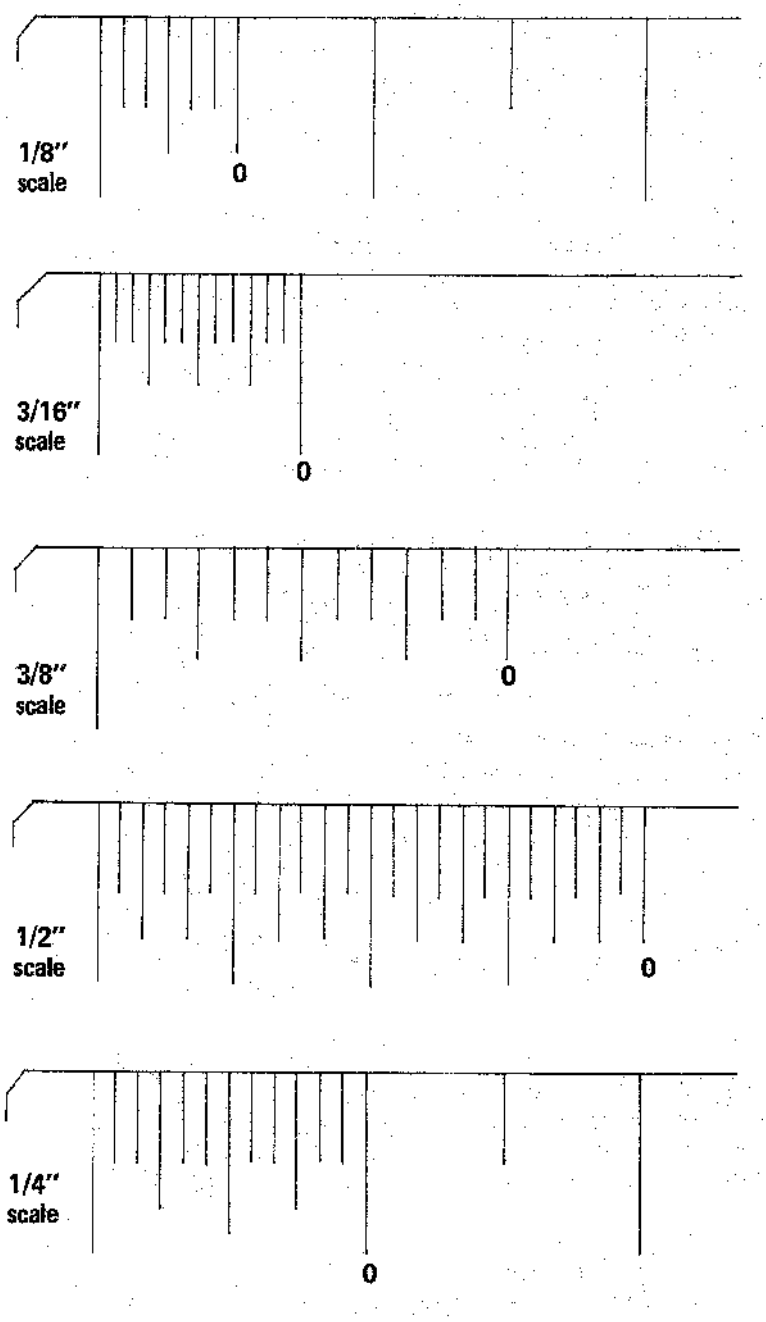
RAPID RULE
Made of lightweight, solid aluminum, you rotate a rapid rule's scale rod to see the desired scale. There's no need to search for the needed edge or read backward.

Remember to keep the scale clean; don't mark on it, and never use it as a straightedge!

SCALES

Determining How Much Each Subdivision Represents

The best procedure is to ask yourself the following question: Each subdivision represents what part of one foot?



FOR ⅛" = 1'-0"
$\frac{12"/FOOT}{6\ DIVISIONS}$ = 2" PER DIVISION

FOR 3⁄16" = 1'-0"
$\frac{12"/FOOT}{12\ DIVISIONS}$ = 1" PER DIVISION

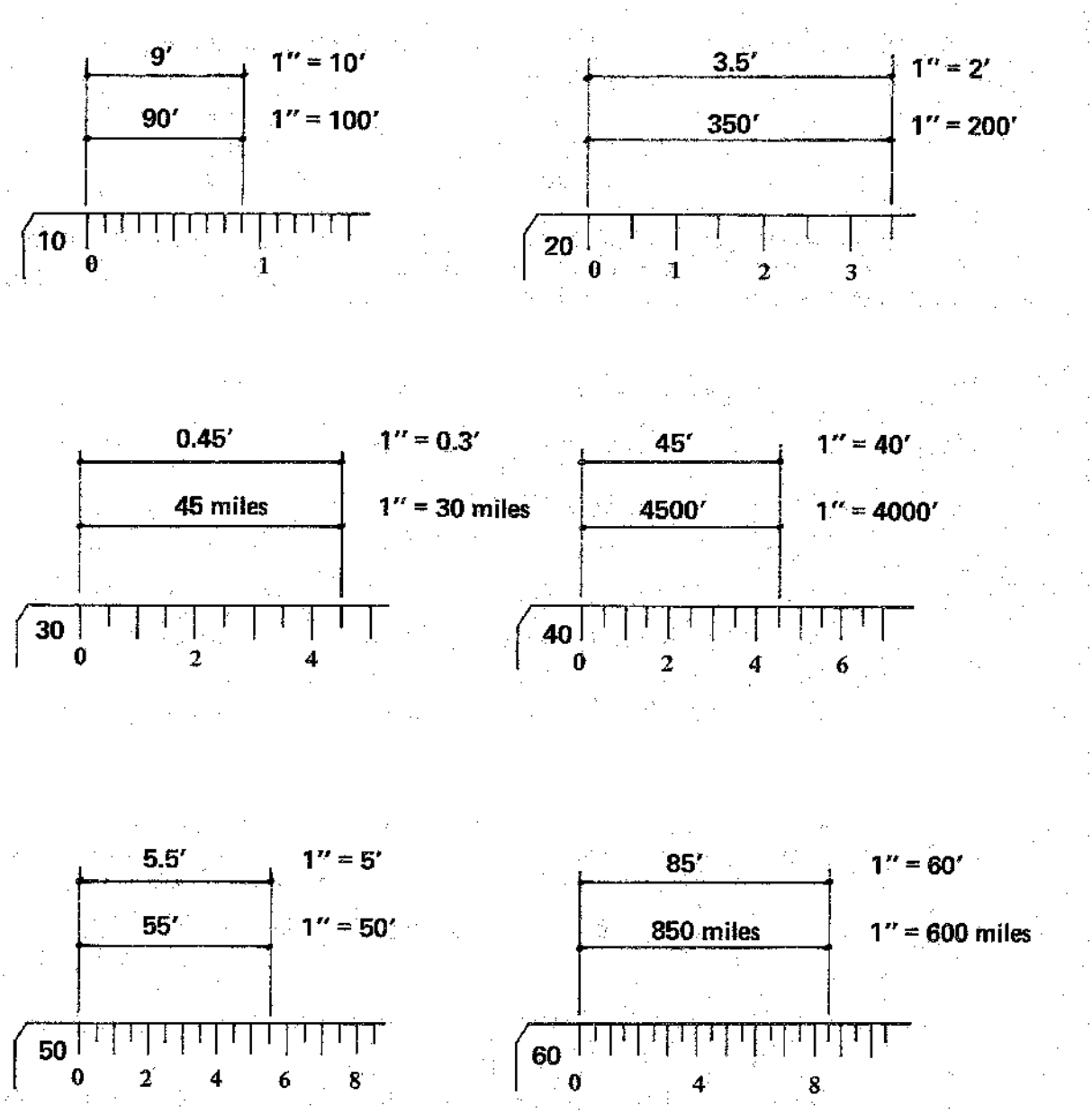
FOR ⅜" = 1'-0"
$\frac{12"/FOOT}{12\ DIVISIONS}$ =1" PER DIVISION

FOR ½" = 1'-0"
$\frac{12"/FOOT}{24\ DIVISIONS}$ =½" PER DIVISION

FOR ¼" = 1'-0"
$\frac{12"/FOOT}{12\ DIVISIONS}$ =1" PER DIVISION

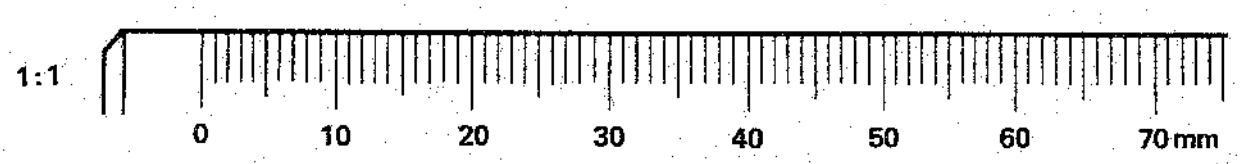
Note that in all of the reduced scales, the major divisions represent feet and their subdivisions represent inches and fractions thereof. Therefore, ½ means ½ inch = 1 foot, not ½ inch = 1 inch.

To facilitate the counting of subdivisions, the above scales have been enlarged from their actual size.

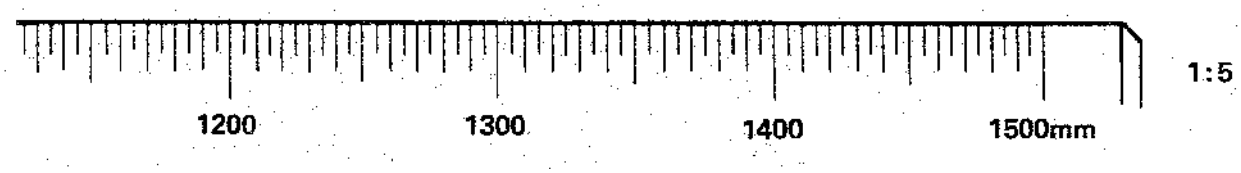


Shown above are the six standard scale units found on the **engineer's scale.** There are many possibilities for each scale unit since different lengths can be indicated for the scale unit. For example, in the case of a 10 scale, 1" can equal any one of the following: 0.1', 1', 10', 100', or 1,000 (feet or miles). Two possibilities are shown above for each of the six standard scale units. Divisions to the inch represent feet, rods, or miles.

Think of the scale number, such as 10, as the number of divisions per inch. Thus, 40 would indicate 40 increments or parts per inch. A 1" = 40' scale would have 40 increments, each increment being one foot. These incremental divisions are then continued along the full length of the scale. The engineer's scale is used primarily for site plans and location plans.

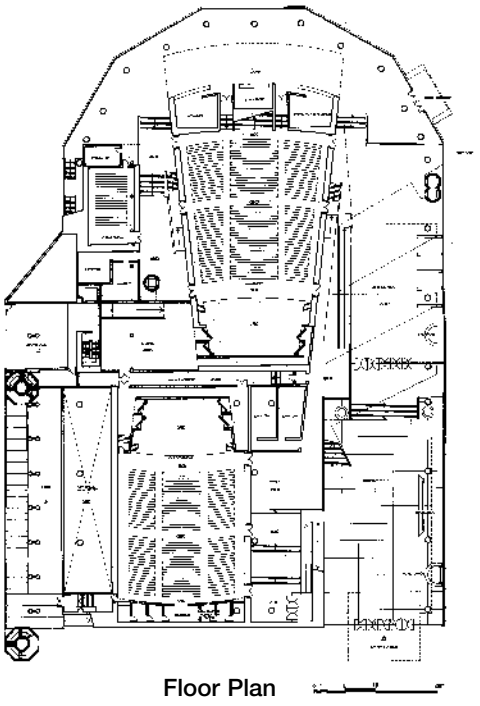


This metric scale has a 1:1 ratio and should be used for **full-size** drawings. For example, 10 mm on the drawing equals 10mm on the object or building.



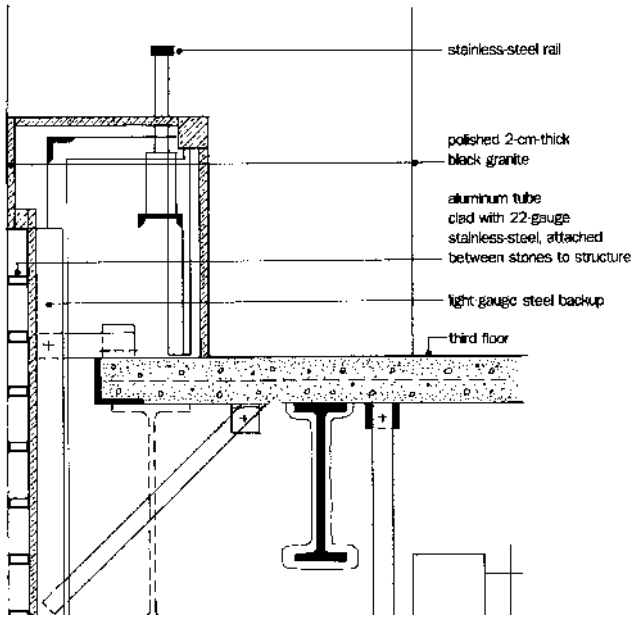
This metric scale has a 1:5 ratio and should be used for drawings **one-fifth full size**. For example, 100 mm on the drawing equals 500 mm on the object or building.

As with the architect's scale, the **metric** scales above have been enlarged for easier reading. Metric scales are expressed as ratios (examples: 1:20 or 1:200). All countries except the United States (which uses inch-pound units) use the SI (International System of Units), a modern version of the metric system. A meter is 3.281 feet in length. It is easy to work with because converting from unit to unit merely requires multiplying or dividing by powers of ten. For example, 1,000 millimeters (mm) equals 1.0 meter (m)—(i.e., 1,000 divided by 1,000). A metric scale is 150 mm long (about 6"). Architects use various metric scales for various types of drawings. For example, 1:500 is a common scale reduction ratio for site plans, whereas 1:100 is used for floor plans and elevations. Ratio reductions of 1:1 and 1:5 are frequently seen for architectural details. These examples show architectural drawings that each require a different metric scale.



Floor Plan

Palazzo del Cinema, Venice, Italy
38 × 53 cm (15" × 20.9")
Medium: Ink on Mylar
Courtesy of Maki and Associates



Partial section detail
One O'Hare Center
Rosemont, Illinois

Courtesy of Kohn Pedersen
Fox Associates, Architects